FINAL REPORT

ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS

Federal Energy Administration
Office of Energy Conservation and Environment

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SUMMARY

The purpose of this study is to examine specific impacts of proposed national legislation which would require a minimum 5-cent deposit on beer and soft drink containers (refillable bottles, nonrefillable bottles and cans).

The study is not a comprehensive cost-benefit analysis of mandatory deposit legislation, but rather examines three major areas of potential impact. These impact areas are 1) changes in annual energy consumption, 2) changes in capital investment requirements (in terms of fixed plant and equipment), and 3) changes in labor requirements (in terms of jobs and earnings). These impacts are developed for those industries in the total beverage system that would be most affected by changes caused by a mandatory deposit. The industries included are: retailers, beverage producers and distributors, container manufacturers, and producers of basic steel and aluminum.

It is important to recognize at the outset that this legislation would not ban any specific container type. Rather, it would create an incentive for consumers to return all types of empty beverage containers for a deposit refund. However, the response of consumers to the deposit incentive (and its requirement to bring containers back) is expected to cause shifts among the types of containers sold.

To develop the potential impacts, the report first projects energy, capital and labor requirements in the beverage industry assuming no deposit legislation is passed. These baseline projections are then compared to projections of what could happen after a deposit law. Results are reported for a 1982 steady-state situation, assuming that: 1) a law would be implemented in the late 1970's and 2) by 1982 transitory effects will have dissipated.

The impact of a deposit law depends primarily on two factors: the technical interrelationships between container types and their respective requirements for energy, capital and labor; and the behavioral (market) responses of producers and consumers to the deposit incentive to return the empty container.

Data does exist to estimate the energy, capital and labor requirements of the beverage container system as a function of the total beverages consumed in each specific type of container (based on a specific trippage of refillable bottles and return rate of cans). This study has identified and measured the technical requirements associated with the production and use of the respective container types. This was done starting with mining the raw materials and continuing through manufacturing, use and disposal of the container, including a loop for recycling or reuse, as appropriate.

However, the behavioral/market response determines the extent and direction of any impact caused by a deposit law. Unfortunately no data exist to predict with any degree of accuracy what the market response to a deposit law is likely to be. However, it is assumed that under a deposit system the market share represented by nonrefillable bottles will fall to zero since, to the consumer, there is no intrinsic difference between a one-way bottle or a

refillable bottle when both have a deposit associated with them. Because cans, on the other hand, are intrinsically different from bottles, being lighter weight, easier to stack and not subject to breakage, it is believed that cans will continue to have a significant share of the market.

What has been done is to establish a set of parameters from which many possible market responses can be evaluated. Three parameters essentially capture the total behavioral market response. These are: the can market share, the can return rate, the refillable bottle return rate (proportion of containers returned) or trippage. (These parameters are graphically presented in chapter 3 of the study.) Each scenario of possible market responses can be described by a unique set of parameter values.

General Findings

The continuation of current trends in the beverage industry without the imposition of a deposit law will mean that in 1982, the base year for which impacts are examined, the production and distribution of beverages will require 383 x 10^{12} Btu of energy (about one-half of one percent of the Nation's total energy consumption), $7.3 billions in capital investment, and 369,000 jobs yielding $4.1 billion in labor earnings. These values are shown in table 1.

A deposit law could change these projections since the refillable bottle system, when the bottles are returned, is a comparatively labor and capital intensive system; the nonrefillable bottle and can systems are relatively materials and energy intensive. Therefore, any market shift toward refillable bottles with the bottles returned would tend to reduce materials and energy usage while increasing capital and labor requirements. Shifts toward nonrefillable bottles and cans would tend to have the opposite effect. The increased usage of recycled materials or increases in refillable bottle trippage would tend to reduce the amount of materials required and conserve energy resources for the total beverage system. Over time technological innovations are reducing per unit energy, labor and material requirements for all container types. The parametric curves in chapter 3 displaying the potential impacts of the deposit legislation have these innovations embodied in them. Beyond these general statements the impact of a deposit law will depend on the extent and direction of the behavioral response.

Impacts Under Various Scenarios

Using the parametric curves found in the body of the report (fig. 10 energy, fig. 11 capital, figs. 12 -14 labor) many different assumptions about the market response may be examined.

One reason the issue of national legislation has been so controversial is that at the extremes of potential market response, a very wide range of impacts can be found. Using the parametric curves for changes in energy usage as an example it can be found that if all consumers switched to refillable bottles, yet discarded them all, energy consumption would increase by 322 x 10^{12} Btu annually, or 155,000 barrels of oil equivalent daily. On the other hand, if consumption shifted entirely to refillable bottles and all bottles were returned, energy consumption would decrease by 292 x 10^{12} Btu annually or by 141,000 barrels of oil equivalent daily.

Table 1. Summary of the net energy and economic impacts of mandatory deposits: illustrative scenarios, 1982.

	1982 Baseline value	Scenario 1 (canned beverage sales equal to 1976 value; container return rate of 0.9)**	Scenario 2 (canned beverage sales equal to one-half of 1976 value; container return rate of 0.8)**
Beverage consumption rate, 10^9 ounces annually	1,893.5	-3.6	-3.5
Container production rate, 10^9 units annually	90.6	-33.6	-48.6
Glass containers	18.0	-12.2	-1.6
Refillable	2.4	+3.4	+14.1
Nonrefillable	15.7	-15.7	-15.7
Cans	72.5	-21.3	-47.0
Steel	42.0	-12.8	-27.5
Aluminum	30.5	-8.4	-19.5
System energy requirements,* 10^{12} Btu annually	383	-168	-144
System capital requirements,* 10^6 dollars	7,303	+824	+2,006
System labor requirements*			
Net employment, 10^3 jobs	369	+118	+117
Jobs gained	NA	156	166
Jobs lost	NA	38	49
Labor earnings, 10^6 dollars annually	4,080	+879	+936

*Major direct and indirect industries.

**The values reported in this column represent deviations from the baseline trends reported in the first column.

NA - Not applicable

Source: Research Triangle Institute.

Neither extreme is realistic. If all refillable bottles are discarded, producers would find it cheaper to package in one-way containers since, unless refillable bottles are returned several times, they are more expensive to use. The other extreme is also unrealistic since some bottles will be broken or chipped and some consumers will not return bottles.

This study uses two illustrative scenarios to indicate how to use the parametric curves. The scenarios were chosen to avoid extreme values and provide the reader with two complete estimates of the impact of a deposit law that fall within the broad range of what can be considered to be a reasonable behavioral response to beverage container legislation.

To place the behavioral responses assumed for the two illustrative scenarios into perspective, and to allow the reader some insight for making his own assumptions a few observations are in order.

Key Behavioral Parameters

- Refillable Bottle Return Rate - Currently this rate is about 0.9 or ten trips per bottle. It has declined over time. When the refillable bottle was the primary container, trippage rates of 30-40 were reportedly obtained. Two offsetting factors have to be evaluated to estimate the impact that a deposit law would have on trippage. First, since all stores would accept returned bottles under a deposit law, the ease of returning them would be greatly increased thus suggesting a higher trippage. On the other hand, present one-way container purchasers who switched to refillables might still be inclined to discard them which would argue for lower trippage.

- Can Return Rates - In most of the nation there currently are collection centers for aluminum can recycling. Aluminum can collection centers, offering three-fourths of a cent per can, today receive approximately 25 percent of all aluminum beverage cans sold. The aluminum industry projects this rate to continue increasing rapidly in the future. In the state of Oregon, which has a deposit law, about 70 percent of all cans are returned.

Under a national law the can return rate will depend on a number of key factors. Since individuals currently purchasing cans generally value the convenience of immediately discarding the container, low return rates would be obtained if this behavior were to continue. However, from a convenience standpoint, cans should be easier to return than bottles, since they are lighter and require less space. In addition, since cans may be returned even in a damaged condition, it will be relatively easy for scavengers to collect cans from waste or litter. Thus, while it is possible that a greater proportion of cans than bottles would be discarded by the initial consumer, it is also possible that the can return rate might be higher than the bottle return rate.

- Can Market Share - By 1982 the can market share is projected to be 59 percent. With the imposition of a deposit law, and the likely (and assumed for this report) demise of nonrefillable bottles, the can market share could either rise or fall. Nonrefillable bottle consumers may switch to purchasing cans. This could lead to continued growth in can sales. In addition, since can makers and beverage producers currently have a large capital investment in equipment dedicated to handling cans, the bulk of which cannot be shifted to other uses, they will have significant incentives to maintain the can as

a competitive container in the beverage market. Arguing for a lower can share is the fact that the imposition of a deposit will require can consumers to incur either some new inconvenience by returning cans or dispose of the can, thus forfeiting the deposit and paying a higher price. This might lead to reductions in the can market share.

Technical Reasons for Impacts

In developing any particular scenario the reader must keep in mind the basic assumptions used in this study. These are:

1. Beverage markets are reasonably competitive.

2. Cans and bottles will be returned at the same rate.

3. The current prices of beer and soft drinks by container reflect the actual costs of each plus a normal return on investment.

4. The relative shares of the can market for steel or aluminum containers will be unaffected by the imposition of a deposit law.

5. The market share represented by nonrefillable bottles will fall to zero after a deposit law.

6. All returned containers will be either recycled or reused, as appropriate.

Combining these assumptions and the specific behavioral responses assumed for the illustrative scenarios yields the following results (table 1, page 3, presents the complete results).

Illustrative Scenario 1

Behavioral Response Assumed: The 1982 quantity of can sales remains at a level equalling 1976 can sales; cans and refillable bottles are both returned at a rate similar to the current average return rate; 0.9, for refillable bottles (this return rate implies a trippage of 10 for refillable bottles). Using the parametric curves, the resulting impact of these assumptions on energy, capital, employment and labor can be found.

Energy: Consumption would be reduced about 168×10^{12} Btu annually or 81,000 barrels of oil equivalent daily, compared with 1982 projections of energy use without deposit legislation. This savings is equal to 44 percent of the energy that would have been used by the beverage industry.

Capital: Requirements would be increased by $824 million. This is an increase of 11 percent over capital needs without deposit legislation.

Labor: Employment increases of 156,000, primarily in beverage distribution and retailing, and decreases of 38,000 in container and metals manufacturing for a net increase of 118,000 jobs. This represents an increase of 32 percent in total employment for the beverage related industries. Total labor income increases by $879 million or 22 percent. This income gain, which is smaller than the net increase in employment is due to the slight reduction

in average earnings per employee since the jobs gained are generally less skilled and lower paying than positions in the original job structure.

Illustrative Scenario 2

Behavioral Response Assumed: The 1982 quantity of can sales falls to one-half of the 1976 sales level; cans and refillable bottles are both returned at a 0.8 return rate (this implies a trippage of five for refillable bottles, about one-half the current trippage rate).

The parametric curves, can be used to determine the impacts of this illustrative scenario. The results are displayed in table 1, page 3.

Energy: Consumption would be reduced by 144 x 10^{12} Btu annually, or 70,000 barrels of oil equivalent daily.

Capital: Requirements would be increased by slightly more than $2 billion.

Labor: Employment increases by a net 117,000 jobs. Total labor income increases by $936 million.

The impacts described have their basis in the assumptions and behavioral responses assumed. The following short discusssion represents the reasons and logical format that yield these results. This same process should be followed to examine and evaluate the impacts obtained from any scenario taken from the parametric curves.

Energy - In the case of the illustrative scenarios, energy savings are due to the increased use of refillable bottles and in the recycling of cans. Reuse of bottles avoids the raw material extraction and processing stages of production, as well as the materials and container-fabrication stages. Energy savings are also obtained from recycling metal since recycling bypasses the raw materials extraction and processing stages and lowers energy needs in the refined materials processing steps. In the case of aluminum, this is of particular importance.

Capital - In the case of the illustrative scenarios, increased capital needs are due to additional space and handling required to return containers, as well as the fact that refillable bottle lines are more expensive per unit of output.

Labor - In the case of the illustrative scenarios, additional labor is required at the retail and the beverage producer and distributor level, both to handle and transport returned containers.

Sensitivity of Results

Although the parametric curves can be used to examine the sensitivity of the impact of a deposit law across the total range of market responses, it is convenient to use the two illustrative scenarios to highlight the sensitivity of the impacts to large perturbations in the market response.

With the exception of capital, all of the impacts are inelastic with respect to market response in the range of the illustrative scenarios. For a

50 percent change in the can share of the market and a 50 pecent change in the trippage (the market response changes going from illustrative scenario 1 to illustrative scenario 2) the energy impact changes only 14 percent, the jobs gained change only 6 percent, the jobs lost change 29 percent, the net jobs gained change 1 percent and the net labor earnings change 6 percent. The major shift is in capital requirements which change 143 percent. There is, however, no a priori basis for assuming that any particular scenario will in fact occur, which is why the parametric curves have been developed allowing for the identification and examination of other scenarios.

Special Note

Due to the controversial nature of this subject an early draft version of this study was sent to various individuals--in other government agencies, industry, labor, environmental groups, researchers, and other knowledgeable and interested persons--for critical review and comment. Their comments and suggestions have been incorporated whenever possible into this final report. For the interest of the reader, these extensive comments have been printed verbatim in appendix L of the study. Specific questions and issues brought out by these comments are addressed in appendix M. For any reader not fully aware of the controversy this issue has generated, we suggest a close reading of these appendixes.

Chapter 1: INTRODUCTION

1.1 Objective

The purpose of this study is to examine specific impacts of proposed national legislation which would require a minimum 5-cent deposit on beverage* containers (refillable bottles, nonrefillable bottles and metal cans). Under consideration are impacts on the beverage container system's annual consumption of energy, the capital investment (in fixed plant and equipment), and the requirements for labor (in terms of jobs and earnings). All impacts are reported for a 1982 steady-state situation under the assumption that, by that time any transitory dislocations will have dissipated.

1.2 Organization

This report is organized into three chapters with 13 supporting appendixes and a bibliography. This chapter is a general introduction, including a description of proposed deposit legislation, a short discussion of the issue involved, and an explanation of the approach taken by the study to the problem being researched.

Chapter 2 provides projections of the beverage system's energy, capital, and labor requirements in the absence of a deposit law. This provides a baseline from which deposit law impacts can be examined.

Chapter 3, presents projections of the energy, capital, and labor impacts of mandatory deposits for alternative market responses.

Projections of beverage consumption and packaging are presented in appendixes A and B, respectively. Appendix C presents an example of a mandatory deposit bill. Appendix D provides the analytical procedures, data, and the resulting energy equations which are used to develop the energy trends and impacts. Appendix E outlines the theoretical model of behavioral market responses to mandatory deposits and lists the computer model used to develop the baseline trends and impacts. Appendix F contains the analytical procedures, data, and the resulting capital and labor coefficients for each beverage and container type which were used to develop the capital labor trends and impacts. In appendix G, a simple procedure is presented for utilizing the energy data presented in this report to develop the energy impacts of regional mandatory deposits. Appendix H provides the data and procedures used to develop the baseline projections of beverage container recycling which affect the energy trends. Appendix I examines the impacts of mandatory deposits on the economics of resource recovery systems. Appendix J examines the impacts of plastic beverage containers on the baseline energy projections. In appendix K results of a national public opinion survey relating to mandatory deposits are presented.

Because of the controversial nature of mandatory deposits, draft copies of this study were mailed to approximately 130 individuals in other government agencies, industry, labor, environmental groups, researchers, and other

*The term "beverages," as used in this report, means only beer and soft drinks.

knowledgeable and interested persons for their critical review and comment. About fifty responses were received. These responses are reproduced in appendix L.

To the extent possible within the scope of this study, the data, information, and insights presented in the reviewers' comments were incorporated into the analysis presented in this final report. However, specific comments are addressed in appendix M. Following appendix M is a bibliography of the major reports and articles used in this study.

1.3 Proposed Legislation

Over the last few years several bills have been introduced at the Federal level and hundreds at the State and local levels, which would, if enacted, result in some form of government intervention in the beverage industry. At the State level alone, 140 laws are currently being considered for action in 36 states (ref. 1).

The most commonly proposed form of intervention is to require mandatory minimum deposits (usually 5 cents) on beer and soft drink containers (refillable bottles,* nonrefillable bottles, and cans). Mandatory deposits have been enacted in several States and localities. However, these currently represent only a small share of the national market for beer and soft drinks.

There is intense controversy over mandatory deposit legislation. Proponents of this legislation support its passage on the basis of the incentive it would provide for container reuse and recycling. They cite the environmental energy benefits of reuse and recycling. The opponents of government intervention argue for consumer sovereignty, question the accuracy of the data used by the environmentalists, and cite the possible economic effects on the major industries that would be affected.

One specific example of a bill that appears to embody most of the features common to other mandatory deposit proposals is a bill in the United States Senate, S.613, introduced by Senator Mark O. Hatfield. (See appendix C for the complete bill.) This legislation is patterned after the Oregon "bottle bill," which was passed during the 1971 legislature and became effective on October 1, 1972.

The stated purpose of S.613 is to induce reductions in littering and in solid waste generation, as well as to create more efficient energy and natural resource utilization. To promote the policy goal, S.613 would require a minimum deposit of 5 cents on all containers of "... beer or any other malt beverage, mineral water, or soda water, or a carbonated soft drink of any variety in liquid form and intended for human consumption"** (ref. 2). The

*The term "refillable" bottle as used in this report means a bottle designed for more than one filling. The industry calls it a returnable bottle; however, the term refillable is more descriptive since all containers are potentially returnable but only the refillable bottle is designed for multiple fillings.

**Also, detachable ends on metal containers would be disallowed. However, this provision is beyond the scope of this analysis. Cans that meet this requirement are now available and are currently being sold.

deposit requirement would go into effect 3 years from the date of the bill's enactment into law.

1.4 Public Opinion

The attitudes of the public toward mandatory deposits appear mixed. Available opinion surveys seem to indicate that the general public supports the introduction of mandatory deposits. A nationwide survey by the Opinion Research Corporation for the Federal Energy Administration in February 1975 asked the question: "Would you favor or oppose a law requiring all soft drinks and beer to be sold in returnable bottles and cans?" Of the respondents, 73 percent said they would favor such a law, 15 percent would oppose it. The remaining 12 percent offered no opinion (see appendix K). In Oregon, a public opinion poll conducted 1 year after the bottle bill was enacted found that the public's reaction was "overwhelmingly" favorable toward the law with 91 percent approving of the law (ref. 3). Only 5 percent disapproved.

On the other hand, mandatory deposits have been defeated in several legislatures and in eight popular referenda since 1970.

1.5 Study Approach

The beverage system consists of a complex set of interrelated production and distribution activities, each requiring inputs of energy, capital, and labor. For this study it was necessary to identify the major activities and quantify their interrelationships. The major components of the system and their interrelationships are shown in figure 1. Figure 1 focuses on the major materials flows associated with the beverage producers' selection of a container in which to package beer or soft drinks. In the left portion of the figure are the container (glass and metal can) and the metals manufacturing industries (steel and aluminum). The center part of figure 1 shows the major types of beverage producers and the distribution outlets. The right portion shows the consumer and the alternatives associated with the ultimate disposition of the empty container.

Although the impact of deposits could potentially affect a number of industries, the focus here is on the set of industries that would be most affected. These industries are: (1) retailers, (2) beverage producers and distributors, (3) container producers, and (4) steel and aluminum producers.

To determine the impact of mandatory deposits, the future requirements of the beverage system for energy, capital, and labor in the absence of government intervention, are first projected. Energy, capital, and labor requirements are developed on a per-unit basis (e.g., Btu per ounce) by container type (see appendixes D and F). To develop the totals, these requirements are then multiplied by the number of ounces of projected sales in each type of container.

The per-unit values were developed from a combined engineering and econometric analysis. Projections of beverage consumption are based on econometric estimates of the relationships between aggregate beer and soft drink consumption in ounces per capita (see appendix A) and economic and demographic variables. Trends in the market share of each container type are projected based on past trends and projections provided by industry (see appendix B).

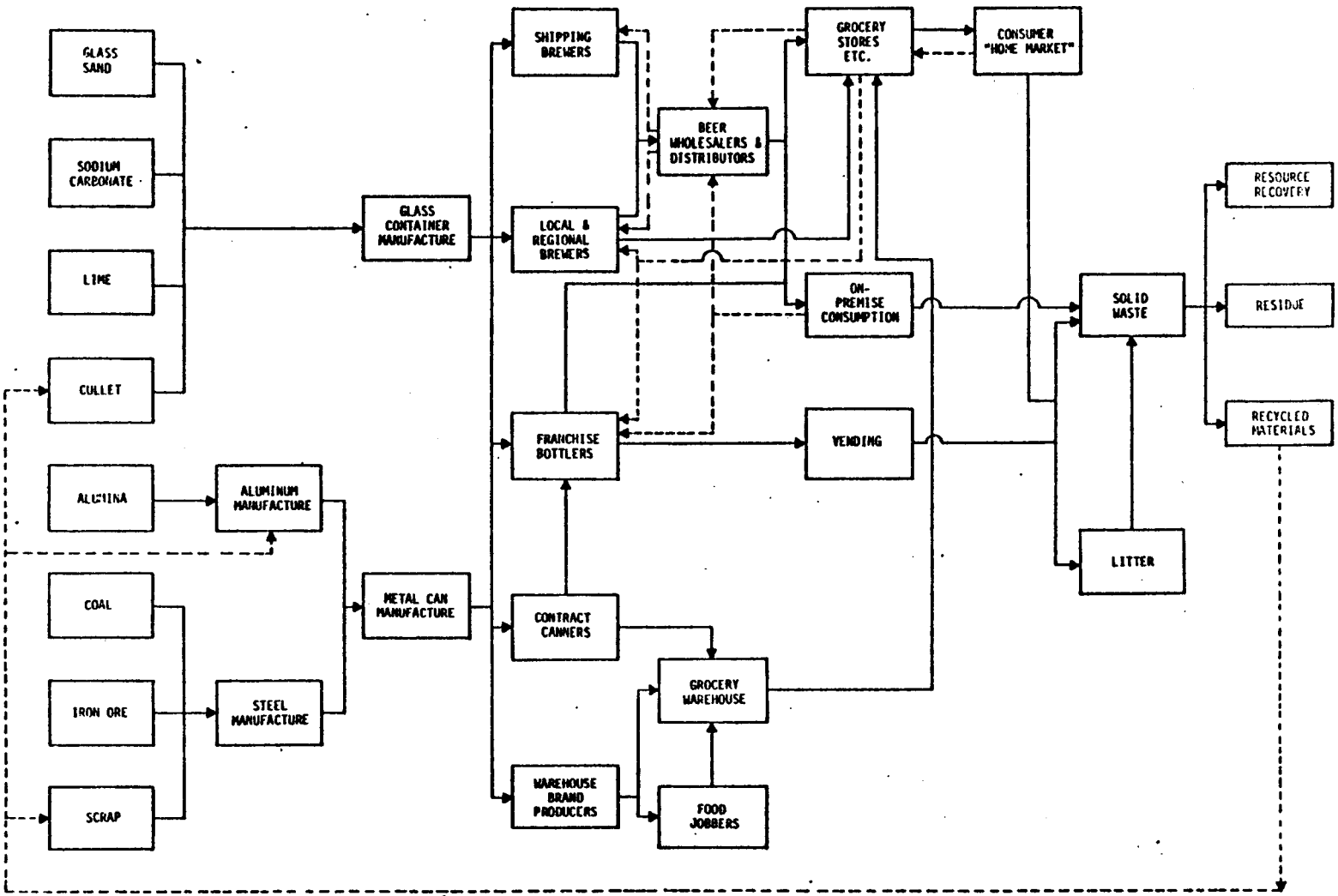


Figure 1. Beverage system interrelationships.

The projected requirements in the absence of government intervention are termed "baseline trends" in this study and are presented in chapter 2. As is apparent in the above discussion, the requirements for the three inputs studied are derived from the final (i.e., consumer) markets for beer and soft drinks by container type.

For comparison with the baseline trends, responses to mandatory deposits in the final markets are examined parametrically. Thus, new sets of energy, capital, and labor requirements may be developed. The energy and economic impacts are reported as the difference (which can be positive or negative, depending on the chosen parameter values) between the baseline trend requirements and the requirements with government intervention. This approach is illustrated in figure 2. Impacts are parametrically presented in chapter 3.

The approach employed in this study presents a substantial extention of the analytical procedures and data presented in previous studies of this issue (refs. 4 and 5). A large number of other studies which have provided useful insights and data are referenced in this study and included in the bibliography.

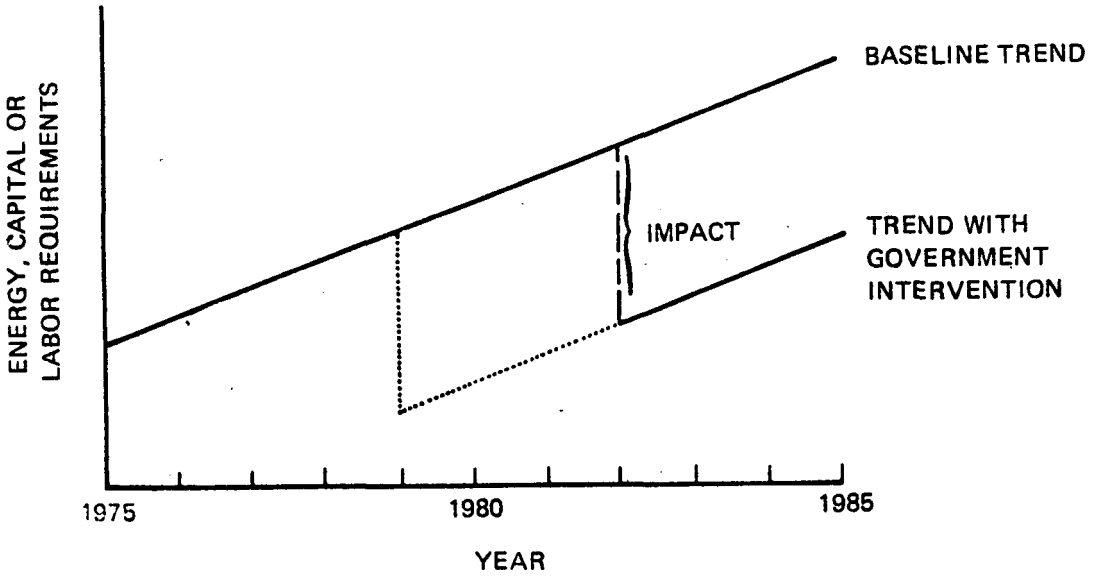


Figure 2. Impact distance.

In evaluating the results presented in this report, the reader should keep in mind that the beverage production and distribution system is very complex and that packaging has a critical effect on the system. Any attempt to describe the system in terms of only three markets each for beer and soft drinks (the refillable bottle, nonrefillable bottle, and metal can markets), as is done in this study, is bound to ignore many factors that will influence the final set of impacts obtained if mandatory deposit legislation is enacted on a national scale. Furthermore, the set of impacts analyzed in this study, while it includes some of the more important issues, does not necessarily provide the complete set of impacts required for a comprehensive cost-benefit evaluation of mandatory deposits. Nevertheless, the material presented can provide an important input to an informed decision-making process.

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Chapter 2: BASELINE PROJECTIONS IN BEVERAGE SYSTEMS

2.1 Introduction

A variety of inputs are required, both directly and indirectly, to produce and distribute beverages. The inputs of interest in this study are energy, capital, and labor. The amounts of these three inputs required by the beverage system are dependent on a large number of variables.

The most important of these variables are: (1) the container type, (2) container market shares, (3) total beverage consumption, (4) the return rate of cans, and (5) the trippage of refillable bottles. Government intervention at the national level in the beverage market would affect the magnitude of these variables in future beverage systems. This chapter develops baseline trends, i.e., trends in the absence of government intervention, in beverage consumption and packaging, energy utilization, capital requirements, labor requirements, and labor earnings. Plastic containers have been omitted from the analysis presented here since they do not hold any significant market share at this time. However, appendixes D and J present data on plastic containers.

2.2 Trends in Beverage Consumption

The average American consumes an estimated 64 ounces of fluids daily. As shown in table 2, the trend has been toward a substitution of prepared beverages for water. Within the prepared beverage market, consumption has shifted from hot to cold beverages--in particular to beer and soft drinks. This trend is frequently attributed by industry observers to increased consumer affluence, favorable demographic factors, and changing tastes and lifestyles. Undoubtedly, technological changes, improved transportation, and aggressive marketing efforts by the beer and soft drink industries have also contributed to these shifts.

Table 2. Consumption of prepared beverages: 1960-1973*

Fluid	Percentage distribution of fluid ounces			
	1960	1965	1970	1973
Beer	13.99	14.47	16.09	16.52
Soft drinks	11.29	14.83	19.72	22.00
Milk	31.90	30.30	25.69	23.96
Coffee	32.84	30.03	26.64	24.94
Tea	4.76	5.37	5.45	5.64
Juices	3.28	2.71	3.70	4.01
Wines	0.84	0.89	1.12	1.34
Distilled spirits	1.21	1.38	1.58	1.58
Total, per capita ounces daily	37.59	38.54	40.54	42.89

*Derived from data on purchased beverages only.

Source: National Soft Drink Association. Statistical Profile: The Soft Drink Industry in the United States, 1974, pp. 18-19.

This trend is frequently attributed by industry observers to increased consumer affluence, favorable demographic factors, and changing tastes and lifestyles. Undoubtedly, technological changes, improved transportation, and aggressive marketing efforts by the beer and soft drink industries have also contributed to these shifts.

2.2.1 Beer

Although the total annual consumption of beer in the United States remained nearly constant from 1947 to 1960, per capita consumption actually dropped. The 1947 total consumption rate was not reached again until 1971. By 1973, however, annual beer consumption had reached 549 billion ounces annually, or 2,611 ounces per capita--about 7.2 ounces daily (see fig. 3).

The aggregate demand for beer is estimated to be relatively insensitive to changes in the price of beer or in the income of consumers.* By employing the data for the 1947-1973 period, a 10-percent increase in the price of beer was estimated to cause a decrease in per capita consumption of 6.0 percent (elasticity = 0.60) (see appendix A).

Three variables have been statistically related to beer consumption (price, income, and age distribution). Based on a similar continued relationship between beer consumption over the 1947-1973 period and these variables, and using government projections of income and the age distribution of the population, total annual consumption is projected to reach 762 billion ounces in 1985 (or 3,234 ounces per capita). This represents a 2.77 percent annual growth rate in total consumption over the 1973-1985 period, or a 1.80 percent annual growth in per capita consumption (fig. 3).

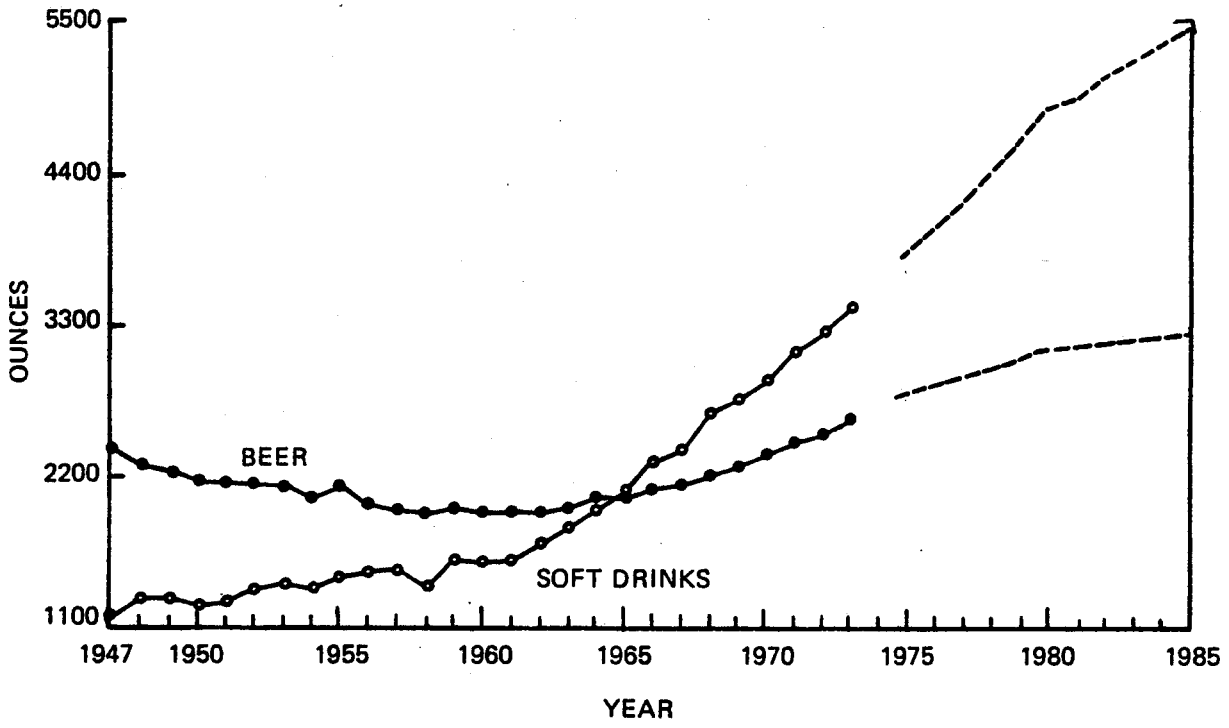
A fourth variable, the type of container, may also have a significant effect on consumption. This effect has not been substantiated statistically in this study. Some beverage industry analysts do attribute consumption changes to this variable (see ref. 2). However, over the 1947-73 period, variation in only the three independent variables (income, price, and age distribution) statistically accounts for 95.8 percent of the variation in per capita beer consumption.

2.2.2 Soft Drinks

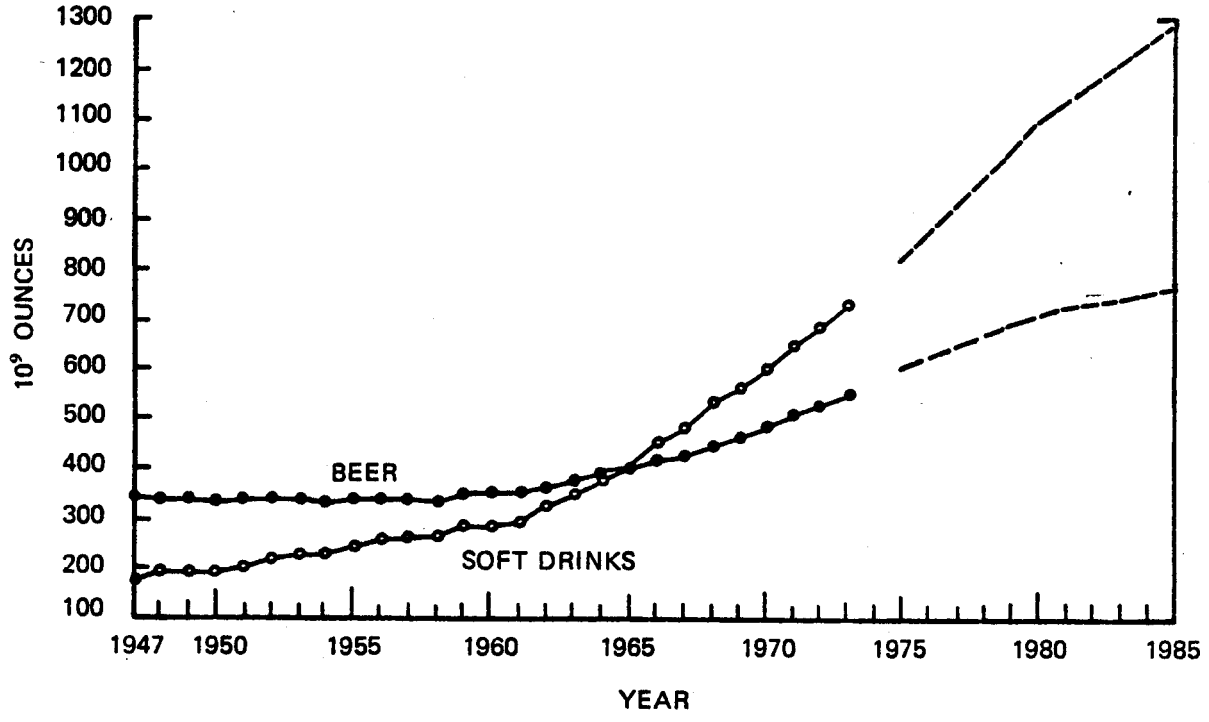
During the period 1947 to 1973, the total consumption of soft drinks increased steadily averaging 5.66 percent annually. In 1973, soft drink consumption was 724 billion ounces, or 3,442 ounces per capita--about 9.4 ounces daily (fig. 3).

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*Specifically, the aggregate demand for beer is estimated to be both price and income inelastic. The term elasticity means the percentage change in price or income. If the absolute value of an elasticity is less than 1.0, demand is said to be inelastic; if greater than 1.0, it is elastic.



a) Per capita.



b) Total

Figure 3. Beverage consumption: historical 1947-73; projected 1975-85 (source: historical Brewers Almanac, 1973 Sales Survey of the Soft Drink Industry projections, Research Triangle Institute).

The aggregate demand for soft drinks is estimated to be relatively insensitive to changes in the price of soft drinks but sensitive to changes in income. Based on data for the 1947-1973 period, a 10-percent increase in the price of soft drinks decreases per capita consumption by 1.4 percent (elasticity = -0.14). However, a 10-percent increase in income increases per capita consumption by 14.7 percent (elasticity = 1.47) (see appendix A).

For soft drinks, as for beer, three variables (price, income, and age distribution) can statistically account for almost all (99.5 percent) of the variation in total soft drink consumption over the 1947-1975 period. Again, the effect of the type of container on aggregate soft drink consumption has not been statistically estimated in this study.

Based on the independently provided projections of income and age distribution, the growth in the per capita consumption of soft drinks is projected to average 4.90 percent annually from 1973 to 1985 reaching 5,453 ounces by 1985. Again, as was also the case in developing the projections of beer consumption, the relative price of soft drinks to all other goods is assumed constant over the 1973-1985 period in the absence of government intervention.

2.3 Trends in Beverage Packaging

Since World War II, the absolute quantities of beer and soft drinks packaged in all container types has increased steadily as has the quantity of nonpackaged, or bulk, soft drinks. However, sales of draught beer have declined.

The factors that affect packaged beer sales are not necessarily the same as those that affect the sales of packaged soft drinks. Such social and cultural trends as the decline of the inner-city and the emergence of television as a major home entertainment medium have been cited as the cause for the decline in on-premise draught beer sales and of a concurrent increase in the sale of packaged beer (ref. 2).

On the other hand, families increasingly are eating away from home, especially at fast-food restaurants where soft drinks are often sold from fountains and served in cups. This trend is frequently cited as a major reason for the decline in the market share of packaged soft drinks.

Based on a continuation of these historical trends, the packaged beer market share will increase from 87 to 92 percent of the total beer market in the period 1973 to 1985. In contrast, the market share of packaged soft drinks is projected to decline from 80 to 66 percent during the same period. The total consumption of packaged soft drinks is projected to increase at an annual rate of 3.28 percent, since total soft drink sales are projected to increase faster than the decline in the packaged market share. For beer the projected increase is 3.23 percent (see appendix B).

A model of technological substitution was developed in this study to project market trends in beverage packaging. This model is similar to that employed in a number of other studies (refs. 3,4,5,6). However, a brief review of the model may be useful. The model states that the substitution of one technology for another (e.g., packaged for bulk sales, and nonrefillable bottles and metal cans for refillable bottles) tends to follow an "S" shaped curve: substitution increases slowly at first; then more rapidly as the new technology is improved and cost reductions are realized; and finally slows again as market saturation is approached. Thus, when a new beverage package is introduced into the market, there is first a period when acceptance is slow. During this time technological improvements are made, perhaps price reductions (either absolute or relative) are achieved, and consumers learn about the characteristics of the new package. If the package is economically viable, it may increase in competitiveness as consumers develop a preference for it and as price reductions occur. These factors accelerate the rate of acceptance. In the final stage, the rate of acceptance slows and tends toward an ultimate limit at which all process improvements and scale economies have been achieved (ref. 5).

The proportions of total ounces of both beer and soft drinks packaged in each container type were projected using both the substitution model and data provided by industry representatives. These "market share" projections, which were developed for bulk sales, refillable bottles, nonrefillable bottles, and metal cans, were then multiplied by the consumption projections reviewed above, to develop projections by container type, measured in ounces. Finally, these projections were divided by projections of average container size to project the number of containers required for cans and nonrefillable bottles in addition to the number of fillings for refillable bottles. As shown in figure 4, by 1985 beverage container production is projected to reach 99 billion containers annually.

2.3.1 The Refillable Bottle

The refillable bottle was the first container used by manufacturers to package single-drink servings of beer and soft drinks. It was expensive compared to the cost of the product it contained. However, it offered, and continues to offer, the durability to withstand 50 or more fillings (trips). Thus, the refillable bottle can potentially reduce the average container cost per filling to a nominal amount. Currently, beer and soft drinks in a refillable bottle cost consumers less than beverages packaged in other container types--provided the bottles are returned for deposit refunds.

The trend, however, has been away from the use of refillable bottles. If this trend continues, refillable bottles will account for only 12 percent of packaged beer and 25 percent of packaged soft drinks by 1985. Over the period 1973 to 1985, the absolute number of ounces packaged in refillable bottles is projected to decrease for beer and increase only slightly for soft drinks (see appendix B).

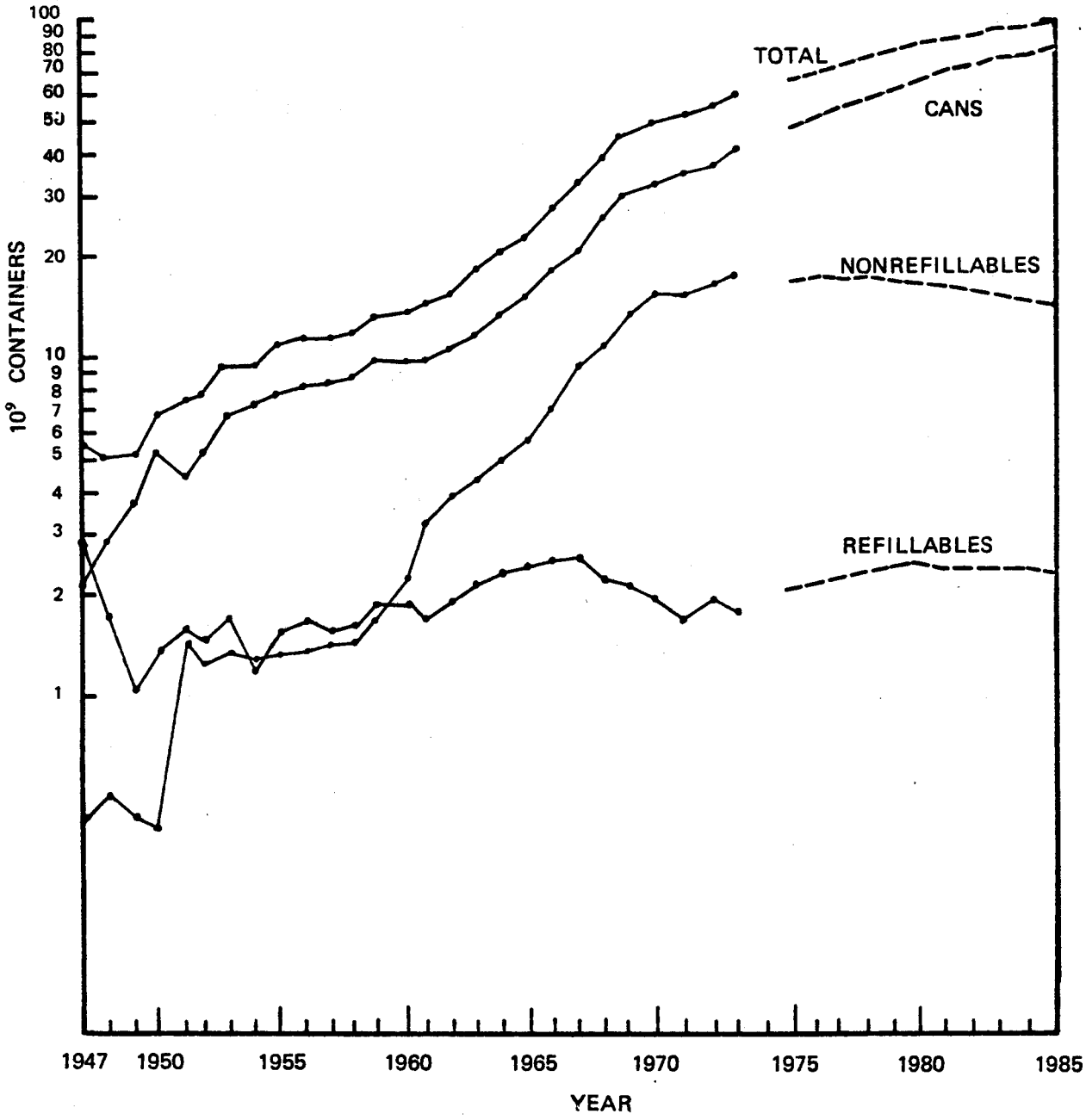


Figure 4. Container production historical 1947-73, projected 1975-85 (source, historical Containers and Packaging, projections by Research Triangle Institute).

The average size of refillable beer bottles has remained at approximately 12 ounces over the past 26 years; the average size of refillable soft drink bottle has increased slightly in the same period and currently is 10 ounces.* For this study, it was assumed that the average size of the refillable beer bottle would remain the same--12 ounces. However, the average size of the refillable soft drink bottle is expected to increase over the coming years, reaching 14 ounces by 1985. Thus for this study bottle size changes each year over the 1975-85 period.

The combined effect of the consumption and bottle size trends is to reduce the forecasted number of fillings of refillable bottles for both beer and soft drinks between 1973 and 1985 (refer to appendix B). "Fillings" are the number units of the beverage sold in refillable bottles.

Besides fillings, trippage--that is, the number of times a refillable bottle is used before it is discarded--is a critical variable that influences the number of containers the industry requires.** Unfortunately, no adequate, published time-series exists to indicate trippage for the period 1947 to 1973. The only national estimates of trippage published by the beverage industry are those developed by the Glass Container Manufacturers Institute (GCMI). Their approach differs from that used in this study. Specifically, their approach was to divide fillings by new refillable bottle shipments. GCMI's trippage estimates were discontinued in their 1970 report.

Because of the importance of trippage in determining refillable bottle requirements and because of the paucity of information, RTI has estimated trippage for both beer and soft drinks for the 1947-1973 period. The estimates were statistically developed using historical data on fillings and refillable bottle shipments. The complete methodology is provided in appendix B. These estimates indicate that there has been a steady decline in the average trippage of refillable bottles and that soft drink bottle trippage has been less than that for beer over the entire period (see appendix B). The trend revealed by these estimates is consistent with industry opinion,

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*The average size of all beverage containers has been calculated by dividing total ounces for each container type by the number of containers (or in the case of refillable bottles, by the number of fillings).

**Another way of expressing the trip life of refillable bottles is through its relationship to the return rate. The return rate is the average fraction of containers returned. Trippage is related to the return rate as follows:

$$\text{trippage} = 1/(1-\text{return rate}).$$

although their estimates may vary from those presented here.*

In the absence of government intervention, how will trippage behave in the coming years? To answer this question it obviously was necessary to develop a basis for projecting trippage. The historical estimates of trippage mentioned briefly above were employed in a behavioral model in which changes in per capita disposable real income were hypothesized to cause changes in trippage. The reason for selecting this particular variable is that an increase in income implies an increase in the value of the consumer's time--in this case, time required to return an empty bottle. Consequently, as income increases, all other things being equal, trippage can be expected to decline, since the time required to return the container will be more valuable to some consumers than the deposit on the refillable bottle.

Obviously, variables other than income could affect trippage, and they are not, of course, likely to remain constant in the future. Such variables include the amount of the deposit, package size, type of product, region, advertising, proximity of outlets accepting empty bottles, and the availability and price of beverages in nonrefillable bottles and metal cans.

The trippage projections--based on projected disposable real income--and the bottle velocity(which is the average number of times a bottle is used annually),** were employed to project the number of new refillable bottles required annually (refer to appendix B). In 1985, the total number of refillable bottle shipments is projected to be 2.3 billion, as compared to 1.7 billion in 1973.

2.3.2 The Nonrefillable Bottle

The nonrefillable bottle is designed for one trip. It was introduced as a direct competitor to metal cans and has enabled the glass container industry to remain a key factor in the convenience container market for beverages. Nonetheless, the market share of nonrefillable bottles for both beer and soft drinks is projected to fall slightly during the period 1973 to 1985. Competition from metal cans accounts for the decrease.

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*For example, for the period 1964 to 1970, the GCMI trippage estimates compared with those developed for this study as follows:

	Beer		Soft Drinks	
	GMCI	RTI	GMCI	RTI
1970	20	17	14	12
1969	20	17	14	12
1968	20	18	15	12
1967	19	19	16	13
1966	23	19	16	14
1965	27	20	17	14
1964	31	21	17	15

**The bottle velocity is estimated to be 4.0 trips annually for beer and 5.7 trips annually for soft drink bottles (refer to appendix B for more detail).

Historically, however, the nonrefillable bottle has been very successful. In 1947, the market share for nonrefillable beer bottles was a scant 3 percent, but by 1973 it had risen to 21 percent. It has remained fairly constant over the past several years. However, based on the substitution model described above, by 1985 the nonrefillable bottle market share among beer containers is projected to be only 13 percent, primarily because of competition from metal cans. Consequently the total number of ounces of beer packaged in nonrefillable bottles is also projected to decline (see appendix B).

The history of the nonrefillable soft drink bottle has been similar. In 1960, its market share was less than 2 percent, rising to 29 percent in 1973. On the other hand, based on the substitution model, its future decline is not expected to be as steep as that of the nonrefillable beer bottle; it is projected to fall to 21 percent by 1985. Again, competition from metal cans appears to be responsible. Unlike beer, however, the total quantity of soft drinks packaged in nonrefillable bottles is projected to increase moderately over the 1973 to 1985 period.

The average size of nonrefillable beer bottles has declined since 1947. In 1973 the average size was 12 ounces and is assumed for the 1973 to 1985 period because it is the most common single drink size. By contrast, the average size of the soft drink bottle remained constant--approximately 18.6 ounces--over the 1960 to 1973 period. But in recent years, the soft drink industry has employed larger bottles. This trend is expected to continue, with the average size of the nonrefillable soft drink bottle expected to reach 26.6 ounces by 1985.

In 1973, glass container manufacturers produced 17.4 billion beverage bottles. With the declining market share projected for nonrefillable bottles over the years 1973 to 1985 and the increase in the size of soft drink bottles, nonrefillable bottle production will decrease. By 1985 the number of bottles produced is projected to be 14.4 billion.

2.3.3 The Metal Can

Introduced in 1935 for beer packaging and, subsequently, for soft drinks, beverage cans originally were made of tin plate. In 1964 the aluminum can was introduced. One year later, a tin-free steel can entered the market. Currently, the majority of beverage cans are either two-piece (drawn and ironed) aluminum cans or are of three-piece bimetal construction (tin plate or tin-free steel body with aluminum ends).

In 1947, the metal can market share for beer was 11 percent, but it had increased to 60 percent by 1973. If the present trend were to continue, it would increase to 75 percent by 1985. For the market share of soft drinks in cans, the trend is no less marked. From 4 percent in 1960, it increased to 36 percent in 1973. By 1985, it is expected to reach 54 percent.

In the past, can size has not fluctuated significantly. In fact, except for the 1971 to 1972 period when the 16-ounce beer can was a factor (average can size slightly exceeded 12 ounces) and the period since 1973 during which the 7-ounce "pony" size has been available (average can size was 11.8 ounces), can size has remained nearly constant. Therefore, the average size of both beer and soft drink cans was projected at 12 ounces for the period 1973 to 1985.

The production of metal beverage cans is projected to rise significantly, reaching 43.6 billion beer cans and 38.3 billion soft drink cans by 1985 (refer to appendix B).

2.4 Trends in Energy Requirements

Energy is one of the major resource requirements of the beverage system. It is used in mining ores, processing the materials and fabricating the containers, filling the containers, and shipping them to distribution outlets. After the beverages are consumed, energy is required to collect, ship, and process the empty containers for refilling, recycling, or discarding. There are, of course, many other minor beverage production and distribution activities requiring energy.

The amounts of energy required are dependent on particular container technologies, on the type of distribution systems, and on total beverage consumption. Projections of the energy requirements of the beverage systems in the absence of government intervention have been developed for this study. This has been done by, first, estimating the per-unit energy requirements, e.g., Btu per ounce of beverage (refer to appendix D for a complete description of the data and methodology). Then, these per-unit values are multiplied by the appropriate projected values of beverage consumption for the 1975 to 1985 period to estimate total energy requirements.

2.4.1 Per-Unit Requirements*

The per-unit energy requirements (i.e., the energy requirements per ounce of beverage delivered to the customer) were developed for each major production process studied as an element. These processes included iron ore mining, aluminum smelting, bottle filling, and so forth. The elements were then

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*The per-unit energy values in this study were derived by revising data from a previous study for the Environmental Protection Agency, Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives, Robert G. Hunt, et al., 1974. In appendix D.10 the energy results of that study are compared to the energy results of this study. As the comparison indicates, the values in this study are generally lower than values presented in the EPA study, by 8 to 33 percent. The reason for these significant differences is that the data base for the EPA study was in some cases as old as 1968, and generally relied on industry average data, the best available at the time that the study was completed. For this study more current data were available, and in most cases it was possible to derive values for the specific manufacturing systems under study. The more specific data used here resulted in revised, and generally significantly lower, energy values.

combined to form a system, and system per-unit totals were developed by summing the energy requiements for the various elements.

Data were developed in considerable detail so that the specific fuel requirements could be determined for each process. This approach permitted calculations to be reported, not only by beverage and container system, but also in terms of five energy resources: 1) natural gas, 2) petroleum, 3) coal, 4) nuclear and hydropower, and 5) wood wastes. The data reflect average actual energy consumption per unit of beverage by container type, based on the current distribution of fuel by type used in each step of the major production processes.

In determining the per-unit energy requirements of the different container systems two approaches are possible--the average energy required per unit and the marginal energy required per unit. In the first, the total energy required for a given number of containers is distributed equally across all units by simple division of the total required energy by the number of containers. The marginal energy requirement is the incremental energy required for the last container. The marginal energy may or may not differ from the average energy depending on the industry circumstances and the assumptions employed.

The difference between average and marginal energy requirements for the beverage industry presented in this study results from the way electricity is valued. The energy equivalent of 1 kWh of electricity is 3413 Btu. However, because of conversion losses the exact amount of energy required to generate 1 kWh of electricity varies as a function of the process used to generate electricity. For example, the average heat rate for all fossil fuel fired thermal electric power plants is 10,429 Btu per kWh. Thus electricity derived from a fossil fuel fired power plant is valued at 10,429 Btu per kWh. By comparison, electricity derived from a hydroelectric plant is frequently valued at 3413 Btu per kWh. In this study when the average energy requirements are computed, electricity is valued as a weighted average of the heat rates of all the different processes used to convert another form of energy into electricity. For example, if in a given region of the country 85 percent of the electricity were derived from thermal electric plants and 15 percent from hydroelectric plants, the electricity for this region would be valued at .85 x 10,429 + .15 x 3,413 = 9,376 Btu per kWh in an average energy computation. Because water, unlike fossil fuel, cannot be store indefinitely behind a dam it must essentially be utilized to generate electricity more or less at the time it is collected or it will be lost. Therefore, thermal electric plants represent the marginal power source. Thus, any reduction in electricity demand caused by a deposit law will result in the amount of thermally derived electricity being reduced and hence the appropriate (marginal) value is 10,429 Btu per kWh.

As a practical matter, the difference between average and marginal energy only significantly affects container systems that derive a large portion of their energy inputs from hydroelectric power. This primarily

applies to the aluminum used in containers since aluminum is produced in areas where low cost hydroelectric power is available.

The 1975 actual average per-unit energy requirements for each container system are summarized in table 3. The magnitude of the energy fuel requirement varies with each container system (see table 3a). For glass containers, hydrocarbon fuels (natural gas and petroleum) are the major fuels. Metal can systems tend to be less dependent on hydrocarbon fuels and more dependent on coal.

The per-unit energy requirements also vary significantly among container types by stage of process (refer to table 3b). At 10 trips, the stages of the refillable bottle system that consume the most energy are supplementary paper and plastic packaging, distribution, and bottle-production. For nonrefillable bottles and cans, container manufacturing dominates.

Those variables that have a major effect on the present and future per-unit energy profiles have been identified for each container system under study here. For all containers, the rate of adoption of energy-conserving manufacturing processes and changes in product design are important. For the refillable bottle, the additional variables are trippage and size; for the nonrefillable bottle, size; and for the metal can, the recycling rate. Size is the size of a bottle in ounces, and the recycling rate is the rate at which empty containers are recycled into the material from which they are fabricated. The effects of these variables for each container system are reviewed below.

2.4.1.1 Refillable Bottles. Estimates of per-unit energy requirements were developed for four types of refillable bottles: the 12-ounce on-premise beer bottle, the 12-ounce off-premise beer bottle, the 16-ounce soft drink bottle, and the 32-ounce soft drink bottle. Beer is sold predominantly in 12-ounce bottles because this is a single-drink size. Large containers of beer have to be resealed; this normally causes a marked loss in flavor. Soft drinks, on the other hand, are sold in refillable bottles of a variety of sizes ranging from 6.5 to 67.6 ounces (two liters).

Figure 5 shows that the average per-unit energy requirements of refillable bottles and the trippage of those bottles are inversely related: the more trips a single bottle makes, the lower are its average energy requirements per ounce of beverage. Other useful information can also be developed from figure 5. For example, the average energy requirements of the on-premise beer bottle are about 10 percent less than those of the off-premise bottle when both are measured at a trippage of 10. The difference is due to the additional supplementary packaging required for the off-premise bottle. It can also be seen that the average per-unit energy requirement for soft drink bottles, although initially higher, becomes much lower than that for beer bottles as trippage increases beyond a few trips. This is so, regardless of the fact that soft drink bottles are heavier and, therefore, require more energy to manufacture. The energy required to manufacture a new bottle and deliver it to the beverage producer is averaged across all the trips in figure 5. Thus at high trippages it has little impact on the per-unit requirements. The lower energy requirements of soft drinks at high trippages are due to their shorter transport distances. Further, per-unit energy requirements for all three bottle types approach a lower limit as trippage

Table 3. Average per-unit energy consumption: 1975

a) By fuel

Container	Btu per ounce				
	Total	Natural gas	Petroleum	Coal	Other*
Refillable bottles (10 trips)					
Beer (off-premise)	168.68	41.75	83.28	22.56	21.09
Soft drink (16-oz)	113.97	47.18	42.49	16.38	7.92
Nonrefillable bottles					
Beer	335.62	140.31	116.87	47.89	30.55
Soft drink (16-oz)	355.54	167.34	115.46	50.08	22.65
Metal can					
Steel					
Bimetal	350.76	109.91	59.98	158.93	21.94
All-steel	299.13	87.94	40.06	160.73	10.39
Aluminum	459.39	170.40	105.15	133.01	50.83

*nuclear, hydropower, and wood wastes

b) By stage of process

Container	Btu per ounce						
	Total	Container raw materials extracting & processing*	Container materials manufacture & fabrication†	Filling (and washing)	Distribution	Supplementary materials systems‡	Waste disposal
Refillable bottles (10-trips)							
Beer (off-premise)	168.68	7.58	31.47	10.80	55.02	63.23	0.58
Soft Drink (16-oz)	113.97	9.68	44.21	17.06	17.74	24.49	0.69
Nonrefillable bottles							
Beer	335.62	46.44	177.31	3.77	26.67	77.49	3.95
Soft drink	355.51	57.00	217.13	10.41	12.63	53.70	4.64
Metal cans							
Steel							
Bimetal	350.76	55.24	252.74	10.12§	7.88§	24.17	0.42
All-steel	299.13	25.22	231.29	10.12§	7.88§	24.17	0.45
Aluminum¶	459.20	102.74	314.15	10.12§	7.88§	24.23	0.08

Note: Hydropower valued a 3,413 Btu per kWh for these average values.

*Includes mining, transport, and preparation of raw materials shipped to primary container materials manufacture plants.

†Includes manufacture of primary materials, fabrication of containers, and transportation.

‡Includes supplementary paper and plastic packaging, bottle lids, and labels.

¶At estimated 1975 recycling rate of 22.3 percent (25.4) (.877)

§Soft drink values used for filling and distribution.

Source: Franklin Associates, Ltd. for Research Triangle Institute.

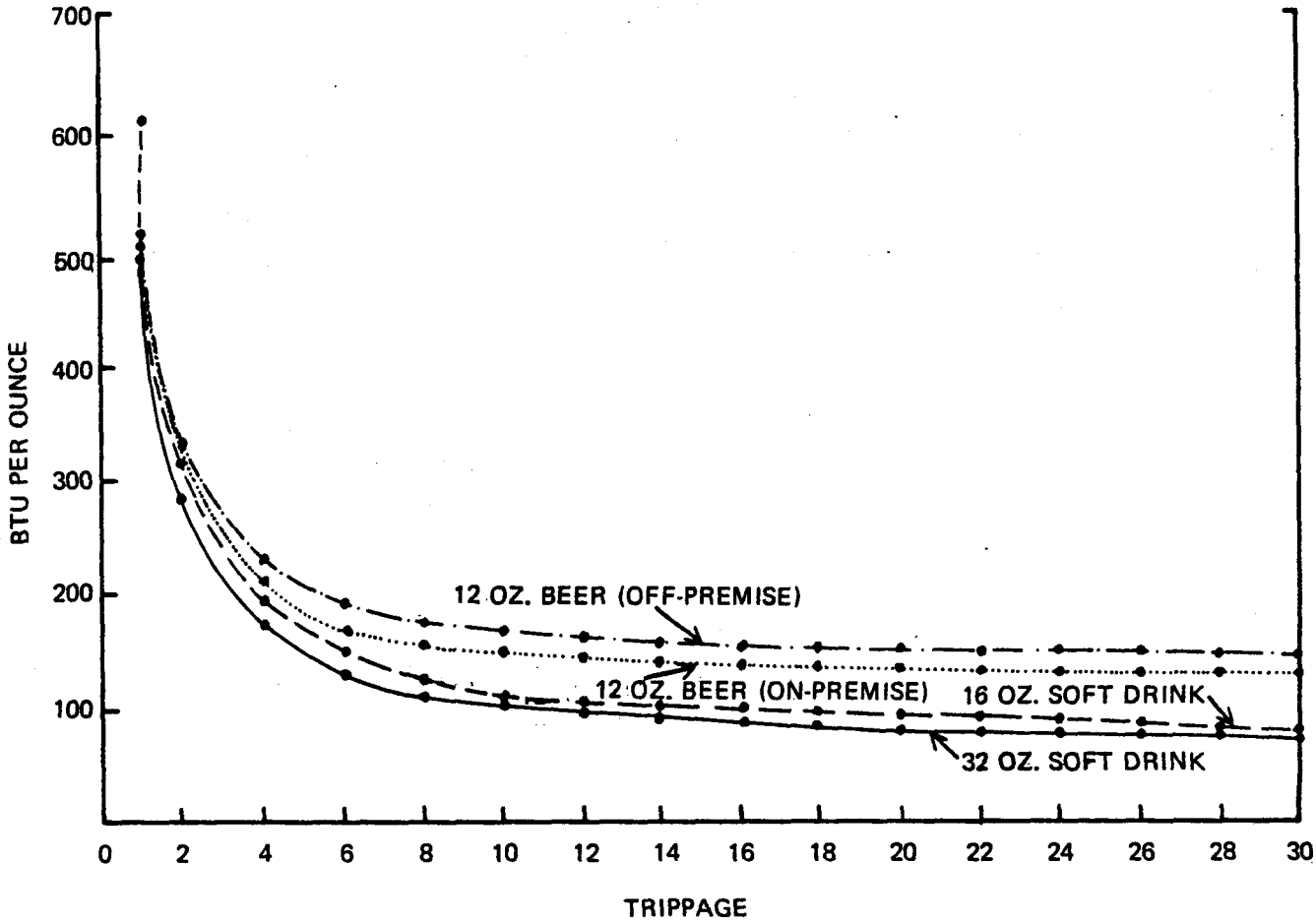


Figure 5. Average per-unit energy requirement of the refillable bottle system 1975 (source: Franklin Associates, Ltd., for Research Triangle Institute).

increases. The lower limit is the energy required for washing, filling, and transporting the bottles since these requirements remain constant for each trip.

Because the surface area of a container increases less rapidly than does the volume, increases in the container size tend to reduce the container's average per-unit energy requirements. The sensitivity of the per-unit energy requirements to bottle size was examined (see appendix D) comparing the 16-ounce to the 32-ounce bottle. At 10 trips, a doubling of size (from 16 to 32 ounces) results in a decline of less than 9 percent in per-unit energy requirements (table 4). Because of the fairly small effects of bottle size and because adequate data on the current size distribution are not available, a 16-ounce refillable bottle has been assumed in this study.

Table 4. Average per-unit energy requirements of soft drink glass containers by bottle size: 1975

Size, ounces	Btu per ounce	
	Refillable bottle (10 trips)	Nonrefillable bottle
16	114	356
32	102	334
64	-	284

Source: Franklin Associates Ltd., for Research Triangle Institute.

The average per-unit energy requirements of refillable bottles are expected to decrease over the 1975 to 1985 period by 1.9 to 2.1 percent annually, depending on the specific refillable bottle, as shown in table 5. The projections are based on expected changes in container design (primarily lightweighting) and on current conservation techniques (see appendix D). Further improvements may be possible, such as ancillary packaging, but they have not been projected here.

2.4.1.2 Nonrefillable Bottles. The average per-unit energy requirements of the nonrefillable bottle, although initially less, exceed those of the refillable bottle that has been filled more than one time (table 6). In addition, the nonrefillable soft drink bottle has a somewhat higher energy requirement, for a given size, than does the nonrefillable beer bottle. The data in table 6 may be compared to those for the refillable bottle, which are presented in figure 5, since trippage is not a factor in determining the energy requirements of the nonrefillable bottle.

The 16-ounce size was assumed as the representative nonrefillable bottle for soft drinks in this study because it is the size for which the best data are available and because it is probably the most popular non-vended bottle size. However, the 32-ounce and 64-ounce plastic-coated glass bottles were also studied to determine the effects of an increase in size on the energy requirements of nonrefillable bottles. This examination (see appendix D for details) has revealed that doubling the size of a bottle from 16 to 32 ounces causes a 7-percent decrease in per-unit energy requirements. Increasing the bottle size from 32 to 64 ounces causes a further reduction of 14 percent (see table 4).

Table 5. Projected growth in average per-unit energy requirements due to technological change: 1975-85

Container	Annual growth rate, percent
Glass container	
Refillable bottles*	
Beer (12 ounce)	
Off-premise	-2.08
On-premise	-1.99
Soft drink (16 ounce)	-1.87
Nonrefillable bottles	
Beer (12 ounce)	-2.12
Soft drinks (16 ounce)	-2.01
Metal cans (12 ounce)†	
Steel cans	-4.03
Aluminum cans	-3.06

*Computed at 10 trips.
†Computed at zero recycling rate.

Source: Franklin Associates Ltd., for Research Triangle Institute.

Table 6. Average per-unit energy requirements-- nonrefillable bottles: 1975, 1985

	Btu per ounce
Beer bottles (12 ounce, off premise)	
1975	336
1985	271
Soft drink bottles (16 ounce)	
1975	356
1985	290

Source: Franklin Associates Ltd., for Research Triangle Institute.

As is the case with refillable bottles, the per-unit energy requirements of nonrefillable bottles are projected to decline over the 1975 to 1985 period at annual rates of 2.12 and 2.01 percent for beer and soft drinks, respectively (see table 5).

2.4.1.3 Metal Cans. As illustrated in figure 6, the per-unit energy requirement of cans is influenced not only by the materials from which the cans are fabricated but also by the recycling rate. Recycling offers the opportunity to bypass the energy-intensive activities of extracting and processing virgin materials.

If aluminum cans are completely fabricated from recycled aluminum the average energy requirement of the aluminum can system is only 33 percent of that of the can made from only virgin materials (0 recycling axis of figure 6b). For steel cans, the impacts of recycling are somewhat less dramatic. If steel cans are completely fabricated from recycled steel the average energy requirement is 82 percent of the zero-recycling value.

When electric power is valued at 10,429 Btu per kWh (i.e., at the margin) the impact of recycling aluminum cans is even more significant. As shown in figure 6b, at zero recycling the marginal energy requirements of the metal can system exceed the average value by about 17 percent. The reason for the size of this difference is because recycling of aluminum avoids the electricity-intensive smelting step required when aluminum is made from virgin materials.

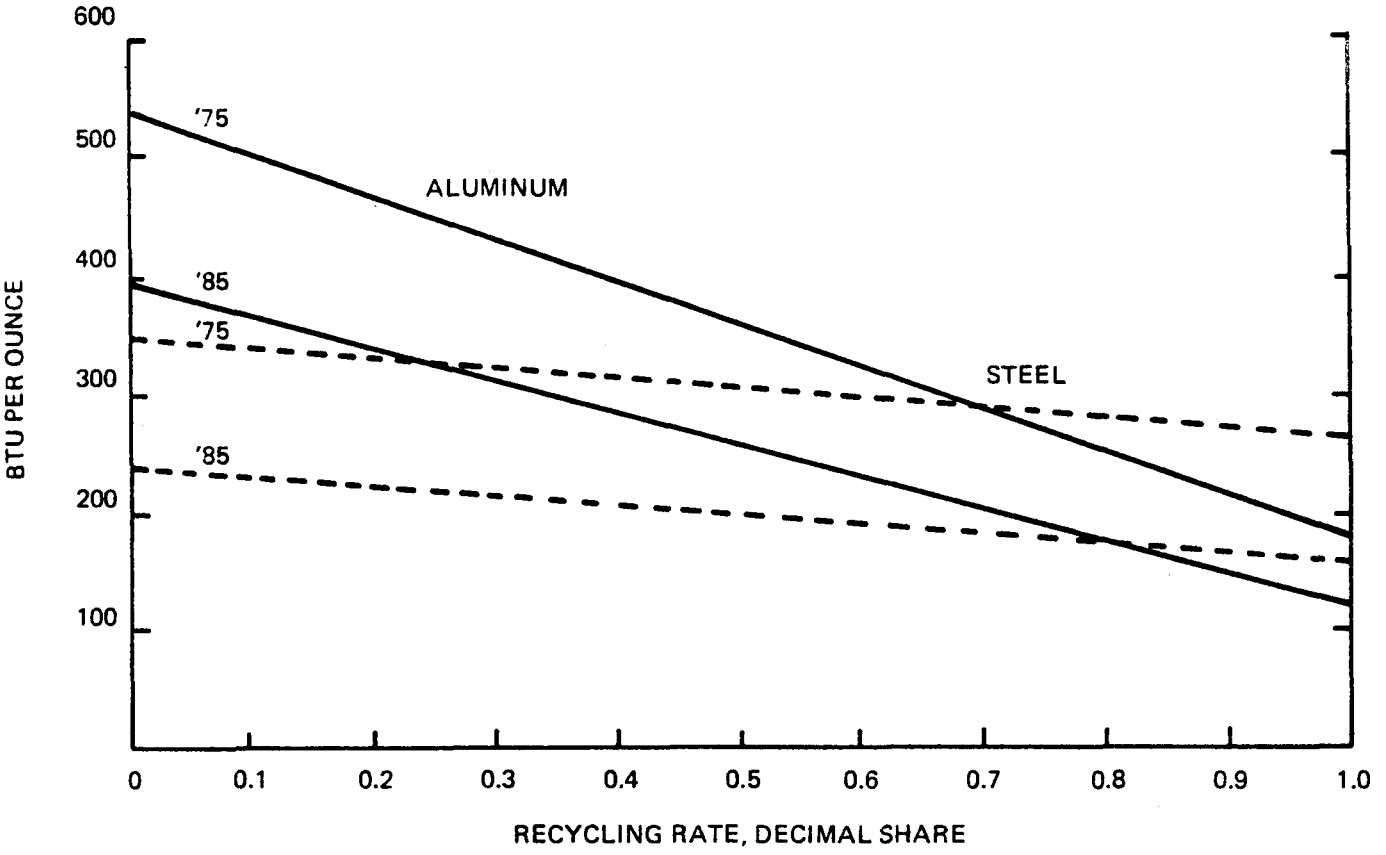
The difference between the marginal and average values for the steel can system shown in figure 6 is fairly small since only the aluminum top of the can and, hence, the hydropower portion of the national grid, is affected by the valuation of hydroelectric power.

It is important to note that only about 87.7 percent of recovered cans can actually be recycled since there are losses in handling and shipment in addition to melt losses in converting containers to molten materials. In 1975 about 25.4 percent of all aluminum cans were recovered for recycling. The estimated recycling rate is 22.3 percent. Steel can recycling is estimated to have been 2.5 percent in 1975.

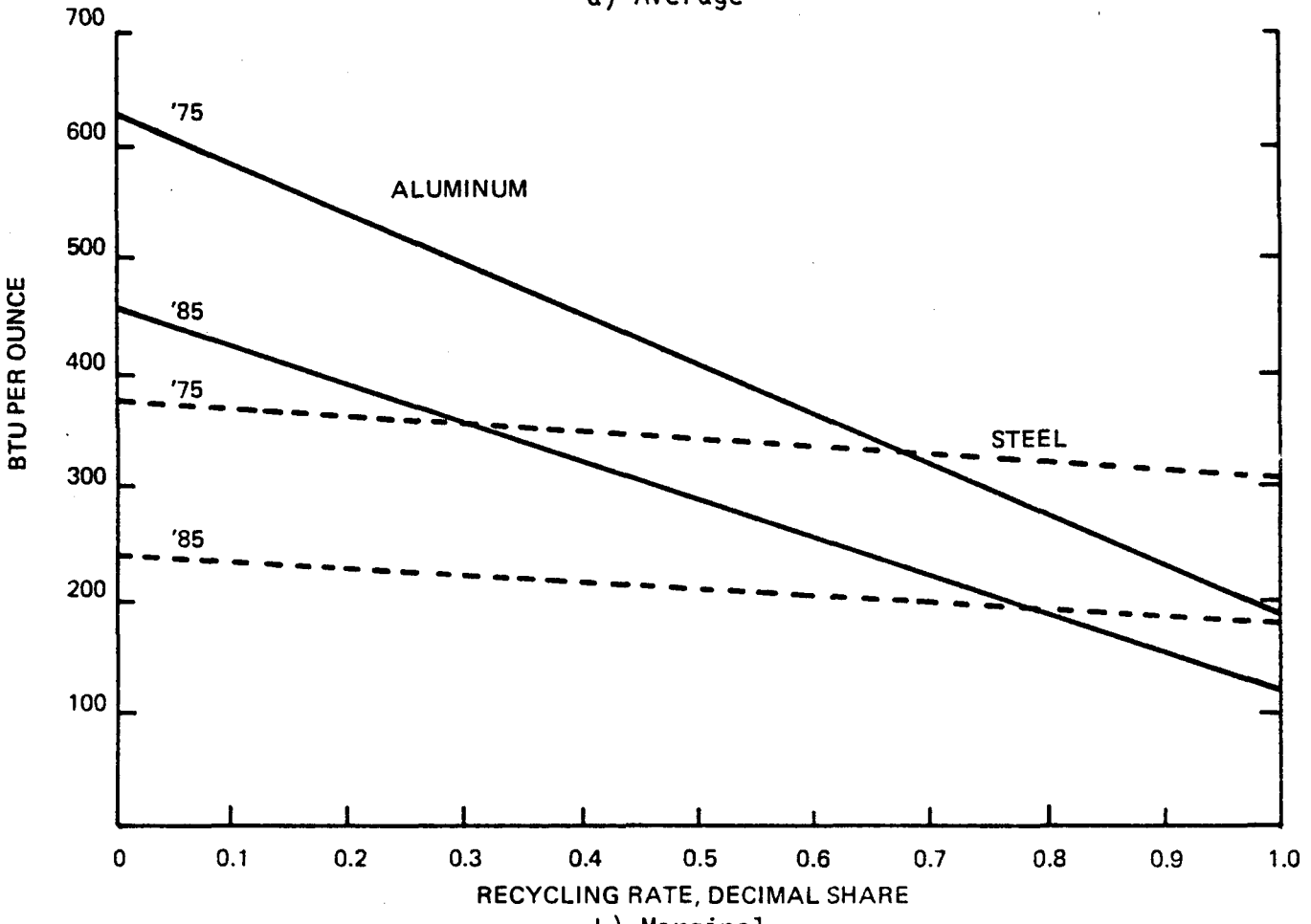
The per-unit energy requirements of steel cans are projected to decline by the greatest percentage amount of all the containers during the 1975 to 1985 period. Currently, the majority of steel cans are of the three-piece bimetal construction. By 1985 a two-piece lightweight can is expected to be on the market. This will tend to reduce the per-unit energy requirements, as shown in table 5. For 1985, the steel can market is projected to be equally distributed between the three-piece bimetal can and the all-steel can.

2.4.2 Total Requirements

The projections of total annual energy requirements for the beer and soft drink systems through 1985 are based on the average per-unit energy requirements, on beverage consumption and packaging trends, and on projected trends in container recycling. The recycling rate for steel cans is projected to increase from approximately 2.5 percent in 1975 to 10.8 percent in



a) Average



b) Marginal

Figure 6. Per-unit energy requirement of the metal can system (source: Franklin Associates, Ltd., for Research Triangle Institute).

1985, while, for the same period, the rate for aluminum cans will increase from 22.3 to 39.5 percent (see appendix H). These projections are shown in table 7, and reflect the assumption that steel cans will be recovered through resource recovery systems and that aluminum cans will be recovered through both resource recovery systems and collection centers. Recycling of glass containers is expected to reach only 3.6 percent by 1985.*

Table 7. Metal beverage container recycling projections: 1975, 1980, and 1985

	percent		
	1975	1980	1985
Steel cans			
Return plus recovery rate*	2.9	5.3	12.5
Recycling rate**	2.5	4.6	11.0
Aluminum cans			
Return plus recovery rate*	25.4	35.0	45.0
Recycling rate**	22.3	30.7	39.5

*Returned containers are those brought to secondary metals dealers directly by consumers. Recovered containers are those reclaimed from the solid waste stream by recovery systems.

**At 0.877 of the return plus recovery rate, due to losses in handling and melt losses.

Source: Franklin Associates, Ltd., for Research Triangle Institute.

*Glass is, however, typically manufactured using significant amounts of internally generated cullet (waste glass) since it reduces melt temperatures and is of known quality.

For 1975, as shown in figure 7, the total energy requirement for the beer and soft drink systems is estimated to be about 0.5 percent of U.S energy consumption (358 x 10^{12} Btu).* The projected trends--developed from baseline data for beverage consumption, packaging, recycling, and technical change--indicate that the beverage system's energy requirement will peak in 1980 and then decline through 1985. This decline is projected to result in the 1985 energy requirement's being 364 x 10^{12} Btu-- only 3 percent higher than the 1975 value. The reason for the small increase is because the projected increase in recycling and the adoption of energy conserving technologies overshadow the projected increases in beverage consumption and decreases in refillable bottle trippage. However, in the absence of the adoption of energy conserving technologies the projection for 1985 would be 504 x 10^{12} Btu. In the absence of both the adoption of energy conserving technologies and increases in can recycling the projection for 1985 would be 531 x 10^{12} Btu.

In 1975, the total energy requirements of the beverage system are estimated to have been evenly divided between the beer and soft drink systems. Projections indicate that, by 1985, the beer system will claim 48 percent of total beverage system energy requirements, with the soft drink system using the remaining 52 percent. The increase in the soft drink share results primarily from a projected growth of cans for soft drink packaging.

As the metal can continues to increase its share of total energy requirements, glass containers are expected to experience a decline in their energy share, since the quantity of beer packaged in nonrefillable bottles will decline. Thus, the metal can is projected to account for the majority of total energy requirements over the 1975 to 1985 period. The aluminum can share of total energy is projected to increase from 40 percent in 1975 to 51 percent in 1985 as the market share of aluminum cans increases.

Petroleum is the major energy source of the beer and soft drink beverage systems, accounting for an estimated 37 percent of the total energy requirements in 1975. Coal, at 29 percent of the 1975 total, is the second major source, with natural gas following at 26 percent. Nuclear and hydropower sources, along with wood wastes, account for the remaining 8 percent. No attempt has been made here to project the future distribution due to the uncertain nature of future energy markets.

2.5 Trends in Capital Stock Requirements

A second major input to the beverage systems under consideration in this study is the requirement for plant and equipment. The put-in-place value of this plant and equipment is known as capital stock.

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*Based on total U.S. energy consumption of 73.176 x 10^{15} Btu for 1974.

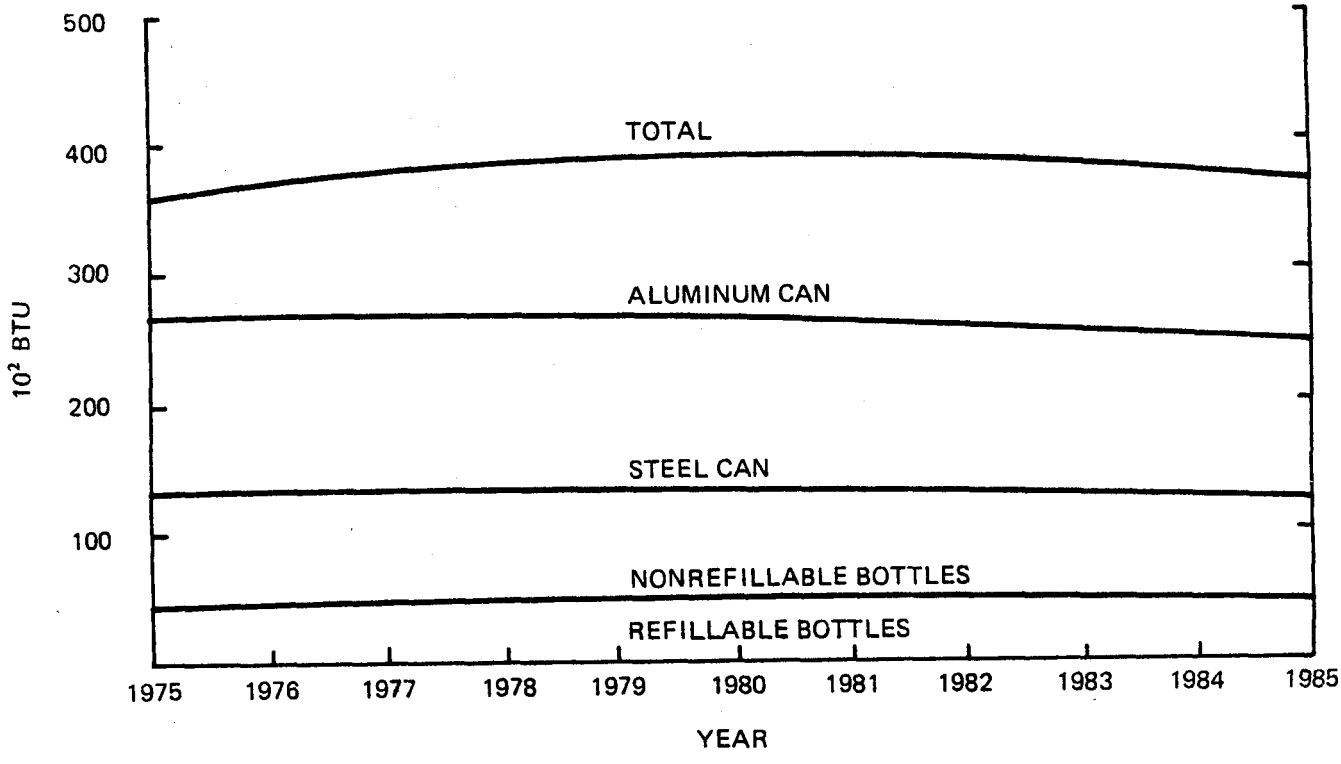


Figure 7. Beverage systems energy requirements: projections 1975-85 (source: Research Triangle Institute).

2.5.1 Per-Unit Requirements

Estimates were developed for four general categories of capital stock required by beer and soft drink producers and distributors: (1) filling lines, (2) production and distribution space, (3) distribution equipment, and (4) other plant and equipment. They were also developed for two categories required by retailers: (1) equipment and (2) space. For container producers a single category was used.

Estimates of the per-unit capital requirements--capital-output ratios--were developed for beverage producers, distributors, and retailers for all three container types using a model plant approach. These estimates are reported in table 8. The capital-output ratios for filling lines reflect the technology generally being installed at the present time and include the price of the equipment and an allowance of 50 percent for installation of new bottle- and can-filling lines. The rated speed of a filling line, which is factored downward by an efficiency factor to adjust for downtime, is multi-

Table 8. Average per-unit capital requirements: 1982

	Dollars per 10^6 ounces annually		
	Refillable bottle system	Nonrefillable bottle system	Metal can system
Beer system			
Brewers and wholesalers	($5422)	($3713)	($2974)
Filling lines	1519	1123	774
Production and distribution space	2210	1404	1162
Distribution equipment	1200	848	768
Other	492	338	270
Retailers	(1325)	--	(495)
Equipment	87	--	--
Space	1238	--	495
Container producers	284	2850	1089
Total	$7031	$6563	$4558
Soft drink system			
Soft drink bottlers and canners	($5827)	($4229)	($2774)
Filling lines	2679	1993	940
Distribution space	1188	836	704
Distribution equipment	1200	848	768
Other	760	552	362
Retailers	(1325)	--	(495)
Equipment	87	--	--
Space	1238	--	495
Container producers	596	1697	1107
Total	$7748	$5926	$4376

Source: Research Triangle Institute.

plied by the average annual hours of operation to determine the requirements. Beer-filling lines represent larger production operations and tend to be operated more hours per year than soft drink lines. The same annual hours of operation have been used for all three soft drink-filling lines (refillable bottles, nonrefillable bottles, and cans), even though in practice the metal can lines, which typically serve larger market areas, operate more hours than bottle-filling lines.

For the space requirements a cost of $22 per square foot was used for all but retail outlets. The $22 value is a liberal estimate based on construction cost data for factories.* For retail space, a figure of $11 per square foot was used on the assumption that the majority of empty containers would not be stored indoors.

*The cost figure value does not include land or architectural fees.

To develop the capital stock requirements for the glass container and metal can industries, an econometric approach was used. (Simply stated, econometrics is the measurement of economic activities by the use of economic theory and statistical techniques.) The capital requirements for each container have been assumed proportional to the price of each container. (For a more complete discussion of the methodology and data, refer to appendix F.)

As shown in table 8, the refillable bottle system is the most capital-intensive of the three container systems. Refillable bottle lines tend to be more expensive, operate at slower speeds, and require more space than can-filling lines. The distribution costs of refillable bottles are offset by lower container costs, since the initial container costs are averaged over several fillings. The cost of a new refillable bottle is approximately twice that of a nonrefillable bottle. However, the initial cost of a refillable bottle can be amortized across several fillings, whereas the cost of a nonrefillable bottle or a can must be recovered in the first and only sale. This probably accounts for the fact that the shelf prices for beverages in refillable bottles are generally lower than those in nonrefillable containers.

The refillable bottles, the fiber or wooden shell to hold basket carriers, and the carrier itself are called the "float." The cost of the float is distributed across producers, distributors, retailers, and consumers, due to the deposit paid on the refillable bottle. In the soft drink industry, for example, it is estimated that approximately two-thirds of the float is "in trade," i.e., in the hands of retailers and consumers. About one-third of the in-trade float is normally at retail outlets; the remaining two-thirds is held by consumers.

Float requirements depend upon the velocity of bottle utilization rather than on trippage. The float velocity is the number of times in a year that a bottle is returned to a plant for refilling. Projections of float requirements are obtained by dividing the velocity (4.0 for beer and 5.7 for soft drinks) into the projected number of fillings to obtain the required float size. By multiplying the required float size by the per-unit cost of its components, the float requirement is obtained. For beer and soft drinks, the float requirements are $2,026 and $2,974 per million ounces, respectively.

The float velocities were statistically estimated for this study. These statistical estimates are somewhat lower than some industry estimates. Therefore, somewhat higher float estimates are produced using the statistical estimates than would be obtained if the industry figures were used.

It is rather immaterial whether the float is viewed as providing a stream of services over a long enough period of time to be included as part of the capital stock or whether it is treated in a manner analogous to nonrefillable bottles and cans. With either approach the float must be paid for and its cost recovered in the price of the product.

However, it does appear that the U.S. Department of Commerce, in developing the national income accounts, treats float as recurring, not as a capital expenditure item. Therefore, float costs are not included in table 8.

2.5.2 Total Requirements

Both the estimated per-unit requirements described in the previous section (excluding the float) and the beverage consumption and packaging trends presented earlier in this chapter were used to project total capital stock requirements for the period 1975 to 1985. The results are shown in figure 8. As can be seen from figure 8, total capital stock requirements for 1975 are about $\$6.1 \times 10^9$. They are projected to increase to $\$7.5 \times 10^9$ by 1985. Beverage producers and distributors account for the bulk of these requirements.

2.6 Trends in Labor Requirements

Labor is the third input to the beverage system of interest in this study. Two measures have been included--employment and labor earnings. The projections of employment and labor earnings have been developed for the major industries that would be directly and indirectly affected by mandatory

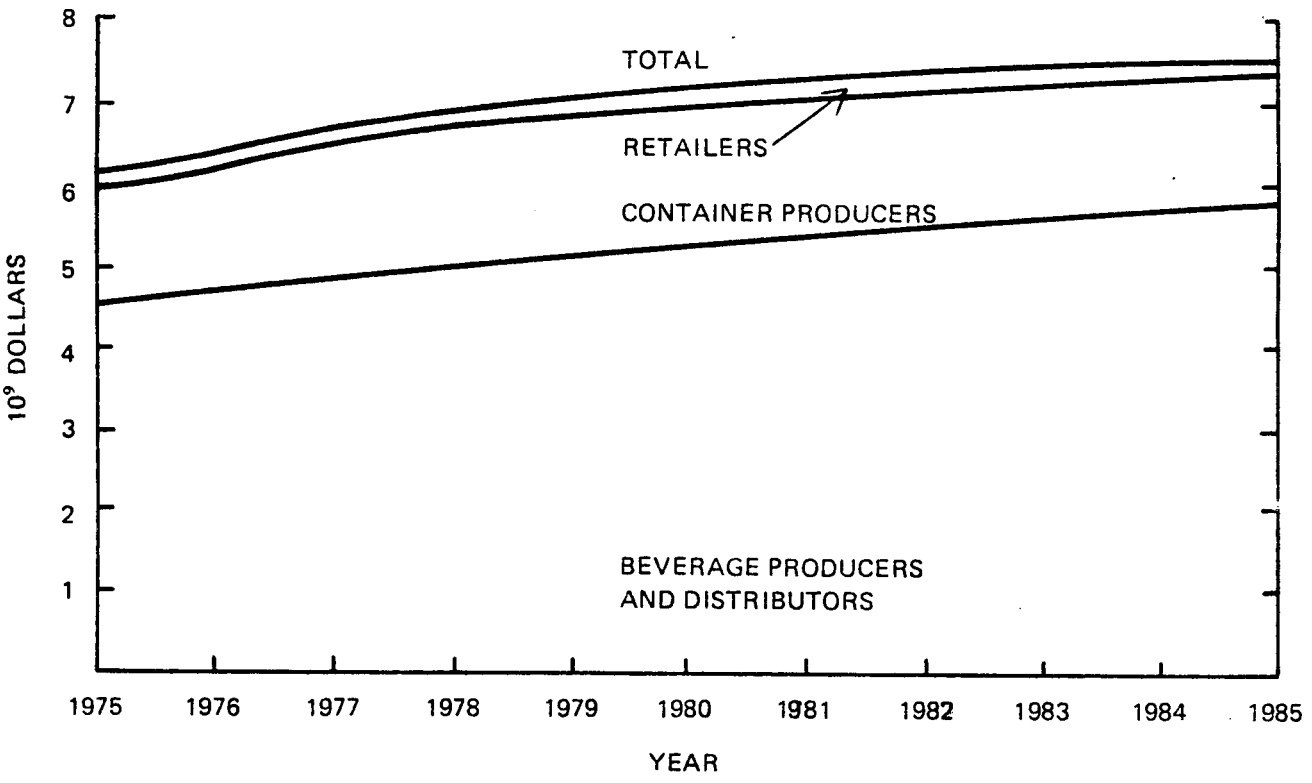


Figure 8. Capital stock requirements: projections 1975-85 (source: Research Triangle Institute).

deposit legislation: the beverage producers and distributors, the container producers, the material (steel and aluminum) producers, and the retailers. In addition, estimates have been developed for the other industries that may be affected indirectly.

2.6.1 Per-Unit Requirements

The industries that would be primarily affected by mandatory deposit legislation include container manufacturers (bottle and can), metal manufacturers (steel and aluminum), beverage producers and distributors, and retailers. In this study these industries are termed the "major direct and indirect industries." However, it can be shown mathematically that all the industries in an economy are interrelated and that an industry initially affected by a governmental policy may impact on many other industries. In this study these industries are termed "other indirect industries."

For each container type the average labor-output ratios have been developed for the major direct and indirect industries and for the other indirectly affected industries. The other indirectly affected industries were selected if they directly or indirectly supply over 0.1 percent of the total value of inputs to container manufacturing. Depending on the industry concerned, one of three approaches was used to develop the labor-output ratios.

For industries where data were available, employment was divided by output to develop the average labor-output ratios. For industries where more disaggregated estimates were required--for example, distribution labor requirements by container type--time and motion types of estimates were employed. (Time-and-motion estimates are actual observations of the time it takes to complete an action.) For the other indirectly affected industries, the 1967 input-output table relationships were used. No estimates have been developed of the labor requirements of the capital-producing or materials-recycling industries. (More complex documentation of the data sources and procedures is presented in appendix F.)

As is shown in table 9 the materials-intensive beverage production and distribution systems (i.e., those systems that use the nonrefillable bottle and metal can) generally have higher labor requirements related to container manufacture. The capital-intensive systems (i.e., refillable bottles) have high labor requirements related to beverage distribution and to handling of empties at the retail level. Table 9 is year-specific because the future labor-output ratios incorporate the assumption that all industries shown there, except retailers, will experience productivity gains. The year 1982 was chosen since it is the year used for developing the impacts in chapter 3.

The most labor-intensive system is the refillable bottle. Each million ounces of beer packaged in refillable bottles is projected to require 0.327 employees; and each million ounces of soft drinks, 0.308 employees. For soft drinks the nonrefillable bottle has the lowest labor requirements, because the average nonrefillable soft drink bottle size is projected to be about twice that of a refillable bottle. Size is important because the labor requirements for beverage distribution and retailing are assumed to be related to the number of containers of the beverage distributed. The beverage production labor requirements are assumed to be related to the quantity of

Table 9. Average per-unit employment requirements in the major direct and indirect industries: 1982

	Jobs per 10^6 ounces							
	Beer				Soft drinks			
	Refillable bottle system	Non-refillable bottle system	Metal can system		Refillable bottle system	Non-refillable bottle system	Metal can system	
			Steel	Aluminum			Steel	Aluminum
Container manufacturing								
Glass containers	0.010	0.094	-	-	0.021	0.071	-	-
Metal cans	-	-	0.062	0.062	-	-	0.062	0.062
Metal manufacturing	-	-	0.022	0.025	-	-	0.023	0.040
Beverage producers and distributors	0.209	0.149	0.139	0.139	0.197	0.095	0.146	0.146
Production	0.031	0.031	0.031	0.031	0.039	0.039	0.039	0.039
Distribution	0.178	0.118	0.107	0.107	0.158	0.056	0.107	0.107
Retailers	0.108	-	-	-	0.089	-	-	-
Total	0.327	0.243	0.223	0.226	0.308	0.166	0.231	0.249

Source: Research Triangle Institute.

ounces packaged; the rest of the labor requirements were assumed to be related to the weight of the containers. For the beer system, cans have the lowest requirement.

In evaluating the indirect employment relationships, caution must be exercised as it is obvious that the relationships among industries are not rigid. Specifically, only major changes in the demand for beer and soft drinks will be transmitted much beyond the major direct and indirect industries. However, the coefficients for the other indirect industries may still be of interest.

For the beer system, each million ounces is estimated to require the following number of employees indirectly: refillables, 0.007; nonrefillables, 0.067; and cans, 0.107. For soft drink the comparable estimates are 0.014, 0.040, and 0.110, respectively.

Average annual earnings for the container industries and the metal-supplying industries were derived by dividing total payroll by total employment in each industry. The resulting values are shown in table 10.

2.6.2 Total Requirements

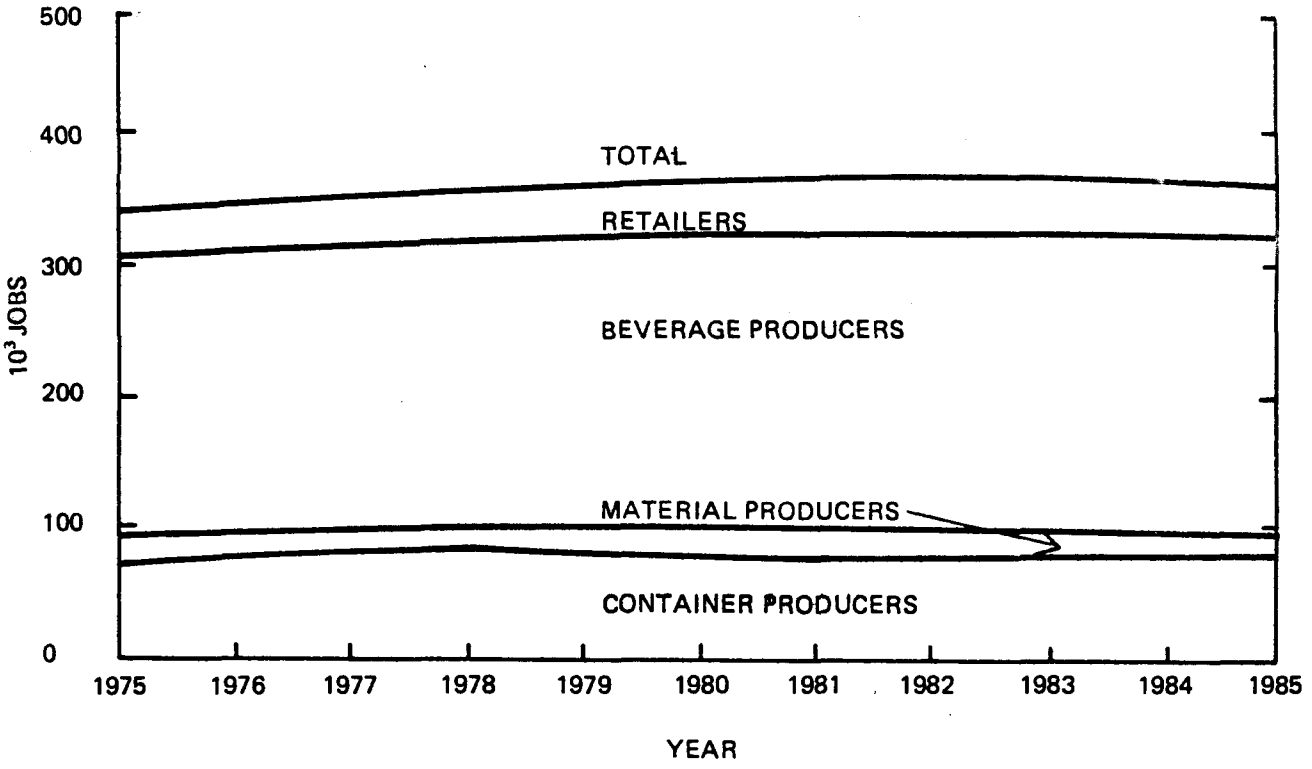
In 1975, an estimated 348,000 jobs were required by the major direct and indirect industries of the beverage system. Earnings for these employees were $\$3.8 \times 10^9$ for major direct and indirect industries, and $\$0.7 \times 10^9$ for the other indirectly affected industries. For the 1975 to 1985 period, projections of total employment requirements and earnings were based on the per-unit values discussed above and on

Table 10. Average per-unit labor earnings in the major direct and indirect industries: 1982

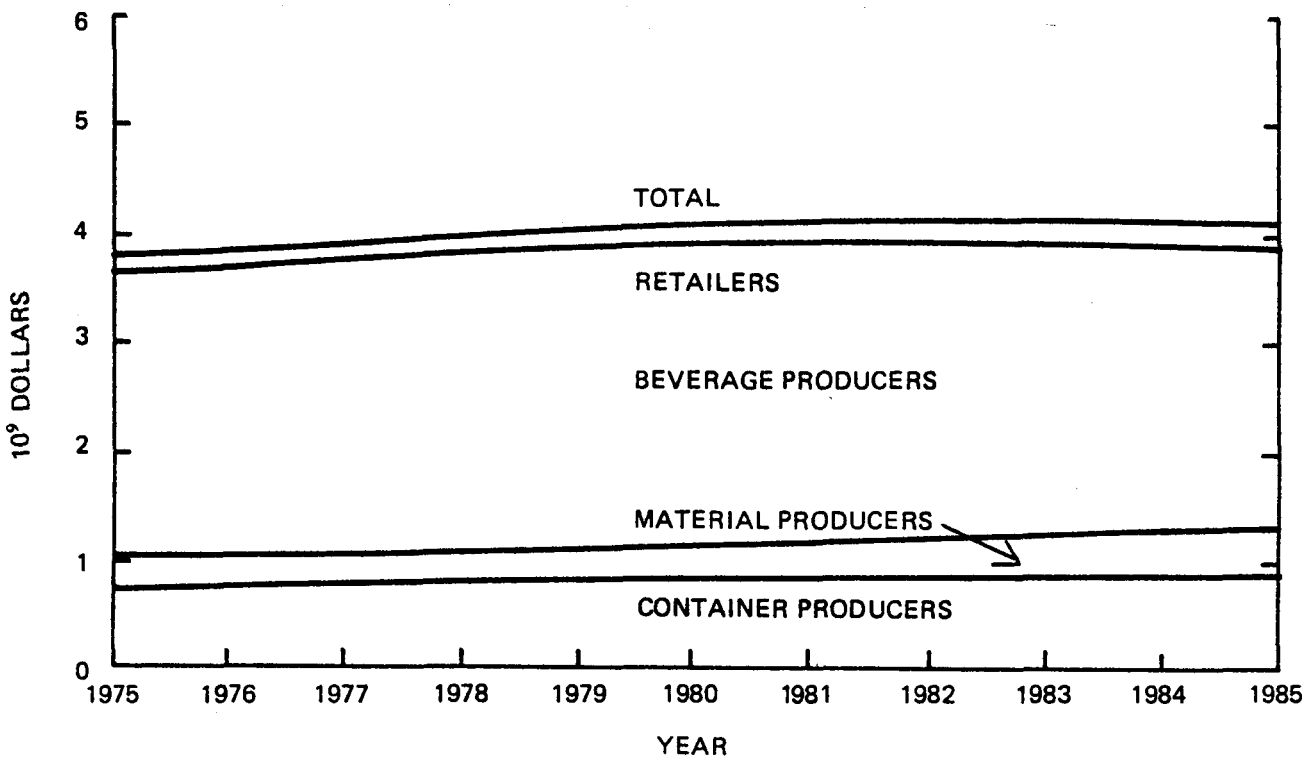
	Dollars per 10^6 ounces							
	Beer				Soft drinks			
	Refillable bottle system	Non-refillable bottle system	Metal can system		Refillable bottle system	Non-refillable bottle system	Metal can system	
			Steel	Aluminum			Steel	Aluminum
Container manufacturing								
Glass containers	93	892	-	-	197	674	-	-
Metal cans	-	-	706	706	-	-	706	706
Metal manufacturing	-	-	266	298	-	-	276	477
Beverage producers and distributors	3,141	2,208	2,053	2,053	1,898	860	1,382	1,382
Production	404	404	404	404	286	286	286	286
Distribution	2,737	1,804	1,649	1,649	1,612	574	1,096	1,096
Retailers	794	-	-	-	659	-	-	-
Total	4,028	3,100	3,025	3,057	2,754	1,534	2,364	2,565

Source: Research Triangle Institute.

the projected beverage consumption and packaging trends. The results of these projections indicate that by 1985 the major direct and indirect industries will require 366,000 employees. The earnings are projected to be \$4.1 x 10^9 for the major direct and indirect industries. Figure 9 shows these projections.



a) Employment



b) Earnings

Figure 9. Labor requirements in the major direct and indirect industries: projections 1975-85 (source: Research Triangle Institute)

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Chapter 3: ENERGY AND ECONOMIC IMPACTS

3.1 Introduction and Overview

This chapter presents projections of the impacts of a 5-cent mandatory minimum deposit on the derived demand for three beer and soft drink inputs--energy, capital, and labor. These projections are developed under the assumption that mandatory deposit legislation will take effect in the late 1970's and that any transitional effects will have died out by 1982.

The impact of mandatory deposits on the beverage system's demands for energy, capital, and labor depends on two features of the system. These are (1) the technical interrelationships between container types (i.e., the requirements of each container for energy, capital, and labor) and (2) the behavioral responses of producers and consumers to the deposit. The technical interrelationships between container types that have been developed in appendixes D and F and were employed in chapter 2 can also be utilized to project the impacts of mandatory deposits.

Mandatory deposits will alter the current price relationships for packaged beverages. Unless demand is completely unresponsive to price, these price changes will, in turn, tend to alter the container mix and total beverage consumption. Understanding how beverage prices may be affected by mandatory deposits and how beverage markets--both producers and consumers--may respond is critical to projecting the impacts of mandatory deposits.

The immediate effect of mandatory deposits will be to raise by 5 cents the price of beverages in nonrefillable bottles or cans that are discarded. Based on current retail prices for each beverage in a 12-ounce container, these initial price increases would be: 19 percent for beer in both nonrefillable bottles and cans, 22 percent for soft drinks in nonrefillable bottles, and 20 percent for soft drinks in cans.

At the same time, if producers continue to sell beverages in the currently offered containers following imposition of mandatory deposits, consumers could return empty nonrefillable bottles and cans and, thus, avoid forfeiting the deposit. Those consumers who return the container will obviously have valued the 5-cent deposit more than the inconvenience involved in its return. The rest will forfeit the deposit. Thus, in terms of monetary expenditures, the price of beverages after imposition of mandatory deposits will be less for those who return the empty containers than for those who dispose of them by some other means.

The long-run equilibrium impacts on beverage prices may differ substantially from the initial impacts. Specifically, assume that producers cannot, in the long run, enjoy excess profits because of competitive pressures. In that case the shelf price of beverages in cans would tend toward the long-run net unit cost to the retailer. This cost would be the algebraic sum of four components: (1) the initial price less (2) the average forfeited deposits per unit plus (3) the average unit handling cost of a returned can minus (4) its scrap value, if any exists.

As an example, consider two extreme situations. First, if all cans are discarded, beverage producers would find themselves with an extra 5 cents of

revenue for each can of beer or soft drink sold. In competitive markets, the shelf price would fall by 5 cents, and the actual outlay by consumers (shelf price plus deposit) would equal the current shelf price. On the other hand, if all containers are returned, all deposits would be refunded. However, for each returned can the retailer would incur a handling cost which is estimated to be 1 cent. If this handling cost is not offset by the scrap value of the can, this would likely cause a higher shelf price, since the additional cost would be passed on to the consumer. Thus, the net changes in shelf prices for canned beverages would range from -5 cents (if no cans are returned) to +1 cent (if all cans are returned and no scrap value is obtainable). Within the canned beverage market, the aluminum can would probably gain relative to the steel can because each returned aluminum can has a scrap value of 0.75 cents while the steel can has a much smaller scrap value once transportation costs are considered. Therefore, if the initial price of a beverage in an aluminum can remains the same as that in a steel can the long-run net cost to the retailer is lower for the former. This would create an economic incentive for an increase in the aluminum can market share.

The shift in the market shares of the alternative containers as a result of mandatory deposits will be dependent on the price effects discussed above and the importance to consumers of the characteristics embodied in each container type. To obtain some insight regarding the attributes of the alternative containers, consumer attitudes toward all three container types were solicited in a recent national survey (see appendix K). Over three-fourths of the consumers who purchased beer or soft drinks in refillable bottles cited ecology-related and/or cost-related reasons for their preference. Some beer consumers preferred nonrefillable bottles because of their convenience as compared to a refillable bottle and better flavor compared to a can (table 11). Those who preferred beer in metal cans cited convenience as the reason in almost 50 percent of the cases. Consumers who preferred soft drinks in nonrefillable bottles cited convenience, presumably over the refillable bottle, as the main reason. Of those who preferred metal cans (both steel and aluminum), convenience accounted for 45 percent of the responses. Eleven percent gave safety from breakage as their reason for purchasing soft drinks in cans.

Based on the survey, it appears reasonable to conclude that from the consumer's perspective the significant difference between the nonrefillable and the refillable beverage bottle is that the former is cheaper to discard. With the introduction of mandatory deposits, this relationship will probably be reversed if the shelf price* of refillables remains below that of nonrefillables. In most markets this will cause the eventual demise of the nonrefillable bottle and the absorption of their market share by refillables and cans.

On the other hand, because cans possess unique characteristics of value to consumers, it appears unlikely that the result of mandatory deposit legislation will be, as is frequently alleged, to "ban the can" as a beverage container. Certain consumers will continue to purchase their beverages in cans, regardless of the likely increase in the total "perceived price"--shelf price plus either a forfeited deposit or the inconvenience of container returns.

*As used in this study "shelf price" is the price to the consumer net of the deposit.

Table 11. Survey results on container selection*
(in percentages)

Reasons	Soft drink-buying public			Beer-buying public		
	Prefer refillable bottles	Prefer nonref. bottles	Prefer metal cans	Prefer refillable bottles	Prefer nonref. bottles	Prefer metal cans
Ecology-related	35	0	6	48	0	8
Cost-related	37	4	4	30	0	2
Better flavor	22	6	3	16	21	6
Convenience	1	65	45	0	45	47
Less breakage/ safer/cleaner	1	1	15	0	2	7

*For those consumers who had all current container types available to them.

Source: Opinion Research Corporation, Princeton, New Jersey, May 23, 1975, for the Federal Energy Administration. See appendix K for additional data.

The impact on the can market share will depend, however, on the degree to which consumers are willing to substitute beverages in refillable bottles for those in cans, on the shift from nonrefillables to cans and on the extent to which the canned beverage buyers return the can for a deposit refund.

Nevertheless, unless the refillable bottle and returned can are perfect substitutes for the nonrefillable bottle and discarded can (which would, in essence, imply that consumers experience no feeling of inconvenience in returning the empty container), total beverage consumption will fall with mandatory deposits. The reason is that the effective price to consumers of beverages currently purchased in nonrefillable bottles and cans will rise.

Based on the logic presented above, a model was developed as part of this study. The purpose of the model is to estimate the impact of mandatory deposits on the long-run equilibrium requirements of the beverage system for energy, capital, and labor. These impacts are highly dependent on the market responses to the legislation. However, the lack of an adequate data base precluded the development of empirical estimates of all parameters required to predict the response of final beverage markets to mandatory deposits. Therefore, a parametric approach has been used to examine the impacts of alternative parameter values.

The market response can be represented by three parameters for each beverage (1) can market share, (2) can return rate, (3) refillable bottle return rate (or trippage). A complete set of parameter values is termed a "scenario." A listing of the computer program that was utilized is provided in appendix E.

One obvious source for these parameter values is the well-documented Oregon experience with mandatory deposits. In Oregon, the legislation virtually eliminated the nonrefillable bottle, as is shown in table 12.

Table 12. Market shares before and after the Oregon Bottle Bill

	Beer		Soft drink	
	Before	After	Before	After
Refillable bottle	36	96	53	91
Nonrefillable bottle	31	0	7	0
Metal can	33	4	40	9

Source: Don Waggoner, "Oregon's Bottle Bill Two Years Later," Oregon Environmental Council, May 1975.

The market shares of metal cans in Oregon fell precipitously after the introduction of mandatory deposits--declining by 88 percent to only 4 percent for beer and by 78 percent to 9 percent for soft drinks. The return rate for cans, however, has averaged 70 percent (ref. 1). For refillable bottles, return rates actually increased, reaching 90 to 95 percent for beer, depending on the bottle type, and 92 percent for soft drinks (ref. 2).

However, while the Oregon experience is a relevant input to the selection of a likely scenario, on a national scale it seems doubtful that the metal can market share will be as sensitive to mandatory deposits as was the case in Oregon for several reasons. First, the Oregon legislation also banned flip-top cans; apparently, a can that could meet the requirements of the law was not then readily available. Second, beverage producers may not have aggressively attempted to market beverages in cans, since Oregon is only a small share of the national market and also since canned beverage sales could be shifted to other areas. Also, there may have been some initial uncertainties regarding the permanency of the legislation. Finally, the Oregon legislation established a two-tier deposit system (2 cents deposit on "certified" refillable bottles, 5 cents on all others) which tends to discriminate against cans.

With respect to container return rates, two comparisons are of interest. First, given a shift toward refillable bottles, will the increase in the number of retail outlets handling refillable bottles be important enough to outweigh the tendency of the former nonrefillable bottle and can consumers to discard the bottle? In other words, will trippage fall, increase, or remain constant? Second, how will can return rates compare to those for refillable bottles? Cans are lighter, more compact, and therefore, easier to return than bottles. Also, since cans could be returned even in a damaged condition they may be scavenaged from waste or litter. However, if refillables maintain their current price advantage, the returned refillable would require the smallest out-of-pocket expenditures.

For the purpose of presenting the possible impacts of mandatory deposits, a full set of analyses has been completed for alternative can market shares and container return rates.

In developing the impacts, the following major assumptions have been made:

1. Beverage markets are reasonably competitive.
2. Cans and refillable bottles will be returned at the same rate.
3. The current prices of beer and soft drinks by container reflect the actual costs of each plus a normal return on investment.
4. The relative shares of the can market for steel and aluminum cans will be unaffected by the imposition of mandatory deposits.
5. Given the imposition of mandatory deposits, the market share represented by nonrefillable bottles will fall to zero.
6. All returned containers will be either recycled or reused, as appropriate.

The parametric examination of the impacts of the deposit is presented in a set of figures below for energy, capital, and labor. The impacts are presented for alternative can market shares (between 0 and 1) and alternative container return rates (between 0 and 1). To provide an example of how the parametric figures can be utilized, to aid the discussion, and to demonstrate the sensitivity of the impacts to the parameter values, two illustrative scenarios have been developed. The illustrative scenarios encompass a fairly wide range of market responses and thus would appear to fall within the range of reasonable market responses to a deposit law. However, the scenarios are for illustrative purposes only and should not be interpreted as being more likely than any other.

	Illustrative scenario 1	Illustrative scenario 2
Can market share	Shares consistent with maintaining canned beverage sales at 1976 volume	Shares consistent with maintaining canned beverage sales at one-half the 1976 volume
Can return rate	0.9	0.8
Refillable bottle return rate, trippage	0.9 = 10 trips	0.8 = 5 trips

3.2 Beverage Consumption and Packaging

The energy and economic impacts of mandatory deposit legislation are dependent upon the changes in beverage consumption and packaging that would be precipitated by the institution of mandatory deposits. As noted above, these market responses are analyzed in alternative scenarios in this report.

Baseline shelf prices, i.e., prices that are projected in the absence of government intervention for beer and soft drinks, are shown by container type in the left-hand columns of table 13. Based both on the projected sales of beer and soft drinks by package type and on refillable bottle return rates, annual consumer expenditures for 1982 are projected to be $13.8 billion for beer and $15.7 billion for soft drinks.

The shelf prices of beer and soft drinks in the presence of mandatory deposits are influenced by the handling costs of returned containers, the scrap value of containers in secondary materials markets, the forfeited deposits, and--for refillable bottles--the cost of a new container and trippage. As described more completely in appendix E, these prices are assumed to be established in reasonably competitive markets; therefore, all handling costs tend to increase the shelf price of the beverage. Forfeited deposits and any obtainable scrap value tend to reduce shelf prices. The changes in shelf prices (and in all other values) from the baseline trend are shown in the right-hand column of table 13.

The price of soft drinks in refillable bottles declines as trippage increases (and vice versa). Since illustrative scenario 1 presents an increase of trippage to 10 from 6.4, the shelf price falls slightly from the baseline value (table 13). However, illustrative scenario 2 implies a decline in the trippage of refillable soft drink bottles to 5 trips, and under that scenario the shelf price increases (table 13).

By contrast, the price of beer in refillable bottles appears likely to increase slightly as trippage increases. This counter-intuitive outcome results because the "cost" of a used refillable beer bottle is the sum of the assumed handling costs (2 cents--1 cent at the retailer and 1 cent at the beverage producer) and the mandatory deposit (5 cents). On the other hand, a new refillable beer bottle costs less, about 6 cents. Both illustrative scenarios represent declines in trippage from the baseline value of 10.4 which in turn is less than the current rates. Therefore, the shelf price of beer in refillable bottles declines slightly, as shown in table 13.

The returned aluminum can is assumed to be worth 1 cent in secondary aluminum markets, whereas the returned steel can is assumed to have no scrap value. Given these assumptions, the shelf price of beverages in aluminum cans would decline slightly for both illustrative scenarios. The shelf price of beverages in steel cans would increase slightly for illustrative scenario 1. However, the forfeited deposits under a 0.8 return rate are large enough to overcompensate for handling costs thus causing shelf prices to fall in illustrative scenario 2.

To develop an estimate of the impact of mandatory deposits on beverage consumption requires the development of a "real" price index with deposits. This index would ideally include not only the change in shelf prices but also the monetary value of the time and effort required to return empty containers. Unfortunately, only a first approximation of such a measure was possible in this study. All consumers who shift from one container type to another are assumed to face a real price equal to that of the container they had been purchasing or to the price of the beverage in the new container--whichever is greater. All consumers who return the empty can after mandatory deposits are assumed to experience no increase in their real price. Finally for all consumers who discard the empty can the relevant real price is the shelf price plus the forfeited deposit. This approach reflects the

Table 13. Beverage consumption and packaging impacts: illustrative scenarios, 1982

	Baseline trend			Net impacts of mandatory deposits*					
				Scenario 1**			Scenario 2†		
	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system
Shelf prices, cents per 12-ounce drink									
Refillable bottle	20.77	19.45	-	-0.01	-0.16	-	-0.10	0.13	-
Nonrefillable bottle	25.83	22.80	-	-	-	-	-	-	-
Cans									
Steel	25.83	25.12	-	0.40	0.40	-	-0.20	-0.20	-
Aluminum	25.83	25.12	-	-0.50	-0.50	-	-1.00	-1.00	-
Consumption, annually									
Per capita, ounces	3,173	5,107	-	-13	-3	-	-10	-6	-
Total, 10^9 ounces	725.6	1,167.9	-	-2.9	-.7	-	-2.2	-1.3	-
Packaging, 10^9 ounces annually	658.7	810.4	1,469.1	-3.0	-0.7	-3.6	-2.2	-1.3	-3.5
Glass containers	189.6	409.3	598.9	118.6	133.2	251.8	294.3	266.3	560.6
Refillable bottles	90.6	223.1	313.7	217.6	319.4	537.0	393.2	452.5	845.7
Nonrefillable bottles	98.9	186.2	285.2	-98.9	-186.2	-285.2	-98.9	-186.2	-285.1
Cans	469.1	401.1	870.3	-121.6	-133.9	-255.6	-296.5	-267.6	-564.1
Steel	184.8	319.7	504.5	-47.9	-106.7	-154.5	-116.8	-213.3	-330.1
Aluminum	284.3	81.4	365.7	-73.7	-27.2	-100.8	-179.7	-54.3	-234.0
Container production, 10^9 containers annually	47.9	42.6	90.6	-16.7	-16.8	-33.6	-26.4	-22.3	-48.6
Glass containers	8.8	9.2	18.0	-6.6	-5.6	-12.2	-1.7	0.1	-1.6
Refillable bottles	0.6	1.8	2.4	1.6	1.8	3.4	6.6	7.5	14.1
Nonrefillable bottles	8.2	7.4	15.7	-8.2	-7.4	-15.7	-8.2	-7.4	-15.7
Cans	39.1	33.4	72.5	-10.1	-11.1	-21.3	-24.7	-22.3	-47.0
Steel	15.4	26.6	42.0	-4.0	-8.9	-12.8	-9.7	-17.8	-27.5
Aluminum	23.7	6.8	30.5	-6.1	-2.3	-8.4	-15.0	-4.5	-19.5
Consumer expenditures, 10^9 dollars annually	13.8	15.7	29.5	-.8	-1.0	-1.8	-1.3	-1.2	-2.6
Refillable bottles	1.6	3.8	5.4	3.9	5.1	9.0	7.1	7.8	15.0
Nonrefillable bottles	2.1	3.5	5.7	-2.1	-3.5	-5.7	-2.1	-3.5	-5.7
Cans	10.1	8.4	18.5	-2.5	-2.6	-5.2	-6.3	-5.5	-11.9

Source: Research Triangle Institute.

*Please note that the values reported in these six columns represent deviations from the baseline trends reported in the first three columns.

**Canned beverage sales equal to 1976 value container return rate of 0.9 (refillable bottle trippage of 10, can return rate of 0.9).

†Canned beverage sales equal to one-half of the 1976 value container return rate of 0.8 (refillable bottle trippage of 5, can return rate of 0.8).

assumption that consumers currently can find each beverage in the container of their choice. Based on the survey in appendix L this assumption appears reasonable, especially for soft drink consumers. The result of this approach is, however, probably to underestimate the real price effects of mandatory deposits and hence also to underestimate the decline in consumption. This is because consumers who shift to lower priced containers or who return empty containers are assumed to experience no change in the real price of the beverage. However, because the sensitivity of aggregate beer and soft drink demand to price is estimated to be quite low, it appears doubtful that this approach has a significant impact on the overall study results.

The impact of mandatory deposits is projected to reduce beverage consumption by less than 1 percent from the baseline projection for both scenarios. This reduction is quite nominal for two reasons: (1) the aggregate price elasticity of demand for both beer and soft drinks is estimated to be quite low, and (2) only the packaged portion of beverage consumption is assumed to be affected by the mandatory deposit legislation.

In comparing the consumption impacts for the two scenarios in table 13 it can be seen that for each beverage the shelf price and consumption are inversely related. For beer, illustrative scenario 2 has a lower (actually negative) impact on all shelf prices than scenario 1. Therefore, the projected declines in consumption are less under scenario 2 than for scenario 1.

The total quantity of beverages packaged in glass containers under illustrative scenarios 1 and 2 would be 42 and 94 percent higher than the baseline trend, respectively. However, because of the expected disappearance of the nonrefillable bottle, total glass container production would be down 69 percent for illustrative scenario 1. If refillable bottle trippage is only 5 (illustrative scenario 2), then the reduction in glass container production from the baseline projection would only be 9 percent.

The reduction in can production would be proportional to the reduction in the total quantity of beverages packaged in cans, since cans are filled only once. The reduction in can production is assumed here to be distributed between the steel and aluminum can in proportion to their baseline shares of the canned beverage market. However, as noted above but not modeled in this study, everything else being equal, one would expect that, with mandatory deposits, aluminum cans would gain relative to steel, since the returned aluminum can has a significant value in the secondary aluminum market.

Consumer expenditures on beverages would decline by $1.8 and $2.6 billion for the two illustrative scenarios respectively. This reduction is primarily due to the assumed shift to refillable bottles, not to reductions in beverage consumption, which are projected to be small. No attempt has been made as part of this study to estimate how consumers will reallocate their budgets, much less to estimate the impacts of any reallocation. However, it is obvious that at least some of the energy savings projected below for the illustrative scenarios would be dissipated by the energy requirements of the increased consumption of other goods purchased with these budget residuals.

3.3 Energy Impacts

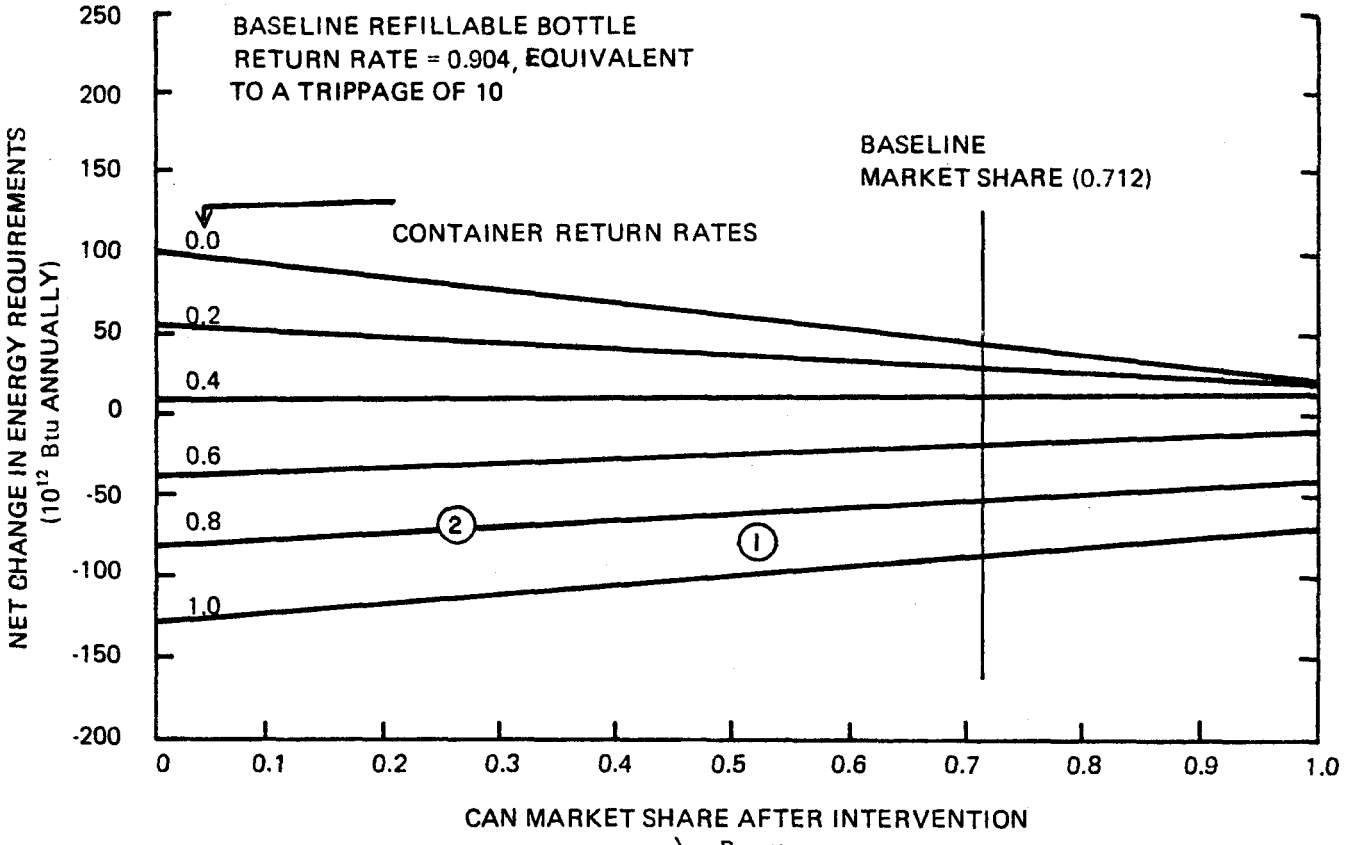
The energy impacts of mandatory deposits are sensitive to changes in the container market shares and return rates. They are also sensitive to the treatment of electric power. As discussed in chapter 2, for this study it was assumed that any decreased demand for electricity due to mandatory deposits would not be reflected in reduced generation from hydroelectric power plants. Thermally generated electricity is assumed to represent the marginal power source. However, beyond this treatment of electricity, no attempt has been made to identify the changes in energy consumption by fuel type since fuels are close substitutes in many applications.

Figure 10 shows the relationships between changes in energy consumption and the can market share and the refillable bottle/can return rates. This figure facilitates the examination of scenarios other than those presented here. As discussed above, the refillable bottle and can return rates have been set equal for all scenarios. The reader is also reminded that the nonrefillable bottle market share is assumed to fall to zero with mandatory deposits. In figure 10, alternative can market shares are measured along the horizontal axis, deviations from the baseline projection of energy requirements along the vertical axis. The projected--i.e., baseline can market shares--are indicated by a vertical line at 0.712 and 0.495 for beer and soft drinks, respectively. Thus, can market shares to the left of the baseline values would represent a decline in the share of cans due to deposits. Shifts from nonrefillables to cans resulting in an increase in the can market share are shown to the right of the baseline values.

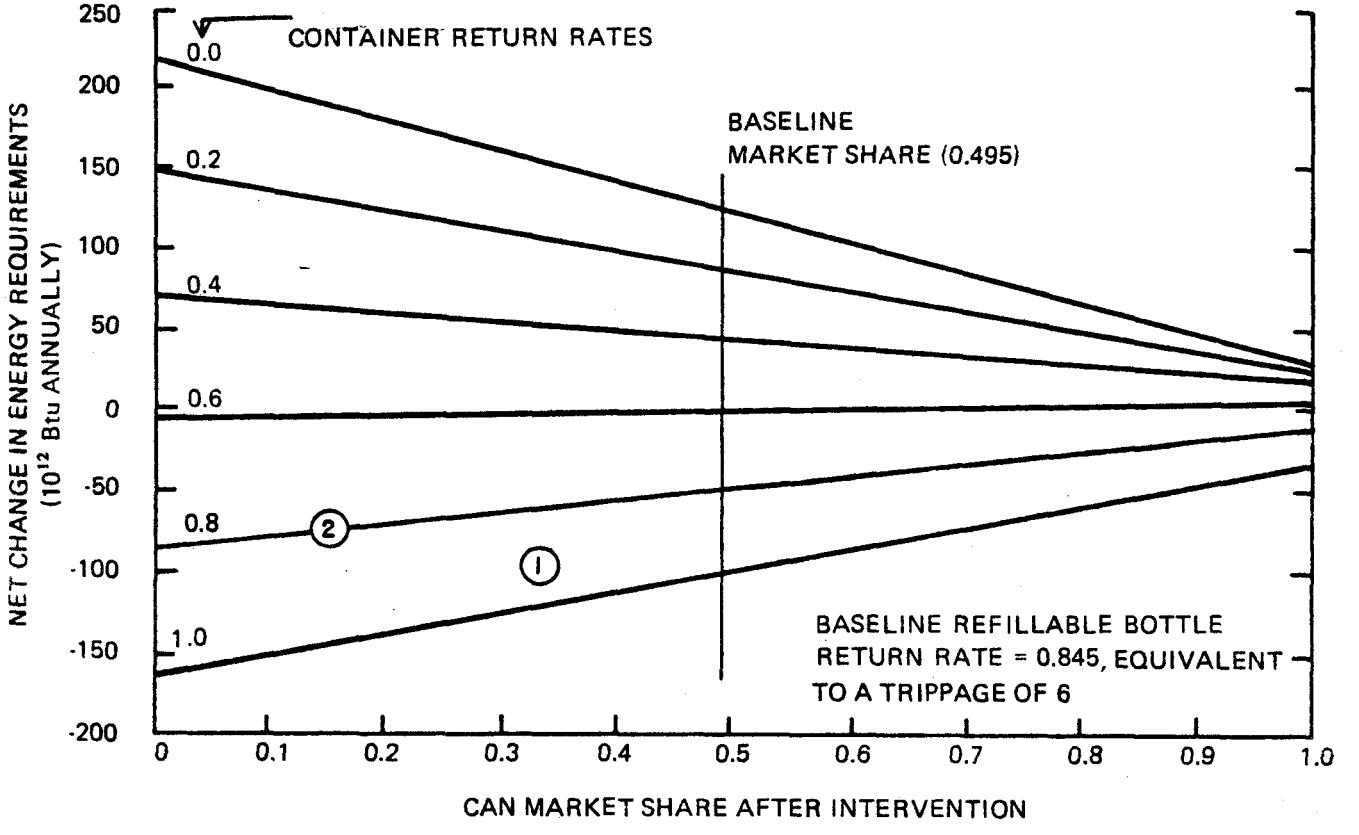
As would be expected from the data presented in chapter 2 , increases in container return rates would result in reductions in the beverage systems energy requirements over all can market shares. However, the effects are most pronounced when the can share is zero and hence all beverages are packaged in refillable bottles.

The effect of the can market share varies depending on the container return rates. Roughly interpreted, figure 10 indicates that changes in the can market share result in decreases in energy consumption from the baseline projection if the container return rates are greater than 0.5 and increases if the rate is less than 0.5. A 0.5 return rate is equivalent to a refillable bottle trippage of 2.

As figure 10 also shows, the net change in energy consumption due to mandatory deposits can be negative, positive, or zero, depending primarily on container return rates. For example, the largest reductions (i.e., negative changes) in consumption would occur if mandatory deposits induced all beverage consumers to shift to refillable bottles and if all bottles were returned. This outcome, which in figure 10 is the vertical intercept of the 1.0 return rate, would induce a total decline in energy consumption of 292 x 10^{12} Btu in 1982. At the other extreme, the largest increase in energy consumption would occur if all the bottles were discarded after one use. This outcome would cause an increase in energy consumption of 322 x 10^{12} Btu in 1982.



a) Beer



b) Soft drinks.

Figure 10. Impact on energy requirements, 1982 rates (source: Research Triangle Institute).

However, with significant declines in trippage, refillable bottle shelf prices would increase, thereby endangering the viability of the refillable bottle. For example, at a zero return rate for refillable bottles, the shelf price of beer in refillables would almost equal that of canned beer; for soft drinks, refillable bottles would have higher shelf prices than cans. To preserve the viability of the refillable bottle system, producers would probably have to increase deposits above the mandatory minimum of 5 cents or would shift back to nonrefillables. Therefore, while trippage reductions could possibly be precipitated initially by mandatory deposit legislation; potential upward adjustments in deposits on refillables suggest that significant permanent declines in trippage are unlikely.

The coordinates associated with the illustrative scenarios are identified in figure 10 with a ① or ②. For example, illustrative scenario 1 utilizes the following parameter values:

	Beer	Soft drink
Can market share	0.53	0.33
Refillable bottle/can return rates	0.9	0.9

As shown in figure 10 the market responses implied by these parameter values result in a reduction in energy consumption of 78×10^{12} and 90×10^{12} Btu annually for the beer and soft drink systems, respectively or 168×10^{12} in total (table 14). At an average value of 5.675×10^{6} Btu per barrel of refined oil, this implies that energy consumption would decline by 81,000 barrels of oil equivalent daily.

The reduction in the consumption of energy is due to the changes in container mix and return rates that are in turn due to the assumed behavioral responses of consumers to the higher prices for discarding nonrefillable bottles and cans. Specifically, for illustrative scenario 1, the market responses that account for the reduction in energy consumption and their relative contributions are: (1) 61 percent of the reduction is accounted for by the substitution of refillables for (a) nonrefillables (32 percent) and (b) cans (29 percent); (2) 34 percent is due to the increased recycling of cans (three-quarters of this is attributable to increased aluminum can recycling); (3) 2 percent is due to the increased trippage of refillable bottles; and (4) the remaining 3 percent is due to the combined effect of the above identified responses.

A reduction of 144×10^{12} Btu (70,000 barrels of oil equivalent daily) is projected for 1982 under illustrative scenario 2. The reduction in refillable bottle trippage to 5 trips plus the shift from cans to refillables causes an increase in the energy consumption attributed to glass containers (table 14). This increase is more than offset by the decrease in energy consumption attributed to canned beverages. The decrease is due to the shift from cans to refillable bottles and the postulated increase in can recycling.

Table 14. Energy impacts: illustrative scenarios, 1982
(10^{12} Btu per year)

	Baseline trend			Net impacts of mandatory deposits*						Relevant appendix and table
				Scenario 1**			Scenario 2†			
	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	
Total	185.0	198.0	383.0	-78	-90	-168	-71	-73	-144	-
Glass containers	41.0	86.0	127.0	4	-32	-28	47	15	61	-
Refillable	12.3	28.2	40.5	34	26	60	77	73	149	D: D.9-5
Nonrefillable	28.7	58.0	86.0	-29‡	-59‡	-88‡	-29‡	-59‡	-88‡	D: D.9-6
Metal cans	144.0	112.0	256.0	-82	-57	-140	-118	-87	-205	-
Steel	49.0	84.0	133.0	-19	-39	-57	-35	-63	-97	D: D.9-4
Aluminum	96.0	27.4	123.0	-64	-19	-83	-84	-25	-108	D: D.9-3

Source: Research Triangle Institute.

*Please note that the values reported in these six columns represent deviations from the baseline trends reported in the first three columns.

**Canned beverage sales equal to 1976 value container return rate of 0.9 (refillable bottle trippage of 10, can return rate of 0.9).

†Canned beverage sales equal to one-half of the 1976 value container return rate of 0.8 (refillable bottle trippage of 5, can return rate of 0.8).

‡Exceeds baseline value because all changes in electricity usage from the baseline projection are valued at 10,429 Btu per kWh under the assumption that thermally generated electricity represents the marginal power source.

3.4 Economic Impacts

The economic impacts projected in this study are confined to the impacts on capital and labor within the beverage system.

3.4.1 Capital Impacts

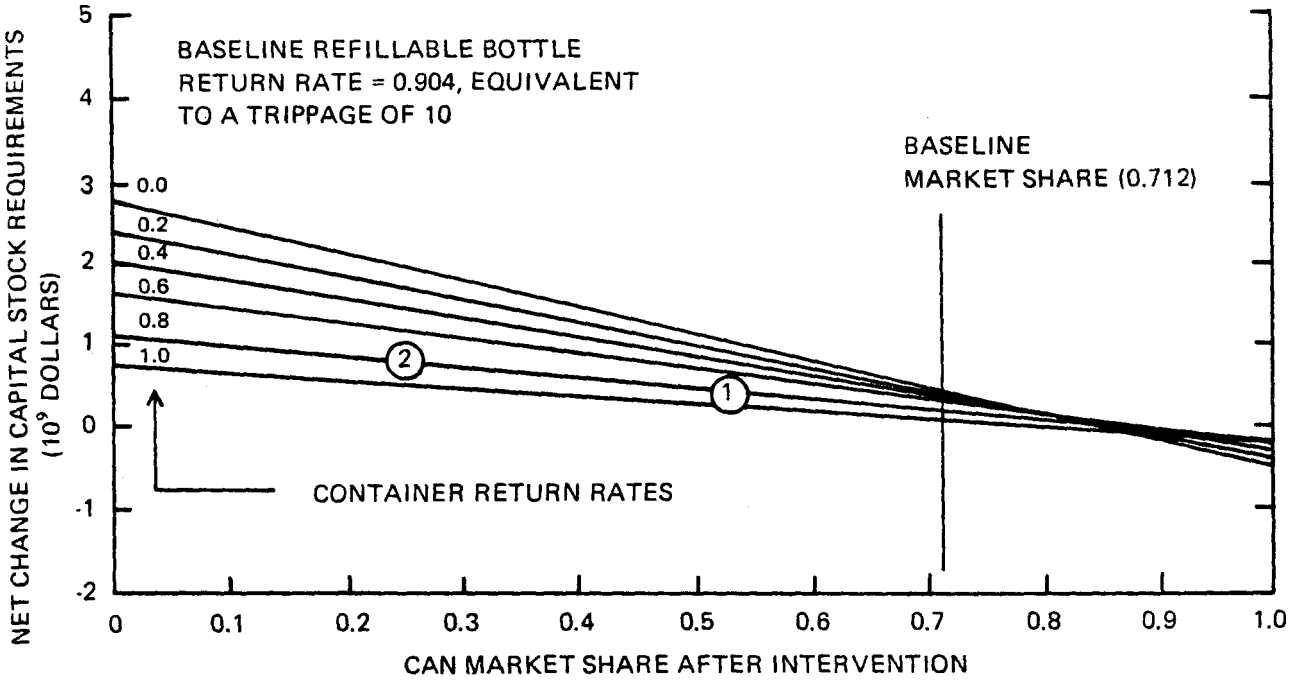
Shifts in the final demands for beer and soft drinks as a result of mandatory deposit legislation imply alternative equilibrium capital stock values for the beverage industry, retailers, and container producers, as compared to the values projected in chapter 2. Figure 11 illustrates the net impact on capital stock requirements for alternative can market share and container return rates.

Reductions in the can market share tend to increase the capital requirements due to the high initial cost and slow filling speeds of refillable bottle lines compared to can-filling lines. Also, additional space for storage of empty bottles must be provided. Not included in the figure are the additional bottle, shell, and carrier float requirements of the refillable bottle system.

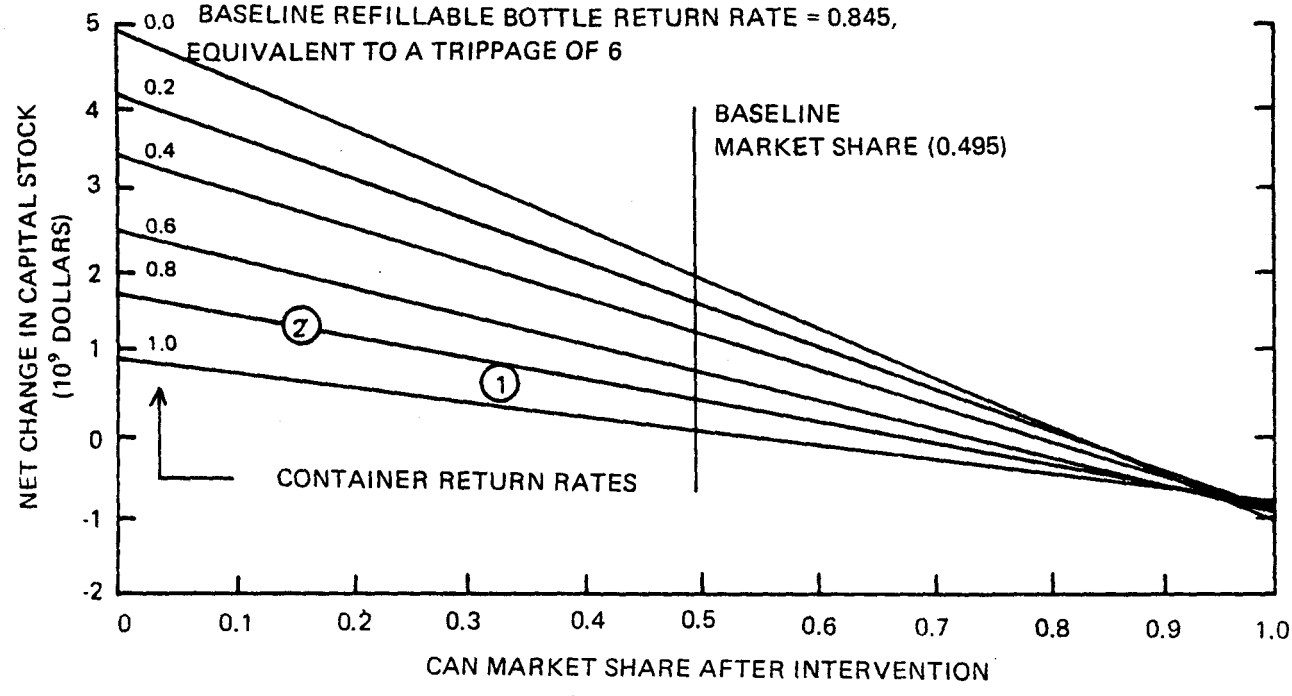
Reductions in container return rates also tend to increase capital requirements. This is because the decreased capital requirements of retailers for storage of empties are more than offset by the increased capital requirements of glass manufacturers since a decline in bottle return rates implies an increase in bottle production.

Again in figure 11, the illustrative scenarios are identified by number. The net capital stock requirements for illustrative scenario 1 would be \$824 x 10^6 higher than the estimated baseline stock for 1982. For the second illustrative scenario, the capital stock requirements would be \$2,006 x 10^6 higher than the baseline values (also see table 15). Not shown in table 15 are additional bottle, shell, and carrier float requirements (\$1.1 and \$1.7 billion for illustrative scenarios 1 and 2, respectively). As discussed in chapter 2, it is arguable whether or not the float requirements are properly part of the capital requirements of a refillable bottle system.

However, the net values obscure some significant shifts in capital requirements within the affected industries. Among beverage producers and distributors capital requirements rise on average. Container producers, on the other hand, would have smaller capital stock requirements under both illustrative scenarios. Reductions in the can market share from the baseline value obviously imply a smaller capital stock requirement for can manufacturers. For glass manufacturers, as discussed above, total production may increase, given large enough reductions in the can market shares and in refillable bottle trippage. However, glass container production does not have to increase for the capital requirements of glass producers to increase since refillables have a higher capital requirement than nonrefillables. Illustrative scenario 2 shows this situation.



a) Beer.



b) Soft drinks.

Figure 11. Impacts on capital stock requirements, 1982 (source: Research Triangle Institute).

Table 15. Capital impacts: illustrative scenarios, 1982 (10^6 dollars)

	Baseline trend			Net impacts of mandatory deposits*						
				Scenario 1**			Scenario 2†			
	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Relevant appendix and table
Beverage producers and distributors	2,252	3,199	5,451	451	704	1,155	883	1,110	1,993	-
Filling lines	610	1,346	1,956	126	361	487	258	592	849	F: F-2
Production and storage space	884	695	1,580	203	123	325	391	185	576	F: F-1
Distribution equipment	555	742	1,297	81	129	210	155	189	344	F: F-3
Other	203	416	619	40	91	132	79	144	224	-
Retailers	42	97	139	153	193	345	184	204	387	-
Equipment	8	20	28	20	29	49	36	41	76	-
Storage space	34	77	111	133	164	297	148	163	311	F: F-1
Container producers	820	893	1,713	-344	-331	-676	-323	-51	-374	-
Glass containers	308	449	758	-212	-182	-395	1	245	245	-
Refillable	26	133	159	70	134	204	283	561	843	F: F-7
Nonrefillable	282	316	599	-282	-316	-599	-282	-316	-598	F: F-7
Metal cans	511	444	955	-132	-149	-281	-323	-296	-619	-
Steel	201	353	555	-52	-118	-170	-127	-235	-363	F: F-7
Aluminum	310	90	400	-80	-30	-110	-196	-60	-256	F: F-7
Total	3,113	4,190	7,303	260	566	824	745	1,263	2,006	-

Source: Research Triangle Institute.

*Please note that the values reported in these six columns represent deviations from the baseline trends reported in the first three columns.

**Canned beverage sales equal to 1976 value container return rate of 0.9 (refillable bottle trippage of 10, can return rate of 0.9).

†Canned beverage sales equal to one-half of the 1976 value container return rate of 0.8 (refillable bottle trippage of 5, can return rate of 0.8).

Assuming that the beverage markets are competitive and that the price of each beverage in each container includes a normal return on investment, any increases in the capital stock induced by mandatory deposits should not, by themselves, be interpreted as suggesting price increases to consumers. Rather, comparing the refillable bottle system to the other container systems, producers substitute capital (and labor) for materials (i.e., containers) and the result is a lower price to the consumer who returns the empty container.

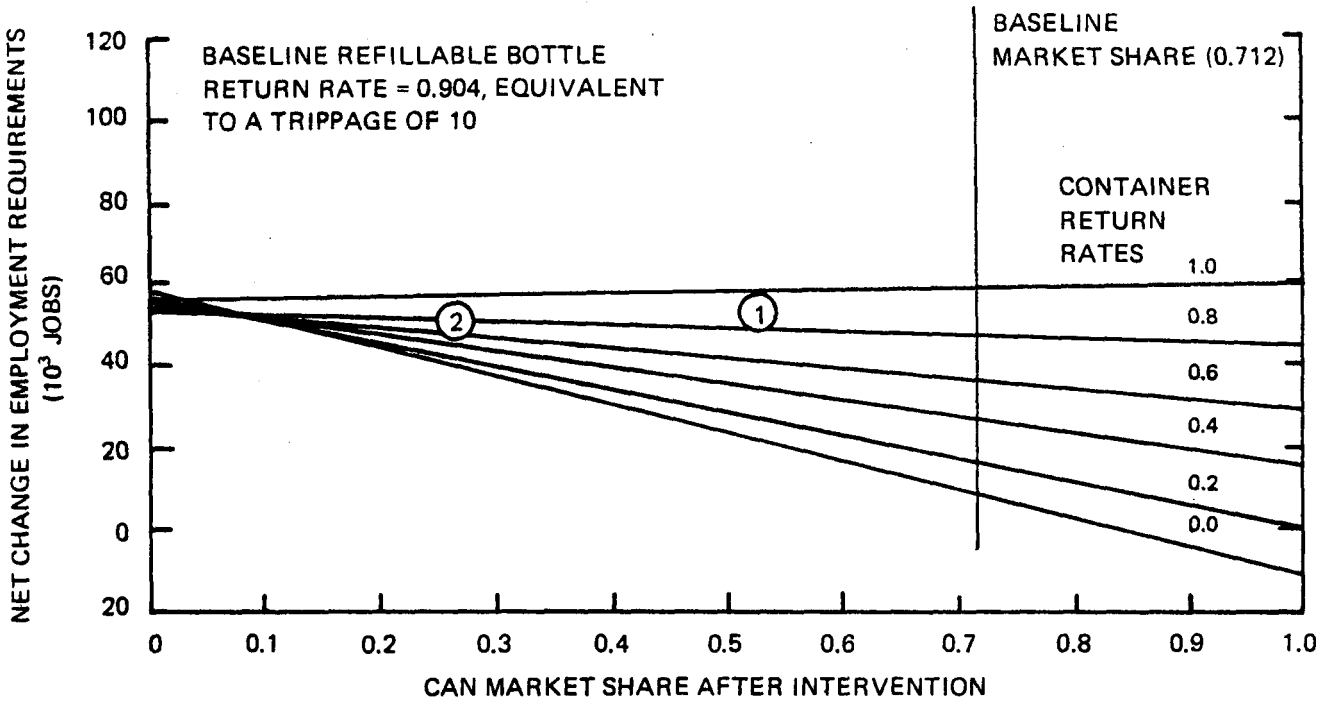
Industries that have surplus capital stock would earn less than a normal return on their capital. The amount of surplus capital stock will be affected by such factors as: 1) the grace period between passage and implementation of the deposits, 2) the degree to which producers can anticipate market shifts caused by the deposits, and 3) the adaptability of the surplus capital to other uses. Industries would shift as much of the costs of the redundant capital to the government as the tax laws permit (as lower tax payments), and as much to their customers (in the form of higher product prices) as market conditions permit. The remainder, if any, would be absorbed by stockholders as lower earnings.

Two final caveats should be mentioned. First, the prices of the various capital components have been assumed constant. However, a sudden increase in the demand for filling lines, trucks, etc., would be likely to increase prices for the capital stock components. Although any price increase would represent a financial transfer from the purchasers to the suppliers of the affected components, it would increase the nominal value of the capital impacts of mandatory deposits. Also, subtracting the without- from the with-government-intervention projections of capital requirements assumes that the capital already in place for the 10 types of equipment shown in table 15 can be perfectly substituted for the desired capital equipment. Given a sufficiently long phase-in period for the mandatory deposits, capital equipment that becomes obsolete could be replaced with the desired equipment and the net value would be a reasonable reflection of the actual additional requirements. However, without the long phase-in period, the net value understates the actual additional requirements by an unknown amount.

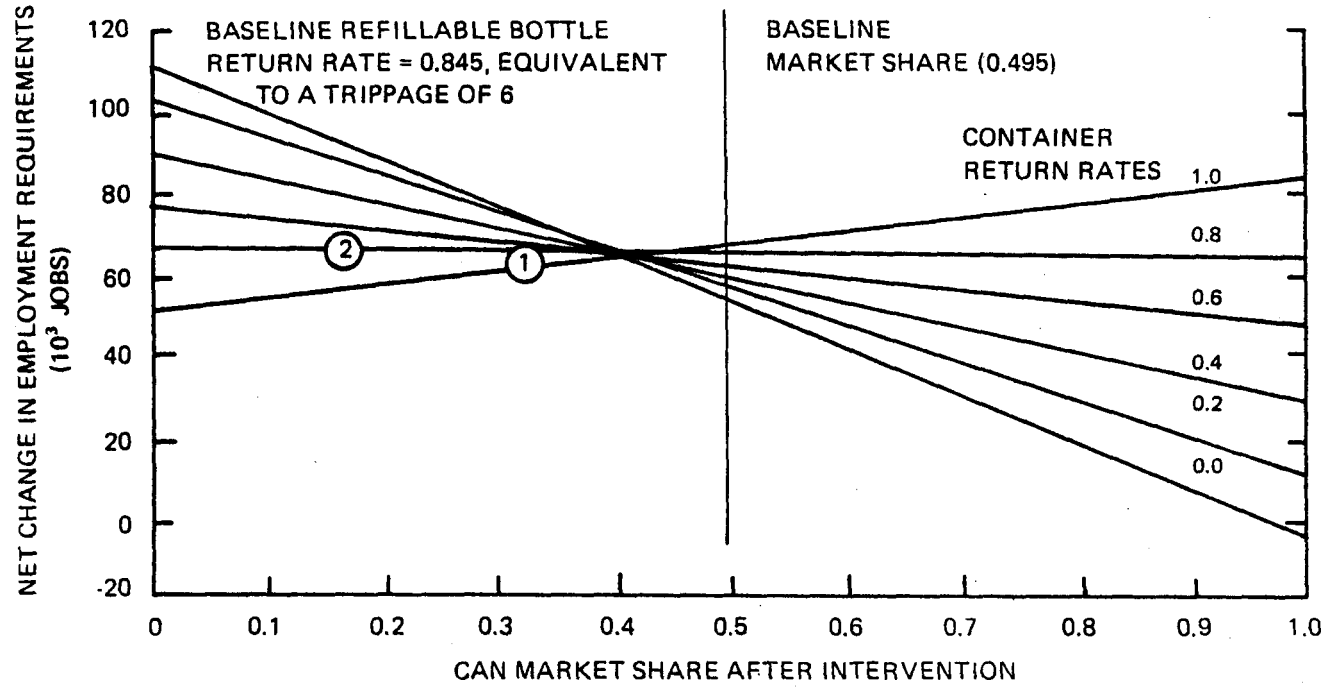
3.4.2 Labor Impacts

Both the level of employment and labor earnings in beverage-related industries would be affected by mandatory deposits.

3.4.2.1 Employment. Reduction in the market share of cans implies reductions in employment in can and metals manufacturing (both steel and aluminum) and increases in employment in beverage distribution and in glass container manufacturing. Increases in container return rates imply increases in employment in retailing and decreases in glass container manufacturing. However, as shown in figure 12, the net employment impacts of changes in can market shares and/or container return rates are complex.



a) Beer.



b) Soft drinks.

Figure 12. Impacts on employment requirements, 1982 (source: Research Triangle Institute).

For the beer system, decreases in the can market share from the baseline projections tend, especially at low return rates, to increase employment on net. Increases in container return rates tend, except at very low can market shares, to increase employment.

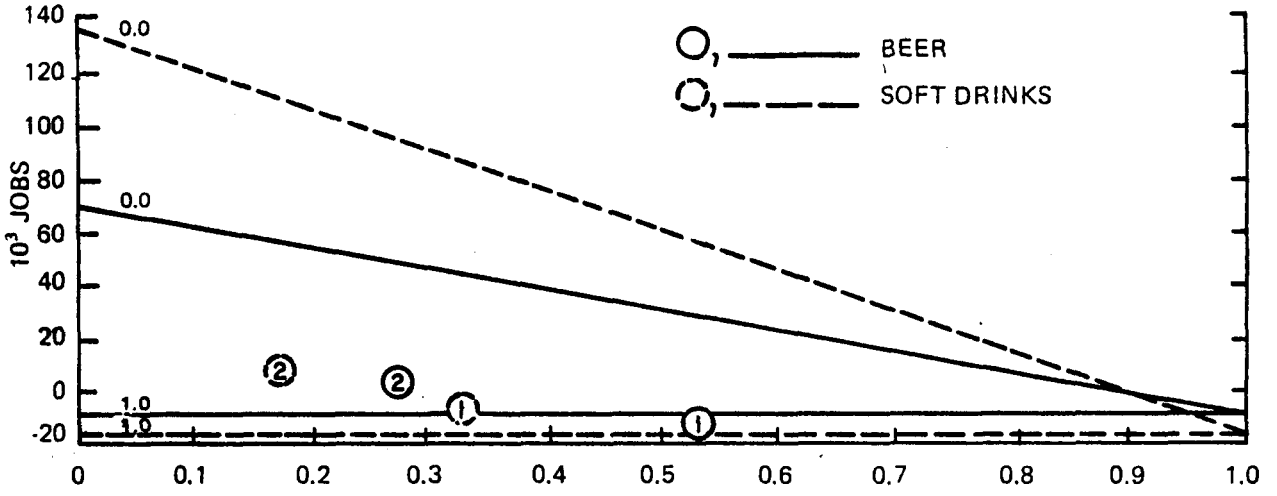
For the soft drink system, at small can market shares, increases in container return rates tend to reduce the magnitude of the net employment impacts. This is because decreases in employment in the glass container industry more than offset the increases in retailing. However, for high can market shares increases in container return rates have the opposite effect--the net employment impacts are raised. In this case employment in the container producing industries is unaffected while that in retailing rises with increases in return rates.

On the other hand, at low container return rates decreases in the can market share increase the net employment impacts as increases in glass container production and beverage distribution employment outweigh the decreases in employment in the can manufacturing and the steel and aluminum industries. At high container return rates, decreases in the can market share have the opposite effect--they reduce the net employment impacts because the decline in can and materials manufacturing employment is not completely offset by increases in employment by glass container producers, beverage distributors and retailers. In all cases the nonrefillable bottle market share is assumed to fall to zero. Thus even without changes in the market share of cans, employment impacts are realized.

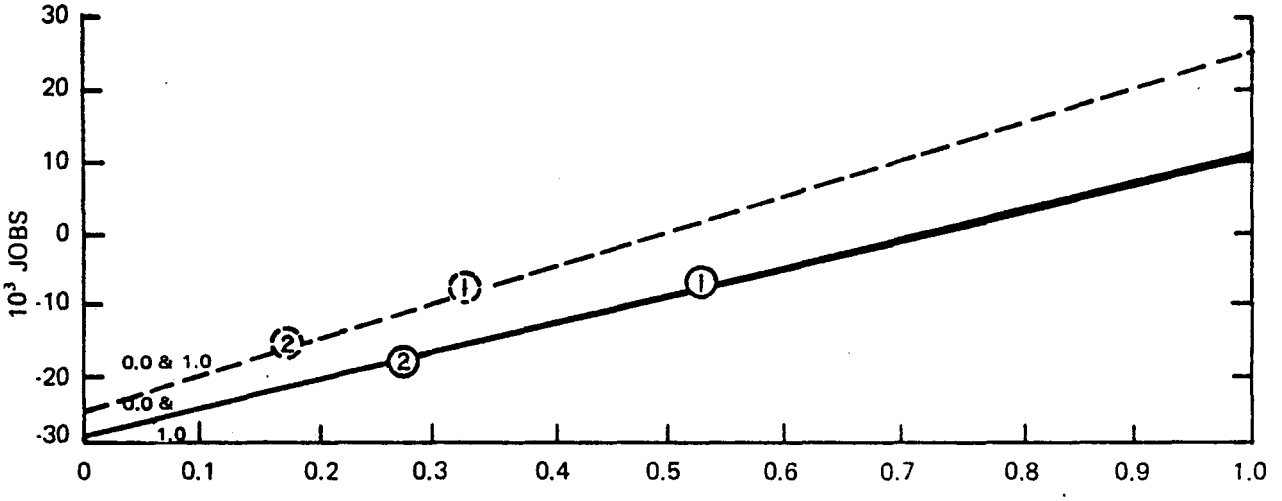
The net employment impacts presented in figure 12 do, however, tend to obscure the extent of the employment dislocations that some market responses imply. Therefore, in figure 13 only the changes in employment due to mandatory deposits are presented by industry. In figure 13 only the extreme return rates are plotted. Both beer and soft drinks are shown on the same plot.

As can be seen in figure 13, the can market share and container return rates interact in unique ways depending on the industry. The employment impacts in the glass container industry are, at low can market shares (i.e., high refillable bottle market shares), very sensitive to container return rates. Employment in can, steel and aluminum manufacturing is only sensitive to the market share of cans, reductions in shares reduce employment in these industries. Reductions in the can market shares tend to increase the employment requirement of beverage producers and distributors due to the extra distribution labor requirements of refillables. Finally, employment in retailing is sensitive to the return rate and not market shares.

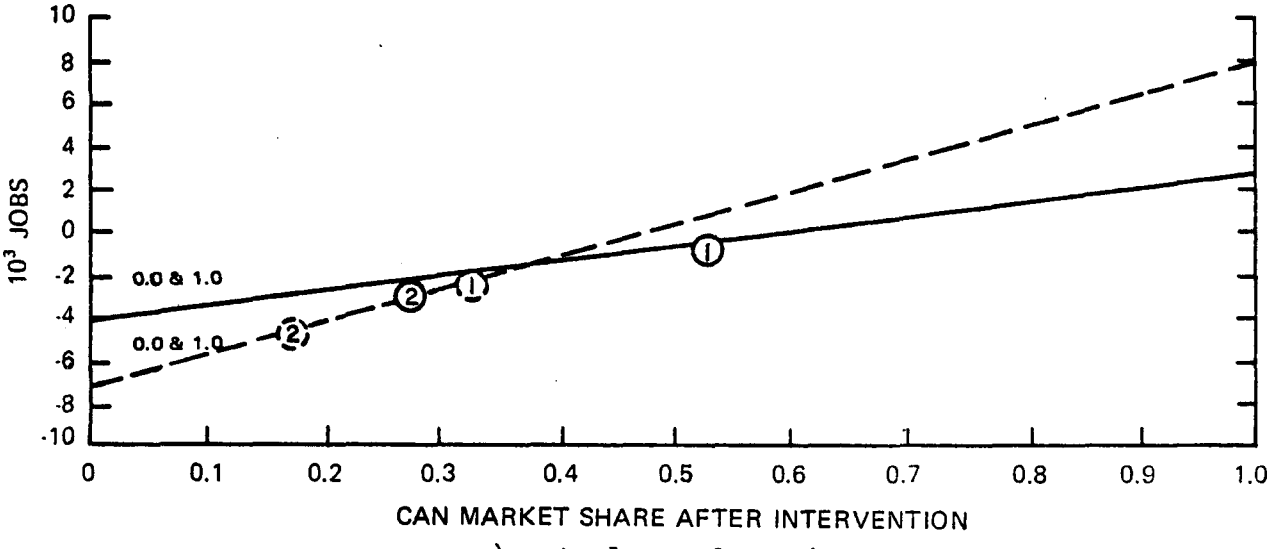
The net employment impacts of the two illustrative scenarios, which are again identified by number in the figures, are similar. For the behavioral responses implied under each scenario, the net effect for both would be to increase the employment in the beverage system by about 117,000 to 118,000 workers. As shown in table 16, employment would decline in the container and metal manufacturing industries (by a total of 37,800 and 49,300 for illustrative scenarios 1 and 2, respectively). On the other hand, there would be employment increases both in beverage distribution and in retailing under both scenarios. These would exceed the above identified reductions.



a) glass container manufacturing

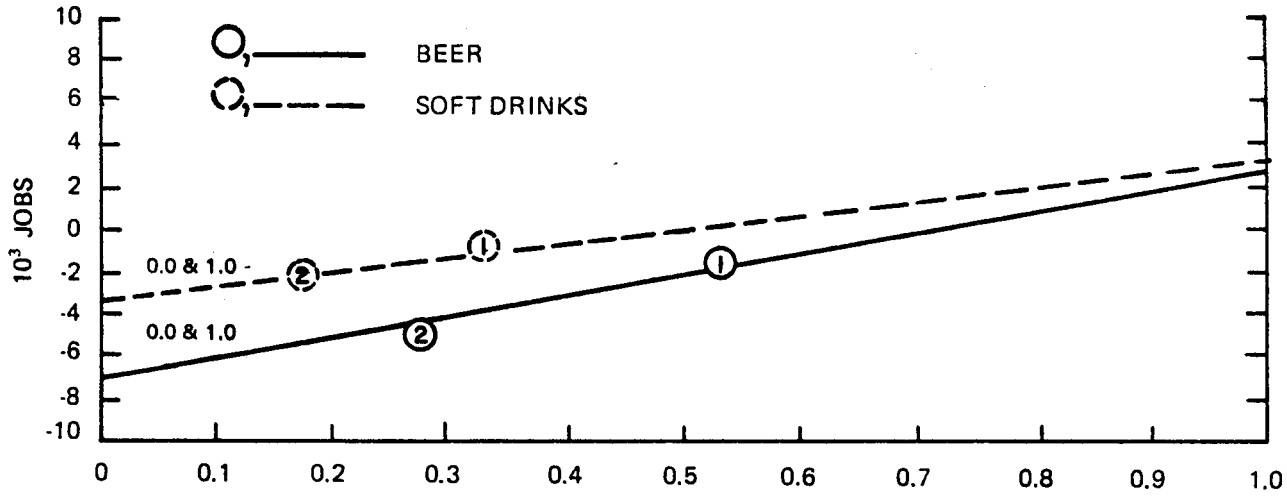


b) can manufacturing

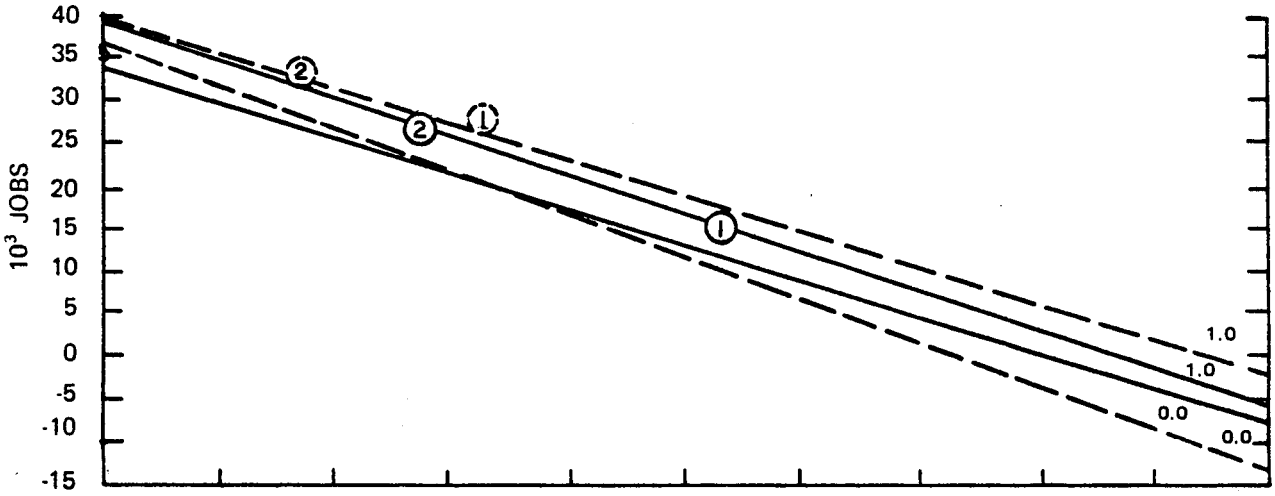


c) steel manufacturing

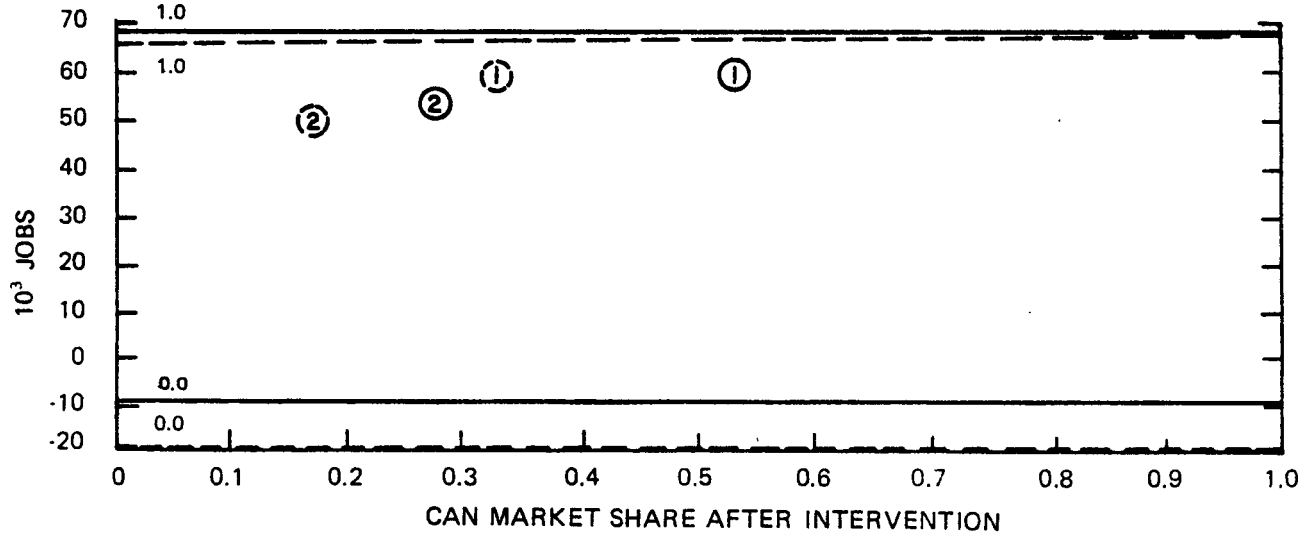
Figure 13. Impacts on employment requirements by industry, 1982 (source: Research Triangle Institute).



d) aluminum manufacturing



e) beverage producers and retailers



f) retailers

Figure 13. Impacts on employment requirements by industry, 1982 (con.) (source: Research Triangle Institute)

Table 16. Employment impacts: illustrative scenarios, 1982 (10^3 man-years)

	Baseline trend			Net impacts of mandatory deposits*						
				Scenario 1**			Scenario 2†			
	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Relevant appendix and table
Container manufacturing	39.3	42.7	82.0	-14.4	-16.9	-31.3	-17.9	-10.3	-28.3	F: F-9
Glass containers	10.2	17.8	28.0	-6.9	-8.6	-15.5	0.5	6.2	6.7	F: F-9
Metal cans	29.1	24.9	53.9	-7.6	-8.3	-15.8	-18.4	-16.6	-35.0	F: F-9
Metal manufacturing	11.3	10.8	22.1	-2.9	-3.6	-6.5	-7.2	-7.2	-14.3	-
Steel	4.2	7.5	11.6	-1.1	-2.5	-3.5	-2.6	-5.0	-7.6	F: F-16
Aluminum	7.2	3.3	10.5	-1.9	-1.1	-3.0	-4.5	-2.2	-6.7	F: F-16
Beverage producers and distributors	100.8	134.5	235.3	14.0	25.8	39.8	26.6	32.5	59.0	-
Production	22.6	45.6	68.2	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	F: F-10
Distribution	78.2	88.9	167.1	14.1	25.8	39.9	26.6	32.5	59.2	F: F-11
Retailers	9.8	20.0	29.7	57.5	58.1	115.7	51.5	49.0	100.5	F: F-12
Total	161.1	208.0	369.1	54.3	63.4	117.7	53.0	64.0	116.9	-

Source: Research Triangle Institute.

*Please note that the values reported in these six columns represent deviations from the baseline trends reported in the first three columns.

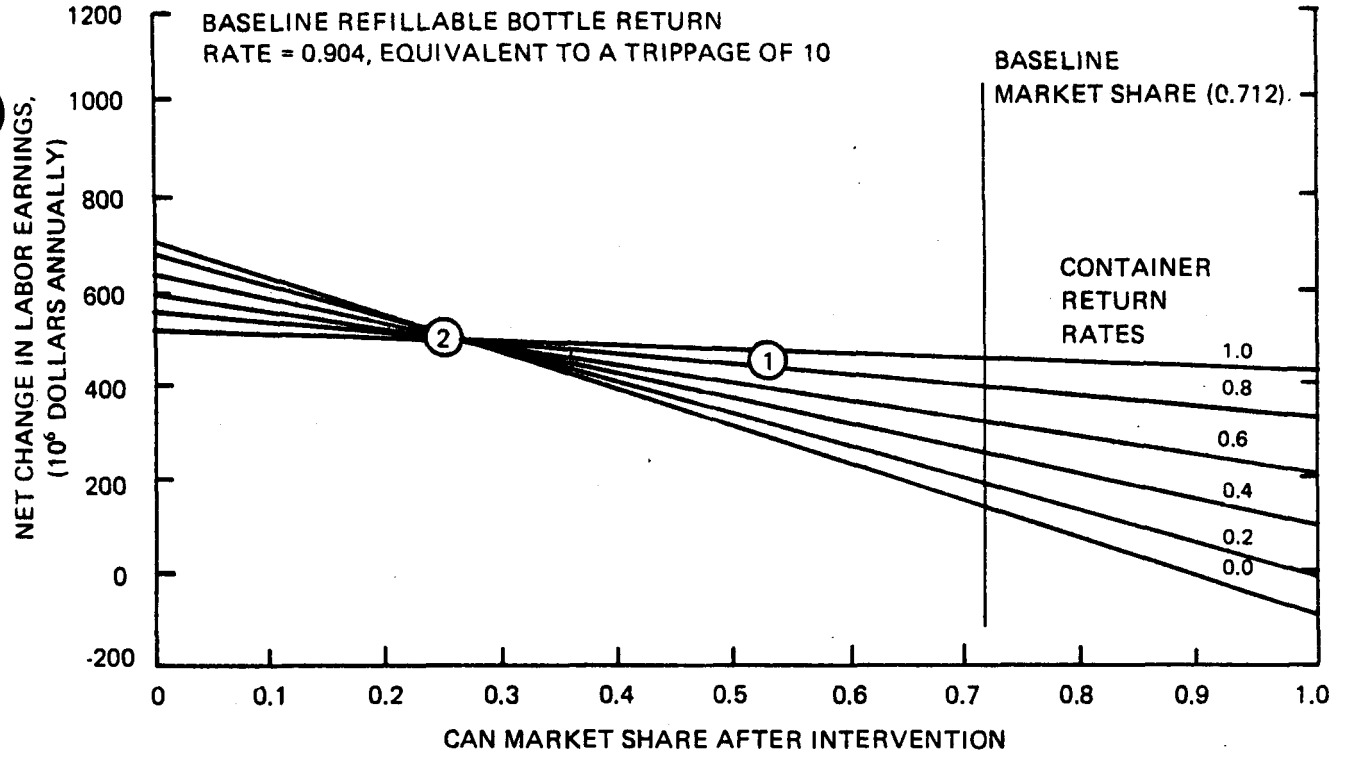
**Canned beverage sales equal to 1976 value container return rate of 0.9 (refillable bottle trippage of 10, can return rate of 0.9).

†Canned beverage sales equal to one-half of the 1976 value container return rate of 0.8 (refillable bottle trippage of 5, can return rate of 0.8).

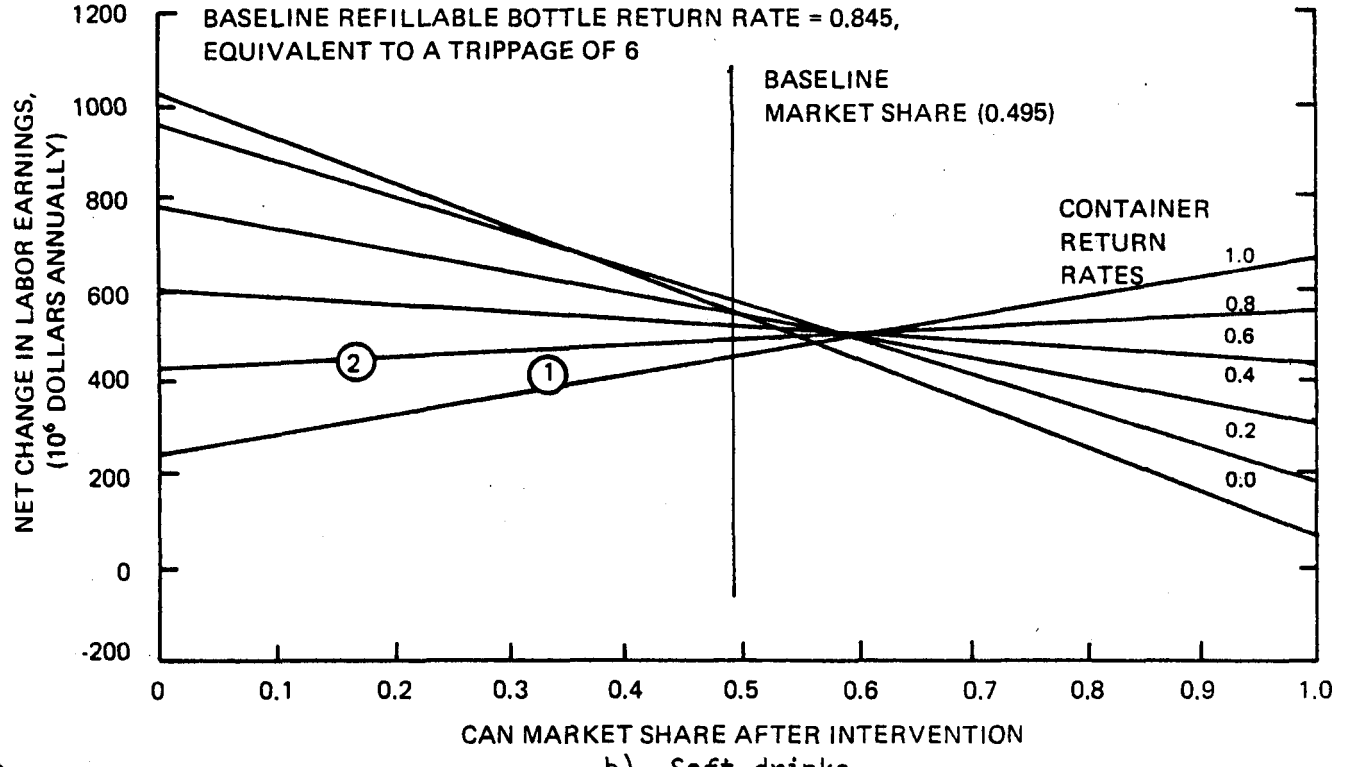
This analysis focuses only on the employment impacts in the major direct and indirect industries. The impact on the other industries has been ignored in this study as discussed in chapter 2.

3.4.2.2 Earnings. The sensitivity of the impact of mandatory deposits on earnings by employees in the major direct and indirect industries is shown in figure 14. As shown there, the effects are complex. At low can market shares, increases in return rates decrease the net earnings impacts as the reductions in earnings in container manufacturing exceed the gains in retailing. At high can market shares, increases in container return rates increase the net earnings impacts. This is caused by increases in retailing that offset any decreases in container manufacturing.

For the illustrative scenarios, average earnings per employee would drop slightly, reflecting the lower skill mix of the refillable bottle and returned can systems. However, the increased employment projected above would more than offset the average wage decrease. Specifically, as shown in table 17, labor earnings would increase $\$936 \times 10^6$ annually at 1982 rates. The container and metal manufacturing industries would experience declines in earnings in proportion to the employment impacts. However, both beverage distribution and retailing industries would have increased wage bills.



a) Beer.



b) Soft drinks.

Figure 14. Impacts on labor earnings, 1982 rates (source: Research Triangle Institute).

Table 17. Earnings impacts: illustrative scenarios, 1982 (10^6 dollars per year)

	Baseline trend			Net impacts of mandatory deposits*						
				Scenario 1**			Scenario 2†			
	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Beer system	Soft drink system	Total beverage system	Relevant appendix and table
Container manufacturing	428	453	881	-151	-176	-327	-205	-130	-335	
Glass containers	97	170	266	-65	-82	-147	4	59	64	
Metal cans	331	283	615	-85	-94	-181	-209	-189	-398	
Metal manufacturing	134	127	261	-35	-42	-77	-85	-85	-170	
Steel	49	89	138	-13	-30	-43	-31	-60	-90	
Aluminum	85	39	124	-22	-13	-35	-54	-26	-80	
Beverage producers and distributors	1,493	1,241	2,735	216	263	478	408	332	740	F: F-19
Production	293	334	627	-1	0	-2	-1	-1	-1	
Distribution	1,200	907	2,108	217	264	480	409	333	741	
Retailers	72	131	203	424	382	805	379	322	701	
Total	2,127	1,953	4,080	454	426	879	497	438	936	

Source: Research Triangle Institute.

*Please note that the values reported in these six columns represent deviations from the baseline trends reported in the first three columns.

**Canned beverage sales equal to 1976 value container return rate of 0.9 (refillable bottle trippage of 10, can return rate of 0.9).

†Canned beverage sales equal to one-half of the 1976 value container return rate of 0.8 (refillable bottle trippage of 5, can return rate of 0.8).

REFERENCES

1. Charles M. Gudger and Jack C. Bailes, The Economic Impact of Oregon's "Bottle Bill", Oregon State University, Corvallis, Oregon, March 1974 p. 25.

2. Gudger and Bailes, p. 27.

Appendix A: BEVERAGE CONSUMPTION

A.1 Introduction

This appendix provides historical estimates of beer and soft drink consumption, estimates of the demand for these beverages, and projections of beverage consumption for 1975-85, in the absence of government intervention.

The purpose of the demand analysis is to provide quantitative estimates of the responsiveness of beverage demand to changes in the values of variables such as price and income. The approach employed is similar to that previously used by RTI (ref. 1). A double-logarithm static demand equation was used for both beer and soft drinks. The dependent variable was per capita annual consumption in ounces. The independent variables were: own-price, per capita disposable income, and a demographic factor.

Assuming the continued historical relationship between beverage consumption and disposable income, prices and the demographic factors as estimated in this demand analysis, the demand equations can be used to project consumption, given future values for the independent variables.

Projections of per capita disposable income and of the demographic characteristics of the population have been developed by the Bureau of Labor Statistics as part of a major study of the U.S. economy. They are shown in tables A-1 and A-2. The relative prices of beer and soft drinks are assumed to be constant between 1973 and 1985.

A.2 Beer Consumption

Total beer consumption (measured as total tax-paid withdrawals) remained fairly constant over the period 1947-60 (see table A-3). Since 1960, however, consumption has increased at an average annual rate of 3.56 percent, reaching 549×10^9 ounces in 1973. This represents an average of 7.15 ounces daily or 2,611 annually per capita.

Since World War II beer consumption has steadily shifted away from the on-premise market (e.g., bars, taverns) to the off-premise market as lifestyles have changed. On an absolute basis, however, on-premise consumption has been fairly stable since 1951 while most of the growth in consumption has occurred in the off-premise market (table A-4).

Table A-1. Disposable personal income and population: annually, 1947-73; projections, 1975-85

Year	Disposable personal income, 10^6 current dollars, projections in 1967 dollars	Implicit price deflator for personal consumption expenditures, 1967 = 100	Total population (including Armed Forces overseas), 10^6	Per capita disposable personal income, 1967 dollars
1947.00	169833.	68.0945	144.698	1730.87
1948.00	189138.	71.9406	147.208	1792.65
1949.00	188585.	71.4161	149.767	1769.77
1950.00	206940.	72.4651	152.271	1883.02
1951.00	226583.	77.4476	154.878	1895.61
1952.00	238312.	79.1084	157.553	1919.63
1953.00	252564.	80.1574	160.184	1974.54
1954.00	257445.	80.8567	163.026	1960.81
1955.00	275348.	81.1189	165.931	2053.48
1956.00	293179.	82.8672	168.903	2103.81
1957.00	308524.	85.4022	171.984	2109.53
1958.00	318826.	87.4126	174.882	2094.66
1959.00	337315.	88.5490	177.830	2151.86
1960.00	350044.	89.9476	180.671	2154.15
1961.00	364424.	90.8217	183.691	2183.89
1962.00	385267.	91.6959	186.538	2252.53
1963.00	404604.	92.7448	189.242	2305.16
1964.00	438096.	93.8812	191.889	2432.14
1965.00	473240.	95.1049	194.303	2561.41
1966.00	511568.	97.3777	196.560	2671.24
1967.00	546341.	100.000	198.712	2749.03
1968.00	590977.	103.497	200.706	2843.98
1969.00	634386.	107.955	202.677	2898.89
1970.00	691699.	113.025	204.879	2985.84
1971.00	746433.	117.485	207.045	3069.35
1972.00	802501.	120.804	208.842	3179.17
1973.00	903714.	127.535	210.396	3369.08

Table A-1 (cont.). Disposable personal income and population: annually, 1947-73; projections, 1975-85

Year	Disposable personal income, 10^6 current dollars, projections in 1967 dollars	Implicit price deflator for personal consumption expenditures, 1967 = 100	Total population (including Armed Forces overseas), 10^6	Per capita disposable personal income 1967 dollars
1975,00	755797,		213,925	3533,00
1976,00	791621,		215,936	3666,00
1977,00	829143,		217,966	3804,00
1978,00	868399,	Does not	220,015	3947,00
1979,00	909430,	apply	222,083	4095,00
1980,00	952337,		224,132	4249,00
1981,00	984596,		226,396	4349,00
1982,00	0,101810E 07		228,683	4452,00
1983,00	0,105263E 07		230,992	4557,00
1984,00	0,108846E 07		233,325	4665,00
1985,00	0,112524E 07		235,701	4774,00

Sources: Income and deflator series: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, July issues;

Population series: U.S. Bureau of the Census, Current Population Reports, series P-25, No. 493, December 1972;

Income, deflator and population projections: U.S. Department of Labor, Bureau of Labor Statistics, The Structure of the U.S. Economy in 1980 and 1985, Bulletin 1831, 1975, p. 13 and 30.

Table A-2. Age composition of the population: annually, 1947-73; projections, 1975-85

Year	Population aged 20-34		Population aged 10-29	
	Total, 10^6	Share	Total, 10^6	Share
1947,00	35,0500	0,242229	45,8670	0,316984
1948,00	35,2880	0,239715	45,8300	0,311328
1949,00	35,4290	0,236561	45,7900	0,305742
1950,00	35,4280	0,232664	45,6940	0,300083
1951,00	35,7420	0,230775	45,9040	0,296388
1952,00	35,6510	0,226279	46,0340	0,292181
1953,00	35,4020	0,221008	46,5490	0,290597
1954,00	35,1720	0,215745	46,8990	0,287678
1955,00	34,9970	0,210913	47,2260	0,284612
1956,00	34,7380	0,205668	47,5970	0,281801
1957,00	34,4470	0,200292	48,9860	0,284829
1958,00	34,2940	0,196098	50,0750	0,286336
1959,00	34,1380	0,191970	51,2550	0,288225
1960,00	34,0270	0,188337	52,4260	0,290174
1961,00	34,0660	0,185453	53,8580	0,293199
1962,00	34,3270	0,184021	55,4260	0,297130
1963,00	34,9590	0,184732	57,1930	0,302221
1964,00	35,4710	0,184852	59,0790	0,307881
1965,00	36,0480	0,185525	60,9990	0,313937
1966,00	36,6690	0,186554	63,0090	0,320559
1967,00	38,2640	0,192560	65,0680	0,327449
1968,00	39,6960	0,197782	67,0750	0,334195
1969,00	41,1650	0,203106	68,9330	0,340113
1970,00	41,2780	0,201475	69,7080	0,340240
1971,00	43,4250	0,209737	71,9380	0,347451
1972,00	45,5720	0,218213	74,1690	0,355144
1973,00	46,9360	0,223084	76,3940	0,363096

Table A-2 (cont.). Age composition of the population: annually, 1947-73; projections, 1975-85

Year	Population aged 20-34		Population aged 10-29	
	Total, 10^6	Share	Total, 10^6	Share
1975,00	50,5180	0,236148	77,7210	0,363310
1976,00	51,9380	0,240525	77,8450	0,360500
1977,00	53,3970	0,244978	77,9700	0,357716
1978,00	54,8980	0,249519	78,0950	0,354953
1979,00	56,4400	0,254139	78,2200	0,352211
1980,00	58,0290	0,258905	78,3290	0,349477
1981,00	58,6500	0,259059	77,9530	0,344321
1982,00	59,2780	0,259215	77,5790	0,339242
1983,00	59,9120	0,259368	77,2070	0,334241
1984,00	60,5530	0,259522	76,8360	0,329309
1985,00	61,1960	0,259634	76,3130	0,323770

Source: U.S. Bureau of the Census, Current Population Reports, series P-25, No. 493, December 1972. The projections are from series E.

Table A-3. Beer consumption: annually, 1947-73; projections, 1975-85

Year	Total consumption*, 10^6 ounces	Average per capita consumption, ounces	Average per capita daily consumption, ounces
1947,00	345898,	2390,48	6,54927
1948,00	337546,	2292,98	6,28215
1949,00	335525,	2240,31	6,13785
1950,00	328672,	2158,46	5,91360
1951,00	332732,	2148,35	5,88589
1952,00	336629,	2136,61	5,85372
1953,00	341429,	2131,48	5,83966
1954,00	330554,	2027,61	5,55511
1955,00	337189,	2032,11	5,56741
1956,00	337312,	1997,08	5,47144
1957,00	334783,	1946,59	5,33313
1958,00	335004,	1915,60	5,24821
1959,00	347687,	1955,17	5,35662
1960,00	348839,	1930,80	5,28986
1961,00	353266,	1923,15	5,26891
1962,00	361868,	1939,92	5,31484
1963,00	372158,	1966,57	5,38786
1964,00	391419,	2039,82	5,58855
1965,00	398470,	2050,76	5,61853
1966,00	413712,	2104,76	5,76647
1967,00	424472,	2136,12	5,85238
1968,00	442097,	2202,71	6,03482
1969,00	461365,	2276,36	6,23659
1970,00	483541,	2360,13	6,46610
1971,00	505513,	2441,56	6,68921
1972,00	523030,	2504,43	6,86145
1973,00	549365,	2611,10	7,15370
1975,00	599386,	2801,85	7,67631
1976,00	618683,	2865,12	7,84965
1977,00	638593,	2929,78	8,02681
1978,00	659146,	2995,91	8,20798
1979,00	680332,	3063,42	8,39292
1980,00	702215,	3133,04	8,58368
1981,00	713821,	3152,98	8,63829
1982,00	725647,	3173,16	8,69358
1983,00	737645,	3193,38	8,74898
1984,00	749864,	3213,82	8,80498
1985,00	762199,	3233,75	8,85960

*tax-paid withdrawals

Source: United States Brewers Association, Inc., Brewers Almanac 1973, Washington, D.C., p. 14.
Projections by Research Triangle Institute.

Table A-4. Beer markets: annually, 1947-73

Year	Total quantity, 10^6 ounces	Off-premise		On-premise	
		Quantity, 10^6 ounces	Share, decimal share	Quantity, 10^6 ounces	Share, decimal share
1947,00	345898,	159851,	0,462132	186047,	0,537868
1948,00	336117,	160902,	0,478709	175215,	0,521291
1949,00	335526,	164624,	0,490645	170902,	0,509355
1950,00	328669,	164299,	0,499891	164370,	0,500109
1951,00	332614,	173830,	0,522619	158783,	0,477381
1952,00	336629,	182326,	0,541622	154303,	0,458378
1953,00	341426,	192051,	0,562496	149375,	0,437504
1954,00	330554,	186155,	0,563160	144399,	0,436840
1955,00	337189,	194499,	0,576827	142689,	0,423173
1956,00	337312,	199594,	0,591721	137717,	0,408279
1957,00	334784,	199967,	0,597302	134817,	0,402698
1958,00	334998,	200316,	0,597963	134682,	0,402037
1959,00	347684,	210336,	0,604962	137348,	0,395038
1960,00	348839,	214133,	0,613846	134706,	0,386154
1961,00	353267,	215244,	0,609296	138023,	0,390704
1962,00	361881,	222363,	0,614463	139519,	0,385537
1963,00	372158,	227672,	0,611760	144487,	0,388240
1964,00	391419,	238985,	0,610559	152435,	0,389441
1965,00	398470,	245306,	0,615618	153165,	0,384382
1966,00	413711,	256702,	0,620485	157010,	0,379515
1967,00	424473,	266590,	0,628050	157883,	0,371950
1968,00	442098,	280129,	0,633634	161970,	0,366366
1969,00	461363,	295112,	0,639652	166251,	0,360348
1970,00	483536,	311365,	0,643933	172171,	0,356067
1971,00	505511,	328332,	0,649505	177179,	0,350495
1972,00	522950,	338264,	0,646838	184686,	0,353162
1973,00	549365,	354092,	0,644548	195273,	0,355452

Source: R. S. Weinberg and Associates, St. Louis, Missouri.

The aggregate demand for beer is assumed to be a function of the price of beer, of per capita income of consumers, and of the proportion of the population aged 20-34.

Per capita beer consumption as shown in table A-3, column 3, is the dependent variable in the beer demand equation. The consumer price index for beer, relative to the price index for all personal consumption expenditures has fallen since the mid-fifties as shown in table A-5, column 3. The share of the U.S. population aged 20-34 which is positively correlated with per capita beer consumption will peak in 1975 and decline thereafter, as shown in column 3 of table A-2.

Because consumer price indexes for beer are not available for the 1947-52 period, a price index was imputed from the consumer price index - wholesale price index relationship for the 1953-73 period as shown below (the numbers in the parentheses below the estimated coefficients are the t-statistics).

$$\ln RPBR = \underset{(-3.981)}{-75.3586} + \underset{(6.869)}{0.925632} \cdot \ln WPBR + 9.9819 \cdot \ln YEAR \qquad \text{(A-1)}$$

$$R^2 = 0.979$$

where

RPBR = consumer price index for beer

WPBR = wholesale price index for beer

YEAR = time period in years.

Using the structural equation (A-1), the consumer price indexes of beer for the period 1947-52 were estimated from the wholesale price indexes of beer for the same period and are reported in table A-5, column 2, along with the published consumer price indexes for the period 1953-73.

The demand equation for beer estimated from 1947-73 data is shown below.

$$\ln BQPC = \underset{(35.199)}{6.8151} + \underset{(7.991)}{0.2546} \cdot \ln PCY - \underset{(-4.723)}{0.5957} \cdot \ln BRPI + \underset{(11.717)}{0.7037} \cdot \ln SP2034 \qquad \text{(A-2)}$$

$$R^2 = 0.958$$

Table A-5. Beer price indexes: annually, 1954-73

Year	Consumer price index for beer,* 1967=100	Relative consumer price index for beer,† 1967=100
1947,00	65,9666	0,968750
1948,00	70,3637	0,978081
1949,00	71,0715	0,995176
1950,00	72,5663	1,00140
1951,00	76,7740	0,991303
1952,00	81,5300	1,03061
1953,00	86,1000	1,07414
1954,00	89,3000	1,10442
1955,00	88,6000	1,09222
1956,00	90,0000	1,08607
1957,00	91,7000	1,07374
1958,00	91,6000	1,04790
1959,00	92,3000	1,04236
1960,00	93,6000	1,04061
1961,00	93,8000	1,03279
1962,00	94,3000	1,02840
1963,00	95,1000	1,02539
1964,00	95,9000	1,02150
1965,00	96,8000	1,01782
1966,00	98,3000	1,00947
1967,00	100,000	1,00000
1968,00	102,800	0,993266
1969,00	105,400	0,976333
1970,00	108,900	0,963504
1971,00	112,900	0,960990
1972,00	113,900	0,942850
1973,00	115,600	0,906418

*Consumer price index for beer for the period 1947-52 were estimated by Research Triangle Institute.

†Consumer price index for beer divided by the implicit price deflator for personal consumption expenditures.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

where

BQPC = annual per capita beer consumption (ounces)
PCY = annual per capita disposable income (1967 dollars)
BRPI = relative price of beer (1967 = 1.0)
SP2034 = proportion of the U.S. population aged 20-34.

The short-run income elasticity of beer consumption is equal to 0.255, and the demand price elasticity is equal to -0.596. Thus an increase in per capita income of 10 percent will increase quantity demanded by 2.6 percent. An increase of 10 percent in the relative price of beer decreases quantity demanded by 6.0 percent.

Using equation (A-2) and the projected values for income and the age composition of the population from tables A-1 and A-2, respectively, projections of beer consumption are shown in table A-3.

A.3 Soft Drink Consumption

Soft drink consumption has grown steadily since 1947, averaging 5.66 percent annually for the 1947-73 period (table A-6) reaching 724×10^9 ounces in 1973. Per capita consumption increased 4.15 percent annually over the same period, reaching 9.43 ounces daily or 3,442 ounces annually in 1973.

The aggregate demand for soft drinks is assumed to be a function of the price of soft drinks, of per capita disposable income, and of the proportion of the population aged 10-29.

Per capita soft drink consumption as shown in table A-6, column 3, is the dependent variable in the soft drink demand equation. The best available consumer price index for soft drinks is for cola only. Because the demand equation is for aggregate soft drink consumption, it was necessary to develop a consumer price index for total soft drinks from the wholesale price index for total soft drinks.

The consumer price index for cola was divided by the wholesale price index for cola to obtain a relationship between the two indexes for the 1953-73 period. As shown in column 4 of table A-7, the ratio has been very stable around unity. This ratio was multiplied by the wholesale price index for all soft drinks to obtain the imputed consumer price index for soft drinks shown in column 6. The ratio of unity was used for the period

Table A-6. Soft drink consumption: annually, 1947-73; projections 1975-85

Year	Total consumption, 10^6 ounces	Average per capita annual consumption, ounces	Average per capita daily consumption, ounces
1947.00	173126.	1196.47	3.27799
1948.00	193901.	1317.19	3.60874
1949.00	194477.	1298.53	3.55761
1950.00	192346.	1263.18	3.46076
1951.00	200410.	1293.98	3.54516
1952.00	217459.	1380.23	3.78144
1953.00	226138.	1411.74	3.86777
1954.00	225926.	1385.85	3.79679
1955.00	242861.	1463.62	4.00993
1956.00	253670.	1501.87	4.11471
1957.00	261293.	1519.28	4.16242
1958.00	261024.	1492.57	4.08923
1959.00	285043.	1602.90	4.39150
1960.00	283488.	1569.08	4.29886
1961.00	292646.	1593.14	4.36478
1962.00	320160.	1716.32	4.70226
1963.00	345773.	1827.15	5.00588
1964.00	374131.	1949.73	5.34172
1965.00	404026.	2079.36	5.69687
1966.00	451699.	2298.02	6.29595
1967.00	474317.	2386.95	6.53960
1968.00	533184.	2656.54	7.27820
1969.00	559315.	2759.64	7.56065
1970.00	594547.	2901.94	7.95052
1971.00	643891.	3109.91	8.52029
1972.00	679949.	3255.80	8.92001
1973.00	724147.	3441.83	9.42967
1975.00	821450.	3839.90	10.5203
1976.00	870032.	4029.12	11.0387
1977.00	921491.	4227.68	11.5827
1978.00	975922.	4435.71	12.1526
1979.00	0.103343E 07	4653.33	12.7488
1980.00	0.109427E 07	4882.25	13.3760
1981.00	0.113036E 07	4992.86	13.6791
1982.00	0.116789E 07	5107.04	13.9919
1983.00	0.120650E 07	5223.14	14.3100
1984.00	0.124659E 07	5342.70	14.6375
1985.00	0.128536E 07	5453.34	14.9406

Source: National Soft Drink Association, 1973 Sales Survey of the Soft Drink Industry, Washington, D.C., p. 16. Projections by Research Triangle Institute.

Table A-7. Soft drink price indexes: annually 1947-73

Year	Consumer price index for cola flavored soft drinks, 1967=100	Wholesale price index for cola flavored soft drinks, 1967=100	Ratio of consumer price index to wholesale price index, 1967=100	Wholesale price index for soft drinks,* 1967=100	Imputed consumer price index for soft drinks,† 1967=100	Relative consumer price index for soft drinks,‡ 1967=100
1947.00	0.0	46.6000	0.0	59.0704	59.0704	0.867477
1948.00	0.0	46.6000	0.0	59.0718	59.0718	0.821119
1949.00	0.0	46.6000	0.0	60.7092	60.7092	0.850077
1950.00	0.0	47.0000	0.0	62.4941	62.4941	0.862403
1951.00	0.0	56.0000	0.0	64.2838	64.2838	0.850029
1952.00	0.0	56.5000	0.0	64.2827	64.2827	0.812590
1953.00	61.0000	57.1000	1.06830	66.0730	70.5858	0.880590
1954.00	64.6000	67.0000	0.964178	70.8148	68.2782	0.844434
1955.00	65.9000	69.9000	0.942775	70.7164	66.6697	0.821876
1956.00	66.5000	69.9000	0.951358	70.7143	67.2747	0.811838
1957.00	69.6000	69.9000	0.995708	70.7089	70.4054	0.824399
1958.00	72.0000	69.9000	1.03004	75.0007	77.2539	0.883784
1959.00	76.2000	79.7000	0.956085	78.5679	75.1176	0.848317
1960.00	77.9000	81.6000	0.954656	82.1434	78.4187	0.871826
1961.00	80.6000	83.5000	0.965270	85.7164	82.7394	0.911009
1962.00	81.6000	86.8000	0.940092	85.7135	80.5786	0.878760
1963.00	86.1000	90.7000	0.949283	92.8576	88.1481	0.950437
1964.00	90.3000	93.9000	0.961661	92.8571	89.2971	0.951171
1965.00	91.3000	94.9000	0.962065	92.8567	89.3342	0.939322
1966.00	94.2000	96.6000	0.975154	96.4275	94.0318	0.965640
1967.00	100.000	100.000	1.00000	100.000	100.000	1.00000
1968.00	107.200	107.800	0.994433	107.144	106.548	1.02948
1969.00	112.700	115.300	0.977449	107.143	104.727	0.970103
1970.00	119.000	121.500	0.979423	110.715	108.437	0.959408
1971.00	125.900	123.700	1.01778	113.885	115.910	0.986618
1972.00	128.300	126.300	1.01585	114.639	116.454	0.963989
1973.00	131.700	124.400	1.05868	117.857	124.773	0.978345

*Estimated by RTI from the total wholesale value and total consumption data in NSDA 1973 Sales Survey of the Soft Drink Industry.

†Imputed by Research Triangle Institute.

‡Imputed consumer price index for soft drinks divided by the implicit price deflator for personal consumption expenditures.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

of 1947-52. This index was then divided by the price index for all personal consumption expenditures to obtain the relative price index for soft drinks shown in column 7.

The demand equation for soft drinks estimated from 1947-73 data is shown below.

$$\ln SQPC = \underset{(-5.933)}{-2.9401} + \underset{(27.217)}{1.4676} \cdot \ln PCY - \underset{(-0.979)}{0.1363} \cdot \ln SRPI + \underset{(6.705)}{0.78995} \cdot \ln SP1029 \qquad \text{(A-3)}$$

$$R^2 = 0.995$$

where

SQPC = annual per capita soft drink consumption (ounces)

PCY = annual per capita disposable income (1967 dollars)

SRPI = relative price of soft drink (1967 = 1.0)

SP1029 = proportion of the U.S. population aged 10-29.

The short-run income elasticity of soft drink consumption is 1.468, and the demand price elasticity is equal to -0.136. However, the t-value for the coefficient estimate of the relative price variable indicates that the demand price elasticity of soft drink is not significantly different from zero.

It is interesting to note that the income elasticity of soft drinks, 1.468, is substantially higher than that of beer, 0.255. The estimate of the price elasticity of beer, -0.596, is more elastic than the previous estimate (ref. 1) of -.17 to -.27. The difference may be attributable to the improved price index used here plus the longer data series.

Using equation (A-3), projections of soft drink consumption are shown in table A-6.

REFERENCES

1. Tayler H. Bingham and Paul F. Mulligan, The Beverage Container Problem, Analysis and Recommendations, Research Triangle Institute, September 1972, pp. 167-170, for the Environmental Protection Agency, Cincinnati, Ohio.

Appendix B: BEVERAGE PACKAGING

B.1 Introduction

Beer and soft drinks are currently distributed either in bulk (nonpackaged) or packaged in one of three containers--refillable glass bottles, nonrefillable glass bottles, or metal cans. This appendix provides historical estimates of the market shares and container requirements for each package and projections of these shares in the absence of government intervention for 1975-85.

As described below, a constrained logistic equation was used to project market shares. These market shares were next converted into projections of container requirements, based on projections of average container size.

B.2 Market Shares

Several studies have shown that an S-shaped curve characterizes many technological substitutions between an existing and a new technology over time (refs. 1,2,3,4). Applied to beverage packaging, this model indicates that, when a new package is introduced into the market, there is first a period when acceptance is slow. During this time technological improvements are made, perhaps price reductions (either absolute or relative) are achieved, and consumers learn about the characteristics of the new package. If the package is economically viable, it may increase in competitiveness as consumers develop a preference for the new package and as price reductions occur, resulting in an acceleration in the rate of acceptance. In the final stage, the rate of acceptance slows, tending toward an ultimate limit at which all process improvements and scale economies have been achieved (ref. 5).

This phenomenon can be expressed mathematically by the logistic growth function. The percentage change in the fraction f(t) in each year $\left(\frac{df(t)}{dt}/f(t)\right)$ is assumed to be a constant times the gap between an asymptote and the present value of the fraction:

$$\frac{1}{f(t)} \cdot \frac{df(t)}{dt} = b\,[\ell - f(t)] \qquad \text{(B-1)}$$

where $f(t)$ = market share captured at time, t, by the challenger,

ℓ = asymptotic upper limit of the market share that the challenger can capture in the long run,

b = constant ratio of the percentage change in $f(t)$ to the gap between ℓ and $f(t)$.

The differential equation (B-1) can be solved as follows. By rearranging equation (B-1)

$$\frac{1}{b} \frac{df(t)}{[\ell - f(t)]\, f(t)} = dt \, . \tag{B-2}$$

Equation B-2 is equivalent to

$$\frac{1}{b} \frac{df(t)}{[\ell - f(t)]\, f(t)} = dt. \tag{B-3}$$

By integrating (B-3) results in

$$\frac{1}{b} \frac{\ell n \frac{f(t)}{\ell - f(t)}}{\ell} = t + C \tag{B-4}$$

where C is a constant of integration, equation (B-4) can be rearranged as

$$\ell n \frac{f(t)}{\ell - f(t)} = b\, \ell (t + C). \tag{B-5}$$

Setting $\Theta = b\ell\, C$ and $\phi = b\ell$ yields a general form of the logistic function used by Blackman (ref. 3).

$$\ell n \frac{f(t)}{\ell - f(t)} = \Theta + \phi t. \tag{B-6}$$

Setting ℓ equal to its maximum feasible value of unity, (B-6) becomes

$$\ell n \frac{f(t)}{1 - f(t)} = \Theta + \phi t \, . \tag{B-7}$$

Equation (B-7) was estimated by ordinary least-squares regression using historical data on market shares by package type. In estimating the logistics for each package, the following pairs of technologies were examined for beer and soft drinks:

defender		challenger
nonpackaged (soft drink: packaged)	vs.	packaged (soft drink: nonpackaged)
glass container	vs.	metal can
refillable bottle	vs.	nonrefillable bottle.

The maximum market share, ℓ, was specified for each package based on the magnitude of the market share, f(t), for the most recent year, 1973. The values of ℓ were arbitrarily set at twice the 1973 value of f(t) or 1.0, whichever was lower:

package	market share, 1973	value of ℓ chosen
beer		
packaged	0.869	1.0
metal can	0.600	1.0
nonrefillable bottle	0.522	1.0
soft drinks		
nonpackaged	0.200	0.5
metal can	0.364	0.7
nonrefillable bottle	0.455	1.0

B.2.1 Beer

As shown in table B-1, the nonpackaged share of beer sales has declined both relatively and absolutely since World War II. Within the share of packaged beer, there have of course been shifts toward nonrefillable bottles and metal cans, as can be seen in the data presented in table B-2. While the share of beer packaged in refillable bottles has declined from 86 percent of total packaged beer consumption in 1947 to 19 percent in 1973, the shares of nonrefillable bottles and metal cans have increased substantially from 3 percent and 11 percent in 1947 to 21 percent and 60 percent respectively, in 1973.

The regression results of the equation (B7) applied to beer packaging market-shares data for 1947-1973 are reported below (t statistics in parentheses).

1. Market share of packaged beer consumption:

$$\ln FPKB = \underset{(18.575)}{0.5673} + \underset{(28.762)}{0.04093} \cdot TIME \qquad (B\text{-}8)$$

Table B-1. Beer packaging: annually, 1947-73

Year	Quantity, 10^6 ounces			Market share, decimal share	
	Total	Packaged	Nonpackaged	Packaged	Nonpackaged
1947,00	345898,	233711,	112187,	0,675665	0,324335
1948,00	337546,	232918,	104628,	0,690033	0,309967
1949,00	335525,	235874,	99651,4	0,702999	0,297001
1950,00	328672,	236048,	92623,4	0,718189	0,281811
1951,00	332732,	244972,	87759,8	0,736245	0,263755
1952,00	336629,	251408,	85220,7	0,746841	0,253159
1953,00	341429,	261217,	80211,4	0,765071	0,234929
1954,00	330554,	253662,	76891,8	0,767385	0,232615
1955,00	337189,	262598,	74591,4	0,778785	0,221215
1956,00	337312,	266201,	71111,1	0,789183	0,210817
1957,00	334783,	265784,	68998,8	0,793900	0,206100
1958,00	335004,	266530,	68473,2	0,795605	0,204395
1959,00	347687,	278986,	68701,4	0,802405	0,197595
1960,00	348839,	281553,	67286,3	0,807114	0,192886
1961,00	353266,	285343,	67922,9	0,807729	0,192271
1962,00	361868,	294140,	67728,4	0,812837	0,187163
1963,00	372158,	302929,	69228,9	0,813980	0,186020
1964,00	391419,	320162,	71257,4	0,817951	0,182049
1965,00	398470,	327852,	70617,8	0,822778	0,177222
1966,00	413712,	343359,	70353,4	0,829946	0,170054
1967,00	424472,	355449,	69023,0	0,837391	0,162609
1968,00	442097,	373023,	69073,9	0,843759	0,156241
1969,00	461365,	392800,	68564,9	0,851387	0,148613
1970,00	483541,	415132,	68408,8	0,858525	0,141475
1971,00	505513,	436587,	68926,3	0,863651	0,136349
1972,00	523030,	453237,	69793,4	0,866559	0,133440
1973,00	549365,	477505,	71860,4	0,869194	0,130806

Source: United States Brewers Association, Inc., Brewers Almanac 1973, Washington, D.C.

Table B-2. Packaged beer by container type: annually, 1947-73

Year	Quantity, 10^6 ounces				Market share, decimal share		
	Total	Refillable bottles	Nonrefillable bottles	Metal cans	Refillable bottles	Nonrefillable bottles	Metal cans
1947,00	233711,	200805,	7106,68	25799,9	0,859200	0,304080E-01	0,110392
1948,00	232918,	189524,	8793,08	34601,0	0,813694	0,377519E-01	0,148555
1949,00	235874,	184155,	7654,45	44084,5	0,780735	0,323666E-01	0,186899
1950,00	236048,	168826,	8340,73	58881,1	0,715220	0,353349E-01	0,249445
1951,00	244972,	168390,	25613,4	50969,0	0,687384	0,104556	0,208060
1952,00	251408,	173017,	21320,1	57071,7	0,688190	0,848024E-01	0,227008
1953,00	261217,	167446,	22296,2	71475,5	0,641020	0,853550E-01	0,273625
1954,00	253662,	157470,	19990,8	76201,4	0,620786	0,788087E-01	0,300405
1955,00	262598,	156053,	20090,0	86454,7	0,594267	0,765046E-01	0,329228
1956,00	266201,	153958,	20153,5	92089,3	0,578353	0,757077E-01	0,345939
1957,00	265784,	150574,	20153,5	95057,3	0,566525	0,758265E-01	0,357648
1958,00	266530,	147649,	20197,1	98684,1	0,553968	0,757779E-01	0,370255
1959,00	278986,	147828,	22447,0	108711,	0,529875	0,804591E-01	0,389666
1960,00	281553,	149562,	28200,6	103791,	0,531203	0,100161	0,368637
1961,00	285343,	145864,	37557,1	101922,	0,511188	0,131621	0,357191
1962,00	294140,	143788,	44552,7	105799,	0,488844	0,151468	0,359689
1963,00	302929,	139424,	49310,3	114195,	0,460252	0,162779	0,376970
1964,00	320162,	136932,	56567,8	126662,	0,427695	0,176685	0,395620
1965,00	327852,	134618,	61083,4	132150,	0,410607	0,186314	0,403079
1966,00	343359,	128829,	65567,1	148963,	0,375202	0,190958	0,433840
1967,00	355449,	123079,	76094,2	156276,	0,346264	0,214079	0,439657
1968,00	373023,	117556,	78006,8	177461,	0,315143	0,209120	0,475736
1969,00	392800,	112282,	86458,6	194059,	0,285851	0,220109	0,494040
1970,00	415132,	107247,	89922,8	217962,	0,258344	0,216612	0,525043
1971,00	436587,	102394,	91323,4	242869,	0,234533	0,209176	0,556291
1972,00	453237,	97838,8	93228,1	262170,	0,215867	0,205694	0,578439
1973,00	477505,	91878,9	100299,	285327,	0,192415	0,210048	0,597537

Source: R. S. Weinberg and Associates, St. Louis, Missouri.

$$R^2 = 0.971$$

where

FPKB = $\frac{f(t)}{1 - f(t)}$ and f(t) is the market share of packaged beer consumption out of total tax-paid beer consumption.

TIME = Year - 1940.

2. Market share of beer in nonrefillable bottles:

$$\ln FNRB = \underset{(-32.545)}{-3.9830} + \underset{(22.059)}{0.1258} \cdot TIME \qquad (B\text{-}9)$$

$$R^2 = 0.951$$

where

FNRB = $\frac{f(t)}{1 - f(t)}$ and f(t) is the market share of nonrefillable bottled beer consumption out of total glass-bottled beer consumption.

3. Market share of beer in metal cans:

$$\ln FCNB = \underset{(-20.634)}{-2.0647} + \underset{(15.663)}{0.0730} \cdot TIME \qquad (B\text{-}10)$$

$$R^2 = 0.908$$

where

FCNB = $\frac{f(t)}{1 - f(t)}$ and f(t) is the market share metal can beer consumption out of total packaged beer consumption.

Usually, the estimated slope coefficient, ϕ, is interpreted as the measure of the expected rate of accepting the new technology--here the new container type. It seems reasonable to assume that the rate of acceptance of new convenience container types (e.g., nonrefillable bottles and cans) is related, among other things, to the relative price of the convenience container to the traditional type of container. Specifically, it was assumed that the rate of acceptance, ϕ, is a linear function of price

$$\phi_t = \alpha + \beta \cdot RP_t \qquad (B11)$$

where RP_t is the relative price of the beverage in the convenience container to the traditional container. Then substituting equation (B-11) into equation (B-7) yields

$$\ln \frac{f(t)}{1 - f(t)} = \Theta + \alpha \cdot t + \beta(RP_t \cdot t). \qquad (B\text{-}12)$$

Since quality data do not exist for the prices of beer in nonrefillable and refillable bottles, equation (B-12) was applied only to explain the share, FCNB of metal cans in total packaged beer consumption for the period 1960 through 1973. The resulting equation is:

$$\ln FCNB = \underset{(-9.069)}{-1.6613} + \underset{(7.437)}{0.1718} \cdot TIME - \underset{(-4.011)}{0.1211} \cdot (RP \cdot TIME) \qquad (B\text{-}13)$$

$$R^2 = 0.983$$

The wholesale price indexes of beer in bottles and metal cans are shown in the second and third columns of table B-3.

The relative price of canned beer to bottled beer was estimated by forming the appropriate price index ratio and normalizing on the 1960 relative price, since the wholesale price index for beer in cans is available only after 1960. These relative prices are shown in column 4 of table B-3.

The results shown in equation (B-13) indicate that the secular decline in the relative price of canned beer has been partially responsible for the increased the use metal cans for beer packaging. The introduction of the relative container price variable has improved the explained variation of the market share of the metal can by approximately 8 percent, as may be seen by comparing equation (B-13) to (B-10).

The market shares of packaged beer were projected for the 1975-85 period using equation (B-8). In table B-4, the results are reported for both the packaged and the nonpackaged shares. Multiplying these shares by the consumption projections from appendix A provides projections of the quantity of packaged and nonpackaged beer, which are also shown in table B-4.

Projections of the market shares and quantities of packaged beer by container type are shown in table B-5. Equation (B-13) was used to project the market share in metal cans holding RP constant. For bottled beer the logistic function was not used because since 1970 the growth of the market share of nonrefillable bottles has slowed considerably, as the potential for its replacing the refillable bottle has diminished. Therefore, it was assumed that the relative shares of refillable and nonrefillable bottles in the total market share of beer packaged in glass containers would remain constant at the 1973 level.

Table B-3. Packaged beer wholesale price indexes: annually, 1947-73

Year	Wholesale price index of beer in bottles, 1967=100	Wholesale price index of beer in metal cans, 1967=100	Relative price of canned to bottled beer,* 1960=1.0
1947.00	69.9000	0.0	0.0
1948.00	74.5000	0.0	0.0
1949.00	75.0000	0.0	0.0
1950.00	76.4000	0.0	0.0
1951.00	81.0000	0.0	0.0
1952.00	85.8000	0.0	0.0
1953.00	87.7000	0.0	0.0
1954.00	91.4000	0.0	0.0
1955.00	91.4000	0.0	0.0
1956.00	92.5000	0.0	0.0
1957.00	94.4000	0.0	0.0
1958.00	94.9000	0.0	0.0
1959.00	95.8000	0.0	0.0
1960.00	95.8000	97.9000	1.00000
1961.00	96.3000	98.1000	0.996841
1962.00	96.5000	97.5000	0.988691
1963.00	97.0000	97.7000	0.985612
1964.00	97.4000	97.9000	0.983574
1965.00	97.5000	98.4000	0.987582
1966.00	98.1000	98.9000	0.986529
1967.00	100.000	100.000	0.978549
1968.00	101.800	101.100	0.971821
1969.00	104.500	101.700	0.952330
1970.00	108.400	103.200	0.931607
1971.00	113.800	105.700	0.908899
1972.00	114.500	106.300	0.908470
1973.00	115.000	107.400	0.913880

*Wholesale price index of beer in cans divided by that in bottles.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

Table B-4. Beer packaging projections: annually, 1975-85

Year	Market share, decimal share		Quantity, 10^6 ounces		
	Packaged	Nonpackaged	Total	Packaged	Nonpackaged
1975.00	0.880781	0.119219	599386.	527928.	71458.1
1976.00	0.885012	0.114988	618683.	547542.	71140.9
1977.00	0.889112	0.110888	638593.	567781.	70812.1
1978.00	0.893084	0.106916	659146.	588672.	70473.2
1979.00	0.896930	0.103070	680332.	610210.	70122.1
1980.00	0.900653	0.993475E-01	702215.	632452.	69763.5
1981.00	0.904255	0.957447E-01	725821.	645476.	68344.5
1982.00	0.907741	0.922592E-01	725647.	658699.	66947.6
1983.00	0.911112	0.888882E-01	737645.	672077.	65567.8
1984.00	0.914371	0.856287E-01	749864.	685654.	64209.9
1985.00	0.917522	0.824779E-01	762199.	699334.	62864.6

Source: Research Triangle Institute.

Table B-5. Beer containerization projections: annually, 1975-85

Year	Market share, decimal share			Quantity, 10^6 ounces			
	Refillable bottles	Nonrefillable bottles	Metal cans	Total	Refillable bottles	Nonrefillable bottles	Metal cans
1975.00	0.182953	0.199720	0.617328	527928.	96585.8	105438.	325905.
1976.00	0.176100	0.192239	0.631661	547542.	96422.0	105259.	345861.
1977.00	0.169356	0.184877	0.645766	567781.	96157.4	104970.	366654.
1978.00	0.162732	0.177646	0.659622	588672.	95795.9	104575.	388301.
1979.00	0.156236	0.170554	0.673210	610210.	95336.7	104074.	410800.
1980.00	0.149876	0.163611	0.686513	632452.	94789.1	103476.	434186.
1981.00	0.143659	0.156825	0.699517	645476.	92728.3	101227.	451521.
1982.00	0.137592	0.150201	0.712207	658699.	90631.5	98937.6	469130.
1983.00	0.131680	0.143748	0.724572	672077.	88499.0	96609.6	486968.
1984.00	0.125928	0.137469	0.736603	685654.	86343.3	94256.3	505055.
1985.00	0.120341	0.131369	0.748290	699334.	84158.3	91871.0	523305.

Source: Research Triangle Institute.

B.2.2 Soft Drinks

Since 1960, the earliest year for which complete estimates are available, nonpackaged soft drink sales have increased relative to packaged sales (table B-6). As was true for beer packaging, the trend is away from refillable bottles in soft drink packaging. The market share of refillable bottles has declined from 95 percent of total packaged soft drink sales in 1960 to 35 percent in 1973 (see table B-7). The shares of nonrefillable bottles and metal cans have increased substantially from 2 percent and 4 percent in 1960 to 29 percent and 36 percent respectively, in 1973.

Because data on soft drink sales by container types are not available for the period 1947-59, equation (B-7) was estimated from 1960-73 data only. The results are reported below.

1. Market share of nonpackaged soft drink consumption:

$$\ln FNPS = \underset{(-20.427)}{-3.20236} + \underset{(14.894)}{0.0871096} \cdot TIME \qquad (B\text{-}14)$$

$$R^2 = 0.949$$

where

$FNPS = \frac{f(t)}{0.5 - f(t)}$ and $f(t)$ is the market share of nonpackaged soft drink consumption out of total soft drink consumption.

2. Market share of soft drinks in nonrefillable bottles:

$$\ln FNRS = \underset{(-23.024)}{-10.7500} + \underset{(19.010)}{0.331135} \cdot TIME \qquad (B\text{-}15)$$

$$R^2 = 0.968$$

where

$FNRS = \frac{f(t)}{1 - f(t)}$ and where $f(t)$ is the market share of nonrefillable bottle soft drink consumption out of total glass bottle-packaged soft drink consumption.

3. Market share of soft drinks in metal cans:

$$\ln FCNS = \underset{(-20.910)}{-7.40354} + \underset{(17.972)}{0.237398} \cdot TIME \qquad (B\text{-}16)$$

$$R^2 = 0.964$$

Table B-6. Soft drink packaging: annually, 1947-73

Year	Quantity, 10^6 ounces			Market share, decimal share	
	Total	Packaged	Nonpackaged	Packaged	Nonpackaged
1947.00	173126.	171754.	1372.80	0.992075	0.792948E-02
1948.00	193901.	0.0	0.0	0.0	0.0
1949.00	194477.	0.0	0.0	0.0	0.0
1950.00	192346.	0.0	0.0	0.0	0.0
1951.00	200410.	0.0	0.0	0.0	0.0
1952.00	217459.	0.0	0.0	0.0	0.0
1953.00	226138.	0.0	0.0	0.0	0.0
1954.00	225926.	225075.	851.200	0.996233	0.376760E-02
1955.00	242861.	0.0	0.0	0.0	0.0
1956.00	253670.	0.0	0.0	0.0	0.0
1957.00	261293.	0.0	0.0	0.0	0.0
1958.00	261024.	254057.	6967.20	0.973309	0.266918E-01
1959.00	285043.	0.0	0.0	0.0	0.0
1960.00	283488.	257696.	25800.0	0.909019	0.910091E-01
1961.00	292646.	260760.	31896.0	0.891042	0.108992
1962.00	320160.	284944.	35216.0	0.890005	0.109995
1963.00	345773.	310160.	35616.0	0.897005	0.103004
1964.00	374131.	329232.	44896.0	0.879991	0.120001
1965.00	404026.	351904.	52120.0	0.870993	0.129002
1966.00	451699.	388456.	63240.0	0.859989	0.140005
1967.00	474317.	392272.	81968.0	0.827025	0.172813
1968.00	533184.	450544.	82648.0	0.845007	0.155008
1969.00	559315.	462560.	96760.0	0.827012	0.172997
1970.00	594547.	485752.	108800.	0.817012	0.182996
1971.00	643891.	521552.	122336.	0.810000	0.189995
1972.00	679949.	547360.	132592.	0.805001	0.195003
1973.00	724147.	579320.	144832.	0.800003	0.200004

Source: National Soft Drink Association. Statistical Profile: The Soft Drink Industry of the United States, 1974, Washington, D.C.

Table B-7. Packaged soft drinks by container type: annually, 1947-73

Year	Quantity, 10^6 ounces				Market share, decimal share		
	Total	Refillable bottles	Nonrefillable bottles	Metal cans	Refillable bottles	Nonrefillable bottles	Metal cans
1947,00	171754,	0,0	0,0	0,0	0,0	0,0	0,0
1948,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1949,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1950,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1951,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1952,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1953,00	0,0	0,0	0,0	0,0	0,0	0,0	0,0
1954,00	225075,	0,0	0,0	5112,00	0,0	0,0	0,227124E-01
1955,00	0,0	0,0	0,0	4068,00	0,0	0,0	0,0
1956,00	0,0	0,0	0,0	3744,00	0,0	0,0	0,0
1957,00	0,0	0,0	0,0	4440,00	0,0	0,0	0,0
1958,00	254057,	0,0	0,0	4920,00	0,0	0,0	0,193657E-01
1959,00	0,0	0,0	0,0	6480,00	0,0	0,0	0,0
1960,00	257696,	243712,	4240,00	9744,00	0,945735	0,164535E-01	0,378120E-01
1961,00	260760,	239176,	6880,00	14704,0	0,917227	0,263844E-01	0,563890E-01
1962,00	284944,	256968,	8160,00	19816,0	0,901819	0,286372E-01	0,695435E-01
1963,00	310160,	275144,	10320,0	24696,0	0,887103	0,332731E-01	0,796234E-01
1964,00	329232,	283808,	11880,0	33544,0	0,862030	0,360840E-01	0,101886
1965,00	351904,	288608,	17200,0	46096,0	0,820135	0,488770E-01	0,130990
1966,00	388456,	290048,	30880,0	67528,0	0,746669	0,794942E-01	0,173837
1967,00	392272,	254592,	50200,0	87480,0	0,649019	0,127972	0,223009
1968,00	450544,	263328,	66880,0	120336,	0,584467	0,148443	0,267090
1969,00	462560,	225072,	96320,0	141168,	0,486579	0,208232	0,305188
1970,00	485752,	195552,	131800,	158400,	0,402576	0,271332	0,326092
1971,00	521552,	204752,	140400,	176400,	0,392582	0,269197	0,338221
1972,00	547360,	205728,	154480,	187152,	0,375855	0,282227	0,341918
1973,00	579320,	200936,	167760,	210624,	0,346848	0,289581	0,363571

Source: National Soft Drink Association. Statistical Profile: The Soft Drink Industry of the United States, 1974, Washington, D.C.

where

FCNS = $\frac{f(t)}{0.7 - f(t)}$ and where f(t) is the market share of metal can soft drink consumption out of total packaged soft drink consumption.

A price variable was not included in equation (B-16) since the required price series does not exist.

The market shares and quantities of nonpackaged soft drink consumption were projected for the 1975-85 period using equation (B-14). The packaged shares were obtained by subtraction (table B-8).

Projections of the market shares by container type are provided in table B-9. Because the growth rate in the market share of metal cans slowed considerably over the 1969-73 period, the logistic function was not used for projecting the metal can share. Instead, the mean annual growth rate of 1.46 percent of the market share of metal cans for the 1969-73 period was used to project the metal can market share. The market shares of refillable and nonrefillable bottles were projected for soft drinks using the same approach as for beer, discussed above.

B.3 Container Requirements

The number of containers required to distribute the projected quantities of beer and soft drinks by container type were obtained by dividing the quantity projections by projections of average container size. The one exception was for refillable bottles. For refillable bottles the quotient is "fillings," not containers, and must be subsequently converted to projections of container requirements based on projections of the average number of trips made by each refillable bottle. The methods and results are described in detail below.

B.3.1 Nonrefillable Bottles and Cans

This section presents the derivation methods and estimates of both the historical and projected annual values for two variables--container size and number of containers--for each of the three container types used in both beer and soft drink packaging. The three container types are, of course, refillable bottles, nonrefillable bottles, and metal cans.

Historical estimates of the average size of beer and soft drink containers are shown in tables B-10 and B-11, respectively.

Table B-8. Soft drink packaging projections: annually, 1975-85

Year	Market share, decimal share		Quantity, 10^6 ounces		
	Packaged	Nonpackaged	Total	Packaged	Nonpackaged
1975,00	0,769154	0,230846	821450,	631822,	189629,
1976,00	0,758300	0,241700	870052,	659745,	210287,
1977,00	0,747414	0,252586	921491,	688736,	232756,
1978,00	0,736539	0,263461	975922,	718804,	257118,
1979,00	0,725714	0,274286	0,103343E 07	749971,	285454,
1980,00	0,714980	0,285020	0,109427E 07	782380,	311888,
1981,00	0,704376	0,295624	0,113036E 07	796200,	334162,
1982,00	0,693940	0,306060	0,116789E 07	810447,	357446,
1983,00	0,683705	0,316295	0,120650E 07	824892,	381611,
1984,00	0,673704	0,326296	0,124659E 07	839829,	406756,
1985,00	0,663965	0,336035	0,128536E 07	853431,	431925,

Source: Research Triangle Institute.

Table B-9. Soft drink containerization projections: annually, 1975-85

Year	Market share, decimal share			Quantity, 10^6 ounces			
	Refillable bottles	Nonrefillable bottles	Metal cans	Total	Refillable bottles	Nonrefillable bottles	Metal cans
1975,00	0,330937	0,276293	0,392770	631822,	209093,	174568,	248160,
1976,00	0,322980	0,269650	0,407370	659745,	213084,	177900,	268760,
1977,00	0,315023	0,263007	0,421970	688736,	216968,	181142,	290625,
1978,00	0,307066	0,256364	0,436570	718804,	220720,	184276,	313808,
1979,00	0,299109	0,249721	0,451170	749971,	224323,	187284,	338364,
1980,00	0,291152	0,243078	0,465770	782380,	227792,	190179,	364409,
1981,00	0,283195	0,236435	0,480370	796200,	225480,	188250,	382470,
1982,00	0,275239	0,229792	0,494970	810447,	223066,	186234,	401147,
1983,00	0,267282	0,223149	0,509570	824892,	220479,	184074,	420340,
1984,00	0,259325	0,216506	0,524170	839829,	217788,	181828,	440213,
1985,00	0,251368	0,209863	0,538769	853431,	214525,	179103,	459803,

Source: Research Triangle Institute.

Table B-10. Average size of beer containers: annually, 1947-1973

Year	Refillable bottles, ounces	Nonrefillable bottles, ounces	Metal cans, ounces
1947.00	11.1369	16.2396	12.0786
1948.00	11.0456	17.1333	11.9314
1949.00	11.0328	17.6664	11.8986
1950.00	11.0831	18.0385	11.6182
1951.00	11.1650	18.1206	11.4127
1952.00	11.1238	18.0600	11.2191
1953.00	11.1156	17.9290	11.2401
1954.00	11.0184	17.9592	11.4589
1955.00	10.8382	17.4153	11.6218
1956.00	11.1640	17.0013	11.6909
1957.00	10.9485	16.4770	11.6979
1958.00	11.3428	16.3015	11.7174
1959.00	11.0301	15.6997	11.7857
1960.00	12.9045	14.4925	11.7770
1961.00	12.5632	13.4634	11.7611
1962.00	12.4443	13.0216	11.8158
1963.00	12.2165	12.8036	11.8521
1964.00	13.0926	12.9549	11.7716
1965.00	12.5721	12.9956	11.7165
1966.00	13.3314	13.0496	11.5594
1967.00	10.9817	13.1552	11.3763
1968.00	10.8159	13.0464	10.8208
1969.00	9.83897	12.5740	10.7215
1970.00	11.1625	12.4200	11.1775
1971.00	10.1996	12.3660	12.0232
1972.00	12.5138	12.2838	12.0261
1973.00	10.9817	12.0299	11.8593

Source: Research Triangle Institute.

Table B-11. Average size of soft drink containers: annually, 1947-73

Year	Refillable bottles, ounces	Nonrefillable bottles, ounces	Metal cans, ounces
1947.00	0.0	0.0	0.0
1948.00	0.0	0.0	0.0
1949.00	0.0	0.0	0.0
1950.00	0.0	0.0	0.0
1951.00	0.0	0.0	0.0
1952.00	0.0	0.0	0.0
1953.00	0.0	0.0	0.0
1954.00	0.0	0.0	12.0000
1955.00	0.0	0.0	12.0000
1956.00	0.0	0.0	12.0000
1957.00	0.0	0.0	12.0000
1958.00	0.0	0.0	12.0000
1959.00	0.0	0.0	12.0000
1960.00	8.62304	17.0199	12.0000
1961.00	8.21400	17.1185	12.0053
1962.00	8.84774	17.1199	12.0024
1963.00	9.27049	18.4138	12.0000
1964.00	9.18554	18.7970	12.0014
1965.00	8.98710	17.0904	12.0010
1966.00	9.67200	15.5994	12.0007
1967.00	8.74810	14.0010	12.0000
1968.00	10.0065	14.4005	12.0000
1969.00	7.56157	15.1001	12.0000
1970.00	7.54180	15.7978	12.0000
1971.00	8.33180	17.0033	12.0000
1972.00	11.1574	17.5998	11.9854
1973.00	9.93817	18.6125	12.0000

Source: Research Triangle Institute.

The average size of metal cans used to package beer has been very stable at or around 12 ounces although there has been a slight increase recently due to the proliferation of the 16 ounce can. The average size of refillable and nonrefillable bottles also have been stable around 12 ounces since 1970. Therefore in projecting beer container requirements for nonrefillable bottles and metal cans and the number of fillings in refillable bottles, 12 ounces has been used as the average container size over the 1975-85 period.

Beer container production and requirements for the 1975-85 period are shown in table B-12. The requirements were obtained by dividing the projections of consumption by the projected average container size. For refillable bottles the value obtained above is "fillings." Refillable bottle requirements were estimated as described in section B.3.2 below.

The distribution of materials used to make metal cans for beer has shifted toward aluminum as shown in table B-13. Projections of these trends are shown in table B-14.

Since the average size of metal cans used to package soft drinks has been stable at or around 12 ounces this value has been used to project future metal can requirements for soft drink packaging. However, since the early 1960's both refillable and nonrefillable glass containers used to package soft drinks have increased in average size. Independently provided projections indicate that the average soft drink container size, based on 1973 market shares, will be 6.7 percent above the 1973 level in 1975, 16.7 above 1973 in 1980, and 23.3 percent above it in 1985. This information can be used to project the number of refillable and nonrefillable bottle fillings; since the total number of soft drink fillings must equal the total quantity of packaged ounces divided by the average container size of all containers, which must in turn equal the sum of fillings in each container type. Assuming the average size of metal cans remains constant at 12 ounces over the 1975-85 period and that the average size of all glass containers increases at the same rate, i, the following condition must be satisfied for each year

$$\frac{SQPK}{AVSZ} = \frac{SQRT}{10.0(X)} + \frac{SQNR}{18.6(X)} + \frac{SQCN}{12.0} \quad . \qquad \text{(B-17)}$$

where

SQPK = quantity of packaged soft drinks, in ounces

SQRT = quantity of soft drinks in refillable bottles, in ounces

Table B-12. Beer containers: annually, 1947-73; projections, 1975-85

Year	Refillable bottles, 10^6 fillings	Nonrefillable bottles, 10^6 containers	Metal cans, 10^6 containers
1947.00	18030.6	437.615	2155.00
1948.00	17158.0	513.215	2900.00
1949.00	16691.6	432.144	3705.00
1950.00	15232.8	402.384	5963.00
1951.00	15082.0	1413.50	4466.00
1952.00	15555.8	1180.51	5087.00
1953.00	15064.0	1243.56	6359.00
1954.00	14291.6	1113.12	6650.00
1955.00	14398.4	1153.58	7439.00
1956.00	13790.6	1185.41	7877.00
1957.00	13752.9	1223.13	8126.00
1958.00	13017.0	1238.97	8422.00
1959.00	13402.2	1429.77	9224.00
1960.00	11590.1	1945.87	8813.00
1961.00	11610.4	2789.57	8666.00
1962.00	11554.6	3421.44	8954.00
1963.00	11412.7	3851.28	9655.00
1964.00	10458.7	4373.27	10760.0
1965.00	10707.7	4700.30	11279.0
1966.00	9663.55	5024.44	12909.0
1967.00	11207.7	5784.32	13737.0
1968.00	10868.8	5979.16	16400.0
1969.00	11412.0	6875.99	18100.0
1970.00	9607.82	7240.16	19500.0
1971.00	10039.0	7385.05	20200.0
1972.00	7818.49	7589.50	21800.0
1973.00	8366.54	8337.45	24100.0
1975.00	6048.81	8786.46	27158.7
1976.00	8035.16	8771.56	28821.6
1977.00	8013.11	8747.49	30554.5
1978.00	7982.99	8714.60	32358.4
1979.00	7944.72	8672.83	34233.3
1980.00	7899.09	8623.02	36182.2
1981.00	7727.36	8435.55	37626.0
1982.00	7552.63	8244.80	39094.2
1983.00	7374.91	8050.80	40580.7
1984.00	7195.27	7854.69	42087.9
1985.00	7013.19	7655.91	43608.7

Source: Research Triangle Institute.

Table B-13. Beer metal cans by material type: annually, 1965-1973

Year	Quantity, 10^6 units			Market share, decimal share	
	Total	Steel cans	Aluminum cans	Steel cans	Aluminum cans
1965	11279	10286	993	.912	.088
1966	12909	11437	1472	.886	.114
1967	13737	11883	1854	.865	.135
1968	16400	14252	2148	.869	.131
1969	18100	15349	2751	.848	.152
1970	19500	15815	3685	.811	.189
1971	20200	15332	4868	.759	.241
1972	21800	14846	6954	.681	.319
1973	24100	15118	8982	.627	.373

Source: Can Manufacturers' Institute.

Table B-14. Beer metal can materials projections: annually, 1975-85

Year	Market share, decimal share		Quantity, 10^6 units		
	Steel cans	Aluminum cans	Total	Steel cans	Aluminum cans
1975,00	0,528000	0,472000	27158,7	14339,8	12818,9
1976,00	0,506000	0,494000	28821,8	14583,8	14237,9
1977,00	0,486000	0,514000	30554,5	14849,5	15705,0
1978,00	0,461000	0,539000	32358,4	14917,2	17441,2
1979,00	0,440000	0,560000	34233,5	15062,6	19170,6
1980,00	0,418000	0,582000	36182,2	15124,1	21058,0
1981,00	0,405000	0,595000	37626,8	15238,8	22387,9
1982,00	0,394000	0,606000	39094,2	15403,1	23691,1
1983,00	0,382000	0,618000	40580,7	15501,8	25078,8
1984,00	0,370000	0,630000	42087,9	15572,5	26515,4
1985,00	0,359000	0,641000	43608,7	15655,5	27953,2

Source: Research Triangle Institute.

SQNR = quantity of soft drinks in nonrefillable bottles, in ounces

SQCN = quantity of soft drinks in metal cans, in ounces

AVSZ = the average size of all containers

$X = 1 + i$.

The values 10.0, 18.6, and 12.0 are the average sizes of refillable bottles, nonrefillable bottles, and metal cans, respectively, in 1973.
Dividing both sides by SQPK

$$\frac{1}{AVSZ} = \frac{SFRT}{10.0(X)} + \frac{SFNR}{18.6(X)} + \frac{SFCN}{12.0} \qquad \text{(B-18)}$$

where
SFRT, SFNR, SFCN are the market shares of the three containers out of the total packaged soft drinks.

The estimated value of X provides an index of the relative size of refillable and nonrefillable bottles based on alternative values of AVSZ.

The projected average size of all soft drink containers is shown in column two of table B-15 and projections for glass containers in the next two columns. Requirements for nonrefillable bottles and metal cans for soft drinks are shown in table B-16 with historical data. They were obtained as described above for beer.

The historical and projected distribution of the materials used for metal cans are shown in tables B-17 and B-18, respectively.

B.3.2 Refillable Bottles and Trippage

The trip-life of refillable bottles is a critical variable, which influences the number of new containers required. Unfortunately, the national estimates of trippage are of low quality. Furthermore there are no empirical analyses of the variables that influence the average trippage of refillable bottles.

Because of the importance of this variable, therefore, a simple stock adjustment model was employed to estimate trippage for beer and soft drink refillable bottles over the 1947-73 period. This model was then combined with a behavioral model as described below.

Let:

F_t = total fillings in refillable bottles at time t

B_t = total stock of refillable bottles at time t

Table B-15. Average size projections for soft drink containers: annually, 1975-1985

Year	All containers, ounces	Refillable bottles, ounces	Nonrefillable bottles, ounces	Metal cans, ounces
1975.00	13.1867	11.1240	20.6906	12.0000
1976.00	13.3781	11.4690	21.3525	12.0000
1977.00	13.5564	11.8240	21.9920	12.0000
1978.00	13.7222	12.1910	22.6752	12.0000
1979.00	13.8741	12.5690	23.3783	12.0000
1980.00	14.0128	12.9600	24.1050	12.0000
1981.00	14.0710	13.2200	24.5692	12.0000
1982.00	14.1221	13.4890	25.0895	12.0000
1983.00	14.1632	13.7610	25.5954	12.0000
1984.00	14.1957	14.0390	26.1125	12.0000
1985.00	14.2186	14.3200	26.6352	12.0000

Source: Research Triangle Institute.

Table B-16. Soft drink containers: annually, 1947-73; projections, 1975-85

Year	Refillable bottles, 10^6 fillings	Nonrefillable bottles, 10^6 containers	Metal cans, 10^6 containers
1947.00	27580.8	0.0	0.0
1948.00	28859.7	1.87200	0.0
1949.00	25982.2	7.19999	0.0
1950.00	33726.7	24.1920	0.0
1951.00	29278.3	25.9200	0.0
1952.00	33949.4	64.2239	0.0
1953.00	29064.5	125.712	0.0
1954.00	29635.2	138.672	426.000
1955.00	31367.6	168.192	539.000
1956.00	29492.9	171.072	512.000
1957.00	30056.5	183.456	570.000
1958.00	29615.9	192.096	410.000
1959.00	31468.9	211.104	540.000
1960.00	28262.9	249.120	612.000
1961.00	29118.1	401.904	1225.00
1962.00	29043.4	476.638	1651.00
1963.00	29679.6	560.448	2058.00
1964.00	30904.0	632.015	2795.00
1965.00	32113.6	1006.42	3841.00
1966.00	29988.4	1979.57	5627.00
1967.00	29102.5	3585.45	7290.00
1968.00	26315.7	4544.28	10028.0
1969.00	29765.2	6378.76	11764.0
1970.00	25929.1	8342.92	13200.0
1971.00	24574.8	8257.24	14700.0
1972.00	18438.6	8777.36	15615.0
1973.00	20218.6	9013.58	17552.0
1975.00	18796.6	8437.08	20080.0
1976.00	18579.2	8339.48	22396.7
1977.00	18349.8	8236.52	24218.8
1978.00	18105.2	8126.75	26150.7
1979.00	17847.4	8011.00	28197.0
1980.00	17576.5	7889.43	30367.4
1981.00	17056.0	7655.79	31872.5
1982.00	16536.9	7422.80	33428.9
1983.00	16022.0	7191.67	35028.5
1984.00	15513.1	6963.25	36684.4
1985.00	14980.8	6724.32	38310.9

Source: Research Triangle Institute.

Table B-17. Soft drink metal can materials projections: annually, 1975-85

Year	Market share, decimal share		Quantity, 10^6 units		
	Steel cans	Aluminum cans	Total	Steel cans	Aluminum cans
1975.00	0.844000	0.156000	20680.0	17453.9	3226.08
1976.00	0.836000	0.164000	22396.7	18723.6	3673.05
1977.00	0.827000	0.173000	24218.8	20028.9	4189.84
1978.00	0.817000	0.183000	26150.7	21365.1	4785.57
1979.00	0.807000	0.193000	28197.0	22755.0	5442.01
1980.00	0.797000	0.203000	30367.4	24202.8	6164.57
1981.00	0.797000	0.203000	31872.5	25402.4	6470.12
1982.00	0.797000	0.203000	33428.9	26642.8	6786.06
1983.00	0.797000	0.203000	35028.3	27917.6	7110.74
1984.00	0.797000	0.203000	36684.4	29237.4	7446.93
1985.00	0.797000	0.203000	38516.9	30538.6	7778.32

Source: Research Triangle Institute.

Table B-18. Soft drink metal cans by material type: annually, 1965-73

Year	Quantity, 10^6 units			Market share, decimal share	
	Total	Steel cans	Aluminum cans	Steel cans	Aluminum cans
1965	3841	NA	NA	NA	NA
1966	5627	NA	NA	NA	NA
1967	7290	7100	190	.974	.026
1968	10028	9617	411	.959	.041
1969	11764	11117	647	.945	.055
1970	13200	12289	911	.931	.069
1971	14700	13451	1249	.915	.085
1972	15615	14007	1608	.897	.103
1973	17552	15675	1876	.893	.107

Source: Can Manufacturers' Institute.

B_t^* = total shipments of new refillable bottles at time t

λ_t = the velocity of bottle utilization at time t (i.e., the average number of trips a bottle makes annually)

δ_t = the rate at which bottles are retired or lost at time t.

Therefore:

$$B_t = \frac{F_t}{\lambda_t}, \quad \text{or} \tag{B-19}$$

$$B_{t-1} = \frac{F_{t-1}}{\lambda_{t-1}}. \tag{B-20}$$

Assuming that the velocity of bottle utilization (λ) has been stable over the period, then the time subscript can be omitted. If it is further assumed that δ is a proportional rate of depreciation, then B_t^* may be defined as the difference between the total stock of bottles required at time t, B_t, and the remaining portion of the total stock of bottles from time t-1, B_{t-1}:

$$B_t^* = \frac{F_t}{\lambda} - (1-\delta_t)B_{t-1}. \tag{B-21}$$

Substituting equation (B-20) into equation (B-21) results in

$$B_t^* = \frac{F_t}{\lambda} - (1-\delta_t)\frac{F_{t-1}}{\lambda}. \tag{B-22}$$

By rearranging equation (B-22)

$$F_t = \lambda B_t^* + (1-\delta_t)F_{t-1}. \tag{B-23}$$

The term $(1-\delta_t)$ is the fraction of the total stock of bottles that will be present at time t from the previous periods stock, B_{t-1} after each bottle is used λ times at t-1. Therefore, the probability of return will be

$$R_t = (1-\delta_t)^{1/\lambda}. \tag{B-24}$$

Accordingly, the average trippage (T) can be obtained by

$$T_t = \frac{1}{1-R_t} \quad . \tag{B-25}$$

Following Becker (ref. 5) and Naslund (ref. 6) the return rate, R, is hypothesized to depend on the deposit (d_t) on refillable bottles and on the value of the time required of consumers to return the empty bottles to collect the deposit. The value of that time (V_t) can be measured as

$$V_t = H \cdot W_t \tag{B-26}$$

where

H = the time required to return empty bottles,

W_t = average wage rate in time t.

The individuals for whom $d_t > V_t$ will return the empty bottles; those for whom $d_t < V_t$ will discard them, forfeiting the deposit.

Since there has not been a significant variation in the deposit rate over the period, R_t or $(1-\delta_t)$ is assumed to have been only a linear function of per capita disposable real income (PCY_t) at time t as follows:

$$(1-\delta_t) = \alpha + \beta \cdot PCY_t. \tag{B-27}$$

Substituting equation (B-27) into equation (B-23)

$$F_t = \lambda \cdot B_t^* + \alpha \cdot F_{t-1} + \beta \cdot (PCY_t \cdot F_{t-1}) \quad . \tag{B-28}$$

Since historical estimates of F, B*, and PCY are available for the 1947-73 period, λ, α, and β can be directly estimated using ordinary least-squares regression. Values for F and B are shown in table B-19 for beer and soft drinks.

Table B-19. Refillable bottle data: annually 1947-73

Year	Refillable bottle* fillings, 10^6		Refillable bottle shipments, 10^6	
	Beer	Soft drinks	Beer	Soft drinks
1947.00	18030.6	27580.8	1433.09	1494.29
1948.00	17158.0	28859.7	590.398	1122.05
1949.00	16691.6	25982.2	287.280	759.455
1950.00	15232.8	33726.7	454.320	905.903
1951.00	15082.0	29278.3	651.455	921.311
1952.00	15553.8	33949.4	325.152	1137.31
1953.00	15064.0	29064.5	422.496	1293.12
1954.00	14291.6	29635.2	306.000	907.775
1955.00	14398.4	31367.8	351.936	1233.36
1956.00	13790.6	29492.9	356.832	1330.41
1957.00	13752.9	30056.5	337.392	1217.09
1958.00	13017.0	29615.9	387.792	1238.97
1959.00	13402.2	31468.9	435.023	1415.52
1960.00	11590.1	28262.9	431.135	1407.02
1961.00	11610.4	29118.1	374.688	1337.76
1962.00	11554.6	29043.4	353.232	1573.92
1963.00	11412.7	29679.6	387.792	1771.63
1964.00	10458.7	30904.0	415.008	1911.60
1965.00	10707.7	32113.6	502.991	1914.33
1966.00	9663.55	29988.4	576.431	1922.54
1967.00	11207.7	29102.5	627.407	1913.18
1968.00	10868.8	26315.7	474.624	1747.01
1969.00	11412.0	29765.2	480.384	1639.87
1970.00	9607.82	25929.1	337.968	1629.65
1971.00	10039.0	24574.8	272.448	1383.84
1972.00	7818.49	18438.6	404.783	1454.25
1973.00	8366.54	20218.6	541.438	1210.61

*Estimated by Research Triangle Institute from metal crowns shipment data.

Source: U.S. Department of Commerce, Containers and Packaging.

The regression results for refillable beer bottles, applied to the period for which the best data are available (1956-73), are shown below using a B before each variable whose value is unique to beer.

$$BF_t = \underset{(1.932)}{4.02236} \cdot BB_t^* + \underset{(8.439)}{1.01842} \cdot BF_{t-1} - \underset{(-1.318)}{0.0007938} \cdot (PCY_t \cdot BF_{t-1}) \qquad \text{(B-29)}$$

$$R^2 = 0.746$$

From the results shown in equation (B-29) equation (B-27) can be directly estimated for beer

$$(1-B\delta_t) = 1.01842 - 0.00007938 \cdot PCY_t \qquad \text{(B-30)}$$

From equation (B-24) and (B-25) BR_t and BT_t can be estimated. Estimates of $(1-B\delta_t)$, BR_t, and BT_t are shown in table B-20. Velocity ($B\lambda$) for refillable beer bottles has been 4.0 per year. As shown in table B-20, the estimated fraction of beer bottles returned (BR_t) dropped by 0,038 between 1947 and 1973, resulting in a decline in the average trippage from 32 to 15 over the 26-year period.

In the same manner, equation (B-28) can be estimated for soft drinks, applying to the period for which the best data are available (1956-73).

$$SF_t = \underset{(1.878)}{5.53469} \cdot SB_t^* + \underset{(8.047)}{1.04503} \cdot SF_{t-1} - \underset{(-2.232)}{0.00014648} \cdot (PCY_t \cdot SF_{t-1}) \qquad \text{(B-31)}$$

$$R^2 = 0.690$$

Equation (B-27) can be directly estimated for soft drinks:

$$(1-S\delta_t) = 0.04503 - 0.00014648 \cdot PCY_t. \qquad \text{(B-32)}$$

Historical estimates of $(1-S\delta_t)$, SR_t, and ST_t are shown in table B-21. Velocity ($S\lambda$) for refillable soft drink bottles has been 5.5 per year. As shown in table B-21, the fraction of soft drink bottles returned SR_t

Table B-20. Refillable beer bottle average trippage estimates: annually, 1947-73

Year	Survival rate, 1-Bδ	Return rate, BR	Average trippage, BT
1947.00	0.881021	0.969000	32.2577
1948.00	0.876117	0.967656	30.9176
1949.00	0.877933	0.968154	31.4014
1950.00	0.868944	0.965680	29.1377
1951.00	0.867944	0.965404	28.9050
1952.00	0.866038	0.964876	28.4708
1953.00	0.861679	0.963667	27.5230
1954.00	0.862769	0.963970	27.7544
1955.00	0.855413	0.961920	26.2604
1956.00	0.851417	0.960801	25.5108
1957.00	0.850963	0.960674	25.4282
1958.00	0.852144	0.961005	25.6441
1959.00	0.847603	0.959729	24.8319
1960.00	0.847421	0.959678	24.8003
1961.00	0.845061	0.959013	24.3978
1962.00	0.839612	0.957472	23.5138
1963.00	0.835434	0.956285	22.8755
1964.00	0.825355	0.953404	21.4610
1965.00	0.815093	0.950443	20.1788
1966.00	0.806375	0.947906	19.1959
1967.00	0.800200	0.946096	18.5515
1968.00	0.792663	0.943873	17.8166
1969.00	0.788304	0.942580	17.4155
1970.00	0.781402	0.940521	16.8127
1971.00	0.774773	0.938531	16.2685
1972.00	0.766056	0.935895	15.5994
1973.00	0.750981	0.931282	14.5523

Source: Research Triangle Institute.

Table B-21. Refillable soft drink bottle average trippage estimates: annually, 1947-73

Year	Survival rate, 1-Sδ	Return rate, SR	Average trippage, ST
1947,00	0,791492	0,958631	24,1725
1948,00	0,782442	0,956641	23,0632
1949,00	0,785793	0,957380	23,4632
1950,00	0,769205	0,953696	21,5965
1951,00	0,767360	0,953283	21,4053
1952,00	0,763842	0,952491	21,0488
1953,00	0,755799	0,950671	20,2722
1954,00	0,757810	0,951128	20,4616
1955,00	0,744236	0,948027	19,2407
1956,00	0,736863	0,946323	18,6300
1957,00	0,736026	0,946129	18,5628
1958,00	0,738204	0,946634	18,7385
1959,00	0,729825	0,944684	18,0778
1960,00	0,729490	0,944605	18,0522
1961,00	0,725133	0,943583	17,7253
1962,00	0,715079	0,941206	17,0085
1963,00	0,707370	0,939365	16,4920
1964,00	0,688770	0,934853	15,3499
1965,00	0,669834	0,930156	14,3176
1966,00	0,653746	0,926079	13,5280
1967,00	0,642352	0,923142	13,0110
1968,00	0,628443	0,919498	12,4220
1969,00	0,620400	0,917360	12,1007
1970,00	0,607664	0,913929	11,6183
1971,00	0,595431	0,910577	11,1828
1972,00	0,579345	0,906082	10,6476
1973,00	0,551527	0,898062	9,80988

Source: Research Triangle Institute.

dropped by 0.061 over the 1947-73 period, resulting in a decline in the average trippage from 24 to 10.

Projections of $(1-B\delta_t)$, BR_t, and BT_t for beer are shown in table B-22. Projections of $(1-S\delta_t)$, SR_t, and ST_t for soft drinks are also shown in table B-23. The projections indicate that the average trippages for beer and soft drinks (table B-23) will be 10 and 6, respectively, for 1985. Using equations (B-29) and (B-31), equation (B-20) can be rewritten for beer

$$BB_t^* = \frac{BF_t}{4.02236} - \frac{(1-B\delta_t)}{4.02236} \cdot BF_{t-1} , \qquad \text{(B-33)}$$

and for soft drinks

$$SB_t^* = \frac{SF_t}{5.53469} - \frac{(1-S\delta_t)}{5.53469} \cdot SF_{t-1} . \qquad \text{(B-34)}$$

Table B-22. Refillable beer bottle average trippage projections: annually, 1975-85

Year	Survival rate, 1-Bδ	Return rate, BR	Average trippage, BT
1975.00	0.737969	0.927244	13.7447
1976.00	0.727411	0.923929	13.1456
1977.00	0.716457	0.920450	12.5707
1978.00	0.705105	0.916803	12.0197
1979.00	0.693357	0.912981	11.4918
1980.00	0.681133	0.908953	10.9833
1981.00	0.673195	0.906308	10.6733
1982.00	0.665019	0.903559	10.3690
1983.00	0.656684	0.900730	10.0736
1984.00	0.648111	0.897793	9.78403
1985.00	0.639458	0.894798	9.50552

Source: Research Triangle Institute.

Table B-23. Refillable soft drink bottle average trippage projections: annually, 1975-85

Year	Survival rate, 1-Sδ	Return rate, SR	Average trippage, ST
1975.00	0.527516	0.890868	9.16325
1976.00	0.508034	0.884832	8.68296
1977.00	0.487820	0.878365	8.22129
1978.00	0.466875	0.871427	7.77767
1979.00	0.445194	0.863973	7.35146
1980.00	0.422637	0.855894	6.93932
1981.00	0.407989	0.850456	6.68700
1982.00	0.392901	0.844686	6.43856
1983.00	0.377521	0.838613	6.19630
1984.00	0.361701	0.832152	5.95778
1985.00	0.345735	0.825392	5.72711

Source: Research Triangle Institute.

The estimates of BB_t^* and SB_t^* for the 1947-73 period were reported with their actual values in tables B-24 and B-25. As might be expected, the estimated values of BB_t^* and SB_t^* fluctuate violently year by year as compared to the historical data on new refillable bottle shipments. This fluctuation may be due to the investment behavior of industries, which is not fully captured by the above analysis. For example, brewers and soft drink bottlers may use inventories to buffer fluctuations in container requirements. Therefore, more reasonable estimates of refillable bottle shipment can be obtained by calculating moving averages of B_t^*. The 5-year moving averages of BB_t^* and SB_t^* are shown in the last columns of tables B-24 and B-25, respectively. Projections of refillable bottle fillings and shipments for both beer and soft drinks are shown in table B-26.

Table B-24. Refillable beer bottle shipments, actual and estimated compared: annually, 1947-73

Year	Fillings, 10^6	Shipments of refillable bottles, 10^6		
		Actual	Estimated	5-year moving average
1947.00	18030.6	1433.09	NA	NA
1948.00	17158.0	590.398	338.379	NA
1949.00	16691.6	287.280	404.741	NA
1950.00	15232.8	454.320	181.173	NA
1951.00	15082.0	651.455	462.610	NA
1952.00	15553.8	325.152	619.592	401.299
1953.00	15064.0	422.496	413.097	416.242
1954.00	14291.6	306.000	321.913	399.677
1955.00	14398.4	551.936	540.277	471.498
1956.00	13790.6	356.832	380.760	455.128
1957.00	13752.9	337.392	501.597	431.529
1958.00	13017.0	387.792	522.585	413.427
1959.00	13402.2	435.023	588.946	466.835
1960.00	11590.1	431.135	57.8738	370.552
1961.00	11610.4	374.688	451.492	384.499
1962.00	11554.6	353.232	449.082	373.996
1963.00	11412.7	387.792	437.453	396.969
1964.00	10458.7	415.008	258.350	330.850
1965.00	10707.7	502.991	542.688	427.813
1966.00	9663.55	576.431	255.854	388.685
1967.00	11207.7	627.407	863.902	471.649
1968.00	10868.8	474.624	493.459	482.850
1969.00	11412.0	480.384	707.069	572.594
1970.00	9607.82	337.968	171.657	498.388
1971.00	10039.0	272.448	645.173	576.252
1972.00	7818.49	404.783	31.8364	409.839
1973.00	8366.54	541.438	620.286	435.204

Source: Research Triangle Institute.

Table B-25. Refillable soft drink bottle shipments, actual and estimated compared: annually, 1947-73

Year	Fillings, 10^6	Shipments of refillable bottles, 10^6		
		Actual	Estimated	5-year moving average
1947.00	27580.8	1494.29	NA	NA
1948.00	28859.7	1122.05	1315.22	NA
1949.00	25982.2	759.455	597.045	NA
1950.00	33726.7	905.903	2482.72	NA
1951.00	29278.3	921.511	613.902	NA
1952.00	33949.4	1137.31	2093.23	1420.42
1953.00	29064.5	1293.12	615.316	1280.44
1954.00	29635.2	907.775	1374.93	1436.02
1955.00	31367.8	1233.36	1682.52	1275.98
1956.00	29492.9	1330.41	1152.57	1383.71
1957.00	30056.5	1217.09	1508.48	1266.76
1958.00	29615.9	1238.97	1342.09	1412.12
1959.00	31468.9	1415.52	1780.49	1493.23
1960.00	28262.9	1407.02	958.801	1348.49
1961.00	29118.1	1337.76	1558.12	1429.60
1962.00	29045.4	1573.92	1485.48	1425.00
1963.00	29679.6	1771.63	1650.55	1486.68
1964.00	30904.0	1911.60	1890.19	1508.62
1965.00	32113.6	1914.33	2062.09	1729.28
1966.00	29988.4	1922.54	1625.07	1742.67
1967.00	29102.5	1913.18	1777.77	1801.13
1968.00	26315.7	1747.01	1450.20	1761.06
1969.00	29765.2	1639.87	2428.13	1868.65
1970.00	25929.1	1629.65	1416.86	1739.60
1971.00	24574.8	1383.84	1650.64	1744.72
1972.00	18438.6	1454.25	759.088	1540.98
1973.00	20218.6	1210.61	1815.68	1614.08

Source: Research Triangle Institute.

Table B-26. Refillable bottle fillings and shipments projections: annually, 1975-1985

Year	Refillable bottle fillings, 10^6		Refillable bottle shipments, 10^6	
	Beer	Soft drink	Beer	Soft drink
1975.00	8048.81	18796.6	527.211	1516.72
1976.00	8035.19	18579.2	542.063	1631.50
1977.00	8013.11	18349.8	560.931	1677.87
1978.00	7982.99	18105.2	579.985	1723.35
1979.00	7944.72	17847.4	599.067	1768.30
1980.00	7899.09	17576.5	618.464	1812.86
1981.00	7727.36	17056.0	599.084	1786.01
1982.00	7552.65	16536.9	600.095	1777.08
1983.00	7374.91	16022.0	600.451	1766.85
1984.00	7195.27	15513.1	600.521	1755.85
1985.00	7013.19	14980.8	599.677	1737.66

Source: Research Triangle Institute.

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94TH CONGRESS
1ST SESSION

S. 613

IN THE SENATE OF THE UNITED STATES

FEBRUARY 7, 1975

Mr. HATFIELD (for himself, Mr. JAVITS, Mr. MCGOVERN, Mr. PACKWOOD, and Mr. STAFFORD) introduced the following bill; which was read twice and referred to the Committee on Commerce

A BILL

To prohibit the introduction into interstate commerce of non-returnable beverage containers, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Returnable Beverage Container Act of 1975".

FINDINGS AND PURPOSE

SEC. 2. (a) The Congress finds that (1) litter composed of beverage containers is a major source of pollution in all areas of this Nation, (2) the collection and disposal of solid waste composed of such containers impose a great cost burden upon the States and their political subdivisions,

(3) nonreturnable beverage containers on which no refundable money deposit is required from the consumer pose a threat to health, safety, and welfare of individuals and environment in the United States, (4) the use of such containers results in a waste of energy, and (5) such containers, representing as they do a high cost in the form of litter, energy, and solid waste management, should be banned from circulation within and among the several States.

DEFINITIONS

SEC. 3. For the purpose of this Act the term—

(1) "Administrator" means the Administrator of the Environmental Protection Agency;

(2) "returnable beverage container" means a beverage container which—

(A) has a clear indication thereon, either by embossing or by a stamp, label, or other method securely affixed thereto, of the refund value of the container, or is a glass container designed for a beverage and having a brand name permanently marked thereon which on the date upon which this section becomes effective has a refund value of not less than 5 cents;

(B) has a refund value of not less than 5 cents;

(C) is not a metal container so designed and constructed that a part of the container is detachable

in opening the container without the aid of a can opener;

(3) "beverage" means beer or any other malt beverage, mineral water, or soda water or a carbonated soft drink of any variety in liquid form and intended for human consumption;

(4) "container" means a bottle, jar, can, or carton of glass, plastic, or metal, or any combination thereof, for use in packaging or marketing any beverage;

(5) "interstate commerce" means (A) commerce between any State or territory and any place outside thereof, and (B) commerce within the District of Columbia or within any other territory not organized with a legislative body;

(6) "territory" means any territory or possession of the United States, including the District of Columbia and excluding the Canal Zone.

PROHIBITION

SEC. 4. (a) No person shall manufacture for sale, sell, offer for sale, or introduce or deliver for introduction in interstate commerce any beverage container other than a returnable beverage container.

(b) Whoever violates subsection (a) of this section shall be fined not more than $1,000, or imprisoned for not more than six months, or both.

REGULATIONS

SEC. 5. The Administrator shall establish such regulations as are necessary for the purpose of this Act.

EFFECTIVE DATES

SEC. 6. The provisions of this Act shall be effective with respect to beverage containers, which are metal containers so designed and constructed that a part of the container is detachable in opening the container without the aid of a can opener, after one year following the date of enactment of this Act and with respect to all other beverage containers after three years following such date of enactment, except that, section 5 is effective on such date of enactment.

Appendix D: ENERGY UTILIZATION REQUIREMENTS OF BEVERAGE CONTAINERS

D.1 Introduction

D.1.1 Appendix Content and Organization

This appendix contains the data, calculations and documentation used for the determination of the energy requirements of total beverage container systems. These systems include industrial operations such as severance of raw materials from the earth; manufacturing processes which transform raw materials to finished products; filling and distribution operations which deliver a unit volume of beverage to the consumer; final disposal of the container; and manufacturing systems of associated materials such as closures, labels and paper packaging.

The appendix is divided into ten sections. The first four present the introduction, calculations summary, methodology and basic conversion factors. The next four sections contain the details of data and calculations for the specific container systems. First, the plastic bottle systems are discussed, followed by the aluminum can systems, steel can systems, and glass bottle systems. The specific containers analyzed include the following:

A. Polyester (PET) Plastic Bottles
B. Acrylonitrile/Styrene (AN/S) Plastic Bottles
C. Aluminum Cans
D. Bimetal (Steel) Cans
E. All-Steel Cans
F. Refillable (REF) Glass Bottles
G. Nonrefillable (NR) Glass Bottles

The analysis incorporates both beer and soft drinks, selected container sizes, and ancillary packaging such as crowns, labels, carriers, boxes, etc., that are required to make up a complete package system.

The final two sections of the appendix present the energy profile equations and a comparison of this study's values with a previous study.

D.1.2 Overview Observations of Energy Analysis Results

Between the years of 1975 and 1985, the various container systems all show a reduction in net energy per unit of beverage packaged of 10 to 40 percent. The most important influencing parameters are:

1. energy conservation measures in the basic manufacturing processes, e.g., furnaces to make glass, steel, aluminum;

2. recycling of recovered container materials to "short cut" the production cycle of containers;

3. container design improvements that reduce energy requirements principally by "lightweighting", configuration changes, and materials changes in the container;

4. ancillary packaging design improvements that "lightweight" carriers or cause a change in materials or increase the trip rate of carriers.

The refillable bottle still shows an energy use advantage over one-trip nonrefillable containers even at relatively low trippage rates (e.g., 5 trips). However, the energy difference between refillable and one-trip containers is not likely to be as pronounced in 1985 as in the early 1970's, especially where recycling and other conservation practices are pursued strongly.

The analysis can turn on total Btu of energy or it can be directed at specific fuel choices. The data that follow can be used to construct an almost infinite variety of "scenarios" involving time lapse, trippage, recycling rates, materials use, container sizes, fuel choices, and other variables affecting the energy requirements for delivery of a given quantity of beverage to the consumer.

D.2 Summary of Calculations

In this section is a set of six tables which summarize the container system energy profile calculations. However, the values given do not represent real container systems. They are in a modular form, and the modules must be combined in an appropriate way in order to obtain values for realistic systems. For example, the aluminum data are given in terms of virgin and recycled material modules. In order to calculate a realistic container system some recycle rate must be assumed. Then, the virgin and recycled material modules must be combined in the proper proportions. In a similar manner, the data modules presented in the other tables must be combined to form realistic container profiles.

The reader is cautioned to not use the energy values given in this appendix without first studying the entire appendix thoroughly. A thorough knowledge of the methodology and assumptions is necessary to insure that the values presented here are used in an appropriate manner. Use of these data by a novice may result in invalid interpretation.

Table D.2-1. Plastic soft drink container module energy profiles - 1975
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
PET							
16-fluid ounce							
Virgin materials	18.46	16.90	6.25	0.58	0.81	0.94	43.94
Recycled materials	8.99	8.86	5.01	0.45	0.68	0.94	24.93
Energy recovery	18.96	17.11	-1.70	0.63	0.87	0.94	36.81
48-fluid ounce							
Virgin materials	11.43	11.37	4.04	0.37	0.48	0.94	28.65
Recycled materials	5.22	6.04	3.22	0.28	0.40	0.94	16.11
Energy recovery	11.78	11.52	-0.71	0.41	0.52	0.94	24.47
AN/S							
16-fluid ounce							
Virgin materials	25.52	11.88	4.41	0.39	0.62	0.94	43.76
Recycled materials	6.08	8.67	4.11	0.36	0.59	0.94	20.76
Energy recovery	26.01	12.10	-5.76	0.44	0.68	0.94	34.41
48-fluid ounce							
Virgin materials	18.66	9.25	3.09	0.27	0.39	0.94	32.60
Recycled materials	2.97	6.03	2.66	0.22	0.35	0.94	13.17
Energy recovery	19.05	9,42	-4.18	0.31	0.43	0.94	25.98

Source: Tables D.5-10, D.5-12, D.5-14 and D.5-16.

Table D.2-2. Plastic soft drink container energy profiles - 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
PET container systems							
16-ounce NR bottle							
100 percent virgin materials	15.37	13.57	4.18	0.38	0.55	0.63	34.67
100 percent recycled PET	7.69	6.99	3.89	0.35	0.52	0.63	20.07
Virgin materials with energy recovery	15.83	13.77	-3.30	0.43	0.60	0.63	27.96
48-ounce NR bottle							
100 percent virgin materials	9.17	8.25	2.72	0.24	0.32	0.63	21.33
100 percent recycled PET	4.06	3.91	2.53	0.22	0.30	0.63	11.65
Virgin materials with energy recovery	9.45	8.37	-0.09	0.27	0.35	0.63	18.95
AN/S container systems							
16-ounce NR bottle							
100 percent virgin materials	21.87	9.76	3.40	0.30	0.48	0.63	36.44
100 percent recycled AN/S	5.34	6.86	3.21	0.28	0.46	0.63	16.78
Virgin materials with energy recovery	22.31	9.95	-6.01	0.35	0.53	0.63	27.76
48-ounce NR bottle							
100 percent virgin materials	16.13	7.64	2.42	0.22	0.30	0.63	27.34
100 percent recycled AN/S	2.67	5.41	2.26	0.20	0.28	0.63	11.45
Virgin materials with energy recovery	16.49	7.77	-4.30	0.26	0.34	0.63	21.19

Source: Table D.5-18.

Table D.2-3. Aluminum soft drink* container module energy profiles - 1974 and 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
1974							
100 percent virgin aluminum system	25.07	16.33	21.38	1.57	5.83	0.76	70.94
100 percent recycled aluminum system	13.13	5.09	3.91	0.36	0.57	0.76	23.82
1985							
100 percent virgin aluminum system	15.95	12.78	16.00	1.17	4.28	0.46	50.64
100 percent recycled aluminum system	8.24	3.66	2.82	0.27	0.42	0.46	15.86

*Values for beer containers do not differ by a significant amount from soft drink values.

Source: Tables D.6-5 and D.6-10.

Table D.2-4. Steel soft drink* container module energy profiles - 1974 and 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
1974 - Three-piece bimetal can	14.54	7.94	21.03	0.60	1.55	0.76	46.41
1985							
Three-piece all-steel can							
Virgin materials	9.34	4.29	15.50	0.27	0.27	0.59	30.27
Recycled materials	11.11	4.26	5.40	0.53	0.53	0.59	22.41
Two-piece D&I all-steel can							
Virgin materials	7.75	4.37	15.97	0.29	0.29	0.59	29.24
Recycled materials	9.56	4.33	5.61	0.56	0.56	0.59	21.19

*Values for beer containers do not differ significantly from soft drink values.

Source: Tables D.7-10, D.7-12 and D.7-13.

Table D.2-5. Glass beer and soft drink container module energy profiles - 1975
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
NR systems							
12-ounce beer bottle	17.96	14.96	6.13	0.32	0.32	3.27	42.97
16-ounce soft drink bottle	21.41	14.78	6.41	0.36	0.36	2.18	45.50
32-ounce soft drink bottle	20.36	13.91	5.80	0.36	0.45	1.6	42.47
64-ounce plastic coated glass soft drink bottle	18.00	11.57	4.82	0.32	0.36	1.31	36.37
REF system							
12-ounce beer							
trippage dependent	27.74	15.60	6.38	0.42	0.42	--	50.56
trippage independent							
on-premise	2.27	8.64	1.96	0.076	0.075	1.70	14.72
off-premise	2.57	9.10	2.25	0.085	0.084	2.44	16.53
16-ounce soft drink							
trippage dependent	38.59	21.45	8.66	0.59	0.59	--	69.87
trippage independent	2.18	3.29	1.23	0.053	0.053	0.79	7.59
32-ounce soft drink							
trippage dependent	31.78	17.67	7.13	0.48	0.48	--	57.54
trippage independent	2.19	3.35	0.95	0.068	0.15	0.60	7.31
Energy savings per 1,000 pounds glass recycled	-1.30	-0.37	-0.34	-0.001	-0.001	--	-2.03

Source: Tables D.8-6, D.8-7, D.8-8 and D.8-14.

Table D.2-6. Glass beer and soft drink container module energy profiles - 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
NR systems							
12-ounce beer bottle	15.64	12.18	3.98	0.26	0.26	2.35	34.67
16-ounce soft drink bottle	18.89	12.01	4.04	0.30	0.30	1.58	37.12
32-ounce soft drink bottle	17.36	10.96	3.46	0.27	0.27	1.17	33.49
64-ounce plastic coated soft drink bottle	15.55	9.40	3.01	0.25	0.25	0.92	29.38
REF systems							
12-ounce beer							
trippage dependent	24.60	12.77	3.65	0.34	0.34	--	41.70
trippage independent							
on-premise	1.88	7.18	1.63	0.064	0.064	1.24	12.06
off-premise	2.09	7.50	1.83	0.070	0.070	1.76	13.32
16-ounce soft drink							
trippage dependent	34.01	17.56	5.08	0.48	0.48	--	57.61
trippage independent	1.88	2.74	1.05	0.046	0.046	0.55	6.31
32-ounce soft drink							
trippage dependent	28.08	14.50	4.19	0.40	0.40	--	47.57
trippage independent	1.63	2.61	0.72	0.039	0.039	0.42	5.46

Source: Table D.8-10.

D.3 Methodology

The basic methodology employed to determine the energy utilization of beverage container systems is a systems analysis. This approach focuses on the unit of product consumption as the focal point of analysis, and proceeds to the determination of energy requirements of the logical sequence of events required to provide a consumer with packaged beer or soft drink. In this case, the product of interest is the container, and the logical sequence of events to provide this product are the various mining, manufacturing, and industrial processes shown in figure D.3-1. Included in this sequence is transportation between the steps shown.

The total package system is defined as the basic container itself, plus the closure, labels, and associated secondary paper and plastic packaging. Sequences similar to figure D.3-1 were also analyzed for the production of closures, labels, and secondary packaging.

Each container studied has a unique sequence of processes which can be described in the form of figure D.3-1. To determine the system energy requirements of each container type, it was first necessary to identify specific containers selected for study. One set was selected for the base period, which was defined as the most current year for which complete data exists (1974 or 1975). Trends were then established to 1985 to identify present changes in industrial practice, and the introduction of new technology. Once the specific containers were identified, diagrams similar to figure D.3-1 were prepared for each, and are contained in the following sections.

The purpose of the major effort expended in this study was to determine the energy requirements for the various component processes for each container system. Energy requirements were sought in a modular form for each major production process. That is, each process (such as iron ore mining, aluminum smelting, bottle filling, etc.) was studied as an independent element, with an appropriate unit output basis such as 1,000

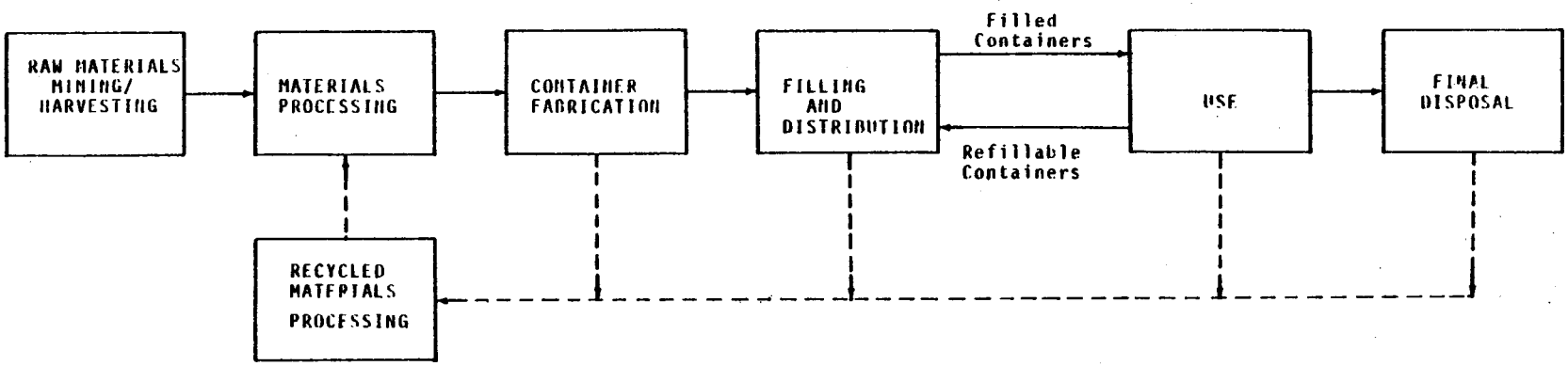


Figure D.3-1. Components of beverage container systems.

pounds. The energy values for each of the modules were then entered into a computer program. System calculations were made by aggregating required amounts of the various modules comprising a system to form system totals (i.e., to express the energy requirements in terms of a given quantity of beverage delivered to the consumer)

The data were gathered by utilizing published information and by personal interviews with representatives of the industries concerned with the various processes. Excellent cooperation was received from the various industries in supplying data, with some industries exerting considerable original effort to secure data for this project.

Data were required in detail so that the specific fuel requirements could be determined for each process module. This detail allowed the results of calculations to be reported in terms of six energy categories, based on the natural resources utilized to supply energy. Those six categories are:

1. Natural gas
2. Petroleum
3. Coal
4. Nuclear
5. Hydropower
6. Wood

For any study of this type, the complex nature of the undertaking requires that numerous assumptions be made during the course of the work. Although a complete listing of all assumptions made is not possible, a list of the most important ones is given here.

1. Data sources: Data were collected from a variety of sources, including published technical literature, reports of previous energy and environmental studies, and personal interviews within the various industries involved. Because of the cooperation of managers in the industries involved, it was possible to obtain national average or "typical" data specific to the container systems. It was assumed that the data supplied by the various industries are accurate and representative.

2. Geographic scope: Energy requirements associated with imported materials are not well documented. In most cases, it was assumed that foreign operators have similar energy requirements to comparable activities in the U.S. Thus, U.S. data were applied to foreign operations.

3. Secondary energy requirements: The energy content of fuels was assumed to include the energy requirements for extraction, processing and transporting of fuels, in addition to the primary energy of a fuel resulting from its combustion. However, energy requirements for manufacture of capital equipment were not included, nor was the energy for heating and lighting of buildings included.

4. Small quantities of materials: Energy of manufacture of supplementary materials was included, but only for those materials which aggregate to more than 5 percent by weight of the container. The energy required by the "less than 5 percent" category was assumed to be small enough to be omitted without causing significant error in the final results.

5. Consumer energy use: Energy required by consumer activities such as transporting beverage containers to and from retail stores was not included. It was assumed that these activities are necessary for other reasons, such as procuring food. In addition, the effect of various container choices on this energy would be quite small.

6. Electricity: For most industries, electricity is a minor source of energy, and detailed data do not exist on the fuels used to generate this electricity for each industry. Therefore, the national average energy expenditure of 10,716 Btu per kilowatt hour was used for most industries (see section D.4.3). However, one industry--aluminum--is based on electrochemical processes and is, therefore, electricity-intensive. Aluminum smelting plants are generally located close to specific electricity power sources (e.g., hydropower).

Data supplied by the aluminum industry on their electric power sources were used in the basic calculations for aluminum containers. A discussion of those energy values compared to those obtained with national or regional grid calculations is in section D.6.4.

7. Energy content of material resources: The primary material resources for plastic products are natural gas and petroleum, and the principal use of these materials in this country is as fuels. Thus, the total energy requirement for plastic products is treated as being the energy value of the fuels used as materials, added to the fuels used in the manufacturing processes. The energy content of wood fiber in paper packaging is not included because use of wood does not presently represent a depletion of an energy resource.

8. Fuel profile projections for 1985: The industries contacted during the course of this study indicated that the rapidly changing situation of fuel availability and price make it quite difficult to project fuel profiles for 1985. Although there is general agreement that there will be conversion from natural gas and fuel oils to coal and electricity, these conversions are usually quite costly and difficult to implement. On the other hand, conversion between natural gas and fuel oils is frequently (but not always) easier to make. At this point in time, the relative price and availability of these fuels in 1985 is highly speculative at best. Thus, lacking better data, we have used the same fuel profiles for 1985 as for present usage. We have, however, been able to project changes in total energy requirements for 1985 for the various types of containers.

D.4 Basic Conversion Factors

D.4.1 Industrial Boilers and Stationary Engines

In order to convert the basic fuel data into a common unit of measure, Btu (British thermal units), a set of conversion factors is required. To accomplish that task for this study, table D.4-1 was prepared. The combustion column contains the heat released by the various fuels upon combustion. However, the true measure of withdrawal of energy from the world's energy reserves must include the energy requirements to extract the raw fuels from the ground, as well as the energy for transporting and processing the fuels. Those values are in the precombustion column and are added to the combustion values to arrive at the total Btu for each fuel.

These factors will change very little over time, so they are treated as constants through 1985.

Table D.4-1. Basic fuel conversion factors (in Btu per unit of fuel)

Fuel	Energy (Btu)/Unit		
	Precombustion	Combustion	Total
Natural gas - cu ft	56	1,032	1,088
Petroleum fuels - gal			
Residual oil	19,900	150,000	169,900
Distillate oil	19,900	139,000	158,900
Gasoline	19,900	125,000	144,900
LPG	19,900	75,800	95,700
Coal - lb	200	13,100	13,300
Wood fiber - lb	--	4,500	4,500

Source: Ref. 1.

D.4.2 Transportation

Table D.4-2 contains the factors used to convert ton-miles of transportation to energy requirements. The fuel factors for 1973 were taken from ref. 2. The 1985 factors were calculated assuming a 15 percent overall reduction in fuel requirements per ton-mile resulting from increased fuel efficiency in mobile engines and increases in route efficiency stimulated by energy conservation measures in the next decade.

Table D.4-2. Transportation fuel requirements per 1,000 ton-miles - 1973 and 1985

	Distillate oil (gallon)		Gasoline (gallon)		Residual oil (gallon)		Natural gas (cu ft)	
	1973	1985	1973	1985	1973	1985	1973	1985
Rail	5.03	4.33	--	--	--	--	--	--
Truck	13.8	11.7	2.97	2.52	--	--	--	--
Barge	0.89	0.76	--	--	2.36	2.01	--	--
Pipeline	--	--	--	--	--	--	670	570
Ocean ship	--	--	--	--	1.20	1.02	--	--

Source: 1973 values - ref. 2, p. 108
1985 values - ref. 2, pp. 120-142, and Franklin Associates estimates.

D.4.3 Electricity

The energy impacts associated with the use of electrical energy are summarized in tables D.4-3 and D.4-4. The impacts were calculated on the basis of a composite kilowatt hour (ckwhr), which is defined as 1 kilowatt hour generated by the U.S. national average mix of fuels and hydroelectric power.

The data for the energy calculations were taken from the Edison Electric Institute Year Book for 1973, (ref. 3). The electricity generated by each fuel and by hydroelectric power was tabulated, and the percent of total for each was calculated.

D.4.3.1 Fossil Fuels. The percent of total electricity generated by fossil fuels was calculated. For each fossil fuel (coal, fuel oil, natural gas), the percent of total fossil fuel generation was calculated. From Edison Electric Institute data, the Btu per net kilowatt hour and Btu per unit of measure for each fossil fuel were tabulated based upon ref. 4.

Table D.4-3. United States national electrical energy matrix - 1973

	Calculations	(1) Hydro* (10^6 kwhr)	(2) Nuclear† (10^6 kwhr)	(3) Coal† (10^6 kwhr)	(4) Fuel oil† (10^6 kwhr)	(5) Natural gas† (10^6 kwhr)	(6) Total Generation† (10^6 kwhr)	(7) Total Fossil fuel Generation‡ (10^6 kwhr)	(8) Total Sales§ (10^6 kwhr)	(9) Uncorrected‖ (Btu/ckwhr)	(10) Correction Factors	(11) Corrected= (Btu/ckwhr)
1. U.S. Total--1973		271,053	83,292	845,986	310,657	336,001	1,849,260	1,492,644	1,703,203			
2. Percent total generation (Col. ÷ Col. 6) x (100)		14.7	4.5	45.7	16.8	18.2	99.9	--				
3. Percent total fossil fuel generation (Col. ÷ Col. 7) x (100)		--	--	56.7	20.8	22.5	--	100.0				
4. Fossil fuel--percent of total (Col. 7 ÷ Col. 6) x (100)	80.7											
5. Btu/net kwhr¶	10,429											
6. Btu/lb coal¶	11,130											
7. Btu/gal fuel oil¶	145,225											
8. Btu/cu ft natural gas¶	1,024											
9. Ratio of generation to sales (Col. 6 ÷ Col. 8)	1.08											
10. Adjusted heat rate (Line 9 x line 5)	11,326											
11. Btu fossil fuel/ckwhr (line 10 x line 4) ÷ (100)	9,140											
12. Coal (Line 3 x line 11) ÷ (100)										5,182	1.024	5,306
13. Fuel oil (Line 3 x line 11) ÷ (100)										1,901	1.134	2,156
14. Natural gas (Line 3 x line 11) ÷ (100)										2,057	1.052	2,163
15. Total Fossil Fuel										9,140		--
16. Btu/hydro/ckwhr (Line 2 x 3,413) ÷ (100)										502	1.086	545
17. Btu nuclear/ckwhr (Line 2 x 11,172) ÷ (100)										503	1.086	546
18. Total Btu/ckwhr												10,716

* Ref. (3), table 13S.
† Ref. (3), table 14S.
‡ Col. 3 + col. 4 + col. 5.
§ Ref. (3), table 22S.
¶ Ref. (4).
‖ (Line 3 x line 11) ÷ (100).
= Col. 9 x col. 10.

Table D.4-4. Regional electrical energy matrix - 1973

Power Source	Corrected Btu/Composite kwhr								
	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Coal	465	5,215	9,175	6,782	6,875	8,540	362	6,255	194
Fuel oil	8,759	4,419	497	257	3,589	234	740	850	2,300
Natural gas	79	373	348	3,663	818	444	10,580	3,034	2,093
Hydro	267	438	39	386	234	547	171	1,236	1,995
Nuclear	2,348	536	975	393	700	24	--	--	337
Total	11,918	10,981	11,034	11,481	12,216	9,789	11,853	11,375	6,919

Source: Franklin Associates, Ltd., based on ref. 3.

Since not all electricity generated is sold (primarily because of transmission losses), the ratio of generation to sales was calculated. This factor was used to calculate an adjusted heat rate as follows:

$$\frac{\text{Total electricity generated (kwhr)}}{\text{Total sales (kwhr)}} \times \text{Btu/net kwhr} =$$

Adjusted heat rate (Btu/net kwhr)

The adjusted heat rate was then used to calculate Btu fuel per composite kwhr:

$$\frac{\text{Adjusted heat rate} \times \% \text{ Total generation}}{100} = \text{Btu/ckwhr}$$

This calculation was made for each fossil fuel as a percent of the total electricity generated by fossil fuel. A correction factor--the ratio of total Btu energy to combustion energy (developed in ref. 1)--was then applied for each fuel to obtain a corrected Btu/composite kwhr. This correction factor includes the indirect, or precombustion energy impacts. For example, the mining, processing and transporting of coal; petroleum production, refining and transporting, etc.

D.4.3.2 Hydroelectric Power. The heat rate for hydroelectric power was calculated as follows:

$$\frac{\% \text{ Total generation} \times 3{,}413 \text{ Btu/kwhr}}{100} = \text{Btu/ckwhr} \qquad \text{(ref. 5)}$$

The ratio of generation to sales calculated above was then used as a correction factor to obtain a corrected Btu/composite kwhr.

When calculating the impacts of mandatory deposits on electricity consumption it is necessary to identify the marginal fuel source. Since the water storage area behind a dam is of a finite capacity, incremental additions to the stock of stored water must be offset of releases of water downstream. This released water must be used to generate electricity or it will be lost. Therefore, it is likely that thermal electric power plants represent the marginal power source and that any reduction in demand for

electricity due to mandatory deposits would be reflected in reduced generation of electricity from these power plants and not hydroelectric plants.

To adjust the hydroelectric component of electricity for a marginal analysis, multiply by 3.056 (i.e., 10,429 ÷ 3,413, where 10,429 = Btu/net kWh for thermal electric power plants).

D.4.3.3 Nuclear power. The heat rate for nuclear power was calculated as follows:

$$\frac{\%\ \text{Total generation} \times 11{,}172\ \text{Btu/kwhr}}{100} = \text{Btu/ckwhr} \qquad \text{(ref. 6)}$$

D.4.3.4 Total Composite for 1973. The corrected Btu/ckwhr for each type of generation described above were added to obtain a total corrected Btu/composite kwhr. This figure was used in the calculation of energy impacts.

The procedure discussed above was used to obtain figures for total U.S. electric generation and for generation in each region as defined by the Edison Electric Institute (ref. 3).

D.4.3.5 Projections for 1985. The primary change taking place in fuel use patterns for electrical utilities during the next 10 years will be a shift from gas and oil consumption to coal and nuclear. Although several projections have been made (for example, see ref. 7), the rapid changes taking place in the electric utility industry make any of those seem unlikely. For example, most projections show a very rapid growth in nuclear capacity by 1985, but recent cancellations and slow-downs in planning and implementation of nuclear capacity make most existing projections seem unrealistically high for 1985 nuclear capacity. Thus, without developing a new set of projections, it was assumed that 1985 fuel use profiles for electric utilities will be the same as for 1973.

NOTES AND REFERENCES - SECTION D.4

1. Hunt, R. G., et al, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives," Volume II, U.S. Environmental Protection Agency, Report SW-91c, 1974.
2. "Projection Independence and Energy Conservation: Transportation Sectors," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 2, November 1974.
3. Statistical Year Book of the Electric Utility Industry for 1973, Edison Electric Institute.
4. Reference 3, Table 43 S.
5. Hydropower was counted at the theoretical conversion factor of 3,413 Btu/kwhr, which assumes a 100 percent conversion of "available energy" to electricity. Thus, the "available energy" was defined as that energy which can be converted to electricity.
6. "Indirect Energy Requirements of Nuclear Electrical Power Generation," Franklin Associates, Ltd., in preparation.
7. Project Independence Report, Federal Energy Administration, November 1974, Table II-24.

D.5 Candidate Containers--Plastic Bottles

D.5.1 Introduction

Two types of plastic materials are expected to be significant market factors in beverage packaging by 1985. These two are polyester (PET) and acrylonitrile/styrene (AN/S). The PET container will be fabricated from a polyester called polyethyleneterephthalate, which is a material now used in food packaging and as a tire cord. The AN/S container will be fabricated from any one of a variety of polymer formulas, all of which use acrylonitrile and styrene as the basic ingredients but sometimes include various other petrochemical based materials. Development of the PET resin for containers has been carried on primarily by one company, while several companies are in competition to develop an optimum resin for use in an AN/S container.

Calculations have been made for plastic nonrefillable soft drink containers only, although it is possible that plastics can be used for other applications. However, there are still unresolved problems concerning beverage container application. Currently, difficulties in washing plastic containers and difficulties of pasteurizing beer in plastic containers are two problems which prevent use as refillable containers and greatly restrict the use of plastics for beer. Although manufacturers of plastic bottles feel these problems can be solved, current forecasts are that the primary use by 1985 will be as nonrefillable soft drink containers. Also, action by the Food and Drug Administration could lead to restrictions in the use of plastic containers for beverage packaging. If that should happen, the plastic bottle would not be a significant market factor in 1985.

The calculations for this study were performed for 16-ounce and 48-ounce volume nonrefillable soft drink containers. The 16-ounce size was selected for purposes of comparing this type of container with the other types of containers studied.

The 48-ounce size was included to show the trend in differences between 16-ounce single portion size plastic bottles and larger family size bottles, such as the 48-ounce size.

Table D.5-1 shows that the weights for the two types of bottles are comparable, although the 48-ounce PET bottle is lighter than AN/S, but the 16-ounce PET is heavier than AN/S. The large PET bottle is expected to be slightly lighter because of the nature of the PET material and because it is fabricated in a different form than AN/S. The AN/S bottle is similar in shape to a conventional glass bottle, while the PET bottle utilizes a hemispherical bottom with the bottle set in a polyethylene cup for stability.

Table D.5-1. Plastic bottle sizes

	Bottle Weight (grams)	
	1975	1985
PET		
16-fluid-ounce	37*	34‡
48-fluid-ounce	75†	68§
AN/S		
16-fluid-ounce	35	32
48-fluid-ounce	84.5	78

* Includes 33 grams of PET and 4 grams polyethylene base cup.
† Includes 65 grams of PET and 10 grams polyethylene base cup.
‡ Includes 30 grams of PET and 4 grams polyethylene base cup.
§ Includes 60 grams of PET and 8 grams polyethylene base cup.

Source: Reference 9 and reference 25.

D.5.2 Container Manufacturing Systems--PET Containers

One of the two types of plastic containers expected to account for a significant share of the soft drink market by 1985 is a polyester material, polyethyleneterephthalate (PET).

The manufacturing for PET is shown in figure D.5-1. It is a highly complex manufacturing system comprised of 13 separate processes. The basic raw materials are crude oil and natural gas, which are converted into numerous intermediate chemicals before being formed into PET resin. The resin is then softened by heat and fabricated into the PET bottle.

The energy profiles for 1,000-pound modules of each process and intervening transportation are shown in table D.5-2. The fuel and transportation factors of table D.5-2 are combined with the basic conversion factors in the tables of Section D.4 to produce the enrgy profile shown at the righthand side of table D.5-2. These values were derived from various current sources. In most cases, an average energy reduction of 15 percent was used to calculate the 1985 profile. However, where data were available on specific new technology implementation, those projections were used.

The next step in forming the energy profile calculations is to aggregate the modules in table D.5-2 into material systems. Figures D.5-1 and D.5-2 show the materials flows for two systems which result in the manufacture of 1,000 pounds PET bottles. The first system utilizes virgin materials, and the second assumes that used bottles are returned and recycled by grinding, washing, and remelting. The return mechanism is assumed to be either: (1) a deposit system which returns bottles through the retailer, or (2) a voluntary rebate collection center program such as now being used for aluminum cans.* In any event, it is necessary that bottles made only from PET be returned for this recycle scheme. Contamination by plastics or materials other than PET could be allowed to only a very small degree.

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*See ref. 23 for a description of Monsanto's approach. to recovery of plastic bottles.

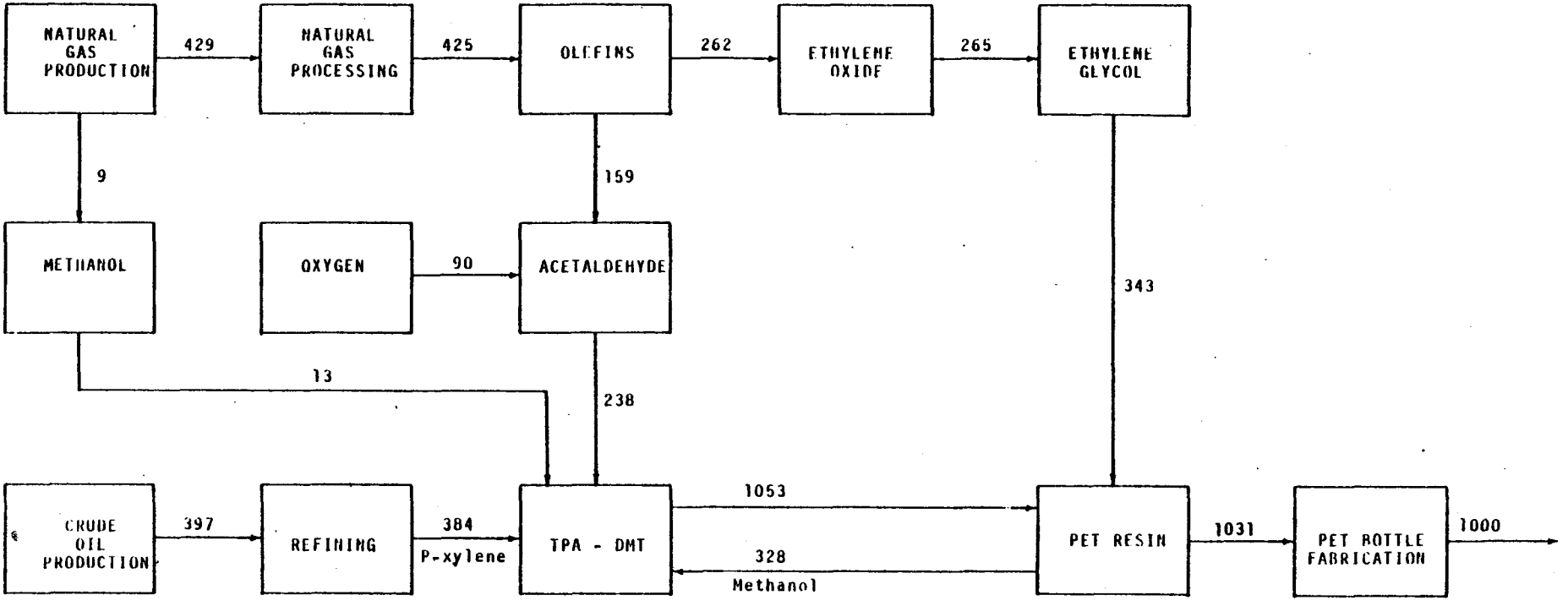


Figure D.5-1. Material flow for manufacture of 1,000 lb PET bottles (in pounds) (Source: Notes and references).

Table D.5-2. Energy profiles for PET component process modules for 1,000 pounds output of each module

	Fuels					Transportation					Energy					
	Residual oil (gal)	Gasoline (gal)	Natural gas (cu ft)	Distillate oil (gal)	Electricity (kwhr)	Rail (ton-miles)	Truck (ton-miles)	Barge (ton-miles)	Pipe-line (ton-miles)	Ocean Ship (ton-miles)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydro-power (10^6 Btu)	Total (10^6 Btu)
Crude oil production*	0.36	0.08	0.04	--	0.63	--	--	--	--	--	--	0.74	--	--	--	0.08
Crude oil transport*	--	--	--	--	--	--	10	28	110	1000	0.08	0.24	--	--	--	0.32
Energy content of crude oil*	--	--	--	--	--	--	--	--	--	--	--	18.00	--	--	--	18.00
Natural gas production*	0.28	0.08	330	--	3.8	--	--	--	--	--	0.37	0.07	0.02	--	--	0.46
Energy content of natural gas*	--	--	--	--	--	--	--	--	--	--	--	22.39	--	--	--	22.39
Natural gas processing*	--	--	769	--	1.3	--	--	--	--	--	0.84	--	--	--	--	0.85
Natural gas transport*	--	--	--	--	--	42	14	14	70	--	0.05	0.08	--	--	--	0.13
Ethylene manufacture*	--	--	6450	--	60	--	--	--	--	--	7.15	0.13	0.32	0.03	0.03	7.66
Acetaldehyde manufacture†	--	--	1864	--	22.5	--	--	--	--	--	2.00	0.05	0.12	0.01	0.01	2.27
Ethylene oxide manufacture (1975)‡	--	--	--	--	1066	--	--	--	--	--	2.31	2.30	5.66	0.58	0.58	11.42
Ethylene oxide manufacture (1985)‡	--	--	-906	--	--	--	--	--	--	--	-0.99	--	--	--	--	-0.99
Ethylene glycol manufacture (1975)†	--	--	1654	--	--	--	--	--	--	--	1.80	--	--	--	--	1.80
Ethylene glycol manufacture (1985)†	--	--	1402	--	--	--	--	--	--	--	1.53	--	--	--	--	1.53
Methanol manufacture†	--	--	212	5.3	67.5	--	--	--	--	--	0.36	0.97	0.31	0.03	0.03	1.69
P-xylene manufacture†	--	--	5329	--	146	--	--	--	--	--	6.11	0.32	0.78	0.08	0.08	7.36
DMT manufacture†	--	--	--	47.8	70.9	--	--	--	--	--	0.15	7.75	0.38	0.04	0.04	8.36
PET resin manufacture†	--	--	--	6.8	58	--	--	--	--	--	0.12	1.08	0.31	0.03	0.03	1.58
PET resin transport†	--	--	--	--	--	250	--	--	--	--	--	0.20	--	--	--	0.20
PET bottle fabrication†	--	--	--	--	660	--	--	--	--	--	1.44	1.44	3.53	0.36	0.36	7.14
PET bottle transport§	--	--	--	20	--	--	--	--	--	--	--	3.18	--	--	--	3.18
Recycle (grind and wash)¶	--	--	1000	--	118	--	--	--	--	--	1.34	0.26	0.63	0.06	0.06	2.35
Waste disposal transport‡	--	0.67	--	--	--	--	--	--	--	--	--	0.10	--	--	--	0.10
Waste processing**	--	340	--	--	134	--	--	--	--	--	0.66	0.29	0.71	0.07	0.07	1.81
Energy recovery																
PET/	--	--	--	--	--	--	--	--	--	--	--	--	-9.74	--	--	-9.74
Polyethylene††	--	--	--	--	--	--	--	--	--	--	--	--	-20.00	--	--	-20.00

* See notes and references 1.
† See notes and references 4.
‡ See notes and references 7.
§ See notes and references 14.
¶ See notes and references 9.
‖ See notes and references 10.
** See notes and references 11.
/ See notes and references 13.
†† See notes and references 16.

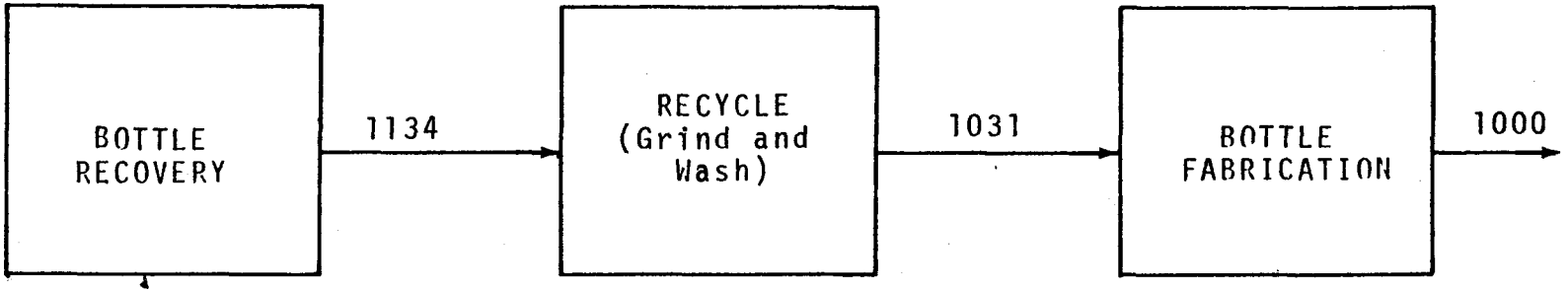


Figure D.5-2. Materials flow for manufacture of 1,000 lb plastic bottles from recycled material.

Figure D.5-3 shows a possible energy recovery scheme for plastic bottles. This assumes that PET bottles are discarded into a mixed waste stream from which segregation of PET bottles would be impractical. In this case, the mixed waste can be processed and incinerated for purposes of energy recovery.

Table D.5-3 contains the calculations for the basic PET systems. This table was prepared by combining the process modules from table D.5-1 in the amounts specified in the figures D.5-1, 2, and 3. In addition, energy recovery of polyethylene, which will be associated with the PET bottle, is included.

The energy requirements for both the virgin and recycle systems are dominated by natural gas and petroleum (table D.5-3). PET containers made of virgin materials require nearly 84 percent of their total energy from oil and natural gas combined, while for the recycle system, about 69 percent of the energy comes from that category. The remainder of the energy requirements are derived from the use of electricity, because none of the remaining four energy sources are used directly in these processes. It is also important to note that of the total energy required in the virgin materials system, 16.75 million Btu, or 34 percent of the total, is the fuel value (Btu) of the feedstock material itself. The remainder of the energy is the process energy.

To examine the relationship of virgin and recycle energy profiles, table D.5-4 was prepared. Overall, the recycled bottle requires 67 percent less energy than the virgin materials system per unit of output, with most of this savings resulting from an 85 percent reduction in oil requirements and a 62 percent reduction in natural gas requirements.

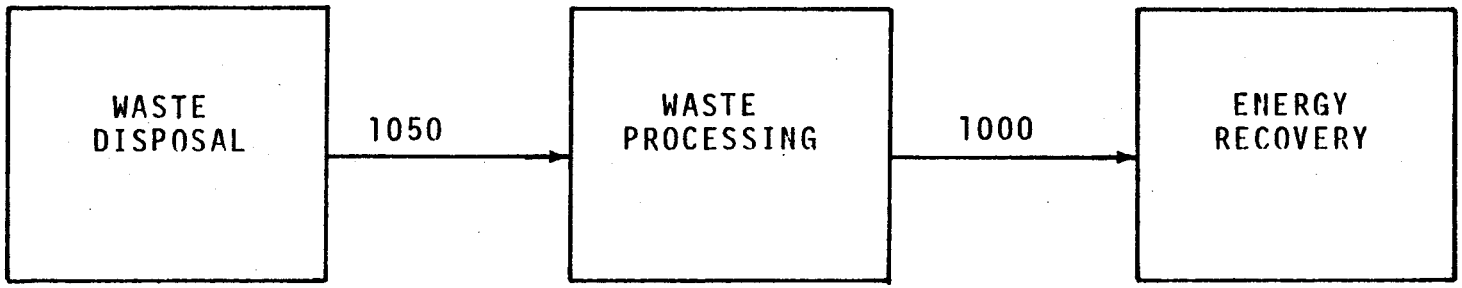


Figure D.5-3. Materials flow for energy recovery from 1,000 lb plastic bottles.

Table D.5-3. Basic PET systems calculations summary - 1975 (million Btu)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of Total
Virgin Materials System*							
Crude oil production - 397 lb	0.001	0.029	0.001	--	--	0.032	0.1
Energy content of petroleum feedstock - 397 lb	--	7.146	--	--	--	7.146	14.6
Crude oil transport - 397 lb	0.032	0.097	--	--	--	0.129	0.3
Natrual gas production - 429 lb	0.158	0.029	0.009	0.001	0.001	0.197	0.4
Energy content of natural gas feedstock - 429 lb	9.605	--	--	--	--	9.605	19.6
Natural gas processing - 425 lb	0.357	0.001	0.003	--	--	0.362	0.7
Natural gas transport - 425 lb	0.022	0.033	--	--	--	0.055	0.1
Ethylene manufacture - 421 lb	3.009	0.054	0.134	0.014	0.014	3.225	6.6
Acetaldehyde manufacture - 238 lb	0.494	0.012	0.028	0.003	0.003	0.540	1.9
Ethylene oxide manufacture - 265 lb	0.611	0.609	1.499	0.154	0.154	3.027	6.2
Ethylene glycol manufacture - 343 lb	0.617	--	--	--	--	0.617	1.3
Methanol manufacture - 13 lb	0.005	0.013	0.004	--	--	0.022	--
P-xylene manufacture - 384 lb	2.348	0.121	0.297	0.031	0.031	2.827	5.8
Oxygen manufacture - 90 lb	0.115	0.050	0.099	0.010	0.010	0.285	0.6
DMT manufacture - 1,053 lb	0.161	8.159	0.396	0.041	0.041	8.798	17.9
PET resin manufacture - 1,031 lb	0.129	1.112	0.317	0.033	0.033	1.624	3.3
PET resin transport - 1,031 lb	--	0.208	--	--	--	0.208	0.4
PET bottle fabrication - 1,000 lb	1.441	1.436	3.534	0.364	0.363	7.137	14.6
PET bottle transport - 1,000 lb	--	3.178	--	--	--	3.178	6.5
Total	22.287	19.704	6.322	0.651	0.649	49.014	100.1
Percent of Total	45.5	39.0	12.9	1.3	1.3	100.0	
Recycled Materials System†							
Used bottle transport - 1,134 lb‡	--	3.604	--	--	--	3.604	22.1
Recycle (grind and wash) - 1,031 lb	1.385	0.262	0.646	0.066	0.066	2.425	14.8
PET bottle fabrication - 1,000 lb	1.441	1.436	3.534	0.364	0.363	7.137	43.7
PET bottle transport - 1,000 lb	--	3.178	--	--	--	3.178	19.4
Total	8.480	2.825	4.179	0.430	0.429	16.344	100.0
Percent of Total	51.9	17.3	25.6	2.6	2.6	100.0	
Energy Recovery Systems§							
Waste processing - 1,050 lb	0.693	0.303	0.747	0.077	0.077	1.896	
Energy recovery--PET	--	--	-9.740	--	--	-9.740	
Total PET System	0.693	0.303	-8.993	0.027	0.077	-7.843	
Waste processing - 1,050 lb	0.693	0.303	0.747	0.077	0.077	1.896	
Energy recovery - polyethylene - 1,000 lb	--	--	-20.001	--	--	-20.001	
Total Polyethylene System	0.693	0.303	-19.254	0.077	0.077	-18.104	

*See figure D.5-1.
†See figure D.5-2.
‡See notes and references 22.
§See figure D.5-3.

Plastics are combustible materials, and hence have the potential of being incinerated with mixed wastes. The potential for energy recovery is shown in table D.5-3. For PET, the heat of combustion is 9,740 Btu per pound, which is relatively low for plastics. We have applied a fuel credit in this study against the total PET system energy of 9,740 Btu per pound of PET for coal, assuming that energy recovery will most likely occur where waste replaces coal to some extent in a utility boiler (ref. 13). However, because of the processing requirements, only 80 percent of the 9,740 Btu per pound, or 7,840 Btu per pound, would be recoverable.

Polyethylene has a much higher heat of combustion--20,000 Btu per pound. Of this total, 91 percent is recoverable.

Table D.5-4. Comparison of 1,000-pound PET bottles manufactured from virgin or recycled materials

(in Btu and percent difference)

	Natural gas	Petroleum	Coal	Nuclear	Hydro-power	Total
Difference * (million Btu)	-13.81	-16.28	-2.143	-0.22	-0.22	-32.67
Percent Difference†	-62	-85	-34	-34	-34	-67

*Calculated by taking (Recycled - Virgin). Negative numbers mean that the virgin numbers exceed the recycle numbers.
†(Difference ÷ Virgin) x 100.

D.5.3 Container Manufacturing Systems--AN/S Containers

The analysis of the second plastic container, acrylonitrile/styrene (AN/S), is similar to the analysis of PET containers. Table D.5-5 contains process modules needed for the AN/S calculations. In addition, a number of the process modules for PET from table D.5-2 are also used for the AN/S calculations.

Table D.5-5. Fuel and energy profile for AN/S process modules - 1975
(in energy related units per 1,000 pounds output)

Description	Fuels			Transport	Energy					
	Residual oil (gallon)	Natural gas (cu ft)	Electricity (kwhr)	Rail (ton-mile)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydro-power (10^6 Btu)	Total (10^6 Btu)
Benzene manufacture*	--	6,000	49	--	6.634	0.106	0.260	0.027	0.027	7.053
Ammonia manufacture*	--	3,700	11	--	4.060	0.024	0.058	0.006	0.006	4.154
Acrylonitrile manufacture*	--	--	70	--	0.151	0.151	0.371	0.038	0.038	0.750
Styrene manufacture†	--	9,450	40	--	10.368	0.086	0.212	0.022	0.022	10.710
AN/S polymer manufacture†	21.6	1,940	70	--	2.262	3.821	0.371	0.038	0.038	6.531
AN/S polymer transport†	--	--	--	500		0.404	--	--	--	0.404
AN/S bottle fabrication†	--	--	493	--	1.066	1.063	2.616	0.269	0.269	5.283
AN/S recycle (grind and wash)‡	--	857	100	--	1.149	0.216	0.531	0.055	0.055	2.004
AN/S energy recovery§	--	--	--	--	--	--	-15.000	--	--	-15.000

* See notes and references 2.
† See notes and references 19.
‡ See notes and references 20.
§ See notes and references 25.

Figure D.5-4 summarizes the virgin materials manufacturing system for AN/S. It consists of 10 process modules and inter-process transportation. Table D.5-6 summarizes the energy profiles for each of the required processes. As in the case of PET, the largest energy requirements are the fuels used for feedstocks, which account for 44 percent of the total energy requirements. No single component process dominates the process profiles, but the polymer manufacture and olefins manufacture account for nearly 23 percent of the total energy requirements and 43 percent of the process requirements. Bottle fabrication, bottle transport, and styrene manufacture are also important consumers of energy.

The AN/S profile is dominated by oil and gas requirements. These two categories combined account for 91 percent of the energy requirements, with the remainder accounted for by electricity.

Materials flows for recycle and energy recovery are identical to those required for PET, as shown previously in figures D.5-2 and D.3-3. Table D.5-6 shows that no single process dominates the recycling profile, although the two transportation steps account for 63 percent of the energy requirements. Seventy-three percent of the energy required is from petroleum and natural gas.

The energy recovery system assumes recovery of 15,000 Btu per pound of bottles burned, with this counted as a fuel credit to coal, as was done for PET. Processing of the waste stream results in an energy cost of 13 percent of the recoverable energy (1,900 Btu per pound), and therefore, a net gain of 13,000 Btu per pound of AN/S is realized out of the 15,000 Btu per pound energy content.

Table D.5-7 shows the comparison of the virgin and recycle systems. An impressive 72 percent energy savings is realized by the recycling system.

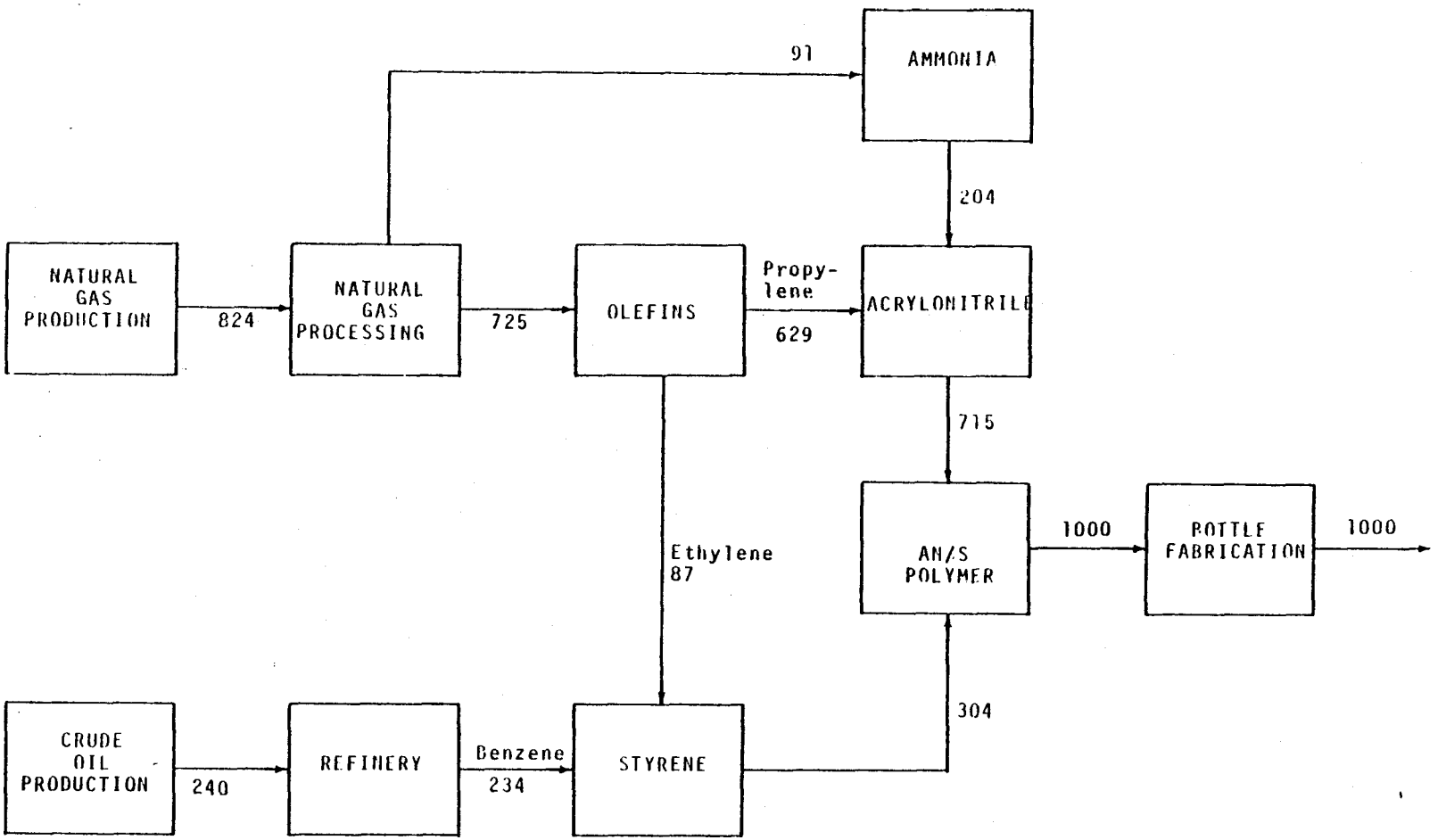


Figure D.5-4. Materials flow for manufacture of 1,000 lb AN/S bottles (in pounds) (Source: Notes and references 2 and 19).

Table D.5-6. Basic AN/S systems calculations summary - 1975 (million Btu)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of total
Virgin Materials System*							
Crude oil production - 240 lb	--	0.018	0.001	--	--	0.019	--
Energy of petroleum used for feedstock - 240 lb	--	4.320	--	--	--	4.320	8.4
Crude oil transport - 240 lb	0.019	0.059	--	--	--	0.078	0.2
Benzene manufacture - 234 lb	1.552	0.025	0.061	0.006	0.006	1.650	3.2
Natural gas production - 824 lb	0.303	0.056	0.017	0.002	0.002	0.378	0.7
Energy of natural gas used as material feedstock - 824 lb	18.449	--	--	--	--	18.449	36.0
Natural gas processing - 816 lb	0.685	0.002	0.006	0.001	0.001	0.694	1.4
Natural gas transport - 816 lb	0.042	0.064	--	--	--	0.106	0.2
Olefins manufacture - 718 lb	5.132	0.093	0.229	0.024	0.023	5.500	10.7
Ammonia manufacture - 204 lb	0.828	0.005	0.012	0.001	0.001	0.847	1.7
Acrylonitrile manufacture - 715 lb	0.108	0.108	0.266	0.027	0.027	0.536	1.0
Styrene manufacture - 304 lb	3.152	0.026	0.065	0.007	0.007	3.256	6.4
Polymer manufacture - 1,000 lb	2.262	3.821	0.371	0.038	0.038	6.531	12.8
Polymer transport - 1,000 lb	--	0.404	--	--	--	0.404	0.8
Bottle fabrication - 1,000 lb	1.066	1.063	2.616	0.269	0.269	5.283	10.3
Bottle transport - 1,000 lb	--	3.178	--	--	--	3.178	6.2
Total	33.599	13.241	3.642	0.375	0.374	51.231	100.0
Percent of Total	65.6	25.8	7.1	0.7	0.7	100.0	
Recycled Materials System†							
Used bottle transport - 1,134 lb‡	--	3.604	--	--	--	3.604	25.5
Recycle (grind and wash) - 1,031 lb	1.184	0.222	0.547	0.056	0.056	2.066	14.6
Bottle fabrication - 1,000 lb	1.066	1.063	2.616	0.269	0.269	5.283	37.4
Bottle transport - 1,000 lb	--	3.178	--	--	--	3.178	22.5
Total	2.251	8.067	3.163	0.325	0.325	14.131	100.0
Percent of Total	15.9	57.1	22.4	2.3	2.3	100.0	
Energy Recovery System§							
Waste processing - 1,050 lb	0.693	0.303	0.747	0.077	0.077	1.896	
Energy recovery--AN/S - 1,000 lb	--	--	-15.000	--	--	-15.000	
Total	0.693	0.303	-14.253	0.077	0.077	-13.104	

*See figure D.5-4.
†See figure D.5-2.
‡See notes and references 22.
§See figure D.5-3

Table D.5-7. Comparison of AN/S bottle manufactured from virgin or recycled materials

Category	Natural gas	Petroleum	Coal	Nuclear	Hydro-power	Total
Difference * (million Btu)	-31.35	-5.17	-0.48	-0.05	-0.049	-37.10
Percent Difference†	-93	-39	-13	-13	-13	-72

* Calculated by (Recycle - Virgin). Negative values mean the virgin values exceed the recycled values.
† Calculated by (Difference ÷ Virgin) x 100.

D.5.4 Supplementary Materials Systems

In order to compare the total energy requirements for various containers which deliver equivalent products to consumers, it is necessary to include supplementary materials required in conjunction with the primary package. For example, a bottle alone is not sufficient to deliver a beverage to a consumer. It is also labeled and packed in a protective carrier. The ancillary packaging included in the energy requirements profile of each container are:

1. Closures
2. Labels
3. Shipping packaging
4. Container carriers

Table D.5-8 summarizes the energy profiles for two kinds of paper products as well as polyethylene products. These materials are used as the supplementary packaging in this study. The basic references give complete descriptions of these systems. In addition to these materials, aluminum is used for closures. A description of the aluminum system is included in a separate section of this appendix.

Table D.5-8. Supplementary packaging materials - 1975
(in energy related units per 1,000 pounds output)

	Fuels						Transportation				Energy						
	Distillate oil (gal)	Residual oil (gal)	Natural gas (gal)	Coal (lb)	Wood (lb)	Electricity (kwhr)	Rail (ton-miles)	Truck (ton-miles)	Barge (ton-miles)	Pipeline (ton-miles)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Wood (10^6 Btu)	Total (10^6 Btu)
Corrugated container manufacture*	6.8	14.28	2352	144	1263	160	301	148	6	--	2.91	4.49	2.78	0.09	0.09	5.69	16.07
Unbleached kraft manufacture*	6.9	14.28	2352	144	1698	160	322	154	6	--	2.91	4.54	2.78	0.09	0.09	7.19	17.58
Polyethylene products manufacture†	--	3.4	32149	--	--	1116	312	105	62	65	37.44	3.54	5.92	0.61	0.61	--	47.52

* See notes and references 2.
† See notes and references 17.

D.5.5 Beverage Distribution--Nonrefillable Soft Drinks

Once containers are fabricated, they are shipped to filling plants to be filled with beverage, closed, and packed for shipment to wholesalers and retailers. The energy requirements for these steps were determined from data submitted to Franklin Associates. These data reflect the bottling energy requirements, but exclude space heating of the buildings. The data are summarized in table D.5-9. The requirements are primarily natural gas used to warm bottles in summer months to prevent condensation and purchased electricity to run cooling and carbonation equipment.

Once the bottles are filled, they are shipped to wholesalers, almost entirely by truck. Because of the highly localized nature of the soft drink bottlers, most beverage is shipped less than 150 miles from the bottling plant. Frequently, one-way bottles are transported by large truck to a distributor, who then transfers the beverage to route trucks. Data submitted to Franklin Associates allowed estimates of the total fuel requirements for both types of transportation. These are displayed in table D.5-9.

D.5.6 Total Beverage Container Systems for Plastic Containers

In order to comprehensively study a particular container system, it is necessary to aggregate data for all the components of importance in that system. In previous sections, the various specific components of the systems have been presented and discussed. In this section, these components are brought together to make up the total beverage container system.

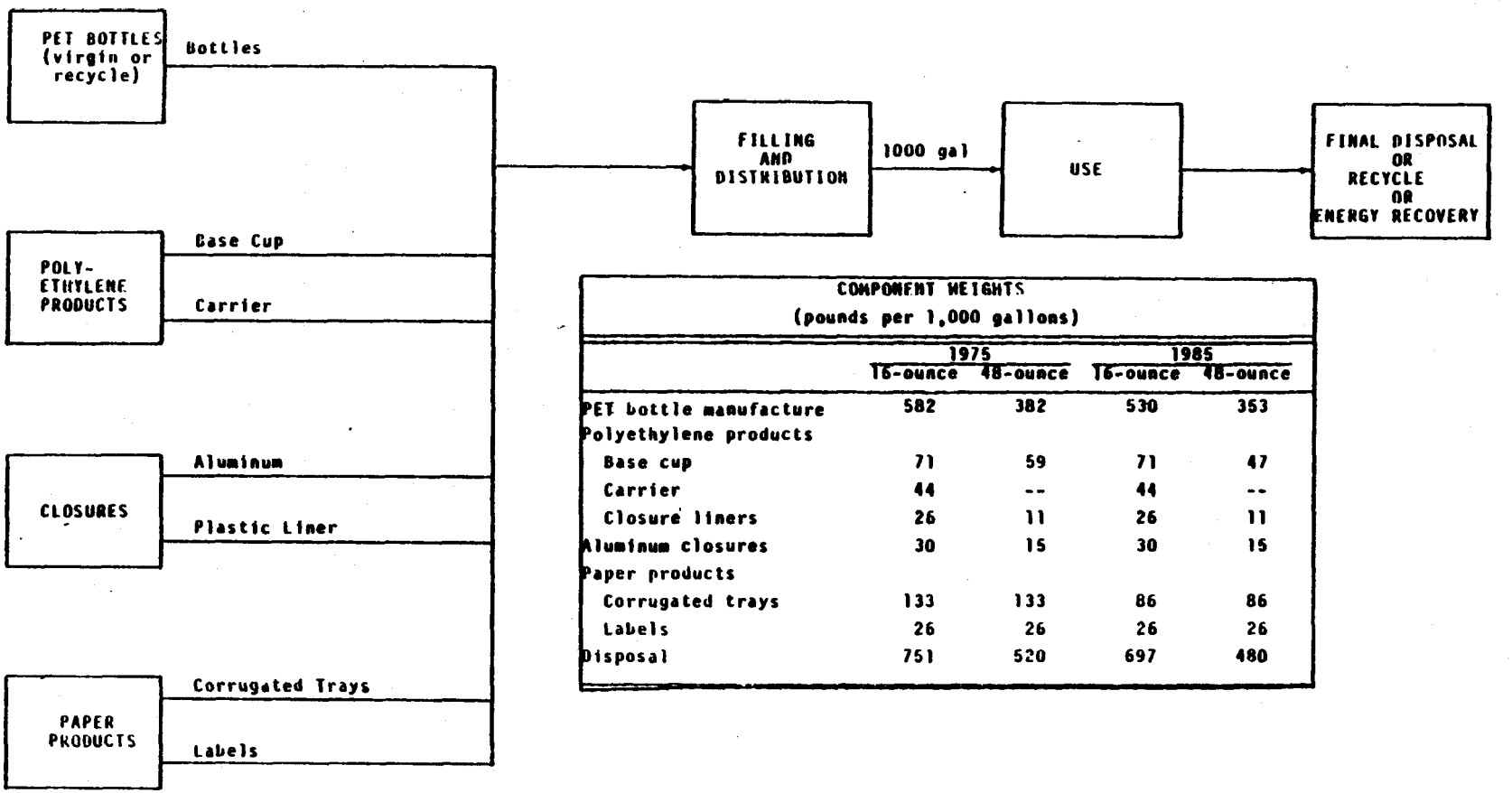
D.5.6.1 PET Containers. Figure D.5-5 presents the components and materials flow necessary to construct two PET bottle systems delivering 1,000 gallons of beverage to a consumer. One of these systems is the 16-ounce size bottle, while the other is a "family size" 48-ounce bottle. Data are given for both 1975 and 1985.

Table D.5-10 displays the energy profiles of the 16-ounce system for the virgin materials option, recycled materials option, and energy recovery option.

Table D.5-9. Energy requirements for filling and distribution plastic soft drink system - 1975 (in energy related units per output category)

	Fuels					Energy					
	Gasoline (gallon)	Distillate oil (gallon)	Natural gas (cu ft)	LPG (gallon)	Purchased Electricity (kwhr)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Total
Filling--plastic nonrefillable bottles - 1,000 gal	--	--	370	3.0	47.5	0.51	0.39	0.25	0.026	0.026	1.20
Distribution--plastic non-refillable bottles - 1,000 gal											
16-ounce	6.94	3.97	--	--	--	--	1.49	--	--	--	1.49
48-ounce	4.17	2.98	--	--	--	--	1.08	--	--	--	1.08

Source: Franklin Associates, Ltd., derived from an industrial source.



COMPONENT WEIGHTS
(pounds per 1,000 gallons)

	1975		1985	
	16-ounce	48-ounce	16-ounce	48-ounce
PET bottle manufacture	582	382	530	353
Polyethylene products				
Base cup	71	59	71	47
Carrier	44	--	44	--
Closure liners	26	11	26	11
Aluminum closures	30	15	30	15
Paper products				
Corrugated trays	133	133	86	86
Labels	26	26	26	26
Disposal	751	520	697	480

Figure D.5-5. Components of total PET bottle systems for delivery of 1,000 gallons beverage (Source: Notes and references 26).

Table D.5-10. Final calculation summary for PET 16-ounce plastic soft drink system - 1975 (million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin Materials*								
PET bottle manufacture system - 582 lb	11.119	12.971	3.680	0.379	0.378	--	28.526	64.9
Polyethylene base cup system - 71 lb	2.658	0.252	0.420	0.043	0.043	--	3.417	7.8
Closures								
Aluminum - 30 lb	1.097	0.756	1.046	0.075	0.308	--	3.281	7.5
Plastic liner - 26 lb	0.973	0.092	0.154	0.016	0.016	--	1.251	2.9
Label--bleached kraft paper - 26 lb	0.076	0.118	0.072	0.002	0.002	0.187	0.457	1.0
Supplementary package								
Polyethylene carrier - 44 lb	1.647	0.156	0.261	0.027	0.027	--	2.117	4.8
Corrugated trays - 133 lb	0.386	0.597	0.368	0.012	0.012	0.756	2.131	4.8
Filling - 1,000 gal	0.505	0.390	0.252	0.026	0.026	--	1.199	2.7
Distribution - 1,000 gal	--	1.492	--	--	--	--	1.492	3.4
Waste disposal - 751 lb	--	0.073	--	--	--	--	0.073	0.2
Total	18.462	16.896	6.253	0.579	0.811	0.943	43.944	100.0
Percent of Total	42.0	38.4	14.2	1.3	1.8	2.1	99.8	
Recycle System								
Recycled PET system - 582 lb	1.644	4.935	2.432	0.250	0.250	--	9.512	38.2
Ancillary systems - 1,000 lb†	7.343	3.924	2.573	0.201	0.433	0.943	15.418	61.8
Total	8.987	8.860	5.006	0.451	0.683	0.943	24.930	100.0
Percent of Total	36.1	35.5	20.1	1.8	2.7	3.8	100.0	
Energy Recovery System								
Virgin materials system - 1,000 gal	18.462	16.896	6.253	0.579	0.811	0.943	43.944	
Energy recovery								
PET - 582 lb	--	--	-5.668	--	--	--	-5.668	
Polyethylene - 141 lb‡	--	--	-2.820	--	--	--	-2.820	
Waste processing - 751 lb	0.495	0.217	0.534	0.055	0.055	--	1.356	
Total	18.957	17.113	-1.702	0.634	0.866	0.943	36.811	

* See figure D.5-5.
† Includes all components of virgin system except virgin PET bottle manufacture system.
‡ Includes base cup, closure liner and carrier.

The total energy requirements of the system show that PET accounts for 65 percent of the total energy, while related systems and supplementary packaging account for the rest. Thus, the supplementary systems are quite important. The energy profile for the virgin materials system shows that hydrocarbons dominate the energy requirements, accounting for 80 percent of the total energy requirements. Similarly, for the recycled system, oil and natural gas are 72 percent of the total. Thus, petroleum and natural gas requirements dominate the systems.

Table D.5-11 summarizes the comparison of the 16-ounce systems. Overall, the PET recycle system requires 43 percent less energy and the energy recovery system requires 16 percent less energy. Thus, recycling of the PET containers is more energy efficient than recovery of the energy content in the container from an energy consumption point of view.

Table D.5-12 summarizes the energy profile for the family size 48-ounce bottles. A similar relationship exists among the three systems displayed there, as for the 16-ounce size. Materials recycling is the system which requires the least total energy and the least hydrocarbon fuels.

A comparison of the 16-ounce and 48-ounce container systems reveals that significantly less energy is required to deliver 1,000 gallons of beverage in the larger size. Table D.5-13 shows that the overall requirement is 35 percent less, with similar percentage differences for all fuels. Thus, it appears that a continuation of the present trend to larger size containers will result in less energy consumed per 1,000 gallons of beverage in the case of plastic containers.

Table D.5-11. Comparison of 16-ounce PET systems virgin materials and recycling

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Virgin and Recycle Systems							
Difference*	-9.48	-8.04	-1.25	-0.13	-0.13	0.0	-19.01
Percent difference†	-51	-48	-20	-22	-16	0.0	-43
Virgin and Energy Recovery Systems							
Difference*	+0.50	+0.22	-7.96	+0.055	+0.055	0.0	-7.13
Percent difference†	+3	+1	-127	+9	+7	0.0	-16

*Calculated by (Recycle/Recovery - Virgin). Negative numbers mean that the virgin values are larger.
†Calculated by (Difference ÷ Virgin) x 100.

Table D.5-12. Final calculations summary for PET 48-ounce plastic soft drink system - 1975
(million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin Materials*								
PET bottle manufacture system - 382 lb	7.298	8.514	2.415	0.249	0.248	--	18.723	65.3
Polyethylene base cup system - 59 lb	2.209	0.209	0.349	0.036	0.036	--	2.839	9.9
Closures								
Aluminum - 15 lb	0.548	0.378	0.523	0.037	0.154	--	1.641	5.7
Plastic liner - 11 lb	0.412	0.039	0.065	0.007	0.007	--	0.529	1.9
Label - bleached kraft paper - 26 lb	0.076	0.118	0.072	0.002	0.002	0.187	0.457	1.6
Supplementary package--corrugated - 133 lb	0.386	0.597	0.368	0.012	0.012	0.756	2.131	7.4
Filling - 1,000 gal	0.505	0.390	0.252	0.026	0.026	--	1.199	4.2
Distribution - 1,000 gal	--	1.078	--	--	--	--	1.078	3.8
Waste disposal - 520 lb	--	0.050	--	--	--	--	0.050	0.2
Total	11.434	11.373	4.044	0.369	0.485	0.943	28.647	100.0
Percent of Total	39.9	39.7	14.1	3.3	1.7	1.3	100.0	
Recycle System								
Recycled PET system - 382 lb	1.079	3.239	1.596	0.164	0.164	--	6.243	38.7
Ancillary systems - 1,000 gal†	4.142	2.806	1.625	0.121	0.232	0.943	9.869	61.3
Total	5.221	6.045	3.221	0.285	0.396	0.943	16.112	100.0
Percent of Total	32.4	37.5	20.0	1.7	2.5	5.8	99.9	
Energy Recovery System								
Virgin materials system - 1,000 gal	11.44	11.37	4.04	0.37	0.48	0.94	28.65	
Energy recovery system								
PET - 382 lb	--	--	-3.721	--	--	--	-3.721	
Polyethylene - 70 lb‡	--	--	-1.400	--	--	--	-1.400	
Waste processing - 520 lb	0.343	0.150	0.370	0.038	0.038	--	0.939	
Total	11.783	11.520	-0.711	0.408	0.518	0.94	24.468	

* See figure D.5-5.
† Includes components of virgin systems except PET bottle manufacture system.
‡ Includes base cup and closure liner.

Table D.5-13. Comparison of 48-ounce and 16-ounce virgin materials PET system

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Difference* (million Btu)	7.03	5.52	2.21	0.21	0.33	--	15.30
Percent difference†	38	33	35	36	40	--	35

*Calculated by (16-ounce values - 48-ounce values).
†Calculated by (Difference ÷ 16-ounce values) x 100.

D.5.6.2 AN/S Containers. Figure D.5-6 presents the process components and materials flow for the 16-ounce and 48-ounce AN/S plastic container systems delivering 1,000 gallons of beverage to the consumers. Table D.5-14 displays the detailed profile for the 16-ounce container. As was the case of the other plastic containers, this profile is dominated by natural gas and petroleum requirements. For the 16-ounce AN/S system, these two energy sources account for 85 percent of the virgin system and 71 percent of the recycle system.

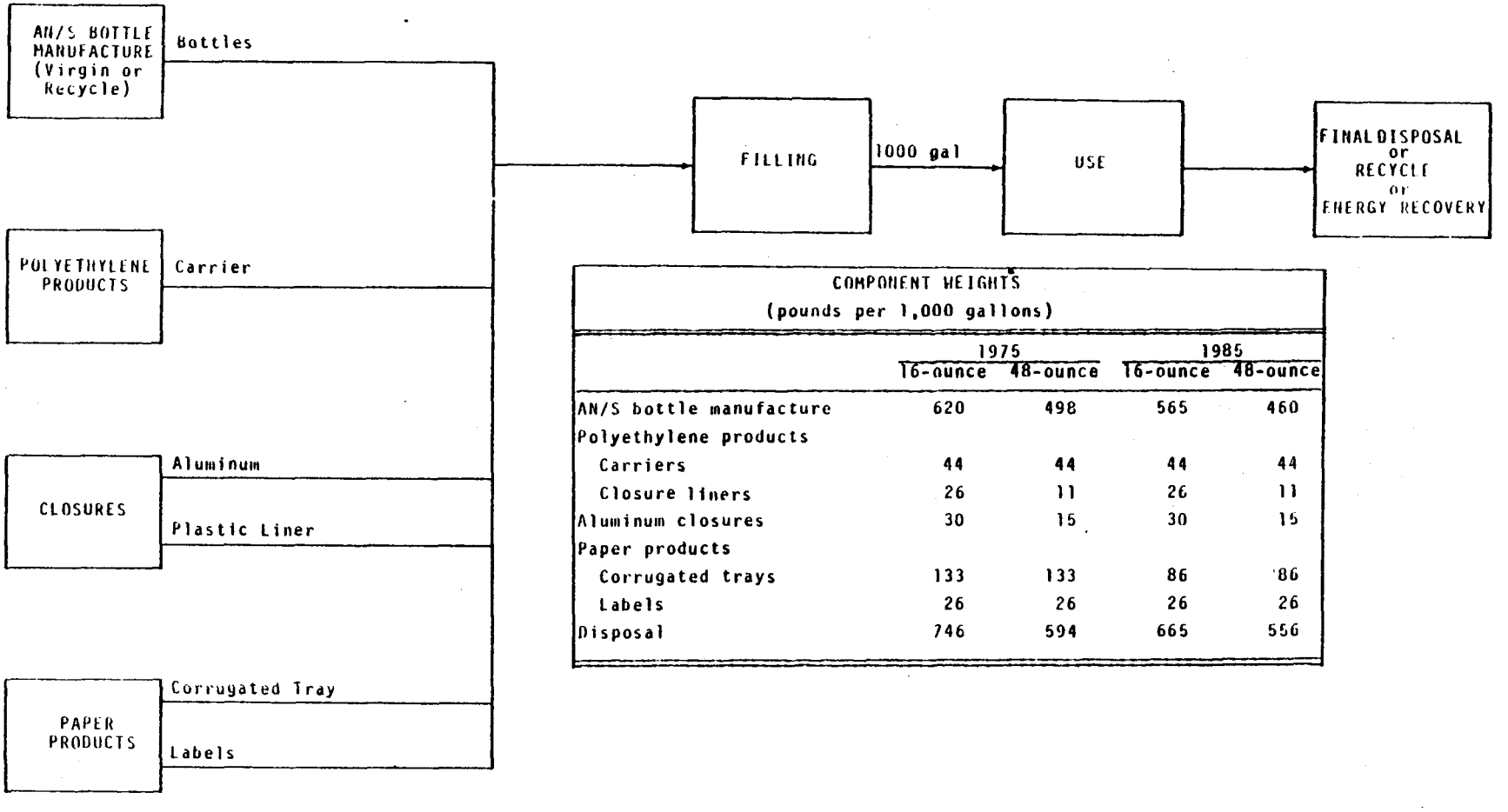
Table D.5-15 shows the comparison of the three 16-ounce systems, also showing results similar to the PET systems. The materials recycle system results in an overall energy reduction of 52 percent. The energy recovery system shows less savings than materials recycle, but the overall savings are 21 percent.

Table D.5-16 contains the detailed profiles of the 48-ounce container, which show similar savings for recycle and energy recovery when compared to the virgin materials system. Table D.5-17 summarizes the comparison of the systems of the two bottle sizes. A significantly lower energy requirement is shown for the larger bottle over the 16-ounce. The 48-ounce size requires 26 percent less total energy per 1,000 gallons beverage, with a similar percentage savings in the oil and natural gas categories.

D.5.7 1985 Calculations

Projections to 1985 are particularly difficult with an emerging technology such as plastic beverage containers. However, 1985 values were estimated from available data. The amounts of material required are specified on figures D.5-5 and D.5-6, with the sources of data generally being plastic industry projected data and analogy to conventional containers discussed elsewhere in this report. In addition, energy for petrochemical processes and transportation steps were assumed to decline 15 percent by 1985 (ref. 3 and 21).

Table D.5-18 is a summary of the 1985 calculations, and table D.5-19 is a comparison of the 1975 and 1985 data.



COMPONENT WEIGHTS
(pounds per 1,000 gallons)

	1975		1985	
	16-ounce	48-ounce	16-ounce	48-ounce
AN/S bottle manufacture	620	498	565	460
Polyethylene products				
Carriers	44	44	44	44
Closure liners	26	11	26	11
Aluminum closures	30	15	30	15
Paper products				
Corrugated trays	133	133	86	86
Labels	26	26	26	26
Disposal	746	594	665	556

Figure D.5-6. Components of total AN/S bottle systems for delivery of 1,000 gallons beverage.
(Source: Notes and references 26).

Table D.5-14. Final calculation summary for AN/S 16-ounce plastic soft drink system - 1975 (million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin Materials*								
AN/S bottle manufacture system - 620 lb	20.832	8.209	2.258	0.232	0.232	--	31.763	72.6
Closures								
Aluminum - 30 lb	1.097	0.756	1.046	0.075	0.308	--	3.281	7.5
Plastic liner - 26 lb	0.973	0.092	0.154	0.016	0.016	--	1.251	2.9
Label--bleached kraft paper - 26 lb	0.076	0.118	0.072	0.002	0.002	0.187	0.457	1.0
Supplementary package								
Polyethylene carrier - 44 lb	1.647	0.156	0.261	0.027	0.027	--	2.117	4.8
Corrugated trays - 133 lb	0.386	0.597	0.368	0.012	0.012	0.756	2.131	4.9
Filling - 1,000 gal	0.505	0.390	0.252	0.026	0.026	--	1.199	2.7
Distribution - 1,000 gal	--	1.492	--	--	--	--	1.492	3.4
Waste disposal - 746 lb	--	0.072	--	--	--	--	0.072	0.2
Total	25.516	11.882	4.411	0.390	0.622	0.943	43.764	100.0
Percent of Total	58.3	27.2	10.1	0.9	1.4	2.2	100.1	
Recycle System								
Recycled AN/S systems - 620 lb	1.395	5.002	1.961	0.202	0.201	--	8.761	42.2
Ancillary systems - 1,000 gal†	4.685	3.672	2.153	0.157	0.390	0.943	12.000	57.8
Total	6.080	8.674	4.114	0.359	0.592	0.943	20.762	100.0
Percent of Total	29.3	41.8	19.8	1.7	2.8	4.5	99.9	
Energy Recovery System								
Virgin materials system - 1,000 gal	25.516	11.882	4.411	0.390	0.622	0.943	43.764	
Energy recovery system								
AN/S - 620 lb	--	--	-9.300	--	--	--	-9.300	
Polyethylene - 70 lb‡	--	--	-1.400	--	--	--	-1.400	
Waste processing - 746 lb	0.492	0.216	0.530	0.055	0.054	--	1.347	
Total	26.008	12.097	-5.759	0.444	0.677	0.943	34.411	

* See figure D.5-6.
† Includes all components of virgin systems except AN/S bottle manufacture.
‡ Includes closure liner and carrier.

Table D.5-15. Comparison of 16-ounce AN/S systems virgin materials use, recycling, and energy recovery (in millions Btu and percent difference)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Virgin and Recycle Systems							
Difference*							
(million Btu)	-19.44	-3.21	-0.30	-0.03	-0.03	--	-23.00
Percent difference†	-76	-27	-7	-8	-5	--	-52
Virgin and Energy Recovery Systems							
Difference*							
(million Btu)	+0.49	+0.22	-10.17	+0.05	+0.05	--	-9.35
Percent difference†	+2	+2	-230	+14	+9	--	-21

*Calculated by (Recycle/Recovery - Virgin). Negative sign means that virgin values are larger.
†Calculated by (Difference ÷ Virgin) x 100.

Table D.5-16. Final calculation summary for AN/S 48-ounce plastic soft drink system - 1975 (million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin Materials*								
AN/S bottle manufacture system - 498 lb	16.732	6.594	1.814	0.187	0.186	--	25.513	78.3
Closures								
Aluminum - 15 lb	0.548	0.378	0.523	0.037	0.154	--	1.641	5.0
Plastic liner - 11 lb	0.412	0.039	0.065	0.007	0.007	--	0.529	1.6
Label--bleached kraft paper - 26 lb	0.076	0.118	0.072	0.002	0.002	0.187	0.457	1.4
Supplementary package								
Corrugated - 133 lb	0.386	0.597	0.368	0.012	0.012	0.756	2.131	6.5
Filling - 1,000 gal	0.505	0.390	0.252	0.026	0.026	--	1.199	3.7
Distribution - 1,000 gal	--	1.078	--	--	--	--	1.078	3.3
Waste disposal - 594 lb	--	0.058	--	--	--	--	0.058	0.2
Total	18.66	9.25	3.09	0.27	0.39	0.94	32.60	100.0
Percent of Total	57.2	28.4	9.5	0.8	1.2	2.9	100.0	
Recycle System								
Recycled AN/S systems - 498 lb	1.041	3.432	1.380	0.142	0.142	--	6.136	46.6
Ancillary systems - 1,000 gal†	1.928	2.598	1.276	0.083	0.204	0.943	7.032	53.4
Total	2.97	6.03	2.66	0.22	0.35	0.94	13.17	100.0
Percent of Total	22.6	45.8	20.2	1.7	2.7	7.1	100.1	
Energy Recovery System								
Virgin materials system - 1,000 gal	18.66	9.25	3.09	0.27	0.39	0.94	32.60	
Energy recovery system								
AN/S - 498 lb	--	--	-7.47	--	--	--	-7.47	
Polyethylene - 11 lb‡	--	--	-0.22	--	--	--	-0.22	
Waste processing - 594 lb	0.392	0.172	0.42	0.043	0.043	--	1.07	
Total	19.05	9.42	-4.18	0.31	0.43	0.94	25.98	

* See figure D.5-6.
† Includes all components of the virgin materials systems except AN/S bottle manufacture system.
‡ Includes closure liner and carrier.

Source: Franklin Associates, Ltd.

Table D.5-17. Comparison of 16-ounce and 48-ounce virgin materials AN/S systems

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Difference*							
(million Btu)	6.86	2.63	1.02	0.089	0.23	--	11.16
Percent difference†	27	22	25	25	37	--	26

*Calculated by (16-ounce values - 48-ounce values).
†Calculated by (Difference ÷ 16-ounce values) x 100.

Table D.5-18. Summary of calculations for plastic containers - 1985
(in million Btu per 1,000 gallons of soft drink delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
PET container systems							
16-ounce NR bottle							
100 percent virgin materials	15.37	13.57	4.18	0.38	0.55	0.63	34.67
100 percent recycled PET	7.69	6.99	3.89	0.35	0.52	0.63	20.07
Virgin materials with energy recovery	15.83	13.77	-3.30	0.43	0.60	0.63	27.96
48-ounce NR bottle							
100 percent virgin materials	9.17	8.25	2.72	0.24	0.32	0.63	21.33
100 percent recycled PET	4.06	3.91	2.53	0.22	0.30	0.63	11.65
Virgin materials with energy recovery	9.45	8.37	-0.09	0.27	0.35	0.63	18.95
AN/S container systems							
16-ounce NR bottle							
100 percent virgin materials	21.87	9.76	3.40	0.30	0.48	0.63	36.44
100 percent recycled AN/S	5.34	6.86	3.21	0.28	0.46	0.63	16.78
Virgin materials with energy recovery	22.31	9.95	-6.01	0.35	0.53	0.63	27.76
48-ounce NR bottle							
100 percent virgin materials	16.13	7.64	2.42	0.22	0.30	0.63	27.34
100 percent recycled AN/S	2.67	5.41	2.26	0.20	0.28	0.63	11.45
Virgin materials with energy recovery	16.49	7.77	-4.30	0.26	0.34	0.63	21.19

Table D.5-19. Comparison of 1975 and 1985 plastic systems (in percent)*

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
PET container systems							
16-ounce NR bottle							
100 percent virgin materials	-17	-20	-33	-34	-32	-33	-21
100 percent recycled PET	-14	-21	-22	-22	-24	-33	-19
Virgin materials with energy recovery	-16	-20	-94	-32	-31	-33	-24
48-ounce NR bottle							
100 percent virgin materials	-20	-27	-32	-35	-34	-33	-26
100 percent recycled PET	-22	-35	-21	-23	-24	-33	-28
Virgin materials with energy recovery	-20	-27	+87	-33	-32	-33	-23
AN/S container systems							
16-ounce NR bottle							
100 percent virgin materials	-14	-25	-23	-23	-23	-33	-17
100 percent recycled AN/S	-12	-39	-22	-22	-22	-33	-19
Virgin materials with energy recovery	-14	-18	-4	-21	-22	-33	-19
48-ounce NR bottle							
100 percent virgin materials	-14	-17	-22	-19	-23	-33	-16
100 percent recycled AN/S	-10	-10	-15	-9	-20	-33	-13
Virgin materials with energy recovery	-13	-18	-3	-16	-21	-33	-18

*Calculated by $\frac{1985 - 1975}{1975} \times 100$.

Source: Tables D.5-10, D.5-12, D.5-14, D.5-16 and D.5-18.

NOTES AND REFERENCES - SECTION D.5

1. The 1975 data were derived from ref. 2 and 3. The basic numbers are from Volume II of ref. 2. Values for 1985 are these values adjusted downward to coincide with a projected 15 percent reduction in energy requirements (ref. 3).
2. Hunt, R. G., et al, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives," U.S. Environmental Protection Agency, Report SW-91c, 1974.
3. "Energy Conservation in the Manufacturing Sector, 1954-1990," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 3, November 1974.
4. These values were obtained from ref. 5 and 6. These two references are previously confidential studies performed for E. I duPont deNemours and Company, Inc. They were released to Franklin Associates for use in this study, and have also been put into the public domain by being transmitted to the Food and Drug Administration.
5. "Environmental Impact Profiles for Polyethyleneterephthalate Beverage Containers," Final Report, June 13, 1973, performed by Midwest Research Institute for E. I duPont deNemours and Company, Inc.
6. "Resource and Environmental Profile Analysis of Ten Beverage Container Systems," Final Report, September 24, 1974, performed by Midwest Research Institute for E. I. duPont deNemours and Company, Inc.
7. This was derived from page 246, ref. 8.
8. Myers, John G., et al, "Energy Consumption in Manufacturing," The Conference Board, Ballinger Publishing Company, Cambridge, Massachusetts, 1974.
9. Private communication, E. I duPont deNemours and Company, Inc.

10. The energy required for disposal is estimated to be the gasoline used to transport the waste to a disposal site. If a 20 cubic yard compactor truck travels an average of 50 miles per load at a fuel efficiency of 5 miles per gallon, then the fuel requirement is 0.5 gallon per cubic yard. It was assumed that plastic bottles will be crushed in a compactor truck, to the extent that they will occupy 10 percent of their original volume. Thus, on this basis, 1,000 gallons of bottles will occupy 36.4 cubic feet in a compactor truck, which is 10.5 cubic feet of plastic and 13.3 cubic feet of void space inside the 90 percent crushed bottle. Thus, the gasoline requirement is (36.4 cu ft ÷ 27 cu ft/cu yd) x 0.5 gallon gasoline/cu yd = 0.67 gallon gasoline.
11. An energy recovery system which includes waste shredding, air classification, magnetic separation, drying and incineration with energy recovery was assumed. The shredding was assumed to be 130 kwhr per 1,000 pounds plastic, with the other impacts derived from ref. 12.
12. Welch, Richard O., William E. Franklin, and Robert G. Hunt, "Resource and Environmental Profile Analysis of Solid Waste Disposal and Resource Recovery Options," paper presented at the Air Pollution Control Association meeting, Denver, Colorado, June 1974.
13. The heat of combustion of PET is 9,740 Btu/pound (ref. 9). This energy was credited back to coal, assuming that energy recovery will be practiced at coal fired electric utility plants. Thus, the energy recovered from plastic will directly replace coal.
14. This assumes a 400 mile haul for plastic bottles, 25 percent by truck and 75 percent by rail (p. 82, ref. 15). For trucks, the load was assumed to be bottles totaling 4,000 gallons, with a truck fuel efficiency of 5 miles/gallon of diesel fuel. Trains were assumed to be 3 times as efficient as trucks.

15. Wharton, F. D., Jr., Ed., "Environmental Impact of Nitrile Barrier Containers," Proceedings of the Symposium sponsored by Monsanto Company, Hartford, Connecticut, July 19, 1973, published by Monsanto Company, St. Louis.
16. Throne, J. L., and R. G. Grisby, "Heating Values and Thermochemical Properties of Plastics," Modern Plastics, November 1972, pp. 96-100.
17. Derived from ref. 18, pp. 50-53. The data for low density and high density polyethylene products from that reference were averaged and these values were used in this study for all polyethylene products.
18. "Resource and Environmental Profile Analysis of Plastics and Competitive Materials," prepared by Midwest Research Institute for the Society of the Plastics Industry, Inc., New York, November 1974.
19. Haller, Gary L., "Resource Utilization and Environmental Impacts of Alternative Beverage Containers, Volume II, Data Base and Computations," presented at Symposium: Environmental Impact of Nitrile Barrier Containers, LOPAC: A Case Study, July 19, 1973.
20. It was assumed that 100 kwhr/1,000 pounds would be required for grinding energy. The washing and processing was assumed to be equivalent to 500,000 Btu per 1,000 gallons volume of 16-ounce bottles.
21. "Project Independence and Energy Conservation: Transportation Sector," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 2, November 1974.
22. It was assumed that the return transport step is the same distance as for transport of finished bottles to filling plants.
23. "Environmental and Safety Aspects of Lopac Containers," Monsanto Commercial Products Company, Container Business Group, 800 N. Lindbergh Boulevard, St. Louis, Missouri.
24. These values were derived from section D.6, using 1985 values and assuming 40 percent aluminum can recovery.

25. Private communication with F. D. Wharton, Monsanto Company, June 1975.
26. Weights of the bottles were obtained from table D.5-1, while the carriers and corrugated trays were assumed to be the same as for an equal volume of beverage delivered in aluminum cans. The closures, closure liners, and labels were assumed to be the same as for glass bottles.

D.6 Candidate Containers--Aluminum

D.6.1 Introduction

There is only one basic type of aluminum beverage can in current use--a two-piece drawn and ironed (D&I) can with an "easy-open" tab top. The predominant size is 12-fluid-ounces, although other sizes do exist; and the predominant style lid has a ring pull detachable tab, although some companies are making a "push tab," or other nondetachable "convenience" opener. This basic type of can is used for both beer and soft drinks.

The aluminum can body is made from a circular disc which is punched from an aluminum sheet. This disc moves through a series of operations where the disc is first formed into a cup, and then drawn and ironed into its final shape.

The aluminum lid is made from a different aluminum alloy than that used for the body. The lid is stamped from a sheet, formed, and then has the easy open tab attached. Both cans and lids undergo a series of coating and decoration steps, interspersed with passes through ovens to dry each application.

Table D.6-1 summarizes the weights used in this study for 1974 and 1985. Between 1974 and 1985, the aluminum can will continue to become lighter, achieving a 16 percent reduction in weight in that time frame. This reduction in weight will come about by technological improvements used to manufacture the can, as well as making improvements in the shape and design. By 1985, the ring pull tab will have disappeared in favor of nondetachable openers.

Table D.6-1. Aluminum container weights, 1974 and 1985

(pounds/thousand containers)

	1974	1985
Lids	11.5	10.0
Bodies	32.5	27.0
Total	44.0	37.0

Source: Notes and references 26.

D.6.2 Container Manufacturing Systems--Aluminum

The manufacturing sequence of aluminum cans is shown in figures D.6-1, D.6-2, and D.6-3. The first figure shows in detail the materials flow for the manufacture of 1,000 pounds of molten metal from virgin materials. The processes consist mainly of converting bauxite ore (which contains aluminum oxides) to a purified state of alumina. The alumina is further processed to aluminum metal by smelting.

An alternate way of obtaining aluminum metal--recycling used aluminum cans--is shown in figure D.6-2. This process consists of recovering the cans, preparing and transporting them, and remelting. Thus, molten aluminum can be prepared from either virgin or recycled materials, and it was assumed that recycled and virgin aluminum are equivalent at this point in the production process.

Figure D.6-3 shows the remainder of the can system. Either virgin or recycled aluminum can be fed to the casting and rolling operation which produces aluminum sheet. The sheet is then formed into can bodies and lids, which are then used to package beverage. Aluminum scrap generated prior to the filling operation is recycled.

The energy profiles for the modules comprising the aluminum system are shown in table D.6-2. The data in this table, reported in terms of 1,000 pounds output from each system component process, are the most recent data available. In two modules--can body and can closure fabrication--1985 projections incorporated significant changes in the energy requirements of those processes. Numerous improvements and innovations will result in a substantial reduction in natural gas requirements for the drying ovens. These improvements include ultraviolet curing of inks, use of washer applied coatings, and use of inks and coatings which do not require solvents.

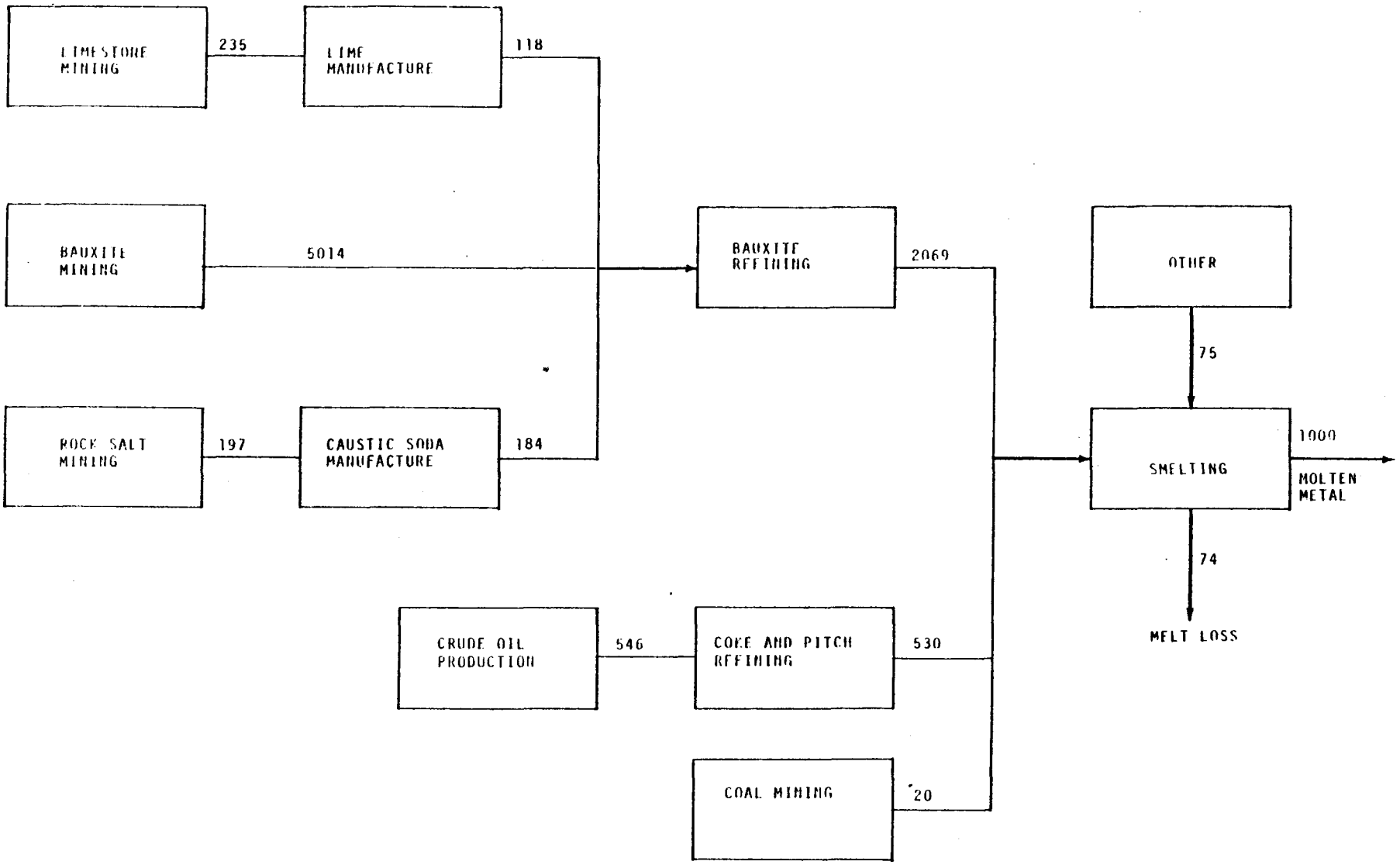


Figure D.6-1. Materials flow for manufacture of 1,000 lb molten aluminum from virgin raw materials (in pounds)
(Source: Franklin Associates, Ltd. based on notes and references 11).

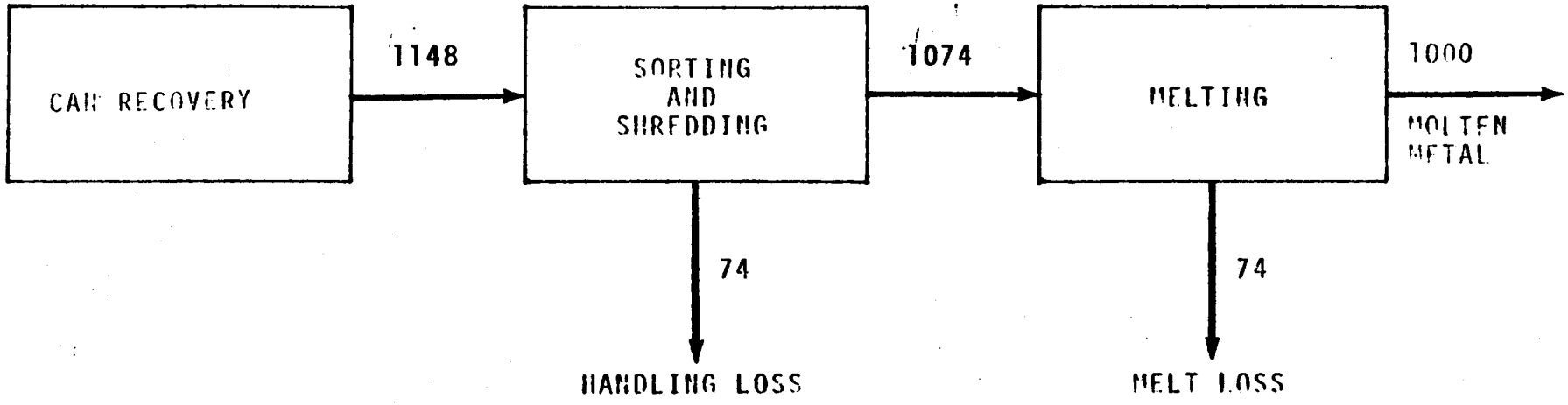


Figure D.6-2 Materials flow for manufacture of 1,000 lb molten aluminum from recycled cans (in pounds)

Source: Franklin Associates, Ltd., based on notes and references 11.

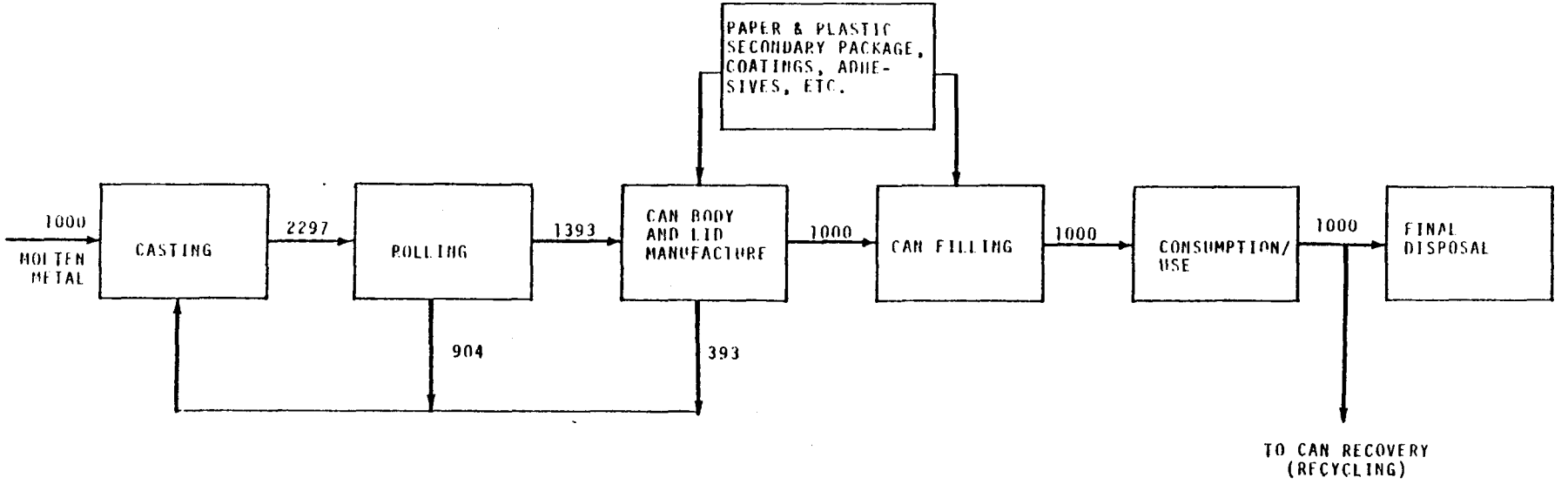


Figure D.6-3. Materials flow for manufacture and use of 1,000 lb aluminum cans (in pounds). (Source: Franklin Associates, Ltd. based on notes and references 11).

Table D.6-2. Fuel and energy profiles for aluminum can process modules, 1974 (in units per 1,000 pounds of output)

Description	Fuels: Residual oil (gallons)	Fuels: Gasoline (gallons)	Fuels: Natural gas (cu ft)	Fuels: Distillate oil (gallons)	Fuels: Coal (pounds)	Electricity (kwhr)	Transportation: Rail (ton-miles)	Transportation: Truck (ton-miles)	Transportation: Barge (ton-miles)	Transportation: Ocean ship (ton-miles)	Energy: Natural gas (10^6 Btu)	Energy: Petroleum (10^6 Btu)	Energy: Coal (10^6 Btu)	Energy: Nuclear (10^6 Btu)	Energy: Hydropower (10^6 Btu)	Energy: Total (10^6 Btu)
Bauxite mining - 1,000 lb*	0.04	0.1	200	0.06	--	1.5	--	--	--	--	0.225	0.030	0.019	0.002	0.002	0.286
Bauxite transport - domestic - 1,000 lb*	--	--	--	--	--	--	--	5	425	--	--	0.244	--	--	--	0.244
Bauxite transport - import - 1,000 lb†	--	--	--	--	--	--	--	--	--	550	--	0.112	--	--	--	0.112
Rock salt mining - 1,000 lb‡	0.06	0.006	85	--	--	42.0	--	--	--	--	0.103	0.102	0.223	0.023	0.023	0.554
Caustic soda manufacture - 1,000 lb§	--	--	--	--	--	722.0	--	--	--	--	1.562	1.557	3.031	0.304	0.303	7.757
Petroleum coke manufacture - 1,000 lb¶	0.03	--	3.04	--	--	0.34	--	--	--	--	0.006	0.006	0.002	--	--	0.012
Petroleum coke transport - 1,000 lb‖	--	--	--	--	--	--	750	--	--	--	--	0.667	--	--	--	0.667
Limestone mining - 1,000 lb#	--	0.02	4.6	0.06	0.12	1.0	--	--	--	--	0.007	0.018	0.007	0.001	0.001	0.033
Limestone transport - 1,000 lb**	--	--	--	--	--	--	5	21	13	--	--	0.056	--	--	--	0.056
Lime manufacture - 1,000 lb††	0.4	0.03	836	0.08	90	14	--	--	--	--	0.930	0.117	1.271	0.000	0.000	2.343
Lime transport - 1,000 lb‡‡	--	--	--	--	--	--	72	27	--	--	--	0.129	--	--	--	0.129
Bauxite refining - 1,000 lb§§	6.3	--	2700	3.28	140	350	--	--	--	--	3.696	2.332	3.719	0.191	0.191	10.128
Alumina transport - domestic - 1,000 lb¶¶	--	--	--	--	--	--	300	34	300	--	--	0.696	--	--	--	0.696
Alumina transport - import - 1,000 lb‖‖	--	--	--	--	--	--	--	--	--	1500	--	0.306	--	--	--	0.306
Aluminum smelting - national grid - 1,000 lb##	--	--	--	--	--	8040	--	--	--	--	17.301	17.334	43.660	4.309	4.362	86.157
Aluminum smelting - ass'n grid - 1,000 lb##'	--	--	--	--	--		--	--	--	--	10.000	9.000	29.230	2.230	10.020	70.480
Aluminum metal casting and rolling - national grid - 1,000 lb***	8.13	--	7270	--	--	226	--	--	--	--	10.618	1.066	1.194	0.123	0.123	13.917
Aluminum metal casting and rolling - ass'n grid - 1,000 lb†††	--	--	--	--	--	--	--	--	--	--	7.260	0.900	1.307	0.106	0.437	10.119
Aluminum sheet transport - 1,000 lb‡‡‡	--	--	--	--	--	--	710	6	--	--	--	0.590	--	--	--	0.590
Aluminum can body fabrication (1974) - 1,000 lb§§§	--	--	18,000	--	--	940	--	--	--	--	13.784	2.027	4.900	0.513	0.512	21.823
Aluminum can body fabrication (1985) - 1,000 lb¶¶¶	--	--	3,020	--	--	750	--	--	--	--	5.361	1.634	4.022	0.414	0.413	11.844
Aluminum can body transport - 1,000 lb‖‖‖	--	--	--	--	--	--	46	55	6	--	--	0.186	--	--	--	0.186
Aluminum closure fabrication (1974) - 1,000 lb###	--	--	500	--	--	63	--	--	--	--	0.637	0.093	0.220	0.023	0.023	1.005
Aluminum closure fabrication (1985) - 1,000 lb####	--	--	150	--	--	36	--	--	--	--	0.260	0.075	0.184	0.018	0.019	0.569
Waste disposal - 1,000 lb#####	--	0.64	--	--	--	--	--	--	--	--	--	0.093	--	--	--	0.093
Recovered can transport - 1,000 lb§§§§	--	0.43	--	--	--	--	--	--	--	--	--	0.932	--	--	--	0.932
Recycled aluminum shredding - 1,000 lb¶¶¶¶	--	--	--	--	--	125	--	--	--	--	0.270	0.270	0.643	0.068	0.068	1.350
Recycled aluminum melting - 1,000 lb‖‖‖‖	2.7	--	2,325	2.9	--	55	--	--	--	--	2.649	1.030	0.292	0.030	0.030	4.030

*See notes and references 1.
†See notes and references 3.
‡See notes and references 6.
§See notes and references 7.
¶See notes and references 8.
‖See notes and references 9.
#See notes and references 6.
**See notes and references 10.
††See notes and references 13.
‡‡See notes and references 14.
§§See notes and references 15.
¶¶See notes and references 22.
‖‖See notes and references 16.
##See notes and references 23.
##'See notes and references 18.
***See notes and references 19.
†††See notes and references 17.

Source: Franklin Associates, Ltd.

Combining the materials flow data from figures D.6-1, D.6-2, and D.6-3 with the process modules of table D.6-2, the energy requirements for basic aluminum can systems were calculated. These are found in table D.6-3.

An examination of the virgin molten metal module shows that 19 individual process modules are required to construct that system. However, three of those modules account for nearly 95 percent of the total energy requirements. Those three are aluminum smelting, bauxite refining, and the fuel value of petroleum used in the manufacture of petroleum coke and pitch.

The recycled molten metal module shows that melting is a dominant energy process for that system, accounting for 62 percent of the module total. However, the total energy for melting with recycled metal is only 4 percent of the virgin metal smelting energy, and the total energy for the recycled molten metal module is only 6 percent of the energy required for virgin molten metal.

The remainder of the table consists of basic system modules needed for calculation of the overall container systems. They include can body and closure manufacture, and the secondary systems required to produce 1,000 gallons of packaged beverage from either virgin or recycled material.

D.6.3 Supplementary Materials, Filling, and Distribution

Previous calculations in this section have developed the energy profiles for can manufacture. However, to determine the energy profile for the entire container-dependent system associated with the delivery of 1,000 gallons of beverage to the consumer, it is necessary to include supplementary packaging, can filling, and distribution.

Table D.6-3. Basic aluminum system calculations summary - 1974

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of Total
Virgin molten metal - 1,000 lb*							
Bauxite mining - 5,014 lb	1.129	0.192	0.093	0.010	0.010	1.434	1.3
Bauxite transport - domestic - 502 lb	--	0.122	--	--	--	0.122	0.1
Bauxite transport - import - 4,512 lb	--	0.506	--	--	--	0.506	0.5
Limestone mining - 235 lb	0.002	0.004	0.002	--	--	0.008	--
Limestone transport - 235 lb	--	0.016	--	--	--	0.016	--
Lime manufacture - 118 lb	0.111	0.014	0.150	0.001	0.001	0.276	0.3
Lime transport - 118 lb	--	0.015	--	--	--	0.015	--
Rock salt mining - 197 lb	0.036	0.020	0.044	0.005	0.005	0.109	0.1
Caustic soda manufacture - 184 lb	0.287	0.286	0.705	0.073	0.072	1.424	1.3
Crude oil production - 546 lb	0.001	0.040	0.002	--	--	0.043	--
Energy value of crude oil feedstock - 546 lb	--	9.828	--	--	--	9.828	9.2
Crude oil transport - 546 lb	0.044	0.134	--	--	--	0.178	0.2
Petroleum coke manufacture - 530 lb	0.003	0.003	0.001	--	--	0.007	--
Petroleum coke transport - 530 lb	--	0.321	--	--	--	0.321	0.3
Coal system - 20 lb	--	--	0.266	--	--	0.266	0.3
Bauxite refining - 2,069 lb	7.644	4.784	7.695	0.395	0.395	20.913	19.6
Alumina transport - domestic - 1,200 lb	--	0.593	--	--	--	0.593	0.6
Alumina transport - import - 869 lb	--	0.266	--	--	--	0.266	0.2
Aluminum smelting - 1,000 lb	19.080	9.060	29.230	2.210	10.820	30.400	66.0
Total	28.336	26.206	38.187	2.693	11.302	106.725	100.0
Percent of total	26.5	24.6	35.8	2.5	10.6	100.0	
Recycled molten metal - 1,000 lb*							
Recovered can transport - 1,148 lb	--	1.070	--	--	--	1.070	16.3
Recycled aluminum shredding - 1,074 lb	0.290	0.289	0.712	0.073	0.073	1.439	22.0
Recycled aluminum smelting - 1,000 lb	2.649	1.038	0.292	0.030	0.030	4.039	61.7
Total	2.939	2.397	1.004	0.103	0.103	6.547	100.0
Percent of total	44.9	36.6	15.3	1.6	1.6	100.0	
Closure manufacture - 1,000 lb*							
Casting and rolling - 1,350 lb	9.812	1.336	1.778	0.143	0.590	13.661	76.9
Aluminum sheet transport - 1,350 lb	--	0.796	--	--	--	0.796	4.5
Closure fabrication - 955 lb	0.608	0.089	0.218	0.022	0.022	0.960	5.4
Coatings, sealants and inks - 43 lb	1.685	0.160	0.266	0.027	0.027	2.166	12.2
Can closure transport - 1,000 lb	--	0.186	--	--	--	0.186	1.0
Total	12.106	2.567	2.262	0.193	0.640	17.769	100.0
Percent of total	68.1	14.4	12.7	1.1	3.6	99.9	
Can manufacture system - 100% virgin* materials - 1,000 gal							
Virgin molten metal - 470 lb	13.318	12.317	17.948	1.266	5.312	50.161	76.8
Can body manufacture - 347 lb	8.496	1.531	2.363	0.229	0.385	13.003	19.9
Closure manufacture - 123 lb	1.480	0.315	0.277	0.024	0.079	2.174	3.3
Total	23.293	14.162	20.587	1.519	5.776	65.338	100.0
Percent of total	35.7	21.7	31.5	2.3	8.8	100.0	
Can manufacture system - 100% recycled* materials - 1,000 gal							
Recycled molten metal - 470 lb	1.381	1.127	0.472	0.049	0.048	3.077	16.9
Can body manufacture - 347 lb	8.496	1.531	2.305	0.229	0.385	13.003	71.2
Closure manufacture - 123 lb	1.480	0.315	0.277	0.024	0.079	2.174	11.9
Total	11.357	2.972	3.111	0.301	0.512	18.254	100.0
Percent of total	62.2	16.3	17.0	1.7	2.8	100.0	

*Amounts of materials required were derived from notes and references 11.

Source: Franklin Associates, Ltd.

The supplementary packaging consists of corrugated trays in which the cans are placed and a polyethylene ring style carrier. The cans are shipped in the trays to the filling plant, where the cans are removed, filled, and then placed back into the same trays, with the plastic carrier applied. Data for the ancillary paper and plastic packaging are found on subsequent can system calculation tables.

The data for filling and distribution are shown in table D.6-4. Complete data were obtained for soft drink energy requirements, but only partial data were available for beer. One factor complicating the container-dependent energy for filling beer is the fact that most beer is pasteurized in the container. There is undoubtedly a variation in the energy requirement for this step from container type to container type, depending on the thermal conductivity and specific heat of the container material. However, because of the extremely wide range of conditions under which beer is pasteurized by the various breweries, we were unable to determine the magnitude of the effect.

D.6.4. Total Beverage Container Systems--Aluminum

D.6.4.1 Summary of 1974 Systems. Figure D.6-4 shows the components of the aluminum can systems selected for calculation in this study. Table D.6-5 summarizes these values. For the virgin materials soft drink packaging system, the aluminum can accounts for over 92 percent of the total energy, thus making any of the other components of the system of minor importance. The beer packaging systems show approximately the same result.

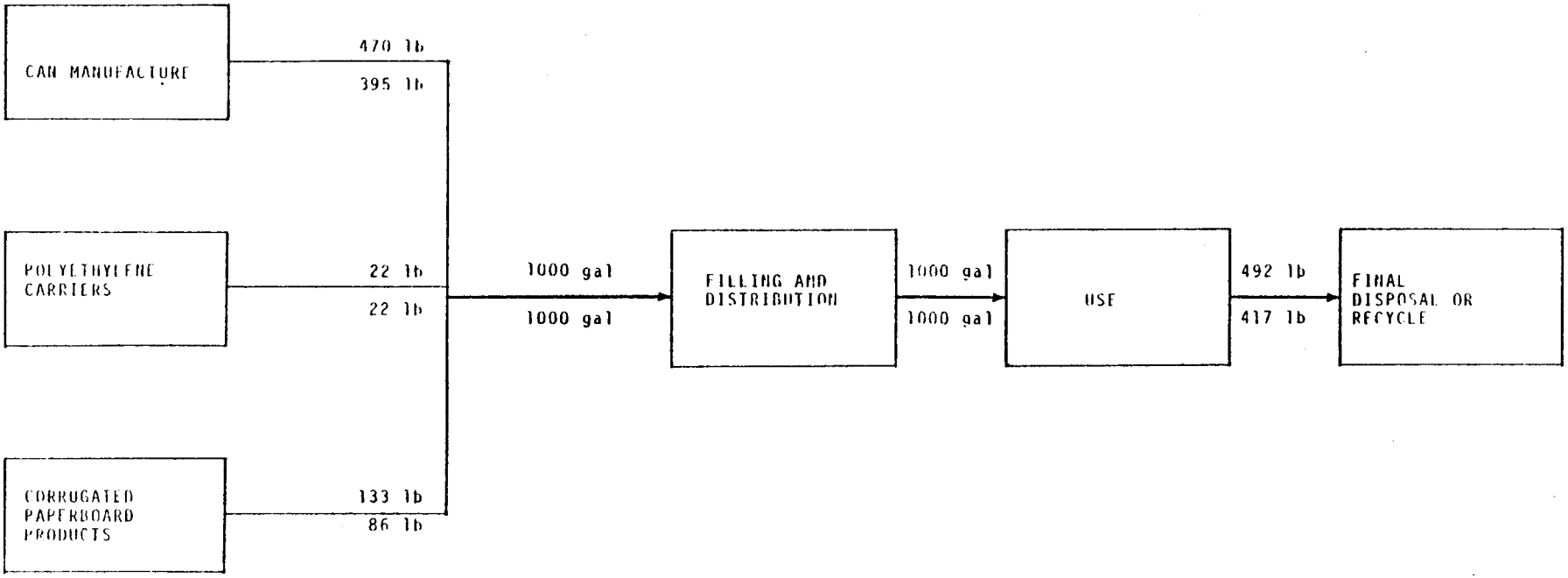
An examination of the beer and soft drink packaging systems shows that there is very little difference between them. In fact, they differ by only 0.1 percent in total energy for the systems, and by no more than 3 percent for any of the individual energy categories. Thus, no distinction is made between beer and soft drink in subsequent analysis.

Table D.6-4. Energy requirements for filling and distribution of 12-fluid-ounce beverage cans - 1974

	Fuels					Energy					
	Gasoline (gallon)	Distillate oil (gallon)	Natural gas (cu ft)	LPG (gallon)	Electricity (kwhr)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Total (10^6 Btu)
Filling											
Soft drink - 1,000 gal*	--	--	410	3.0	55.9	0.57	0.41	0.30	0.031	0.030	1.34
Beer - 1,000 gal†	--	--	--	--	25.0	0.054	0.054	0.13	0.014	0.014	0.27
Distribution											
Soft drink - 1,000 gal*	4.26	2.65	--	--	--	--	1.04	--	--	--	1.04
Beer - 1,000 gal*†	4.26	7.29	--	--	--	--	1.78	--	--	--	1.78

*See notes and references 31.
†See notes and references 22.

Source: Franklin Associates, Ltd.



Note: Numbers above lines are for 1974, both beer and soft drink
Numbers below lines are for 1985, both beer and soft drink

Source: Franklin Associates, Ltd.

Figure D.6-4. Components of total aluminum can systems - 1974 and 1985

Table D.6-5. Final calculation summary for aluminum 12-ounce beverage system - 1974 (million Btu per 1,000 gallons beverage delivered to consumer)

Category	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin materials--soft drink system - 1,000 gal								
Can manufacture system--100% virgin materials - 1,000 gal	23.29	14.16	20.59	1.52	5.78	--	65.34	92.1
Supplementary package								
Corrugated tray - 133 lb*	0.39	0.60	0.37	0.012	0.012	0.76	2.13	3.0
Polyethylene carriers - 22 lb†	0.82	0.078	0.13	0.013	0.013	--	1.06	1.5
Filling--soft drink - 1,000 gal	0.57	0.41	0.30	0.031	0.030	--	1.33	1.9
Distribution--soft drink - 1,000 gal	--	1.04	--	--	--	--	1.04	1.5
Waste disposal - 492 lb‡	--	0.046	--	--	--	--	0.046	0.1
Total	25.07	16.33	21.38	1.57	5.83	0.76	70.94	100.1
Percent of total	35.4	23.0	30.1	2.2	8.2	1.1	100.0	
Recycled aluminum--soft drink system - 1,000 gal								
Can manufacture system--100% recycled aluminum - 1,000 gal§	11.36	2.97	3.11	0.30	0.51	--	18.25	76.6
Ancillary systems	1.77	2.12	0.80	0.06	0.06	0.76	5.56	23.4
Total	13.13	5.09	3.91	0.36	0.57	0.76	23.81	100.0
Percent of total	55.1	21.4	16.4	1.5	2.4	3.2	100.0	
Virgin materials--beer system - 1,000 gal								
Can manufacture system--100% virgin materials--1,000 gal	23.29	14.16	20.59	1.52	5.78	--	63.34	92.5
Supplemtary package								
Corrugated tray - 133 lb*	0.39	0.60	0.37	0.012	0.012	0.76	2.13	3.0
Polyethylene carrier - 22 lb†	0.82	0.078	0.13	0.013	0.013	--	1.06	1.5
Filling--beer - 1,000 gal	0.054	0.054	0.13	0.014	0.014	--	0.27	0.4
Distribution--beer - 1,000 gal	--	1.78	--	--	--	--	1.78	2.5
Waste disposal - 492 lb‡	--	0.046	--	--	--	--	0.046	0.1
Total	24.56	16.71	21.22	1.56	5.81	0.76	70.62	100.0
Percent of total	34.8	23.7	30.0	2.2	8.2	1.1	100.0	
Recycled aluminum--beer system - 1,000 gal								
Can manufacture system - 100% recycled aluminum - 1,000 gal	11.36	2.97	3.11	0.30	0.51	--	18.25	77.7
Ancillary systems¶	1.26	2.51	0.63	0.04	0.04	0.76	5.24	22.3
Total	12.62	5.48	3.74	0.34	0.55	0.76	23.49	100.0
Percent of total	53.7	23.3	15.9	1.5	2.3	3.2	99.9	

*See notes and references 20.
†See notes and references 21.
‡This includes 470 lb aluminum and 22 lb polyethylene. It is assumed the corrugated tray will be removed by the retailer and recycled.
§This includes all components of the virgin system except can manufacture and waste disposal.

Source: Franklin Associates, Ltd.

D.6.4.2 Recycling of Aluminum Cans. A comparison of virgin materials with recycled aluminum cans shows a dramatic energy difference in the two (table D.6-6). The table shows that overall, the recycled can system requires 66 percent less energy than the virgin materials system, with energy savings ranging from 48 percent to 90 percent in the individual energy categories. Thus, the recycle system displays impressive energy conservation potential.

D.6.4.3 Electricity. One of the most important and controversial issues concerning energy analyses of aluminum systems is the calculation of the Btu value of a kilowatt hour of electricity used in smelting aluminum. In this study for the baseline trends, the calculations have been based on the actual fuel mix (where available). An attempt has been made in each case to represent manufacturing operations as they really exist today, and to make realistic projections into the future. Thus, in the base calculations for aluminum systems, electricity has been calculated for aluminum smelting on the basis of actual fuel and hydropower use data supplied by the Aluminum Association. These data represent the actual usage by the aluminum industry, which has sought specific geographic locations for smelters based on the availability of low cost electric power.

An alternative point of view is that the regional or even national fuel mix should be used.

In order to assess the effects of these different treatments of calculating Btu values for electricity, tables D.6-7 and D.6-8 have been prepared. Table D.6-7 conveys information about the geographical structure of aluminum smelting. By combining this table with the regional electricity fuel mixes in table D.5-4, the Btu profile of electricity requirements can be calculated for smelting. This regional mix is displayed in table D.6-8, along with the national mix and The Aluminum Association mix.

Table D.6-6. Comparison of virgin materials and recycled aluminum can systems for soft drinks - 1974

Category	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Energy requirement							
Difference* (million Btu/ thousand gal)	-11.94	-11.24	-17.47	-1.21	-5.26	0.0	-47.13
Percent difference†	-47.6	-68.8	-81.7	-77.1	-90.2	0.0	-66.4

* Calculated by (Recycle - Virgin). Negative numbers mean that virgin values are larger.
† Calculated by (Difference ÷ Virgin) x 100.

Source: Franklin Associates, Ltd.

Table D.6-8 shows that The Aluminum Association's mix based on actual plant locations shows less energy per unit of output than the other two mixes. It is 18 percent lower than the national mix, and 12 percent lower than the regional mix. This is largely a result of the use of more hydropower and less use of fossil fuels.

For this study, the most important aspect to examine is the impact that the various electricity assumptions have on the can system totals. To examine this, table D.6-9 was developed. As shown, the total virgin materials container system energy is 10 percent higher when using the national electricity mix rather than The Aluminum Association's electricity mix, and 6 percent higher when using the regional electricity mix. However, this is for the virgin materials system only, and in actuality, some fraction of container metal is always recycled. Thus, for a "real world" container system, the differences will be less than shown in table D.6-9.

A related issue, more fully discussed on page D-19, is the difference between average and marginal energy valuations of electricity. Resolution of this issue requires the identification of the marginal fuel source. The average values are computed by simple division of the heat values by the kWh value.

Table D.6-7. Aluminum smelting capacity by region (in percent of total)

Region	Percent
Middle Atlantic	5.4
East North Central	9.9
West North Central	1.5
South Atlantic	7.5
East South Central	22.0
West South Central	22.5
Mountain	3.8
Pacific	27.2
Total	99.8

Source: Notes and references 31.

D.6.4.4 1985 Aluminum Can Profiles

In order to project 1985 aluminum container profiles, projections were made in three major categories: (1) reduction of weight in cans and supplementary packaging, (2) implementation of new technology, and (3) energy conservation in existing manufacturing and transporting processes. The specific values used are listed in ref. 25. The calculations are summarized in table D.6-10.

Table D.6-8. Electric energy profiles for smelting 1,000 pounds aluminum*

(in million Btu)

Type of Electricity Fuel Mix	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total
National Mix	17.4	17.3	42.7	4.39	4.38	86.2
(percent of total)	(20)	(20)	(49)	(5)	(5)	(99)
Regional Mix	26.8	11.6	32.6	2.26	6.42	79.7
(percent of total)	(34)	(15)	(41)	(3)	(8)	(101)
Aluminum Association Mix	19.1	9.06	29.2	2.21	10.8	70.4
(percent of total)	(27)	(13)	(41)	(3)	(15)	(99)

*This assumes a requirement of 8.04 kwhr of smelter electricity use to produce 1 pound of molten aluminum.

Source: Franklin Associates, Ltd.

Table D.6-9. Virgin aluminum container system energy totals with different electricity assumptions

	Total Energy (million Btu/ 1,000 gal)	Percent Difference*
Virgin Container System		
(using national fuel mix for virgin materials smelting)	77.9	9.9
(using regional fuel mix for virgin materials smelting)	75.0	5.8
(using Aluminum Association fuel mix for materials smelting)	70.9	--

*Calculated by [(national or regional mix - Aluminum Association mix) ÷ Aluminum Association mix] x 100.

Source: Franklin Associates, Ltd.

To study the overall changes between 1974 and 1985, table D.6-11 was prepared. The combined effect of lightweighting and energy conservation produces a 29 percent overall reduction in energy requirements for virgin metal systems and a 33 percent reduction in recycled can systems. Thus, impressive improvements are projected to take place in aluminum can systems, which will be further heightened by increases in the recycling rate (which are discussed in another section).

Table D.6-10. Final calculation summary for aluminum 12-ounce beverage system - 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

Category	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Virgin aluminum system - 1,000 gal								
Can manufacture system - 1,000 gal*	14.51	11.07	15.42	1.12	4.24	--	46.33	91.5
Supplementary package								
Corrugated trays - 86 lb†	0.24	0.36	0.22	0.007	0.007	0.46	1.29	2.5
Polyethylene carrier - 22 lb†	0.70	0.066	0.11	0.011	0.011	--	0.90	1.8
Filling†	0.51	0.37	0.27	0.027	0.027	--	1.20	2.4
Distribution‡	--	0.88	--	--	--	--	0.88	1.7
Waste disposal*	--	0.039	--	--	--	--	0.039	0.1
Total	15.95	12.78	16.00	1.17	4.28	0.46	50.64	100.0
Percent of total	31.5	25.2	31.6	2.3	8.5	0.9	100.0	
Recycled aluminum system - 1,000 gal								
Can manufacture system - 1,000 gal*	6.53	2.25	2.22	0.22	0.37	--	11.58	73.0
Ancillary systems§	1.71	1.41	0.60	0.05	0.05	0.46	4.28	27.0
Total	8.24	3.66	2.82	0.27	0.42	0.46	15.86	100.0
Percent of total	52.0	23.1	17.8	1.7	2.6	2.9	100.1	

* See notes and references 25.
† See notes and references 30.
‡ See notes and references 31.
§ Includes supplementary package, filling and distribution from virgin aluminum system.

Source: Franklin Associates, Ltd.

Table D.6-11. Comparison of aluminum container systems - 1974 and 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

Category	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Virgin materials system							
Difference*	-9.12	-3.55	-5.38	-0.40	-1.55	-0.30	-20.30
Percent difference†	-36.4	-21.7	-25.2	-25.4	-26.6	-39.5	-28.6
Recycled materials system							
Difference*	-4.89	-1.43	-1.09	-0.09	-0.15	-0.30	-7.95
Percent difference†	-37.2	-28.1	-27.9	-25.0	-26.3	-39.5	-33.4

*Calculated by (1985 values - 1974 values). Negative values mean 1974 values are larger.
†Calculated by (difference ÷ 1974 value) x 100.

Source: Franklin Associates, Ltd.

NOTES AND REFERENCES - SECTION D.6

1. Page 162, ref. 2.
2. Hunt, R.G., et al, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives," Volume II, U.S. Environmental Protection Agency, Report SW-91c, 1974.
3. Calculated from data in ref. 4.
4. Haller, Gary L., "Resource Utilization and Environmental Impact of Alternative Beverage Containers," Volume II, Data Base and Computations, presented at Symposium: Environmental Impact of Nitrile Barrier Containers, LOPAC: A Case Study, July 19, 1973.
5. Page 165, ref. 2.
6. Page 163, ref. 2.
7. Page 164, ref. 2.
8. Page 70, ref. 2.
9. Page 71, ref. 2.
10. These values were derived from ref. 11, which is a preliminary energy report issued by the Aluminum Association. The basic data were reported in Btu of basic natural resources. In addition, we have increased these values to reflect the indirect energy required to mine, transport and process fuels. The indirect factors may be calculated from ref. 2, with the nuclear factor from ref. 12. The calculations are summarized below.

ALUMINUM SMELTING - 1,000 lb

Energy Source	Aluminum Association	Indirect Energy Correction Factor	Total
Coal - 10^6 Btu	28.8	1.015	29.23
Hydropower - 10^6 Btu	9.96	1.086	10.82
Nuclear - 10^6 Btu	1.94	1.138	2.21
Natural Gas - 10^6 Btu	18.1	1.054	19.08
Petroleum - 10^6 Btu	8.0	1.132	9.06

11. "Energy Content of Aluminum Cans, Energy Conservation: Historical Performance and Future Potential," Preliminary Draft, The Aluminum Association, Inc., New York, June 30, 1975.
12. "Indirect Energy Requirements of Nuclear Electrical Power Generation," Franklin Associates, Ltd., in preparation.
13. The casting and rolling values were derived in a manner similar to that described in ref. 10 for smelting. The basic values are from ref. 11. The casting and rolling operation requires 718 pounds of molten metal and 218 pounds of clean industrial scrap to produce 1,000 pounds of aluminum sheet. The energy calculations are summarized below.

Casting and Rolling - 1,000 lb

Energy Source	Aluminum Association	Indirect Energy Correction Factor	Total
Coal - 10^6 Btu	1.298	1.015	1.3
Hydropower - 10^6 Btu	0.403	1.086	0.438
Nuclear - 10^6 Btu	0.0933	1.138	0.106
Natural gas - 10^6 Btu	6.898	1.054	7.270
Petroleum - 10^6 Btu	0.875	1.132	0.990

14. Page 168, ref. 2.
15. Page 169, ref. 2.
16. Page 170, ref. 2.
17. Page 171, ref. 2.
18. For waste disposal calculation, see ref. 10 in section D.6.5. For aluminum, it is estimated that 1,000 pounds of aluminum will occupy 5.93 cu ft, and 10 percent void space is 28.5 cu ft. From ref. 10 in section D.6.5, the gasoline required to dispose of 34.4 cu ft is 0.64 gallon.

19. This estimate was based on a crushed can volume of 34.4 cu ft per 1,000 lb (ref. 18), and rail travel of 1,500 miles.
20. This assumes a 0.3 lb corrugated tray per 24 can case, from ref. 22. The same tray is assumed for beer or soft drink.
21. This assumes 0.05 lb polyethylene ring carriers per 24 can case, from ref. 22. The same carrier is assumed for beer and soft drinks.
22. U.S. Brewers Association, private communication, July 1975. This information was based on a survey of major breweries to obtain information for this project. Transportation values were estimated from ref. 32.
23. Private communication from can manufacturer, assuming UV curing, powder coatings, and washer applied coatings.
24. The same 1974-1985 ratios were used as in ref. 23.
25. Weights for 1985 are assumed to be 27.0 lb/1,000 can bodies and 10.0 lb/1,000 can closures; based on ref. 26. Smelting, rolling and casting was assumed to require 15 percent less energy in 1985 than in the base year (1974), based on ref. 27 and 28; and can body and closure energy were based on new technology (ref. 23 and 29). Transportation energies were assumed to be reduced by 15 percent (ref. 28), and alumina manufacture was assumed to require 1,200 cu ft less natural gas per thousand pounds of alumina (ref. 33).
26. The Aluminum Association, private communication, June 1975.
27. "Energy Conservation in the Manufacturing Sector, 1954-1990," Federal Energy Administration, Project Independence Blue Print, Final Task Force Report, Volume 3, November 1974.
28. "Project Independence and Energy Conservation: Transportation Sector," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 2, November 1974.

29. "Beverage Packaging System Energy Study," American Can Company, Greenwich, Connecticut, 1975.
30. Corrugated tray weights for 1985 were assumed to be 35 percent less than in 1985, with the same values used for beer and soft drinks (ref. 22), but the plastic carriers were assumed to remain the same.
31. Private data submitted to Franklin Associates, Ltd.
32. U.S. Department of Commerce, Census of Transportation, 1972, Government Printing Office, Washington, D.C.
33. Atkins, P. R., and C. N. Cochran, "Future Energy Needs in the U.S. Light Metals Industry," Aluminum Company of America, Pittsburgh, Pennsylvania, draft copy received May 1975.

D.7 Candidate Containers--Steel Cans (Bimetal and All-Steel)

D.7.1 Introduction

There is currently one basic style of steel can widely used for both beer and soft drinks--the 12-fluid-ounce three-piece bimetal--consisting of a steel body and bottom and an aluminum "easy open" top. Other sizes do exist, and there is also a small but rapidly growing production of two-piece drawn and ironed (D&I) steel cans with aluminum lids, but, at present, the three-piece bimetal can dominates.

The three-piece can is made by stamping rectangular pieces of steel from rolls of strip; forming the piece into a can cylinder; and sealing the side seam by soldering, welding, or using an adhesive. A steel bottom is also punched from steel strip, formed, and fastened to the can body. An aluminum lid is fabricated as described in section D.6, and shipped with the steel can to the filler. In addition to the metal forming, the can must be decorated and coated. After each decorating and coating stage, the steel strip, or can part, is passed through a drying oven. These ovens account for much of the energy consumption in a can plant.

It is forecast that by 1985 the D&I can will have a large share of the steel can market. It is also predicted that a steel lid with a nondetachable convenience opener will have displaced the aluminum closure. Both D&I and three-piece all-steel cans were selected for study in 1985.

The weights of the candidate steel containers are shown in Table D.7-1.

D.7.2 Can Manufacturing Systems--Steel Bimetal and All-Steel Cans

D.7.2.1 Introduction. The steel can system is comprised of three basic modules shown in figure D.7-1. The first module includes the entire process for the manufacture of steel strip, including raw materials. The second is the process of manufacturing of steel cans, including lids and bottoms. Filling, distribution, and final disposal of the cans are grouped into the third module.

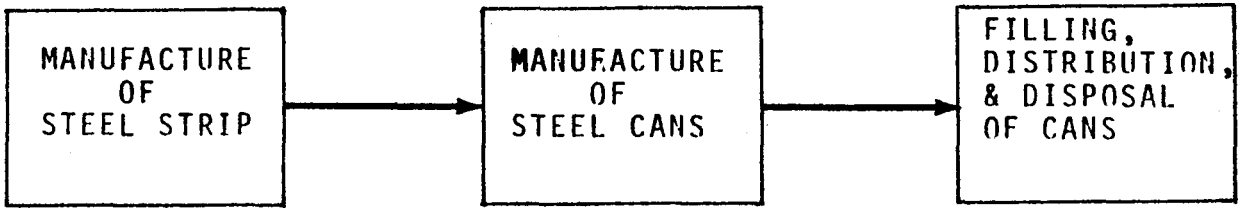


Figure D.7-1. Basic modules for steel can systems

Table D.7-1. Steel beverage container weights for 12-ounce cans (pounds per thousand containers)

1974	
Three-piece bimetal	
Steel body	74.0
Steel bottom	24.8
Aluminum "easy open" lid	11.5
Total	110.3
1985	
Two-piece D&I all-steel	
Steel body and bottom	65.6
Steel "easy-open" lid	19.8
Total	85.4
Three-piece all-steel	
Steel body	57.5
Steel bottom	19.8
Steel "easy-open" lid	19.8
Total	97.1

Source: Reference 3.

The energy profiles for 1,000-pound output modules involved in the steel process are tabulated in table D.7-2. The fuel, electricity, and transportation figures are used with the conversion factors described in section D.4 to produce the energy profile. In certain instances, modules involved in the steel process, e.g., mining of limestone, are profiled under other beverage container systems.

D.7.2.2 Energy Savings by 1985. For the 1985 energy profile, it was assumed that energy savings will take place in three categories: (1) reduction of materials required, (2) implementation of new can technology, and (3) improvements in conventional process efficiency. The reduction in metal requirements will come through conversion from three-piece cans to two-piece cans and from reducing the weight of metal in the cans. New can-making technology

Table D.7-2. Fuel and energy profile for steel process modules per 1,000 lb of output (in energy-related terms by process modules)

Description	Fuels: Residual oil (gallons)	Fuels: Gasoline (gallons)	Fuels: Natural Gas (cu ft)	Fuels: Distillate oil (gallons)	Fuels: Coal (pounds)	Electricity (kwhr)	Transportation: Rail (ton-miles)	Transportation: Truck (ton-miles)	Transportation: Barge (ton-miles)	Energy: Natural gas (10^6 Btu)	Energy: Petroleum (10^6 Btu)	Energy: Coal (10^6 Btu)	Energy: Nuclear (10^6 Btu)	Energy: Hydropower (10^6 Btu)	Energy: Total (10^6 Btu)
Iron ore mining - 1,000 lb[a]	0.21	--	100	0.12	--	14	--	--	--	0.226	0.006	0.076	0.000	0.000	0.401
Iron ore transport - 1,000 lb[a]	--	--	--	--	--	--	41	--	150	--	0.119	--	--	--	0.119
Coal mining - 1,000 lb[a]	0.01	0.02	1.9	0.11	1.0	6	--	--	--	0.013	0.034	0.040	0.003	0.003	0.092
Coal transport - 1,000 lb[a]	--	--	--	--	--	--	90	2	15	--	0.093	--	--	--	0.093
Oxygen manufacture - 1,000 lb[a]	0.3	0.25	764	0.1	--	208	--	--	--	1.281	0.552	1.104	0.114	0.113	3.163
Oxygen transport - 1,000 lb[a]	--	--	--	--	--	--	27	6.5	--	--	0.039	--	--	--	0.039
Steel scrap procurement - 1,000 lb[a]	--	--	96	0.7	--	20	--	--	--	0.147	0.154	0.146	0.011	0.011	0.429
Steel scrap transport - 1,000 lb[a]	--	--	--	--	--	--	66	--	10	--	0.068	--	--	--	0.068
Coke manufacture - 1,000 lb[b]	--	--	--	--	--	83.2	--	--	--	0.029	0.020	0.030	0.007	0.007	0.141
Agglomerates manufacture - 1,000 lb[b]	0.07	--	114	--	--	7.16	--	--	--	0.100	0.095	0.038	0.004	0.004	0.281
Steel strip production - 1,000 lb[m]	3.2	--	2085	--	936	213	--	--	--	3.164	1.003	13.579	0.116	0.116	17.979
Electric furnace - 1,000 lb[f]	--	--	50	--	--	276	--	--	--	0.649	0.593	1.450	0.150	0.150	3.001
Steel milling - 1,000 lb[b]	0.74	--	2124.4	--	--	181.72	--	--	--	2.704	0.610	0.964	0.099	0.099	4.304
Steel strip transport - 1,000 lb[a]	--	--	--	--	--	--	127	38	47	--	0.220	--	--	--	0.220
3-piece can body fabricate 1974 - 1,000 lb[j]	--	--	3110	--	--	167.3	--	--	--	3.624	0.231	0.569	0.059	0.060	4.542
3-piece can body fabricate 1985 - 1,000 lb[j]	--	--	3689	--	--	138.1	--	--	--	4.112	0.283	0.696	0.072	0.074	5.234
DWI can body fabricate 1985 - 1,000 lb[j]	--	--	1807	--	--	167.2	--	--	--	1.612	0.317	0.781	0.080	0.080	2.771
Can bottom fabricate 1974 - 1,000 lb[j]	--	--	1416	--	--	27.4	--	--	--	1.6	0.059	0.146	0.015	0.015	1.834
Can end fabricate 1985 - 1,000 lb[j]	--	--	1561	--	--	33.2	--	--	--	1.769	0.072	0.176	0.018	0.018	2.043
Steel can transport - 1,000 lb[a]	--	--	--	--	--	--	48	56	5	--	0.186	--	--	--	0.186
Waste disposal transport - 1,000 lb[a]	--	0.31	--	--	--	--	--	--	--	--	0.046	--	--	--	0.045
Scrap can transport - 1,000 lb[a]	--	--	--	--	--	--	100	60	--	--	0.212	--	--	--	0.212
Waste processing - 1,000 lb[b]	--	--	1360	--	--	936	--	--	--	1.748	0.289	0.711	0.073	0.073	2.894

[a] See notes and references 4.
[b] See notes and references 1.
[f] See notes and references 3.
[g] See table B.6-2, 1,000 cu ft natural gas added.
[h] Assumed to be 100 ton-miles by rail and 50 ton-miles by truck.
[j] Calculated by method of reference 10, plastics section. Assumed 1.47×10^{-3} cu ft per can.
[m] Manufacturing process for steel strip, including blast furnace, BOF furnace, and milling. See notes and references 1.
[f] Manufacturing process for steel strip, beginning with molten metal from electric furnace.

Source: Franklin Associates, Ltd.

can also result in substantial energy savings. In addition, it was assumed that the energy to produce steel strip will be reduced 10 percent by 1985 (ref. 7). Energy conservation for the other steel systems is the same as for the ancillary systems for aluminum cans (see section D.6.4).

D.7.2.3 Manufacture of Steel Strip. As defined in this study, the steel strip manufacturing process includes all steps from obtaining the raw materials through the milling process. The raw materials may be virgin or recycled.

D.7.2.3.1 Virgin Materials. Figure D.7-2 is a materials flowsheet for the manufacture of steel strip from virgin materials. The basic oxygen process (BOP), which was used in over 55 percent of the raw steel production in the U.S. in 1973, (ref. 5) was assumed to be used with the virgin materials. At least 70 percent of the can stock manufactured in this country is made by this process (ref. 8).

The energy consumed in the production of steel strip in the steel mill is summarized in table D.7-3. The virgin materials are turned into pig iron in the blast furnace and are refined into steel in the BOP furnace. The steel is cast into ingots, then proceeds through various milling, cleaning, and annealing processes before emerging as tin plated steel strip appropriate for use in steel cans.

The energy profile for the components of the virgin materials steel strip system is shown in table D.7-4. It is apparent that the production of strip in the steel mill consumes by far the most energy--87.9 percent. Coal accounts for almost 70 percent of the system's energy requirement.

D.7.2.3.2 Recycled Materials. If recycled cans are to be used to produce steel strip, a materials flow as represented in figure D.7-3 would be required. The waste cans would be collected, processed, and transported to a steel mill. It was assumed that an electric furnace would be used to melt the steel cans, since this type of furnace can accept a charge of nearly 100 percent scrap (ref. 1). After the molten steel leaves the electric furnace, the remainder of the milling process would be the same as for steel strip produced from virgin materials.

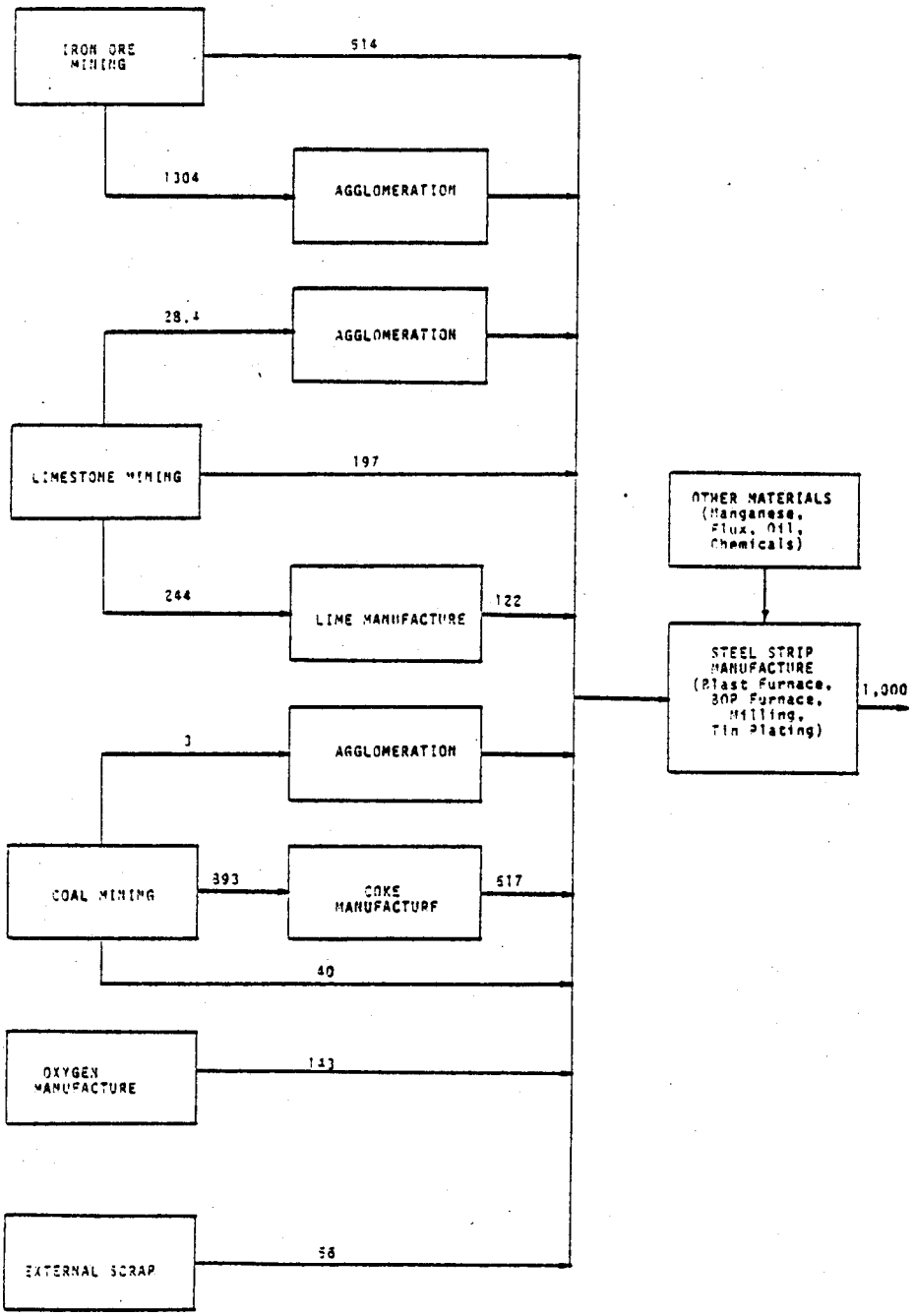


Figure D.7-2. Materials flow for the manufacture of 1,000 lb steel strip from virgin materials.

Table D.7-3. Energy consumption in steel mill processes*
(1,000 pounds steel strip)

Process	Residual oil (gallon)	Natural gas (cu ft)	Coal (pound)	Electricity† (kwhr)
Blast furnace	2.43	204.75	936	12.6
BOP furnace	--	155.9	--	18.7
Vacuum degassing	--	--	--	1.24
Ingot casting	--	--	--	1.2
Slabbing/blooming mill	--	37.6	--	15.29
Slab reheat furnace	0.3	1,312.2	--	1.53
Hot strip mill	--	--	--	48.92
Pickle line	--	--	--	5.34
Cold rolling mill	--	--	--	34.91
Cleaning line	--	--	--	3.93
Annealing line	0.44	774.6	--	13.1
Double reduction cold mill	--	--	--	16.26
Tin line	--	--	--	40.0
Total	3.17	2,485.05	936	213.02

*See notes and references 6.

†Purchased. It was assumed that reference 1 figures are for total electricity used. Purchased electricity is 80 percent of total for 1973, according to reference 5, table 47.

Source: Franklin Associates, Ltd.

The energy profile for production of steel strip from recycled cans is summarized in table D.7-5. The energy used is divided rather evenly among the three steps in the process.

At the present time, steel recycling cannot be viewed as part of a "closed loop" process where cans may be recycled into cans an indefinite number of times. Scrap cans are used in the production of

Table D.7-4. Steel strip systems calculations summary - virgin materials, 1974
(million Btu for 1,000 lb steel strip)

System	Natural Gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of Total
Iron ore mining - 1818 lb*	0.411	0.154	0.135	0.014	0.014	0.728	3.6
Iron ore transport - 1818 lb*	--	0.216	--	--	--	0.216	1.1
Limestone mining - 469.4 lb†	0.003	0.008	0.003	--	--	0.015	0.1
Limestone transport - 469.4 lb†	--	0.031	--	--	--	0.031	0.1
Lime manufacture - 22 lb	0.115	0.014	0.155	0.001	0.001	0.286	1.4
Lime transport - 22 lb	--	0.016	--	--	--	0.016	0.1
Coal mining - 936 lb*	0.012	0.031	0.037	0.003	0.003	0.086	0.4
Coal transport - 936 lb*	--	0.087	--	--	--	0.087	0.4
Coke manufacture - 617 lb*	0.018	0.018	0.043	0.004	0.004	0.087	0.4
Agglomerates manufacture - 1534 lb*	0.214	0.146	0.058	0.006	0.006	0.430	2.1
Purchased scrap - 56 lb*	0.008	0.009	0.006	0.001	0.001	0.024	0.1
Scrap transport - 56 lb*	--	0.003	--	--	--	0.003	--
Oxygen manufacture - 143 lb*	0.183	0.079	0.158	0.016	0.016	0.452	2.2
Oxygen transport - 143 lb*	--	0.006	--	--	--	0.006	--
Steel strip production - 1,000 lb*	3.164	1.003	13.579	0.116	0.116	17.979	87.9
Total	4.128	1.821	14.175	0.161	0.161	20.446	99.9
Percent of total	20.2	8.9	69.3	0.8	0.8	100.0	

*Calculated from table D.7-2.
†Calculated from table D.6-2.

Source: Franklin Associates, Ltd.

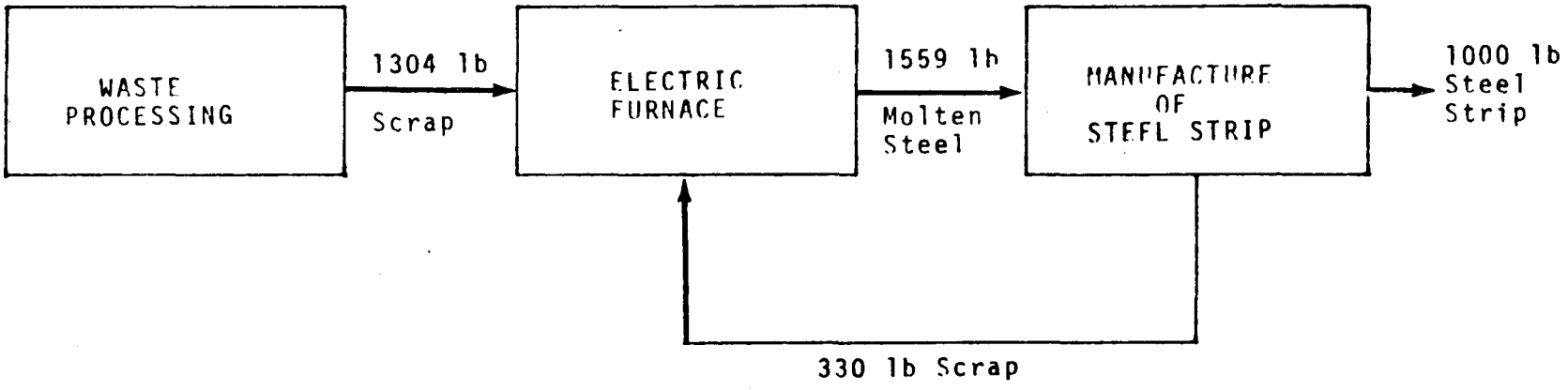


Figure D.7-3. Materials flow for manufacture of 1,000 lb steel strip from recycled material

Table D.7-5. Steel strip systems calculations summary - recycled materials, 1974
(million Btu for 1,000 lb steel strip)

System	Natural Gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of total
Waste processing - 1304 lb*	2.279	0.377	0.927	0.095	0.095	3.774	29.4
Electric furance - 1559 lb*	1.012	0.924	2.275	0.234	0.234	4.679	36.4
Steel milling - 1,000 lb*	2.704	0.518	0.964	0.099	0.099	4.384	34.2
Total	5.996	1.819	4.166	0.429	0.428	12.837	100.0
Percent of total	46.7	14.2	32.5	3.3	3.3	100.0	

*Calculated from table D.7-2.

Source: Franklin Associates, Ltd.

copper, or tend to be recycled back into steel products such as reinforcing bar or other structural products from which recycling does not ordinarily take place. The reason for this is that post-consumer scrap cans are contaminated and cannot normally be tolerated at recycling rates of greater than 5 percent into high grade steels such as can stock. Thus, in these recycling calculations, it has been assumed that it is necessary to upgrade the scrap through some processing mechanism to make it suitable for "closed loop" recycling of the type in which aluminum cans participate.

Table D.7-6 compares the energy requirements for virgin and recycled steel strip. The table shows that recycling by using an electric furnace results in a 37 percent energy savings, with 71 percent savings of coal energy, and a 45 percent increase in natural gas requirements.

D.7.2.4 Manufacture of Steel Cans

D.7.2.4.1 Three-Piece Cans. A three-piece bimetal can with steel body and bottom and aluminum closure was selected for the 1974 case and a three-piece all-steel can for 1985. For 1974 virgin materials were used; for 1985, both virgin and recycled materials were considered.

Flow sheets for the manufacture of steel can bodies and can ends are shown in figures D.7-4 through D.7-7. More steel is used in the manufacture of 1,000 pounds of ends than 1,000 pounds of bodies because of the waste in stamping the circular shapes from steel strip. This scrap is, however, recycled within the steel industry.

The energy profiles for the steel can bodies, ends, and closures are summarized in table D.7-7 for 1974 and table D.7-8 for 1985. Coal provides a large percentage of the energy for the steel bodies and ends, with natural gas accounting for most of the rest. The energy profile for aluminum closures for 1974 is taken from section D.6.

D.7.2.4.2 Drawn and Ironed Cans. For 1985, a D&I all-steel can with steel "easy-open" closure was selected. Figure D.7-8 shows the materials flow for the manufacture of D&I can bodies. Steel can ends for D&I cans were assumed to be the same as those described earlier.

Table D.7-6. Comparison of virgin and recycled steel strip systems (in million Btu and percent difference)

	Natural Gas	Petroleum	Coal	Nuclear	Hydropower	Total
Difference* (million Btu)	+1.87	-0.002	-10.01	+0.27	+0.27	-7.61
Percent difference†	+45	-0.1	-71	+168	+168	-37

*Calculated by (Recycled - Virgin). Negative numbers mean virgin numbers are larger.

†Calculated by (Difference ÷ Virgin) x 100.

Source: Franklin Associates, Ltd.

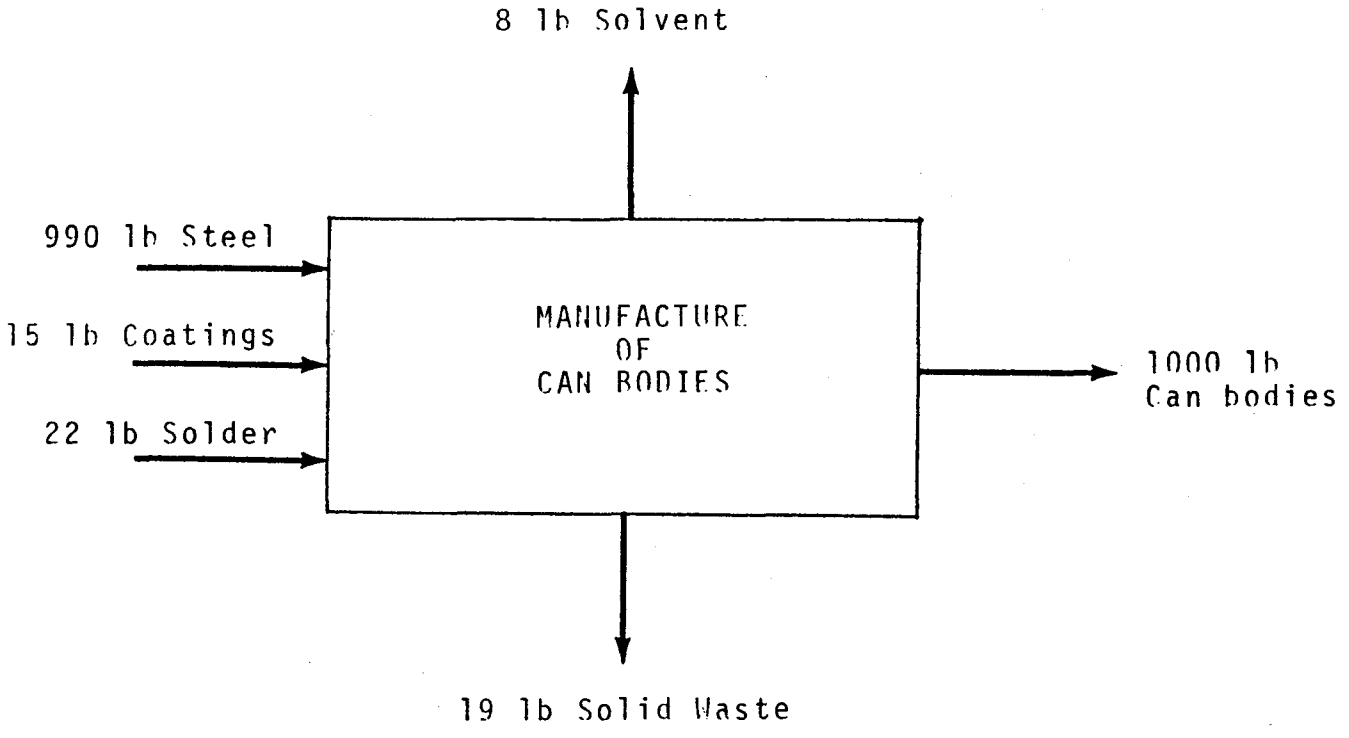


Figure D.7-4. Materials flowsheet for manufacture of 1,000 lb bodies for three-piece steel cans, 1974

Source: Franklin Associates, Ltd., based on Reference 2.

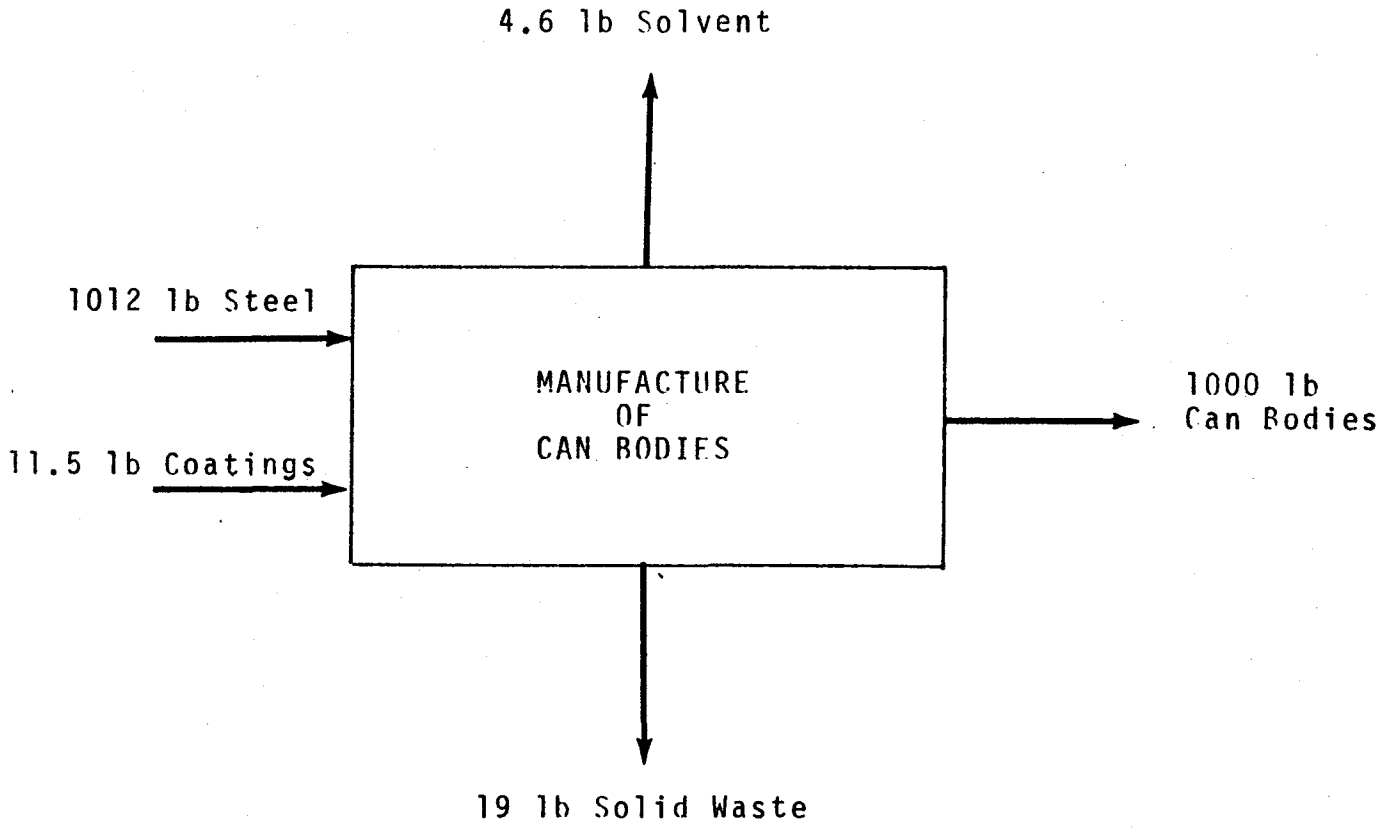


Figure D.7-5. Material flowsheet for manufacture of 1000 lb bodies for three-piece steel cans, 1985

Source: Franklin Associates, Ltd., based on ref. 2.

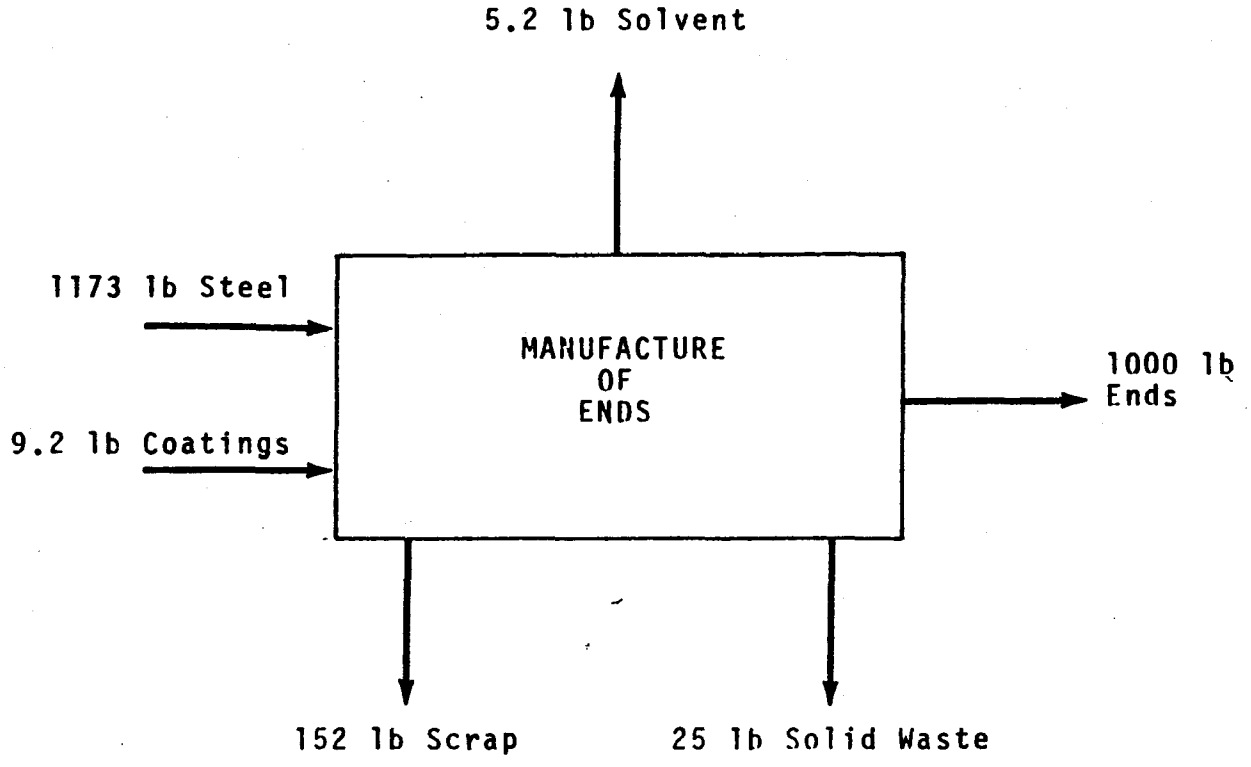


Figure D.7-6. Materials flowsheet for manufacture of 1,000 lb ends for steel cans, 1974

Source: Franklin Associates, Ltd., based on ref. 2.

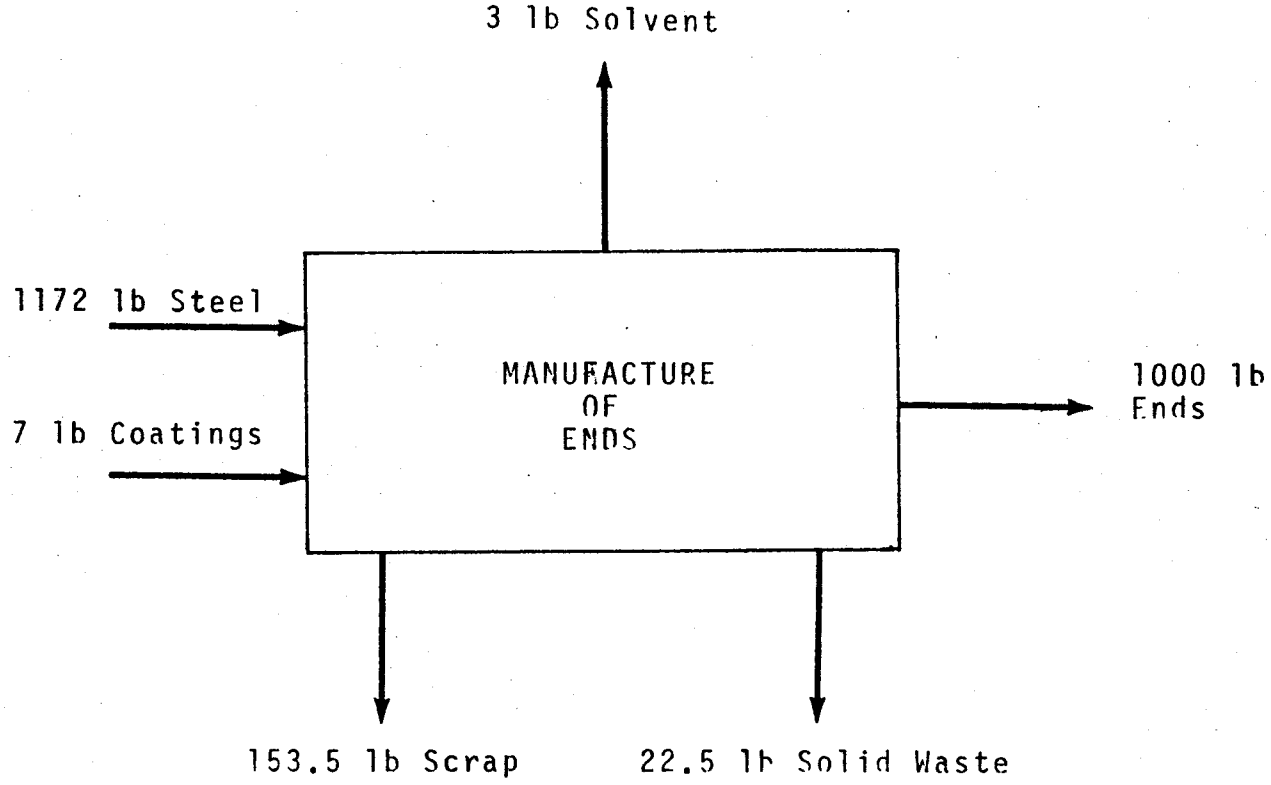


Figure D.7-7. Materials flowsheet for manufacture of 1,000 lb ends for steel cans, 1985

Source: Franklin Associates, Ltd., based on ref. 2.

Table D.7-7. Three-piece bimetal can manufacturing system calculations summary, 1974
(million Btu)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of Total
Virgin materials system							
Can bodies - 1,000 lb							
Steel strip - 990 lb*	4.087	1.803	14.033	0.160	0.159	20.242	78.1
Steel strip transport - 990 lb*	--	0.226	--	--	--	0.226	0.9
Coatings - 15 lb†	0.562	0.053	0.089	0.009	0.009	0.722	2.8
Can fabrication - 1,000 lb*	3.624	0.231	0.569	0.059	0.058	4.542	17.5
Can transport - 1,000 lb§	--	0.186	--	--	--	0.186	0.7
Total	8.273	2.499	14.691	0.227	0.227	25.918	100.0
Percent of total	31.9	9.6	56.7	0.9	0.9	100.0	
Can ends - 1,000 lb							
Steel strip - 1173 lb*	4.843	2.136	16.627	0.189	0.189	23.984	89.8
Steel transport - 1173 lb*	--	0.267	--	--	--	0.267	1.0
Coatings - 9.2 lb†	0.344	0.033	0.054	0.006	0.006	0.443	1.7
End fabricate - 1,000 lb*	1.600	0.059	0.145	0.015	0.015	1.834	6.9
End transport - 1,000 lb§	--	0.186	--	--	--	0.186	0.7
Total	6.787	2.681	16.827	0.210	0.209	26.714	100.0
Percent of total	25.4	10.0	63.0	0.8	0.8	100.0	
Aluminum closures - 1,000 lb‡	36.561	25.195	34.862	2.496	10.260	109.374	
Percent of total	33.4	23.0	31.9	2.3	9.4	100.0	

*From table D.7-2.
†See section D.5. The polyethylene products system was used as an estimate for the coatings system.
‡See section D.6.
§See notes and references 4.

Source: Franklin Associates, Ltd.

Table D.7-8. Three-piece all-steel can manufacturing system calculations summary, 1985 (million Btu)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of total
Virgin materials system							
Can bodies - 1,000 lb							
Steel strip - 1012 lb*	3.859	1.691	12.967	0.152	0.151	18.820	75.7
Steel transport - 1012 lb†	--	0.196	--	--	--	0.196	0.8
Coatings - 11.5 lb‡	0.366	0.035	0.058	0.006	0.006	0.470	1.9
Can fabrication - 1,000 lb§	4.112	0.283	0.696	0.072	0.071	5.234	21.0
Can transport - 1,000 lb†	--	0.158	--	--	--	0.158	0.6
Total	8.337	2.362	13.721	0.229	0.229	24.878	100.0
Percent of total	33.5	9.5	55.1	0.9	0.9	99.9	
Can ends - 1,000 lb							
Steel strip - 1172 lb*	4.469	1.959	15.017	0.176	0.175	21.796	88.9
Steel transport - 1,172†	--	0.227	--	--	--	0.227	0.9
Coatings - 7 lb‡	0.223	0.021	0.035	0.004	0.004	0.286	1.2
End fabrication - 1,000 lb§	1.759	0.072	0.176	0.018	0.018	2.043	8.3
End transport - 1,000 lb†	--	0.158	--	--	--	0.158	0.6
Total	6.451	2.436	15.229	0.197	0.197	24.510	99.9
Percent of total	26.3	9.9	62.1	0.8	0.8	99.9	
Recycled materials system							
Can bodies - 1,000 lb							
Steel strip - 1012 lb¶	5.461	1.657	3.794	0.391	0.390	11.693	65.9
Ancillary systems#	4.478	0.671	0.754	0.077	0.078	6.058	34.1
Total	9.939	2.328	4.548	0.468	0.468	17.751	100.0
Percent of total	56.0	13.1	25.6	2.6	2.6	100.0	
Can ends - 1,000 lb							
Steel strip - 1172 lb¶	6.324	1.919	4.395	0.391	0.390	13.419	82.6
Ancillary systems#	1.982	0.478	0.211	0.082	0.083	2.836	17.4
Total	8.306	2.397	4.606	0.473	0.473	16.255	100.0
Percent of total	51.1	14.7	28.3	2.9	2.9	99.9	

*It was assumed that 10 percent energy reductions would be achieved for steel strip between 1974 and 1985.
†See section D.4.2 for discussion of energy savings for transportation.
‡See section D.5. The polyethylene products system was used as an estimate for the coating system.
§From table D.7-2.
¶A 10 percent energy reduction was assumed between 1974 and 1985.
#Includes all components of virgin system except steel strip.

Source: Franklin Associates, Ltd.

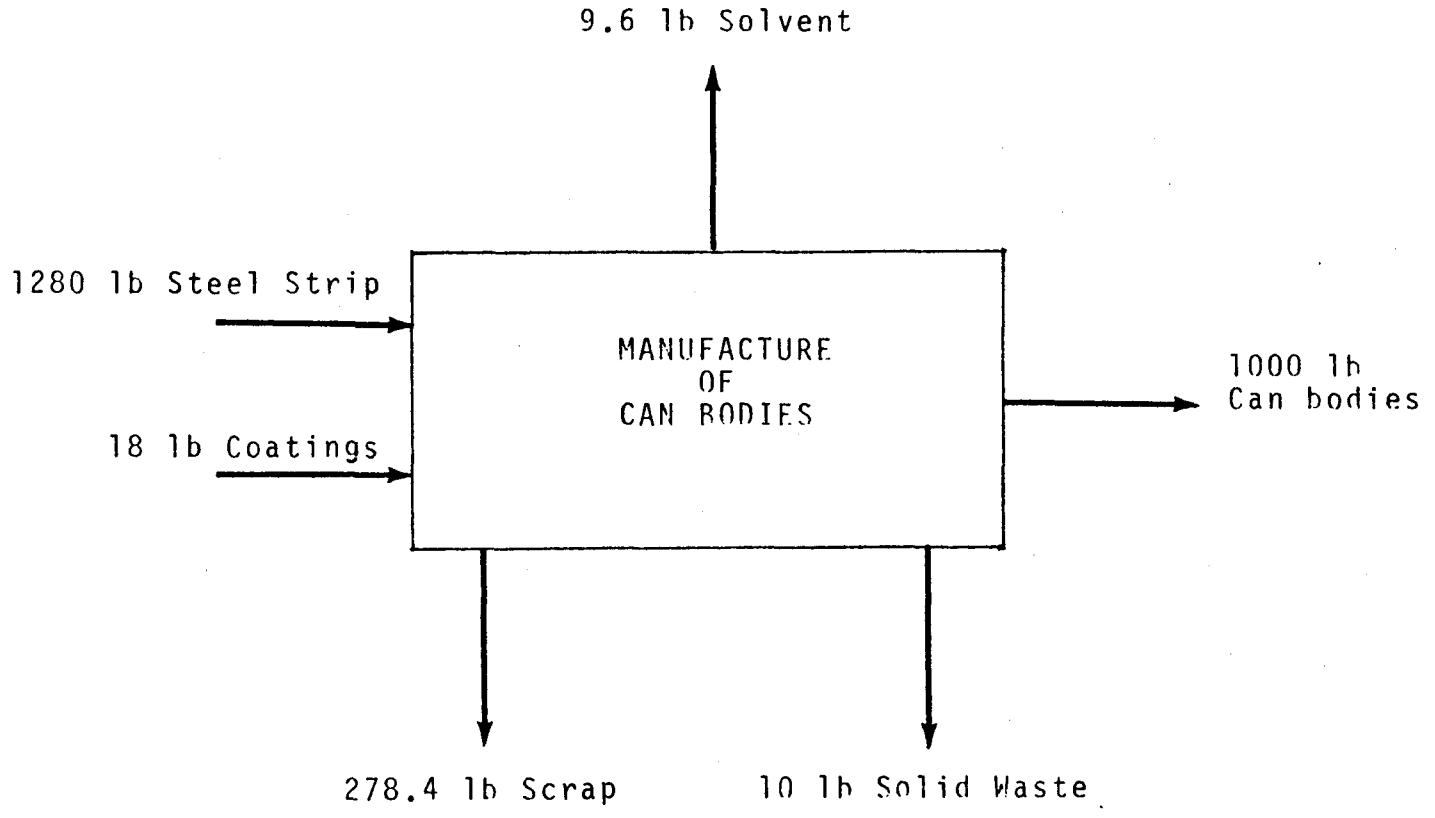


Figure D.7-8 Materials flowsheet for manufacture of 1,000 lb bodies for D&I steel cans, 1985

Source: Franklin Associates, Ltd., based on ref. 2.

The energy profile for D&I all-steel cans is shown in table D.7-9. For the virgin materials, coal is once again the major source of energy used, with the manufacture of steel strip accounting for 86 percent of the total.

A comparison of the virgin materials system and the recycled materials system shows that recycling consumes about 32 percent less energy overall. When recycled steel is used, natural gas consumes about one-half of the energy used because of the waste processing and electric furnace used in reclaiming the scrap cans.

D.7.3 Supplementary Materials, Filling, and Distribution

The supplementary materials, filling, and distribution were assumed to be the same for both steel and aluminum cans. Those systems are described in section D.6.3.

D.7.4 Total Container Systems for Steel Cans

D.7.4.1 Three-Piece Cans. The various components of the three-piece can system are brought together as shown in figure D.7-8. The containers proceed through filling, packaging, and distribution steps to use and final disposal. Energy profiles for the total three-piece can system in 1974 are displayed in tables D.7-10 and D.7-11. Data for soft drinks and beer are developed separately to show the differences in filling and distribution. For 1985 (table D.7-12), a complete energy profile for the three-piece soft drink system is developed. The recycling scenario is summarized on the same table.

The energy consumed in the manufacture of steel can bodies and bottoms has been detailed previously in this section. Energy profiles for aluminum closures, polyethylene carriers, corrugated trays, filling of cans, and distribution are developed elsewhere in this appendix. Inspection of the energy profiles reveals that the manufacture of the components of the cans themselves consumes over 85 percent of the energy. Packaging, filling, distribution, and waste disposal account for the rest, with filling being relatively more important for soft drinks, and distribution for beer.

Table D.7-9. D&I all-steel can manufacturing system calculations summary - 1985 (million Btu)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of total
Virgin materials system							
Can bodies - 1,000 lb							
Steel strip - 1280 lb*	4.881	2.139	16.401	0.192	0.191	23.804	85.9
Steel transport - 1280 lb†	--	0.248	--	--	--	0.248	0.9
Coatings - 18 lb‡	0.573	0.054	0.091	0.009	0.009	0.736	2.7
Can fabrication - 1,000 lb§	1.512	0.317	0.781	0.080	0.080	2.771	10.0
Can transport - 1,000 lb†	--	0.158	--	--	--	0.158	0.6
Total	6.966	2.917	17.273	0.281	0.281	27.717	100.1
Percent of total	25.1	10.5	62.3	1.0	1.0	99.9	
Can ends - 1,000 lb							
Steel strip - 1172 lb*	4.469	1.959	15.017	0.176	0.175	21.796	88.9
Steel transport - 1172 lb†	--	0.227	--	--	--	0.227	0.9
Coatings - 7 lb‡	0.223	0.021	0.035	0.004	0.004	0.286	1.2
End fabrication - 1,000 lb§	1.759	0.072	0.176	0.018	0.018	2.043	8.3
End transport - 1,000 lb†	--	0.158	--	--	--	0.158	0.6
Total	6.451	2.436	15.229	0.197	0.197	24.510	99.9
Percent of total	26.3	9.9	62.1	0.8	0.8	99.9	
Recycled materials system							
Can bodies - 1,000 lb							
Steel strip - 1280 lb¶	6.907	2.095	4.799	0.494	0.493	14.788	79.1
Ancillary systems‖	2.085	0.778	0.872	0.089	0.090	3.913	20.9
Total	8.992	2.873	5.671	0.583	0.583	18.701	100.0
Percent of total	48.1	15.4	30.3	3.1	3.1	100.0	
Can ends - 1,000 lb							
Steel strip - 1172 lb¶	6.324	1.919	4.395	0.391	0.390	13.419	82.6
Ancillary systems‖	1.982	0.478	0.211	0.082	0.083	2.836	17.4
Total	8.306	2.397	4.606	0.473	0.473	16.255	100.0
Percent of total	51.1	14.7	28.3	2.9	2.9	99.9	

*It was assumed that 10 percent energy reductions would be achieved for steel strip between 1974 and 1975.
†See section D.4.2 for discussion of energy savings for transportation.
‡See section D.5. The polyethylene products system was used as an estimate for the coating system.
§From table D.7-2.
¶A 10 percent energy reduction was assumed between 1974 and 1985.
‖Includes all components of virgin system except steel strip.

Source: Franklin Associates, Ltd.

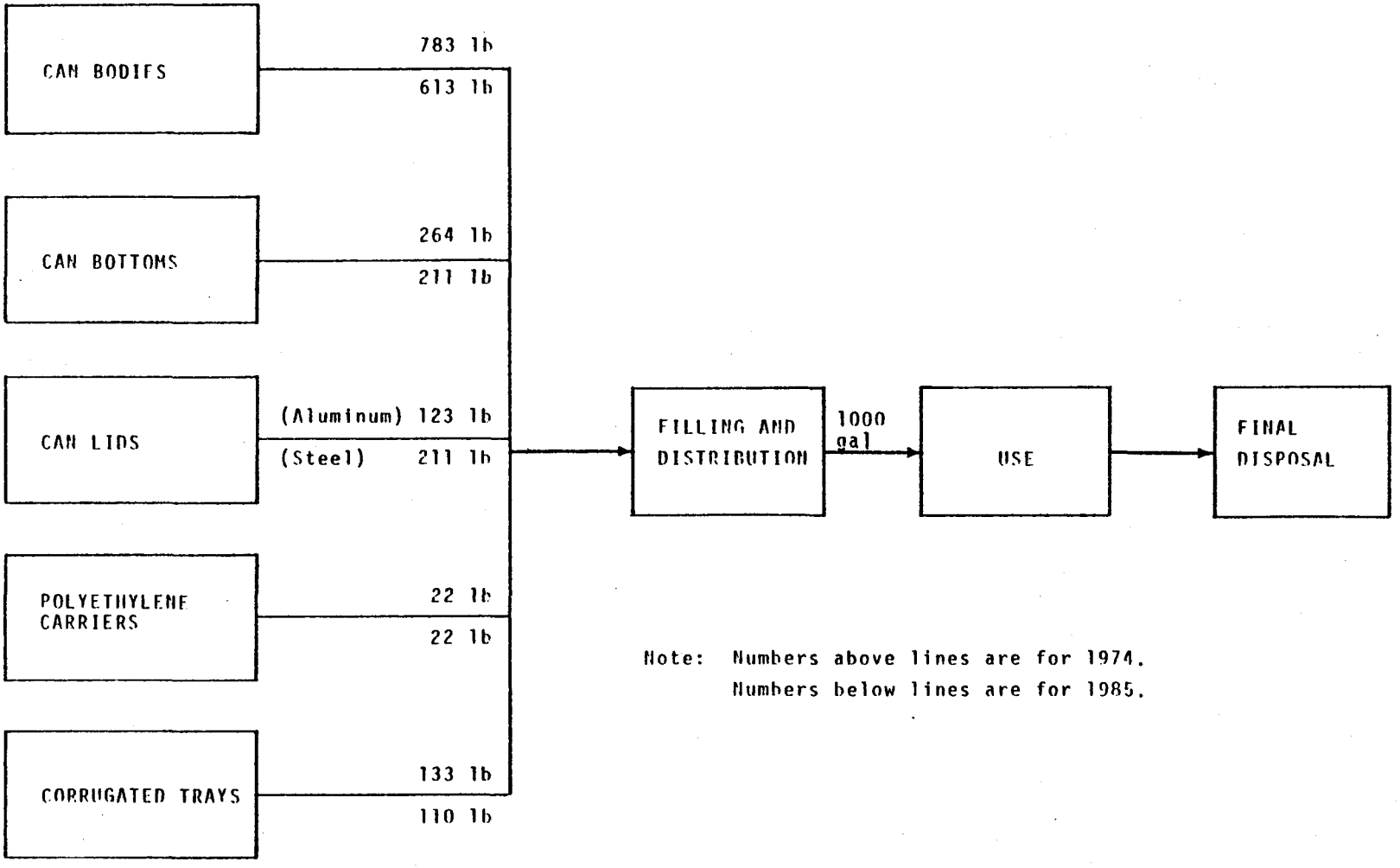


Figure D.7-8. Component of total 12-ounce three-piece steel can system.

Table D.7-10. Final calculation summary for 12-ounce three-piece bimetal can soft drink system - 1974
(million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of total
Virgin materials system								
Steel can bodies - 783 lb*	6.478	1.957	11.503	0.178	0.178	--	20.293	43.7
Steel can ends - 264 lb*	1.792	0.708	4.442	0.055	0.055	--	7.052	15.2
Aluminum can lids - 123 lb*	4.497	3.099	4.288	0.307	1.262	--	13.453	29.0
Supplementary package								
Polyethylene carrier - 22 lb†	0.824	0.078	0.13	0.013	0.013	--	1.059	2.3
Corrugated trays - 133 lb†	0.386	0.597	0.368	0.012	0.012	0.756	2.131	4.6
Filling - 1,000 gal‡	0.567	0.408	0.297	0.031	0.030	--	1.332	2.9
Distribution - 1,000 gal‡	--	1.038	--	--	--	--	1.038	2.2
Waste disposal - 1192 lb§	--	0.054	--	--	--	--	0.054	0.1
Total	14.543	7.937	21.029	0.596	1.550	0.756	46.412	100.0
Percent of total	31.3	17.1	45.3	1.3	3.3	1.6	99.9	

*From table D.7-7.
†Includes steel, aluminum, and polyethylene. It is assumed the corrugated tray will be removed by the retailer and recycled.
‡From table D.7-2.
§See section D.6.

Source: Franklin Associates, Ltd.

Table D.7-11. Final calculation summary for 12-ounce three-piece bimetal can beer system - 1974
(million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of total
Virgin materials system								
Steel can bodies - 783 lb*	6.478	1.957	11.503	0.178	0.178	--	20.293	44.0
Steel can bottoms - 264 lb*	1.792	0.708	4.442	0.055	0.055	--	7.052	15.3
Aluminum can lids - 123 lb*	4.497	3.099	4.288	0.307	1.262	--	13.453	29.2
Supplementary package								
Polyethylene carrier - 22 lb†	0.824	0.078	0.130	0.013	0.013	--	1.059	2.3
Corrugated trays - 133 lb†	0.386	0.597	0.368	0.012	0.012	0.756	2.131	4.6
Filling - 1,000 gal†	0.054	0.054	0.133	0.014	0.014	--	0.268	0.6
Distribution - 1,000 gal†	--	1.776	--	--	--	--	1.776	3.9
Waste disposal - 1192 lb†	--	0.054	--	--	--	--	0.054	0.1
Total	14.031	8.321	20.865	0.579	1.534	0.756	46.085	100.0
Percent of total	30.4	18.1	45.3	1.3	3.3	1.6	100.0	

*From table D.7-7.
†See section D.6.
‡Includes steel, aluminum, and polyethylene. It is assumed the corrugated tray will be removed by the retailer and recycled. From table D.7-2.

Source: Franklin Associates, Ltd.

Table D.7-12. Final calculation summary for 12-ounce three-piece all-steel can soft drink systems - 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of total
Virgin materials system								
Steel can bodies - 613 lb*	5.111	1.448	8.411	0.140	0.140	--	15.250	50.4
Steel can ends - 422 lb*	2.722	1.028	6.427	0.083	0.083	--	10.343	34.2
Supplementary package								
Polyethylene carriers - 22 lb†	0.700	0.066	0.111	0.011	0.011	--	0.899	3.0
Corrugated trays - 110 lb†	0.300	0.454	0.286	0.009	0.009	0.588	1.646	5.4
Filling - 1,000 gal†	0.511	0.367	0.267	0.027	0.027	--	1.199	4.0
Distribution - 1,000 gal†	--	0.882	--	--	--	--	0.882	2.9
Waste disposal - 1057 lb‡	--	0.047	--	--	--	--	0.047	0.2
Total	9.344	4.292	15.502	0.270	0.270	0.588	30.266	100.1
Percent of total	30.9	14.2	51.2	0.9	0.9	1.9	100.0	
Recycled materials system								
Steel can bodies - 613 lb*	6.093	1.427	2.788	0.287	0.287	--	10.881	48.5
Steel can ends - 422 lb*	3.505	1.012	1.944	0.200	0.200	--	6.860	30.6
Ancillary systems§	1.511	1.816	0.664	0.047	0.047	0.588	4.673	20.8
Total	11.109	4.255	5.396	0.534	0.534	0.588	22.414	99.9
Percent of total	49.6	19.0	24.1	2.4	2.4	2.6	100.1	

*From table D.7-8.
†See section D.6.
‡Includes steel and polyethylene. It is assumed that the corrugated tray will be removed by the retailer and recycled.
§Can bodies and ends from table D.7-8. Other components are the same as virgin system above.

Source: Franklin Associates, Ltd.

Coal provides 45 percent of the energy for the three-piece bimetal can system in 1974 with natural gas and petroleum together providing another 49 percent.

D.7.4.2 Two-Piece D&I Cans. The complete cycle for the D&I can system for 1985 is illustrated in figure D.7-9. The energy profile for the can is shown in table D.7-13, for both virgin materials and recycled materials.

For virgin materials, manufacture of cans and lids consumes 84 percent of the energy used. Coal provides over half of the fuel for the virgin system--but only about 25 percent of the recycled system. Natural gas and petroleum account for over 65 percent of the energy for the recycled system. On a total energy basis, the recycled can system consumes 24 percent less energy than the virgin materials system.

To compare the three-piece can for 1985 with the three-piece can in 1974, table D.7-14 was prepared. The can requires 35 percent less energy for virgin materials and 54 percent less energy for recycled materials in 1985. Recycling provides a very large saving (74 percent) for coal, but smaller savings for natural gas because of the scrap processing required.

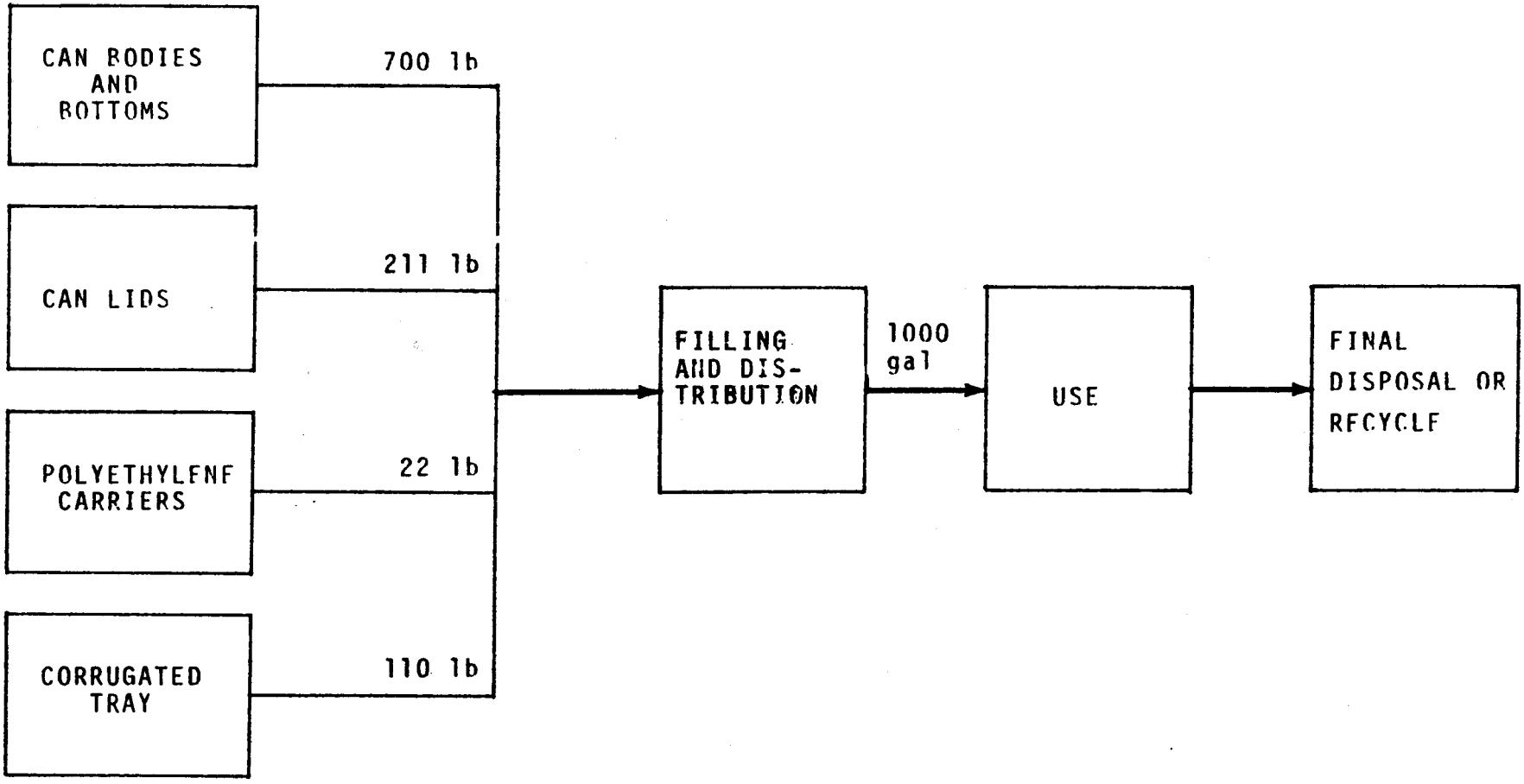


Figure D.7-9. Components of total 12-ounce D&I steel can system - 1985

Source: Franklin Associates, Ltd.

Table D.7-13. Final calculation summary for 12-ounce D&I all-steel can soft drink system, 1985
(million Btu per 1,000 gallons beverage delivered to consumer)

System	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of total
Virgin materials system								
Steel can bodies - 700 lb*	4.876	2.042	12.091	0.197	0.197	--	19.402	66.3
Steel can ends - 211 lb*	1.361	0.514	3.213	0.042	0.042	--	5.172	17.7
Supplementary package								
Polyethylene carriers - 22 lb†	0.700	0.066	0.111	0.011	0.011	--	0.899	3.1
Corrugated trays - 110 lb†	0.300	0.454	0.286	0.009	0.009	0.588	1.646	5.6
Filling - 1,000 gal†	0.511	0.367	0.267	0.027	0.027	--	1.199	4.1
Distribution - 1,000 gal†	--	0.882	--	--	--	--	0.882	3.0
Waste disposal - 933 lb‡	--	0.042	--	--	--	--	0.042	0.1
Total	7.748	4.367	15.968	0.286	0.286	0.588	29.242	99.9
Percent of total	26.5	14.9	54.6	1.0	1.0	2.0	100.0	
Recycled materials system								
Steel can bodies - 700 lb*	6.294	2.011	3.970	0.408	0.408	--	13.091	61.8
Steel can ends - 211 lb*	1.753	0.506	0.972	0.100	0.100	--	3.430	16.2
Ancillary systems§	1.511	1.811	0.664	0.047	0.047	0.588	4.668	22.0
Total	9.558	4.328	5.606	0.555	0.555	0.588	21.189	100.0
Percent of total	45.1	20.4	26.5	2.6	2.6	2.8	100.0	

*From table D.7-9.
†See section D.6.
‡Includes steel and polyethylene. It is assumed that the corrugated tray will be removed by the retailer and recycled.
§Can bodies and ends from table D.7-9. Other components are the same as virgin system above.

Source: Franklin Associates, Ltd.

Table D.7-14. Comparison of 12-ounce three-piece steel container soft drink systems - 1974 and 1985 (million Btu per 1,000 gallons beverage delivered to consumer)

Category	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
Virgin materials system							
Difference*	-5.12	-3.64	-5.53	-0.33	-1.28	-0.17	-16.1
Percent difference†	-35.7	-45.9	-26.3	-54.7	-82.6	-22.2	-34.8
Recycled materials system							
Difference‡	-3.43	-3.68	-15.63	-0.06	-1.02	-0.17	-24.0
Percent difference†	-23.6	-46.4	-74.3	-10.4	-65.5	-22.2	-51.7

*Calculated by (1985 values - 1974 values). Negative values mean that 1974 values are larger.
†Calculated by (difference ÷ 1974 value) x 100.
‡Calculated by [1985 values (recycled) - 1974 values (virgin)].

Source: Franklin Associates, Ltd.

NOTES AND REFERENCES - SECTION D.7

1. "Potential for Energy Conservation in the Steel Industry," Appendix A, Battelle Columbus Laboratories for Federal Energy Administration, May 30, 1975.
2. "Beverage Packaging Systems Energy Study," American Can Company, 1974.
3. Calculated by Franklin Associates, Ltd., from data in ref. 2.
4. Hunt, R. G., et al, "Resource and Environmental Profile Anaylsis of Nine Beverage Container Alternatives," Volume II, U.S. Environmental Protection Agency, Report SW-91c, 1974.
5. American Iron and Steel Institute, Annual Statistical Report, 1973.
6. Calculated by Franklin Associates, Ltd., from data in ref. 1.
7. "Energy Conservation in the Manufacturing Sector, 1954-1990," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 3, November 1974.
8. Private communication from industrial source.

D.8 Candidate Containers--Glass

D.8.1 Introduction

As opposed to the can systems previously discussed, no basic glass container completely dominates the glass container market. Instead, there is a wide variety of shapes and sizes in common use, especially for soft drinks. Two basic categories of interest in this study are the nonrefillable bottle (NR) and the refillable bottle (REF). Within these categories, a number of sizes are in common use.

Table D.8-1 lists common glass beverage containers, along with the type of closure customarily used. In the case of beer, although nine containers are listed, two of them represent a large percentage of beer sales in glass. These two are the 12-ounce NR and 12-ounce REF. These two were selected for detailed study, with an analysis of the effects of container size discussed later.

The 12-ounce REF beer container was analyzed for two different modes of consumption. One mode is referred to as on-premise consumption, the other is off-premise consumption. The difference between them is the location of the beverage consumption. In the case of on-premise, the beer is consumed at a bar or tavern, so that a six-pack bottle carrier is not required. The off-premise container is removed from the retail establishment for consumption, and typically is packaged in a bottle carrier, in addition to the corrugated case.

In the case of soft drinks, one container size does not dominate the market, with significant sales occurring in all of the sizes listed. However, the 16- and 32-ounce NR, 16- and 32-ounce REF, and the 64-ounce plastic coated glass were selected as being representative. A discussion of the effects of container size on energy profiles of soft drink systems is found later in the appendix.

Table D.8-1. Glass container weights

Container	Volume (fluid ounces)	Weight - 1975 Ounce/ Bottle	Weight - 1975 Pounds/1,000 Containers	Closure*	Weight - 1985 Ounce/ Bottle	Weight - 1985 Pounds/1,000 Containers	Percent Change†
NR beer							
	7	4.5	281	S	--	--	
	12	6.125	383	S	5.6	350	9
	16	8.5	531	S	--	--	
	32	15.5	969	S	--	--	
NR soft drink							
	10	7	438	S	--	--	
	16	10	625	S	9.2	575	8
	32	19	1,188	A	17.1	1,070	10
	48	30	1,875	A	--	--	
	64	36	2,250	A	--	--	
REF beer							
	7	7	438	S	--	--	
	12	10	625	S	9.2	575	8
	16	13	812	S	--	--	
	32	20	1,250	S	--	--	
REF soft drink							
	10	15	938	S	--	--	
	16	17	1,062	S	15.6	975	8
	32	28	1,750	A	25.8	1,610	8
Plastic coated glass‡							
	32	15	938	A	--	--	
	48	22	1,375	A	--	--	
	64	29	1,812	A	27	1,688	7

*A is used to designate a 1.2 gram aluminum closure
S is used to designate a 2.25 gram steel closure.

†Calculated by $\frac{\text{1975 weight - 1985 weight}}{\text{1975 weight}} \times 100$.

‡A plastic coat ranging from 0.2 ounce to 0.4 ounce in weight is present in addition to the glass weight shown here.

Source: Notes and references 7.

As table D.8-1 shows, glass bottle weights were projected to 1985 for the candidate containers. We have assumed (based on notes and references 7) that 1985 bottles will weigh 7-10 percent less than 1975 weights. These weight reductions will come about primarily through industrywide implementation of improved glass manufacturing techniques and new forming equipment, along with more efficient designs in bottle shape.

D.8.2 Container Manufacturing Systems--Glass

The manufacturing system for glass containers is shown in figure D.8-1. The manufacture of glass consists of mixing the various raw materials including glass cullet (mostly produced on site), and melting the "batch" in a glass furnace. The molten glass is then formed into finished glass containers at the same plant.

Table D.8-2 contains the basic energy data modules for these calculations, although two modules--salt mining and limestone--may be found in table D.6-2. The glass modules are combined on table D.8-3 to provide a basic glass system module which will be used in subsequent calculations.

One adjustment is made to the values in table D.8-2 in the case of container manufacture because different containers require differing amounts of energy, depending on the efficiencies achieved by glass plants for different containers, and because of differing energy requirements such as annealing and decoration. Table D.8-4 gives basic conversion rates for the candidate glass containers.

The total energy column (table D.8-3) presents the energy for each component module, and shows that 75 percent of the energy total is required by the glass plant, while the remaining 25 percent is divided among the 11 raw material modules.

Another important aspect shown in table D.8-3 is the dependence of the glass system on hydrocarbons. Natural gas accounts for 55.3 percent of the system energy requirements, while petroleum accounts for another 30.0 percent, for a hydrocarbon total of 85.3 percent.

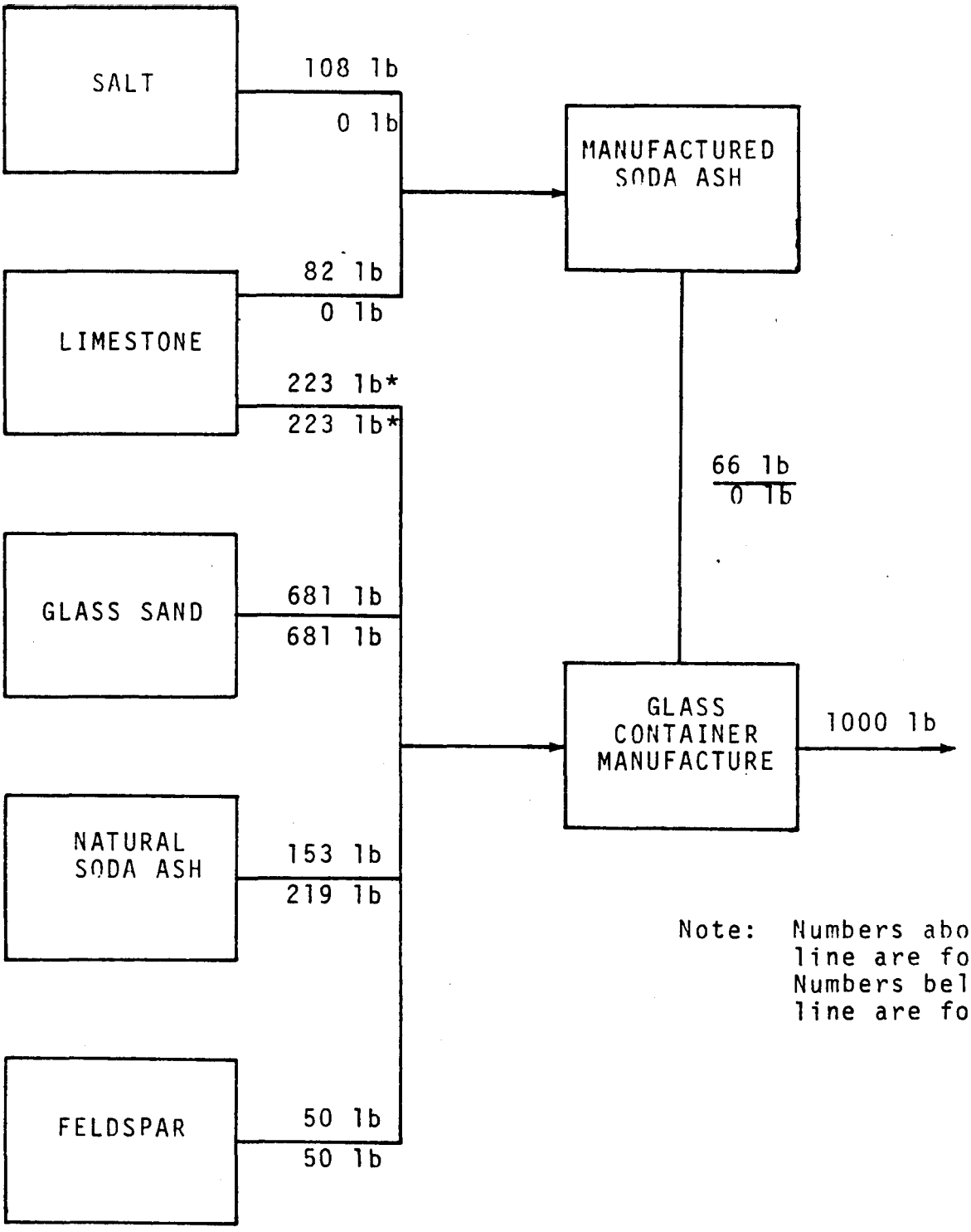


Figure D.8-1. Materials flow for manufacture of 1,000 pounds glass bottles.

* Includes 37 lb of dolomite, slag and other.

Table D.8-2. Energy requirements for producing 1,000 lb output of glass raw material and container modules (in energy related units per module)

Description	Fuels						Transportation			Energy					
	Residual oil (gallon)	Gasoline (gallon)	Natural gas (cu ft)	Distillate (gallon)	Coal (pound)	Electricity (kwhr)	Rail (ton-miles)	Truck (ton-miles)	Barge (ton-miles)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Total (10^6 Btu)
Glass sand mining - 1,000 lb*	0.05	0.04	215	0.15	5.8	7.0	--	--	--	0.249	0.053	0.114	0.004	0.004	0.424
Glass sand transport - 1,000 lb*	--	--	--	--	--	--	45	14	--	--	0.073	--	--	--	0.073
Natural soda ash mining - 1,000 lb‡	--	--	2900	--	--	--	--	--	--	3.155	--	--	--	--	3.155
Natural soda ash transport - 1,000 lb‡	--	--	--	--	--	--	325	--	--	--	0.263	--	--	--	0.263
Soda ash manufacture - 1,000 lb‡§	8.4	--	878	--	335	--	--	--	--	0.955	1.427	4.456	--	--	6.838
Manufactured soda ash transport - 1,000 lb‡	--	--	--	--	--	--	110	12.6	58	--	0.153	--	--	--	0.153
Feldspar mining - 1,000 lb¶	--	0.13	30	1.9	--	28.0	--	--	--	0.093	0.381	0.149	0.015	0.015	0.653
Feldspar transport - 1,000 lb¶	--	--	--	--	--	--	250	--	--	--	0.202	--	--	--	0.202
HK glass container manufacture - 1,000 lb¶	4.0	--	2695	4.0	--	95.5	--	--	--	3.139	1.521	0.507	0.052	0.052	5.271
Glass container transport - 1,000 lb¶	--	2.0	--	--	--	--	--	--	--	--	0.290	--	--	--	0.290
Waste disposal - glass - 1,000 lb-	--	0.79	--	--	--	--	--	--	--	--	0.114	--	--	--	0.114

*See notes and references 1.
†See notes and references 3.
‡See notes and references 4.
§See notes and references 5.
¶See notes and references 6.
#See notes and references 7.
-See notes and references 8.

Source: Franklin Associates, Ltd.

Table D.8-3. Basic glass manufacture system calculation summary - 1975
(million Btu)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Total	Percent of Total
Glass bottle manufacture system - 1,000 lb*							
Glass sand mining - 681 lb	0.170	0.036	0.078	0.003	0.003	0.289	4.1
Glass sand transport - 681 lb	--	0.050	--	--	--	0.050	0.7
Limestone mining - 305 lb	0.002	0.005	0.002	--	--	0.010	0.1
Limestone transport - 305 lb	--	0.020	--	--	--	0.020	0.3
Salt mining - 108 lb	0.020	0.011	0.024	0.002	0.002	0.060	0.9
Natural soda ash - 153 lb	0.483	--	--	--	--	0.483	6.9
Natural soda ash transport - 153 lb	--	0.040	--	--	--	0.040	0.6
Synthetic soda ash - 66 lb	0.063	0.094	0.294	--	--	0.451	6.4
Synthetic ash transport - 66 lb	--	0.010	--	--	--	0.010	0.1
Feldspar mining - 50 lb	0.005	0.019	0.007	0.001	0.001	0.033	0.5
Feldspar transport - 50 lb	--	0.010	--	--	--	0.010	0.1
Bottle transport - 1,000 lb	--	0.29	--	--	--	0.29	4.1
Materials and transport subtotal	0.743	0.585	0.405	0.006	0.006	1.746	24.8
Beer bottle manufacture--12-ounce Nonrefillable - 1,000 lb	3.139	1.521	0.507	0.052	0.052	5.271	75.1
Total	3.881	2.107	0.912	0.058	0.058	7.016	99.9
Percent of total	55.3	30.0	13.0	0.8	0.8	99.9	

†See notes and references 7.

Source: Franklin Associates, Ltd.

D.8.3 Supplementary Materials, Filling and Distribution

Supplementary packaging materials for glass containers consist of steel or aluminum closures (with plastic liners), paper labels, paperboard carriers and corrugated shipping containers. For the metal closures, the same energy profile was used as for metal can closures. For the remaining plastic and paper products, data were used from table D.6-5.

Data relating to filling and distribution requirements are shown in table D.8-5. A basic discussion of these data, their origins and some observations on their validity may be found in section D.5.

Table D.8-4. Energy ratios for manufacture of glass containers

Container	Energy Ratio*
NR beer and soft drink	1.00
NR PCG - 64-ounce	1.00
REF beer - 12-ounce	1.09
REF soft drink - 16-ounce	1.21

*Calculated by dividing energy requirement for various containers by energy requirement for NR beer and soft drink.

Source: Notes and references 7.

D.8.4 Total Beverage Container Systems--Glass

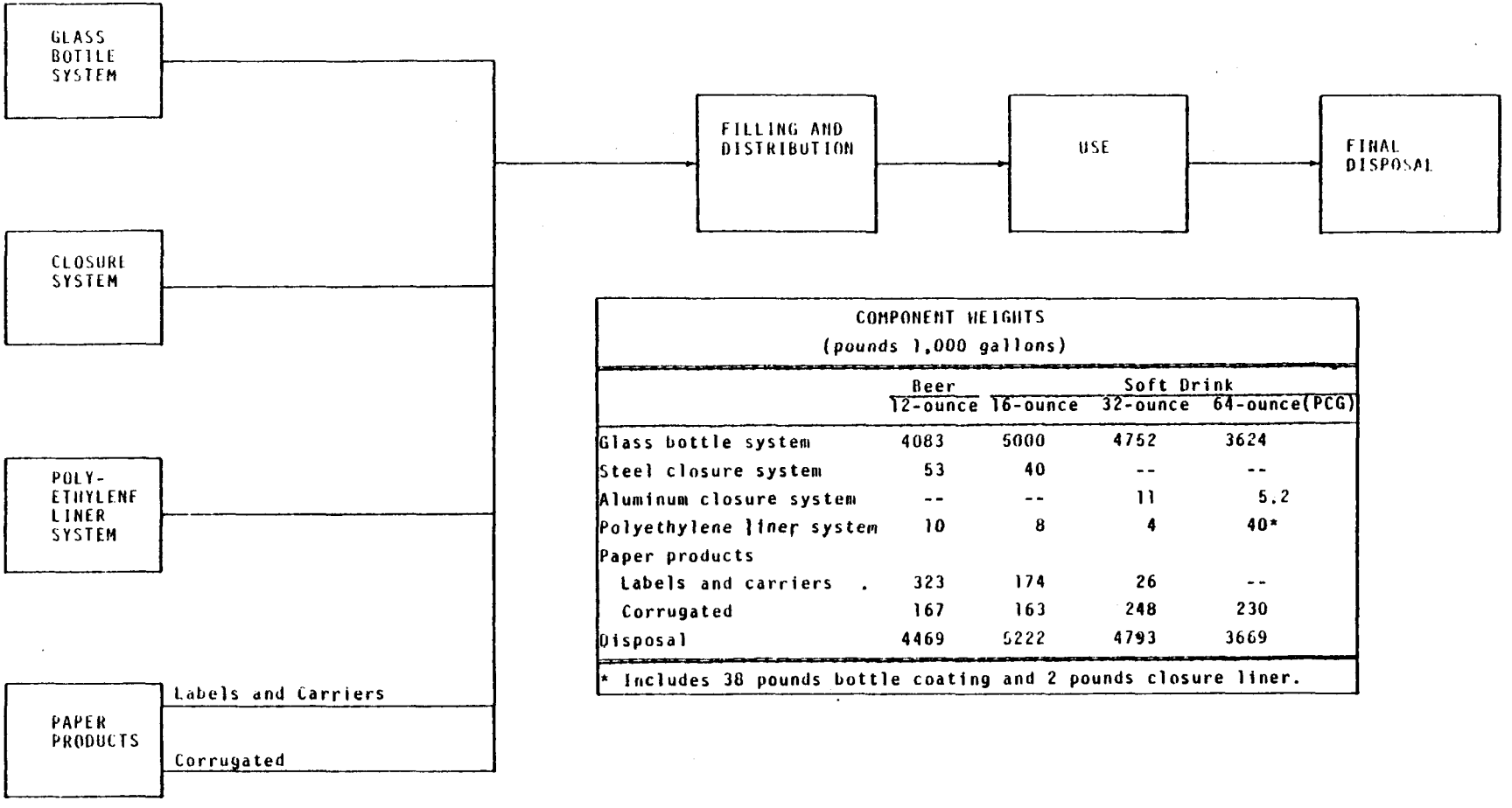
D.8.4.1 NR Glass Bottles. Figure D.8-2 shows the components of the NR glass bottles selected for study. Table D.8-6 summarizes the calculations for those systems. The 12-ounce beer bottle system energy profile has some unique features when compared to the can systems. Table D.8-6 shows that the container itself accounts for 66.7 percent of the system total energy, with packaging accounting for 18.3 percent of the total, and distribution requiring 7.9 percent.

Table D.8-5. Energy requirements for filling and distribution of glass containers - 1975

Description	Fuels					Energy					
	Gasoline (gallon)	Natural gas (cu ft)	Distillate oil (gallon)	LPG (gallon)	Electricity (kwhr)	Natural gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Total (10^6 Btu)
Glass--refillable 16-ounce soft drink--washing and filling - 1,000 gal*	--	1165	--	3	58.6	1.39	0.41	0.31	0.032	0.032	2.18
Glass--nonrefillable 16-ounce soft drink--filling - 1,000 gal*	--	410	--	3	55.9	0.57	0.41	0.30	0.031	0.030	1.33
Glass--refillable 16-ounce soft drink--delivery - 1,000 gal*	11.1	--	4.17	--	--	--	2.27	--	--	--	2.27
Glass--nonrefillable 16-ounce soft drink--delivery - 1,000 gal*	5.94	--	4.76	--	--	--	1.62	--	--	--	1.62
Glass--refillable 32-ounce soft drink--filling - 1,000 gal*	--	1165	--	3	58.6	1.394	0.413	0.311	0.032	0.032	2.18
Glass--nonrefillable 32-ounce soft drink--filling - 1,000 gal*	--	410	--	3	55.9	0.567	0.408	0.297	0.031	0.030	1.33
Glass--refillable 32-ounce soft drink--delivery - 1,000 gal*	11.1	--	4.17	--	--	--	2.271	--	--	--	2.27
Glass--nonrefillable 32-ounce soft drink--delivery - 1,000 gal*	5.23	--	4.19	--	--	--	1.423	--	--	--	1.42
Glass--nonrefillable 64-ounce soft drink--filling - 1,000 gal*	--	410	--	3	55.9	0.567	0.408	0.297	0.031	0.030	1.33
Glass-nonrefillable 64-ounce soft drink--distribution - 1,000 gal*	4.81	--	3.86	--	--	--	1.310	--	--	--	1.31
Glass--refillable 12-ounce beer--filling - 1,000 gal†	--	630	--	--	65.0	0.83	0.14	0.34	0.035	0.035	1.38
Glass--nonrefillable 12-ounce beer--filling - 1,000 gal†	--	--	--	--	45.0	0.097	0.097	0.24	0.025	0.025	0.48
Glass--refillable 12-ounce beer--delivery - 1,000 gal‡	11.1	--	34.2	--	--	--	7.04	--	--	--	7.04
Glass--nonrefillable 12-ounce beer--delivery - 1,000 gal	4.96	--	17.0	--	--	--	3.41	--	--	--	3.41

* See notes and references 9.
† See notes and references 10.
‡ See notes and references 11.

Source: Franklin Associates, Ltd.



COMPONENT WEIGHTS
(pounds 1,000 gallons)

	Beer		Soft Drink	
	12-ounce	16-ounce	32-ounce	64-ounce(PCG)
Glass bottle system	4083	5000	4752	3624
Steel closure system	53	40	--	--
Aluminum closure system	--	--	11	5.2
Polyethylene liner system	10	8	4	40*
Paper products				
Labels and carriers	323	174	26	--
Corrugated	167	163	248	230
Disposal	4469	5222	4793	3669

* Includes 38 pounds bottle coating and 2 pounds closure liner.

Figure D.8-2. Components of NR glass bottle systems.

Table D.8-6. Final calculation summary for nonrefillable glass beer and soft drink systems - 1975 (million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Beer bottle system--12-ounce nonrefillable - 1,000 gal								
Bottles - 4,083 lb*	15.84	8.60	3.73	0.24	0.24	--	28.65	66.7
Closures								
Steel - 53 lb*	0.22	0.097	0.75	0.009	0.009	--	1.08	2.5
Liner - 10 lb†	0.37	0.035	0.059	0.006	0.006	--	0.48	1.1
Label--bleached kraft paper - 26 lb†	0.076	0.12	0.072	0.002	0.002	0.19	0.46	1.1
Supplementary package								
Kraft paper - 297 lb‡	0.86	1.35	0.82	0.026	0.026	2.14	5.22	12.1
Corrugated container - 167 lb‡	0.48	0.75	0.46	0.015	0.015	0.95	2.68	6.2
Filling - 1,000 gal§	0.097	0.097	0.24	0.025	0.025	--	0.48	1.1
Distribution - 1,000 gal¶	--	3.41	--	--	--	--	3.41	7.9
Waste disposal								
Glass - 4,083 lb	--	0.47	--	--	--	--	0.47	1.1
Other - 386 lb	--	0.037	--	--	--	--	0.037	0.1
Total	17.96	14.96	6.13	0.32	0.32	3.27	42.97	99.9
Percent of total	41.8	34.8	14.3	0.7	0.7	7.6	99.9	
Soft drink bottle system--16-ounce nonrefillable - 1,000 gal								
Bottles - 5,000 lb*	19.40	10.53	4.56	0.29	0.29	--	35.08	77.1
Closures								
Steel - 40 lb*	0.16	0.073	0.57	0.006	0.006	--	0.82	1.8
Liner - 8 lb†	0.30	0.028	0.047	0.005	0.005	--	0.38	0.8
Label--bleached kraft paper - 26 lb†	0.076	0.12	0.072	0.002	0.002	0.19	0.46	1.0
Supplementary package								
Kraft paper - 148 lb‡	0.43	0.67	0.41	0.013	0.013	1.07	2.60	5.7
Corrugated trays - 163 lb‡	0.47	0.73	0.45	0.014	0.014	0.93	2.61	5.7
Filling - 1,000 gal§	0.57	0.41	0.30	0.031	0.030	--	1.33	2.9
Distribution - 1,000 gal¶	--	1.62	--	--	--	--	1.62	3.6
Waste disposal								
Glass - 5,000 lb	--	0.57	--	--	--	--	0.57	1.3
Other - 222 lb	--	0.022	--	--	--	--	0.022	--
Total	21.41	14.78	6.41	0.36	0.36	2.18	45.50	99.9
Percent of total	47.1	32.5	14.1	0.8	0.8	4.8	100.1	
Soft drink bottle system--32-ounce nonrefillable - 1,000 gal								
Bottles - 4,752 lb*	18.44	10.01	4.33	0.28	0.28	--	33.34	78.5
Closures								
Aluminum - 11 lb*	0.40	0.28	0.38	0.027	0.113	--	1.20	2.8
Liner - 4 lb†	0.15	0.014	0.024	0.002	0.002	--	0.19	0.4
Label--bleached kraft paper - 26 lb†	0.076	0.12	0.072	0.002	0.002	0.19	0.46	1.1
Supplementary package								
Corrugated container - 248 lb‡	0.72	1.11	0.69	0.022	0.022	1.41	3.97	9.4
Filling - 1,000 gal§	0.57	0.41	0.30	0.031	0.030	--	1.33	3.1
Distribution - 1,000 gal¶	--	1.42	--	--	--	--	1.42	3.3
Waste disposal								
Glass - 4,752 lb	--	0.54	--	--	--	--	0.54	1.3
Other - 41 lb	--	0.004	--	--	--	--	0.004	--
Total	20.36	13.91	5.80	0.36	0.45	1.6	42.47	99.9
Percent of total	47.9	32.8	13.6	0.8	1.0	3.8	99.9	
Soft drink bottle system--64-ounce nonrefillable PCG - 1,000 gal								
Bottles - 3,624 lb*	15.08	8.13	3.47	0.23	0.23	--	27.13	74.6
Plastic coating - 38 lb*	1.42	0.13	0.23	0.023	0.023	--	1.83	5.0
Closures								
Aluminum - 5.2 lb*	0.19	0.13	0.18	0.013	0.053	--	0.57	1.6
Liner - 2 lb†	0.075	0.007	0.012	0.001	0.001	--	0.096	0.3
Supplementary package								
Corrugated container - 230 lb‡	0.67	1.03	0.64	0.020	0.020	1.31	3.69	10.1
Filling - 1,000 gal§	0.57	0.41	0.30	0.031	0.030	--	1.33	3.7
Distribution - 1,000 gal¶	--	1.31	--	--	--	--	1.31	3.6
Waste disposal								
Glass - 3,624 lb	--	0.42	--	--	--	--	0.42	1.1
Other - 45 lb	--	0.004	--	--	--	--	0.004	--
Total	18.00	11.57	4.82	0.32	0.36	1.31	36.37	100.0
Percent of total	49.5	31.8	13.3	0.9	1.0	3.6	100.1	

*See notes and references 7.
†See notes and references 13.
‡See notes and references 14.
§See notes and references 16.
¶See notes and references 9.
‖See notes and references 20.

There are two reasons for the large packaging energy requirement. First, glass is much less resistant to shipping damage than cans, so sufficient packaging must be used to cushion the bottles. Second, beer is quite sensitive to light, so filled beer bottles must be as completely shielded from light as possible. Thus, closed opaque packages are important.

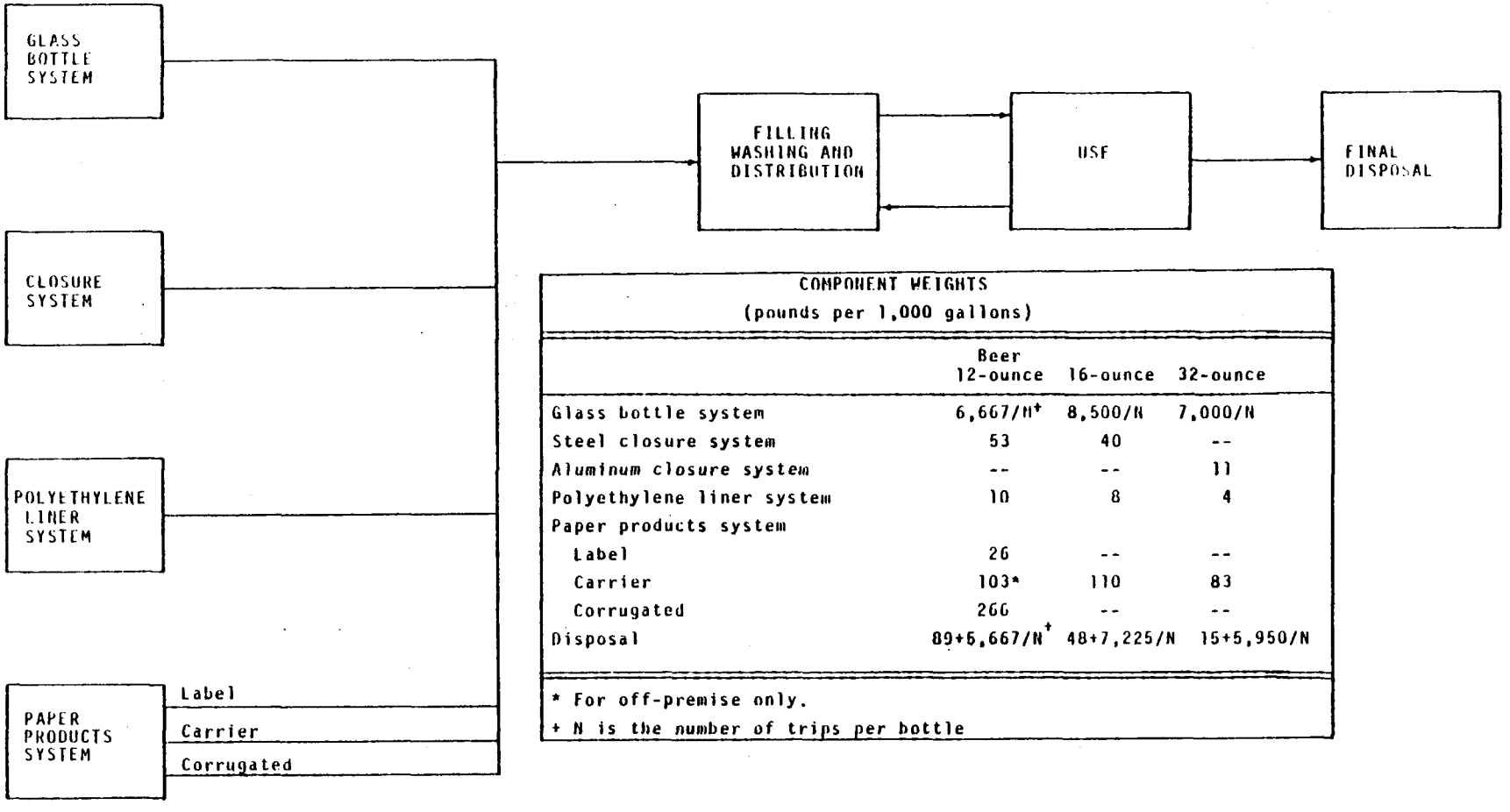
The relatively high transportation values occur for several reasons. High transportation energy requiements are caused by a combination of long distances and less efficiency of vehicle space utilization than other container types. The centralized nature of the brewing industry leads to long transportation distances, thus contributing to higher transportation energy requirements. In addition, glass is a bulky package to ship in itself, and when coupled with the significant paper packaging requirements for beer leads to relatively inefficient utilization of vehicle space.

The soft drink system in table D.8-6 shows many of the same characteristics as the beer system, but the paper packaging requirements are less, and transportation energy is less. However, soft drink bottles must be designed to withstand considerably higher internal pressures than beer, so the weight of glass required for 1,000 gallons of soft drink is generally greater than the glass requirements for an equal volume of beer (when processed in comparably sized containers).

An examination of the fuel requirements for these two systems show that they both depend greatly on hydrocarbon energy. The beer system requires 41.8 percent of its total as natural gas, and 34.8 percent in fuel oils, for a hydrocarbon total of 76.6 percent. Similarly, the soft drink system (16-ounce size) requires 47.1 percent natural gas and 32.5 percent oil, for a hydrocarbon total of 80.3 percent. Thus, both systems rely on hydrocarbons for more than three-quarters of their energy requirements. Other size soft drink bottles require similar fractions of their total energy as hydrocarbons.

D.8.4.2 REF Glass Bottles. Figure D.8-3 shows the components of the REF glass bottle systems with the calculations summarized on tables D.8-7 and D.8-8. The REF systems consist of two distinct phases--one which depends on the average trips achieved for each bottle, and one which does not depend on trippage. The trippage dependent impacts are all related directly to the use of glass. As shown in the table, this consists primarily of the container manufacture system. Thus, if a container is used 10 times, the average new glass use per 1,000 gallons of beverage is just one-tenth as much as if only new glass were used for the container. Thus, the allocated amount of new glass going into the system is the amount that would be experienced for one trip, divided by N, the average number of trips a bottle makes. The data for the candidate containers on tables D.8-7 and D.8-8 are separated into the trippage dependent and trippage independent factors, where the trippage dependent factors relate to the new glass required. The trippage independent factors consist of the filling, distribution, and supplementary packaging requirements. For these steps in the operation, it makes little or no difference if the bottles are new or reused. Each bottle is washed, filled, capped, packaged, and distributed, no matter what the source of the bottle.

The data shown on tables D.8-7 and D.8-8 do not represent real beverage container systems. In order to construct the energy requirements for a system, it is necessary to select a trippage factor and calculate the trippage dependent requirements. Then the trippage dependent factors must be added to the trippage independent factors to calculate a total system.



COMPONENT WEIGHTS
(pounds per 1,000 gallons)

	Beer 12-ounce	16-ounce	32-ounce
Glass bottle system	6,667/N+	8,500/N	7,000/N
Steel closure system	53	40	--
Aluminum closure system	--	--	11
Polyethylene liner system	10	8	4
Paper products system			
Label	26	--	--
Carrier	103*	110	83
Corrugated	266	--	--
Disposal	89+6,667/N+	48+7,225/N	15+5,950/N

* For off-premise only.
\+ N is the number of trips per bottle

Figure D.8-3. Components of REF glass bottle systems.

Table D.8-7. Final calculation summary for refillable glass beer system - 1975
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Beer bottle system - 12-ounce refillable - 1,000 gal								
Trippage dependent factors (for 1 trip)								
Bottles - 6,667 lb*	27.74	14.95	6.38	0.42	0.42	--	49.91	98.7
Waste disposal - glass - 5667 lb	--	0.65	--	--	--	--	0.65	1.3
Total	27.74	15.60	6.38	0.42	0.42	--	50.56	100.0
Percent of total	54.9	30.9	12.6	0.8	0.8	--	100.0	
Trippage independent factors								
On-premise								
Closures								
Steel - 53 lb*	0.22	0.10	0.75	0.009	0.009	--	1.08	7.4
Liners - 10 lb†	0.37	0.035	0.059	0.006	0.006	--	0.48	3.3
Label - bleached kraft paper-26 lb†	0.076	0.118	0.072	0.002	0.002	0.19	0.46	3.1
Supplementary Package								
Corrugated container (3-trip) - 266 lb‡	0.77	1.19	0.74	0.023	0.023	1.51	4.26	29.0
Filling and washing - 1,000 gal§	0.83	0.14	0.34	0.035	0.035	--	1.38	9.4
Distribution - 1,000 gal§	--	7.04	--	--	--	--	7.04	47.8
Waste disposal - 89 lb	--	0.009	--	--	--	--	0.009	0.1
Total	2.27	8.64	1.96	0.076	0.075	1.70	14.72	100.1
Percent of total	15.4	58.7	13.3	0.5	0.5	11.5	99.9	
Off-premise								
On-premise total	2.27	8.64	1.96	0.076	0.075	1.70	14.72	89.1
Carriers - bleached kraft paper (3-trip) - 103 lb‡	0.30	0.47	0.29	0.009	0.009	0.74	1.81	10.9
Total	2.57	9.10	2.25	0.085	0.084	2.44	16.53	100.0
Percent of total	15.5	55.1	13.6	0.5	0.5	14.8	100.0	

*See notes and references 15.
†See notes and references 13.
‡See notes and references 14.
§See notes and references 20.

Source: Franklin Associates, Ltd.

Table D.8-8. Final calculation summary for refillable glass soft drink systems - 1975
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total	Percent of Total
Soft drink bottle system - 16-ounce refillable - 1,000 gal								
Trippage dependent factors (for 1 trip)								
Bottles - 8,500 lb*	38.59	20.62	8.66	0.59	0.59	--	69.05	98.8
Waste disposal - glass - 7,225 lb	--	0.83	--	--	--	--	0.83	1.2
Total	38.59	21.45	8.66	0.59	0.59	--	69.87	100.0
Percent of total	55.2	30.7	12.4	0.8	0.8	--	99.9	
Trippage independent factors								
Closures								
Steel - 40 lb*	0.16	0.073	0.57	0.006	0.006	--	0.82	10.8
Liners - 8 lb†	0.30	0.028	0.047	0.005	0.005	--	0.38	5.0
Carriers - kraft paper (3 trips) - 110 lb‡	0.32	0.50	0.31	0.010	0.010	0.79	1.93	25.4
Filling and washing - 1,000 gal§	1.39	0.41	0.31	0.032	0.032	--	2.18	28.7
Distribution - 1,000 gal§	--	2.27	--	--	--	--	2.27	29.9
Waste disposal - 48 lb	--	0.005	--	--	--	--	0.005	--
Total	2.18	3.29	1.23	0.053	0.053	0.79	7.59	99.8
Percent of total	28.7	43.3	16.2	0.7	0.7	10.4	100.0	
Soft drink bottle system - 32-ounce refillable - 1,000 gal								
Trippage dependent factors (for 1 trip)								
Bottles - 7,000 lb*	31.78	16.98	7.13	0.48	0.48	--	56.86	98.8
Waste disposal - 5,950 lb	--	0.68	--	--	--	--	0.68	1.2
Total	31.78	17.67	7.13	0.48	0.48	--	57.54	100.0
Percent of total	55.2	30.7	12.4	0.8	0.8	--	99.9	
Trippage independent factors								
Closures								
Aluminum - 11 lb*	0.40	0.28	0.38	0.027	0.113	--	1.20	16.5
Liners - 4 lb†	0.15	0.014	0.024	0.002	0.002	--	0.19	2.6
Carriers - kraft paper (3 trips) - 83 lb‡	0.24	0.38	0.23	0.007	0.007	0.60	1.46	20.0
Filling and washing - 1,000 gal§	1.39	0.41	0.31	0.032	0.032	--	2.18	29.9
Distribution - 1,000 gal§	--	2.27	--	--	--	--	2.27	31.1
Waste disposal - 15 lb	--	0.001	--	--	--	--	0.001	--
Total	2.19	3.35	0.95	0.068	0.15	0.60	7.31	100.1
Percent of total	29.9	45.9	13.0	0.9	2.1	8.2	100.0	

*See notes and references 7.
†See notes and references 13.
‡See notes and references 9.
§See notes and references 20.

Source: Franklin Associates, Ltd.

An example of this procedure is shown in table D.8-9, where a trip rate of 10 trips per bottle was selected (for convenience of calculation) and the energy impacts were calculated for three of the candidate systems for illustrative purposes.

In table D.8-9, three returnable systems have been calculated. The two beer systems are quite similar, their only difference being that one represents on-premise consumption, while the other represents off-premise consumption. The on-premise container is used in shipments to bars or taverns, and does not require a bottle carrier. The difference between the two systems, then, is 103 pounds of paperboard carrier which is required for the off-premise bottle.

The beer systems in table D.8-9 show that for a 10-trip bottle, the impact of container manufacture is only about one-fourth of the system energy requirements. Thus, the primary energy use is in filling, packaging, and transporting the bottles. For beer packaging systems, one-fourth or slightly more of the beer trippage independent impacts are for paper packaging, with another 48 percent of the energy being required for the distribution (table D.8-7). Thus, the important impacts for a 10-trip REF beer bottle are paper packaging, transportation, and the glass container itself, with transportation being the most important impact.

Because the soft drink bottle is much heavier, for a 10-trip bottle the container-related impacts in table D.8-9 are much higher than beer, at 47.9 percent. Of the remaining 52.1 percent, reference to table D.8-8 shows that paper packaging is about one-quarter of the trippage independent impacts, with filling and washing accounting for 28.7 percent, and distribution accounting for 29.9 percent.

Table D.8-9. Example calculations of REF energy profiles assuming a 10-trip bottle (million Btu per 1,000 gallons and percent)

	Natural gas	Petroleum	Coal	Nuclear	Hydrocarbon	Wood	Total	Percent of Total
Beer bottle--on-premise								
Trippage dependent-- N = 10*	2.77	1.56	0.64	0.04	0.04	--	5.06	25.6
Trippage independent-- on-premise	2.27	8.64	1.96	0.08	0.08	1.7	14.72	74.4
Total	5.04	10.20	2.60	0.12	0.12	1.7	19.78	100.0
Percent of total	25.5	51.6	13.1	0.6	0.6	8.6	100.0	
Beer bottle--off-premise								
Trippage dependent-- N = 10*	2.77	1.56	0.64	0.04	0.04	--	5.06	23.4
Trippage independent-- Off-premise	2.57	9.10	2.25	0.08	0.08	2.44	16.53	76.6
Total	5.34	10.66	2.89	0.12	0.12	2.44	21.59	100.0
Percent of total	24.7	49.4	13.4	0.6	0.6	11.3	99.9	
Soft drink - 16-ounce								
Trippage dependent-- N = 10*	3.86	2.14	0.87	0.06	0.06	--	6.99	47.9
Trippage independent	2.18	3.29	1.23	0.05	0.05	0.79	7.59	52.1
Total	6.04	5.43	2.10	0.11	0.11	0.79	14.58	100.0
Percent of total	41.4	37.2	14.4	0.8	0.8	5.4	100.0	

*Calculated by dividing the appropriate row on table D.8-7 or D.8-8 by N = 10, the trip rate.

Source: Franklin Associates, Ltd.

An inspection of the fuel use patterns in tables D.8-7, D.8-8, or D.8-9 shows that these systems are all highly dependent on hydrocarbon energy. In fact, for any trip rate, the energy profile will show approximately three-quarters of the energy derived from hydrocarbons.

D.8.4.3 1985 Profiles. In order to calculate the 1985 energy profiles, it was assumed that energy reductions will occur primarily by: (1) lightweighting of bottles, (2) eliminating the use of synthetic soda ash, (3) reducing paper packaging requirements, (4) improvements in glass making processes, and (5) energy conservation programs. The detailed assumptions are listed in ref. 17. These assumptions were applied to the data, with the resulting calculations shown in table D.8-10.

These calculations are further summarized in table D.8-11 which shows the comparison of 1975 data to 1985. The data are tabulated in terms of the specific containers studied with the trippage dependent and trippage independent factors listed separately. The energy improvements appear to be quite similar for all systems, with total energy savings ranging from a high of 25 percent for 32-ounce REF soft drink trippage independent impacts, to 17 percent for REF 32-ounce soft drink trippage dependent factors.

D.8.5 Effect of Container Size on Energy Profiles

Because only selected container sizes were included in the candidate containers, it is important to assess the effect of using different size containers. Some of the possible differences in energy profiles of various sized containers are the amount of glass required to deliver a specific volume of beverage, the amount of packaging required, and differences in distribution energy.

Table D.8-10. Final calculation summary for glass beer and soft drink systems - 1985*
(million Btu per 1,000 gallons beverage delivered to consumer)

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
NR systems							
12-ounce beer bottle	15.64	12.18	3.98	0.26	0.26	2.35	34.67
16-ounce soft drink bottle	18.89	12.01	4.04	0.30	0.30	1.58	37.12
32-ounce soft drink bottle	17.36	10.96	3.46	0.27	0.27	1.17	33.49
64-ounce plastic coated glass soft drink bottle	15.55	9.40	3.01	0.25	0.25	0.92	29.38
REF systems							
12-ounce beer							
trippage dependent	24.60	12.77	3.65	0.34	0.34	--	41.70
trippage independent							
on-premise	1.88	7.18	1.63	0.064	0.064	1.24	12.06
off-premise	2.09	7.50	1.83	0.070	0.070	1.76	13.32
16-ounce soft drink							
trippage dependent	34.01	17.56	5.08	0.48	0.48	--	57.61
trippage independent	1.88	2.74	1.05	0.046	0.046	0.55	6.31
32-ounce soft drink							
trippage dependent	28.08	14.50	4.19	0.40	0.40	--	47.57
trippage independent	1.63	2.61	0.72	0.039	0.039	0.42	5.46

*See text and notes and references 17 for explanation of these values.

Table D.8-11. Comparison of energy requirements of glass container systems - 1975 and 1985 (in percent difference)*

	Natural gas	Petroleum	Coal	Nuclear	Hydropower	Wood	Total
NR systems							
12-ounce beer bottle	-12.9	-18.6	-35.1	-18.7	-18.7	-28.1	-19.3
16-ounce soft drink bottle	-11.8	-18.7	-37.0	-16.7	-16.7	-27.5	-18.4
32-ounce soft drink bottle	-14.7	-21.2	-40.3	-25.0	-25.0	-26.9	-21.1
64-ounce PCG soft drink bottle	-13.6	-18.8	-37.6	-21.9	-21.9	-29.8	-19.2
REF systems							
12-ounce beer bottle							
Trippage dependent	-11.3	-18.1	-42.8	-19.0	-19.0	--	-17.5
Trippage independent							
on-premise	-17.2	-16.9	-16.8	-15.8	-14.7	-27.1	-18.1
off-premise	-18.7	-17.6	-18.7	-17.6	-16.7	-27.9	-19.4
16-ounce soft drink bottle							
trippage dependent	-11.9	-18.1	-41.3	-18.6	-18.6	--	-17.5
trippage independent	-13.8	-16.7	-14.6	-13.2	-13.2	-30.4	-16.9
32-ounce soft drink bottle							
trippage dependent	-11.6	-17.9	-41.2	-16.7	-16.7	--	-17.3
trippage independent	-25.6	-22.1	-24.2	-42.6	-74.0	-30.0	-25.3

* Calculated by $\left(\frac{1985 - 1975}{1975} \times 100\right)$ The 9975 values are from table D.8-6, D.8-7, and D.8-8. The 1985 values are from table D.8-10.

Table D.8-12 was prepared to show the difference in energy requirements for the two sizes of comparable glass bottles for which calculations were performed, the 16- and 32-ounce soft drink sizes.* For NR bottles, the 32-ounce container requires 6.6 percent less energy than the 16-ounce container. For ten trip refillable bottles, the energy advantage for the 32-ounce bottle is 10.4 percent. An examination of the table reveals that the advantage of the 32-ounce bottle is 17.6 percent for trippage dependent impacts, but only 3.7 percent for the trippage independent impacts. Thus, the advantage of the larger container diminishes at higher trip rates, but becomes greater at lower trip rates.

Noticeably absent from this analysis are calculations for small bottles. Considerable amounts of beverage are delivered in containers with less volume than 16-ounces, with most of this volume being delivered in 10-ounce bottles. This container was not included in these calculations because of a paucity of data for that size, and because the 10-ounce sales frequently do not compete directly with the larger sizes. A large amount of the beverage delivered in 10-ounce bottles is for vending sales. This bottle is generally not packaged with paper, and is vended from a refrigerated machine, one container at a time. Although the absence of paper packaging would reduce the energy required by the total system, this is offset by the need of more glass per gallon of beverage, and because delivery requires more fuel per gallon of beverage. Based on these factors, and on the scarce data available for 10-ounce bottles, the researchers estimate that the 10-ounce container requires from zero to ten percent more energy per

*No size effect was calculated for beer containers because of the dominance of the 12-ounce size.

gallon of beverage delivered when compared to a 16-ounce container.

D.8.6 Plastic Coated Glass. The plastic coated glass (PCG) bottle is presently available in NR family size soft drink configurations, especially in 48- and 64-ounce sizes. Calculations were performed for 64-ounce PCG bottles for purposes of determining the magnitude of possible energy savings. Table D.8-13 was prepared to show one advantage of applying the plastic coat. The table shows that a 19 to 27 percent savings in glass is accomplished by the application of the very lightweight plastic film.

Referring to table D.8-6, an evaluation of energy savings can be made. The container most comparable to the 64-ounce PCG (for which energy calculations were made) is the 32-ounce NR bottle. Overall, the energy requirements are 6.1 million Btu/thousand gallons beverage, or 14.4 percent less for the PCG. Most of this energy savings (4.4 million Btu) occurs because of the lower energy for container manufacture, although small savings are accomplished in all other subsystems. Thus, significant energy savings are possible with PCG containers.

Table D.8-12. Size effect in glass containers

	Total energy (Btu/thou gal)	Comparison with 16-ounce	
		Difference (Btu/thou gal)	Percent difference*
NR bottles			
16-ounce	45.50	--	--
32-ounce	42.47	3.03	6.6
Ten-trip refillable bottles			
16-ounce	14.58	--	--
32-ounce	13.06	1.52	10.4

*Calculated by $\left(\frac{\text{Difference}}{\text{16-ounce}}\right) \times 100$.

Source: Tables D.8-6, D.8-7, D.8-8, and D.8-9.

Table D.8-13. Comparison of plastic coated glass (PCG) and conventional bottles

Bottle size (fluid ounce)	Glass weight (ounces)	Plastic coat* (ounces)	Conventional NR soft drink weight (ounces)	Percent glass savings for PCG†
32	15	0.2 - 0.3	19	21
48	22	0.2 - 0.4	30	27
64	29	0.2 - 0.4	36	19

*This coating is usually a polystyrene foam, or an ionomer film.
†Calculated by [(Conventional - PCG) ÷ Conventional] x 100.

Source: Table D.8-1.

D.8.7 Glass Container Recycling

Glass has been routinely recycled internally by the glass industry for many years. However, at present, the use of post-consumer glass cullet is relatively low (see appendix H). In the development of energy profiles, data were sought to calculate the energy savings resulting from recycling post-consumer glass (i.e., above the rate of use of internally generated cullet). Although there is only limited data available on the energy savings potential in a glass plant as a function of the amount of cullet used, one recent experiment did establish that for a glass furnace the addition of 50 percent cullet above normal operating conditions resulted in a 15 percent energy savings. This energy savings probably does not increase uniformly with the recycle rate, but data were supplied that show the energy savings at 100 percent recycling is in the range of 12 to 22 percent (ref. 21).

In order to assess the potential effect of glass recycling on energy profiles, a set of calculations was performed. Table D.8-14 summarizes the energy requirements of a glass bottle system using only cullet as raw material. A 20 percent reduction in glass manufacturing energy was assumed.

A comparison of a virgin 1975 system and 100 percent recycled system for a 12-ounce beer nonrefillable bottle is shown in table D.8-14. The overall results show that recycled nonrefillable systems can potentially reduce natural gas consumption by 33.5 percent, with an overall energy savings of 29 percent for the bottle manufacturing energy. Energy savings for refillable systems would depend on the trip rate achieved, but would generally be much less than this. However, because of projected energy conservation measures for virgin glass, the magnitude of the savings will be reduced somewhat by 1985.

Table D.8-14. Example calculation of energy savings from glass recycling (1975) of recycled glass containers

Description	Electricity (kwhr)	Transportation Truck (ton-mile)	Energy: Natural Gas (10^6 Btu)	Petroleum (10^6 Btu)	Coal (10^6 Btu)	Nuclear (10^6 Btu)	Hydropower (10^6 Btu)	Total (10^6 Btu)
Cullet grinding - 1,200 lb	30	--	0.065	0.065	0.16	0.017	0.017	0.32
Cullet transport - 1,200 lb	--	60	--	0.16	--	--	--	0.16
Recycled glass manufacture - 1,000 lb								
Nonrefillable 12-ounce beer*	--	--	2.51	1.22	0.41	0.042	0.042	4.22
Bottle transport - 1,000 lb†	--	--	--	0.29	--	--	--	0.29
Total recycled bottle manufacture system	--	--	2.58	1.74	0.57	0.059	0.059	4.99
Total virgin bottle manufacture system†	--	--	3.88	2.11	0.91	0.058	0.058	7.02
Difference‡	--	--	-1.30	-0.37	-0.34	-0.001	-0.001	-2.03
Percent difference§	--	--	-33.5	-0.18	-37.4	-1.7	-1.7	-28.9

*From table D.8-3. Reduced 20 percent.
†From table D.8-3.
‡Calculated by (Recycle - Virgin).
§Calculated by $\left(\frac{\text{Difference}}{\text{Virgin}}\right) \times 100$.

It was concluded that the recycling of post-consumer glass containers can result in process energy savings, but that the overall process energy savings are likely to be small. Since a relatively low recycling rate is projected for post-consumer glass in appendix H (about 4 percent), the process energy savings would be small enough that their omission from the basic calculations would not introduce a significant difference between the energy requirements of glass containers produced with or without post-consumer glass cullet at low recycling rates. However, any one glass plant recycling at a high rate can achieve a significant energy savings in that plant.

D.8.8 Durable Secondary Packaging

It was assumed in this study that secondary packaging for refillable bottles was corrugated boxes and paperboard carriers with an average reuse of 3 trips. However, the possibility exists for using more durable packaging. In some situations at the present time, corrugated boxes are not used for on-premise beer cases. Instead, more durable fiberboard boxes are used which can be reused 10 to 20 times. Also, in limited cases, plastic bottle carriers are being used for both beer and soft drinks. These carriers are quite durable and are structurally capable of achieving reuse rates of several hundred trips.

Although the use of durable secondary packaging (DSP) is not yet widespread, it is possible that future conditions will stimulate its use. In order to assess the possible effect on refillable bottle profiles, table D.8-15 was prepared.

In order to make these calculations, it was assumed that DSP achieves a very high trip rate, so that the energy associated with manufacture of DSP is allocated to hundreds of trips. Thus, the energy for DSP manufacture for each delivery of beverage is insignificant.

The values on the table show that the advantages gained by using DSP vary from a 2.2 percent energy savings to 31.8 percent savings for the systems calculated. Generally, the beer systems show more advantages than soft drink systems because more packaging is required. For 10-trip beer systems, the average energy savings is 24.8 percent. For soft drink systems at 10-trips, the average energy savings is 12.2 percent. Thus, the use of DSP is likely to result in significant energy savings, as long as the return of the packaging occurs at a high rate.

Table D.8-15. Effect of durable secondary packaging on REF bottle energy profiles

(million Btu per 1,000 gallons delivered to consumer)

	1975 system total*	Secondary packaging†	DSP system total‡	Percent difference§
Beer container systems				
On-premise				
1-trip	65.27	4.26	61.01	-6.5
10-trip	19.78	4.26	15.52	-21.5
20-trip	17.24	4.26	12.98	-24.7
Off-premise				
1-trip	67.08	6.07	61.01	-9.0
10-trip	21.59	6.07	15.52	-28.1
20-trip	19.06	6.07	12.99	-31.8
Soft drink container systems				
16-ounce				
1-trip	77.47	1.93	75.54	-2.5
10-trip	14.58	1.93	12.65	-13.2
20-trip	11.09	1.93	9.16	-17.4
32-ounce				
1-trip	64.85	1.46	63.39	-2.2
10-trip	13.06	1.46	11.60	-11.2
20-trip	10.19	1.46	8.73	-14.3

* Calculated from tables D.8-7 and D.8-8.
† Includes corrugated boxes and paperboard carriers.
‡ The "durable secondary packaging" (DSP) system was calculated by subtracting the secondary packaging from the 1975 system total.
§ Calculated by $\left(\frac{\text{DSP System Total - 1975 System Total}}{\text{1975 System Total}}\right) \times 100$.

NOTES AND REFERENCES - SECTION D.8

1. From page 69, ref. 2.
2. Hunt, R. G., et al, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives," Volume II, U.S. Environmental Protection Agency, Report SW-91c, 1974.
3. Private communication from industrial source, June 1975.
4. From page 73, ref. 2.
5. From page 77, ref. 2.
6. From pages 74-76, ref. 2.
7. "Prospects for Energy Savings in Glass Beverage Container Systems by 1985," Stanford Research Institute for The Glass Container Manufacturers Institute, Inc., Draft Report, November 24, 1975.
8. This is calculated in a manner similar to that used in ref. 10, section D.5, assuming that 65 percent of the void space remains in glass bottles after waste disposal.
9. Private data submitted by an industrial source.
10. Accurate data for the filling of beer were not determined, but the U.S. Brewers Association provided helpful guidance from their membership. The difference in electrical requirements for various containers is listed.
11. U.S. Department of Commerce, Census of Transportation, 1972. Government Printing Office, Washington, D.C.
12. Data for nonrefillable bottles were used as found in ref. 11. However, transport of empty bottles was added for refillable bottles for all modes of transport except private truck. It was assumed that private trucks would make return trips to the brewery whether empty bottles were handled or not, so the return trip is already included in the census data.

13. Franklin Associates, Ltd., estimates.

14. Data submitted by U.S. Brewers Association, July 1975, combined with ref. 9.

15. Derived from ref. 7.

16. Ref. 9 and previous table.

17. The following alterations were made in 1975 glass system values in order to calculate the 1985 glass system values.

System Changes	References
Reduce glass container weights	Table D.8-1
Glass plant energy conservation - 8 percent	Notes and references 7
Replace all manufactured soda ash with natural soda ash	Notes and references 7
Use steel closures on all glass bottles	Notes and references 7
Reduce weight of paper packaging 25 percent	Notes and references 9
Reduce paper industry energy - 6 percent	Notes and references 18
Reduce plastic industry energy - 15 percent	Notes and references 18
Reduce energy for filling and washing - 10 percent	Notes and references 9
Reduce all transportation energies - 15 percent	Notes and references 19

18. "Energy Conservation in the Manufacturing Sector, 1954 - 1990," Federal Energy Administration Project Independence Blue Print, Final Task Force Report, Volume 3, November 1974.

19. "Project Independence and Energy Conservation: Transportation Sectors," Federal Energy Administration Independence Blue Print, Final Task Force Report, Volume 2, November 1974.

20. See table D.8-5.

21. Private communication, Glass Containers Manufacturers Institute, July 1975.

D.9 Energy Profile Equations

In order to facilitate computer calculations, the data contained in section D.2 were summarized in equation form and presented here. The general methodology employed was to achieve equations which combined information on time trends and energy source (natural gas, petroleum, etc.), as well as allowing combination of various recycling (and/or energy recovery) rates. However, it should be emphasized that the information contained in these equations is identical to the information contained in section D.2.

In order to derive the equations, it was first necessary to define all of the important factors and assign symbols to them. The list of symbols is in table D.9-1. The basic organization of the equations was then determined to be a set of terms which include time trend information for each energy source, which would then be weighted in accordance with recycling and energy recovery percents. Thus, the first term in the first equation on table D.9-2 is the natural gas term, given by $[18.46 - 3.09 (\frac{t}{10})]$, which is multipled times V, the decimal fraction of containers made from virgin materials. The 18.46 is the 1975 natural gas term given in table D.2-1. The value 3.09 is the difference between 18.46, and the 1985 natural gas value 15.37 (from table D.2-2). The factor $(\frac{t}{10})$ is the time dependent term, where t = 0 is 1975, and t = 10 is 1985. Substituting values of 0 and 10 in for t, the reader can verify that the first term gives the proper result. This procedure was applied step-wise to all data in the plastic container tables to arrive at the equations in table D.9-2.

Although there are some variations, the other equations in this section are organized in approximately the same way, and the derivations were similar. One important problem is the fact that data for steel and aluminum were given for 1974, rather than 1985. In order to put all equations on a common base, an equation transformation was necessary.

The equations were first derived from section D.2 tables in the fashion described above, except the time term is $(\frac{t}{11})$ instead of $(\frac{t}{10})$. Thus, each term is in the form of $A' - B'(\frac{t'}{11})$. In order to correct to the desired form of $A - B(\frac{t}{10})$, the following transformations were carried out.

$$A = A' - (\frac{B'}{11})$$

$$B = (\frac{10}{11})B'$$

The equations in tables D.9-3 and D.9-4 have been appropriately transformed.

Table D.9-1. Symbols used in energy profile equations

NG = Natural Gas

P = Petroleum

C = Coal

N = Nuclear

H = Hydropower

W = Wood Waste

(The above symbols are identifying labels denoting the energy source).

E = Energy in million Btu/1,000 gallons of beverage delivered to final consumer. (The numerical value preceeding each energy source such as natural gas is million Btu/1,000 gallons).

R = Decimal fraction recycled, based on net material recovery.

V = Decimal fraction of containers made from virgin materials which are discarded into a waste stream after use.

ER = Decimal fraction of plastic containers made from virgin materials and disposed of in a waste stream which is incinerated in an energy recovery installation.

N_t = Number of trips for refillable glass containers.

t = Time in years, $t_0 = 0$ is 1975, $0 \leq t \leq 10$

$R + V + ER = 1.0$

Source: Franklin Associates, Ltd., for Research Triangle Institute

Table D.9-2. Energy profile equations for plastic bottle systems

PET 16-ounce NR soft drink

$$E = V\left\{\left[18.46 - 3.09\left(\frac{t}{10}\right)\right]NG + \left[16.90 - 3.33\left(\frac{t}{10}\right)\right]P + \left[6.25 - 2.07\left(\frac{t}{10}\right)\right]C + \left[0.58 - 0.20\left(\frac{t}{10}\right)\right]N + \left[0.81 - 0.26\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + R\left\{\left[8.99 - 1.3\left(\frac{t}{10}\right)\right]NG + \left[8.86 - 1.87\left(\frac{t}{10}\right)\right]P + \left[5.01 - 1.12\left(\frac{t}{10}\right)\right]C + \left[0.45 - 0.10\left(\frac{t}{10}\right)\right]N + \left[0.68 - 0.16\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + ER\left\{\left[18.96 - 3.13\left(\frac{t}{10}\right)\right]NG + \left[17.11 - 3.34\left(\frac{t}{10}\right)\right]P + \left[-1.70 - 1.6\left(\frac{t}{10}\right)\right]C + \left[0.63 - 0.20\left(\frac{t}{10}\right)\right]N + \left[0.87 - 0.27\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\}$$

PET 48-ounce NR soft drink

$$E = V\left\{\left[11.43 - 2.66\left(\frac{t}{10}\right)\right]NG + \left[11.37 - 3.12\left(\frac{t}{10}\right)\right]P + \left[4.04 - 1.32\left(\frac{t}{10}\right)\right]C + \left[0.37 - 0.13\left(\frac{t}{10}\right)\right]N + \left[0.48 - 0.16\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + R\left\{\left[5.22 - 1.16\left(\frac{t}{10}\right)\right]NG + \left[6.04 - 2.13\left(\frac{t}{10}\right)\right]P + \left[3.22 - 0.69\left(\frac{t}{10}\right)\right]C + \left[0.28 - 0.06\left(\frac{t}{10}\right)\right]N + \left[0.40 - 0.10\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + ER\left\{\left[11.78 - 2.33\left(\frac{t}{10}\right)\right]NG + \left[11.52 - 3.15\left(\frac{t}{10}\right)\right]P + \left[-0.71 + 0.62\left(\frac{t}{10}\right)\right]C + \left[0.41 - 0.41\left(\frac{t}{10}\right)\right]N + \left[0.52 - 0.17\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\}$$

AN/S 16-ounce NR soft drink

$$E = V\left\{\left[25.52 - 3.65\left(\frac{t}{10}\right)\right]NG + \left[11.88 - 2.12\left(\frac{t}{10}\right)\right]P + \left[4.41 - 1.01\left(\frac{t}{10}\right)\right]C + \left[0.39 - 0.09\left(\frac{t}{10}\right)\right]N + \left[0.62 - 0.14\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + R\left\{\left[6.08 - 0.74\left(\frac{t}{10}\right)\right]NG + \left[8.67 - 1.81\left(\frac{t}{10}\right)\right]P + \left[4.11 - 0.90\left(\frac{t}{10}\right)\right]C + \left[0.36 - 0.08\left(\frac{t}{10}\right)\right]N + \left[0.59 - 0.13\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + ER\left\{\left[26.01 - 3.70\left(\frac{t}{10}\right)\right]NG + \left[12.10 - 2.15\left(\frac{t}{10}\right)\right]P + \left[-5.76 - 0.25\left(\frac{t}{10}\right)\right]C + \left[0.44 - 0.09\left(\frac{t}{10}\right)\right]N + \left[0.68 - 0.15\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\}$$

AN/S 48-ounce NR soft drink

$$E = V\left\{\left[18.66 - 2.53\left(\frac{t}{10}\right)\right]NG + \left[9.25 - 1.61\left(\frac{t}{10}\right)\right]P + \left[3.09 - 0.67\left(\frac{t}{10}\right)\right]C + \left[0.27 - 0.05\left(\frac{t}{10}\right)\right]N + \left[0.39 - 0.09\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + R\left\{\left[2.97 - 0.30\left(\frac{t}{10}\right)\right]NG + \left[6.03 - 0.62\left(\frac{t}{10}\right)\right]P + \left[2.66 - 0.40\left(\frac{t}{10}\right)\right]C + \left[0.22 - 0.02\left(\frac{t}{10}\right)\right]N + \left[0.35 - 0.07\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\} + ER\left\{\left[19.05 - 2.56\left(\frac{t}{10}\right)\right]NG + \left[9.42 - 1.65\left(\frac{t}{10}\right)\right]P + \left[-4.18 - 0.12\left(\frac{t}{10}\right)\right]C + \left[0.31 - 0.05\left(\frac{t}{10}\right)\right]N + \left[0.43 - 0.09\left(\frac{t}{10}\right)\right]H + \left[0.94 - 0.31\left(\frac{t}{10}\right)\right]W\right\}$$

The hydro (H) term in this equation is based on 3413 Btu per kwh. For marginal analysis where changes in energy consumption would not be reflected in altered hydroelectric power consumption multiply the hydro term by 3.056. See p. D-19 for a more complete discussion.

Source: Table D.2-1 and D.2-2.

Table D.9-3. Energy profile equations for aluminum can systems

$$E = \left\{\left[24.24 - 8.29\left(\frac{t}{10}\right)\right] NG + \left[16.01 - 3.23\left(\frac{t}{10}\right)\right] P + \left[20.89 - 4.89\left(\frac{t}{10}\right)\right] C + \left[1.53 - 0.36\left(\frac{t}{10}\right)\right] N + \left[5.69 - 1.41\left(\frac{t}{10}\right)\right] H + \left[0.69 - 0.27\left(\frac{t}{10}\right)\right] W\right\}(1-R) + \left\{\left[12.69 - 4.44\left(\frac{t}{10}\right)\right] NG + \left[4.96 - 1.30\left(\frac{t}{10}\right)\right] P + \left[3.81 - 0.99\left(\frac{t}{10}\right)\right] C + \left[0.35 - 0.08\left(\frac{t}{10}\right)\right] N + \left[0.56 - 0.14\left(\frac{t}{10}\right)\right] H + \left[0.73 - 0.27\left(\frac{t}{10}\right)\right] W\right\} R$$

The hydro (H) term in this equation is based on 3413 Btu per kwh. For marginal analysis where changes in energy consumption would not be reflected in altered hydroelectric power consumption multiply the hydro term by 3.056. See p. D-19 for a more complete discussion.

Source: Table D.2-3, transformed from 1974 to 1975.

Table D.9-4. Energy profile equations for steel can systems

$$E = \left[13.99 - 5.45\left(\frac{t}{10}\right)\right] NG + \left[7.61 - 3.28\left(\frac{t}{10}\right)\right] P +$$
$$\left[20.55 - 4.81\left(\frac{t}{10}\right)\right] C + \left[0.57 - 0.29\left(\frac{t}{10}\right)\right] N +$$
$$\left[1.43 - 1.15\left(\frac{t}{10}\right)\right] H + \left[0.74 - 0.15\left(\frac{t}{10}\right)\right] W - (-1.79\ NG +$$
$$0.038\ P + 10.23\ C - 0.26\ N - 0.27\ H)R$$

This assumes 50 percent three-piece and 50 percent D&I for 1985.

The hydro (H) term in this equation is based on 3413 Btu per kwh. For marginal analysis where changes in energy consumption would not be reflected in altered hydroelectric power consumption multiply the hydro term by 3.056. See p. D-19 for a more complete discussion.

Source: Table D.2-4, transformed from 1974 to 1975.

Table D.9-5. Energy profile equations for refillable glass bottles

Beer

On-premise bottles

$$E = \left\{\left\{\left[27.74 - 3.14\left(\frac{t}{10}\right)\right] NG + \left[15.60 - 2.83\left(\frac{t}{10}\right)\right] P + \left[6.38 - 2.73\left(\frac{t}{10}\right)\right] C + \left[0.42 - 0.08\left(\frac{t}{10}\right)\right](N + H) - R \times \left[7.97\,NG + 2.27\,P + 2.09\,C + 0.006\,(N + H)\right]\right\} \div N_t\right\} + \left[2.27 - 0.39\left(\frac{t}{10}\right)\right] NG + \left[8.64 - 1.46\left(\frac{t}{10}\right)\right] P + \left[1.96 - 0.33\left(\frac{t}{10}\right)\right] C + \left[0.076 - 0.012\left(\frac{t}{10}\right)\right](N + H) + \left[1.70 - 0.46\left(\frac{t}{10}\right)\right] W$$

Off-premise bottles

$$E = \left\{\left\{\left[27.74 - 3.14\left(\frac{t}{10}\right)\right] NG + \left[15.60 - 2.83\left(\frac{t}{10}\right)\right] P + \left[6.38 - 2.73\left(\frac{t}{10}\right)\right] C + \left[0.42 - 0.08\left(\frac{t}{10}\right)\right](N + H) - R \times \left[7.97\,NG + 2.27\,P + 2.09\,C + 0.006\,(N + H)\right]\right\} \div N_t\right\} + \left[2.57 - 0.48\left(\frac{t}{10}\right)\right] NG + \left[9.10 - 1.60\left(\frac{t}{10}\right)\right] P + \left[2.25 - 0.42\left(\frac{t}{10}\right)\right] C + \left[0.085 - 0.015\left(\frac{t}{10}\right)\right](N + H) + \left[2.44 - 0.68\left(\frac{t}{10}\right)\right] W$$

Soft drink

16-fluid-ounce

$$E = \left\{\left\{\left[38.59 - 4.58\left(\frac{t}{10}\right)\right] NG + \left[21.45 - 3.89\left(\frac{t}{10}\right)\right] P + \left[8.66 - 3.58\left(\frac{t}{10}\right)\right] C + \left[0.59 - 0.11\left(\frac{t}{10}\right)\right](N + H) - R \times \left[10.14\,NG + 2.89\,P + 2.66\,C + 0.008\,(N + H)\right]\right\} \div N_t\right\} + \left[2.18 - 0.30\left(\frac{t}{10}\right)\right] NG + \left[3.29 - 0.55\left(\frac{t}{10}\right)\right] P + \left[1.23 - 0.18\left(\frac{t}{10}\right)\right] C + \left[0.053 - 0.007\left(\frac{t}{10}\right)\right](N + H) + \left[0.79 - 0.24\left(\frac{t}{10}\right)\right] W$$

32-fluid-ounce

$$E = \left\{\left\{\left[31.78 - 3.70\left(\frac{t}{10}\right)\right] NG + \left[17.67 - 3.17\left(\frac{t}{10}\right)\right] P + \left[7.13 - 2.94\left(\frac{t}{10}\right)\right] C + \left[0.48 - 0.080\left(\frac{t}{10}\right)\right](N + H) - R \times \left[8.37\ NG + 2.38\ P + 2.19\ C + 0.006\ (N + H)\right]\right\} \div N_t\right\}$$

$$+ \left[2.19 - 0.56\left(\frac{t}{10}\right)\right] NG + \left[3.35 - 0.74\left(\frac{t}{10}\right)\right] P + \left[0.95 - 0.23\left(\frac{t}{10}\right)\right] C + \left[0.068 - 0.029\left(\frac{t}{10}\right)\right] N + \left[0.15 - 0.11\left(\frac{t}{10}\right)\right] H + \left[0.60 - 0.18\left(\frac{t}{10}\right)\right] W$$

The hydro (H) term in this equation is based on 3413 Btu per kwh. For marginal analysis where changes in energy consumption would not be reflected in altered hydroelectric power consumption multiply the hydro term by 3.056. See p. D-19 for a more complete discussion.

Source: Table D.2-5 and D.2-6. Recycling factors are based on 1985 bottle weights.

Table D.9-6. Energy profile equations for nonrefillable glass bottle systems

$$E = \left[17.96 - 2.32\left(\frac{t}{10}\right)\right] NG + \left[14.96 - 2.78\left(\frac{t}{10}\right)\right] P + \left[6.13 - 2.15\left(\frac{t}{10}\right)\right] C + \left[0.32 - 0.06\left(\frac{t}{10}\right)\right](N + H) + \left[3.27 - 0.92\left(\frac{t}{10}\right)\right] W - R\left[4.85\ NG + 1.38\ P + 1.27\ C + 0.004\ (N + H)\right]$$

Table D.9-6. Energy profile equations for nonrefillable glass bottle systems (Cont.)

Soft drink
16-fluid-ounce

$$E = \left[21.41 - 2.52 \left(\frac{t}{10}\right)\right] NG + \left[14.78 - 2.77 \left(\frac{t}{10}\right)\right] P + \left[6.41 - 2.37 \left(\frac{t}{10}\right)\right] C + \left[0.36 - 0.060 \left(\frac{t}{10}\right)\right] (N + H) + \left[2.18 - 0.60 \left(\frac{t}{10}\right)\right] W - R \left[5.98\ NG + 1.70\ P + 1.56\ C + 0.005\ (N + H)\right]$$

32-fluid-ounce

$$E = \left[20.36 - 3.00 \left(\frac{t}{10}\right)\right] NG + \left[13.91 - 2.95 \left(\frac{t}{10}\right)\right] P + \left[5.80 - 2.34 \left(\frac{t}{10}\right)\right] C + \left[0.36 - 0.090 \left(\frac{t}{10}\right)\right] N + \left[0.45 - 0.18 \left(\frac{t}{10}\right)\right] H + \left[1.6 - 0.43 \left(\frac{t}{10}\right)\right] W - R \left[5.56\ NG + 1.58\ P + 1.46\ C + 0.004\ (N + H)\right]$$

64-fluid ounce (plastic coated glass)

$$E = \left[18.00 - 2.45 \left(\frac{t}{10}\right)\right] NG + \left[11.57 - 2.17 \left(\frac{t}{10}\right)\right] P + \left[4.82 - 1.81 \left(\frac{t}{10}\right)\right] C + \left[0.32 - 0.070 \left(\frac{t}{10}\right)\right] N + \left[0.36 - 0.11 \left(\frac{t}{10}\right)\right] H + \left[1.31 - 0.39 \left(\frac{t}{10}\right)\right] W - R \times \left[2.19\ NG + 0.62\ P + 0.57\ C + 0.002\ (N + H)\right]$$

The hydro (H) term in this equation is based on 3413 Btu per kwh. For marginal analysis where changes in energy consumption would not be reflected in altered hydroelectric power consumption multiply the hydro term by 3.056. See p. D-19 for a more complete discussion.

Source: Tables D.2-5 and D.2-6. Recycling factors are based on 1985 bottle weights.

D.10 Comparison of Values With a Previous Study

The 1974-75 baseline values in this study were derived by revising data from a beverage container study issued by the Environmental Protection Agency in 1974.* The effects of the data revision are shown by comparing the EPA values with values found in this study (table D.10-1). For containers where reasonably comparable data exist, the percent difference ranges from 8.3 to 40 percent lower than the EPA values, with the largest percentage decrease occurring for plastics and glass NR bottle systems.

An analysis of the system was undertaken to determine why the differences existed between the studies, especially for those systems which differ by more than 10 percent. A preliminary examination of the two studies reveals that even though the present study data base was predicated on the EPA data, the revisions undertaken were quite extensive. This study relied heavily on industry-supplied energy data that were current and specific to the containers studied, whereas the EPA data base frequently used nationwide government statistics for the data. This difference was especially significant for glass systems. The most current energy data available at the time of writing the EPA study were from the 1968 Census of Manufactures, with the compounding problem that the data applied only to the glass container industry as a whole, rather than applying specifically to the containers being studied. As an example of the magnitude of this change, the energy of manufacture of NR beer bottles in the current study was 23 percent less than the values used in the EPA study.

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*See notes and references 1.

Table D.10-1. Comparison of total energy values for beer container systems from two studies (million Btu/thousand gallons delivered to consumer)

	EPA*	FEA†	Percent Difference‡
10-trip refillable bottles	21.6	19.8	8.3
Plastic bottles	63.3	43.9	30.6
Plastic coated glass bottles	60.7	36.4	40.0
NR glass bottles	64.4	43.0	33.2
Bimetal cans	53.7	46.4	13.6
Aluminum cans	75.0	62.0§	17.3

* See notes and references 1.
† Values derived from the various sections of this study for the 1974-1975 baseline.
‡ Calculated by $\left(\frac{EPA - FEA}{EPA}\right) \times 100$.
§ This assumes a 19 percent recycling rate.

A difference of less than 10 percent is considered to be good agreement, especially in light of the important differences between the data bases discussed above. Thus, in table D.10-1 the agreement between the studies for 10-trip refillable bottles is considered to be reasonable. The specific reasons for the differences greater than 10 percent in the other systems are described below.

Plastic bottles. The plastic bottle used in the EPA study was a 12-fluid-ounce bottle which weighed 1.2 ounces, or 0.1 ounce per fluid-ounce. The most comparable bottle in the current study is the 16-fluid-ounce AN/S bottle which weighs 1.23 ounces, or 0.0769 ounces per fluid-ounce. Thus, the difference in weight per unit volume is 23 percent, which accounts for most of the difference on table D.10-1. The remaining difference is accounted for by different filling and transportation energies, as well as revised packaging estimates.

Plastic coated glass (PCG). The PCG containers compared in table D.10-1 are quite different containers. In the EPA study, the PCG bottle was a 12-ounce beer bottle, while in the present study the PCG bottle is a 64-ounce soft drink container. Thus, considerable difference in packaging and transportation exist. The remaining differences are accounted for by the revised energy values for manufacturing glass. For the reasons cited above, the current values per pound of glass manufactured are 23 percent lower than those in the EPA study.

NR glass. The difference between the NR glass container exists because of revised packaging requirements, filling energy values, and the above cited lower values for glass manufacture. In addition, the 1975 glass bottles required 7 percent less glass than the bottle used for the EPA study.

Bimetal can. The difference between the bimetal can values is caused by a complete revision of steel manufacturing energy values for the current study, coupled with less energy required to manufacture the aluminum lid. The aluminum energy values are discussed below.

Aluminum can. The difference in aluminum can values is explained by two factors: (1) rapidly increasing aluminum recycling; and (2) use of Aluminum Association electricity values for this study, as compared to use of national grid values in the EPA study. A recalculation of energy values used in this study, substituting the national grid and 15 percent recycling (the percent recycling used in the EPA study), results in a value within 3 percent of the EPA value.

Thus, we conclude that even though table D.10-1 shows differences between this study and its predecessor (the EPA study), these differences can be explained by examining the extensive revisions of the EPA data base carried out for this study.

NOTES AND REFERENCES - SECTION D.10

1. Hunt, R. G., et al, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives," Volume II, U.S. Environmental Protection Agency, Report SW-91c, 1974.

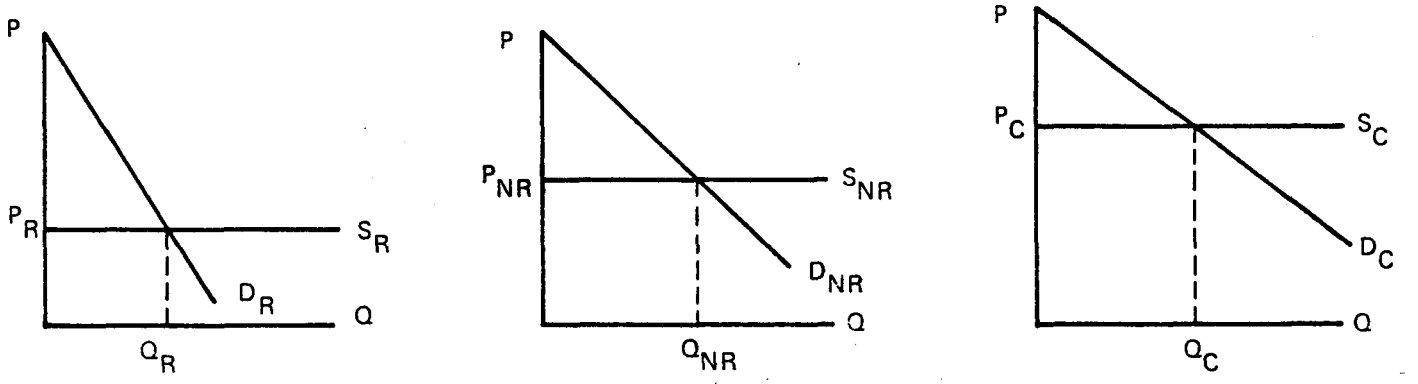
Appendix E: IMPACT MODEL

E.1 Introduction

To develop the estimates of the energy, capital, and labor impacts of mandatory deposits, a theoretical model of the interrelationships between producer and consumer behavior was needed. Such a model is outlined below. This discussion is followed by the presentation of a computer model which was designed and implemented as part of this study.

E.2 Theoretical Model

A simplified representation of the current beverage markets (i.e., without government intervention) is shown in the diagrams of figure E-1.



(a) refillable bottle market

(b) nonrefillable bottle market

(c) can market

Figure E-1. Current beverage market.

For the purpose of this study, beverage manufacturers are regarded as producing three differentiated products, which are close substitutes (the beverage in refillable bottles, nonrefillable bottles, and cans). The supply curves are perfectly elastic under the assumption that producers are willing to supply any quantity of the beverage at the current price.

The supply curves drawn in figure E-1 reflect the observation that the shelf prices of beer and soft drinks are ranked from lowest to highest by container type as follows: refillable bottle, nonrefillable bottle, can

(for a 12-ounce container). These current prices are assumed to reflect all costs of production and distribution associated with the selection of a specific container type plus a normal return on investment.*

From figure E-1, total beverage consumption is:

$$Q_R + Q_{NR} + Q_C$$

where the subscript indicates the type of container.

The market for beverages in refillable bottles, however, can be further subdivided into two markets: one for convenience and one for cost-oriented consumers. The demand curves for these two markets are represented in figure E-2 by D_{R_D} and D_{R_R} respectively. The additional subscript represents "discarded" (D) or "returned" (R). Although both consumer groups pay the same shelf price, P_R, those consumers who discard the empty bottle forfeit the deposit (d) and their actual outlay is $P_R + d$. Therefore, the total revenue (outlays) of beverage producers (consumers) is:

$$TR = (P_R + d)(Q_{R_D}) + (P_R)(Q_{R_R}) + (P_{NR})(Q_{NR}) + (P_C)(Q_C).$$

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*The argument has been advanced that current shelf prices for beer do not accurately reflect the opportunity costs of production and distribution. Specifically, Coors indicates (see their letter in appendix L) that when all costs are considered, the can may be a cheaper container for beer distribution than the nonrefillable bottle. Weinberg (see his letter in appendix L) goes somewhat further, arguing that the refillable bottle is "subsidized" by the more efficient convenience containers. While a thorough investigation of this question is beyond the scope of this study, two explanations of the hypothesized situation can be advanced.

The first and most obvious is that brewers may not have complete, current knowledge regarding the distribution of their production and distribution costs across all containers. Therefore, they may have adopted a traditional pricing scheme which reflected actual, or estimated, costs in some previous time.

A second reason is somewhat more complex. Instead of maximizing profits on beer in each container separately, producers may maximize profits jointly. In such situations, it can be shown that if the elasticities of demand vary by container type, then profit maximizing behavior would dictate that producers discriminate and charge higher prices for the product with the most inelastic demand (presumably beer in cans).

Regardless of the rationale, if the prices of beer do not reflect their opportunity costs of production and distribution, the incentive would exist for producers to enter the market and sell beer in cans below the prices established by the price-discriminating producers. To explain why this has not happened, if it indeed has not, one would probably have to identify significant barriers to entry.

The refillable bottle return rate is:

$$RR_R = Q_{R_R}/(Q_{R_R} + Q_{R_D}).$$

The refillable bottle trippage is:

$$T = 1/(1 - RR_R).$$

The institution of mandatory minimum deposits can be regarded as imposing a price floor on all empty containers. Retailers who sell beverages must, by law, be willing to pay at least the minimum deposit for any returned container.

From the consumer's perspective, the immediate effect of mandatory deposits will be to raise the price of beverages in nonrefillable bottles

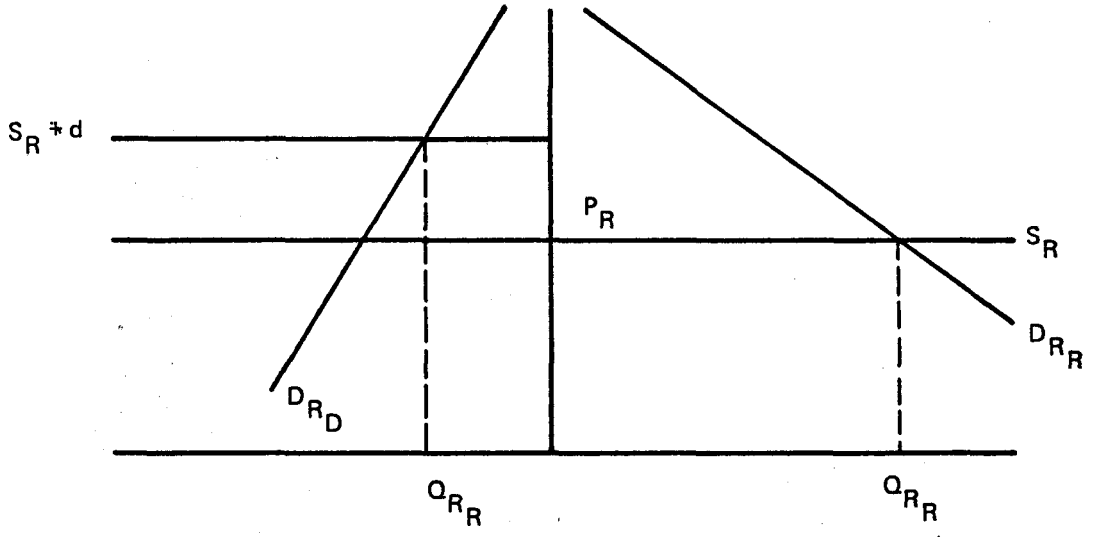


Figure E-2. Refillable bottle markets.

and cans that are discarded by the amount of the deposit. The impact of mandatory deposits on consumption will be dependent on price changes which are in turn affected by the degree of substitution between beverages in the alternative containers and the extent of the economies of scale for each container. Assuming constant returns to scale and less than perfect sub-

substitution between the discarded can and nonrefillable bottle markets and the refillable bottle and returned can markets, beverage consumption will fall.*

If consumers perceive no differences in the physical attributes of the nonrefillable and refillable bottle, the nonrefillable bottle would, in the long run, vanish from the market if the final equilibrium shelf price, P'_{NR}, of beverages in nonrefillable bottles exceeds that, P'_{R}, of beverages in refillable bottles. Based on current market prices, this outcome appears likely.

The impact of mandatory minimum deposits on the metal can market will depend on the extent to which the refillable bottle and returned can are good substitutes for the discarded can.

---

*If the beverage markets are competitive and current prices reflect opportunity costs, then consumers who would face a higher price for their beverage with mandatory deposits would obviously be made worse off by the legislation and, therefore, their consumption can be expected to decline. After all, they could always have chosen refillable bottles.

A counter argument to the above is that consumers currently do not have the "choice" of purchasing their beverages in refillable bottles. As part of a public opinion survey taken for this study, the question was asked of beer and soft drink buyers:

"Is the beer (soft drink) you prefer available in the following containers where you shop: returnable bottles, nonreturnable bottles, can?" Forty percent of the respondents found beer, and 75 percent of the respondents found soft drinks, available in refillable bottles.

Thus, it would appear that the nonavailability argument is most relevant to beer. However, even here one must be careful in interpreting the survey results. Mere availability and availability at a price consumers are willing and able to pay are not the same. It is conceivable that in some markets, for some brands, the costs of providing beer in refillable bottles, even assuming normal return rates, may exceed that of nonrefillable bottles or cans due to the costs of transportation.

After the short-run adjustment process is complete, the final equilibrium shelf price, P'_R, of beverages in refillable bottles is the algebraic combination of four components:

(1) CIC = container-independent unit cost of the packaged beverage.

(2) $(RR'_R)(HC_R)$ = average unit handling cost for refillable bottles: estimated as the handling cost per returned container, HC_R, times the proportion returned, i.e., the return rate, RR'_R.

(3) CC_R/T' = average unit refillable bottle cost: estimated as the cost per new container, CC_R, divided by the average number of trips, T', each makes.

(4) $(1 - RR'_R)d$ = average amount of the unit deposit that is forfeited on bottled beverages. This is a product of the unit deposit, d, and the proportion, $1 - RR'_R$, of refillable bottles not returned. This proportion not returned is expressed as 1 minus the return rate, RR'_R.

The actual average unit production cost of beverages in refillable containers is the sum of the first three of these components, since the first is assumed to include a normal return (profit) to the capital required for production and distribution. Ordinarily, the price of the beverage would be thought of as the sum of these three components. However, it is also assumed that beverage producers and retailers cannot, because of competition, enjoy excess profits in the long run. Therefore, they cannot, in addition to charging a price equal to the sum of the first three components, retain the forfeited deposits. In the long run, the price of beverages in refillable bottles must be:

$$P'_R = (1) + (2) + (3) - (4).$$

The shelf price of beverages in cans is composed of terms similar to those associated with refillable bottles in addition to a credit for the

salvage value of a returned can. The first term is identical to that in the shelf price of refillable bottles. The remaining four are:

(2)' $(RR_C')(HC_C)$ = average unit handling cost for a returned can.

(3)' CC_C = average unit can cost; estimated as the cost of a new container, CC_C, since by definition a can is used for a single trip.

(4)' $(1 - RR_C')d$ = average amount of the unit deposit that is forfeited on canned beverages.

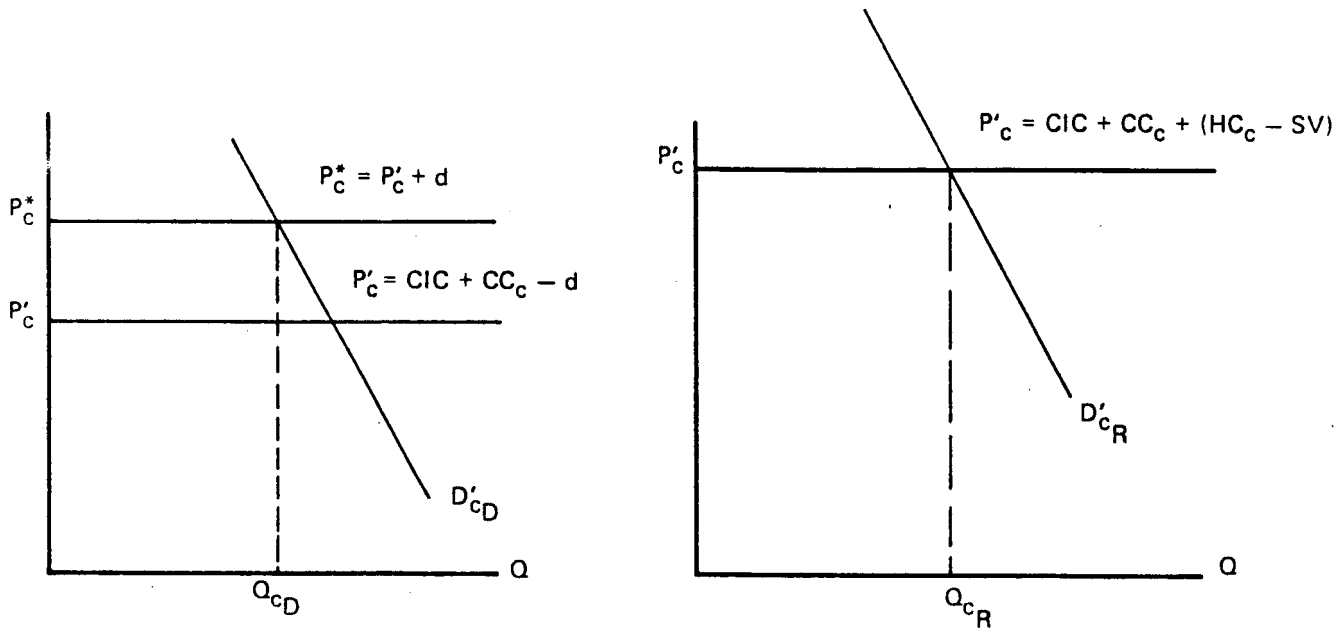
(5)' $(RR_C')(SV)$ = average realized unit scrap value for can; estimated as the unit scrap value of a can, SV, times the can return rate.

Therefore, the long-run shelf price of a beverage in a can is the sum of the unit container independent costs, average handling cost, and can cost less forfeited deposits and scrap value per unit:

$$P_C' = (1) + (2)' + (3)' - (4)' - (5)'.$$

In figure E-3, two extreme reponses of the canned beverage market are shown. In figure E-3a, all cans are assumed discarded ($RR_C' = 0$), and in figure E-3b, all are assumed returned ($RR_C' = 1$)--HC_c, the unit can handling cost, is assumed to be greater than the scrap value of a can.

In both the refillable bottle and can markets the share of containers which are discarded affects the intercept of the supply curve. For refillable bottles, increases in the return rate lower average container costs and hence the supply curve (as long as the cost of a new bottle exceeds the deposit plus the handling costs). Thus, if consumers shift from nonrefillable bottles and cans to the discarded refillable market in greater proportions than the distribution before government intervention, trippage will fall and hence prices increase. Should trippage decline, producers have, of course, the option of raising deposits above the minimum and would be expected to do so to preserve the price advantage of the returned refillable bottle. An upper limit on the deposit of the price of a new bottle may in some situations prevent the deposit from being raised to a level sufficient to insure adequate trippage. In these cases producers would shift to nonrefillable bottles.



a) 100 percent discard

b) 100 percent return

Figure E-3. Canned beverage market extreme solutions.

With respect to cans, returned containers have the opposite effect on the supply curve from that discussed above for refillable bottles. Returned cans impose additional handling costs on retailers which are assumed to be reflected in the shelf prices of canned beverages.

E.3 Computer Model

The major relationships incorporated in the computer model are shown in figure E-4. In table E-1, the complete model is listed.

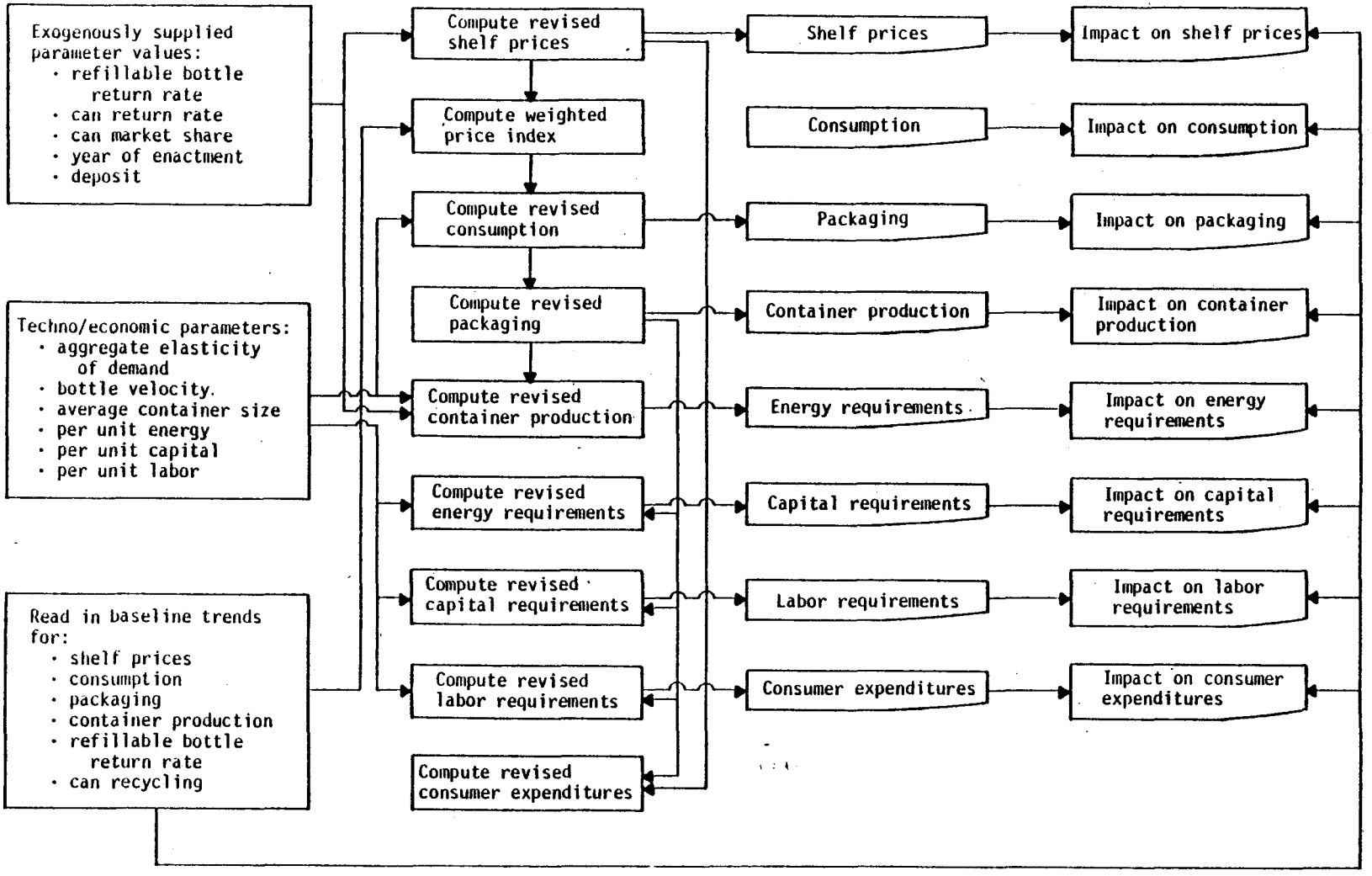


Figure E-4. Beverage model flow diagram.

Table E-1. Model listing

```
//PACK JOB RTI,C41,P06397,PC,PRTY=1,T=(,39),M=1,R=200K                    00000010
// EXEC FTGCLG                                                            00000020
//FT04F001 DD DSN=RTI.C41.P06397.PC.PACK.LIB,DISP=(OLD,DELETE),           00000030
// UNIT=DISK,VOL=SER=RTI111                                               00000040
//C.SYSIN DD *                                                           00000050
      COMMON/N5/TT(105,2,11),T1(124,2,11)                               00000060
      COMMON/N4/T(124,2,11)                                             00000070
      COMMON/N3/TL1(30,15),TL2(132,15),TL4(111,15)                      00000080
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)               00000090
      DIMENSION R(21),RR(17),R2(10),RM(126),E(40),E1(14)                00000100
      DIMENSION A(35),B(17),C(10),D(132),RRR(4),PK(4),CP(4),ASC(4),     00000110
     *R3(40),R4(14),G(13),R5(13),SP(4)                                  00000120
      EQUIVALENCE (A,D),(B,D(36)),(C,D(52)),(E,D(62)),(E1,D(102))       00000130
      EQUIVALENCE (RM,R),(RM(22),RR),(RM(38),R2),(RM(48),R3),(RM(112),R400000140
     *),(D(122),G),(RM(99),R5)                                          00000150
      DATA M0,M1/126,132/                                               00000160
C  READ WITHOUT GOVT. INTERVENTION (W.G.I.) OPTION DATA                 00000170
C    IR OPTION NUMBER, RRRR RETURN RATE FOR OPTIONS 2-5, STRR AND ALRR  00000180
C    ARE RECYCLING RATES FOR STEEL AND ALUMINUM RESPECTIVELY            00000190
      READ(1,10) IR,RRRR,STRR,ALRR,PC                                   00000200
C  READ IN TITLES FOR EACH TABLE                                        00000210
      CALL TITL                                                         00000220
C                                                                       00000230
C                                                                       00000240
C  WITHOUT GOVERNMENT INTERVENTION ANALYSIS                             00000250
C                                                                       00000260
C                                                                       00000270
C  K=1 IS BEER SYSTEM,K=2 IS SOFT DRINK SYSTEM                          00000280
      DO 1 K=1,2                                                        00000290
C  L IS YEAR INDEX L=1 IS 1975                                          00000300
      DO 3 L=1,11                                                       00000310
C  READ IN A YEAR OF DATA                                               00000320
      CALL READD(R,IT)                                                  00000330
C  OVERRIDE RETURN RATE IF OPTION NUMBER IS EVEN.                       00000340
      IF(MOD(IR,2).EQ.0) R(13)=RRRR                                     00000350
C  OVERRIDE RECYCLING RATE DATA FOR OPTIONS 3,4,7 AND 8.                00000360
      IF(IR.NE.3.AND.IR.NE.4.AND.IR.NE.7.AND.IR.NE.8) GOTO 40           00000370
      R(20)=STRR                                                        00000380
      R(21)=ALRR                                                        00000390
C  SET UP VARIABLES USED IN ENERGY CALCULATIONS(= 1 MINUS RECYCLING RATE00000400
40    DO 5 I=1,6                                                        00000410
      P1(10,I,3,K)=1.-R(20)                                             00000420
5     P1(10,I,4,K)=1.-R(21)                                             00000430
C  SET UP RETURN RATES (RRR VECTOR) AND PACKAGING VALUES(PK VECTOR)     00000440
C  THESE VALUES DRIVE THE ENERGY,CAPITAL STOCK AND                      00000450
C  EARNINGS AND EMPLOYMENT CALCULATIONS.                                00000460
C  EACH VECTOR HAS 4 DIMENSIONS: REFILLABLE BOTTLES,NON REFBLE. BOTTLES,00000470
C  STEEL CANS AND ALUMINUM CANS RESPECTIVELY.                           00000480
      RRR(1)=R(13)                                                      00000490
      RRR(2)=0.                                                         00000500
```

Table E-1. Model listing (con.)

```
      RRR(3)=0.                                                          00000510
      RRR(4)=0.                                                          00000520
      PK(1)=R(4)                                                         00000530
      PK(2)=R(5)                                                         00000540
      PK(3)=R(7)                                                         00000550
      PK(4)=R(8)                                                         00000560
      CALL ENERGY(RR,R,K,IT,RRR,PK,IR)                                   00000570
      CALL STOCK(R,K,RRR,R2,R(4),R(9))                                   00000580
      CALL STOCK1(RM,K,M0,88,14,38)                                      00000590
C  SET AVERAGE CAN SIZE AND CONTAINER PRODUCTION VECTORS (ACS AND CP      00000600
C  VECTORS)                                                            00000610
      DO 15 I=1,4                                                        00000620
15.   ASC(I)=R(8+I)                                                      00000630
      CP(1)=R(14)                                                        00000640
      CP(2)=R(15)                                                        00000650
      CP(3)=R(17)                                                        00000660
      CP(4)=R(18)                                                        00000670
C  COMPUTE EARNINGS AND EMPLOYMENT VALUES                              00000680
      CALL EARN(PS,PK,CP,L,RRR,ASC,R(2),K)                               00000690
C COMPUTE SHELF PRICES                                                 00000700
      CALL SHELF(K,RM,95,RRR(1),5.)                                      00000710
C  COMPUTE CONSUMER EXPENDITURES                                       00000720
      CALL CONEX(K,R4,PK,RM,RRR(1),95,5.,M0,0,0,)                        00000730
C  SET UP SHELF PRICE VECTOR (SP).                                     00000740
      DO 30 I=1,4                                                        00000750
30    SP(I)=RM(94+I)                                                     00000760
C  COMPUTE MARKET SHARES                                               00000770
      CALL MARKT(K,L,RM)                                                 00000780
C  COMPUTE CONSUMER OUTLAYS.                                           00000790
      CALL CONOUT(SP,R5,0,5.,RRR(1),0,0)                                 00000800
C  STORE VECTOR OF CALCULATED UANTITIES(RM), IN TABLE FORMAT.          00000810
      CALL ACCUM1(RM,K,L)                                                00000820
3     CONTINUE                                                           00000830
C  PRINT TABLES 2 AND 3.                                               00000840
      CALL TABL2(K,T,124,TL2,132,1,K+1,124,PC)                           00000850
1     CONTINUE                                                           00000860
C  PRINT SUMMARY TABLE 1.                                              00000870
      CALL TABL1(1,T,124,TL2,132,T1,1,3,PC)                              00000880
C                                                                        00000890
C                                                                        00000900
C  WITH GOVERNMENT INTERVENTION ANALYSIS.                              00000910
C                                                                        00000920
C  INITIALIZE DEPOSIT (5 CENTS).                                       00000930
88    DD=5.                                                              00000940
11    FORMAT(I6,5F10.1)                                                  00000950
10    FORMAT(I5,5F10.0)                                                  00000960
      DO 2 K=1,2                                                         00000970
C  READ IN NEW DEPOSIT VALUE(DDD), RETURN RATES REFILLABLES AND CANS    00000980
C   (RRRR,RR4C), BOTTLE MARKET SHARE(FMS), AND ANNUAL GROWTH           00000990
C.  RATE(GRFMS) BEGINNING IN YEAR IT.                                   00001000
```

Table E-1. Model listing (con.)

```
      READ(1,10,END=99) IT,DDD,RRRR,RRMC,FMS,GRFMS                    00001010
      A(24)=0.                                                        00001020
      WRITE(3,11) IT,DDD,RRRR,RRMC,FMS,GRFMS                          00001030
      DO 4 L=1,11                                                     00001040
C  COMPUTE QANTITIES USED PRIOR TO INTERVENTION YEAR.                  00001050
      C01=0                                                           00001060
      A(4)=T(5,K,L)/T(3,K,L)                                          00001070
      A(7)=T(7,K,L)/T(3,K,L)                                          00001080
      A(1)=0.                                                         00001090
      A(6)=T(14,K,L)                                                  00001100
C  IF YEAR L >= YEAR IT THEN SET VALUES FOR INTER VENTION.             00001110
      IF(L-IT+1974) 17,18,19                                          00001120
18    A(6)=RRRR                                                       00001130
      A(1)=RRMC                                                       00001140
      DD=DDD                                                          00001150
      A(4)=FMS                                                        00001160
      A(7)=1.-FMS                                                     00001170
      GOTO 17                                                         00001180
19    A(4)=FMS*(1.+GRFMS)**(L-IT+1974)                                00001190
      A(7)=1.-A(4)                                                    00001200
      A(6)=RRRR                                                       00001210
      A(1)=RRMC                                                       00001220
C  CALCULATE PACKAGING AND CONTAINER PRODUCTION VALUES.                00001230
17    CALL CALC1(DD,A,K,L,C01)                                        00001240
C  COMPUTE ENERGY EXOGENOUS VARIABLES.                                 00001250
C  CALCULATED VALUES ARE 1 MINUS RECYCLING RATES.                      00001260
      DO 8 J=1,6                                                      00001270
      P1(10,J,3,K)=1.-A(31)                                           00001280
      P1(10,J,4,K)=1.-A(32)                                           00001290
      DO 8 I=1,2                                                      00001300
8     P1(10,J,I,K)=T(5,K,L)*P1(10,J,I,K)/A(18)                        00001310
C  SET UP RETURN RATE VECTOR -EXOGENOUS VARIABLES.                     00001320
      RRR(1)=A(5)                                                     00001330
      RRR(3)=0.                                                       00001340
C  SET UP PACKAGING VECTOR                                             00001350
      DO 6 IL=1,4                                                     00001360
6     PK(IL)=A(IL+17)                                                 00001370
99    FORMAT(1X,4E15.6)                                               00001380
      ITT=1974+L                                                      00001390
C  COMPUTE ENERGY REUIREMENTS.                                         00001400
      CALL ENERGY(8,R,K,ITT,RRR,PK,IR)                                00001410
      R(4)=A(18)                                                      00001420
      R(5)=A(19)                                                      00001430
      R(6)=A(20)+A(21)                                                00001440
      RRR(3)=A(1)                                                     00001450
C  COMPUTE CAPITAL STOCK REUIREMENTS.                                  00001460
      CALL STOCK(R,K,RRR,C,A(18),T(10,K,L))                           00001470
C  SET UP AVERAGE CAN SIZE VECTOR.                                     00001480
      DO 16 I=1,4                                                     00001490
16    ASC(I)=T(I+9,K,L)                                               00001500
```

Table E-1. Model listing (con.)

```
C  SET UP CONTAINER PRODUCTION VECTOR.                                    00001510
      CP(1)=A(25)                                                        00001520
      CP(2)=0.0                                                          00001530
      CP(3)=A(26)                                                        00001540
      CP(4)=A(27)                                                        00001550
C  COMPUTE EARNINGS AND EMPLOYMENT REUIREMENTS.                           00001560
      CALL EARN(E,PK,CP,L,RRR,ASC,A(33),K)                               00001570
C  COMPUTE CONSUMER EXPENDITURE VALUES.                                   00001580
      CALL CONEX(K,E1,PK,D,RRR(1),8,DD,M1,1,RRR(3))                      00001590
C  COMPUTE CAPITAL STOCK REUIREMENTS-CONTAINER PRODUCERS.                 00001600
      CALL STOCK1(D,K,M1,116,25,52)                                      00001610
C  SET UP SHELF PRICE VECTOR.                                             00001620
      DO 31 I=1,3                                                        00001630
31    SP(I)=D(7+I)                                                       00001640
C  COMPUTE CONSUMER OUTLAY VALUES.                                        00001650
      CALL CONOUT(SP,G,1,DD,RRR(1),RRR(3))                               00001660
C  STORE COMPUTED VALUES IN INTERVNTION TABLE FORMAT.                     00001670
      CALL ACCUM2(D,K,L)                                                 00001680
4     CONTINUE                                                           00001690
C  PRINT TABLES 5 AND 6.                                                  00001700
      CALL TABL2(K,TT,105,TL4,111,2,4+K,105,PC)                          00001710
2     CONTINUE                                                           00001720
C  PRINT TABLE 4.                                                         00001730
      CALL TABL1(4,TT,105,TL4,111,T1,2,2,PC)                             00001740
C  COMPUTE NET TABLE.                                                     00001750
      CALL DIFF(T1)                                                      00001760
C  PRINT NET TABLE (NUMBER 7).                                            00001770
      CALL TABL2(2,T1,105,TL4,111,2,7,124,PC)                            00001780
      GOTO 88                                                            00001790
89    STOP                                                               00001800
      END                                                                00001810
      SUBROUTINE STOCK1(RM,K,M,I1,I2,I3)                                 00001820
C  THIS SUBROUTINE COMPUTES THE CONTAINER PRODUCERS ESTIMATES OF CAPITAL  00001830
C     STOCK. INPUT PARAMETERS ARE:                                        00001840
C   RM-OUTPUT VECTOR, K-BEER S.D. INDEX, I1,I2,I3 LOCATIONAL             00001850
C        PARAMETERS  WHERE QUANTITIES ARE TO BE RETRIEVED AND STORED.     00001860
      REAL A(3,2,2)/42958.,34258.,13081.,74993.,42603.,13268.,           00001870
     *42958.,34258.,13081.,74993.,42603.,13268./                         00001880
      DIMENSION RM(M)                                                    00001890
C  WITHOUT GOVT. INTERVENTION.                                            00001900
      RM(I1+2)=A(1,K,1)*RM(I2)/1.E6                                      00001910
      IF(I1.NE.88) GOTO 1                                                00001920
      RM(I1+3)=A(2,K,1)*RM(I2+1)/1.E6                                    00001930
      RM(I1+5)=A(3,K,1)*RM(I2+3)/1.E6                                    00001940
      RM(I1+6)=A(3,K,1)*RM(I2+4)/1.E6                                    00001950
      RM(I1+4)=RM(I1+5)+RM(I1+6)                                         00001960
      RM(I1+1)=RM(I1+2)+RM(I1+3)                                         00001970
      RM(I1)=RM(I1+1)+RM(I1+4)                                           00001980
      RM(I3)=RM(I3)+RM(I1)                                               00001990
      RETURN                                                             00002000
```

Table E-1. Model listing (con.)

```
C  WITH GOVT. INTERVENTION.                                                00002010
1     RM(I1+4)=A(3,K,1)*RM(I2+1)/1.E6                                      00002020
      RM(I1+5)=A(3,K,1)*RM(I2+2)/1.E6                                      00002030
      RM(I1+1)=RM(I1+2)                                                    00002040
      RM(I1+3)=RM(I1+4)+RM(I1+5)                                           00002050
      RM(I1)=RM(I1+1)+RM(I1+4)                                             00002060
      RM(I3)=RM(I3)+RM(I1)                                                 00002070
      RETURN                                                               00002080
      END                                                                  00002090
      SUBROUTINE EARN(R,PK,CP,IT,RR,ASC,QC,K)                              00002100
C  THIS ROUTINE COMPUTES EARNINGS AND EMPLOYMENT ESTIMATES.                00002110
C  INPUT PARAMETERS ARE R THE OUTPUT VECTOR, PK = PACKAGING                00002120
C       VECTOR, CP CONTAINER PRODUCTION VECTOR, IT YEAR OF                 00002130
C       ESTIMATE, RR= RETURN RATE VECTOR, QC =                             00002140
C       ASC BOTTLE-CAN SIZE VECTOR, K BEER S.D. INDEX.                     00002150
C  COF COEFFICIENTS FOR ESTIMATES.                                         00002160
      DIMENSION R(40),PK(4),CP(4),RR(4),ASC(4)                             00002170
      REAL COF(29,2)/1.74734,-.0234,1.33049,-.0234,                        00002180
     *.32113,-.0247,.423832,-.0469,16.425,.067,2.139,1.41,1.289,           00002190
     *1.429,1.316,1.002,.799,1.281,1.281,.0095,.0114,.011820,              00002200
     *.011820,.012960,.015357,.007360,.008876,.848034,-.0186,              00002210
     *3.07409,-.0234,2.10217,-.0234,.334805,-.0247,                        00002220
     *.678065,-.0469,15.076,.053,2.139,1.41,1.289,1.429,1.316,1.750,       00002230
     *.994,1.322,1.322,.009500,.011400,.011820,.011820,.007320,.010205,    00002240
     *.006564,.00750,.848034,-.0186/                                       00002250
      ITT=IT-1                                                             00002260
C  EMPLOYMENT CALCULATIONS.                                                00002270
      DO 1 I=1,4                                                           00002280
      J=(I-1)*2+1                                                          00002290
1     R(I)=CP(I)*COF(J,K)*(1.+COF(J+1,K))**ITT                             00002300
      R(5)=(CP(3)+CP(4))*COF(28,K)*(1.+COF(29,K))**ITT                     00002310
      R(6)=QC/(COF(9,K)*EXP(COF(10,K)*(3+ITT)))                            00002320
      R(7)=COF(12,K)*PK(2)/ASC(2)+COF(13,K)*(PK(3)+PK(4))/ASC(3)+          00002330
     *COF(11,K)*PK(1)/ASC(1)                                               00002340
      R(8)=PK(1)*RR(1)*COF(14,K)/ASC(1)                                    00002350
      R(9)=(PK(3)+PK(4))*RR(3)*COF(15,K)/ASC(3)                            00002360
99    FORMAT(3F20.6)                                                       00002370
      DO 3 I=1,4                                                           00002380
3     R(I+9)=CP(I)*COF(15+I,K)                                             00002390
      R(14)=R(1)+R(2)                                                      00002400
      R(15)=R(14)+R(5)                                                     00002410
      R(16)=R(4)+R(3)                                                      00002420
      R(17)=R(12)+R(13)                                                    00002430
      R(18)=R(10)+R(11)+R(17)                                              00002440
      R(19)=R(8)+R(9)                                                      00002450
      R(20)=R(6)+R(7)                                                      00002460
      R(39)=R(15)+R(16)+R(19)+R(20)                                        00002470
      DO 2 I=1,20                                                          00002480
2     R(I)=R(I)                                                            00002490
C  EARNINGS CALCULATIONS.                                                  00002500
```

Table E-1. Model listing (con.)

```
      R(39)=R(39)                                                        00002510
      R(21)=R(18)+R(39)                                                  00002520
      R(22)=COF(20,K)*R(14)                                              00002530
      R(23)=COF(21,K)*R(5)                                               00002540
      DO 4 I=2,3                                                         00002550
4     R(I+22)=COF(20+I,K)*R(I+1)                                         00002560
      R(32)=R(6)*COF(24,K)                                               00002570
      R(33)=R(7)*COF(25,K)                                               00002580
      R(26)=R(32)+R(33)                                                  00002590
      R(27)=R(19)*COF(26,K)                                              00002600
      R(34)=R(8)*COF(26,K)                                               00002610
      R(35)=R(9)*COF(26,K)                                               00002620
      R(28)=R(18)*COF(27,K)                                              00002630
      R(36)=R(10)*COF(27,K)                                              00002640
      R(37)=R(11)*COF(27,K)                                              00002650
      R(38)=R(17)*COF(27,K)                                              00002660
      R(29)=R(24)+R(25)                                                  00002670
      R(30)=R(22)+R(23)                                                  00002680
      R(40)=R(30)+R(29)+R(27)+R(26)                                      00002690
      R(31)=R(40)+R(28)                                                  00002700
      RETURN                                                             00002710
      END                                                                00002720
      SUBROUTINE CONEX(K,A,PK,RM,RR,L,D,M,IN,RMC)                        00002730
C  THIS ROUTINE CALCULATES THE ESTIMATES OF CONSUMER OUTLAYS,            00002740
C     INPUT PARAMETERS ARE K THE BEER S.D. INDEX, A THE OUTPUT VECTOR,   00002750
C    RM THE INPUT VECTOR (SHELF PRICES), PK - THE PACKAGING VECTOR,      00002760
C     RR - THE RETURN RATE VECTOR, D, THE DEPOSIT, IN THE WITHOUT-       00002770
C     WITH INTERVENTION INDEX, L A LOCATIONAL PARAMETER, RMC -           00002780
      DIMENSION RM(M),A(14),PK(4)                                        00002790
      INTEGER IL(4)/10,11,13,14/                                         00002800
      INTEGER IK(4)/3,7,13,14/                                           00002810
      A(6)=0.                                                            00002820
      A(10)=0.                                                           00002830
      A(11)=0.                                                           00002840
      DO 1 I=1,4                                                         00002850
      J=IK(I)                                                            00002860
1     A(J)=PK(I)*RM(I+L-1)/1200.                                         00002870
      A(4)=A(3)/RM(L)*100.*((RM(L)+D)/100.)*(1.-RR)                      00002880
      A(3)=A(3)*RR                                                       00002890
      IF(IN.EQ.0) GOTO 2                                                 00002900
      A(7)=0.                                                            00002910
      DO 3 I=1,2                                                         00002920
      J=IL(I)                                                            00002930
      J1=IL(I+2)                                                         00002940
      A(J)=PK(I+2)*RM(L+I)*RMC/1200.                                     00002950
3     A(J1)=PK(I+2)*(D+RM(L+I))*(1.-RMC)/1200.                           00002960
2     A(12)=A(13)+A(14)                                                  00002970
      A(9)=A(10)+A(11)                                                   00002980
      A(8)=A(9)+A(12)                                                    00002990
      A(5)=A(6)+A(7)                                                     00003000
```

Table E-1. Model listing (con.)

```
      A(2)=A(3)+A(4)                                                    00003010
      A(1)=A(2)+A(5)+A(8)                                               00003020
      RETURN                                                            00003030
      END                                                               00003040
      SUBROUTINE SHELF(K,RM,L,RR,D)                                     00003050
C  THIS ROUTINE CALCULATES SHELF PRICES WITHOUT GOVT. INTERVENTION.      00003060
C     INPUT PARAMETERS ARE K=THE BEER-S.D. INDEX,RM=THE OUTPUT          00003070
C     VECTOR,RR=THE REFILLABLE BOTTLE RETURN RATE, D=THE DEPOSIT,       00003080
C     L=AN OUTPUT LOCATIONAL PARAMETER.                                 00003090
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)               00003100
      DIMENSION RM(126)                                                 00003110
      REAL F(2)/18.86,16.998/                                           00003120
      RM(L)=F(K)+P3(2,1,K)*(1.-RR)-D*(1.-RR)+P3(3,1,K)*RR               00003130
      RM(L+1)=P3(1,2,K)                                                 00003140
      RM(L+2)=P3(1,3,K)                                                 00003150
      RM(L+3)=P3(1,4,K)                                                 00003160
      RETURN                                                            00003170
      END                                                               00003180
      SUBROUTINE CONOUT(SP,A,L,D,RR,RRM)                                00003190
C  THIS ROUTINE CALCULATES CONSUMER OUTLAYS .                           00003200
C     INPUT PARAMETERS ARE: SP=THE SHELF PRICE VECTOR, A=THE OUTPUT VECT00003210
C     L=THE WITHOUT-WITH GOVT. INTER. INDEX, D=THE BOTTLE DEPOSIT,      00003220
C     RR=THE BOTTLE RETURN RATE, RRM=THE CAN RETURN RATE,               00003230
      DIMENSION A(15),SP(4)                                             00003240
      COMMON /NN/MSR,MSNR,MSMC,MSSC,MSAC                                00003250
      REAL MSR,MSNR,MSMC,MSSC,MSAC                                      00003260
      INTEGER IJ(4,2)/2,4,12,13,2,6,7,0/                                00003270
      DO 1 I=1,4                                                        00003280
      J=IJ(I,L+1)                                                       00003290
      IF(J.EQ.0) GOTO 1                                                 00003300
      A(J)=SP(I)                                                        00003310
1     CONTINUE                                                          00003320
      A(3)=SP(1)+D                                                      00003330
      A(1)=A(2)*RR+A(3)*(1.-RR)                                         00003340
      IF(L.EQ.1) GOTO 2                                                 00003350
      DO 3 I=5,11                                                       00003360
3     A(I)=0.                                                           00003370
      A(6)=A(4)                                                         00003380
      A(11)=(A(12)*MSSC+A(13)*MSAC)/(MSSC+MSAC)                         00003390
      A(7)=A(11)                                                        00003400
      RETURN                                                            00003410
2     A(9)=A(6)+D                                                       00003420
      A(10)=A(7)+D                                                      00003430
      A(8)=(A(9)*MSSC+A(10)*MSAC)/(MSSC+MSAC)                           00003440
      A(5)=(A(6)*MSSC+A(7)*MSAC)/(MSSC+MSAC)                            00003450
      A(4)=A(5)*RRM+A(8)*(1.-RRM)                                       00003460
      RETURN                                                            00003470
      END                                                               00003480
      SUBROUTINE CALC1(D,A,K,L,C01)                                     00003490
C  THIS ROUTINE CALCULATES PACKAGING AND CONTAINER PRODUCTION WITH       00003500
```

Table E-1. Model listing (con.)

```
C      GOVERNMENT INTERVENTION.                                                  00003510
C   INPUT PARAMETERS ARE D-DEPOSIT, A OUTPUT VECTOR, K BEER-S,D, INDEX,          00003520
C     L YEAR INDEX,C01=NOT USED.                                                00003530
      COMMON/N4/T(124,2,11)                                                     00003540
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)                       00003550
      REAL MSR,MSNR,MSMC,MSSC,MSAC,NUM1,NUM2,NUM3,NUM4                          00003560
      COMMON /NN/ MSR,MSNR,MSMC,MSSC,MSAC                                       00003570
      DIMENSION A(35)                                                           00003580
      A(2)=T(14,K,L)                                                            00003590
      A(3)=T(14,K,L)                                                            00003600
      MSMC=T(7,K,L)/T(3,K,L)                                                    00003610
      MSR=T(5,K,L)/T(3,K,L)                                                     00003620
      MSNR=T(6,K,L)/T(3,K,L)                                                    00003630
      A(5)=A(1)*MSMC                                                            00003640
      RRMC=A(1)                                                                 00003650
      PR=A(1)                                                                   00003660
      A(1)=PR                                                                   00003670
      A(8)=T(93,K,L)+(T(14,K,L)-A(6))*(P3(2,1,K)-5.-P3(3,1,K)                   00003680
     *-(D-5.)*(1.-A(6)))                                                        00003690
      DO 1 I=9,10                                                               00003700
1     A(I)=T(86+I,K,L)-D*(1.-A(1))+(P3(4,I-6,K)+P3(3,I-6,K)+P3(5,I-6,K)         00003710
     *-P3(6,I-6,K))*A(1)                                                        00003720
      A(1)=RRMC                                                                 00003730
      NUM1=MSR*((A(8)+D)*(1.-A(6))+A(8)*A(6))                                   00003740
      NUM2=MSNR*C01*((P3(1,2,K)-P3(1,1,K)+A(8)+D)*(1.-A(6))+                    00003750
     * (P3(1,2,K)-P3(1,1,K)+A(8))*A(6))                                         00003760
      FMSM=MSMC+MSNR*(1.-C01)                                                   00003770
      MSSC=T(8,K,L)/T(7,K,L)                                                    00003780
      MSAC=T(9,K,L)/T(7,K,L)                                                    00003790
      W=1.                                                                      00003800
      NUM3=(FMSM*(T(8,K,L)/T(7,K,L))*A(1)*W)*((P3(1,3,K)-P3(1,1,K)+A(8)         00003810
     * +D)*(1.-A(6))+(P3(1,3,K)-P3(1,1,K)+A(8))*A(6))                           00003820
      NUM4=(FMSM*(T(9,K,L)/T(7,K,L))*A(1)*W)*((P3(1,4,K)-P3(1,1,K)+A(8)         00003830
     * +D)*(1.-A(6))+(P3(1,4,K)-P3(1,1,K)+A(8))*A(6))                           00003840
      DNOM=MSR+MSNR*C01+(FMSM*(T(8,K,L)/T(7,K,L))*A(1)*W)+(FMSM*(T(9,K,L00003650
     *)/ T(7,K,L))*A(1)*W)                                                      00003860
      A(11)=(NUM1+NUM2+NUM3+NUM4)/DNOM                                          00003870
      A(1)=PR                                                                   00003880
      A(12)=(A(9)+D)*(1.-A(1))+A(9)*A(1)                                        00003890
      A(13)=(A(10)+D)*(1.-A(1))+A(10)*A(1)                                      00003900
      A(14)=(A(12)*T(8,K,L)/T(7,K,L))+(A(13)*T(9,K,L)/T(7,K,L))                 00003910
      A(1)=RRMC                                                                 00003920
      CDR=A(8)*A(6)+(A(8)+D)*(1.-A(6))                                          00003930
      CDDR=A(8)+D                                                               00003940
      CDDMC=(A(9)+D)*MSSC+(A(10)+D)*MSAC                                        00003950
      CDRMC=A(9)*MSSC+A(10)*MSAC                                                00003960
      A(15)=MSR*CDR                                                             00003970
      PNR=T(94,K,L)                                                             00003980
      PSC=T(95,K,L)                                                             00003990
      IF(CDDR.LT.PNR) CDDR=PNR                                                  00004000
```

Table E-1. Model listing (con.)

```
      A(15)=A(15)+(CODR*(1.-A(6))+PNR*A(6))*MSNR                        00004010
      CODR=A(8)+D                                                       00004020
      IF(CODR.LT.PSC) CODR=PSC                                          00004030
      A(15)=A(15)+(CODR*(1.-A(6))+PSC*A(6))*(MSMC-A(7))+                00004040
     *(CODMC*(1.-A(1))+CORMC*A(1))*A(7)                                 00004050
      A(1)=PR                                                           00004060
      A(16)=MSR*T(97,K,L)+T(94,K,L)*MSNR+T(95,K,L)*MSMC                 00004070
      A(17)=(1.+P4(2,K)*((A(15)-A(16))/A(16)))*T(3,K,L)                 00004080
C     WRITE(3,99) (A(MN),MN=15,17)                                      00004090
99    FORMAT(5F20.6)                                                    00004100
      A(18)=A(4)*A(17)                                                  00004110
      A(19)=0.                                                          00004120
      A(20)=A(17)*A(7)*T(8,K,L)/T(7,K,L)                                00004130
      A(21)=A(17)*A(7)*T(9,K,L)/T(7,K,L)                                00004140
      A(22)=0.                                                          00004150
      A(23)=A(24)                                                       00004160
      A(24)=A(18)/T(10,K,L)                                             00004170
      GGG=A(6)**(P4(1,K)+1.)                                            00004180
      GG=0.                                                             00004190
      IF(ABS(GGG-1.0).GT.1.E-4) GG=(1.-A(6))/(1.-GGG)                   00004200
      A(25)=A(24)*GG-A(6)**P4(1,K)*A(23)*GG                             00004210
      A(26)=A(20)/T(12,K,L)                                             00004220
      A(27)=A(21)/T(13,K,L)                                             00004230
      A(28)=A(26)+A(27)                                                 00004240
      A(35)=A(25)                                                       00004250
      A(29)=A(28)+A(35)                                                 00004260
      A(30)=T(22,K,L)                                                   00004270
      A(31)=A(1)*.877                                                   00004280
      IF(A(31).LT.T(23,K,L)) A(31)=T(23,K,L)                            00004290
      A(32)=A(1)*.877                                                   00004300
      IF(A(32).LT.T(24,K,L)) A(32)=T(24,K,L)                            00004310
      A(33)=A(17)+T(2,K,L)-T(3,K,L)                                     00004320
      A(34)=A(33)/T(2,K,L)*T(1,K,L)                                     00004330
      A(22)=A(20)+A(21)                                                 00004340
      RETURN                                                            00004350
      END                                                               00004360
      SUBROUTINE ACCUM2(D,K,L)                                          00004370
C  THIS ROUTINE TAKES THE INPUT VECTOR, D AND PUTS IT INTO TABLE         00004380
C       T WHERE K IS THE BEER - S.D. INDEX AND L IS THE YEAR INDEX,      00004390
C       THIS ROUTINE IS USED TO DEFINE THE WITH GOVT. INTERVENTION TABL  00004400
C        FORMAT.                                                         00004410
      DIMENSION D(132)                                                  00004420
      COMMON/N5/T(105,2,11),T1(124,2,11)                                00004430
      INTEGER IK(105)/6,1,1,4,7,8,9,10,122,123,124,125,126,127,128,129, 00004440
     *130,131,34,33,17,18,22,20,                                        00004450
     *21,29,35,25,28,26,27,39,40,41,43,44,45,46,47,48,49,50,            00004460
     *51,52,53,54,55,56,60,57,58,59,116,117,118,119,120,121,61,21,39,15,00004470
     *14,5,16,3,4,20,6,7,19,                                            00004480
     *8,9,18,10,17,31,40,30,22,23,29,24,25,26,32,33,27,34,35,28,36,38,  00004490
     *102,103,104,105,109,110,111,112,113,114,115/                      00004500
```

Table E-1. Model listing (con.)

```
      DO 1 I=1,104                                                      00004510
      J=IK(I)                                                           00004520
      IF(I.GT.59.AND.I.LT.94) J=J+61                                    00004530
1     T(I,K,L)=D(J)                                                     00004540
      RETURN                                                            00004550
      END                                                               00004560
      SUBROUTINE TITL                                                   00004570
C  THIS ROUTINE INPUTS THE TITLES AND THE ENERGY DATA.                  00004580
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)               00004590
      COMMON/N3/TL1(30,15),TL2(132,15),TL4(111,15)                      00004600
      DATA M/4/                                                         00004610
C  THESE TITLES ARE NO LONGER USED.                                     00004620
      DO 1 I=1,30                                                       00004630
1     READ(M,10) (TL1(I,J),J=1,15)                                      00004640
C  THESE TITLES ARE THE WITHOUT GOVT. INTERVENTION TABLES.              00004650
      DO 2 I=1,132                                                      00004660
2     READ(M,10) (TL2(I,J),J=1,15)                                      00004670
C  THESE TITLES ARE THE WITH GOVT. INTERVENTION TABLS.                  00004680
      DO 5 I=1,111                                                      00004690
5     READ(M,10) (TL4(I,J),J=1,15)                                      00004700
10    FORMAT(15A4)                                                      00004710
      DO 3 J=1,4                                                        00004720
      DO 3 I=1,10                                                       00004730
      READ(M,11) ((P1(I,K,J,L),K=1,6),L=1,2)                            00004740
3     WRITE(3,14) ((P1(I,K,J,L),K=1,6),L=1,2)                           00004750
      DO 4 J=1,3                                                        00004760
      DO 4 I=1,7                                                        00004770
      READ(M,11) (P2(I,J,K),K=1,2)                                      00004780
4     WRITE(3,14) (P2(I,J,K),K=1,2)                                     00004790
      DO 7 J=1,4                                                        00004800
      DO 7 I=1,6                                                        00004810
      READ(M,11) (P3(I,J,K),K=1,2)                                      00004820
7     WRITE(3,14) (P3(I,J,K),K=1,2)                                     00004830
      DO 6 I=1,2                                                        00004840
      READ(M,11) (P4(I,K),K=1,2)                                        00004850
6     WRITE(3,14) (P4(I,K),K=1,2)                                       00004860
14    FORMAT(12F10.3)                                                   00004870
11    FORMAT(12F6.3)                                                    00004880
      RETURN                                                            00004890
      END                                                               00004900
      SUBROUTINE READD(R,IT)                                            00004910
C  THIS ROUTINE INPUTS A YEARS WORTH OF WITHOUT GOVT. INTERVENTION      00004920
C    DATA . INPUT PARAMETERS ARE R=THE STORAGE(OUTPUT) VECTOR, AND      00004930
C     IT=THE YEAR INDEX.                                               00004940
      DIMENSION R(21)                                                   00004950
      DATA M/4/                                                         00004960
      READ(M,10) IT,(R(I),I=1,6)                                        00004970
10    FORMAT(I4,F16.0,5F10.0)                                           00004980
      READ(M,13) IT1,(R(I),I=15,18),R(7),R(8)                           00004990
13    FORMAT(I4,F16.0,4F10.0,F12.0)                                     00005000
```

Table E-1. Model listing (con.)

```
      READ(M,11) IT1,(R(I),I=9,11),R(13),R(14)                          00005010
      R(12)=R(11)                                                       00005020
11    FORMAT(I4,16X,3F10.0,10X,2F10.0)                                  00005030
      READ(M,12) (R(I),I=19,21)                                         00005040
12    FORMAT(3F10.0)                                                    00005050
C     WRITE(3,99) R                                                     00005060
99    FORMAT(1X,8E15.7)                                                 00005070
      RETURN                                                            00005080
      END                                                               00005090
      SUBROUTINE ENERGY(A,R,K,IT,RRR,PK,IR)                             00005100
C  THIS ROUTINE COMPUTES  THE ENERGY REQUIREMENTS FOR A GIVEN YEAR,     00005110
C  INPUT PARAMETERS ARE:  A OUTPUT VECTOR, K =                          00005120
C     THE BEER S.D. INDEX, IT=THE YEAR INDEX, RRR=THE RETURN RATE VECTOR00005130
C    F  , PK=THE PACKAGING VECTOR, AND IR=THE FIRST YEAR OPTION INDICATOR00005140
      DIMENSION A(17),R(21),EN(4,6),RRR(4),PK(4)                        00005150
      DO 1 I=1,4                                                        00005160
      DO 1 J=1,6                                                        00005170
      CALL SOLVE(EN(I,J),K,I,J,IT,RRR,PK,IR)                            00005180
1     CONTINUE                                                          00005190
      DO 2 I=1,4                                                        00005200
      T=0.                                                              00005210
      DO 3 J=1,6                                                        00005220
3     T=T+EN(I,J)                                                       00005230
2     A(5+I)=T                                                          00005240
      A(10)=A(9)                                                        00005250
      A(9)=A(8)                                                         00005260
      A(8)=A(9)+A(10)                                                   00005270
      DO 4 J=1,6                                                        00005280
      T=0.                                                              00005290
      DO 5 I=1,4                                                        00005300
5     T=T+EN(I,J)                                                       00005310
4     A(11+J)=T                                                         00005320
      A(15)=A(15)+A(17)                                                 00005330
      A(11)=A(13)+A(14)+A(15)+A(16)+A(12)                               00005340
      A(4)=A(11)                                                        00005350
      A(5)=A(6)+A(7)                                                    00005360
      A(1)=R(4)+R(5)                                                    00005370
      A(3)=R(14)+R(15)                                                  00005380
      A(2)=A(3)+R(16)                                                   00005390
      RETURN                                                            00005400
      END                                                               00005410
      SUBROUTINE SOLVE(A,K,I,J,IT,RRR,PK,IR)                            00005420
C  THIS ROUTINE IS USED TO CALCULATE ENERGY REQUIREMENTS, THE           00005430
C     ROUTINE IS CALLED BY ENERGY. INPUT PARAMETERS ARE: A, THE OUTPUT  00005440
C     K=THE BEER S.D. INDEX, I=THE BOTTLE(CAN) TYPE INDEX, IT= THE YEAR 00005450
C     INDEX, RRR=THE RETURN RATE VECTOR, PK=THE PACKAGING VECTOR, AND   00005460
C     IR=THE FIRST YEAR OPTION INDICATOR USED WITHOUT GOVT. INTER.      00005470
      DIMENSION RRR(4),PK(4)                                            00005480
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)               00005490
      T=IT-1975                                                         00005500
```

Table E-1. Model listing (con.)

```
      IF(IR.GT.4) T=0.                                                  00005510
      WA=P1(10,J,I,K)                                                   00005520
      IF(I.EQ.3) WA=1.                                                  00005530
      W=(P1(1,J,I,K)-P1(2,J,I,K)*T/P1(3,J,I,K))*(1.-RRR(I))             00005540
      A=(W+P1(4,J,I,K)-P1(5,J,I,K)*T/P1(6,J,I,K))*PK(I)*WA*7.81+        00005550
     *(W+P1(7,J,I,K)-P1(8,J,I,K)*T/P1(9,J,I,K))*PK(I)*(1.-P1(10,J,I,K))*00005560
     *7.81                                                              00005570
      A=A/1000000.                                                      00005580
      RETURN                                                            00005590
      END                                                               00005600
      SUBROUTINE STOCK(PK,K,RR,R2,PKK,ACS)                              00005610
C  THIS ROUTINE COMPUTES THE CAPITAL STOCK REQUIREMENTS NOT INCLUDING    00005620
C     THE CONTAINER PRODUCERS WHICH ARE COMPUTED IN STOCK1.             00005630
C  INPUT PARAMETERS ARE: PK=THE PACKAGING VECTOR, K=THE BEER S.D. INDEX  00005640
C     RR=THE RETURN RATE VECTOR, R2=THE OUTPUT VECTOR, ACS=THE AVERAGE  00005650
C     CAN SIZE VECTOR.                                                  00005660
      COMMON /N2/P1(10,6,4,2),P2(7,3,2),P3(6,4,2),P4(2,2)               00005670
      DIMENSION S(3,10),R2(10),PK(21),RR(4)                             00005680
      REAL FLO(2)/1.63,1.58/                                            00005690
      DO 2 I=1,3                                                        00005700
      DO 1 J=1,3                                                        00005710
1     S(I,J+2)=PK(3+I)*P2(1,I,K)*P2(1+J,I,K)                            00005720
      S(I,7)=PK(3+I)*P2(5,I,K)                                          00005730
      S(I,8)=PK(3+I)*P2(6,I,K)*RR(I)                                    00005740
      S(I,6)=S(I,7)+S(I,8)                                              00005750
      S(I,9)=PK(3+I)*P2(1,I,K)*P2(7,I,K)                                00005760
      S(I,2)=S(I,3)+S(I,4)+S(I,5)+S(I,9)                                00005770
2     S(I,1)=S(I,6)+S(I,2)                                              00005780
      FR=PKK*FLO(K)*P3(2,1,K)/(100.*ACS*P4(1,K))                        00005790
      DO 3 J=1,9                                                        00005800
      T=0.                                                              00005810
      DO 4 I=1,3                                                        00005820
4     T=T+S(I,J)                                                        00005830
3     R2(J)=T                                                           00005840
      R2(10)=FR                                                         00005850
      RETURN                                                            00005860
      END                                                               00005870
      SUBROUTINE ACCUM1(R,K,L)                                          00005880
C  THIS ROUTINE STORES THE WORKING VECTOR IN TABLE FORMAT.               00005890
C       THIS IS THE WITHOUT GOVT. INTERVENTION TABLE FORMAT.             00005900
C  THE INPUT PARAMETERS ARE: R=THE INPUT(WORKING) VECTOR, K=THE BEER S.D00005910
C       INDEX AND L=THE YEAR INDEX.                                      00005920
      DIMENSION R(126)                                                  00005930
      COMMON/N4/T(124,2,11)                                             00005940
      INTEGER IK(126)/1,2,3,5,6,7,8,9,10,11,12,13,14,17,18,19,20,21,22,200005950
     *3,24,4,15,16,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,4200005960
     *,44,45,46,43,54,4,5,8,9,6,11,12,14,15,17,18,0,0,3,2,              00005970
     *7,19,16,13,10,-55,23,24,26,27,28,31,34,25,22,20,29,30,32,33,35,36,00005980
     *37,56,76,47,48,49,50,51,52,53,93,94,95,96,97,98,99,100,101,102,   00005990
     *103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,1100006000
```

Table E-1. Model listing (con.)

```
     *9,120,121,122,123,124/                                                    00006010
      DO 1 I=1,126                                                              00006020
      J=IK(I)                                                                   00006030
      IF(J.EQ.0) GOTO 1                                                         00006040
      IF(I.GT.47.AND.I.LT.86) J=J+55                                            00006050
      IF(J.EQ.0) J=55                                                           00006060
      T(J,K,L)=R(I)                                                             00006070
1     CONTINUE                                                                  00006080
      RETURN                                                                    00006090
      END                                                                       00006100
      SUBROUTINE TABL2(KR,T,N1,TL2,N2,N3,N4,N5,PC)                              00006110
C  THIS ROUTINE PRINTS ALL OF THE TABLES.                                       00006120
C  INPUT PARAMETERS ARE: T=THE TABLE TO BE PRINTED, TL2 THE LABELS              00006130
C     ASSOCIATED WITH THE TABLE, N4=THE TABLE NUMBER, N5 AND N2                 00006140
C     =TABLE DIMENSIONS, N1=NUMBER OF LINES PRINTED, PC=THE                     00006150
C     PRINT OPTION PARAMETER=PC=0 IMPLIES PRINT YEARS 1979-1985                 00006160
C     OTHERWISE PRINT YEARS 1975 TO 1981, FINALLY KR INDICATES TABLE            00006170
C     LOCATION  MOST OF THE TIME KR IS THE BFER S.D. INDEX.                     00006180
      DIMENSION T(N5,2,11),TL2(N2,15)                                           00006190
      REAL*4 IA(12),IB(4)                                                       00006200
      INTEGER IK(10,2)/1,11,12,15,26,28,99,102,105,199,1,5,8,10,13,24,28        00006210
     *,199,199,199/                                                             00006220
      INTEGER IC(7)/3,1,2,3,1,2,4/                                              00006230
      DATA IA,IB/'    ','BEER','    ',' SOF','T DR','INK ',' BE','VERA'         00006240
     *,'GE  ',' NE','T ',' IMP','ACT ','WITH','OUT ',' WI','TH  '/              00006250
11    FORMAT('1 TABLE',I2,1X,3A4,' SYSTEM TRENDS ',2A4,'GOVERNMENT INTER        00006260
     *VENTION   (CONTINUED)'///,60X,7I9)                                        00006270
      J=0                                                                       00006280
      L1=1979                                                                   00006290
      L2=1985                                                                   00006300
      L3=5                                                                      00006310
      L4=11                                                                     00006320
      IF(PC.EQ.0.) GOTO 20                                                      00006330
      L1=1975                                                                   00006340
      L2=1981                                                                   00006350
      L3=1                                                                      00006360
      L4=7                                                                      00006370
20    KL=1                                                                      00006380
      N7=IC(N4)                                                                 00006390
      NN1=N1+1                                                                  00006400
      DO 1 I=1,NN1                                                              00006410
      K=KR                                                                      00006420
      IF(MOD(I-1,49).EQ.0)WRITE(3,11) N4,(IA((N7-1)*3+L),L=1,3),(IB((N3-        00006430
     *1)*2+L),L=1,2),(L,L=L1,L2)                                                00006440
      IF(K.GT.2) K=1                                                            00006450
2     J=J+1                                                                     00006460
C     IF(J.GT.89) RETURN                                                        00006470
      IF(IK(KL,N3).NE.J) GOTO 3                                                 00006480
      WRITE(3,10) (TL2(J,M),M=1,15)                                             00006490
10    FORMAT(1X,15A4,11F9.0)                                                    00006500
```

Table E-1. Model listing (con.)

```
12    FORMAT(1X,15A4,11F9.2)                                          00006510
14    FORMAT(1X,15A4,11F9.4)                                          00006520
      KL=KL+1                                                         00006530
      GOTO 2                                                          00006540
3     IF(ABS(T(I,K,11)).LT.40.) GOTO 5                                00006550
      WRITE(3,10) (TL2(J,M),M=1,15),(T(I,K,L),L=L3,L4)                00006560
      GOTO 1                                                          00006570
5     IF(ABS(T(I,K,1)).LT.1.) GOTO 4                                  00006580
      WRITE(3,12) (TL2(J,M),M=1,15),(T(I,K,L),L=L3,L4)                00006590
      GOTO 1                                                          00006600
4     WRITE(3,14) (TL2(J,M),M=1,15),(T(I,K,L),L=L3,L4)                00006610
1     CONTINUE                                                        00006620
      WRITE(3,16)                                                     00006630
16    FORMAT(4X,'SOURCE:  RESEARCH TRIANGLE INSTITUTE')               00006640
      RETURN                                                          00006650
      END                                                             00006660
      SUBROUTINE TABL1(M,T,N1,TL,N2,T1,N4,N6,PC)                      00006670
C  THIS ROUTINE COMPUTES THE SUMMARY TABLES (TABLES 1 AND 4)          00006680
C       AND CALLS TABL1 TO PRINT THE SUMMARY TABLE.                   00006690
C  INPUT PARAMETERS ARE: T=THE TABLE COMPONENTS, TL ARE THE LABELS    00006700
C     ASSOCIATED WITH THE TABLE, N1,N2 ARE THE TABLE DIMENSIONS,      00006710
C     T1 IS THE COMPUTED SUMMARY TABLE LOCATION, N4=THE WITH-WITHOUT IND00006720
C     PC THE PRINT YEAR OPTION DESCRIBED ABOVE, M=IS NOT USED,        00006730
      DIMENSION T(N1,2,11),TL(N2,15),T1(124,2,11)                     00006740
      DATA N5/25/                                                     00006750
      INTEGER IK(25,2)/10,11,12,13,14,22,23,24,93,94,95,96,97,98,99,100,00006760
     *101,102,103,104,105,106,107,108,109,1,2,3,4,5,6,7,8,9,10,11,12,13,00006770
     *14,15,16,17,18,0,0,0,0,0,0,0/                                   00006780
      NN1=N1-1                                                        00006790
      DO 3 J=1,11                                                     00006800
      DO 2 I=1,NN1                                                    00006810
2     T1(I,N4,J)=T(I,1,J)+T(I,2,J)                                    00006820
      IF(N1.EQ.124) T1(124,N4,J)=T(124,1,J)+T(124,2,J)                00006830
3     CONTINUE                                                        00006840
      DO 4 I=1,N5                                                     00006850
      II=IK(I,N4)                                                     00006860
      IF(II.EQ.0) GOTO 5                                              00006870
      DO 4 K=1,11                                                     00006880
4     T1(II,N4,K)=.999999999.                                         00006890
5     CONTINUE                                                        00006900
      N8=1                                                            00006910
      IF(N4.EQ.2) N8=4                                                00006920
      CALL TABL2(N6,T1,N1,TL,N2,N4,N8,124,PC)                         00006930
      RETURN                                                          00006940
      END                                                             00006950
      SUBROUTINE MARKT(K,L,R)                                         00006960
C  THIS ROUTINE COMPUTES MARKET SHARES USED AS INTERMEDIATE           00006970
C     OUTPUT.   INPUT PARAMETERS ARE K=THE BEER S.D. INDEX, L=THE     00006980
C     YEAR INDEX,R=THE INPUT VECTOR.                                  00006990
      COMMON /NN/MSR,MSNR,MSMC,MSSC,MSAC                              00007000
```

Table E-1. Model listing (con.)

```
      DIMENSION R(124)                                                  00007010
      REAL MSR,MSNR,MSMC,MSSC,MSAC                                      00007020
      MSR=R(4)/R(3)                                                     00007030
      MSSC=R(7)/R(3)                                                    00007040
      MSAC=R(8)/R(3)                                                    00007050
      RETURN                                                            00007060
      END                                                               00007070
      SUBROUTINE DIFF(T1)                                               00007080
C     THIS ROUTINE COMPUTES THE NET TABLE(TABLE7),                      00007090
C     INPUT PARAMETERS ARE: T1=TABLES 4 AND 1 WHICH COMPRISE TABLE7,    00007100
      DIMENSION T1(124,2,11)                                            00007110
      INTEGER IK(86)/1,2,3,5,7,8,9,15,16,17,19,20,21,25,26,27,29,30,31,300007120
     *2,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,51,52,53,54,500007130
     *5,56,57,58,61,62,63,64,65,66,67,68,69,70,71,72,74,75,76,77,78,79,800007140
     *0,81,82,83,84,85,86,87,88,89,90,92,110,111,112,113,117,118,119,12000007150
     *,121,122,123/                                                    00007160
      DO 1 I=19,104                                                     00007170
      K=IK(I-18)                                                        00007180
      IF(K.EQ.0) GOTO 2                                                 00007190
      DO 1 J=1,11                                                       00007200
1     T1(I,2,J)=-T1(K,1,J)+T1(I,2,J)                                    00007210
2     RETURN                                                            00007220
```

Appendix F: CAPITAL, LABOR, AND EARNINGS COEFFICIENTS

F.1 Introduction

Capital, employment, and earnings coefficients were developed for the major industries that would be impacted by mandatory deposit legislation. As described below, the capital-output ratios are based on 1974 prices, the employment-output ratios have been projected over the 1975-85 period to account for improvements in productivity, and the earnings coefficients have been taken from 1974 averages.

F.2 Capital

Capital-output ratios were developed using a model plant approach for the beer and soft drink systems from the beverage producer through the retail levels. For the container-manufacturing industries, an econometric approach was used. The ratios are expressed in dollars per 10^6 ounces of each beverage for each container--refillable bottles, nonrefillable bottles, and metal cans. All refillable beer bottle ratios have been developed for the space-conserving, stubby, 11-ounce bottle. Five categories of capital (production and distribution space; filling line purchase and installation; distribution equipment; bottle, shell, and carrier float; and other) have been identified and costed for four industries (malt liquor production, wholesale beer distribution, soft drink production and distribution, and retail trade). For the container-manufacturing industries, an aggregate estimate has been developed.

In developing the capital-output ratios, only those capital items affected by the type of beverage package were included.

F.2.1 Production and Distribution Space

The space requirements and their associated costs for malt liquor production, wholesale beer distribution, soft drink distribution, and retail distribution of beverages were estimated and are summarized in table F-1. In developing these capital-output ratios, a cost per square foot of $22 was used for interior space. This value is based on average construction cost data for factories, three-fourths of which cost less than $22 per square foot. The cost figure value does not, however, include land or architectural fees. For retail space, $11 per square foot was assumed. All empties are assumed stored in exterior space.

Table F-1. Production and distribution space requirements

	Units of measure	Per 10^6 ounces annually: Refillable bottles	Nonrefillable bottles	Metal cans
Malt liquor production				
production and maintenance[a]	ft^2	10.4	9.7	7.8
full goods storage*	ft^2	3.2	3.2	2.4
empties storage†	ft^2	15.9	1.1	0.8
loading[a]	ft^2	5.6	3.3	3.3
main aisles[a]	ft^2	2.4	0.5	0.5
total	ft^2	37.5	17.8	14.8
cost for production and storage at $22 per ft^2 [b]	dollars	825	392	326
Wholesale beer distribution				
storage and loading[c]	ft^2	63	46	38
cost for storage at $22[b] per ft^2	dollars	1385	1012	836
Soft drinks distribution				
storage and loading[d]	ft^2	54	38	32
cost for storage at $22[b] per ft^2	dollars	1188	836	704
Retail distribution				
space for handling and storage at convenience stores[e]	ft^2	69.4	--	--
space for handling and storage at supermarkets[e]	ft^2	27.8	--	--
share of beverages sold in convenience stores[f]	percent	23.4	--	--
cost for retail distribution at $11 per ft^2	dollars	413		165‡

*Two-day supply with 84 cases of cans per pallet stacked two pallets high and 63 cases of refillable (stubby) bottles and NR bottles per pallet, also stacked two pallets high.

†Three-week supply of refillable bottles and 1-day supply of NR bottles and cans, all stacked two pallets high.

‡For returned metal cans. Forty percent of refillable bottle value provided by Coors Container Co.

Sources: [a] Industry sources and Research Triangle Institute.

[b] Building Construction Cost Data: 1972, Robert Snow Means Company, Duxbury, Massachusetts, 1972, pp. 168-69, 174. Survey of Current Business, LIV, October 1974, p. 16; LV, May 1975, p. 8.

[c] Research Triangle Institute; includes 3-week full goods storage and 3-day storage for empties.

[d] Industry sources and Research Triangle Institute; 3 days' supply of full and empties.

[e] James E. Poteet, Soft Drinks: A New Look at Profitability, Case and Company, 1972, as quoted in New York State Task Force, The Bottle Bill, Albany, 1975, Appendix F, pp. 6-12 to 6-15.

[f] Research Triangle Institute.

The space requirements for beer production and distribution tend to be somewhat larger than those for soft drinks. This is because beer bottle-filling lines take up more space than can-filling lines and because the soft drink industry can operate with a smaller inventory of empty bottles than the beer industry because a typical soft-drink-bottling plant serves a relatively small area and can depend on a steady return of empty bottles, since it collects the bottles itself.

F.2.2 Filling Lines

Capital-output ratios for filling lines are shown in table F-2. The cost of the filling lines includes not only the price of the equipment but also an allowance of 50 percent for installation. Although this figure for installation is a reasonable one for new can- and bottle-filling lines, it is possible that replacing a can-filling line with a bottle-filling line might require significantly higher installation costs in some situations because of space constraints, a need to take out old equipment, change plumbing connections, etc. The filling lines shown in table F-2 represent the technology generally being installed at the present time; however, faster lines are available. The rated speed of the line is factored downward by an efficiency factor to adjust for down time and is then multiplied by the average annual hours of operation. In general, beer-filling lines tend to be operated more hours per year than soft-drink-filling lines because they represent larger production operations. The same annual hours of operation have been used for all three soft-drink-filling lines, although current common practice is for metal can lines to run more hours of operation than bottle-filling lines, because metal can lines typically serve larger market areas.

F.2.3 Distribution Equipment

The key component in distribution equipment is the truck, and the key factor in costs is the productivity of the driver. The number of cases a driver can deliver varies significantly, depending upon the population of the market area, the layout of the route, the size of the truck, the mix of containers, and union regulations, among other things. The values shown in table F-3 are based upon those for a typical soft drink bottler. For beer, these same values are used to estimate the

Table F-2. Filling lines requirements

	Units of measure	Refillable bottles	Nonrefillable bottles	Metal cans
Beer				
installed cost of filling lines*	10^6 dollars	3.1	2.4	2.2
rated speed	cpm	1,000	1,000	1,300
efficiency	percent	84	88	90
annual hours of operation†	hours	3,375	3,375	3,375
annual capacity	10^6 ounces	2,041	2,138	2,843
cost for filling line	dollars/10^6 ounces	1,519	1,123	774
Soft drinks				
installed cost of filling lines*	10^6 dollars	2.1	1.6	1.2
rated speed	cpm	660	660	1,000
efficiency	percent	80	82	86
annual hours of operation‡	hours	2,062	2,062	2,062
annual capacity	10^6 ounces	784	803	1,277
cost for filling line	dollars/10^6 ounces	2,679	1,993	940

*Selected manufacturers of filling equipment. Installation is estimated to be 50 percent of equipment cost.

†Based on a 7.5 hour shift, 9 shifts per week, 50 weeks per year.

‡Based on a 7.5 hour-shift, 5.5 shifts per week, 50 weeks per year.

Table F-3. Distribution equipment requirements

	Units of measure	Per 10^6 ounces annually		
		Refillable bottles	Nonrefillable bottles	Metal cans
Route delivery vehicles				
Cases per day per driver[a]	cases	186	263	288
Cases per truck annually*	cases	46,500	65,750	72,000
Vehicles per 10^6 ounces annually	vehicles	0.075	.053	.048
Cost per 10.5 bay vehicle†	dollars	16,000	16,000	16,000
Cost for vehicles	dollars	1,200	848	768
Retail store racks				
Racks per 10^6 ounces[b]	racks	1.736	--	--
Cost of racks at $50 per rack[b]	dollars	87	--	--

*Based on 250 working days per year.

†This is the 1974 price for a 10-1/2 bay, dropped frame, all-aluminum route delivery truck. The price includes lettering, delivery, and Federal excise taxes.

Sources: [a] Research Triangle Institute, based on data in Booz- Allen & Hamilton, Study of Distribution Practices in the Soft Drink Industry. Vol I., National Soft Drink Association. Washington, D.C., 1968, and adjusted with data in 1967 Census of Manufactures.

[b] James E. Poteet, Soft Drinks: A New Look at Profitability, Case and Company, 1972, as quoted in New York State Task Force, The Bottle Bill, pp. 6-12 to 6-15.

distribution equipment requirements from the wholesale distributor through the retail outlet. No specific attempt has been made to measure the utilization of railroad cars or other common carriers for the trip from the brewery to the wholesale distributor.

A 10.5 bay delivery truck has been used. These trucks have a capability of handling more than 186 cases per day of refillable bottles, including space for the empty bottles; 263 cases of nonrefillable bottles; and 288 cases of metal cans.

F.2.4 Bottle, Shell, and Carrier Float

The float consists of the beverage bottles, basket carriers to hold six or eight bottles, and a fiber or wooden shell to hold the basket carriers. Basket carriers are usually used two to four times, while the trippage on bottles and shells can be substantially more. Float requirements depend upon the velocity of bottle utilization rather than on trippage. That is, the number of times during a year which the bottles, carriers, and shells return to the plant is the key variable in estimating the total float necessary. Data on bottle shell and float requirements for beer and soft drinks are given in table F-4.

Table F-4. Bottle, shell, and carrier float requirements

	Unit of measure	Refillable bottles
Beer		
cost per bottle	cents	6.0*
cost per shell	cents	66.0†
cost of carriers per case	cents	25.0‡
Soft drinks		
cost per bottle	cents	12.5[a/]
cost per shell	cents	225.0§
cost of carriers per case	cents	25.0‡

*Estimated cost of 12-ounce stubby refillable bottle based on beer industry sources for 11-ounce stubby returnable bottles and the 12-ounce export returnable bottle.

†Fiber carton to hold 24 bottles.

‡Will last two to four trips.

§Wooden or plastic case to hold 24 bottles. Only two-thirds of a shell is required for each case of bottles.

Source: [a/] Soft drink industry sources.

F.2.5 Other Capital Costs

To account for other capital costs, which may vary according to the specific container chosen and yet are not included in the above categories, 15 percent of the sum of the above capital costs for soft drinks and 10 percent for beer have been included. The value for soft drinks is larger than that for beer because transport and vending machines are not applicable to the brewing and wholesale beer distribution industries.

F.2.6 Capital Costs for the Container-Producing Industries

Capital-output ratios for the container-producing industries were developed using a slightly different approach from the one used above for the beer and soft drink systems. While ratios for the latter were developed using a model plant approach as discussed above, the former were developed using a simple stock adjustment model.

Let:

O_t = value of containers output at time t,

K_t = total capital stock in container industry at time t,

I_t = Expenditures on machines and equipment at time t, (all the above three variables are measured in 10^6 dollars),

λ_t = the capital-output ratio at time t,

δ_t = the rate of capital depreciation at time t.

Therefore:

$$K_t = \lambda_t \cdot O_t \text{ , or} \qquad \text{(F-1)}$$

$$K_{t-1} = \lambda_{t-1} \cdot O_{t-1} \cdot \qquad \text{(F-2)}$$

Assuming that the capital-output ratio (λ_t) and the rate of capital depreciation have been stable over the period, then the time subscripts can be omitted. The gross investment, I_t, may be defined as the sum of net investment ($K_t - K_{t-1}$) and replacement investment, δK_{t-1}:

$$I_t = (K_t - K_{t-1}) + \delta K_{t-1} \text{ , or} \qquad \text{(F-3)}$$

$$I_t = K_t - (1-\delta) K_{t-1} \cdot \qquad \text{(F-4)}$$

Substituting equations (F-1) and (F-2) into equation (F-4) results in

$$I_t = \lambda O_t - (1-\delta)\ \lambda\ O_{t-1} \ . \qquad \text{(F-5)}$$

By rearranging equation (F-5),

$$O_t = \frac{1}{\lambda} I_t + (1-\delta)\ O_{t-1} \ . \qquad \text{(F-6)}$$

Since historical data for the glass-container- and metal-can-producing industries for O_t and I_t are available for the 1958-73 period, λ and δ can be directly estimated using ordinary least squares. Current and 1967 constant-dollar values for O and I are shown in tables F-5 and F-6 for the two industries. For the regressions, the constant dollar values were used.

The regression results of equation (F-6) for the metal can industry are shown below, using a C before each variable whose value is unique to the metal can industry.

$$CO_t = \underset{(1.537)}{3.847} \cdot CI_t + \underset{(10.160)}{0.898} \cdot CO_{t-1} \qquad \text{(F-7)}$$

$$R^2 = 0.957 \ .$$

From the results shown in equation (F-7), $C\lambda$ and $C\delta$ can be estimated using equation (F-6) as

$$C\lambda = 0.260 \qquad \text{(F-8)}$$

$$C\delta = 0.102 \ . \qquad \text{(F-9)}$$

In the same manner, equation (F-6) can be estimated for the glass container industry using a G before each unique variable:

$$GO_t = \underset{(1.441)}{1.179} \cdot GI_t + \underset{(17.022)}{0.961} \cdot GO_{t-1} \ . \qquad \text{(F-10)}$$

$$R^2 = 0.951 \ .$$

From equations (F-10) and (F-9), $G\lambda$ and $G\delta$ are estimated as:

$$G\lambda = .848 \qquad \text{(F-11)}$$

$$G\delta = .039 \ . \qquad \text{(F-12)}$$

Equations (F-8) and (F-11) indicate that 26.0 cents and 84.8 cents of capital stock are required to produce 1 dollar's worth of metal cans and glass bottles, respectively, in 1967 dollars.

Table F-5. Output and capital expenditures for the metal can industry: annually, 1958-74

Year	Current dollar value of container output (10^6)	1967 constant dollar value of container output (10^6)	Current dollar expend-itures on machine and equipment (10^6)	1967 constant dollar value of container output (10^6)	Wholesale price index for metal cans (1967=100)	Wholesale price index for machine and equipment (1967=100)
1958	1824.10	2022.28	54.3000	60.7382	90.2000	89.4000
1959	1933.70	2184.97	50.8000	55.6407	88.5000	91.3000
1960	1936.40	2175.73	68.4000	74.3478	89.0000	92.0000
1961	2095.30	2305.06	47.9000	52.1219	90.9000	91.9000
1962	2112.40	2281.21	60.0000	65.2174	92.6000	92.0000
1963	2075.00	2221.63	66.5000	72.1258	93.4000	92.2000
1964	2255.70	2397.13	71.8000	77.3707	94.1000	92.8000
1965	2395.00	2494.79	79.4000	84.5580	96.0000	93.9000
1966	2631.30	2679.53	99.5000	102.789	98.2000	96.8000
1967	2890.60	2890.60	99.2000	99.2000	100.000	100.000
1968	3345.40	3226.04	119.100	115.407	103.700	103.200
1969	3548.40	3322.47	137.900	129.484	106.800	106.500
1970	3898.30	3474.42	144.500	129.713	112.200	111.400
1971	4159.40	3409.34	129.500	112.121	122.000	115.500
1972	4505.30	3484.38	138.800	117.727	129.300	117.900
1973	4660.80	3429.58	144.900	119.063	135.900	121.700

Sources: Census of Manufactures 1972.
Various issues of Survey of Current Business.

Table F-6. Output and capital expenditures for the glass container industry: annually, 1958-74.

Year	Current dollar value of container output (10^6)	1967 constant dollar value of container output (10^6)	Current dollar expend-itures on machine and equipment (10^6)	1967 constant dollar value of container output (10^6)	Wholesale price index for glass bottle (1967=100)
1958	862.100	856.107	31.2000	34.8993	100.700
1959	915.600	907.433	32.9000	36.0350	100.900
1960	939.200	957.390	34.8000	37.8261	98.1000
1961	967.400	994.244	68.9000	74.9728	97.3000
1962	987.600	1030.90	53.6000	58.2608	95.8000
1963	1004.50	1052.93	53.8000	58.3514	95.4000
1964	1055.90	1099.90	59.5000	64.1164	96.0000
1965	1091.80	1125.57	72.3000	76.9968	97.0000
1966	1207.50	1222.17	116.800	120.661	98.8000
1967	1352.40	1352.40	70.8000	70.8000	100.000
1968	1407.30	1309.12	74.300	71.9961	107.500
1969	1664.70	1448.82	118.000	110.798	114.900
1970	1857.70	1544.22	125.700	112.837	120.300
1971	1943.60	1476.90	119.500	103.463	131.600
1972	2125.00	1572.91	121.000	102.629	135.100
1973	2251.00	1620.59	120.900	99.3426	138.900

Sources: Census of Manufactures, 1972.
Various issues of Survey of Current Business.

In order to obtain the capital stock requirements per unit of container, the unit prices of metal cans and glass bottles should be applied to the estimated capital-output ratios. The unit prices of containers and capital stock requirements per unit of containers are shown in table F-7. Table F-7 reveals that glass bottles require more capital stock per unit of container than metal cans, and refillable bottles require more than nonrefillable bottles.

Table F-7. Unit prices of containers and capital stock requirements

Containers	Unit price* in 1967 ($/ unit)	Capital stock requirement in 1967† ($/$10^6$ units)	Capital stock requirement in 1967‡ ($/$10^6$ units)
Metal can			
Beer	0.0361	9,386.0	13,084.1
Soft drinks	0.0366	9,516.0	13,265.3
Glass bottle			
Beer			
Refillable	0.0363	30,816.3	42,958.0
Nonrefillable	0.0290	24,575.0	34,258.0
Soft drink			
Refillable	0.0634	53,797.1	74,993.0
Nonrefillable	0.0360	30,561.9	42,603.0

*Unit prices for metal cans were obtained from Beverage Industry Annual Manual and deflated to the 1967 prices. Unit prices for glass bottles were obtained from the Census of Manufactures, 1967.

†The estimated capital-output ratios of 0.26 and 0.848 were used for metal cans and glass bottles respectively.

‡The 1967 capital stock requirements were inflated to 1974 dollars, using the wholesale price index of machine and equipment.

F.3 Employment Requirements

Employment-output coefficients were developed for the container-manufacturing industries, the metal-supplying industries, beverage production and distribution industries, and retail stores. Indirect employment relationships were estimated for industries supplying the glass container and metal can industries, based on data in the 1967 Input-Output Table of the U.S. economy (ref. 1). Projections of increases in productivity were assumed to equal the average annual rates for each industry over the period (ref. 2).

Average earnings for all industries were calculated for 1972 to estimate the income effects of employment changes.

F.3.1 Glass Container Manufacturing (SIC 3221)

The productivity per employee by container type was estimated assuming that employment is proportional to the weight of glass containers. The resulting output-per-employee ratios are shown in table F-8. For the period 1972-85, an average annual increase in productivity of 2.4 percent per employee was used (table F-9).

F.3.2 Metal Can Manufacturing (SIC 3411)

Productivity estimates for the metal can industry were obtained by dividing the 1972 total number of metal can production (76×10^6) by total employment (68,200). The resulting value for 1972 is 101.144×10^9 cans per employee. For the period 1972-85 a productivity growth rate of 1.9 percent was used. Table F-9 shows the projected labor output ratios. These are derived from the inverse of the productivity data in column 5 of table F-8 and the 1.9 percent productivity increase.

F.3.3 Bottled and Canned Soft Drinks (SIC 2086)

Productivity estimates were developed for both production and distribution employees in the bottled and canned soft drink industry. Historical data on total production employees and output in the soft drink industry are shown in table F-10. For 1972 the estimated production employee requirement per 10^6 ounces of soft drink is 0.0663. For the period 1972-85 an annual average growth rate of 5.3 percent in productivity has been used. To estimate distribution labor requirements, estimates developed from a study for the National Soft Drink Association (ref. 3)

Table F-8. Glass container manufacturing employee productivity: annually, 1972

	Average weight per container, kg	Container production		Productivity*, 10^6 containers per employee
		10^6 container	10^6 kg	
Beer bottles				
refillable	0.275	250	68.8	0.553
nonrefillable	0.217	7,590	1,647.2	0.700
Soft drink bottles				
refillable	0.502	1,450	728.4	0.303
nonrefillable	0.343	8,760	3,008.0	0.443
Other glass containers	0.273	20,610	5,633.7	0.556
Total		38,660	11,086.1	

*Based on total employment of 72,936.

Source: Research Triangle Institute.

Table F-9. Beverage container production employment - output coefficients: annually, 1975-85

	Jobs per 10^6 containers				
	Glass containers				
	Beer bottles		Soft drink bottles		
Year	Refillable	Nonrefillable	Refillable	Nonrefillable	Metal cans
1975	1.74734	1.33049	3.07409	2.10217	0.848034
1976	1.70648	1.29938	3.00120	2.05297	0.832224
1977	1.66639	1.26888	2.93169	2.00481	0.816727
1978	1.62734	1.23916	2.86287	1.95810	0.809475
1979	1.58932	1.21007	2.79564	1.91205	0.786535
1980	1.55183	1.18175	2.73000	1.86707	0.771904
1981	1.51561	1.15393	2.66596	1.82349	0.757520
1982	1.48017	1.12689	2.60349	1.78063	0.743385
1983	1.44530	1.10059	2.54259	1.73913	0.729502
1984	1.41143	1.07481	2.48262	1.69952	0.715924
1985	1.37836	1.04954	2.42483	1.65837	0.702544

Source: Research Triangle Institute.

Table F-10. Beverage production employment and productivity: annually, 1962-72

Year	Beer			Soft drink		
	Production employment	Production, 10^6 ounces	Productivity, 10^6 ounces per employee	Production employment	Production 10^6 ounces	Productivity, 10^6 ounces per employee
1962	44800	382583	8.540	41400	320160	7.733
1963	42700	388709	9.103	40900	345793	8.454
1964	42000	408775	9.733	41000	374131	9.125
1965	40600	428604	10.557	42100	404026	9.597
1966	40300	435432	10.805	43700	451699	10.336
1967	40000	462526	11.563	46600	474319	10.178
1968	39700	466335	11.746	47700	533184	11.178
1969	38600	486703	12.609	49300	559315	11.345
1970	38000	534307	14.061	49600	594547	11.987
1971	37200	532077	14.303	45900	643891	14.028
1972	33900	556818	16.425	45100	699949	15.076

Source: Research Triangle Institute.

were adjusted, based on data presented in the 1967 Census of Manufactures. Specifically, table F-11 shows the distribution labor costs for each of the three containers as taken from the Booz-Allen & Hamilton study. These values are multiplied by the total number of fillings (column 3) to estimate the total distribution labor costs of 605.1 x 10^6 dollars. This value is 19.3 percent larger than the total payroll for nonproduction workers ($507.4 x 10^6) for the bottled and canned soft drink sector, as shown in the 1967 Census of Manufactures. Therefore, the average labor cost per filling was discounted to 80.7 percent of the Booz-Allen estimates and is shown in table F-8. The labor costs per filling were converted to fillings per man-year by dividing the 1967 average annual wage of $6,615 for nonproduction workers in the soft drink industry (SIC 2086) by the labor cost per filling. The resulting productivity and number of distribution employees are shown in table F-11. For the period 1967-85 the only growth in productivity assumed is that associated with changes in the mix of beverage containers.

Table F-11. Soft drink distribution labor cost and requirements estimates: 1967

Container type	Labor cost per filling*	Fillings, 10^6	Implied labor costs, 10^6	Adjusted labor cost per filling	10^6 fillings per employee
Refillable bottle	$0.016875	29,102.5	$491.1	$0.01415	0.4675
Nonrefillable bottle	0.011125	3,585.5	39.9	0.009329	0.7091
Metal cans	0.010167	7,290.0	74.1	0.008525	0.7760
Total		39,978.0	$605.1		

*Booz-Allen & Hamilton, Inc. for the National Soft Drink Association. Study of Distribution Practices in the Soft Drink Industry.

Source: Research Triangle Institute.

F.3.4 Malt Liquor (SCI 2082)

Production and distribution labor requirements were estimated for malt beverage and wholesale distribution of beer (SIC 5095).

Historical data for total production employment requirement per 10^6 ounces in 1972 was 0.0609. For the period 1972-85 an annual average growth rate in productivity of 6.7 percent has been used.

The combined total malt liquor and wholesale beer distribution employment was estimated. Productivity estimates were assumed to be the same as those developed for soft drinks as above. The values are shown in table F-11. Total distribution employment for 1967 was estimated at 49,833 employees. USBA suggests that the 1967 total employment in the wholesale beer distribution industry is 57,182 employees and 53.0 to 56.0 percent of total wholesale wages and salaries are accounted for by delivery and warehouse workers. The above figures imply that approximately 31,164 distribution workers were employed in the wholesale beer distribution industry in 1967. Therefore, 18,669 distribution workers were employed in the malt liquor industry in 1967. USBA further provides information that 19.9 percent of total malt liquor production worker employers are engaged in warehousing and shipping (but not delivering; delivery workers are classified as non-production workers in Census of Manufactures). Since total production employment was 40,000 employees in 1967, one can compute that 7,960 employees were engaged in warehousing and shipping work

Table F-12. Man-hours per refillable bottle for nine categories of labor costs

Labor Category	Man-hours per bottle
Accounting	0.0000073
Clerk ringing deposits	0.0000958
Clerk refunding deposits	0.0001846
Busboy racking empties	0.0005185
Moving rack to bottle storage area	0.0003900
Clearing of bottle storage area	0.0001900
Sorting of bottles from rack	0.0010000
Moving empty rack to front	0.0003900
Checking empties to driver	0.0000600
Total	0.0028335

Source: Bottle Survey '71, A California Supermarket Report on the Cost of Handling Returnable Soft Drink Bottles, Alpha Beta Acme Markets, La Habra, Calif., 1971.

(classified as production workers) and 10,709 were delivering workers (classified as non-production workers) in the beer industry.

F.3.5 Grocery Stores (SIC 5411)

Labor requirements for handling refillable bottles at retail outlets have been developed based on a study of California supermarkets (ref. 4). Table F-12 gives the man-hours per refillable bottle as 0.0028335. A full-time employee is required for every 14,000 bottles returned per week.

A second study, (ref. 5) shows that the time required to handle returned metal cans is less than that for a returned refillable bottle by approximately 8 percent. Thus an estimate of 1.36 man-years per million cans returned has been used.

F.3.6 Metal-Supplying Industries (SIC 3312 and 3352)

The blast furnance and steel mill industry (SIC 3312) supplies all the stell tinplate to the metal can industry. The aluminum rolling and drawing industry (SIC 3352) provides all the aluminum used by the metal can industry.

Historical data on total production and total employment in the blast furnace and steel mill industry are shown in table F-13. Similar data for the aluminum-rolling and -drawing industry are shown in table F-14. In 1972 metal cans accounted for 6.3 percent of all steel con-

Table F-13. Steel output and productivity estimates: annually, 1967-72

Year	Total production, 10^6 tons	Metal can stock, 10^6 tons	Metal can share of total, percent	Total employment	Productivity, tons per employee
1967	83.9	5.323	6.34	533,100	157.4
1968	91.9	5.684	6.18	533,100	172.4
1969	93.9	5.855	6.24	537,700	174.6
1970	90.8	5.970	6.57	526,500	172.5
1971	87.0	5.573	6.41	482,200	180.4
1972	91.8	5.748	6.26	469,600	195.5

Source: Developed from data provided in the Annual Survey of Manufactures.

Table F-14. Aluminum output and productivity estimates: annually, 1967-72

Year	Total production, 10^6 tons	Metal can stock, 10^6 tons	Metal can share of total, percent	Total employment	Productivity, tons per employee
1967	4.43	.228	5.16	61500	71.87
1968	4.93	.235	4.77	66000	74.70
1969	5.36	.298	5.56	68200	78.59
1970	4.98	.365	7.33	65000	76.62
1971	5.13	.413	8.05	64500	79.53
1972	5.91	.478	8.09	64400	91.77

Source: Developed from data provided in the Annual Survey of Manufactures.

sumption and 8.1 percent of all aluminum consumption. The productivity in tons per employee is shown in the sixth column of tables F-13 and 14. In 1972 production per employee was 195.5 short tons in the steel industry and 91.8 in the aluminum industry. By using this estimate of tons per employee, employment in these metal-supplying industries due to metal can usage was estimated and reported in the last columns in table F-13 and 14. The number of cans produced per ton in 1972 is shown in table F-15 by container type.

In projecting the employment requirements in metal-supplying industries (table F-16), an annual growth rate of productivity of 2.5 percent in the steel industry and 4.8 percent in the aluminum industry was used.

F.3.7 Indirect Employment Requirements

Indirect employment relationships were developed from data presented in the 1967 484-sector, input-output table of the U.S. economy (ref. 1). In developing these estimates, only those industries which account for greater than .1 percent of the total inputs to glass container- and metal can-manufacturing were developed.

The indirect employment coefficients for each supplying industry were obtained by multiplying the employment requirement per 1 dollar of output in that industry by the total requirement (direct and indirect) coefficients from that industry to deliver 1 dollar of glass container or metal can output to final demand. Before the total requirement coefficients from 1967 input-output table were applied, they were modified for the blast furnace and steel mill industry (I/O No. 37.0,) and the aluminum-rolling and -drawing industry (I/O No. 38.08) to get only indirect requirements coefficients by subtracting the direct coefficients of these two industries. The reason for this modification is that the employment requirement from these metal-supplying industries was separately estimated above. The estimated total employment requirements were 27.586 per million dollars of glass container demand and 33.044 per million dollars of metal can demand for 1967. The estimated total employment requirement coefficients were multiplied by the price of a million containers by container type to obtain the indirect employment requirement (excluding the metal-supplying industries) per 10^6 containers. The prices of containers calculated from the 1967 Census of Manufactures are shown in table F-17.

Table F-15. Employment in metal supplying industries attributed to beverage containers: 1972

	Cans per basebox	Cans per ton	10^6 cans per employee
Beer			
steel can	591	14,775	2.889
aluminum can	371	22,260	2.043
Soft drinks			
steel can	567	14,175	2.771
aluminum can	232	13,920	1.277

Source: Research Triangle Institute.

Table F-16. Employment - output coefficients for the metal supplying industries: annually 1975-85

	per 10^6 containers			
	Beer cans		Soft drink cans	
Year	Steel	Aluminum	Steel	Aluminum
1975	0.321130	0.423832	0.334805	0.678065
1976	0.313201	0.403969	0.326538	0.646286
1977	0.305468	0.385036	0.318476	0.615997
1978	0.297926	0.366991	0.310613	0.587128
1979	0.290570	0.349791	0.302944	0.559611
1980	0.283396	0.333398	0.295464	0.533385
1981	0.276399	0.317773	0.288169	0.508387
1982	0.269575	0.302880	0.281054	0.484561
1983	0.262919	0.288685	0.274115	0.461851
1984	0.256427	0.275156	0.267347	0.440206
1985	0.250096	0.262260	0.260746	0.419575

Source: Research Triangle Institute.

Table F-17. Beverage container prices: 1967

Container	Price, $ per 10^6 containers
Beer	
refillable bottle	36,340
nonrefillable bottle	28,980
metal can	37,900
Soft drink	
refillable bottle	63,440
nonrefillable bottle	36,040
metal can	40,010

Source: 1967 Census of Manufactures.

The weighted average prices of metal cans were used instead of separate prices for steel and aluminum cans because the total employment requirement per dollar of container demand excludes the employment requirement from the metal-supplying industries.

The estimated total employment requirements per 10^6 containers are shown in table F-18.

F.4 Personal Income

Average annual earnings for each of the above industries in 1974 dollars are shown in table F-19.

The average annual earnings for the container industries and the metal-supplying industries were derived by dividing total payroll by total employment in each industry from the 1967 Census of Manufactures. The average annual earnings for distribution and labor in beer and soft drink industries were obtained by dividing payroll for non-production workers by non-production employment in beer and soft drinks industry from the 1967 Census of Manufactures. The average annual earnings for beverage industries are derived by dividing payroll for production workers by production employment in the beverage industries. As an average annual earning for indirect employment required, the average earnings for total manufacturing, which were obtained by multiplying the manufacturing weekly earnings by 50, were used. The average annual earning for retail labor is used for retail employees.

REFERENCES

1. U.S. Department of Commerce, Input - Output Structure of the U.S. Economy: 1967, 484 sector computer tape.
2. U.S. Department of Labor, Bureau of Labor Statistics, Indexes of Output per Man-Hour, selected industries, 1973 edition, bulletin 1780, U.S. Government Printing Office, Washington, D.C., 1973.
3. Booz-Allen & Hamilton, Inc., Study of Distributor Practices in the Soft Drink Industry, (2 Volumes) report for the National Soft Drink Association, Washington, D.C., 1968.
4. Bottle Survey '71. A California Supermarket Report on the Cost of Handling Returnable Soft Drink Bottles. La Habra, Calif., Alpha Beta Acme Markets, 1971.

Table F-18. Total indirect employment requirement coefficients

	Indirect employment requirements, employees per 10^6 containers
Beer	
refillable bottles	1.002
nonrefillable bottles	0.799
metal cans	1.252
Soft drinks	
refillable bottles	1.750
nonrefillable bottles	0.994
metal cans	1.322

Source: Research Triangle Institute.

Table F-19. Average annual earnings by industry: 1974

Glass container manufacturing	$ 9,500
Metal can manufacturing	11,400
Bottled and canned soft drink production	7,320
Bottled and canned soft drink distribution	10,205
Malt liquor production	12,960
Malt liquor distribution	15,357
Retail	7,360
Steel manufacturing	11,820
Aluminum manufacturing	11,820
Indirect industries	8,876

Source: Environmental Protection Agency.

Appendix G: A SIMPLE METHODOLOGY FOR THE EVALUATION OF ENERGY EFFECTS OF BEVERAGE CONTAINER USE IN SPECIFIC GEOGRAPHIC AREAS

G.1 Introduction

A part of this contractual effort was to develop a methodology for evaluating energy effects of beverage container use in specific geographic areas--e.g., state or county or SMSA or city. Upon investigation, it was found that developing a methodology was relatively straightforward. Unfortunately, the readily available data sources required to execute regional calculations are very scarce. Thus, it is necessary to utilize national data in many instances where regional data would be preferable. Discussions by the research team with numerous industry experts and checking of other beverage packaging studies and published data sources confirmed the limitations of data. While some regional data are available, most of the sources of such data are proprietary and costly to develop.

Nonetheless, it is possible to regionalize beverage container calculations to some extent. For this reason, using the regional methodology set out below is useful because it does give a better indication of regional impacts of proposed regional legislation than the national average data developed elsewhere in the study.

Many proposals have arisen on a local, regional, or state level to establish beverage container legislation. However, any regional legislation adopted would have an impact on a national basis. The determination of local or regional energy requirements should take place in three parts: (1) the calculation of energy requirements of existing beverage consumption patterns in a given region; (2) the calculation of energy requirements "after legislation" beverage consumption patterns are determined; and (3) determining the differences between the two.

A stepwise description of the methodology is given in the following section.

G.2 Regional Energy Methodology

Several basic factors should be known to the extent possible in order to tailor any calculations to the characteristics of the region under question, e.g., state, county, SMSA, etc. These basic factors are:

(1) Population base affected by the proposed legislation (population data is readily available from Federal census reports or local population reports. The sources should be basically the latest U.S. Bureau of Census data, unless more up-to-date local data is available).

(2) Per capita beer and soft drink consumption. This data is available in published form only on a state or regional basis. Other per capita consumption may be available in proprietary reports not readily obtainable. The principal sources are:

"The Brewing Industry in the United States. Brewers Almanac, 1974." United States Brewers Association, Inc., 1750 K Street, N.W., Washington, D.C. 20006.

"Statistical Profile. The Soft Drink Industry of the United States, 1974," National Soft Drink Association, 1101 16th Street, N.W., Washington, D.C. 20036.

Both of these are annual volumes.

(3) Container market share for beer and soft drink by size and type of container: refillable bottles, nonrefillable bottles, steel cans, aluminum cans, and plastic bottles (if any). This data is generally available only on a national basis. Occasionally some local published data exists, but in general only national data are available. Thus, reference to Appendix B and to Chapter 2 of this report will give market share data on a year by year basis. In addition, the same data is available from the Bureau of Census "Current Industrial Reports" series on Metal Cans, Glass Containers and Closures for Containers.

(4) Establish return rate (trippage) of refillable bottles. There may be local data; however, that is unlikely so the national average data for beer and soft drinks can be obtained from Appendix B of this report. By contrast, it may be possible to estimate this data by direct contact with regional brewers or soft drink bottlers.

(5) Establish recovery rate regionally of aluminum, glass, and steel containers. In the case of voluntary collection centers or resource recovery facilities this data would have to be gathered directly from the source and related to the packaging by type from (3) above.

Once these data are established they can be used to provide the input data for the energy equations that describe each container system in Appendix D. Application of the regional data to the general energy equations in Appendix D would give current total energy requirements by type of fuel for any given set of regional beverage consumption characteristics. The use of the energy equations imposes national average data for energy values for each container but it would be very difficult to develop any regional data for energy use in beverage containers.

Based upon the expected behavior of consumers under National deposit legislation developed elsewhere in this study, the "post regional legislation" results should be established. The two parameters of importance are: (1) changes in container market share and (2) return rates for each type of container. The post legislation criteria can be based on the National legislation case or on one that is estimated for the region considering legislation.

To illustrate how this methodology would work, an example follows.

G.3 Example Calculation of Hypothetical Proposed Legislation

Several assumptions must be made to set up the calculations. The lack of usable regional data makes the calculation virtually a microcosm of the total USA but nonetheless the calculation is an approximation of what the energy impacts would be of regional legislation. The first case calculated assumes no governmental legislation.

Assume for a base year 1982 and:

Regional population: 3,000,000
Per capita beer consumption: 20 gal/year
Per capita soft drink consumption: 30 gal/year

Therefore total consumption in 1982 is:

$3 \times 10^6 \times 20 = 60 \times 10^6$ gal/year beer
$3 \times 10^6 \times 30 = 90 \times 10^6$ gal/year soft drink
Total 150×10^6 gal/year beverage

Container share is calculated as follows, based upon forecast national averages for 1982 (RTI data, this report).

Beer

Container Type	Number Fillings (10^6)	X	Average Container Size (oz)	=	Total Ounces (10^6)	Percent of Total
REF glass	7,553		12		90,636	13.7
NR glass	8,244		12		98,928	15.0
Steel can	15,403		12		184,836	28.1
Aluminum can	23,691		12		284,292	43.2
Total					658,692	100.0

Soft Drink

Container Type	Number Fillings (10^6)	X	Average Container Size (oz)	=	Total Ounces (10^6)	Percent of Total
REF glass	16,536		16		264,576	23.1
NR glass	7,422		32		237,504	20.8
Steel can	26,642		12		319,704	28.0
Aluminum can	26,786		12		321,432	28.1
Total					1,143,216	100.0

Using the container percentages calculated above, the regional container shares can be calculated as follows:

Container Type	Beer Percent	Beer Consumption (10^6 gal/yr)	Soft Drink Percent	Soft Drink Consumption (10^6 gal/yr)	Total Beverage Consumption (10^6 gal/yr)
REF glass	13.7	8.2	23.1	20.8	29.0
NR glass	15.0	9.0	20.8	18.7	27.7
Steel can	28.1	16.9	28.0	25.2	42.1
Aluminum can	43.2	25.9	28.1	25.3	51.2
Total		60.0		90.0	150.0

The energy used for the various containers is calculated using the equations in Appendix D, Section D.9. Recycling rate, R, was assumed to be as follows:

Glass R = 0.0275
Steel R = 0.0650
Aluminum R = 0.3420

Number of trips, N_t, is assumed to be 10.37 for refillable beer bottles, and 6.44 for refillable soft drink bottles. Time, t = 7 years. Energies used (million Btu/1,000 gallons) for refillable glass beer bottles (off-premise) and 16-fluid-ounce soft drink bottles were calculated from equations in table D.9-5. Nonrefillable glass bottle equations are in table D.9-6, steel cans in table D.9-4, and aluminum cans in table D.9-3. Combining these calculations with the consumption rates calculated above produces the following data for energy required to supply beverages to the example region.

"No government intervention" case

Container Type	Energy* (10^6 Btu/10^3 gal)	Consumption (10^6 gal/yr)	Energy (10^9 Btu/yr)	Percent of Total
REF glass (beer)	18.53	8.2	152	3.0
REF glass (SD)	16.15	20.8	336	6.6
NR glass (beer)	36.95	9.0	333	6.5
NR glass (SD)	35.95	18.7	672	13.1
Steel can	33.78	42.1	1420	27.7
Aluminum can	43.11	51.2	2210	43.1
Totals		150.0	5123	100

*Calculated from energy equation tables D.9-5, D.9-6, D.9-4 and D.9-3.

To calculate the effects of government intervention, the consumption rate is assumed to remain the same. Container share is calculated as follows, based upon the RTI illustrative scenario 1 case, this report, for national average.

Beer

Container Type	Number fillings (10^6)	X	Container Size (oz)	=	Total ounces (10^6)	Percent of Total
REF glass	28,962		12		347,544	50.0
NR glass	0		-		-	-
Steel can	11,411		12		136,932	19.7
Aluminum can	17,551		12		210,612	30.3
					695,088	100.0

Soft Drink

Container Type	Number fillings (10^6)	X	Container Size (oz)	=	Total ounces (10^6)	Percent of Total
REF glass	40,217		16*		643,472	70.7
NR glass	0		-		-	-
Steel can	17,747		12		212,964	23.4
Aluminum can	4,520		12		54,240	5.9
					910,676	100.0

*The average size would probably rise, but for purposes of calculation a 16 oz container was assumed.

The regional container shares are calculated as before:

	Beer		Soft Drink		Total Beverage Consumption
Container Type	Percent	Consumption (10^6 gal/yr)	Percent	Consumption (10^6 gal/yr)	(10^6 gal/yr)
REF glass	50.0	30.0	70.7	63.6	93.6
Steel can	19.7	11.8	23.4	21.1	32.9
Aluminum can	30.3	18.2	5.9	5.3	23.5
		60.0		90.0	150.0

Making the same assumptions on recycling rates and trip rates, the energy is calculated from the equations as follows:

"After government intervention" case*

Container Type	Energy (10^6 Btu/10^3 gal)	Consumption (10^6 gal/yr)	Energy (10^9 Btu/yr)	Percent of Total
REF glass (beer)	18.53	30.0	556	15.0
REF glass (SD)	16.15	63.6	1027	27.7
Steel can	33.78	32.9	1111	30.0
Aluminum can	43.11	23.5	1013	27.3
Totals		150.0	3707	100.0

* Illustrative scenario 1

Comparing the "no government intervention" and "after government intervention" examples shows a savings of 1416 x 10^9 Btu/year, or 28 percent. This is equivalent to a savings of 106 million pounds of coal.

An alternative calculation would be to assume maximum recycling rates under legislation assuming all returned metal containers are recycled. To calculate the energy used for the various containers, recycling rate, R, was then assumed to be as follows:

Glass	R = 0.818
Steel	R = 0.7785
Aluminum	R = 0.780

These recycling rates are based upon a return rate of 90 percent and recycling of the entire quantity less adjustment for losses in handling and melting.

Number of trips, N_t, is assumed to be 10 for both beer and soft drink bottles.

The energy calculations are as follows:

"After government intervention" case*

Container Type	Energy 10^6 Btu/10^3 gal	Consumption 10^6 gal/yr	Energy 10^9 Btu/yr	Percent of Total
REF glass (beer)	17.71	30.0	531	17.8
REF glass (SD)	14.11	63.6	897	30.2
Steel can	28.11	32.9	925	31.1
Aluminum can	26.43	23.5	621	20.9
Totals		150.0	2974	100.0

* Illustrative scenario 1

Comparing the "no government intervention" and "after government intervention" examples shows a savings of $2,149 \times 10^9$ Btu/year, or 42 percent. On an equivalent coal basis, this savings is equal to 182 million pounds of coal at 13,300 Btu/lb of coal.

Appendix H: RECOVERY FORECASTS FOR BEVERAGE CONTAINERS, 1972 TO 1985*

H.1 Introduction

The recovery of beverage containers for recycling started in about 1967, when Reynolds Metals Company instituted a few local collection programs to recover aluminum cans. These programs were expanded to numerous locations across the USA and now all three major aluminum producers have established collection centers (as well as distributors and private groups). Steel can and glass bottle collection centers have been established as well, but are not as wide spread as for aluminum cans. Actual recovery of steel and glass beverage containers for recycling has been relatively low as a percentage of total beverage containers consumed--generally on the order of 1 to 4 percent.

However, aluminum cans were recovered in 1975 at the rate of 24 percent of consumption, from collection centers established for the purpose.+ In addition, the advent of commercial size resource recovery facilities promises to expand the recovery of all three materials in the years ahead. However, each material will have a very different recycling "success" in the future.

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* The basic sources for the forecasts were derived from previous work done for EPA: Franklin, W. E., et al, "Base Line Forecasts of Resource Recovery, 1972 to 1990," and revisions of the aluminum recovery forecasts based on recovery data through 1975 reported by The Aluminum Association.

\+ This is 24 percent of all-aluminum cans excluding aluminum used for ends on steel cans. If the aluminum ends on steel beverage cans are included, the recovery rate would be about 17 percent. Also, this number includes a small amount of non-can aluminum collected along with the cans (e.g., foil, lawn furniture, cook ware, etc. The non-can aluminum is probably not more than 5 to 6 percent of the total metal collected, according to the aluminum industry sources contacted).

It is expected that the rate of glass container recovery will increase only slightly in the next decade; that the rate of steel can recovery will somewhat outpace the development of centralized resource recovery; and that the rate of aluminum recovery will proceed more rapidly than the others on the basis of expanded operation of local collection centers, plus centralized resource recovery.

These forecasts of recycling which follow were developed on the basis that no beverage container legislation would take place. Under these conditions, it is important to recognize that voluntary return systems (collection centers) and centralized resource recovery are the basic recovery mechanisms for recycling of beverage containers and, that a relatively high growth in demand for nonrefillable containers would stimulate the rate of recovery that can be practiced successfully.

H.2 Summary of Recycling Forecasts, 1972 to 1985

H.2.1 Overview. The recovery and net recycling forecasts are given in table H.2-1. Recovery rates are usually considered equivalent or equal to the recycling rate. However, to facilitate the energy calculations in other parts of the study, adjustment has been made to the recovery rates to account for losses in handling and shipment, plus melt losses in converting containers to molten glass or metal in the furnace. The latter adjustment gives the "net" recycling rates based on the forecast recovery ("gross recycling") rate.

As shown, glass container recovery (which includes beverage and nonbeverage containers) will rise from 2.3 percent in 1972 to 4 percent in 1985. Steel can recovery (beverage and nonbeverage) will rise from 0.8 percent in 1972 to 12.5 percent in 1985. By contrast, aluminum can recovery (all-aluminum beverage containers only) will rise from 13 percent in 1972 to 45 percent in 1985.* All of the rates above are given on a recovered material basis, by weight.

The factors that were used to adjust to a molten material basis (i.e., net recycling rate) for use in the energy requirements equations for each container are given in table H.2-2.

The basis for the recovery calculations and forecasts are given in the sections that follow.

* Care should be used in interpretation of the aluminum can data because the recovery rate is based only on all-aluminum beverage containers, not on total aluminum can metal. The recovery rate would be about one-third less as a percent of total can metal for all uses (i.e., lids for steel cans, snack food cans, etc.). However, the recovery calculations and energy calculations are on an internally consistent basis for aluminum cans.

Table H.2-1. Recycling summary--glass and metal beverage containers, 1972 to 1985

Category	Recovery and Recycling Rate in Percent 1972	1975	1980	1985
Glass containers (refillable and nonrefillable)				
Recovery Rate*	2.3	2.3	2.5	4.0
Net Recycling Rate+ @ 0.909	2.1	2.1	2.3	3.6
Steel cans				
Recovery Rate*	0.8	2.9	5.3	12.5
Net Recycling Rate+ @ 0.865	0.7	2.5	4.6	10.8
Aluminum Cans‡				
Recovery Rate*	13.0	24.2	35.0	45.0
Net Recycling Rate+ @ 0.867	11.3	21.0	30.3	39.0

* Recovery Rate ≅ "gross" recycling rate.
+ Net Recycling Rate ≅ recycling on a molten glass or metal basis.
‡ This is percent recovery of all-aluminum cans and not of the total aluminum used in beverage cans since it excludes tabs and ends on steel cans. If the recovery rate were calculated on the basis of all aluminum used in beverage cans, it would drop by about one-third, e.g., 1975 would be about 17 percent versus 24.2 percent shown above.

Source: Franklin Associates, Ltd.

H.2.2 Glass Container Recovery and Recycling. Glass container recovery faces some technical and economic difficulties when compared to metals recovery. Where color-sorted glass can be delivered to a glass container plant, it can be used in quantity at a very high rate of recycling. Most companies now seek it, but few have experienced a high recovery rate because of lack of viable collection systems. (A glass container plant in Dayville, Connecticut, is an example of a location where source-separated glass is collected and used in quantity). However, to date, consumer glass collection centers have not been very successful and the technology of recovering color-sorted glass is unproven on a commercial scale even though development work and testing of recovery systems has taken place at Franklin, Ohio, among other locations.

Glass container plants are not uniformly located throughout the nation, and the present prospects for widespread glass recovery for recycling into containers appear to be limited. Glass shipment over 200 miles becomes marginally economic and the value of color-sorted glass--$20 to $25 per ton--is too low to offset recovery costs plus transportation distances much in excess of 200 miles.

For these reasons, it appears glass (beverage) container recovery will lag metals recovery in the absence of a system that brings them back more efficiently (e.g., a deposit). The key point is that glass is technically recyclable once it is available in clean, color-sorted form at a glass plant; but glass is difficult to recover economically in recyclable form from post-consumer waste.

By contrast, technology to recover finely ground unsorted glass of high purity has been developed by Occidental Petroleum Corporation. This technology will be tested on a commercial scale in the next few years. Market applications for this type of recovered glass are now being investigated also.

Table H.2-2. Conversion factors--recovered container to recycled molten material

Aluminum		
Loss in handling	6.9%	
Melt loss	6.4%	
Total Loss	13.3%	1.153 lb = 1.0 lb of molten metal or 0.867 yield from recovered metal.
Steel		
Loss in handling	7.0%	
Melt loss	6.5%	
Total Loss	13.5%	1.156 lb = 1.0 lb of molten metal or 0.865 yield factor on recovery.
Glass		
Loss in handling	6.0%	
Melt loss	3.0%	
Total Loss	9.0%	1.10 input = 1.0 lb of molten glass or 0.909 yield factor on recovery

Source: Franklin Associates, Ltd., for steel and glass. The Aluminum Association for aluminum.

A summary of glass container recovery for the period 1972 to 1985 is given in table H.2-3. Glass beverage containers are estimated to be just under half of all glass containers (by weight) and will remain about at the same level in the next decade.

H.2.3 Steel Can Recovery and Recycling. Steel can recovery is relatively easy to accomplish technically, but steel cans are not recyclable into new can metal without special processing to remove tin or other "contaminating" coatings. However, there are no real technical limits to metal can recovery and recycling per se, particularly into products that do not have strict specification requirements.

Steel can recovery is practiced via consumer can collection centers and resource recovery systems. Voluntary collection centers are not expected to be a significant source of steel can recovery, but magnetic separation in "front end" recovery systems will come into wider use in the next decade. In addition, ferrous metal recovery is relatively simple to incorporate in almost any centralized resource recovery system. By the early 1980s it is probable that technology will be in use for processing cans to "clean them up" to the point where they can be recycled into can making steel.

The value of steel can scrap is about $30 to $35 per ton (it can range higher or lower) and steel furnaces are generally located within reasonable shipping distances of most large population centers. Thus, steel recovery will likely take place in conjunction with resource recovery from mixed waste over the next 10 years, and beverage cans will be recovered in proportion to their occurrence in mixed waste.

The key point is that ferrous metal is readily recovered by magnetic separation, but only recyclable within limits until such time as technology comes into use to remove impurities such as tin and solder from post-consumer waste.

Table H.2-3. Summary of glass container recycling, 1972 to 1985
(in thousand tons and percent)

Category	1972	1975	1980	1985
Glass, total in solid waste	13,220	13,500	16,400	16,600
Glass containers, total	12,219	12,520	15,110	15,110
Glass beverage containers	6,011	6,400	7,800	7,800
Percent beverage containers of glass containers	49.2	51.1	51.6	51.6
Percent beverage containers of total glass	45.5	47.4	47.5	47.0
Glass recovery				
Volunteer collections	175	180	225	250
Cullet dealers	100	95	100	
Resource recovery plants	--	--	50	350
Total Recovery	275	275	375	600
Number of resource recovery plants for glass	0	0	4	11
Mixed glass processed for recovery	Neg	Neg	80	540
Glass recovery efficiency			0.65	0.70
Glass recovery from central systems	--	Neg	50	350
Percent glass recovery for recycle (as a percent of containers)	2.3	2.2	2.5	4.0

Note: "Salvage Markets for Materials in Solid Wastes," EPA Publication SW-29c (p. 66) estimates one percent (100,000 tons) of purchased cullet from glass containers for 1967. Flat glass and pressed and blown glass is also used as container cullet where it is available.

Source: Franklin Associates, Ltd., based on "Base Line Forecasts of Resource Recovery, 1972 to 1990."

Steel beverage cans are estimated to be about 30 percent of all steel cans by weight and the number will rise in proportion to total cans produced. A summary and forecast of steel can recovery for the period 1972 to 1985 is given in table H.2-4.

H.2.4 Aluminum Can Recovery and Recycling. The recovery of aluminum beverage cans is taking place at a much higher rate than glass or steel because of the high value of the metal ($300 per ton); high geographic concentration in use patterns (e.g., West Coast); and heavy emphasis by aluminum companies and brewers on operation of collection centers and can recovery. In addition, aluminum recovery technology, while unproven commercially, appears to be viable in the next decade. Aluminum cans are also recyclable (and recycled) into new can metal. Thus, the factors encouraging recovery are favorable and the history of recovery of beverage cans demonstrates this--an actual rate of 24.2 percent of all-aluminum beverage cans in 1975 (or 17 percent of all aluminum used in beverage cans).*

The calculation of aluminum can recovery is summarized in table H.2-5, which shows the rapid rise in demand for aluminum beverage cans and also aluminum can recovery. It is forecast that the recovery rate will increase at over 2 percent of total beverage cans per year to 1985. This will put recovery at 45 percent in 1985.+

A summary of all aluminum recovery is given in table H.2-6. The forecast is based upon a continuing rise in success of the can collection centers and resource recovery system recovery after 1980. In fact, can collection centers are forecast to account for 55 percent of the aluminum cans recovered in 1985 and could be even higher. This forecast is based upon aluminum recovery technology (such as the "aluminum magnet") being proven technically and beverage container concentration rising in solid waste as forecast.

*Actually the Aluminum Association reports a recovery rate of 25.4 percent based on recovery of 174 million pounds of aluminum in 1975. FAL used the actual recovery quantity reported and a slightly different calculation procedure, resulting in a rate of 24.2 percent (see table H.2-5).

+The Aluminum Association estimates are 50 percent "minimum" to 70 percent "possible" by 1985.

Table H.2-4. Summary of ferrous metal recycling, 1972 to 1985
(in thousand tons and percent)

Category	1972	1975	1980	1985
Ferrous metal in solid waste, total	9,265	9,870	11,085	13,500
Steel cans, total	5,560	5,625	5,770	6,075
Steel beverage cans	1,536	1,615	1,800	1,900
Percent steel beverage cans of total cans (by weight)	27.5	28.7	31.2	31.3
Percent steel beverage cans of total ferrous	16.6	16.4	16.2	14.1
Steel recovery				
Volunteer collections } Magnetic separation systems }	68	160	180	205
Resource recovery plants	0	20	395	1,450
Total Recovery	68	180	575	1,655
Steel can recovery only	47	105	305	760
Number of resource recovery plants for ferrous metal	0	5	12	32
Mixed ferrous processed for recovery	Neg	25	415	1,705
Recovery efficiency	--	0.85	0.85	0.85
Ferrous metals recovery from central systems	--	20	395	1,450
Percent ferrous metal can recovery for recycle (as a percent of cans)	0.8	1.9	5.3	12.5

Source: Franklin Associates, Ltd., based on "Base Line Forecasts of Resource Recovery, 1972 to 1990."

Table H.2-5. Aluminum beverage can shipments and recovery, 1970 to 1985

(in thousand tons and percent)

Year	Aluminum--1,000 Tons Beer and Soft Drink				Recovery as a % of	
	Ends and Tabs on Steel Cans	All Aluminum Cans	Total Aluminum	Aluminum Can Recovery	Total Aluminum	Aluminum Cans
1970	162,000	111,500	273,500	4,250	1.6	3.8
1971	163,000	147,300	310,300	17,500	5.6	11.9
1972	162,000	193,200	355,200	27,300	7.7	14.1
1973	173,000	238,800	411,800	34,000	8.3	14.2
1974	165,000	305,800	470,800	51,500	10.9	16.8
1975	148,400	358,900	507,300	87,000	17.1	24.2
1976	151,000	393,500	544,500	102,300	18.8	26.0
1977	147,000	442,000	589,000	123,800	21.0	28.0
1978	150,000	470,400	620,400	141,100	22.7	30.0
1979	147,000	495,000	642,000	158,400	24.7	32.0
1980	150,000	516,000	666,000	180,600	27.1	35.0
1985	0	620,000	620,000	279,000	45.0	45.0

Source: Franklin Associates, Ltd., based partly on 1970 to 1975 Aluminum Association recovery quantities and average can weights for 1972 to 1980. All other calculations by Franklin Associates, Ltd. The period 1970 to 1975 is calculated actual; 1976 to 1985 is forecast.

Aluminum beverage can metal is 80 to 85 percent of total aluminum used in all types of aluminum cans. It was assumed that aluminum ends and foil are virtually unrecoverable from mixed waste sources. All-aluminum cans are about 38 percent of aluminum packaging and will rise to nearly 50 percent by 1985. Thus, the presence of the aluminum beverage can is very important to aluminum recovery.

Table H.2-6. Summary of aluminum can recycling, 1972 to 1985
(in thousand tons and percent)

Category	1972	1975	1980	1985+
Aluminum packaging metal in solid waste, total	684	955	1,265	1,265
Aluminum cans and ends, total (includes non-beverage)	403	575	750	740
Aluminum beverage cans (all-aluminum only)	193	359	520	620
Percent all-aluminum beverage cans of total cans and ends*	47.9	62.4	69.3	83.8
Percent all-aluminum beverage cans of total aluminum	27.8	37.6	41.1	49.0
Aluminum recovery				
Volunteer collection centers	27	87	165	200
Resource recovery systems	0	Neg	25	160
Total Recovery	27	87	190	360
Aluminum can recovery only	27	87	180	279
Number of resource recovery systems recovering aluminum	0	1	7	25
Mixed aluminum processed for recovery @ 0.65 recovery efficiency	Neg	Neg	38	246
Percent aluminum can recovery for recycle (as a percent of aluminum cans)	14.0	24.2	35.0	45.0
Percent aluminum recovery (as a percent of total aluminum)	3.9	9.1	15.0	28.5

* Aluminum beverage can metal is estimated to be about 85 percent of total aluminum used in all types of aluminum cans.
\+ Assumes that the aluminum top and tab are no longer used on steel beverage caps.

Source: Franklin Associates, Ltd..

NOTES AND REFERENCES - Appendix H

1. Franklin, W. E., et al, "Base Line Forecasts of Resource Recovery, 1972 to 1990," Midwest Research Institute for U.S. Environmental Protection Agency, March 1975, 376 pp.
2. Darnay, A. and W. E. Franklin, "Salvage Markets for Materials in Solid Wastes," Midwest Research Institute for U.S. Environmental Protection Agency, Report SW-29c, 1972, 187 pp.
3. "Energy Content of Aluminum Cans, Energy Conservation: Historical Performance and Future Potential, U.S. Aluminum Industry," The Aluminum Association, Inc., New York, New York, June 30, 1975.

Appendix I: IMPACTS OF MANDATORY DEPOSITS ON RESOURCE RECOVERY SYSTEMS

I.1 Introduction

Because beverage containers make up a significant percent of the total inorganic materials in solid waste, the suggestion has been made that, were mandatory deposits to result in a significant reduction in the number of containers discarded to the solid waste stream, the economics of resource recovery would be significantly affected. This section analyzes the sensitivity of resource recovery systems to the quantities of beverage containers in the waste stream on the basis of two scenarios--the "Without Legislation" base line case and the illustrative scenario 1 case calculated by RTI.

I.2 Basic Parameters of the Analysis

I.2.1 Overview.

The economics of resource recovery systems are a function of several technical and economic parameters that affect system costs and revenues. These parameters include the composition of the solid waste stream, the system's capital and operating costs, the market for the recoverable products, and the costs of alternative disposal methods.

A comparative economic analysis was developed on the basis of an "optimistic" recycling scenario. The meaning of this is that it is assumed that both energy and materials recovery are viable, and that all the materials of value (ferrous, nonferrous, glass) are recoverable at their highest value uses (e.g., sorted color glass for container recycling). The deposit value of discarded containers is ignored. In addition, it was assumed that all recoverable materials and energy could be sold in the quantity recovered at the market price given.

The effect of these assumptions is that the beverage container legislation impact is the "maximum" impact, i.e., that any materials (aluminum, steel or glass) "lost" to the recovery system after legislation are materials that have values and would otherwise be recovered.

These assumptions therefore result in a test of the resource recovery impact of beverage container legislation from a suboptimization viewpoint--i.e., from the viewpoint of the resource recovery system operator utilizing a full range of recovery options and markets.

In point of fact the "real world" condition, for the next few years at least, is that only combustible waste and ferrous metal are "assured" of being recovered; and that aluminum and glass will be recovered only where technology, economics, markets, and concentrations are adequate to justify these recovery subsystems. Further, the rate of development and implementation of commercial size units is proceeding at a relatively slow pace now and is not likely to accelerate again until the early 1980's. The number of commercial size resource recovery systems in operation by the early 1980's is expected to be in the order of 12 to 35 (1,000 TPD equivalent).

In other words the viability of resource recovery itself is not tested in this scenario, but only the potential negative impact of beverage container legislation on the development and use of large scale resource or recovery systems.

The basic resource recovery system was assumed to have the following characteristics:

(a) 1000 TPD capacity; 300,000 TPY waste throughput.

(b) Recovery of refuse derived fuel (RDF); color sorted glass; ferrous metal; aluminum; other nonferrous metal.

(c) National average waste composition for 1982 based on net waste discards (i.e., allowance for source separation collection centers, quantities to reduce gross discards of aluminum, glass and steel) for the "without legislation" base line case.

(d) Recovery efficiencies of: combustible waste, 95%; glass, 65%; ferrous metal, 85%; aluminum, 65%; other nonferrous metals, 9%.

(e) Waste stream composition based on RTI forecast for illustrative scenario 1 conditions after legislation considering changes in container market shares and a return rate of 90% (i.e., only 10% of containers show up in the mixed municipal waste).

(f) Capital investment and operating costs based upon conditions described in previously published work* with a 20% allowance for increase in construction costs and 15% increase in unit operating costs over 1974. In other words the materials and energy values, the capital investment, and operating costs are on a 1976 base year; the waste processed is a 1982 waste composition.

(g) Value of recovered materials as follows: RDF, $0.50/million Btu to $1.00/million Btu reduced by 20% to allow for transportation and handling at the power plant site; this translates to $3.60 to $6.20 per ton of input. Ferrous metals $35/ton fob resource recovery plant; glass $18/ton fob recovery plant; aluminum $300/ton fob recovery plant; other nonferrous metals $250/ton fob recovery plant. Energy content is assumed to be 4500 Btu per input ton and 5,000 Btu/ton of combustible waste. No adjustment was made for energy efficiency of the plant and process itself.

Other parameters of the analysis are contained in the details of the sections that follow.

I.2.2 Waste Composition, 1982

The RTI analysis sets early 1980's for the point when deposit legislation is assumed to have taken full effect under the deposit legislation scenario. Accordingly, the resource recovery cases were developed based on a forecast waste composition for 1982. Two sources of data were relevant: (1) previous work done for EPA+ and (2) RTI's forecast of beverage container demand "without" and "with" (illustrative scenario 1) deposit legislation.

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* Franklin, William E., et al, "Alternative Strategies and Plans for Effective Solid Waste Management and Resource Recovery in the Twin Cities Metropolitan Area," Final Report and Appendices, Metropolitan Council of the Twin Cities Area, 1975. See especially pages 87-102 and F-6 to F-7.

+ Franklin, William E., et al, "Base Line Forecasts of Resource Recovery, 1972 to 1990," Report SW 107c, U.S. Environmental Protection Agency, Office of Solid Waste Management Programs, 1975, 386 p. See especially pages 46-49.

The average waste composition for the USA is shown in table I.1. This table gives the national average waste composition "Without" legislation and "After" deposit legislation. As may be noted, deposit legislation "removes" 4.6 million tons of beverage containers from the normal municipal waste stream and reduces the concentration of glass and metals--ferrous metals drops from 7.1 percent to 6.3 percent; aluminum from 1.3 percent to 1.0 percent; glass from 9.3 percent to 7.9 percent.

These waste compositions for the beverage container content were based on data in table I.2. These values were calculated for the "Baseline Trend Case" and the illustrative scenario developed by RTI, using container weights developed by FAL in Appendix D. (The discard tonnage developed in this manner corresponds closely to those in Appendix H; the latter were developed independently by FAL for purposes of calculating recycle rates over time).

I.2.3 The Recovery Values of Glass, Ferrous Metals, and Aluminum

As shown in table I.3 on a 1982 composition basis, recyclable inorganic materials make up about 17 percent of the total weight of municipal waste. Of this total, approximately 31 percent is containers (by both weight and value). Beer and soft drink containers constitute about 44 percent of all glass solid waste, 15 percent of the total ferrous metal solid waste, and 22 percent of total aluminum solid waste. (It should be borne in mind that these are values based on net discards of waste and therefore exclude aluminum, glass and steel containers recovered in collection centers).

Based on the recovery ratios shown in table I.3 and the given market prices, the market value of a typical ton of separated inorganic municipal solid waste is $4.96 per input ton of total waste of which $1.20 (24 percent) is represented by the market value of beverage containers.

Mandatory deposit legislation would reduce the total number of containers discarded to the solid waste stream and hence the market value of the separated waste. The illustrative scenario 1 assumes that not only is the nonrefillable bottle market absorbed by the refillable bottle system, but most (90%) of

Table I.1. Waste composition - 1982 - total USA
(in tons and percent)

Waste component	Without legislation		After legislation*	
	Million tons	Percent	Million tons	Percent
Paper	53.3	32.6	53.3	33.6
Glass, total	15.2	9.3	12.6	7.9
non beverage containers	(7.1)	(4.3)	(7.1)	(4.4)
beverage containers	(6.7)	(4.1)	(4.1)	(2.6)
other	(1.4)	(0.9)	(1.4)	(0.9)
Ferrous metal	11.6	7.1	9.95	6.3
non beverage containers	(3.9)	(2.4)	(3.9)	(2.5)
beverage containers	(1.8)	(1.1)	(0.15)	(0.1)
other	(0.1)	(0.1)	(0.1)	(0.1)
misc ferrous	(5.8)	(3.5)	(5.8)	(3.6)
Nonferrous metals, total	1.8	1.1	1.45	0.9
aluminum pkg (non can)	(0.6)	(0.4)	(0.6)	(0.4)
non bev. alum cans	(0.1)	(0.1)	(0.1)	(0.1)
alum bev. cans	(0.4)	(0.2)	(0.05)	(0.0)
other aluminum	(0.2)	(0.1)	(0.2)	(0.1)
other nonferrous	(0.5)	(0.3)	(0.5)	(0.3)
Plastics	9.5	5.8	9.5	6.0
Leather/Rubber	4.6	2.8	4.6	2.9
Textiles	2.6	1.6	2.6	1.6
Wood	6.0	3.7	6.0	3.8
Total	104.6	64.0	100.0	63.0
Food	25.2	15.4	25.2	15.9
Yard	30.8	18.9	30.8	19.4
Misc. Inorg.	2.7	1.7	2.7	1.7
Grand Total	163.3	100.0	158.7	100.0
Combustible	132.0	80.8	132.0	83.2
Inorganics	31.3	19.2	26.7	16.8

* Illustrative scenario 1.

Source: Franklin Associates, Ltd. for Research Triangle Institute based upon "Baseline Forecasts of Resource Recovery, 1972 to 1990," EPA, 1975; Appendix H; Research Triangle Institute, Beverage Container Demand Forecasts.

Table I. 2. Calculation of beverage container waste generation for the year 1982 (Based on RTI forecasts of demand for beverage containers by material and size and FAL container weights)

Type container	No. discarded	Weight/1,000 containers (tons)	Total weight discarded (tons)	Rounded to 1,000 tons
Baseline Case: Without Federal Legislation				
Refillable glass (beer) 12 oz avg.	728 x 10^6	0.2875	209,300	209
Refillable glass (soft drink) 16 oz avg.	2568 x 10^6	0.4875	1,251,900	1252
NR glass (beer) 12 oz avg.	8244 x 10^6	0.1750	1,442,700	1443
NR glass (soft drink) 32 oz avg.	7422 x 10^6	0.535	3,970,770	3971
Total glass			6,874,670	6875
Steel cans (beer and soft drink) 12 oz	42,045 x 10^6	0.046	1,934,070	1934
Aluminum cans (beer and soft drink) 12 oz	30,477 x 10^6	0.0185	563,825	564
Grand total			9,372,565	9373
After Federal Legislation*				
Refillable glass (beer) 12 oz avg.	2896 x 10^6	0.2875	832,600	833
Refillable glass (soft drink) 32 oz+	4022 x 10^6	0.805	3,237,710	3238
Total glass			4,070,310	4071
Steel cans (beer and soft drink) 12 oz	2916 x 10^6	0.046	134,136	134
Aluminum cans (beer and soft drink) 12 oz	2207 x 10^6	0.0185	40,830	41
Grand total			4,245,276	4246

* Return rate = 0.90. Therefore discard rate = 0.10 (10%).
\+ Assumes that refillables will become a combination of 16-ounce, 32-ounce, and 64-ounce with a 32-ounce average.

Source: Franklin Associates, Ltd. for Research Triangle Institute.

Table I.3. Revenue potential of glass, ferrous and aluminum in solid waste, 1982*

Material	Percent	Recovery Effic.	Recoverable Share %	Market Value fob ($/ton)	Value $/ton of input	Beverage % of Total
Without Legislation						
Glass, total	9.3	0.65	6.05	18	1.09	
Beverage	(4.1)		(2.67)		(0.48)	44.0
Ferrous, total	7.1	0.85	6.04	35	2.11	
Beverage	(1.1)		(0.94)		(0.33)	15.6
Nonferrous-aluminum	0.9	0.65	0.59	300	1.76	
Beverage-aluminum	(0.2)	___	(0.13)	___	(0.39)	22.2
Total	17.3	-	-	-	4.96	
Beverage	(5.4)	-	-	-	1.20	24.2
After Legislation (illustrative scenario 1)						
Glass, total	7.9	0.65	5.14	18	0.92	
Beverage	(2.6)		(1.69)		(0.30)	32.6
Ferrous, total	6.3	0.85	5.36	35	1.87	
Beverage	(0.1)		(0.09)		(0.03)	1.6
Nonferrous-aluminum	0.6	0.65	0.39	300	1.17	
Beverage-aluminum	(0.0)	___	(0.0)	___	(0.00)	0.0
Total	14.8	-	-	-	3.96	-
Beverage	(2.7)				(0.33)	8.3
Potential Revenue Loss, total +					1.00	

* Percent and dollar values related to total waste input.

\+ "Without Legislation" case less "After Legislation" case.

Source: Franklin Associates, Ltd. for Research Triangle Institute.

the cans will be returned for deposit and recycled without going through the municipal solid waste system.

The maximum impact the deposit legislation could have would be to reduce the revenue potential of solid wastes by $1.20 per input ton, which would assume that all beverage containers disappear from the municipal waste stream (net waste discards). However, since both glass bottles and metal cans would still be discarded after legislation (at a rate of 10 percent) there is still some potential value in solid waste from beverage containers. Thus, the revenue potential of glass, ferrous metal and aluminum combined drops from $4.96 per input ton to $3.96 per input ton or $1.00 per input ton (table I.3). This is a decline of 20.2 percent for these three materials combined.

Further impact type comparisons are made for beverage containers in tables I.4 to I.6 which follow.

Table I.4. Beverage containers as a percent of materials by weight before and after legislation

Material	Without Legislation - %	With Legislation - %	Difference
Glass	44.0	32.6	11.4
Ferrous	15.6	1.6	14.0
Aluminum	22.2	0.0	22.2
Total	24.2	8.3	15.9

Source: Franklin Associates, Ltd. for Research Triangle Institute

Table I.5. Recovery revenue comparisons after beverage container legislation

	Nonferrous and glass subsystems operate after legislation	Nonferrous and glass subsystems are not installed or operated after legislation
Revenue "loss" $/input ton	$1.00	$3.09
% of "before" legislation revenue from glass, steel, aluminum	20.2%	62.3%

Source: Franklin Associates, Ltd. for Research Triangle Institute.

Table I.6. Percent reduction in materials available after legislation takes place (illustrative scenario)

Material	Percent of total material	Percent of containers
Glass	17.1	19.9
Ferrous	14.2	30.5
Aluminum	26.9	85.7
Total	16.3	52.1

Source: Franklin Associates, Ltd. for Research Triangle Institute

I.2.4 Capital Costs of a Resource Recovery Facility

In order to build a large resource recovery facility a substantial commitment of capital is involved. The summary of capital costs for a 1,000 TPD RDF and materials recovery plant is given in table I.7. This data was based on updating cost estimates prepared in another study.*

The results of this updating are that a RDF/materials recovery plant would likely cost $17.2 million in 1976 or $17,200 per daily ton of capacity. This estimated cost was then compared to the cost of the only two "commercial" RDF plants that are configured similar to the one in table I.7 on which "hard" data has been released.

The Ames, Iowa plant at 250 TPD cost $22,250 per daily ton; the Americology-City of Milwaukee plant has a cost of $15,000 per daily ton of capacity at 1,200 TPD. These are both on a 1975 costs basis. Therefore the cost estimate given in table I.8 was judged to be reasonable for the size, configuration, and base year (1976).

*Franklin, William E., et al, "Alternative Strategies and Plans for Effective Solid Waste Management and Resource Recovery in the Twin Cities Metropolitan Area," Final Report and Appendices, Metropolitan Council of the Twin Cities Area, 1975. See especially pages 87-102 and F-6 to F-7.

Table I.7. Summary of capital requirements of a 1,000 TPD RDF and materials recovery facility (processing 300,000 TPY)

	Cost - $
Amortized Investment	
Engineering, R&D (12 percent x FPI)	1,700,000
Plant startup (2 months DOE)	460,000
Total	2,160,000
Fixed Plant Investment	
Receiving and outloading facilities	1,800,000
Materials handling and storage	1,920,000
Processing plant	6,000,000
Controls, instrumentation and electrical	240,000
Miscellaneous equipment	960,000
Ferrous metal recovery	840,000
Aluminum and glass recovery	2,400,000
Total	14,160,000
Recoverable Investment	
Land (7.5 acres at $50,000)	375,000
Working capital (3 months DOE)	460,000
Total	835,000
TOTAL CAPITAL REQUIREMENT	17,155,000*

* $17,155/daily ton of capacity.

Source: Franklin Associates, Ltd. for Research Triangle Institute.

Table I.8. Resource recovery facility waste composition, recovery potential, and revenue potential (based upon 1,000 TPD facility; 300,000 TPY waste throughput)

Waste component	Without Federal Legislation					With Federal Legislation[7/]					
	Quantity tons	Recoverable quantity	Value $/ton	Value $ (1000)	Value $/ input ton	Quantity tons	Recoverable quantity	Value $/ton	Value $ (1000)	Value $/ input ton	Diff.
Combustible waste	242,400	230,300[1/]	4 to 8[6/]	921 to 1,842	3.07 to 6.14	242,400	230,300[1/]	4 to 8[6/]	921 to 1,842	3.16 to 6.32	0.09 to 0.14
Ferrous metal	21,300	18,100[2/]	35	633.5	2.11	18,300	15,550[2/]	35	544.4	1.87	(0.24)
Nonferrous metals											
aluminum	2,400	1,560[3/]	300	468	1.56	1,750	1,140[3/]	300	342	1.17	(0.39)
other nonferrous	900	90[4/]	250	22.5	0.08	900	90[4/]	250	22.5	0.08	0.00
Glass	27,900	18,100[5/]	18	326	1.09	23,150	15,050[5/]	18	270.9	0.93	(0.16)
Other	5,100	0	0	0	0	5,100	0	0	0	0	-
Totals	300,000	268,150	-	2,371 to 3,292	7.90 to 10.97	291,600	262,130	-	2,100.8 to 3,021.8	7.20 to 10.36	0.70[8/] to (0.61)

1/ At 0.95 recovery effeciency and 5000 Btu/lb of combustible waste (10×10^6 Btu/ton)
2/ At 0.85 recovery effieiency.
3/ At 0.65 recovery efficiency.
4/ At 0.10 recovery efficiency.
5/ At 0.65 recovery efficiency.
6/ Value is based upon $0.50/million Btu gross energy content to $1.00/million Btu less 20% for transportation and handling cost to and at the power plant facility. It is assumed that all combustible material is processed for energy content; however, there is an ash content and moisture content to this quantity. In addition the Btu content is calculated on a gross basis with no deduction for process energy requirements.
7/ Assuming "loss" of beverage container tonnage is not absorbed by other waste, to bring total quantity to 300,000 tons.
8/ Revenue loss from glass, aluminum and steel is $1.00/ton assuming all materials recovery subsystems operate after legislation.

Source: Franklin Associates, Ltd. for Research Triangle Institute

I.2.5 Recovery Values of a Resource Recovery Facility

The revenue potential for a commercial size resource recovery facility processing 1,000 TPD (300,000 TPY) of solid waste is summarized in table I.8 for the "Without" and "With" legislation cases. Considering the entire system, the revenue potential is $7.90 per input ton to $10.97 per input ton; after legislation the revenue potential drops to $7.20 per input ton to $10.36 per input ton. However, because the total quantity of waste goes down while the percentage of combustible waste goes up, the per ton value of combustible waste goes up $0.09 for the after legislation case. By contrast the revenue decline is 11.4 percent for ferrous metals, 33.1 percent for aluminum, and 14.7 percent for a glass (based on $ per input ton of revenue).

On an overall basis the dollar revenue "loss" is 11.4 percent to 8.2 percent depending on the value of the RDF. Since there are still significant quantities of ferrous metals, aluminum, and glass in the waste stream, it was assumed that these recovery subsystems would continue to operate at reduced rates after legislation takes effect. (It is possible that the aluminum and glass recovery may not be economic after legislation. However, the comparative basis was restricted to the case where recovery takes place both before and after legislation).

The total impact of the legislation is summarized in the section that follows.

I.3 Comparative Analysis of Resource Recovery System Operation Without and With Deposit Legislation

In order to determine the impact of the illustrative scenario 1 case (Deposit Legislation) on resource recovery, an estimate was made of gross operating costs, revenues and net operating costs of resource recovery systems. The baseline case is developed in table I.9.

The baseline system (outlined in section I.2) has a gross operating cost of $15.40 per input ton of waste; an income of $7.90 per ton of waste; and a net operating cost of $7.50 per input ton of waste. What this summary shows is that the system configured as described would be economical to operate where alternative disposal costs were $7.50/ton or above. If the RDF was worth $0.80 per million Btu the system could be operated where the costs of disposal were above $4.43 per ton. (Average landfill costs are expected to be in the range of $6 to $8 per ton by the early 1980's, especially for new landfill sites).

The illustrative scenario 1 system (also outlined in section I.2) is summarized in table I.10. This system has a gross operating cost of $15.42 per input ton of waste; an income of $7.20 per input ton; and a net operating cost of $8.22 per input ton. This summary is based on several assumptions: (a) that reduced capital investment would not be likely because built-in subsystem redundancy, seasonal variations of incoming waste, and "average" capacities of recovery subsystems would be the determining parameters of investment requirements, and not the decline in average incoming materials to each subsystem, (b) that direct operating costs could be reduced by about 5.0 percent while the quantity of recoverable materials (tons) would decline by 2.8 percent of total waste or 16.3 percent of the net discard of glass, steel and aluminum combined, (c) that all other factors would remain the same except the total amount of waste processed and the net recovery of glass, ferrous metal and aluminum.

Table I.9. Summary of annual cost of operation, revenues, and net operating costs of a 1,000 TPD (300,000 TPY) resource recovery facility
(Recovering RDF, ferrous metal, nonferrous metal, and glass)

Category or Classification	Cost - $*	Cost - $/input ton
Operating Cost:		
Direct operating cost		
Direct labor	969,000	3.23
Payroll loadings @ 30%	291,000	0.97
Other direct cost-supplies, utilities, etc.	580,000	1.93
Total DOE	1,840,000	6.13
Fixed plant overhead		
Overhead labor	60,000	0.20
Payroll loadings @ 30%	18,000	0.06
Capital related costs at 0.01 of total capital investment	172,000	0.57
Other fixed expense @ 0.05 of DOE	92,000	0.31
Total fixed plant expense	342,000	1.14
Residue disposal (32,000 tons)	240,000	0.80
Capital charges		
Amortized investment at 24.4 percent	527,000	1.76
Fixed plant investment at 11.4 percent	1,615,000	5.38
Recoverable investment at 7.0 percent	58,000	0.19
Total capital costs	2,200,000	7.33
TOTAL GROSS OPERATING COST	4,622,000	15.40
Revenues from Product Sales		
Combustible waste - 230,300 tons @ $4.00/ton ($0.40/million Btu)	921,200	3.07
Ferrous metals: 18,100 tons @ $35/ton fob plant	633,500	2.11
Aluminum: 1,560 tons @ $300/ton	468,000	1.56
Other nonferrous metals: 90 tons @ $250/ton	22,500	0.08
Glass: 18,100 tons @ $18/ton	325,800	1.09
Total revenue+	2,371,000	7.90
NET OPERATING COST+	2,251,000	7.50

* At 300,000 TPY waste throughput.

+ If the combustible waste were valued at $0.80/million Btu, the revenue for RDF would increase to $1,842,000; the total revenue would increase to $3,292,000 ($10.97/ton); net operating cost would decline to $1,330,000 or $4.43 per input ton.

Source: Franklin Associates, Ltd. for Research Triangle Institute

Table I.10. Summary of annual cost of operation, revenues, and net operating costs of a 1,000 TPD (291,600 TPY) resource recovery facility - illustrative scenario 1 case (Recovering RDF, ferrous metal, nonferrous metal, and glass)

Category or Classification	Cost - $*	Cost - $/input ton
Operating Cost:		
Direct operating cost	1,748,000+	6.00
Fixed plant expense	342,000	1.17
Residue disposal (21,000 tons)	206,500	0.71
Capital charges	2,200,000	7.54
Total gross operating cost	4,496,500	15.42
Revenues from Product Sales		
Combustible wastes	921,200	3.16
Ferrous metals	544,300	1.87
Aluminum	342,000	1.17
Other nonferrous metals	22,500	0.08
Glass	270,900	0.93
Total revenue‡	2,100,900	7.20
NET OPERATING COST‡	2,395,600	8.22

* At 291,600 TPY waste throughput (after legislation).

\+ Estimated direct cost savings of 5.0 percent as a result of operating materials subsystems fewer total hours per year.

‡ If the combustible waste were valued at $0.80/million Btu the revenue for RDF would be $1,842,200; the total revenues would be $3,021,900 ($10.36 per input ton); and net operating cost would be $1,474,600 or $5.06 per input ton.

Source: Franklin Associates, Ltd. for Resource Triangle Institute.

Finally, the economic impact of beverage container legislation is summarized in table I.11. This table shows that beverage container decline results in a loss of revenue of $0.70 per input ton; essentially the same operating cost; and thus a rise of net operating costs of $0.72 per ton. This change is 9.6 percent up on a $ per ton basis and 6.4 percent on a dollar basis. (Because reliable data could not be developed on a subsystem basis the comparative values of materials before and after legislation must be used. For the three principal beverage container materials the decline in revenue would be $1.00 per ton (table I.3) or 20.2 percent on a composite basis--which varies from 11.4 percent for ferrous metal to 33.5 percent for aluminum.

Some aluminum and glass subsystems perhaps could not be operated economically with such declines in revenue potential. In this case they would be shut down (for existing systems) or not built in new systems. At any rate the net result, while not calculated, could result in a revenue decline of $3.09 per input ton and a decline in operating costs of something less than $3.09 thus total system net operating costs would rise. However, this "extreme case" situation has essentially the same outcome as the example worked out in detail above.

Table I.11. Economic impact of beverage container deposit legistion on resource recovery systems

Category	Baseline Trend Case $	Baseline Trend Case $/ton	Illustrative Scenario 1 $	Illustrative Scenario 1 $/ton	Net Impacts $	Net Impacts $/ton
Revenues	2,371,000	7.90	2,100,900	7.20	270,100	0.70*
Operating costs	4,622,000	15.40	4,496,500	15.42	150,000	0.02
Net operating costs	2,251,000	7.50	2,395,600	8.22	144,600	0.72

Source: Franklin Associates, Ltd. for Research Triangle Institute
*Based on 300,000 TPY input the difference is $0.90/input ton.

I.4 Conclusions

The following conclusions may be drawn from this analysis:

(1) The "disappearance" of beverage containers from the waste stream would result in about a 19 percent decline in the value of metals and glass recoverable from waste or in the order of $0.90 per ton of total waste input. This would translate to about 11 percent of the gross operating revenues of a resource recovery system.

(2) From the viewpoint of the resource recovery system owner/operator there is a negative economic impact. However, the effect of the disappearance of beverage containers is to raise the net operating costs of resource recovery systems. It is unlikely that the decision to install a resource recovery system would be altered except in marginal economic circumstances. Aluminum and glass subsystems could become uneconomic to justify, in which case the negative income impact would be about three times greater.

(3) The controlling parameters of resource recovery are related to markets, waste quantity and composition, waste recovery potential, economics, and recovery technology. The presence or absence of beverage container materials would be important in some decisions and not in others. Local alternative conventional disposal costs are more likely to be the controlling economic parameter.

(4) Resource recovery should not be treated inadvertently as a suboptimization process. If certain components of waste are necessary to "enrich" the recovery potential of that waste, this in itself is not justification to produce that waste component. Resource recovery must be able to stand on the basis that local source separation may take place and that the waste stream will not be intentionally "enriched" to justify the operation of a resource recovery system. In other words, resource recovery systems are not the basis on which national policy should determine

whether certain waste components will or will not be generated.

(5) Although beverage containers make up a low percentage of waste and a much higher percentage of value in the waste stream, the focus of attention should be directed to the overall economics of the waste processing system, as determined by the individual components.

Appendix J: IMPACTS OF PLASTICS ON BASELINE ENERGY PROJECTIONS

J.1 Introduction

Although glass and metal containers currently dominate the beverage-packaging market, in the future plastic containers are expected to become an important factor. Currently, Coca Cola is using large-sized (32-ounce) plastic bottles in Providence, Rhode Island. The Society of the Plastics Industry, Inc. (SPI), predicts plastics will obtain 10 percent of the nonrefillable container market by 1985 (see their letter in appendix M). At the present time, plastic bottles do not hold their shape well enough over multiple fillings to be able to be refilled. However, SPI and industry representatives report that such a container is currently under development.

Below, the effects are presented of replacing, first, nonrefillables and, second, cans with plastic containers on the baseline projections of energy consumption. These effects are presented for both beer and soft drinks, but because most beer is pasturized in the container, the greatest potential for plastic containers appears to be the soft drink market. However, some beer, notably Coors, is not pasturized and, therefore, could utilize plastic containers without significant changes in the beer-production process.

J.2 Sensitivity Analysis

The sensitivity of the energy projections to changes in plastics market shares has been estimated by calculating, first, the results of substituting plastic containers for nonrefillable bottles and, second, the results of also substituting plastic containers for metal cans in the production of soft drinks and beer. Table J-1 presents the energy requirements for each of the container types.

The impacts of increasing the market share of plastics in containers for soft drinks and beer are calculated in table J-2 and are graphically represented in figure J-1. If only the nonrefillable bottles were replaced by plastic containers (23.0 percent of soft drinks and 15.0 percent of beer), a 4-percent reduction in required energy would be realized in the soft drink industry and a 1-percent reduction in the beer industry. Likewise, if metal cans were also replaced by plastic containers (49.5 percent of soft drinks and 71.2 percent of beer), an additional reduction of 2 percent for soft

drinks and 9 percent for beer would be realized. The total effect of these substitutions would be a 6-percent energy reduction for soft drinks, 10 percent for beer, and an overall total of 8 percent for both beverages combined.

Table J-1. Energy requirements per package for glass bottles, metal cans and plastics

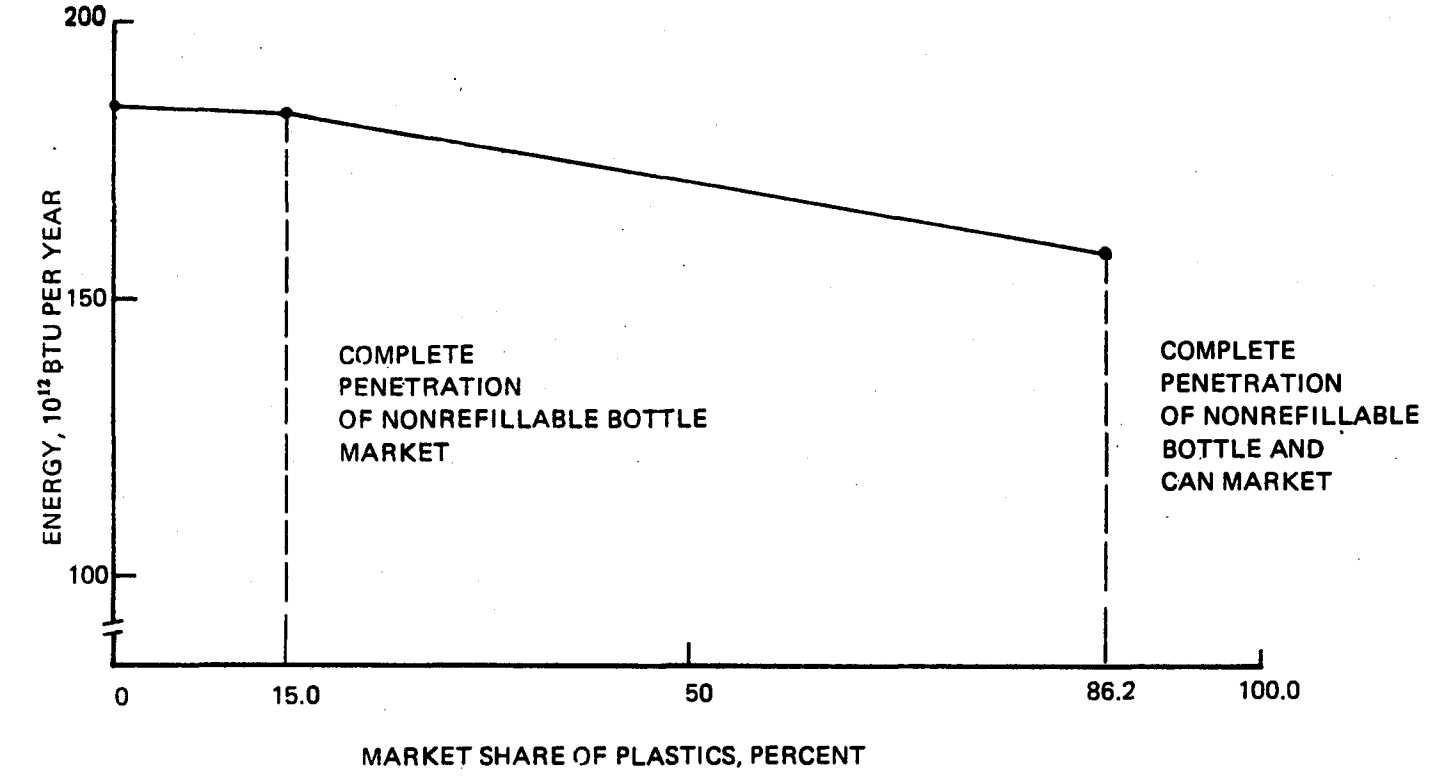
Package type	Market share, percent	Energy required, 10^{12} Btu per year, 1982 rates	Total packaging, 10^{6} ounces per year	Energy per package, Btu per ounce
Soft drinks				
Nonrefillable bottles	23.0	58	186,234	311.44
Metal cans	49.5	112	401,147	279.20
Plastics	--	--	--	270.86
Beer				
Nonrefillable bottles	15.0	29	98,937	290.19
Metal cans	71.2	144	469,130	306.95
Plastics	--	--	--	270.86

Source: Research Triangle Institute.

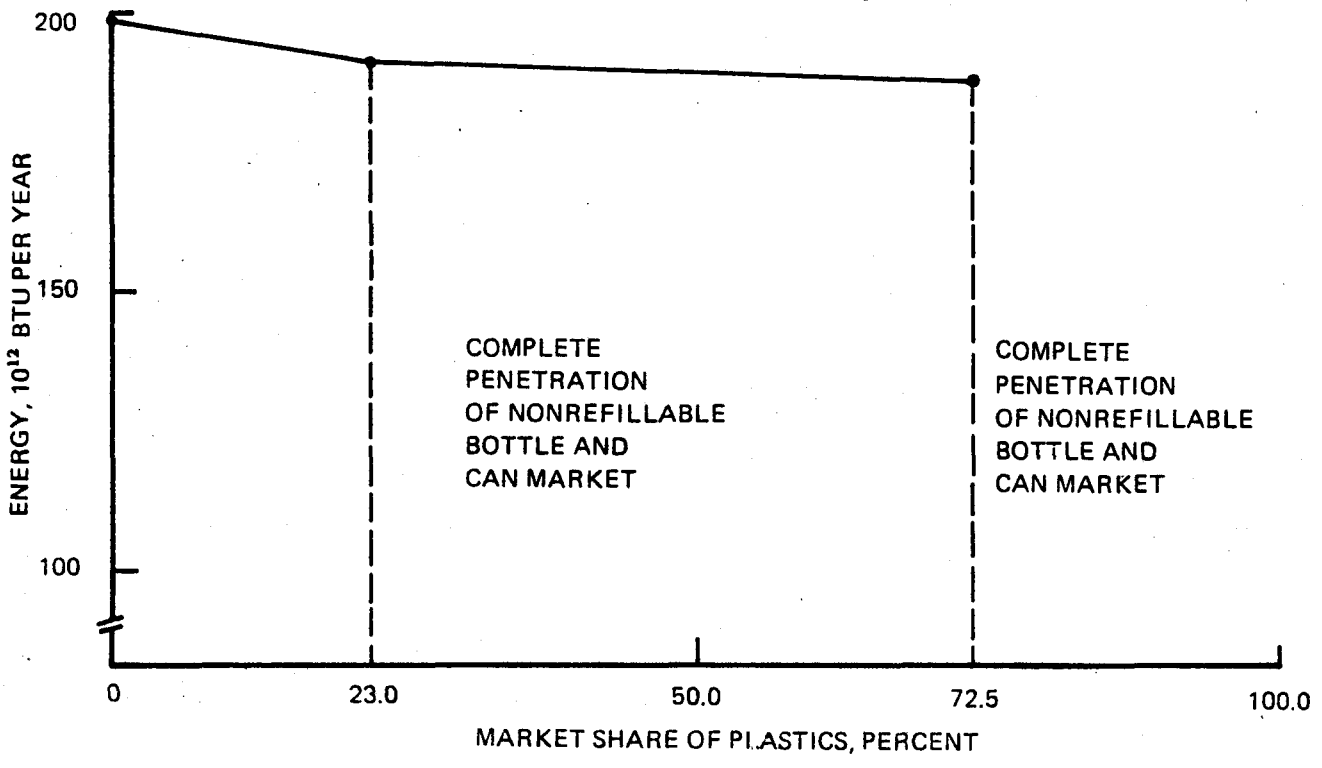
Table J-2. Impacts of plastics on baseline energy projections, 1982

Market share of plastics, percent	Total energy required, 10^{12} Btu per year, 1982 rates	Energy reduction, percent
Soft drinks		
0.0	198	--
23.0	190	4
72.5	187	2
Beer		
0.0	185	--
15.0	183	1
86.2	166	9

Source: Research Triangle Institute.



a) beer



b) soft drinks

Figure J-1. Impacts of plastics on baseline energy projections, 1982.

Appendix K: PUBLIC OPINION SURVEY

As part of this study and also as part of an on-going public opinion survey periodically conducted for FEA, three sets of questions related to beverage container legislation were asked a national sample by the Opinion Research Corporation. These questions were asked on January 26, 1975, February 9, 1975 and March 9, 1975. The results of these surveys are included with this appendix.

From Survey of January 26, 1975

QUESTION B34L ENERGY CO-OP WAVE 22 INT. ENDED JAN 26 197

HAVE YOU RECYCLED ANY BOTTLES OR CANS IN THE PAST THREE MONTHS

	PERCENTAGE BASE	YES	NO	CON'T KNOW
TOTAL PUBLIC	603	25	74	1
MEN	301	29	71	0
WOMEN	302	22	77	1
AGE 18-29	149	34	65	1
30-49	232	28	72	0
50 OR OVER	218	16	83	1
LESS THAN HIGH SCHOOL COMPLETE	154	19	81	*
HIGH SCHOOL COMPLETE	207	30	69	1
SOME COLLEGE	236	28	72	0
FAMILY INCOME UNDER $10,000	215	18	81	1
$10,000 TO $15,000	164	24	75	1
OVER $15,000	163	36	64	0
WHITE	540	27	72	1
NONWHITE	57	13	87	0
ENVIRONMENTALLY ACTIVE	108	37	62	1
CITY	191	22	78	0
SUBURB	189	29	71	*
SMALL TOWN	115	22	76	2
RURAL AREA	101	30	70	0
EAST	143	19	80	1
MIDWEST	179	24	75	1
SOUTH	175	23	77	*
WEST	106	40	60	0
NONCAR HOUSEHOLDS	50	13	85	2
ONE CAR	224	21	79	*
TWO OR MORE CARS	329	32	68	*
SINGLE FAMILY HOUSE	440	28	72	*
OTHER DWELLING	162	19	80	1
ENERGY SHORTAGE VERY SERIOUS	253	24	75	1
SOMEWHAT SERIOUS	252	29	71	*
NOT SERIOUS AT ALL	76	24	76	0
LOW ENERGY USER	225	18	82	*
MODERATE ENERGY USER	286	26	73	1
HIGH ENERGY USER	92	47	53	0

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PRINCETON, NEW JERSEY

From February 9, 1975

UESTION K74A ENERGY CO-OP WAVE 22 & 23 INT. ENDED FEB 9 1975

OULD YOU FAVOR OR OPPOSE A LAW REQUIRING ALL SOFT DRINKS AND BEER TO BE SOLD IN RETURNABLE BOTTLES ND CANS

	PERCENTAGE BASE	FAVOR	OPPOSE	DON'T KNOW
OTAL PUBLIC	1211	73	15	12
EN	602	78	13	9
OMEN	609	69	17	14
GE 18-29	336	85	10	5
0-49	452	72	19	9
0 OR OVER	419	65	15	20
ESS THAN HIGH SCHOOL COMPLETE	285	68	16	16
IGH SCHOOL COMPLETE	397	73	17	10
OME COLLEGE	518	81	11	8
AMILY INCOME UNDER $10,000	407	70	15	15
10,000 TO $15,000	305	77	14	9
VER $15,000	394	78	15	7
HITE	1074	74	15	11
ONWHITE	126	69	17	14
EMOCRAT	239	69	19	12
EPUBLICAN	103	60	26	14
NVIRONMENTALLY ACTIVE	224	80	10	10
ITY	403	72	14	14
UBURB	369	78	14	8
MALL TOWN	239	69	17	14
URAL AREA	192	72	16	12
AST	284	74	15	11
IDWEST	350	69	19	12
OUTH	365	71	16	13
EST	212	83	8	9
ONCAR HOUSEHOLDS	93	65	17	18
NE CAR	444	74	16	10
WO OR MORE CARS	674	75	14	11
INGLE FAMILY HOUSE	875	72	16	12
THER DWELLING	335	77	13	10
NERGY SHORTAGE VERY SERIOUS	436	74	13	13
OMEWHAT SERIOUS	562	73	16	11
OT SERIOUS AT ALL	171	75	19	6
OW ENERGY USER	442	72	14	14
ODERATE ENERGY USER	563	75	16	9
IGH ENERGY USER	206	75	16	9

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Opinion Research Corporation
PRINCETON, NEW JERSEY

THE GENERAL PUBLIC OVERWHELMINGLY FAVORS A LAW REQUIRING ALL SOFT DRINKS AND BEER TO BE SOLD IN RETURNABLE BOTTLES AND CANS.

Favor Returnable Bottles and Cans

"Would you favor or oppose a law requiring all soft drinks and beer to be sold in returnable bottles and cans?" (Q. K74a)

	Total Public
Favor	73%
Oppose	15
Don't know	12

HOW MANY CENTS DEPOSIT SHOULD BE CHARGED TO ENCOURAGE YOU TO RETURN BOTTLES AND ALUMINUM CANS INSTEAD OF THROWING THEM AWAY

1. UNDER 5 CENTS
2. 5 CENTS
3. OVER 5 CENTS
4. NOT REPORTED

	PERCENTAGE BASE	1.	2.	3.	4.
TOTAL PUBLIC	1211	19	37	16	28
MEN	602	19	36	22	23
WOMEN	609	19	38	10	33
AGE 18-29	336	23	40	20	17
30-49	452	16	40	19	25
50 OR OVER	419	19	32	10	39
LESS THAN HIGH SCHOOL COMPLETE	285	18	30	13	39
HIGH SCHOOL COMPLETE	397	20	43	15	22
SOME COLLEGE	518	19	40	20	21
FAMILY INCOME UNDER $10,000	407	20	36	12	32
$10,000 TO $15,000	305	20	38	19	23
OVER $15,000	394	17	42	20	21
WHITE	1074	19	38	16	27
NONWHITE	126	18	34	14	34
DEMOCRAT	239	25	34	15	26
REPUBLICAN	103	17	45	16	22
ENVIRONMENTALLY ACTIVE	224	15	43	23	19
CITY	403	19	34	15	32
SUBURB	369	18	43	15	24
SMALL TOWN	239	23	36	13	28
RURAL AREA	192	16	36	22	26
EAST	284	29	36	11	24
MIDWEST	350	16	38	17	29
SOUTH	365	14	41	16	29
WEST	212	20	32	19	29
NONCAR HOUSEHOLDS	93	17	28	7	48
ONE CAR	444	20	37	14	29
TWO OR MORE CARS	674	18	40	19	23
SINGLE FAMILY HOUSE	875	18	38	16	28
OTHER DWELLING	335	22	37	14	27
ENERGY SHORTAGE VERY SERIOUS	436	16	36	15	33
SOMEWHAT SERIOUS	562	22	41	16	21
NOT SERIOUS AT ALL	171	18	34	20	28
LOW ENERGY USER	442	20	35	11	34
MODERATE ENERGY USER	563	19	39	17	25
HIGH ENERGY USER	206	16	39	25	20

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PRINCETON, NEW JERSEY

OF THOSE PEOPLE EXPRESSING AN OPINION ABOUT THE AMOUNT OF DEPOSIT NECESSARY TO ENCOURAGE THEM TO RETURN BOTTLES AND CANS, THE MAJORITY CITE 5 CENTS.

Over one-third of the general public claims that if the deposit on a bottle or can was 5 cents that they would be encouraged to return the bottle or can rather than discard it.

Nineteen percent of the people say that less than 5 cents would be sufficient incentive for them to return a bottle or can, while 16% indicate that for them to be encouraged to return bottles and cans, more than 5 cents would be necessary.

It is important to note that a sizable number of people (28%) are undecided about the amount of deposit required to get them to return bottles and cans.

Amount of Deposit Necessary
To Encourage Return of Bottles and Cans

"How many cents deposit should be charged to encourage you to return bottles and aluminum cans instead of throwing them away?" (Q. K74b)

	Total Public
Under 5 cents	19%
5 cents	37
Over 5 cents	16
Don't know	28

From Survey of March 9, 1975

QUESTION 834L ENERGY CO-OP WAVE 25 INT. ENDED
HAVE YOU RECYCLED ANY BOTTLES OR CANS IN THE PAST THREE MONTHS MARCH 9 197

	PERCENTAGE BASE	YES	NO	DON'T KNOW
TOTAL PUBLIC	605	28	72	*
MEN	295	30	69	1
WOMEN	310	26	74	0
AGE 18-29	194	34	65	1
30-49	223	25	75	0
50 OR OVER	186	26	74	*
LESS THAN HIGH SCHOOL COMPLETE	117	18	82	0
HIGH SCHOOL COMPLETE	219	28	72	0
SOME COLLEGE	266	41	58	1
FAMILY INCOME UNDER $10,000	225	22	78	0
$10,000 TO $15,000	132	28	72	0
OVER $15,000	202	41	58	1
WHITE	545	30	70	*
NONWHITE	56	13	87	0
DEMOCRAT	240	28	72	0
REPUBLICAN	106	28	72	0
ENVIRONMENTALLY ACTIVE	92	56	43	1
CITY	230	27	73	*
SUBURB	149	35	65	0
SMALL TOWN	123	29	70	1
RURAL AREA	100	22	78	0
EAST	145	22	78	*
MIDWEST	174	30	70	*
SOUTH	193	19	81	*
WEST	93	46	54	0
NONCAR HOUSEHOLDS	51	21	77	2
ONE CAR	222	21	79	*
TWO OR MORE CARS	331	35	65	0
SINGLE FAMILY HOUSE	446	29	71	0
OTHER DWELLING	157	26	74	*
ENERGY SHORTAGE VERY SERIOUS	212	32	68	0
SOMEWHAT SERIOUS	282	28	72	*
NOT SERIOUS AT ALL	93	22	78	0
LOW ENERGY USER	217	19	80	1
MODERATE ENERGY USER	278	34	66	0
HIGH ENERGY USER	110	39	61	0

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PRINCETON, NEW JERSEY

QUESTION K151 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

ARE THE SOFT DRINKS YOU PREFER AVAILABLE IN THE FOLLOWING CONTAINERS WHERE YOU SHOP

1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. DON'T BUY SOFT DRINKS
5. NOT REPORTED

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	905	67	70	72	11	*
MEN	447	64	65	69	15	*
WOMEN	458	69	74	75	8	0
18-29 YEARS OF AGE	287	77	74	80	5	0
30-49	317	66	77	77	10	0
50 OR OVER	274	60	61	61	16	*
LESS THAN HIGH SCHOOL COMPLETE	150	67	68	70	11	0
HIGH SCHOOL COMPLETE	344	68	71	73	11	0
SOME COLLEGE	397	66	70	75	12	*
FAMILY INCOME UNDER $10,000	279	64	68	69	12	0
$10,000-$15,000	215	73	74	76	9	0
OVER $15,000	312	68	72	75	10	*
LOST THEIR JOB/BEEN LAID OFF	154	70	73	76	9	0
WORKING HOURS SHORTENED	48	71	74	78	3	0
LOST OVERTIME WORK	39	58	85	80	4	0
NONE OF THESE	668	66	67	69	13	*
WHITE	796	67	69	73	12	*
NONWHITE	96	68	79	68	4	0
DEMOCRAT	323	68	71	73	9	0
REPUBLICAN	146	72	60	71	12	0
ENVIRONMENTALLY ACTIVE	130	58	59	69	20	0
CITY	317	68	71	70	13	*
SUBURB	262	66	79	76	7	0
SMALL TOWN	173	62	59	71	14	0
RURAL AREA	135	71	64	69	10	0
EAST	224	40	78	67	16	0
MIDWEST	264	77	68	73	11	*
SOUTH	270	80	75	72	8	0
WEST	147	63	55	77	10	0
TAKE BUSINESS TRIPS	187	66	68	72	11	*
TAKE WEEKEND TRIPS	569	67	73	77	8	0
TOOK MAJOR 1974 VACATION TRIP	484	68	72	75	9	0

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K152 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

DO YOU USUALLY PURCHASE SOFT DRINKS IN RETURNABLE BOTTLES, NONRETURNABLE BOTTLES, OR CANS (ASKED ONLY OF THOSE WHO PURCHASE SOFT DRINKS)

A. PER CENT ASKED THIS QUESTION
1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.
TOTAL PUBLIC	905	89	44	25	26	1
MEN	447	85	42	23	27	2
WOMEN	458	92	46	27	25	1
18-29 YEARS OF AGE	287	95	49	25	28	1
30-49	317	90	42	28	28	3
50 OR OVER	274	83	43	24	22	1
LESS THAN HIGH SCHOOL COMPLETE	150	89	47	25	23	2
HIGH SCHOOL COMPLETE	344	89	42	26	29	1
SOME COLLEGE	397	88	43	25	26	1
FAMILY INCOME UNDER $10,000	279	88	44	26	26	2
$10,000-$15,000	215	91	44	24	28	1
OVER $15,000	312	90	46	26	25	*
LOST THEIR JOB/BEEN LAID OFF	154	91	47	26	24	4
WORKING HOURS SHORTENED	48	97	53	35	28	0
LOST OVERTIME WORK	39	96	25	47	27	0
NONE OF THESE	668	87	45	23	25	1
WHITE	796	88	44	24	25	1
NONWHITE	96	96	45	34	31	1
DEMOCRAT	323	91	48	27	25	1
REPUBLICAN	146	88	49	17	27	1
ENVIRONMENTALLY ACTIVE	130	80	38	22	24	1
CITY	317	86	45	27	25	1
SUBURB	262	93	40	33	25	2
SMALL TOWN	173	86	40	18	32	0
RURAL AREA	135	90	54	20	23	4
EAST	224	84	20	49	22	1
MIDWEST	264	89	55	15	25	1
SOUTH	270	92	57	22	20	1
WEST	147	90	39	16	43	3
TAKE BUSINESS TRIPS	187	89	49	21	25	1
TAKE WEEKEND TRIPS	569	92	44	26	29	1
TOOK MAJOR 1974 VACATION TRIP	484	91	42	28	27	1

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PRINCETON, NEW JERSEY

QUESTION K153 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY BOTTLES DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE SOFT DRINKS IN RETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	44	20	13	4	4	1	*	1	1
MEN	447	42	17	12	6	5	*	0	*	1
WOMEN	458	46	22	14	3	3	1	*	1	1
18-29 YEARS OF AGE	287	49	17	17	5	8	1	0	0	1
30-49	317	42	13	14	7	4	1	*	1	2
50 OR OVER	274	43	29	10	2	*	*	0	1	1
LESS THAN HIGH SCHOOL COMPLETE	150	47	21	13	5	4	1	0	2	2
HIGH SCHOOL COMPLETE	344	42	17	13	5	5	1	*	0	1
SOME COLLEGE	397	43	21	15	3	3	1	0	*	1
FAMILY INCOME UNDER $10,000	279	44	22	12	4	3	1	0	1	1
$10,000-$15,000	215	44	17	13	6	5	1	0	1	1
OVER $15,000	312	46	18	16	4	5	*	*	1	2
LOST THEIR JOB/BEEN LAID OFF	154	47	17	13	7	7	1	0	0	1
WORKING HOURS SHORTENED	48	53	15	22	13	4	0	0	0	0
LOST OVERTIME WORK	39	25	4	12	2	3	2	0	0	0
NONE OF THESE	668	45	21	13	4	3	1	*	1	1
WHITE	796	44	19	14	5	3	1	*	1	1
NONWHITE	96	45	26	10	1	6	2	0	0	0
DEMOCRAT	323	48	21	13	5	5	1	*	0	2
REPUBLICAN	146	49	30	16	1	2	0	0	0	1
ENVIRONMENTALLY ACTIVE	130	38	17	13	2	3	0	0	*	1
CITY	317	45	23	11	4	4	1	0	1	*
SUBURB	262	40	18	14	3	3	*	*	0	2
SMALL TOWN	173	40	15	15	4	3	1	0	2	0
RURAL AREA	135	54	21	16	7	5	1	0	0	3
EAST	224	20	12	5	0	2	*	0	0	*
MIDWEST	264	55	21	14	8	8	1	0	0	2
SOUTH	270	57	23	20	6	2	1	*	2	2
WEST	147	39	23	12	3	1	0	0	*	1
TAKE BUSINESS TRIPS	187	49	18	17	6	1	1	0	2	2
TAKE WEEKEND TRIPS	569	44	16	15	4	5	1	*	1	1
TOOK MAJOR 1974 VACATION TRIP	484	42	17	14	2	5	1	*	*	2

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K154 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

ABOUT HOW MANY OF THESE BOTTLES DO YOU USUALLY RETURN (ASKED ONLY OF THOSE WHO PURCHASE SOFT DRINKS IN RETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. ALL
2. THREE-FOURTHS
3. ONE-HALF
4. ONE-QUARTER
5. NONE
6. OTHER
7. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.
TOTAL PUBLIC	905	44	41	1	*	0	1	*	1
MEN	447	42	37	1	*	0	2	0	1
WOMEN	458	46	45	*	0	0	*	*	1
18-29 YEARS OF AGE	287	49	44	2	*	0	2	0	1
30-49	317	42	40	1	0	0	0	*	1
50 OR OVER	274	43	41	*	*	0	1	0	1
LESS THAN HIGH SCHOOL COMPLETE	150	47	46	0	0	0	1	0	*
HIGH SCHOOL COMPLETE	344	42	39	1	*	0	1	0	1
SOME COLLEGE	397	43	38	1	*	0	2	*	2
FAMILY INCOME UNDER $10,000	279	44	42	1	0	0	1	0	*
$10,000-$15,000	215	44	43	1	0	0	0	0	1
OVER $15,000	312	46	41	1	0	0	2	0	2
LOST THEIR JOB/BEEN LAID OFF	154	47	45	1	*	0	1	0	0
WORKING HOURS SHORTENED	48	53	47	4	0	0	2	0	0
LOST OVERTIME WORK	39	25	25	0	0	0	0	0	0
NONE OF THESE	668	45	41	*	*	0	1	*	2
WHITE	796	44	41	1	*	0	1	*	1
NONWHITE	96	45	40	2	0	0	2	0	1
DEMOCRAT	323	48	45	1	0	0	1	*	1
REPUBLICAN	146	49	46	1	0	0	1	0	2
ENVIRONMENTALLY ACTIVE	130	38	34	1	0	0	1	0	3
CITY	317	45	41	1	0	0	1	0	1
SUBURB	262	40	37	1	0	0	1	*	1
SMALL TOWN	173	40	38	*	*	0	1	0	1
RURAL AREA	135	54	50	1	0	0	*	0	2
EAST	224	20	18	0	0	0	1	0	1
MIDWEST	264	55	51	1	*	0	1	0	2
SOUTH	270	57	54	1	*	0	1	*	*
WEST	147	39	36	1	0	0	*	0	2
TAKE BUSINESS TRIPS	187	49	45	2	0	0	1	0	1
TAKE WEEKEND TRIPS	569	44	41	1	*	0	*	*	1
TOOK MAJOR 1974 VACATION TRIP	484	42	38	1	*	0	1	*	2

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K155 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY BOTTLES DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE SOFT DRINKS IN NONRETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	25	15	6	1	1	*	0	0	1
MEN	447	23	13	5	2	2	*	0	0	1
WOMEN	458	27	17	7	*	1	0	0	0	2
18-29 YEARS OF AGE	287	25	18	3	*	2	*	0	0	1
30-49	317	28	14	9	2	2	0	0	0	1
50 OR OVER	274	24	14	6	1	*	0	0	0	1
LESS THAN HIGH SCHOOL COMPLETE	150	25	14	7	*	1	*	0	0	2
HIGH SCHOOL COMPLETE	344	26	18	5	1	2	0	0	0	1
SOME COLLEGE	397	25	13	7	2	1	0	0	0	1
FAMILY INCOME UNDER $10,000	279	26	17	5	1	1	0	0	0	1
$10,000-$15,000	215	24	16	5	1	1	0	0	0	1
OVER $15,000	312	26	13	8	2	2	0	0	0	1
LOST THEIR JOB/BEEN LAID OFF	154	26	15	5	1	2	0	0	0	3
WORKING HOURS SHORTENED	48	35	22	6	2	4	0	0	0	0
LOST OVERTIME WORK	39	47	24	15	3	2	0	0	0	3
NONE OF THESE	668	23	15	6	1	1	*	0	0	1
WHITE	796	24	15	7	1	1	*	0	0	1
NONWHITE	96	34	22	3	3	2	0	0	0	4
DEMOCRAT	323	27	17	6	2	1	*	0	0	2
REPUBLICAN	146	17	10	4	0	1	0	0	0	2
ENVIRONMENTALLY ACTIVE	130	22	13	4	2	2	0	0	0	1
CITY	317	27	18	6	1	1	0	0	0	*
SUBURB	262	33	19	9	1	1	*	0	0	3
SMALL TOWN	173	18	9	4	1	2	0	0	0	1
RURAL AREA	135	20	13	5	1	1	0	0	0	*
EAST	224	49	31	14	2	1	0	0	0	1
MIDWEST	264	15	8	5	*	1	0	0	0	1
SOUTH	270	22	12	4	2	2	*	0	0	*
WEST	147	16	12	1	0	0	0	0	0	3
TAKE BUSINESS TRIPS	187	21	10	7	1	2	0	0	0	2
TAKE WEEKEND TRIPS	569	26	15	7	1	2	*	0	0	1
TOOK MAJOR 1974 VACATION TRIP	484	28	15	9	1	2	0	0	0	1

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K156 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY CANS DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE SOFT DRINKS IN CANS)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	26	10	10	2	2	*	*	0	1
MEN	447	27	10	10	2	3	*	*	0	1
WOMEN	458	25	11	10	3	1	*	0	0	1
18-29 YEARS OF AGE	287	28	11	12	1	1	0	1	0	2
30-49	317	28	7	13	4	4	*	0	0	1
50 OR OVER	274	22	13	6	2	1	*	0	0	*
LESS THAN HIGH SCHOOL COMPLETE	150	23	11	8	2	1	0	0	0	1
HIGH SCHOOL COMPLETE	344	29	10	11	3	3	*	1	0	1
SOME COLLEGE	397	26	10	11	1	3	0	0	0	1
FAMILY INCOME UNDER $10,000	279	26	12	8	3	2	0	*	0	1
$10,000-$15,000	215	28	11	13	3	*	0	0	0	0
OVER $15,000	312	25	8	10	1	4	1	0	0	2
LOST THEIR JOB/BEEN LAID OFF	154	24	8	10	3	1	*	0	0	2
WORKING HOURS SHORTENED	48	28	12	5	4	5	0	0	0	2
LOST OVERTIME WORK	39	27	8	18	0	1	0	0	0	0
NONE OF THESE	668	25	10	10	2	3	*	*	0	1
WHITE	796	25	10	9	2	2	*	0	0	1
NONWHITE	96	31	13	12	2	1	0	2	0	*
DEMOCRAT	323	25	10	10	1	2	*	1	0	1
REPUBLICAN	146	27	14	8	5	1	0	0	0	0
ENVIRONMENTALLY ACTIVE	130	24	6	11	6	2	0	0	0	0
CITY	317	25	11	9	1	3	*	0	0	*
SUBURB	262	25	11	10	1	1	*	0	0	1
SMALL TOWN	173	32	9	12	6	3	0	0	0	2
RURAL AREA	135	23	11	7	2	1	0	1	0	1
EAST	224	22	6	11	1	2	*	0	0	*
MIDWEST	264	25	8	11	2	2	*	0	0	2
SOUTH	270	20	8	8	1	2	0	1	0	1
WEST	147	43	23	9	6	3	0	0	0	2
TAKE BUSINESS TRIPS	187	25	10	11	1	1	0	0	0	2
TAKE WEEKEND TRIPS	569	29	10	11	2	3	*	*	0	1
TOOK MAJOR 1974 VACATION TRIP	484	27	9	11	3	3	*	0	0	1

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K157 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHAT TYPE OF BEVERAGE CONTAINER DO YOU PREFER FOR SOFT DRINKS RETURNABLE BOTTLES, NONRETURNABLE BOTTLES, OR CANS

1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. NO PREFERENCE
5. DON'T BUY SOFT DRINKS
6. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.	6.
TOTAL PUBLIC	905	45	19	19	6	11	1
MEN	447	40	16	22	8	15	1
WOMEN	458	49	22	17	4	8	0
18-29 YEARS OF AGE	287	49	19	24	4	5	*
30-49	317	44	22	20	6	10	*
50 OR OVER	274	43	18	14	8	16	1
LESS THAN HIGH SCHOOL COMPLETE	150	48	18	16	7	11	1
HIGH SCHOOL COMPLETE	344	42	21	21	6	11	*
SOME COLLEGE	397	45	18	20	4	12	1
FAMILY INCOME UNDER $10,000	279	46	20	18	6	12	0
$10,000-$15,000	215	44	20	20	7	9	2
OVER $15,000	312	45	19	21	6	10	*
LOST THEIR JOB/BEEN LAID OFF	154	45	18	17	11	9	2
WORKING HOURS SHORTENED	48	58	17	8	14	3	0
LOST OVERTIME WORK	39	29	37	34	1	4	0
NONE OF THESE	668	45	19	19	4	13	*
WHITE	796	44	20	19	6	12	1
NONWHITE	96	51	19	23	4	4	0
DEMOCRAT	323	47	21	19	5	9	*
REPUBLICAN	146	47	16	20	4	12	2
ENVIRONMENTALLY ACTIVE	130	46	15	15	4	20	0
CITY	317	42	25	16	4	13	1
SUBURB	262	44	22	18	7	7	1
SMALL TOWN	173	45	14	27	1	14	0
RURAL AREA	135	49	11	16	14	10	0
EAST	224	26	37	14	7	16	*
MIDWEST	264	52	10	20	6	11	*
SOUTH	270	54	21	15	4	8	*
WEST	147	43	9	29	8	10	1
TAKE BUSINESS TRIPS	187	48	16	21	5	11	*
TAKE WEEKEND TRIPS	569	45	20	21	5	8	1
TOOK MAJOR 1974 VACATION TRIP	484	46	22	21	3	9	*

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K158A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHY DO YOU SAY THAT (YOU PREFER RETURNABLE BOTTLES FOR SOFT DRINKS)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. FOR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	402	10	26	16	19	20	2	*	0	1	1	13	6
MEN	188	13	24	19	20	13	3	1	0	2	2	15	4
WOMEN	214	7	28	13	18	24	1	0	0	1	0	12	8
18-29 YEARS OF AGE	148	11	24	24	22	19	1	0	0	3	1	6	6
30-49	135	10	29	9	23	14	1	2	0	1	*	17	7
50 OR OVER	111	7	25	15	12	26	4	0	0	0	1	16	6
LESS THAN HIGH SCHOOL COMPLETE	71	6	17	20	14	26	2	1	0	0	0	16	7
HIGH SCHOOL COMPLETE	145	5	28	16	22	16	1	1	0	2	2	9	9
SOME COLLEGE	181	22	35	10	22	16	2	0	0	1	*	14	1
FAMILY INCOME UNDER $10,000	129	5	21	20	15	30	2	0	0	1	1	12	5
$10,000-$15,000	95	13	32	9	19	8	1	1	0	2	*	17	7
OVER $15,000	142	16	31	15	24	11	2	1	0	1	0	11	[illegible]
LOST THEIR JOB/BEEN LAID OFF	74	8	25	15	22	25	0	1	0	2	0	12	[illegible]
WORKING HOURS SHORTENED	26	19	21	14	11	16	0	0	0	0	0	18	9
LOST OVERTIME WORK	11	33	12	27	4	0	0	0	0	0	0	4	20
NONE OF THESE	295	9	27	16	19	19	3	*	0	1	*	14	6
WHITE	354	11	29	11	20	21	1	1	0	1	1	13	6
NONWHITE	43	0	6	47	13	13	11	0	0	0	1	12	5
DEMOCRAT	142	5	20	21	21	17	1	0	0	2	0	19	6
REPUBLICAN	77	12	37	11	17	16	1	1	0	0	1	15	6
ENVIRONMENTALLY ACTIVE	65	30	32	6	20	15	2	0	0	2	0	9	0
CITY	124	5	23	26	21	14	4	1	0	1	0	11	6
SUBURB	120	11	35	7	19	21	0	0	0	0	*	15	6
SMALL TOWN	84	12	20	15	18	29	1	0	0	0	0	15	6
RURAL AREA	66	12	27	10	19	18	1	0	0	4	3	13	8
EAST	58	10	39	24	12	5	4	0	0	0	0	19	*
MIDWEST	144	15	28	17	18	11	1	0	0	1	0	9	10
SOUTH	137	6	18	15	24	30	2	1	0	2	2	15	5
WEST	63	9	28	9	14	26	1	0	0	1	*	12	7
TAKE BUSINESS TRIPS	96	22	34	13	26	13	1	0	0	1	0	13	2
TAKE WEEKEND TRIPS	256	11	31	13	19	19	1	*	0	1	1	11	6
TOOK MAJOR 1974 VACATION TRIP	216	12	26	14	22	21	1	1	0	1	1	13	6

0065

QUESTION K1588 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHY DO YOU SAY THAT (YOU PREFER NONRETURNABLE BOTTLES FOR SOFT DRINKS)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. FOR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	171	0	0	*	7	10	1	38	24	5	*	21	2
MEN	71	0	0	0	3	13	0	49	15	1	1	19	4
WOMEN	100	0	0	*	9	8	2	31	30	7	0	22	1
18-29 YEARS OF AGE	52	0	0	1	5	11	0	44	24	7	1	17	4
30-49	70	0	0	0	7	12	3	29	23	6	0	29	1
50 OR OVER	47	0	0	0	8	7	1	41	26	1	0	17	3
LESS THAN HIGH SCHOOL COMPLETE	27	0	0	0	0	7	4	39	28	0	0	21	3
HIGH SCHOOL COMPLETE	68	0	0	0	12	8	0	35	24	5	0	23	2
SOME COLLEGE	75	0	0	1	7	17	0	42	16	11	1	20	2
FAMILY INCOME UNDER $10,000	52	0	0	0	9	9	1	43	21	4	1	18	2
$10,000-$15,000	41	0	0	0	0	9	5	35	23	9	0	21	2
OVER $15,000	69	0	0	0	9	14	0	32	30	3	0	26	2
LOST THEIR JOB/BEEN LAID OFF	27	0	0	0	12	20	9	32	22	2	0	16	0
WORKING HOURS SHORTENED	9	0	0	0	0	8	0	42	12	0	0	28	10
LOST OVERTIME WORK	12	0	0	0	0	28	0	26	47	0	0	28	0
NONE OF THESE	123	0	0	*	7	6	0	40	23	6	*	23	3
WHITE	150	0	0	0	6	10	2	38	24	5	*	22	1
NONWHITE	20	0	0	0	11	9	0	38	22	0	0	13	11
DEMOCRAT	72	0	0	*	6	9	3	33	21	5	1	26	4
REPUBLICAN	24	0	0	0	2	6	0	70	13	6	0	6	0
ENVIRONMENTALLY ACTIVE	17	0	0	0	13	9	0	74	8	2	0	7	0
CITY	75	0	0	0	4	4	0	50	18	7	1	21	2
SUBURB	61	0	0	1	14	13	5	28	23	5	0	20	2
SMALL TOWN	21	0	0	0	0	19	0	22	27	0	0	39	6
RURAL AREA	14	0	0	0	9	16	0	38	49	0	0	2	0
EAST	74	0	0	0	10	15	3	35	18	8	0	23	2
MIDWEST	32	0	0	0	12	5	0	29	33	2	2	26	2
SOUTH	51	0	0	*	3	7	0	46	24	1	0	18	3
WEST	14	0	0	0	0	3	0	36	40	5	0	16	4
TAKE BUSINESS TRIPS	26	0	0	0	9	8	0	40	29	4	0	15	0
TAKE WEEKEND TRIPS	115	0	0	0	9	12	0	35	25	6	1	23	1
TOOK MAJOR 1974 VACATION TRIP	101	0	0	0	9	8	0	42	17	6	1	26	2

0066

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K150C ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHY DO YOU SAY THAT (YOU PREFER CANS FOR SOFT DRINKS)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. FOR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	179	*	7	1	2	3	0	43	4	17	11	30	3
MEN	95	*	10	1	2	4	0	31	4	20	9	33	4
WOMEN	84	0	4	0	2	1	0	57	3	13	15	25	1
18-29 YEARS OF AGE	62	0	11	0	2	5	0	34	5	15	10	28	6
30-49	67	1	7	2	3	3	0	34	2	17	21	33	2
50 OR OVER	43	0	1	0	0	0	0	61	4	20	2	31	0
LESS THAN HIGH SCHOOL COMPLETE	24	0	6	3	0	3	0	53	1	20	0	27	0
HIGH SCHOOL COMPLETE	77	0	8	0	4	2	0	41	5	13	16	27	4
SOME COLLEGE	76	1	7	0	1	3	0	38	4	20	16	34	4
FAMILY INCOME UNDER $10,000	53	0	6	0	2	4	0	46	*	17	12	25	4
$10,000-$15,000	47	1	9	0	1	0	0	39	5	17	18	36	0
OVER $15,000	60	0	7	2	2	2	0	41	7	16	6	31	3
LOST THEIR JOB/BEEN LAID OFF	30	0	10	0	10	0	0	52	5	11	16	11	3
WORKING HOURS SHORTENED	5	0	0	0	0	0	0	62	0	0	12	40	0
LOST OVERTIME WORK	14	0	9	0	0	0	0	60	0	0	24	26	0
NONE OF THESE	128	*	6	1	*	4	0	36	4	21	10	35	3
WHITE	150	*	8	1	2	3	0	44	4	17	12	26	3
NONWHITE	27	0	3	0	0	0	0	39	0	10	11	53	0
DEMOCRAT	68	0	5	0	2	1	0	50	5	17	10	28	1
REPUBLICAN	22	0	15	0	0	0	0	55	3	6	3	34	5
ENVIRONMENTALLY ACTIVE	18	0	0	0	0	0	0	69	0	13	8	53	3
CITY	60	1	2	0	3	3	0	39	6	12	8	37	6
SUBURB	40	0	13	0	*	1	0	57	1	4	9	27	4
SMALL TOWN	45	0	5	0	3	5	0	35	4	27	11	29	0
RURAL AREA	28	0	10	0	0	0	0	41	2	26	21	22	0
EAST	35	0	18	0	0	6	0	18	0	11	21	44	6
MIDWEST	46	0	0	0	2	0	0	61	0	14	10	21	4
SOUTH	53	1	5	3	1	7	0	42	10	19	13	26	1
WEST	45	0	8	0	3	0	0	43	4	21	6	32	1
TAKE BUSINESS TRIPS	36	0	19	0	1	0	0	32	1	16	15	36	0
TAKE WEEKEND TRIPS	122	*	9	0	3	1	0	38	5	16	12	37	3
TOOK MAJOR 1974 VACATION TRIP	100	*	7	1	1	3	0	44	5	16	14	35	3

C067

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K159 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

IS THE BEER YOU PREFER AVAILABLE IN THE FOLLOWING CONTAINERS WHERE YOU SHOP

1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. DON'T BUY BEER
5. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	905	22	36	48	45	*
MEN	447	24	43	56	38	0
WOMEN	458	20	31	40	52	*
18-29 YEARS OF AGE	287	26	44	58	36	*
30-49	317	24	41	53	38	0
50 OR OVER	274	17	27	36	58	0
LESS THAN HIGH SCHOOL COMPLETE	150	16	29	42	54	0
HIGH SCHOOL COMPLETE	344	26	39	49	42	0
SOME COLLEGE	397	25	42	53	39	*
FAMILY INCOME UNDER $10,000	279	18	34	44	49	*
$10,000-$15,000	215	24	36	44	49	0
OVER $15,000	312	29	43	59	33	0
LOST THEIR JOB/BEEN LAID OFF	154	23	40	50	45	0
WORKING HOURS SHORTENED	48	24	40	47	39	0
LOST OVERTIME WORK	39	20	47	54	37	0
NONE OF THESE	668	21	35	47	46	*
WHITE	796	24	37	49	44	*
NONWHITE	96	6	29	36	52	0
DEMOCRAT	323	21	36	46	47	*
REPUBLICAN	146	22	32	51	42	0
ENVIRONMENTALLY ACTIVE	130	26	39	56	38	0
CITY	317	21	41	49	44	*
SUBURB	262	28	39	56	37	0
SMALL TOWN	173	18	29	39	54	0
RURAL AREA	135	21	32	42	51	0
EAST	224	22	51	56	32	0
MIDWEST	264	31	37	49	46	0
SOUTH	270	16	31	42	53	*
WEST	147	19	27	45	47	0
TAKE BUSINESS TRIPS	187	22	41	56	38	0
TAKE WEEKEND TRIPS	569	26	43	55	36	*
TOOK MAJOR 1974 VACATION TRIP	404	24	41	53	38	0

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K160 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

DO YOU USUALLY PURCHASE BEER IN RETURNABLE BOTTLES, NONRETURNABLE BOTTLES, OR CANS (ASKED ONLY OF THOSE WHO PURCHASE BEER)

A. PER CENT ASKED THIS QUESTION
1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.
TOTAL PUBLIC	905	55	7	17	32	1
MEN	447	62	8	18	37	1
WOMEN	458	48	7	16	29	*
18-29 YEARS OF AGE	287	64	8	18	40	1
30-49	317	62	7	20	38	*
50 OR OVER	274	42	7	14	22	1
LESS THAN HIGH SCHOOL COMPLETE	150	46	3	16	29	0
HIGH SCHOOL COMPLETE	344	58	10	18	32	1
SOME COLLEGE	397	60	8	17	37	1
FAMILY INCOME UNDER $10,000	279	51	5	19	29	1
$10,000-$15,000	215	51	7	14	32	*
OVER $15,000	312	67	12	17	41	1
LOST THEIR JOB/BEEN LAID OFF	154	55	4	22	32	1
WORKING HOURS SHORTENED	48	61	9	21	36	2
LOST OVERTIME WORK	39	63	2	25	40	0
NONE OF THESE	668	53	8	15	32	*
WHITE	796	55	8	17	33	1
NONWHITE	96	48	1	16	32	0
DEMOCRAT	323	53	8	17	31	*
REPUBLICAN	146	58	7	10	43	0
ENVIRONMENTALLY ACTIVE	130	62	13	14	34	1
CITY	317	56	6	21	33	*
SUBURB	262	63	9	17	36	*
SMALL TOWN	173	46	6	13	27	*
RURAL AREA	135	49	8	13	31	1
EAST	224	68	8	34	29	*
MIDWEST	264	54	10	10	34	1
SOUTH	270	46	3	15	30	1
WEST	147	53	8	8	38	*
TAKE BUSINESS TRIPS	187	62	10	16	39	1
TAKE WEEKEND TRIPS	569	64	8	21	36	1
TOOK MAJOR 1974 VACATION TRIP	484	62	7	21	36	1

C069

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K161 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY BOTTLES DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE BEER IN RETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	7	4	1	*	1	*	0	*	*
MEN	447	8	4	2	*	*	*	0	*	*
WOMEN	458	7	4	1	0	1	*	0	*	1
18-29 YEARS OF AGE	287	8	3	2	*	1	*	0	0	1
30-49	317	7	4	2	0	1	*	0	*	0
50 OR OVER	274	7	5	1	*	*	*	0	*	0
LESS THAN HIGH SCHOOL COMPLETE	150	3	2	*	0	0	*	0	0	0
HIGH SCHOOL COMPLETE	344	10	6	2	*	1	*	0	*	*
SOME COLLEGE	397	8	4	2	*	1	0	0	0	1
FAMILY INCOME UNDER $10,000	279	5	3	1	*	*	0	0	*	*
$10,000-$15,000	215	7	4	*	*	1	1	0	1	0
OVER $15,000	312	12	6	4	0	1	*	0	0	1
LOST THEIR JOB/BEEN LAID OFF	154	4	2	1	0	*	*	0	0	1
WORKING HOURS SHORTENED	48	9	7	1	0	1	0	0	0	0
LOST OVERTIME WORK	39	2	0	1	0	1	0	0	0	0
NONE OF THESE	668	8	4	2	*	1	*	0	*	*
WHITE	796	8	5	2	*	1	*	0	*	*
NONWHITE	96	1	1	0	0	0	0	0	0	0
DEMOCRAT	323	8	3	2	*	*	1	0	*	*
REPUBLICAN	146	7	4	2	0	1	0	0	0	0
ENVIRONMENTALLY ACTIVE	130	13	7	4	0	0	1	0	0	2
CITY	317	6	2	2	*	*	0	0	0	1
SUBURB	262	9	4	2	*	1	1	0	*	1
SMALL TOWN	173	6	5	*	0	0	1	0	0	0
RURAL AREA	135	8	7	1	0	0	0	0	1	0
EAST	224	8	5	1	*	*	1	0	*	0
MIDWEST	264	10	4	3	*	2	*	0	0	1
SOUTH	270	3	2	1	0	0	*	0	0	0
WEST	147	8	6	2	0	0	0	0	*	0
TAKE BUSINESS TRIPS	187	10	4	3	0	1	0	0	1	1
TAKE WEEKEND TRIPS	569	8	4	2	*	1	*	0	*	0
TOOK MAJOR 1974 VACATION TRIP	484	7	4	2	*	1	*	0	*	*

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K162 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

ABOUT HOW MANY OF THESE BOTTLES DO YOU USUALLY RETURN (ASKED ONLY OF THOSE WHO PURCHASE BEER IN RETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. ALL
2. THREE-FOURTHS
3. ONE-HALF
4. ONE-QUARTER
5. NONE
6. OTHER
7. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.
TOTAL PUBLIC	905	7	6	*	0	0	*	0	1
MEN	447	8	6	*	0	0	*	0	1
WOMEN	458	7	5	0	0	0	0	0	1
18-29 YEARS OF AGE	287	8	7	*	0	0	0	0	1
30-49	317	7	6	*	0	0	0	0	1
50 OR OVER	274	7	5	0	0	0	*	0	1
LESS THAN HIGH SCHOOL COMPLETE	150	3	3	0	0	0	0	0	*
HIGH SCHOOL COMPLETE	344	10	9	*	0	0	*	0	1
SOME COLLEGE	397	8	6	*	0	0	0	0	1
FAMILY INCOME UNDER $10,000	279	5	4	*	0	0	0	0	1
$10,000-$15,000	215	7	7	0	0	0	0	0	0
OVER $15,000	312	12	10	*	0	0	*	0	2
LOST THEIR JOB/BEEN LAID OFF	154	4	3	0	0	0	*	0	1
WORKING HOURS SHORTENED	48	9	9	0	0	0	0	0	0
LOST OVERTIME WORK	39	2	1	0	0	0	0	0	1
NONE OF THESE	668	8	7	*	0	0	0	0	1
WHITE	796	8	7	*	0	0	*	0	1
NONWHITE	96	1	1	0	0	0	0	0	0
DEMOCRAT	323	8	6	*	0	0	*	0	1
REPUBLICAN	146	7	7	0	0	0	0	0	0
ENVIRONMENTALLY ACTIVE	130	13	10	1	0	0	1	0	2
CITY	317	6	5	0	0	0	0	0	1
SUBURB	262	9	7	*	0	0	*	0	1
SMALL TOWN	173	6	5	1	0	0	0	0	*
RURAL AREA	135	8	6	0	0	0	0	0	2
EAST	224	8	8	0	0	0	0	0	0
MIDWEST	264	10	7	*	0	0	0	0	3
SOUTH	270	3	3	0	0	0	*	0	*
WEST	147	8	6	1	0	0	0	0	1
TAKE BUSINESS TRIPS	187	10	8	0	0	0	0	0	2
TAKE WEEKEND TRIPS	569	8	7	*	0	0	*	0	*
TOOK MAJOR 1974 VACATION TRIP	484	7	6	*	0	0	0	0	1

0071

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K163 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY BOTTLES DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE BEER IN NONRETURNABLE BOTTLES)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	17	8	5	*	2	1	0	*	1
MEN	447	18	8	6	*	2	1	0	0	2
WOMEN	458	16	8	4	*	2	1	0	*	0
18-29 YEARS OF AGE	287	18	9	5	0	2	1	0	0	1
30-49	317	20	11	3	1	4	1	0	*	0
50 OR OVER	274	14	5	6	*	1	0	0	1	2
LESS THAN HIGH SCHOOL COMPLETE	150	16	8	5	1	2	1	0	0	0
HIGH SCHOOL COMPLETE	344	18	8	4	0	3	1	0	*	2
SOME COLLEGE	397	17	8	5	*	2	*	0	*	1
FAMILY INCOME UNDER $10,000	279	19	9	5	*	3	*	0	*	1
$10,000-$15,000	215	14	7	4	1	1	2	0	0	*
OVER $15,000	312	17	8	5	*	2	1	0	0	*
LOST THEIR JOB/BEEN LAID OFF	154	22	14	3	1	2	2	0	0	*
WORKING HOURS SHORTENED	48	21	16	2	0	3	0	0	0	0
LOST OVERTIME WORK	39	25	12	3	0	11	0	0	0	0
NONE OF THESE	668	15	6	5	*	2	1	0	*	1
WHITE	796	17	8	5	*	2	1	0	*	1
NONWHITE	96	16	7	4	0	4	0	0	0	1
DEMOCRAT	323	17	5	7	0	2	*	0	*	1
REPUBLICAN	146	10	5	2	1	*	1	0	0	1
ENVIRONMENTALLY ACTIVE	130	14	4	3	*	1	1	0	*	4
CITY	317	21	8	5	1	4	1	0	1	2
SUBURB	2[illegible]	17	9	6	0	*	1	0	0	1
SMALL TOWN	173	13	5	5	0	2	1	0	*	*
RURAL AREA	135	13	9	3	1	*	1	0	0	0
EAST	224	34	14	10	*	7	1	0	0	2
MIDWEST	264	10	7	1	0	1	1	0	0	1
SOUTH	270	15	6	5	1	1	*	0	1	*
WEST	147	8	5	1	*	*	1	0	*	0
TAKE BUSINESS TRIPS	187	16	6	5	0	3	1	0	0	1
TAKE WEEKEND TRIPS	569	21	9	6	*	3	1	0	*	*
TOOK MAJOR 1974 VACATION TRIP	484	21	11	5	*	3	1	0	*	*

C072

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K164 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

HOW MANY CANS DOES YOUR FAMILY PURCHASE EACH WEEK (ASKED ONLY OF THOSE WHO PURCHASE BEER IN CANS)

A. PER CENT ASKED THIS QUESTION
1. UNDER 6
2. 6 - 12
3. 13 - 18
4. 19 - 24
5. 25 - 50
6. OVER 50
7. OTHER
8. DON'T KNOW

	PERCENTAGE BASE	A.	1.	2.	3.	4.	5.	6.	7.	8.
TOTAL PUBLIC	905	32	16	10	1	2	1	*	*	2
MEN	447	37	17	12	2	3	1	*	1	1
WOMEN	458	29	16	8	1	2	*	0	*	2
18-29 YEARS OF AGE	287	40	18	14	3	3	*	0	0	2
30-49	317	38	20	10	1	4	1	*	1	1
50 OR OVER	274	22	12	6	1	*	1	0	*	2
LESS THAN HIGH SCHOOL COMPLETE	150	29	14	11	2	1	0	0	1	3
HIGH SCHOOL COMPLETE	344	32	16	9	2	3	1	*	*	1
SOME COLLEGE	397	37	21	9	1	3	1	0	*	1
FAMILY INCOME UNDER $10,000	279	29	13	9	1	2	1	*	0	2
$10,000-$15,000	215	32	17	9	1	3	1	0	1	1
OVER $15,000	312	41	21	12	2	3	1	0	1	1
LOST THEIR JOB/BEEN LAID OFF	154	32	16	11	1	2	*	0	0	0
WORKING HOURS SHORTENED	48	36	22	6	0	6	0	2	0	0
LOST OVERTIME WORK	39	40	20	13	3	3	0	0	0	1
NONE OF THESE	668	32	16	10	1	2	1	0	1	2
WHITE	796	33	17	9	1	2	1	*	1	2
NONWHITE	96	32	10	13	5	2	*	0	0	*
DEMOCRAT	323	31	15	11	1	2	*	*	0	1
REPUBLICAN	146	43	25	9	2	2	1	0	*	4
ENVIRONMENTALLY ACTIVE	130	34	12	14	1	1	*	0	0	6
CITY	317	33	19	8	2	1	1	*	*	1
SUBURB	262	36	15	13	2	3	1	0	1	1
SMALL TOWN	173	27	12	7	*	3	1	0	*	3
RURAL AREA	135	31	15	12	0	2	*	0	0	1
EAST	224	29	20	6	1	2	0	0	1	*
MIDWEST	264	34	15	10	3	3	*	*	1	1
SOUTH	270	30	15	13	*	2	1	0	0	0
WEST	147	38	15	10	1	3	2	0	0	6
TAKE BUSINESS TRIPS	187	39	22	12	*	2	2	0	1	*
TAKE WEEKEND TRIPS	569	36	17	12	1	3	*	*	1	2
TOOK MAJOR 1974 VACATION TRIP	484	36	19	10	1	4	1	*	*	2

0073

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K165 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHAT TYPE OF BEVERAGE CONTAINER DO YOU PREFER FOR BEER RETURNABLE BOTTLES, NONRETURNABLE BOTTLES, OR CANS

1. RETURNABLE BOTTLES
2. NONRETURNABLE BOTTLES
3. CANS
4. NO PREFERENCE
5. DON'T BUY BEER
6. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.	6.
TOTAL PUBLIC	905	12	11	27	5	45	*
MEN	447	15	11	30	6	38	*
WOMEN	458	10	10	24	4	52	1
18-29 YEARS OF AGE	287	17	10	34	2	36	1
30-49	317	11	13	32	5	38	1
50 OR OVER	274	8	9	17	8	58	*
LESS THAN HIGH SCHOOL COMPLETE	150	8	10	24	4	54	0
HIGH SCHOOL COMPLETE	344	13	10	29	6	42	1
SOME COLLEGE	397	16	12	28	5	39	1
FAMILY INCOME UNDER $10,000	279	9	12	25.	6	49.	*
$10,000-$15,000	215	16	4	25	3	49	1
OVER $15,000	312	16	13	33	5	33	0
LOST THEIR JOB/BEEN LAID OFF	154	11	11	29	4	45	0
WORKING HOURS SHORTENED	48	15	16	21	9	39	0
LOST OVERTIME WORK	39	9	21	28	5	37	0
NONE OF THESE	668	12	10	26	5	46	1
WHITE	796	13	10	27	6	44	1
NONWHITE	96	7	13	27	1	52	0
DEMOCRAT	323	10	10	29	4	47	*
REPUBLICAN	146	13	6	33	6	42	*
ENVIRONMENTALLY ACTIVE	130	19	5	31	7	38	*
CITY	317	12	12	29	4	44	1
SUBURB	262	16	11	27	8	37	1
SMALL TOWN	173	8	10	24	4	54	0
RURAL AREA	135	11	7	27	5	51	0
EAST	224	13	23	22	11	32	1
MIDWEST	264	18	5	26	4	46	1
SOUTH	270	5	9	30	3	53	*
WEST	147	14	6	30	4	47	0
TAKE BUSINESS TRIPS	187	18	7	32	5	38	*
TAKE WEEKEND TRIPS	569	14	14	30	6	36	*
TOOK MAJOR 1974 VACATION TRIP	484	13	14	30	6	38	1

0074

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K166A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHY DO YOU SAY THAT (YOU PREFER RETURNABLE BOTTLES FOR BEER)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. FOR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	119	15	33	10	18	12	2	0	0	1	1	14	5
MEN	75	22	23	10	25	12	3	0	0	2	0	15	3
WOMEN	44	7	48	9	10	12	0	0	0	0	1	12	8
18-29 YEARS OF AGE	51	15	38	19	16	12	0	0	0	2	1	6	0
30-49	38	18	28	0	25	9	0	0	0	0	0	15	11
50 OR OVER	29	13	33	5	16	17	6	0	0	3	0	24	8
LESS THAN HIGH SCHOOL COMPLETE	12	8	31	20	18	6	0	0	0	0	0	19	9
HIGH SCHOOL COMPLETE	46	14	25	9	20	20	0	0	0	2	0	15	6
SOME COLLEGE	60	23	43	3	17	7	0	0	0	2	2	11	3
FAMILY INCOME UNDER $10,000	30	7	40	14	16	15	5	0	0	2	2	10	8
$10,000-$15,000	30	21	27	14	17	6	0	0	0	3	0	14	2
OVER $15,000	53	19	33	1	21	13	0	0	0	0	0	19	[illegible]
LOST THEIR JOB/BEEN LAID OFF	21	13	47	1	18	14	0	0	0	0	0	12	0
WORKING HOURS SHORTENED	9	0	52	11	20	12	0	0	0	0	0	5	0
LOST OVERTIME WORK	4	40	0	0	60	0	0	0	0	0	0	0	0
NONE OF THESE	87	16	29	12	18	12	2	0	0	2	1	16	7
WHITE	112	17	34	5	20	13	2	0	0	2	1	15	6
NONWHITE	6	0	30	70	0	4	0	0	0	0	0	0	0
DEMOCRAT	35	14	18	11	27	9	5	0	0	2	0	22	7
REPUBLICAN	22	17	34	14	7	12	0	0	0	0	0	22	5
ENVIRONMENTALLY ACTIVE	27	25	37	5	18	7	0	0	0	0	0	12	5
CITY	40	14	45	12	21	6	4	0	0	0	1	10	0
SUBURB	43	15	28	4	23	13	0	0	0	0	0	22	7
SMALL TOWN	17	14	31	12	3	23	0	0	0	0	0	4	22
RURAL AREA	17	19	21	14	15	14	0	0	0	9	0	16	0
EAST	33	22	43	7	13	5	0	0	0	0	0	14	7
MIDWEST	45	13	33	10	26	17	0	0	0	0	0	11	2
SOUTH	1[illegible]	23	22	24	22	9	0	0	0	0	4	17	0
WEST	24	8	31	2	9	13	7	0	0	6	0	18	13
TAKE BUSINESS TRIPS	33	31	23	9	17	4	0	0	0	6	0	22	0
TAKE WEEKEND TRIPS	86	15	37	11	19	7	0	0	0	1	1	14	3
TOOK MAJOR 1974 VACATION TRIP	63	17	41	5	14	5	0	0	0	0	1	15	11

0375

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION R1668 ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1979

WHY DO YOU SAY THAT (YOU PREFER NONRETURNABLE BOTTLES FOR BEER)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. FOR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	88	0	0	0	2	26	1	28	9	5	1	30	4
MEN	46	0	0	0	1	33	0	26	8	6	2	24	5
WOMEN	42	0	0	0	2	19	1	30	11	4	0	36	4
18-29 YEARS OF AGE	28	0	0	0	0	28	0	23	20	2	0	28	9
30-49	35	0	0	0	4	21	0	32	3	9	0	37	0
50 OR OVER	24	0	0	0	0	31	2	26	9	2	3	24	6
LESS THAN HIGH SCHOOL COMPLETE	17	0	0	0	0	17	2	36	0	2	3	38	6
HIGH SCHOOL COMPLETE	28	0	0	0	2	42	0	19	11	11	0	24	0
SOME COLLEGE	41	0	0	0	2	17	0	33	15	1	0	30	9
FAMILY INCOME UNDER $10,000	30	0	0	0	2	32	1	29	12	0	0	26	4
$10,000-$15,000	13	0	0	0	0	14	0	12	4	16	0	42	12
OVER $15,000	37	0	0	0	2	23	0	32	8	8	0	30	3
LOST THEIR JOB/BEEN LAID OFF	15	0	0	0	5	38	4	29	8	0	0	21	0
WORKING HOURS SHORTENED	4	0	0	0	0	0	0	87	13	0	0	0	0
LOST OVERTIME WORK	5	0	0	0	0	30	0	16	44	29	0	0	11
NONE OF THESE	69	0	0	0	1	25	0	21	7	4	1	40	5
WHITE	77	0	0	0	2	29	1	24	10	6	1	31	3
NONWHITE	11	0	0	0	0	8	0	52	4	0	0	27	12
DEMOCRAT	36	0	0	0	4	33	2	19	7	2	0	35	3
REPUBLICAN	12	0	0	0	0	21	0	40	11	0	10	34	0
ENVIRONMENTALLY ACTIVE	10	0	0	0	16	21	0	20	0	0	0	59	0
CITY	35	0	0	0	0	23	0	34	8	0	0	25	10
SUBURB	26	0	0	0	5	29	3	16	14	10	3	37	0
SMALL TOWN	18	0	0	0	0	35	0	12	11	12	0	36	0
RURAL AREA	9	0	0	0	0	16	0	60	0	0	0	20	4
EAST	41	0	0	0	2	33	1	17	16	9	0	27	3
MIDWEST	16	0	0	0	0	34	0	23	12	0	0	22	9
SOUTH	23	0	0	0	2	14	0	35	0	2	4	43	7
WEST	8	0	0	0	0	8	0	68	0	0	0	24	0
TAKE BUSINESS TRIPS	13	0	0	0	6	12	0	29	9	19	0	29	0
TAKE WEEKEND TRIPS	65	0	0	0	1	26	0	25	10	4	0	31	5
TOOK MAJOR 1974 VACATION TRIP	52	0	0	0	1	19	0	31	5	4	0	39	3

0276

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K166C ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

WHY DO YOU SAY THAT (YOU PREFER CANS FOR BEER)

1. HELP ECOLOGY, ENVIRONMENT/PREVENT POLLUTION
2. RECYCLE/DON'T HAVE TO THROW OUT/REDUCE REFUSE COLLECTION PROBLEM
3. PCR DEPOSIT/GET MONEY BACK
4. CHEAPER/MORE ECONOMICAL
5. BETTER FLAVOR
6. SANITARY/PURE/CLEAN
7. EASY TO DISPOSE OF/CAN BE THROWN OUT
8. DON'T LIKE TO RETURN BOTTLES
9. CONVENIENT TO CARRY/TO STORE
10. LESS BREAKAGE/SAFER
11. OTHER ANSWERS
12. DON'T KNOW

PERCENTAGE

	BASE	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
TOTAL PUBLIC	264	0	7	0	2	7	0	36	2	10	6	31	8
MEN	133	0	11	0	2	9	0	27	1	9	7	40	4
WOMEN	131	0	4	0	1	4	0	46	3	12	3	21	12
18-29 YEARS OF AGE	94	0	7	0	2	10	0	27	2	11	4	39	7
30-49	107	0	12	0	1	5	0	32	2	9	9	29	9
50 OR OVER	58	0	1	0	2	3	0	57	2	11	0	23	8
LESS THAN HIGH SCHOOL COMPLETE	36	0	11	0	2	7	0	51	1	3	4	19	6
HIGH SCHOOL COMPLETE	105	0	6	0	0	10	0	35	3	8	8	33	9
SOME COLLEGE	119	0	7	0	5	2	0	21	2	19	5	43	8
FAMILY INCOME UNDER $10,000	76	0	10	0	1	7	0	43	1	6	3	28	10
$10,000-$15,000	63	0	8	0	2	7	0	26	2	7	5	42	5
OVER $15,000	103	0	5	0	3	7	0	31	3	18	8	30	7
LOST THEIR JOB/BEEN LAID OFF	47	0	19	0	2	7	0	35	0	9	1	32	3
WORKING HOURS SHORTENED	10	0	19	0	0	9	0	36	10	0	10	27	0
LOST OVERTIME WORK	15	0	0	0	5	0	0	40	0	3	0	41	11
NONE OF THESE	190	0	4	0	2	7	0	36	2	11	7	31	10
WHITE	230	0	9	0	2	6	0	36	2	10	6	29	9
NONWHITE	31	0	0	0	2	8	0	35	3	12	4	49	2
DEMOCRAT	103	0	6	0	2	6	0	42	2	3	7	29	11
REPUBLICAN	49	0	5	0	3	6	0	43	2	16	1	30	5
ENVIRONMENTALLY ACTIVE	34	0	12	0	0	3	0	39	2	6	4	37	5
CITY	95	0	6	0	3	8	0	31	2	8	8	28	11
SUBURB	80	0	6	0	1	4	0	44	2	14	3	27	7
SMALL TOWN	46	0	5	0	1	10	0	36	0	7	3	43	6
RURAL AREA	38	0	15	0	0	3	0	34	3	12	7	29	5
EAST	53	0	8	0	2	6	0	26	4	11	13	36	7
MIDWEST	77	0	3	0	2	4	0	34	*	9	7	40	5
SOUTH	90	0	4	0	2	9	0	41	2	13	3	24	10
WEST	44	0	20	0	0	7	0	40	1	6	1	25	9
TAKE BUSINESS TRIPS	61	0	10	0	3	6	0	19	2	17	5	43	5
TAKE WEEKEND TRIPS	183	0	10	0	2	7	0	33	2	12	4	30	8
TOOK MAJOR 1974 VACATION TRIP	154	0	6	0	3	5	0	37	2	13	3	33	6

0077

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K167A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

IF THERE WERE A 5 CENTS DEPOSIT ON ALL SOFT DRINKS SOLD, WOULD YOU

1. PURCHASE LESS SOFT DRINKS
2. BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
3. NOT BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
4. DON'T BUY
5. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	451	5	80	5	8	3
MEN	224	3	79	6	10	3
WOMEN	227	6	81	4	7	3
18-29 YEARS OF AGE	140	5	85	6	3	2
30-49	149	4	82	6	6	3
50 OR OVER	150	5	75	2	13	5
LESS THAN HIGH SCHOOL COMPLETE	82	3	79	7	10	1
HIGH SCHOOL COMPLETE	169	3	84	4	7	3
SOME COLLEGE	193	11	76	3	7	5
FAMILY INCOME UNDER $10,000	139	5	75	6	12	4
$10,000-$15,000	103	3	87	4	3	3
OVER $15,000	157	7	85	3	5	2
LOST THEIR JOB/BEEN LAID OFF	74	6	74	5	14	2
WORKING HOURS SHORTENED	23	8	85	5	2	0
LOST OVERTIME WORK	21	6	86	6	2	0
NONE OF THESE	334	4	81	5	7	4
WHITE	397	5	80	4	9	3
NONWHITE	48	5	82	8	4	4
DEMOCRAT	170	5	81	4	10	2
REPUBLICAN	76	10	76	0	9	6
ENVIRONMENTALLY ACTIVE	68	2	79	2	15	2
CITY	154	6	75	8	10	2
SUBURB	142	7	84	3	2	4
SMALL TOWN	83	2	82	5	10	2
RURAL AREA	66	3	80	*	13	5
EAST	153	6	76	10	7	2
MIDWEST	121	2	80	5	8	5
SOUTH	115	6	86	2	4	3
WEST	62	6	75	2	17	2
TAKE BUSINESS TRIPS	91	3	89	1	2	5
TAKE WEEKEND TRIPS	291	5	81	6	6	3
TOOK MAJOR 1974 VACATION TRIP	244	5	80	4	7	4

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Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K167A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

IF THERE WERE A 10 CENT DEPOSIT ON ALL SOFT DRINKS SOLD, WOULD YOU

2. BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
3. NOT BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
4. DON'T BUY
5. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	454	7	72	5	13	3
MEN	223	9	66	6	16	4
WOMEN	231	6	78	3	11	2
18-29 YEARS OF AGE	147	8	80	3	9	1
30-49	168	9	78	4	6	4
50 OR OVER	124	6	64	5	21	4
LESS THAN HIGH SCHOOL COMPLETE	68	4	72	7	13	4
HIGH SCHOOL COMPLETE	175	8	76	3	12	2
SOME COLLEGE	204	10	68	4	14	3
FAMILY INCOME UNDER $10,000	140	6	71	4	17	2
$10,000-$15,000	112	7	79	4	5	5
OVER $15,000	155	8	69	6	14	3
LOST THEIR JOB/BEEN LAID OFF	80	10	75	2	7	7
WORKING HOURS SHORTENED	25	5	82	0	6	7
LOST OVERTIME WORK	18	5	72	14	6	3
NONE OF THESE	334	7	71	5	16	2
WHITE	399	8	72	5	14	2
NONWHITE	48	4	78	3	6	9
DEMOCRAT	153	5	76	5	10	4
REPUBLICAN	70	12	62	8	18	0
ENVIRONMENTALLY ACTIVE	62	12	61	0	26	1
CITY	163	8	74	4	13	1
SUBURB	120	10	72	2	10	8
SMALL TOWN	90	6	65	10	19	0
RURAL AREA	69	5	79	3	13	3
EAST	71	7	69	6	14	4
MIDWEST	143	8	76	4	11	1
SOUTH	155	7	76	2	12	3
WEST	85	6	65	6	18	5
TAKE BUSINESS TRIPS	96	6	78	6	9	4
TAKE WEEKEND TRIPS	278	7	74	4	15	1
TOOK MAJOR 1974 VACATION TRIP	240	6	77	4	11	3

0146

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K168A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

IF THERE WERE A 5 CENTS DEPOSIT ON ALL BEER SOLD, WOULD YOU

1. PURCHASE LESS BEER
2. BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
3. NOT BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
4. DON'T BUY
5. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	451	4	57	5	28	6
MEN	224	4	60	6	23	7
WOMEN	227	4	55	4	32	5
18-29 YEARS OF AGE	140	5	66	6	23	2
30-49	149	4	56	7	24	9
50 OR OVER	150	4	53	2	35	6
LESS THAN HIGH SCHOOL COMPLETE	82	3	53	4	34	6
HIGH SCHOOL COMPLETE	169	3	59	5	25	8
SOME COLLEGE	193	6	62	4	26	3
FAMILY INCOME UNDER $10,000	139	3	59	4	27	7
$10,000-$15,000	103	4	45	7	40	4
OVER $15,000	15[illegible]	6	66	6	20	5
LOST THEIR JOB/BEEN LAID OFF	74	4	46	5	38	7
WORKING HOURS SHORTENED	23	7	57	5	16	15
LOST OVERTIME WORK	21	3	50	6	41	0
NONE OF THESE	334	4	60	5	25	6
WHITE	397	4	57	5	29	6
NONWHITE	48	6	64	2	24	4
DEMOCRAT	170	4	61	4	25	6
REPUBLICAN	76	10	54	2	29	6
ENVIRONMENTALLY ACTIVE	68	2	67	3	24	4
CITY	154	4	58	10	26	3
SUBURB	142	6	67	2	19	6
SMALL TOWN	83	4	51	3	37	5
RURAL AREA	66	2	50	1	34	13
EAST	153	6	63	12	14	5
MIDWEST	121	3	60	3	29	5
SOUTH	115	2	54	3	33	8
WEST	62	7	52	1	36	5
TAKE BUSINESS TRIPS	91	3	66	3	22	6
TAKE WEEKEND TRIPS	291	3	62	6	24	5
TOOK MAJOR 1974 VACATION TRIP	244	4	62	6	22	6

C079

Opinion Research Corporation
PRINCETON, NEW JERSEY

QUESTION K168A ENERGY CO-OP WAVE 30 & 31 INT. ENDED MAY 23 1975

IF THERE WERE A 10 CENT DEPOSIT ON ALL SOFT DRINKS SOLD, WOULD YOU

2. BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
3. NOT BRING THE CONTAINERS BACK FOR A DEPOSIT REFUND
4. DON'T BUY
5. DON'T KNOW

	PERCENTAGE BASE	1.	2.	3.	4.	5.
TOTAL PUBLIC	454	4	50	4	33	8
MEN	223	5	47	4	40	4
WOMEN	231	4	52	5	27	12
18-29 YEARS OF AGE	147	6	55	3	36	1
30-49	168	4	60	7	23	6
50 OR OVER	124	4	39	3	38	16
LESS THAN HIGH SCHOOL COMPLETE	68	4	40	3	34	18
HIGH SCHOOL COMPLETE	175	4	55	4	35	2
SOME COLLEGE	204	6	54	7	30	4
FAMILY INCOME UNDER $10,000	140	5	44	1	38	12
$10,000-$15,000	112	2	57	6	30	5
OVER $15,000	155	4	58	9	25	4
LOST THEIR JOB/BEEN LAID OFF	80	3	55	1	35	7
WORKING HOURS SHORTENED	25	1	66	2	23	8
LOST OVERTIME WORK	18	9	57	16	18	0
NONE OF THESE	334	5	49	5	35	7
WHITE	399	4	49	5	33	8
NONWHITE	48	4	53	3	34	6
DEMOCRAT	153	2	46	3	40	9
REPUBLICAN	170	5	50	8	29	8
ENVIRONMENTALLY ACTIVE	62	11	46	0	41	2
CITY	163	5	53	4	34	4
SUBURB	120	7	50	4	26	14
SMALL TOWN	90	2	42	4	45	7
RURAL AREA	69	1	53	7	30	9
EAST	71	*	65	10	23	2
MIDWEST	143	7	43	4	39	7
SOUTH	155	4	45	3	37	11
WEST	85	4	50	1	32	13
TAKE BUSINESS TRIPS	96	3	58	7	30	1
TAKE WEEKEND TRIPS	278	4	54	5	30	8
TOOK MAJOR 1974 VACATION TRIP	240	4	57	6	29	6

0147

Opinion Research Corporation
PRINCETON, NEW JERSEY

SUMMARY OF PUBLIC BEHAVIOR AND ATTITUDES REGARDING BEVERAGE CONTAINERS

A LARGE MAJORITY OF AMERICANS BUY SOFT DRINKS.

"Are the soft drinks you prefer available in the following containers where you shop: returnable bottles, nonreturnable bottles, cans?" (Q. K151)

	Total Public
Buy soft drinks	89%
Don't buy soft drinks	11

REGION PLAYS A ROLE IN SOFT DRINK CONTAINER AVAILABILITY.

Overall, most people agree that the soft drinks they prefer are generally available where they shop in whatever type of container they want -- this includes returnable or nonreturnable bottles as well as cans.

Availability of beverage containers of all types in the store where shopping is generally done varies somewhat by region. According to respondent testimony, returnable bottles are not as readily obtainable in the East as they are in other parts of the United States, and nonreturnable bottles are not always available in the West.

Regional Differences in Availability of Containers (Q. K151, Cont'd)

	Soft Drink Buying Public[1/]	Availability of Preferred Soft Drink in ... Returnable Bottles	Nonreturnable Bottles	Cans
Total	(803)	75%	79%	81%
East	(188)	48%	93%	80%
Midwest	(235)	87%	76%	82%
South	(248)	87%	82%	78%
West	(132)	70%	61%	86%

1/ Percentages based on people who buy soft drinks.

SLIGHTLY OVER HALF OF THE POPULATION BUY BEER AT STORES.

This agrees well with several other recent ORC surveys of the beer market.

"Is the beer you prefer available in the following containers where you shop: returnable bottles, nonreturnable bottles, cans?" (Q. K159)

	Total Public
Buy beer at stores	55%
Don't buy	45

RETURNABLE BOTTLES ARE AVAILABLE TO ONLY ABOUT 40% OF BEER BUYERS.

Almost all beer buyers can get their favorite beer in cans.

As was true with soft drinks, the region of the country plays a part in availability by beverage container. (See page II-2.) Returnable bottles are apparently available more in the Midwest than in other parts of the United States, and nonreturnable bottles are found less frequently in the West than they are in other regions.

Regional Differences in Availability of Containers (Q. K159, Cont'd)

	Beer Buying Public[1/]	Availability of Preferred Beer in ... Returnable Bottles	Nonreturnable Bottles	Cans
Total	(500)	40%	65%	87%
East	(152)	32%	75%	82%
Midwest	(143)	57%	69%	91%
South	(127)	34%	66%	89%
West	(78)	36%	51%	85%

1/ Percentages based on people who buy beer.

MOST PEOPLE SAY THEY PREFER RETURNABLE BOTTLES FOR SOFT DRINKS.

About half of soft drink buyers prefer returnable bottles. About one-fourth say they like nonreturnable bottles, and another one-fourth choose cans.

Type of Container Preferred for Soft Drinks

"What type of beverage container do you prefer for soft drinks: returnable bottles, nonreturnable bottles, or cans?" (Q. K157)

	Soft Drink Buying Public 1/
Returnable bottles	51%
Nonreturnable bottles	21
Cans	21
No preference	7

GIVEN GENERAL AVAILABILITY, PREFERENCE AND BUYING CORRELATE CLOSELY.

Since soft drinks are available in most locations in assorted beverage containers, it naturally follows that the majority of people who purchase soft drinks will usually buy them in the container they say they prefer. Only a few people (about 6%) claim to usually purchase more than one type of container.

Soft Drink Container Usually Purchased

"Do you usually purchase soft drinks in returnable bottles, nonreturnable bottles, or cans?" (Q. K152)

	Soft Drink Buying Public 1/
Returnable bottles	49%
Nonreturnable bottles	28
Cans	29

(Multiple answers)

1/ Percentages based on people who buy soft drinks.

AMONG PEOPLE WHO CONSUME BEER, MOST SAY THEY PREFER TO PURCHASE IT IN CANS.

Of beer purchasers, 49% choose the can as their preferred container type. Among those who prefer to drink beer from bottles, 22% select returnable and 20% select nonreturnables.

Type of Container Preferred for Beer

"What type of beverage container do you prefer for beer: returnable bottles, nonreturnable bottles, or cans?" (Q. K165)

	Beer Buying Public[1/]
Returnable bottles	22%
Nonreturnable bottles	20
Cans	49
No preference	9

THE LOW AVAILABILITY OF BEER IN RETURNABLE BOTTLES LIMITS ACTUAL PURCHASING.

When it comes to the beer container usually purchased, there are slightly more people who say they buy beer in cans than there are who say they prefer beer in cans. This is, most likely, the result of what is available in the store. Only about half as many people buy returnable bottles as claim to prefer them.

Beer Container Usually Purchased

"Do you usually purchase beer in returnable bottles, nonreturnable bottles, or cans?" (Q. K160)

	Beer Buying Public[1/]
Returnable bottles	13%
Nonreturnable bottles	31
Cans	58

(Multiple answers)

It would appear that just making beer available everywhere in returnable bottles might as much as double returnable purchases.

1/ Percentages based on people who buy beer.

Reasons for Container Selection
Among Those Who Have All Three Kinds Available

	Soft Drink Buying Public		
	Prefer Returnable Bottles	Prefer Nonreturnable Bottles	Prefer Cans
Percentage Base	(256)	(101)	(106)
Recycle/don't have to throw out/ reduce refuse/collection problem/ help ecology, environment/prevent pollution	35%	0%	6%
Cheaper/more economical/for deposit, get money back	37	4	4
Better flavor	22	6	3
Sanitary/pure/clean	1	1	0
Convenient to carry/to store	1	1	20
Less breakage, safer	*	0	15
Easy to dispose of/can be thrown out/don't like to return bottles	0	64	45

(Special analysis)

1/ Indicates less than one-half percent.

The data on the table above are based on those people who have all three beverage container types available to them where they usually shop.

REASONS FOR CONTAINER PREFERENCE AMONG BEER DRINKERS ARE ESSENTIALLY THE SAME AS REASONS GIVEN BY SOFT DRINK CONSUMERS.

The sample sizes for an analysis of reasons for beer container preference are quite small. Nevertheless, the data show an interesting pattern which generally corroborates attitudes about soft drinks. Ease of disposal is the chief reason cited by those people who prefer beer in cans. Other reasons mentioned include such things as convenience, storage, flavor, and recycling. In some locations provisions are available for recycling aluminum.

As with soft drinks, among those people who like their beer in bottles, the issue of what to do with the empty bottle is usually the deciding factor in the choice between returnable or nonreturnable. Most people who buy beer in returnable bottles do so because the bottles don't have to be thrown out, while most who buy beer in nonreturnable bottles do so because the bottles can be thrown out.

Reasons for Container Selection
Among Those Who Have All Three Kinds Available

	Beer Buying Public		
	Prefer Returnable Bottles	Prefer Nonreturnable Bottles	Prefer Cans
Percentage Base	(54)	(24)	(86)
Recycle/don't have to throw out/ reduce refuse/collection problem/ help ecology, environment/prevent pollution	48%	0%	8%
Cheaper/more economical/for deposit, get money back	30	0	2
Better flavor	16	21	6
Sanitary/pure/clean	0	2	0
Less breakage, safer	0	0	7
Convenient to carry/to store	0	5	9
Easy to dispose of/can be thrown out/don't like to return bottles	0	40	38

(Special analysis)

The data on the table above are based on those people who have all three beverage container types available to them where they usually shop.

HEAVY USERS ARE MORE LIKELY TO PREFER RETURNABLES.

In particular, heavy users of soft drinks are more likely to prefer returnable bottles than is the population as a whole.

"What type of beverage container do you prefer for (soft drinks, beer): returnable bottles, nonreturnable bottles, or cans?" (Q. K157 & K165)

	Returnable Bottles	Nonreturnable Bottles	Cans
Soft drink buying public	50%	22	21
Heavy soft drink buyers[1/]	62%	9	26
Beer buying public	22%	20	49
Heavy beer buyers[1/]	25%	28	40

Just as for the public as a whole, soft drink preference and actual purchase pattern is much the same for heavy soft drink buyers. However, again due to low availability, only about half as many heavy beer buyers purchase their beer in nonreturnable bottles as claim to prefer such a container.

1/ A heavy buyer is defined as someone whose family buys 13 or more bottles or cans of the appropriate beverage each week (Q. K153, K155, K156, K161, K163, K164).

Heavy users do not show any significant differences from other users in the reasons they give for preferring a particular container. This is true for both soft drinks and beer.

In particular, heavy users are not significantly more cost conscious than users in general.

"Why do you say that (prefer returnable for soft drinks, beer)?" (Q. K158a, K166a)

	Base	Cost Reasons
All returnable soft drink preferrers	(402)	35%
Heavy soft drink returnable preferrers	(88)	39%
All returnable beer preferrers	(119)	28%
Heavy beer returnable preferrers	(23)	29%

MOST PEOPLE CLAIM THEY WOULD RETURN CONTAINERS FOR DEPOSITS.

Almost all of those people who buy returnable bottles claim to return virtually all of them for the deposit (Q. K154 and K162).

To see what people claim they would do if all containers carried deposits, we split the sample of 900 into two groups of approximately 450 each. One group was asked how they would react to a 5¢ a bottle deposit and the other group was asked about a 10¢ a bottle deposit.

The facing tables show the results for soft drink and beer buyers separately. In all cases, overwhelming majorities claim they would return the containers for the deposit. This is, of course, borne out by actual experience in Oregon.

Thus it would appear that mandatory deposits would produce substantial recycling of beverage containers. This would apply to cans as well as bottles. Many people would still prefer cans on the basis of storage convenience, etc., so deposits in themselves would not seem to discriminate between bottles and cans.

Public Reaction to Deposit on Soft Drinks Containers

"If there were a 5¢ (10¢) deposit on all soft drinks sold, would you: purchase less soft drinks, bring the containers back for a deposit refund, or not bring the containers back for a deposit refund?" (Q. K167a, K167b)

	(Q. K167a) 5¢ Deposit	(Q. K167b) 10¢ Deposit
Soft drink buying public	(401)	(381)
Purchase less soft drinks	5%	8%
Bring containers back for deposit refund	90	86
Not bring containers back for deposit refund	5	6

Based on soft drink buyers.

("Don't know" omitted)

Public Reaction to Deposit on Beer Containers

"If there were a 5¢ (10¢) deposit on all beer sold, would you: purchase less beer, bring the containers back for a deposit refund, or not bring the containers back for a deposit refund?" (Q. K168a, K168b)

	(Q. K168a) 5¢ Deposit	(Q. K168b) 10¢ Deposit
Beer buying public	(298)	(268)
Purchase less beer	6%	7%
Bring containers back for deposit refund	86	86
Not bring containers back for deposit refund	8	7

Based on beer buyers.

("Don't know" omitted)

Appendix L: REVIEWERS' COMMENTS

Copies of the preliminary draft research memorandum were mailed to approximately 130 representatives of agencies, organizations, and interested individuals. All the responses received from those contacts are included in this appendix. Table L-1 identifies the reviewers.

Table L-1. Summary of parties providing comments on the draft study

Correspondence Number	Date		Page
		Federal Government	
1	11/18	Tennessee Valley Authority, Dr. Peter A. Krenkel, Director of Environmental Planning, Chattanooga, Tennessee	L-7
		Administrations/Agencies:	
2	12/5	Environmental Protection Agency, Office of Solid Waste Management Programs, John H. Skinner, Deputy Director, Resource Recovery Division, Washington, D.C.	L-7
3	11/21	General Services Administration, Dwight A. Ink, Acting Administrator, Washington, D.C.	L-15
4	11/20	United States Energy Research and Development Administration, James S. Kane, Deputy Assistant Administrator for Conservation, Washington, D.C.	L-14
		Departments:	
5	11/24	U.S. Department of Commerce, William V. Skidmore, Assistant General Counsel for Legislation	L-16
6	11/5	U.S. Department of Defense, George Marienthal, Deputy Assistant Secretary of Defense, Health and Environment	L-17
7	11/10	U.S. Department of Justice, Alfred T. Ghiorzi (Acting Chief, Pollution Control Section) and Walter Kiechel, Jr. (Acting Assistant Attorney General), Land and Natural Resources Division	L-18
		Congressional - House of Representatives	
8	10/20	Ike Andrews, 4th District, North Carolina	L-20
9	11/7 11/14	Les AuCoin, 1st District, Oregon	L-20 L-21
10	11/26	James M. Jeffords, Vermont	L-22
		Congressional - U.S. Senate	
11	11/3	Trenton Crow (for Jennings Randolph, (W.Va.), Chairperson, Committee on Public Works)	L-25
		State Governments	
12	11/10 11/25	State of Maryland, Ted Scheinman, Staff Economist, Governor's Council of Economic Advisors	L-27

Table L-1. Summary of parties providing comments on the draft study (con.)

Correspondence

Number	Date		Page
13	11/11	State of New York, Robert R. Quinn, Policy Analyst, Senate Task Force on Critical Problems	L-29
14	11/26	The State of Oregon, William R. Bree and Loren Kramer, Department of Environmental Quality, Recycling Information Office	L-31
15	11/10	State of Vermont, Donald W. Webster, Director, Agency of Environmental Conservation, Division of Environmental Protection	L-32
		Universities	
16	11/14 12/31 3/4/76	University of Connecticut, Carlos D. Stern, Assistant Professor, Environmental Economics	L-34 L-39 L-40
17	11/4	University of Illinois at Urbana-Champaign, Bruce M. Hannon, Director, Energy Research Group	L-41
18	11/25	State University of New York, David L. Hanselman, Associate Professor and Coordinator, Educational Communications, College of Environmental Science and Forestry	L-42
19	11/12	Oregon State University, Dr. Charles M. Gudger, Associate Professor, School of Business	L-47
20	11/14	University of Tennessee, John H. Gibbons, Director Environment Center	L-50
		Environmental Organizations	
21	11/28 12/2	Allied Civic Group, Inc., Steven A. Frank, Chairman, Environmental Affairs Committee, Bethesda, Maryland	L-52 L-52
22	11/14	Crusade for a Cleaner Environment, Betsy Greer, Director, Washington, D.C.	L-56
23	11/24 3/1/76	Environmental Action, Patricia Taylor, Arthur Purcell, and Pamela Deuel, (National Environmental Lobby), Washington, D.C.	L-57 L-68
24	11/11 11/15	Environmental Management Council, Forest Golden, Vice Chairman, Cayuga County, Auburn, New York	L-85 L-93
25	11/18	National Wildlife Federation, Thomas L. Kimball, Executive Vice President, Washington, D.C.	L-103
26	11/26	Natural Resources Defense Council, Inc., Thomas Fenner (Legal Assistant) & Richard Cotton (Staff Attorney), Palo Alto, California	L-105

Table L-1. Summary of parties providing comments on the draft study (con.)

Correspondence

Number	Date		Page
27	11/12	Oregon Environmental Council, Don Waggoner, Portland, Oregon	L-110
		Corporations	
28	11/12	Admiral Beverage Corporation, Frank E. Bowers, General Manager, Worland, Wyoming	L-113
29	11/25	Aluminum Company of America, J. Tyson Kennedy, Marketing Manager, Packaging, Pittsburgh, Pennsylvania	L-133
30	11/26	American Can Company, H. Blair Smith, Vice President, Corporate Environmental Affairs	L-134
31	12/1	Amoco Chemicals Corporation, Earle R. Stout, (Subsidiary of Standard Oil Company, (Indiana))	L-135
32	11/7	Anchor Hocking Corporation, C. J. Arnsbarger, Vice President, Director of Public Affairs	L-137
33	11/15	Angelus Sanitary Can Machine Company, H. E. Schellenberg, Vice President of Sales, Los Angeles, California	L-137
34	11/25	Coors Container Company, E. G. Anderson, Vice President, Quality Assurance, Golden, Colorado	L-138
35	11/19	Dow Chemical, USA, R. W. Dupree, Director, Government Relations	L-143
36	11/11	E. I. Du Pont de Nemours & Company, P. J. Vanderhorst, Research and Development Division	L-146
37	11/13	Monsanto Commerical Products, F. D. Wharton, Jr., Manager, Environmental Affairs, Container Business Group	L-148
38	12/2 1/23/76	Pepsico, Inc., Lloyd Curtiss, Director, Environmental Affairs, Purchase, New York	L-149 L-163
39	12/1	Reynolds Aluminum, Robert F. Testin, Director, Environmental Planning, Richmond, Virginia	L-166
		Industrial Associations and Organizations	
40	12/1	The Aluminum Association, S. L. Goldsmith, Jr., President, New York, New York	L-169

Table L-1. Summary of parties providing comments on the draft study (con.)

Correspondence

Number	Date		Page
41	11/26	Can Manufacturers Institute, Barclay, T. Resler, Manager, Government Relations, Washington, D.C.	L-174
42	1/16/76 2/09/76	Glass Bottle Blowers Association of the United States and Canada, Harry L. Moore, Director of Legislation, Media, Pennsylvania	L-176 L-180
43	11/28 12/23	Glass Containers Manufacturers Institute, William W. Sadd, President and General Manager, Washington, D.C. with material developed by Stanford Research Institute	L-180 L-182
44	11/26	National Soft Drink Association, Thomas F. Baker, Executive Vice President, Washington, D.C.	L-234
45	12/11	National Solid Wastes Management Association, Warren T. Gregory, Director of Legislative Affairs, Washington, D.C.	L-247
46	11/13	The Society of the Plastic Industry, Inc., Peter Thomas Smith, Assistant General Counsel, (Keller & Heckman, Washington, D.C.)	L-248
47	12/3	United States Brewers Associations, Inc., Henry B. King, President, Washington, D.C.	L-251
48	12/3	United Steel Workers of America, Walter J. Burke, International Secretary-Treasurer, Pittsburgh, Pennsylvania	L-292
		Interested Parties	
49	11/20	Ms. Eileen Claussen	L-294
50	11/7	A. W. Wortham	L-298

Federal Government

208 401 Big

TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

November 18, 1975

RECEIVED
NOV 20 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

We have completed our review of the FEA study on the energy and economic impacts of establishing a program of mandatory deposits on beverage containers transmitted by your letter of October 10, 1975. TVA supports the recycling of products and materials to conserve our natural resources. We have recently had an opportunity to review EPA's proposed beverage container guidelines to be established solely for Federal agencies. We believe that legislation establishing a national commitment to utilize returnable beverage containers is the better solution to the problem. We are in general agreement with the methodology and data used in your studies and the conclusions you have reached.

We think your study, however, should be revised with regard to information concerning the possible effect of mandatory beverage container deposit legislation on resource recovery. Recent studies performed by TVA show that the costs and feasibility of waste resources recovery systems in the Tennessee Valley could be affected by the removal of beverage cans from the total waste volume. In this region, for example, beverage cans comprise approximately 22-26 percent of the ferrous metal content and 28-32 percent of the nonferrous metal content in the waste stream. Complete removal of this waste from the total waste stream could reduce the potential income from such a resource recovery system by approximately $2.50 per ton of waste process. This is approximately 25 percent of the total revenue which might be obtained from the balance of recovered products in such a system. Of course, net energy savings from the use of returnable containers may outweigh energy recovery through other recycling systems.

We appreciate the opportunity to review the FEA study and hope that our comments will assist you in completing the overall assessment.

Sincerely yours,

Peter A. Krenkel, Ph.D., P.E.
Director of Environmental Planning

Enclosure: Review copy

An Equal Opportunity Employer

L-7

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460
OFFICE OF SOLID WASTE MANAGEMENT PROGRAMS

5 DEC 1975

Mr. Taylor Bingham
Research Triangle Institute
Research Triangle Park, NC 27709

Dear Taylor:

Attached are our comments on the draft study "Energy and Economic Impacts of Mandatory Deposits" conducted for the Federal Energy Administration. I hope they will be useful in preparing the final document. Please contact me if we can answer any questions or give you any other assistance you may require in final report preparation.

Sincerely,

John H. Skinner
Deputy Director
Resource Recovery Division

Enclosures

cc: Mr. Morris Zusman, FEA

RECEIVED
DEC 11 1975
ECONOMICS DEPARTMENT

Comments on FEA Review Draft of:
Energy and Economic Impacts of Mandatory Deposits

We are pleased to be able to comment on your draft study entitled "Energy and Economic Impacts of Mandatory Deposits." The decisions of local, state and national legislative bodies must be based on a realistic appraisal of the benefits and potential problems associated with deposit systems for beer and soft drinks. Although only a draft report and containing some important and inaccurate assumptions, your report, when revised, should be a useful tool for decision makers across the country.

As you know in 1974 the Environmental Protection Agency testified before the U.S. Congress in favor of the adoption of a nationwide container deposit system to provide for the widescale use of returnable containers for malt liquor and soft drink beverages. Based upon several years of analysis of this issue and observation of the experiences in the States of Oregon and Vermont, which had enacted container deposit laws, EPA concluded that a nationwide returnable container system would conserve significant quantities of energy and materials and would reduce litter and solid waste generation. However, it was recognized that if mandatory deposit legislation caused a rapid shift in the relative market shares of different container types some adverse transitional effects could occur (such as unemployment in the container industries, and accelerated obsolescence of equipment). Therefore, EPA recommended that such legislation provide for gradual phase-in of a nationwide returnable container system over an extended period of time.

The draft study produced for FEA by Research Triangle Institute and Franklin Associates basically supports and refines a segment of the data base from which EPA's position has been developed. This study examines the complete energy system, now and with future projections, as well as developing a detailed analysis of portions of the capital and labor needs of the beverage associated industries. We feel that there are important changes in methodology and assumptions, that when corrected, would show greater benefits obtained by switching to a mandatory deposit system. Even with these differences, the study supports the previous findings that energy savings will be obtained and overall employment gains will occur if a mandatory deposit system is established. Specific comments concerning the draft study are discussed in the remainder of this analysis. We are also sending the draft report back with significant editorial comments indicated throughout the text. Those comments will not be highlighted in this review.

1. The choice of scenarios does not reflect "realistic" outcomes.

The scenarios chosen for evaluation are highly unrealistic and cannot be used by or useful to any decision makers' evaluation of the potential impact of a deposit law. This is true both for the baseline case and the deposit law cases. While we recognize the need to examine extremes, these results should only be included in an appendix. Certainly, they should not be examined in a summary as an indication of the "potential" impact of a deposit law.

2. The baseline scenarios can be improved.

The baseline case used in the summary has not been justified as a realistic or appropriate estimate of future projects. In fact, table 2-12 and figure 2-19 indicate that, by modifying the basic assumptions, significant differences in the results will occur. Unless detailed rationale can be developed to support a particular baseline, a range of practical potential results should be indicated. Four major factors influence the results: the container mix chosen; the recycling rate for one-way containers; the trippage rate for refillable bottles; and the extent and speed of technological improvements. Each will be discussed separately with respect to realistic baseline projections.

2-A. Baseline container mix

The mix of containers offered in the market has been continually changing due to a wide variety of factors. Among these are changing industry patterns, primarily consolidation of local facilities into regional distribution points; changing consumer and retailer attitudes; and changing costs of labor, capital and raw materials. While consolidation of facilities has lead to increased product shipping distances (and therefore a tendency toward using one-way containers), recent shifts in consumer and retailer attitudes and changes in the overall cost structure of the industry may result in the reversal of the decline in refillable bottle shipments. Two obvious examples are the mandatory deposit laws passed and enthusiastically supported by consumers in Oregon and Vermont and the significantly higher cost increases of steel and aluminum when compared to glass.

Based on these factors, we believe that at least three container mix scenarios should be included in any baseline projection. First should be a scenario indicating a stabilization of the percentage of refillable bottles in the market. This container mix could be taken directly from the tables detailed on pages B-9 and B-14 using 1975 values. The second container mix baseline scenerio should be a projection of past trends and would be equivalent to the container mix estimated for 1985 (this is the basis for the baseline case currently used in the summary).

A third container mix scenario should also be considered. This would be an accelerated decline in the use of refillable bottles. As fewer refillable bottles are consumed, it is possible that a more rapid decline than is indicated by past trends, which started from a high level of use, could occur. For ease of calculation, it is suggested that the percentage decline from 1975 current values to 1985 projected values be used to indicate the lowest refillable bottle use practically possible by 1985. As an example, refillable bottles contained 33 percent of the soft drink volume in 1975, they are projected to contain only 25 percent of the volume in 1985 a difference of 8 percentage points. Therefore, the lowest practical volume should be 17 percent (25 minus 8). These three container mix baseline values should provide a range of realistic estimates of future container mix without a deposit law.

One additional factor relating to container mix has not been accounted for. That is the changing mix of aluminum based cans compared to steel based cans. All aluminum cans have been significantly penetrating the beverage market. Accounting for no continued increase in the percentage of aluminum cans in the container mix is completely unrealistic.

2-B. Baseline recycling rates

The recycling rates for one-way containers in the baseline scenario are derived from two underlying calculations: the quantities of materials obtained from voluntary collection activities; and the operations of resource recovery facilities. These values seem to have been obtained from an EPA study "Baseline Forecasts of Resource Recovery, 1972 to 1990." While this study is the best available, it is already slightly out of date. The results appear slightly optimistic with respect to the building of resource recovery plants, at least in the short run, since the report overestimates the quantities of materials recovered in 1975. With this in mind, and knowing that both recycling center and large scale recovery facilities will normally only obtain materials from metropolitan areas, a slight decrease in the projected recycling rates is required for the baseline case.

With respect to the aluminum can recycling potential, voluntary collection activities should improve enough to compensate for the technical problems associated with obtaining aluminum from resource recovery facilities. The maximum recycling potential, then, approaches 30 percent. If recycling centers are established in all SMSA's (70 percent of the population) and approximately 50 percent voluntary response occurs, (a high but not inconceivable response), and if net losses as stated in the report allow only .877 of the returned material to be used, then the maximum recycling rate is 30.7 percent (0.7 x 0.5 x 0.877). The market penetration of aluminum cans today is highly localized and if it remains so then aluminum recycling could approach

this limit. However, if the aluminum can continues to penetrate a wider geographic market area, then the potential recycling rate should decline (to perhaps 25 percent).

Estimating steel can recycling quantities results in additional problems and assumptions. Steel can scrap values are relatively low and, therefore, it may not be economically practical to recover steel cans from low volume recycling centers or in areas that are distant from user markets. In addition, bi-metal cans cannot be directly recycled for most scrap uses and therefore further processing would be required. The recycling rate of all steel cans is probably approximately as stated in the draft report. However, for reasons discussed in the technology change section, a recycling rate should also be applied to bi-metal cans. This rate should be slightly over 50 percent of the recycling rate for all steel cans.

One additional point should be made concerning recycling and the potential energy savings to be derived. There is some energy consumed in recovering material and in transporting that material to a facility where it can be recycled. This is true both for the voluntary recycling center and the resource recovery facility. If these energy requirements are insignificant the report should clearly state this. If not, then the energy savings from recycling should be reduced by the appropriate amount.

2-C. Baseline trip rates

The number of times a refillable bottle is actually used, trippage, is the third important factor in the baseline scenario. Again, problems exist in the base case parameters used in the summary. The report states that data on trippage is not available and that the data available to estimate trippage by statistical means is not good. However, a model was designed to provide some estimates and--even though the empirical results did not confirm their hypothesis, the model was inconclusive from a statistical standpoint--the results were used for the baseline case. This is especially important due to the sensitivity of energy savings to trippage rates and the fact that changes in other socioeconomic variables that affect trippage were not included in the model (i.e. number of return locations, case returns only, same brand only, and the general availability of refillables). Industry sources and previous studies indicate a higher trippage rate for refillable bottles today than does the model used in the report. In addition, if the percentage of refillable bottles in the market continues to decline, it is logical to assume that an even greater share of the refillable market will be on-premise use. Since higher trippage rates can be and are obtained from these sources, fewer bottles in the absence of a deposit law should lead to higher average trippage rates. At minimum a complete review of the methodology is called for and the inclusion of a higher trippage rate (18 has been used elsewhere in the report) is appropriate when the percentage of refillable bottles declines.

2-D. Baseline technological change

The fourth major factor that significantly influences the results of the baseline scenario is the projected speed of energy saving technical change occuring at all levels of industry activity effecting beverage containers. These results are based on individual industry studies examining the potential energy saving techniques that could be applied by 1985. Two problems arise from using this data exclusively.

First, no attempt is made to see if all the capital equipment needed by all the industries involved could be produced and installed between 1975 and 1985. If all industries are attempting to improve their energy efficiency at the same time, then some industries will be delayed in actual implementation due to the large total capital equipment requirements. Therefore, some lesser amount of technical innovation will be obtainable throughout the economy than would be projected using only individual, segmented studies of achievable savings.

Second, the study has obtained the most up to date energy values that the beverage associated industry can provide. By using this data and then decreasing these results by the rates of energy conservation potential developed by earlier FEA studies, significant duplication of values probably has occured. With the energy crisis and the general industry-wide push toward conservation, the most easily achievable energy conservation measures have already taken place. Therefore the analysis overstates the energy conservation potential of technological change by a significant amount.

This problem can be accounted for by showing the impact of technology change in the baseline case in the summary. Two calculations should be made. First, a scenario with no further technical change, to represent a minimum energy conservation potential. Second, a scenario using perhaps 80 percent of the draft report estimated change, to represent a realistic maximum technical change within the period projected.

2-E. Baseline plastic bottles

A final point concerning the baseline estimate deals with the exclusion of plastic bottles from the analysis. Various industry projections of how fast and to what extent plastic bottles will penetrate the beverage market have been made. The plastic bottle has been projected to achieve 10 percent of the throwaway market by 1980. Since the capital, labor, and energy requirements for plastic bottles are significantly different than current one-way containers, some projections of the potential system impact due to the introduction of plastic bottles should be included in the final report.

3. The deposit law scenarios can be improved.

The scenarios dealing with the impact of deposit laws on the industry like the baseline, provide unrealistic and inappropriate values. use. The three sets of parameter extreme values should not be treated as if they were potentially useful to any understanding of a deposit law's impact. If used at all, in the summary or elsewhere, care should be taken to inform the reader that these extreme values are only theoretical, with no practical chance of occuring. Any deposit law scenarios should be based on a range of practical potential results. As with the baseline scenarios the results are sensitive to different assumptions. The four major factors influencing the results are: the container mix; recycling rates; trippage; and technological change. Each will be discussed separately with respect to realistic baseline projections.

3-A. Deposit law container mix

The container mix resulting from mandatory deposit laws is a key variable and also very difficult to project. However, potentially realistic bounds can be set by looking at the results of Oregon and Vermont as well as other countries. Aside from countries that have never, in practice, allowed one way containers into the market, the Oregon deposit law experience shows the largest percentage gain of refillable bottles in the market place. The State of Oregon, before it passed a deposit law, had metal can market shares in soft drinks at 40 percent, slightly above the national average, and metal can shares of the beer market of 33 percent, significantly below the national average. After the deposit law became effective the refillable bottle share of the total beverage market grew to over 92 percent. To project this high a refillable market share nationwide, based on the Oregon and Vermont experience, is unrealistic. But a maximum achievable refillable bottle share under a deposit law would probably fall between 85 and 90 percent of the beverage market.

Two other container mix scenarios should be presented as realistic potential impacts of a deposit law. First, a scenario in which metal cans continue their current market penetration, that is, approximately 50 percent of the market in metal cans, the remainder shifting to refillable bottles. Second, a mid-range scenario where there is some shift away from metal cans. A split of the market with 70 to 75 percent of the containers being refillable bottles and 25 to 30 percent of the beverage packaged in metal cans seems practical and realistic. Together the three container mix scenarios described represent a realistic boundaries for describing the impact of national deposit legislation.

One additional factor, as stated in the baseline comments, is that market share of aluminum cans compared to steel cans should be increase Again since aluminum has been significantly penetrating the beverage market, these trends should be projected into any future market mix considerations.

3-B. Deposit law recycling rates

When dealing with recycling rates under a deposit system, a completely new method of returning containers is established. The deposit requires return of containers to a store or redemption center, thereby resulting in a completely segregated waste stream. Since the Oregon experience with deposit laws resulted in a 70 percent return rate for cans, and preliminary data from Vermont indicates a 90 percent return rate, these two values should be used as boundaries for a realistic estimate of the impact on recycling from a national deposit law.

3-C. Deposit law trip rates

The choice of a trippage rate for refillable bottles under a deposit law is another difficult variable to project. However, two studies have looked at trippage in Oregon after that deposit law became effective. The Applied Decision Systems, Inc. study "Study of the Effectiveness and Impact of the Oregon Minimum Deposit law," reported increased trippage for beer containers and the same number of trips for soft drink refillable bottles. The Gudger and Bailes study "The Economic Impact of Oregon's Bottle Bill" reported increased trippage for both beer and soft drink refillable bottles. It is clear that no decline in trippage has been experienced in Oregon. Therefore, a minimum parameter of expected trippage under a deposit law should be the continuation of current trip rates.

Looking at other countries that have a significant percentage of refillable bottles (Norway, for example, gets between 25 and 33 trips per bottle and Oregon 18 trips for beer, 24 trips for soft drink containers) leads to the conclusion that trippage under a deposit law could increase. A trippage rate between 18 and 25 seems to be a practical boundary for estimating the impact of a deposit law.

3-D. Deposit law technological change

As with the baseline scenarios the extent and speed of technological change significantly affects the results. When comparing a baseline scenario to a deposit law scenario, valid comparisons can be made only with equivalent assumptions. That is, a rapid introduction of new technology in a baseline case should be compared to a deposit law case which includes the same assumption. Likewise, a slow introduction of technology should be used in comparisons of the two cases. The concept of an envelope of possibilities is not valid when discussing new technology, since it will either occur or not irrespective of a deposit law.

3-E. Deposit law plastic bottles

A final point concerning plastic bottles must be mentioned: As with the baseline scenarios, exclusion of plastic bottles and their potential impact is not valid, given the current test marketing and the industries' projections of future growth in this area.

4. The analysis of the impact of a deposit measure on resource recovery systems is incomplete and the summary statements inaccurate.

A major error in the summary is the discussion and conclusion statement concerning the impact of deposit laws on resource recovery facilities. The summary states on page 1-9 that "the revenue potential of municipal solid waste would be decreased by a maximum of 22 percent." However, in the text (page 3-31), a statement is made "that even completely eliminating beverage containers from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal of situations." This second statement is an appropriate conclusion, while the first statement is very misleading with respect to the potential impact on resource recovery facilities.

In addition the methodology chosen to estimate the impact on resource recovery plants of a deposit law is incomplete. The values considered for the inorganic fraction revenue potential are estimated gross revenues. No attempt was made to examine the potential net revenue received by the resource recovery plants after accounting for the costs required to remove this material from the waste stream or to transport the material to a buyer who would pay the market price only at the delivery point. If both of these items were included, substantial reductions in the gross revenue cost would occur. In fact the equipment needed to recover glass and aluminum through large scale resource recovery facilities has not yet been demonstrated to be either technologically or economically feasible. Therefore, any estimated revenue from recovering these materials is purely conjecture.

The major source of revenue from resource recovery facilities, as currently being demonstrated, will be the fuel value of the combustible fraction of solid waste. The gross revenue from this fraction is estimated to range from $5 to $15 per input ton. This fuel value of solid waste, plus the elimination of landfill or incineration costs, will be the primary motivation for building resource recovery facilities. It is therefore clear that deposit laws will have negligible impacts on recovery system implementation. In fact, over the next 10 years, with the inherent risks of the new resource recovery technology, only cities having high cost alternative disposal solutions are expected to implement resource recovery systems. In those cases a small reduction in potential revenue should not alter any decision to install recovery systems.

5. Some assumption regarding energy values are questionable.

Various factors affect the energy values presented in the study. Factors having a major impact on the energy values that have already been discussed as problem areas include: the speed and extent of introducing new energy saving technology; the extent of recycling, both in the baseline and deposit law calculations; the container mix, including an increase in the aluminum can market share and the introduction of plastic bottles; and the trippage rate for refillable bottles. Recommended changes in these factors would cause significantly different results.

5-A. Steel can energy

In addition the assumed shift from bi-metal cans to all steel cans is cited as a definite outcome, resulting in significant energy savings. However, a March 22, 1974 article in Beverage Industry predicts continued growth in bi-metal can output through 1978, the last year for which estimates were made. The article also predicts continued growth of the drawn and ironed can (all steel or aluminum). While we agree that the all steel can will be a significant factor in the beverage industry by 1985, and that all steel cans utilize less energy than bi-metal cans, it is clear that bi-metal cans will continue to be sold in substantial quantities through 1985. Based on this article and current trends, perhaps a better estimate of the type of steel cans in the market by 1985 would be 50 percent bi-metal and 50 percent all steel. Even to attain this mix, significant changes would have to take place in industry practices.

5-B. Recycling energy

The energy saved by recycling of materials, as used in the report, does not consider the energy it takes to obtain the materials from the waste stream, either through recycling centers or resource recovery facilities. Nor do these energy savings values consider the energy it takes to transport the materials to a final user. Both of these values should be estimated to obtain a net energy savings from recycling. Since these values are difficult to estimate, some technique for accounting for them could be used, possibly reducing the recycling energy savings by 10 to 20 percent.

5-C. Refillable carrier energy

On page D-3 a statement is made that "the energy difference between refillable and one-trip containers is not likely to be as pronounced in 1985 as in the early 1970's, especially if recycling and other conservation practices are pursued strongly." A note to this point indicates that "this conclusion could be altered if use of durable, reusable carriers and cases are adopted for refillable containers before 1985."

The assumption that recycling and conservation practices are pursued strongly, but not for the refillable bottle system obvious skews the results. It is not only conceivable but probable that under a deposit law minor innovations such as a durable, reusable carrier or case will extensively penetrate the market. This factor should certainly be included in any calculation of energy values within a deposit law scenario.

5-D. Transportation energy

The reduction in transportation energy value by 1985 (page D-23) is not reasonable. The fuel requirements are projected to decrease by 15 percent due to increased fuel efficiency in mobile engines and increases in route efficiency. While this is possible for truck transportation, it seems excessively high for ocean shipping, pipeline, barge, or rail transportation. These modes of transportation will not have significant changes in route efficiency by 1985, nor will the large quantity of currently operating equipment be replaced by more efficient equipment to the extent needed to reduce overall energy consumption by 15 percent. A much higher value is needed for energy consumption in the transportation sector.

5-E. Aluminum energy

The electricity profile used for aluminum smelting (page D-80 -D-84) is subject to considerable discussion. As stated on page D-83, there are arguments that can be used to support the use of a national, regional, or aluminum industry pattern of electrical use by type of resource--coal, oil, etc. This is important to the energy values since if the aluminum industry receives credit for its current extensive use of hydroelectric power, the energy requirements of aluminum containers are reduced by about 12 percent. With the nation moving toward a national grid and already having some regional electricity sharing capacity, it is clear that the extensive use of one source of electrical power diverts others from using that power. Since a kilowatt of electricity to a user is the same no matter how generated, the use of the national average material requirements for electrical production is an easily defended assumption. Especially if can production continues to grow, aluminum consumption of hydroelectric power should decline in the future. Given that constraint, EPA feels that a national profile is the proper energy requirement to use for the aluminum industry's electrical energy requirements.

5-F. Energy values in other studies

The 1975 energy requirements indicated for all of the container types differ markedly from the results of other studies. While this difference is briefly mentioned, in a note on page D-2, it would be very

helpful to discuss in greater detail the reasons why and the key areas where these savings have taken place. The report does not provide enough detail to agree or disagree with the basic energy values. While we understand the confidential nature of company data, a comparison of the results to other studies would help clear up any doubts concerning the reliability of the 1975 energy requirements.

6. The methodology used to determine capital expenditures is incomplete.

6-A. Filler through retailer only

The exclusion of capital requirements occuring before filling of containers raises serious questions concerning capital needs. The statement on page 3-15 "capital requirements for the container and metals manufacturing industries were not developed since reductions in container production are projected for all scenarios," ignores any increase in capital needs in the baseline scenarios. Moreover, a decrease in capital needs will allow other capital funds to be used elsewhere in the economy and this is a major impact of the deposit law that is not taken into account. In addition, the mining, transportation, and refining of materials used for beverage containers is highly capital intensive. These values are also excluded by starting the capital needs analysis at the filling stage. All these values should be included for a total capital requirement value.

6-B. Recycling capital

Another potentially large capital requirement that has been excluded is the equipment required to recycle materials. This is especially important in scenarios where substantial quantities of recycled materials are generated from large scale, highly capital intensive resource recovery facilities. Since the capital needs to reuse refillable bottles are counted, equal treatment should be given to the capital needs to recycle one-way containers.

6-C. Technology change capital

Another exclusion from the total capital needs of the complete beverage industry is the capital requirements to change from the current energy useage patterns to a newer technology with lower energy consumption. If all of the conservation techniques are to be in place by 1985, it is clear that a significant amount of new equipment will have to be purchased as well as scrapping current equipment that might still be useful.

6-D. Float capital requirement

The treatment of refillable bottle float as a capital investment conforms with general industry accounting procedures. Whenever a deposit system is implemented or when significant recycling takes place, there is an equivalent concept to refillable bottle float for one-way containers. This is the quantity of material "floating" between the retailer and the container manufacturer prior to being reused as recycled material. To provide equal treatment between refillable bottles and one-way containers, the value of this material should be included as a capital investment in one-way container materials.

6-E. Storage capital

The costs for storage of returned containers at retail outlets is based on the premise that the container will be stored inside the retail outlet. However, it is highly probable that retailers will use enclosed outdoor storage areas, of very low cost, instead of using valuable in-store space. To the extent that this would occur the capitol requirements for retail storage space are significantly overstated.

7. The analysis of labor impacts is incomplete and misleading.

The analysis of beverage container derived labor requirements is incomplete and as such presents an incorrect view of the impact of a deposit law. When dealing with indirect labor requirements, it is necessary to include all of the indirect effects of a deposit law in order to obtain a realistic estimate of total labor requirements. The study examines only a few of the indirect supplying industry labor requirements, i.e. if cans are not produced, some steel workers may be unemployed. A complete supply industry labor requirements calculation was not attempted. In addition, the gain or loss in income received by all persons, directly or indirectly employed, should also be used in the analysis as it can stimulate further changes in the economy leading to other employment impacts. Furthermore, changes in prices to final consumers (such as lower average prices for beverages when sold in refillable bottles), should also be factored into the analysis. If consumers can purchase the same quantity of beverage for a lower price, then the money saved can be spent to buy more beverage or more of any other product. This would lead to additional changes in labor requirements.

Since these factors were not considered in the study, it is recommended that the partial indirect labor requirements identified be eliminated from the final report. Unless a total labor requirements calculation can be made, the direct requirements impact represents a more reasonable and defendable analysis of the labor impact than a partial indirect analysis.

8. Consumer impacts are not adequately covered.

The impact of a deposit law on the consumer is given only cursory coverage, especially in the summary. The consumer attitude survey is not mentioned in the summary at all, even though a detailed discussion of this survey can be found in chapter two. One major economic effect that is not discussed in any detail throughout the study is the final market price of beverage to the consumer. Since the average market price under a deposit law should decline, this factor should be highlighted. The model used to project quantities of beverage consumed incorporates data related to the final price internally. Not explicitely stating the values used makes it difficult to evaluate one of the assumptions of the study.

9. Presentation of results has to be handled carefully.

Whenever a report contains as much data as this one does, the summary is often the only section read and used. It is therefore critical that the summary accurately reflect the remainder of the report in a clear and concise manner. The changes that we have recommended would alter most of the data contained in the Summary. However, two suggestions concerning format will still be appropriate. Any conclusion statement should not be so broad as to be meaningless. A specific quantitative range of potential impact should be included in the conclusion statement. For example, a useful conclusion is not "that energy will be saved under a deposit law," but rather "that the energy saved could amount to between 100,000 to 200,000 barrels of oil per day." Also the headings on tables and figures must provide enough information to clearly indicate what the data presented represents.

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

NOV 20 1975

RECEIVED
NOV 21 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

This is in response to your draft study of "Energy and Economic Impacts of Mandatory Deposits."

It appears that the genesis of the mandatory deposit is within the area of litter control and that at least energy impact is a late add-on. Within the energy context, certain points are of interest:

1. The report seems to assume that there is no energy expenditure involved in the physical return system, apparently on the theory that the vehicle returning the container was making the identical trip in any event. This assumption should be addressed factually. Some consumer to dealer trips will be made, if only to accomplish the final return of the container. In actual practice, personal preference will lead to direct trips or extension of other trips to recoup funds, relieve clutter, return to the place of purchase, etc. Similarly, the report assumes that all vehicles from producer to distributor to dealer deadhead and make a direct retrace of route on return trips. This needs confirmation as an assumption. It seems logical that at least some of these return trips involve freight in some form to add profitability. The energy to move the returned containers is assumed to be negligible.

2. The report assumes that only bottles are refillable. The can industry will no doubt develop a refillable can if the motive exists.

3. Logically, it seems that removing dried sugar syrup and product will require more energy than washing virgin bottles. I would agree that sterilization will require no additional energy.

4. There is considerable discussion on the savings achieved in packaging when products are delivered for on premises consumption. This assumption should be readdressed. In certain locations it is known that glass nonreturnable bottles are loaded in vending machines by breaking open six packs further packaged at four, six packs to the case.

UNITED STATES OF AMERICA
GENERAL SERVICES ADMINISTRATION
WASHINGTON, DC 20405

NOV 21 1975

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Thank you for your letter of October 10, 1975, requesting our comments on your contract study of the Energy and Economic Impacts of Mandatory Deposits.

The information contained in the review copy of "Energy and Economic Impacts of Mandatory Deposits," prepared by the Research Triangle Institute is highly informative and appears to be authoritative. We are in general agreement with the concept of using returnable beverage containers as a means to promote economic and environmental benefits through the reduction of energy and raw material consumption and the decrease of litter.

Requiring deposits on all beverage containers should be an effective incentive to return those containers for reuse or recycling.

We recognize that the imposition of a mandatory deposit system could cause GSA, as the primary operator of civil agency Federal buildings, to incur additional costs. In this connection, the report does not, in our opinion, contain information which would be directly helpful to GSA in evaluating the impact a mandatory deposit system would have on GSA's operations. This, however, is a matter which GSA has under direct discussion with the Environmental Protection Agency with respect to that agency's proposed solid waste management guidelines for beverage containers.

We are returning the review copy of the study as you requested. If we can ever be of any other assistance, please let us know.

Sincerely,

Dwight A. Ink
Acting Administrator

Enclosure

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5. The report addresses, but fails to assess, the source and highest uses of energy forms. The report favors the refillable glass bottle, yet 55% of that industry's power is from natural gas, which is the form of energy reported to be in shortest supply.

The following added comments are not specifically energy related:

1. The report states that the return system will produce more jobs than are eliminated from the can and glass industries. The point not discussed is the impact of the conversion of jobs from skilled to unskilled.

2. What incentives will be provided for the dealer to expend capital to construct and maintain storage space for returnables other than the negative punishment for violating law? In addition, what incentives will exist for the dealer to return the empties to the distributor? It may suit the former's purpose to put these in the waste stream at his level.

3. Why permit cans only with nondetachable tabs, yet permit the bottle to have a cap which can be detached to form litter?

4. Are the various tables, most of which are by Research Triangle Institute or their subcontractor, Franklin Associates, fully supported by the data in the report?

5. What has been done to trace the history of the development of the nonreturnable bottle? It may be grounded in considerations beyond customer convenience.

6. The report assumes no health and safety impact. What is the effect of roaches and vermin attracted to sugar-coated bottles and cans while in the return stream?

In conclusion, ERDA supports the concept of the report if energy is to be saved by the process. The questionable assumptions and other data need support to insure that the proposal does not have a negative energy impact.

Sincerely,

James S. Kane
Deputy Assistant Administrator
for Conservation

GENERAL COUNSEL OF THE
DEPARTMENT OF COMMERCE
Washington, D.C. 20230

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NOV 26 1975
ECONOMICS DEPARTMENT

NOV 24 1975

Mr. Taylor Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

A preliminary copy of your report "Energy and Economic Impacts of Mandatory Deposits" has been reviewed at your request by technical personnel in the Department of Commerce. I have outlined those comments in the following paragraphs. Thank you for the opportunity to comment.

This study confirms and extends a large body of information on this subject. I am sure that the dimensions of the issue, the recognized absence of critical data and the limited time available for this effort made the task of you and your staff difficult.

The comments which follow are directed to major conclusions presented in the Summary of the report. Specific comments relative to data and methodology have not been prepared.

a. The estimates of energy use associated with the various beverage systems are consistent in magnitude and ranking with other recent estimates of energy content developed by several agencies and contractors who have studied this issue.

b. The estimated capital requirements associated with systems using more refillable containers (and particularly "scenario c") are somewhat higher than previous industrial estimates and those developed by the Bureau of Domestic Commerce. A review of the data and methodology underlying these computations proved difficult. For example, the assumed float levels, "the model plant approach", and the rationale for substitution of in-place equipment require industry's capital needs. Therefore, our people felt it was not possible to judge the basis for estimation.

c. Labor requirements (and to some extent, labor earnings) have been treated more comprehensively in this report than in others. However, it appears to our people that the analyzed results are based on 1967 input-output data and a rather simplified set of assumptions; (i.e., labor requirements for distribution and retailing are "related" to the number of containers produced and labor requirements for production are proportional to the weight of containers). Perhaps the sensitivity of the employment estimates to these assumptions should be explored in greater depth and the underlying rationale for the estimates be clearly indicated in the Summary where these values first appear.

d. The potential revenue recovery estimate of beverage containers from municipal solid waste is consistent with previous Commerce estimates. It would be worth while to point out that while recovery is theoretically possible, it is not economically viable at the present time.

In the opinion of some of our readers, the value of this work might be enhanced through 1) reorganization and clarification of the presentation and 2) elimination of extraneous material which is not central to the main theme of the paper and which is often not carried to any definitive conclusion.

Sincerely,

WILLIAM V. SKIDMORE

Assistant General Counsel
for Legislation

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NOV 12 1975
ECONOMICS DEPARTMENT

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

HEALTH AND ENVIRONMENT

5 NOV 1975

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Thank you for sending us review copies of RTI's study, "Energy and Economic Impacts of Mandatory Deposits." We have reviewed and are returning the copies as you requested.

While a complete analysis of your methodologies and data was not conducted, we did review the results obtained in the study and are in general agreement with your findings. On the basis that a refillable container system is generated by a mandatory minimum deposit and such system will yield substantial energy, material, and pollution savings, the Department of Defense favors the enactment of national mandatory deposit legislation.

On the other hand, we do not believe such benefits would be derived if a system were imposed only on Federal agencies, and particularly the Department of Defense, as the U.S. Environmental Protection Agency is proposing. We strongly believe that a system imposed on 3% of the total beverage market will not generate changes in the producers packaging policies, production techniques, capital investments, or distribution methods. In short, we believe that as a matter of convenience, customers who have historically purchased beverages on federal property will turn to the easily accessible and unaffected commercial market. This anticipated action will not only have a significant impact on the sales and profits of military exchanges and commisaries but will do little to achieve the objectives which in our opinion would be realized with national mandatory legislation.

Our views on this matter were also discussed with William E. Franklin of Franklin Associates, Ltd., during his recent visit to Washington, D.C. In the interest of minimizing the number of replies to your report, the views expressed herein reflect those of all Department of Defense addressees.

Thanks again for the opportunity to review your study at this early stage.

Sincerely,

George Marienthal

George Marienthal
Deputy Assistant Secretary of Defense
(Environmental Quality)

Enclosure

UNITED STATES DEPARTMENT OF JUSTICE

WASHINGTON, D.C. 20530

Address Reply to the Division Indicated and Refer to Initials and Number

ATG:RWM
90-5-1-0

November 10, 1975

RECEIVED
NOV 13 1975
ECONOMICS DEPARTMENT

Mr. Taylor H. Bingham
Research Triangle Institute
Energy and Environmental
Research Division
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

We appreciate the opportunity to review your study of the Energy and Economic Impacts of Mandatory Deposits on beverage containers. As you probably realize, most of the material lies beyond the scope of the expertise of this Department; hence, we cannot offer a critical evaluation of the study. However, one minor point, we feel, merits comment: While the study investigates the reduction in revenue potential of solid waste recovered in resource recovery plant if beverage containers become a much smaller portion of the solid waste stream, it does not compute the effects upon the cost and energy requirements of handling a lesser volume of solid waste.

Because we have made no helpful annotations in our copy of the study, we are not enclosing it with this letter.

Sincerely,

Walter Kiechel, Jr.
Acting Assistant Attorney General
Land and Natural Resources Division

By: Alfred T. Ghiorzi
Alfred T. Ghiorzi
Acting Chief, Pollution Control Section

L-18

Congress

IKE ANDREWS
4TH DISTRICT, NORTH CAROLINA

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COMMITTEE ON
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October 20, 1975

Mr. Tayler H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

Thank you so much for your letter of October 10 and for the review copy of the RTI study, "Energy and Economic Impacts of Mandatory Deposits."

I am tremendously impressed with this study and wish that I had time to review it with some degree of thoroughness. However, my schedule between now and your deadline of November 14 is such that I will be unable to do so.

Being from Oregon, Congressman Les AuCoin and his aide, Dr. Roger Eiss, have a considerable interest in and knowledge about the subject of mandatory deposits, and Dr. Eiss has expressed interest in studying what you have prepared. We are, therefore, sharing our copy with Dr. Eiss, and, by copy of this letter, asking him to return it to you by November 14.

In closing, please let me say that your study seems to me to be a job well done for the Federal Energy Administration.

With best wishes.

Sincerely yours,

Ike Andrews
Member of Congress

CC: Dr. Roger Eiss

IA/rma

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L-20

LES AuCOIN
1ST DISTRICT, OREGON

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ECONOMICS DEPARTMENT
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November 7, 1975

Mr. Tayler H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Congressman Ike Andrews passed along to me a copy of your draft report, "Energy and Economic Impacts of Mandatory Deposits," in hopes that I would be able to add my review comments.

I referred the report to the most knowledgeable individual I know in the area, Mr. Don Waggoner of the Oregon Environmental Council, with a request for his analysis. Mr. Waggoner responded by advising me that he will be responding under separate cover to a copy of the report sent directly to the Council.

I want to emphasize my deep regard and confidence for Mr. Waggoner's expertise in this area, and am confident you will find his remarks both pertinent and extremely helpful. I am returning, in accordance with your request, the draft report but would be most interested in receiving a copy of the final report as soon as it becomes available. The information that it contains is most helpful.

With kindest regards,

Sincerely,

LES AuCOIN
Member of Congress

LA/ren
Enclosure
cc: Mr. Don Waggoner
Hon. Ike Andrews

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LES AuCOIN
1st District, Oregon

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NOV 17 1975
ECONOMICS DEPARTMENT

November 14, 1975

Mr. Tayler H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Since my letter of November 7 I have received some further comments about your draft report, "Energy and Economic Impacts of Mandatory Deposits". I would like to pass them along to you.

It has been pointed out that there may be a major methodology assumption problem in section I-3. This assumption is that the capital requirements of refillable bottles versus non-refillable bottles and metal cans can be adequately described by considering only the capital requirements of beverage producers, distributors, and retailers. The rationale for this is found on III-15 with the statement "Capital requirements for the container and metals manufacturing industries were not developed since reduction in container production were projected for all scenarios. Hence these industries would have unutilized capacities."

It has been suggested to me that this statement would probably be true if we are considering only the alternative of various types of consumer in relation to each other alternative after it has been assumed that a deposit system is in effect. The thrust of this report, however, is to consider the impact of mandatory deposit with the implicit assumption that a mandatory deposit may not be in effect. If the alternative is really deposit legislation versus no-deposit legislation, then the capital requirements for beverage manufacuring industries are very much at issue. The strong growth for both soft drinks and beer projected for metal cans in Figure 2-6 for 1975-1985 would therefore definitely require significantly more plants to be built and hence their capital requirements should be included.

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I understand this assumption leads to numerous statements in the draft report referring to the refillable bottle system as the most capital intensive of the three container systems. Indeed it may well be the most capital intensive system. However, it may be that until the major impacts of the container manufacturer's capital requirements are included, the statement is not justified.

On page 1-7 it is stated that Coors Container Company is obtaining a 50 percent return rate by paying 0.75 cents per can. Again on page 3-5 it is stated that "Virtually all returned cans are Coors cans, therefore it would appear reasonable that a mandatory 5 cent deposit would result in at least a .50 return rate." If this is the independent finding of Research Triangle Institute, then the statement should probably be accepted. However, I have heard that, rather than it being the return rate for Coors' containers, it is instead the total return rate for all aluminum containers being returned to Coors compared to Coors' sales in that area. This point needs clarification.

On Page 1-8 in Table 1-3, there is a reference to the Oregon Parameter values but there has been problems finding what these parameters are in the body of the text. Perhaps these should be explicitly stated.

On Page 2-2, it was stated that "the Oregon Bottle Bill" was enacted in that state 1972. As you no doubt well remember, it was enacted in 1971 and became effective in 1972.

On Page 2-25, an annual growth rate (presumably compounded) in the energy requirements of -3.19 percent for aluminum cans is used. This leads to an energy reduction of 30 percent for cans between 1975 and 1985. Is this really expected?

On Page 2-38 and 2-40, a tabulation of beer and soft drink production and distribution costs for the year 1967 is shown. Perhaps some note in the text should comment that between 1967 and the present, beer refillables have dropped from 42 percent of the market to 20 percent of the market and that for soft drinks, the change has been 72 percent to a current 38 percent as shown on Figure 2-4. Therefore the percentage of packaging costs relative to other costs has probably increased significantly.

On Page 2-45, the statement is made that aluminum has a true salvage value of .5 to .7 cents per can. Again, on Page 3-8, the statement is made that aluminum cans have a salvage value of 1 cent per can. It is true that Coors is paying .75 cents per can. However, this is not necessarily the same thing as stating that this is the true salvage value. It may well be, rather, that this is instead a good public relations program aimed at maintaining the can in the market place. An analysis of current and projected scrap value for aluminum of the type used in beverage cans should be included in the report to verify this statement.

Finally, on Page F-13, Table F-15, the employment requirement coefficients which are stated to be "indirect" in the heading but on Page F-12 are referred to the "estimated total employment requirements", show that a metal can required more employees for beer than a refillable bottle. I understand this is contrary to all previous reports. My source did not have time to review this in detail, but there may some error which has been here.

I hope these comments are helpful to you, and I again commend you for an outstanding report.

With kindest regards,

Sincerely,

LES AuCOIN
Member of Congress

LA:ret

JAMES M. JEFFORDS
VERMONT CONGRESSMAN

COMMITTEE ON AGRICULTURE
SUBCOMMITTEES:
DAIRY AND POULTRY—RANKING MINORITY MEMBER
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November 26, 1975

RECEIVED
DEC 1 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709

Dear Mr. Bingham:

Thank you very much for forwarding the review copy of the Research Institute's draft "Energy and Economic Impacts of Mandatory Deposits." I appreciate very much the opportunity to comment upon this draft. In the interests of brevity, I will limit my comments to criticism. I will say in passing, however, that the data assembled seem to be technically good, but I am more concerned with the assumptions which lead to the RTI's choosing of specific data ranges and the intermediate conclusions which were derived from that exercise.

As a legislator, I am particularly interested in acquiring a solid set of statistics that will demonstrate the impact of deposit legislation on industry, employment, and energy and resource savings. Other studies that have been conducted on this issue seem to fall too often into the initial trap of assuming that deposit legislation is ban-the-can legislation. It has been studies such as these that provide fuel for detractors of deposit legislation to use in inciting the emotions of labor and beverage distributors. It was pleasing to see that the RTI eschewed, at least on the surface, this misassumption and examined other alternative outcomes.

However, if cans were to be eliminated, the industrialists and laborers would know where they stand. The only thing that is potentially worse to business than this certainly is total uncertainty. Uncertainity is fostered by the RTI study. It is clear to everyone that if market shares changed at all there would be significant dislocations in employment and industry as well as savings and energy and material resources. I submit, however, that the extent of such dislocations is not as significant as is the question of what we should expect market shares

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to be in the first place. An ideal study from a public policy point of view would give us a calculated estimate on what market shares would actually end up to be rather than extreme uncertain parameters.

Already, from my point of view, this study will be something less than successful. Yet by using good parameters, the RTI would at least minimize its documented uncertainty. Since it is the parameters, the assumptions, that people will look at as far as conclusions are concerned, it is terribly important that contextually logical parameters are employed. A look at the five RTI parameters will demonstrate some of the shortcomings.

Each parameter assumes a market share and also a return rate for that market share. The first three compose the purported extreme values that could result from a deposit. The first parameter assumes there would be "no change in the projected market share of metal cans and a zero return rate." The second assumes there would be "no change in the projected market share of metal cans but a 100 percent return rate." Each of these "extreme" rates has preempted an additional possibility, that the can market share could actually increase. The real conceptual problem then on the part of the RTI engineers is that of a limited initial horizon. It would appear that there is a very plausible scenario that the can market could actually pick up some of the lost non-refillable business. (More on this below.)

But not only is there a problem with minimal extremes in the coefficient, there is perhaps a equally devastating problem with using maximum extremes in the return rate coefficient. If RTI is going to limit possibility for market shares for cans why should it not make a similar and more plausible limitation for return rates. To use 100% and 0% rates, exclusively, ascribes equal credibility to each. Beverage distributors will use these two possibilities to show that savings would not necessarily be extensive with a deposit. Obviously, if return rates in Oregon and Vermont, both above 90%, are any indication the rate for each of these coefficients should be far closer to 100 than to 0.

The third scenario, "complete switch of metal cans to refillable bottles," raises a similar question. From what RTI says later in its report about the advantages of cans, perhaps it would have been better to create a new extreme parameter "switch of all refillables to cans." Certainly this is as plausible as a 0 return rate for cans with a deposit.

I must object to the use of the final two parameters. It would appear to be an understatement when it says in a footnote that "the Oregon parameters may overstate the sensitivity of the national metal can market to deposits". By its own admission this is a poor example -- why does RTI bother to use it?

The Coors parameter approaches it better. This can producer and brewer did everyone involved a great service by pointing out that can profits can be made under a deposit system, but equating the 50% return generated by 75¢ premium to that which would be generated with a 5¢ deposit seems to lack imagination. If RTI is going to use this kind of logic, it should at least call the Coors example something other than the "midrange" parameter.

RTI evidently decided originally to use three suspect parameter possibilities. Then someone suggested that it would be nice to throw in some historical perspective. Obviously, Coors did RTI the disservice of adding its input after you were set in your assumptions and computer programs, because instead of using their data and industrial perspective, RTI chose instead to add but one more extraneous parameter.

RTI failed to consider a parameter that would even approach what even it could view as a legitimately expectable outcome. Yet, some of its intermediate assumptions lead me to wonder what kind of legitimate outcome RTI would come up with. By way of commenting on these intermediate assumptions, I offer a new parameter, a common-sense scenario.

In this parameter, one-way bottles are eliminated much as RTI would assume. However, rather than diminish cans, both steel and aluminum would pick up some of the one-way bottle market as would refillable bottles. The return rate for these containers would approximate 90% in most areas. Rather than describe the

impact that this scenario would have on employment and energy, which I am obviously unprepared to do, I would like to describe how I deduced this parameter.

RTI assumes that all one-way bottle users will switch to refillables. Has it investigated whether or not refillables would be readily available in those markets? Would retailers who do not have refillable bottles be willing to stock them now? Moreover, depending upon the extent to which people use one-way bottles for convenience one could make an excellent case for a switch to cans. If one does not like returning items in the first place or cluttering up a room with containers, it would certainly be far easier to crush cans, stick them in a paper bag and return them than it would be to lug around the same number of refillable bottles. For these reasons, I think it is a little illogical to assume that every single one-way bottle user will switch to the refillable bottle.

In addition, I can think of two market structure factors that would preempt significant erosion of the can market share. One is that great expense of transporting beer in their containers over long distances. Refillable bottles just are not as economical where long hauls are necessary. Also, the low return rates of refillable bottles in many cities make them less economical, as Sidney Mudd would testify, than cans.

There is another factor that is brought to light in RTI data, but for some reason ignored in its assumptions. This may surprise you, but I see no reason for considering the refillable bottle market as inviolate. If it is true as they say, that 48% of refillable beer bottle users use that packaging because of ecology related reasons, what is to prevent those users from switching to cans when high recycling rates will enable the can distributors to advertise their product as ecologically sound.

The assumption that cans would experience a declining market is based on that fact that in pure terms the bottle is cheaper than a can. Yet, this study goes to lengths in showing that cans have many cost advantages going for them. TRI mentions the lower per unit energy and material costs involved with recycling. They tend to admit that the Coors assumptions are right and the aluminum cans would hold their own in a deposit system. However, although one of the original assumptions says that relative shares of aluminum and bimetal would remain the same, RTI contradicts this later in saying that steel would have a harder time. However, I believe the former assumption would

assumptions. The data could have been put to far more constructive use if you had used it as a basis for arriving at conclusions. Data used in one context are not necessarily immune from consideration in another. Despite these drawbacks, I'm afraid any study that does not address the fundamental question of actual market share reactions to a deposit will add very little to policy making in the final analysis.

Again, thank you for the opportunity to participate.

Sincerely,

James M. Jeffords

JMJ:bla

cc: Morris Zusman
Patricia Taylor
Roger Strelow

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United States Senate

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WASHINGTON, D.C. 20510

November 3, 1975

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NOV 5 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina
27709

Dear Mr. Bingham:

I appreciate receiving a review copy of the Energy and Economic Impacts of Mandatory Deposits. Unfortunately, my work load does not permit enough time to make helpful suggestions. I am pleased with this effort and look forward to seeing the end result.

Sincerely,

Trenton Crow

Trenton Crow
Prefessional Staff Member

State Governments

GOVERNOR'S COUNCIL OF ECONOMIC ADVISERS
STATE OF MARYLAND
STATE TREASURY BUILDING
ANNAPOLIS, MARYLAND 21404

November 25, 1975

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DEC 1 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

I am pleased to have the opportunity to review the report, Energy and Economic Impacts of Mandatory Deposits, prepared for the Federal Energy Administration by Research Triangle Institute. As I believe the methodology used is the most important portion of the report, I have focused my comments on the appendicies of the report.

I wish to congratulate you on a well-done analysis of the impacts of a mandatory deposit system. For the most part, your assumptions and analysis are appropriate; however, I do have several recommended changes. This transmittal letter details my comments on the report, but I wish to list the areas of concern below:

--specification of the beer and soft drink consumption models;

--projected market shares of various beverage containers;

--projected size of beverage containers;

--return rates for refillable beverage containers;

--energy requirements for various beverage containers;

--recycling rates for aluminum beverage containers;

--calcutation and cost of retailer space; and

--projected productivity increases in beverage related industries.

I have not traced through what impacts my comments would have on your results. This can be easily done.

Our detailed comments follow, organized by appendix section.

L-27

Comments on Appendices

Appendix A

(A.2) Beer Consumption. Appropriately, you have included a variable in your beer consumption and soft drink consumption models to reflect the price of beer and the price of soft drinks. You use the ratio of the CPI for beer to the CPI for personal consumption expenditures. Through our analysis of beer sales for the State of Maryland's revenue estimating model, we have found that the fit of the equation for beer sales is improved by using the ratio of beer CPI to soft drink CPI. We expect that the reason the ratio of beer to soft drink prices provides a better fit is that the CPI for personal consumption expenditures masks the true substitution of beer for soft drinks. I would suggest a run of your demand model for beer with a variable for the ratio of the beer CPI to the soft drink CPI, instead of the own-price of beer. You already have all the data necessary to rerun this model.

(A.3) Soft Drink Consumption. For the same reasons as mentioned above for the beer consumption, I suggest a run of the model using the ratio of the beer CPI to the soft drink CPI, instead of the own price of soft drinks.

I expect inclusion of these variables will lower projections for soft drink consumption and raise projections for beer consumption.

Appendix B

(B.2) Market Share. Please explain your rationale for arbitrarily setting the value of λ to twice the 1973 value of f(t) or 1.0.

(B.2.1) Beer Market Share. Your model used to estimate the market shares of the different packaged beer containers is based primarily on a time variable and the relative price of the challenging container. Use of this model is appropriate as long as the relative prices of competing containers remains constant. And, in fact, you do assume that the relative prices remain constant at the 1973 level. However, I question this assumption because since 1973, there have been shifts in the relative prices of raw materials needed to produce the various containers. As a result, I expect that your assumption results in an underestimation of the future share of that container which has relatively lower prices. You should use a variable for the relative factor prices. (Historical data and projections to 1985 of prices of crude materials is available from INFORUM, Bureau of Business and Economic Research, University of Maryland, College Park, Maryland, phone (301) 454-5384.) I expect that the model underestimates the future share of refillable bottles.

I further question the assumption of the constancy of the relative market shares of refillable and non-refillable bottles at the 1973 level.

(B.2.2) Soft Drink Market Shares. The same questions raised with respect to the beer market shares apply to soft drink market shares.

(B.3.1) Non-refillable Container Requirements. In the recent past, there has been an introduction of a 7-ounce beer container in non-refillable bottles. As this introduction has occurred since 1973, the latest data you have available does not reflect this container in determining container size. From discussions with beer distributors, we have learned that the smaller size refillable is becoming quite popular. I expect that the average non-refillable container size will fall from its current 12 ounces to a smaller size, resulting in more beer containers need to package the beer than you have predicted in Table B-12.

I find it difficult to believe that the average non-refillable bottle for soft drinks will increase from the 1973 size of 18.6 ounces to 22.9 ounces by 1985. The "independently provided projections" mentioned on page B-17 seem to be based on a time trend, where in reality I expect the introduction of the 16-ounce container should be treated with the same type of S-curve used for market shares. I expect use of an S-curve will reduce the average size and therefore increase the projections for non-refillable soft drink bottles in Table B-16.

(B.3.2) Refillable Bottles and Trippage. The use of per capita real income as an explanatory variable for the return rate is a good start (however, some measure of distribution of income, as it affects scavenging, would also be useful), but I would suggest another variable — market share of refillable bottles. If the market share of refillable bottles becomes smaller, the return rate should become smaller; if the market share of the refillable bottles becomes larger, the return rate should rise, as the tendency to return containers is dependent on the ability to find a convenient place for returning them. (The evidence from Oregon seems to support this.) With the inclusion of a market share variable, I would expect the R^2 to increase. What decline in trippage you attribute to higher per capita real income may be the effect of a lower market share and higher per capita real income.

Appendix D

(D.1) I do not feel qualified to make substantial comments on the methodology used in developing energy utilization requirements of beverage containers. However, a few comments can be made.

(D.3) It appears from your discussion that there are various rates of energy conservation for different fuels, but you assume that energy conservation estimates apply uniformly to all fuels. You should investigate this assumption further.

You assume that no additional energy is required to transport containers to and from retail stores by consumers, stating that these activities are necessary for other reasons. However true for a refillable container returned to a store, this may not be true for a container returned to a recycling center, which may be distant. Also, the various weights of containers require various amounts of additional energy to transport to and from the store. The net effect is that a refillable bottle weighs more than the other containers, but is returned to a store, rather than a recycling center. As a result your methodology overestimates the energy required for refillable containers, and underestimates the energy required for non-refillable containers.

(D.4.2) Transportation Conversion Factors. Why do you assume a 15 percent overall reduction in fuel requirements for 1985? What evidence do you have for this? I expect the reduction to be greater.

(D.8.4.1) NR Glass Bottles. You assume that the location of plants will not change as a result of the recent increases in the prices of energy. I expect that there will be a mild reversal in the trend of breweries to centalize operations and ship beer long distances. In other words, the economies of scale leading to decentralization in the past may be reduced because of higher transportation costs.

(D.9.2) Steel Can Recovery and Recycling. What do you expect to be the impact on your recovery rates of the recent failures of resource recovery plants, used for front-end recovery?

(D.9.2.4) Aluminum Can Recovery and Recycling. What evidence do you have to support an increase in the recycling rate for aluminum beverage cans from 13 percent in 1972 to 40 percent in 1985? In your model to predict the return rates for refillable containers, you predict a large reduction in the return rate, based on an increasing per capita real income and a constant deposit. You do not even use this simple model to predict recycling rates for aluminum, but use an increase in the recycling rate at 2 percent a year.

Appendix F

(F.2) Capital. Your size estimate for the space-conserving, stubby bottle is wrong. It is currently 11 ounces for beer and 16 ounces for soft drink.

(F.2.1) Production and Distribution Space. Why do you use a cost estimate of $22 per square foot for space requirements, especially since you state that 3/4 of space costs less than $22 per square foot?

It does not automatically follow that the space requirements for beer production and distribution will be larger than those for soft drinks because of the differences in market area. The inventory requirement may be reduced through the use of a uniform container or aggressive collection program.

(F.2.2) Filling Lines. Upon what basis do you make the statement that installation charges of 50 percent is reasonable for a new can and bottle filling line?

You are mistaken in the choice of using the technology of lines currently being installed at the present time. A producer will use that speed and size of line that will be compatible with the expected rate of output. If the market area is small, or sales of one type of container are low, one might rationally not chose the fastest line available.

(F.2.3) Distribution Equipment. Is the use of a 10.5 bay delivery truck appropriate? Over time, adjustments may result in different size trucks or trucks with different configurations.

(F.2.5) Other Capital Costs. Your choice of 15 percent and 10 percent for soft drink and beer capital goods, not elsewhere included, seems arbitrary. Is there a basis for this estimate?

(F.3) Employment Requirements. Upon what model do you base your projections of increases in productivity from 1975 to 1985? It is hard to accept your projections of annual productivity increases ranging from 1.9 percent to 6.7 percent, depending on the industry. Information available to me indicates growth rates for productivity considerably below your projections. The estimates for labor productivity increases are critical in developing employment impacts of mandatory deposit legislation. I recommend two sources for projections of productivity increases to 1985: Chase Econometrics, Industry Forecasts, or Inforum, University of Maryland.

(F.3.1) Glass Container Manufacturing. Your estimates for current jobs per million containers of 1.3 to 3.1 are in the same range as the estimate we calculated in the Maryland study, using the Oregon experience -- 2.0 jobs per million containers.

You do not show historical output coefficients on Table F-6 -- it would be useful to have these available

(P.3.2) Metal Can Manufacturing. Your estimate for current jobs per million containers of about .85 is in the same range as the estimate we calculated in the Maryland study, using the Oregon experience -- .8 jobs per million containers.

(P.3.3) Bottled and Canned Soft Drinks. It is difficult to compare estimates for productivity that you provide with what we have calculated in Maryland. Our estimate for soft drink bottlers, which includes some distribution labor requirements, is 13.0 x 10^6 ounces per employee. Your estimate excludes distribution labor requirements of .54 x 10^6 fillings per employee (weighted average, equal to 7.12 x 10^6 ounces per employee). Including both production and distribution labor requirements, your estimate is 22.2 x 10^6 ounces per employee. This sounds high to me.

(P.3.4) Malt Liquors. Your estimates can not be compared easily with our estimates in Maryland. Compared to the soft drink production and distribution, your estimates seem reasonable. However, soft drink distribution should take more labor, as vending machines must be filled.

(P.3.5) Grocery Stores. References 4 and 5 are missing from the end of the section.

I do not understand your estimate of .316 man-years per million cans returned. This number can not be derived from Table F-9.

Why haven't you used the study by James E. Pateet, Soft Drinks: A New Look At Profitability, Case and Co., November, 1972, for your labor requirements at the retail level?

(P.3.6) Metal-Supplying Industries. The last columns in Tables F-10 and F-11 seem to have been left out. They are supposed to indicate employment in metal supplying industries due to metal can usage.

(P.4) Personal Income. You should be careful, in developing these estimates of annual earnings to divide the total payroll by total full-time employment in each industry. This is especially important for the retail sector, which has large numbers of part-time employees.

Appendix G

(G.1) I really like the approach of providing a do-it-yourself kit for evaluating the energy effects of beverage container use in specific geographic regions. Your methodology needs some special understanding to use, but it is the right idea.

I would further suggest including a methodology on the employment effect of beverage containers. I would be willing to assist you in developing it.

I appreciate the opportunity I have been given to review the report. With my suggestions incorporated into it, I feel that the report can assist in the evaluation of a mandatory deposit.

Sincerely yours,

Ted Scheinman

Ted Scheinman
Staff Economist

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ECONOMICS DEPARTMENT

THE SENATE
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STEPHEN F. SLOAN
DIRECTOR
R FORCE ON CRITICAL PROBLEMS

518 474-8087

November 10, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Tayler:

Our comments on Energy and Economic Impacts of Mandatory Deposits are offered below. While we have made marginal notations in some sections of the report itself, they have been primarily for our own use in preparing the comments herein, and represent no attempt to proof the text nor check data calculations.

- Scenarios--It is difficult to ascertain which of the possible outcomes (scenarios) is most likely, although "mid-range" may suggest it is more likely than the "envelope" or the Oregon parameters. We are well aware of the uncertainties of behavioral response to mandatory deposit, but have repeatedly heard from certain manufacturers and the beverage industries that mandatory deposits will lead to a predominantly refillable bottle market. Coupled with the Oregon experience it would seem prudent to incorporate a near-Oregon parameter scenario (perhaps with market shares between those of Oregon and "mid-range") with "floor" trippages, a trippage of 18, and actual Oregon trippages. While we have frequently heard intimations that trippages could not equal those of environmentally conscious Oregon, the argument you make for the convenience of an institutionalized return system (pp. 3-5 to 3-6 virtually all retailers become redemption centers) is most persuasive. We agree that current trippages represent a floor for those under a mandatory deposit system.

- New Technologies--Page 2-24 indicates that, "All reductions in pre-unit energy requirements are based on the assumed complete market penetration by 1985 of currently available energy conserving technologies." We appreciate the difficulty in developing reasonable assumptions, but feel that complete market penetration of current technologies in response to increases in the relative price of energy resources is unlikely. Differential future pricing of alternative energy sources will probably complicate this assumption.

A possible increased use of electric-fired steel furnaces, for example, could contribute an off-setting increase in energy use in the materials processing stage. Further, some informal checks suggest that the pace of new technology development simply will not allow for complete market penetration by 1985 (and, in fact, the impact tables in chapter 3 use 1982 as their actual calculation date).

Offering the reader the option of omitting the energy conserving technologies is also not completely realistic (some conserving measures will certainly take place) and further complicates the broad range of energy impacts. We suggest that some percentage of total market penetration of energy-conserving measures be applied to a near-Oregon or adjusted "mid-range" scenario. Again this reflects our concern that the reader be given some indication of the more probable outcome(s) among the very broad range of scenarios offered.

- Float--Capital requirements should treat float needs most cautiously. This point is well taken on p.3-19, but several other factors suggest that the without-float estimate is the more meaningful figure. Since deposits would be adjusted above the statutory minimum to assure adequate return rates, they are likely to offset a major portion of float investments. Forfeited deposits provide a "windfall" offset to float investments. Also, if a meaningful comparison between non-intervention and intervention scenarios is to be made, it seems most proper to consider those beverage containers in the recycling process a float--and a very significant portion of the float so long as a shift toward use of refillables does not occur. Of course, the cost of this portion of the float is a public one (the cost of recycling and resource recovery processes) to the extent that private firms do not finance recycling programs.

- Net Capital Investments--The most meaningful figures which should emerge from the section on capital investments are the actual differences in expenditures between the non-intervention projections and each of the scenarios. While disclaimors (p.3-15, line starting "Capital requirements..." and p.3-19, line starting "These capital requirements...") of the significance of the differences between these (e.g., the $6.8 billion "additional" needed when comparing the metal-can-market-share-falls-to-zero scenario and non-intervention) appear, they do not go far enough in alerting the reader to what caveats must be applied in judging their meaning.

The statement on p.3-15 ("Capital requirements for the container and metals manufacturing industries were not developed since reductions in container production are projected for all scenarios.") ignores the increase in container production (as compared to current levels) and concomitant capital requirements, in the non-intervention alternative. Additional capital will be required in the container manufacturing industries, and in those industries which provide their

inputs, as container consumption increases with an increasing use of nonrefillable containers. Capital will also be required to get energy conserving technologies on line and to implement sophisticated materials recovery systems if greater recycling of beverage container materials is to occur.

The statement on p. 3-19 (starting "These capital requirements..") does not adequately inform the reader that these figures are derived by applying the capital-output ratio for appropriate container types to the early-1980's scenario market mixes and therefore do not take into account several factors. These are: the continuing use of some refillable bottling lines (our survey in New York indicates that a soft drink bottle line life of 20 to 30 years is not uncommon); the convertibility of "nonrefillable-only" bottle lines to refillable operation (at an average cost of about $200,000 for a 200 BPM line in New York in 1973); the revenue produced and depreciation taken on existing equipment's use from the present to the early 1980's.

As our comments suggest, most of the deficiences we see in the review draft result from a need to explicitly define the terms used (and thereby, the limitations of their meaningfulness), and to indicate the probability of broad range outcomes described.

We should note that we find much of value in the review draft. As noted, we agree that "non-intervention" trippages should represent a floor. The findings of our Jack Faucett Associates study are in basic agreement with your conclusions regarding beverage prices and sales in a mandatory deposit system. Your findings regarding mandatory deposit impacts on resource recovery systems confirm our conclusions and testimony received at hearings in New York this year.

Our thanks for the opportunity to review this draft. We hope that the final report will make a contribution to the resolution of this issue at the national level.

Sincerely,

Bob

Robert R. Quinn
Policy Analyst

RRQ/emh

ROBERT W. STRAUB
GOVERNOR

DEPARTMENT OF ENVIRONMENTAL QUALITY

RECYCLING INFORMATION OFFICE

1234 S.W. MORRISON STREET • PORTLAND, OREGON • 97205 • (503) 229-5119

November 26, 1975

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ECONOMICS DEPARTMENT

Mr. Taylor H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Caroling 27709

Dear Mr. Bingham:

Thank you for the opportunity to comment on your study, "Energy and Economic Impacts of Mandatory Deposits". We in Oregon are very pleased to see the growth of national interest in mandatory deposit systems. The success of our deposit law in Oregon assures us that a national law of similar concept is not too far off in the future. Studies such as this will help lay the groundwork for such national action. This study helps to identify the minor economic readjustment that will be necessary for a mandatory deposit container system to be implemented.

It is apparent to this reviewer that before this study can provide the "important input to an informal decision-making process" for which it was compiled, some corrections and expansion will be necessary.

I will leave it to others to provide comments on the technical data in the study. Other reviewers from Oregon have addressed these areas. From the quality of work in this draft, I am confident that the authors will make the quantitative changes necessary.

Throughout the study, one of the parameters used is "Oregon parameter values". There is no complete test description of these values and their derivation. There is also no adequate explanation as to why Oregon trippage rates are not used. There should be a clear statement of how the parameter values used relate to conclusions which can be drawn from national trends, and how these have been modified by the direct experience in Oregon and Vermont.

The effect of unique modifications in container systems which result from mandatory deposit legislation should be included in all these considerations. Activities such as standardization of containers, relocation of points in existing distribution systems, and a variety of institutionalized systems of recycling and return/refill in both distribution and retail marketing will have major effects on the impacts studied in this report.

There does not appear to be a "full system" analysis for the capitol requirements in the different container system scenarios. Capitol requirements for all phases of production, distribution, retail, return, and recycling, should be considered for each of the systems. In one case, capitol value changes related to can manufacturing are not included. In another case, the value of raw material should be used as a value parallel to capitol needed for a float of returnable containers and associated handling equipment. Values or parallel values should be developed for all of the parameters in each scenario.

More attention needs to be directed at the consumer, not only the effect on him but how he will affect each of the scenarios. Materials which should be considered here are: effects of consumer cost or savings on the various systems; the effects of purchasing power and price on system development; the effects of the container system on purchasing patterns; the effects of consumer attitudes toward each of the systems, with projection of future trends,; and effects of consumer attitudes toward disposal systems upon purchasing patterns.

Two other points which need further clarification are the methodology by which recycling rates for steel and aluminum cans was derived and whether the methodology is applicable to a national rate. Some consideration should also be given to the effects of resource recovery on such an institutional recycling rate and to the relationship of real market value of recyclable material to the present price paid with its associated public relations value/cost.

The second point is the treatment of the relationship of resource recovery to mandatory deposits. Further consideration should be given to the nature of the decision-making process in planning of a resource recovery program. I think it is more important to consider the effects which resource recovery will have on recycling programs and on consumer attitudes than the effects which mandatory deposits will have on resource recovery. In fact, some resource recovery systems, would be greatly benefited by the removal of

beverage containers from the waste stream before processing. In any case, no fiscally responsible Solid Waste Management program is going to be based or dependant on the values of beverage containers in the waste stream. It is difficult at best to project the impacts of resource recovery on the efficiency of recovery. Even the efficiency of resource recovery systems is far from proven. Resource recovery and mandatory deposit systems are highly compatible, but each must stand economically and energetically on its own.

Again, thank you for the opportunity to provide these general comments. I feel assured that if you address these concerns with the same effort which has already been put into the study, the resulting document will be of greater decision-making value.

Sincerely,

LOREN KRAMER
Director

William R. Bree

WRB:lg

State of Vermont

AGENCY OF ENVIRONMENTAL CONSERVATION
MARTIN L. JOHNSON, Secretary
Montpelier, Vermont 05602
DIVISION OF ENVIRONMENTAL PROTECTION

Department of Fish and Game
Department of Forests and Parks
Department of Water Resources
Environmental Board
Division of Environmental Protection
Division of Recreation
Division of Planning
Natural Resources Conservation Council

November 10, 1975

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ECONOMICS DEPARTMENT

Mr. Taylor H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

I am returning Copy No. 90 of your study ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS, as requested.

I find no reason to suggest changes, as the report appears thorough and well done, with the conclusions well supported by the materials and analyses.

I'm sure that some nit-picking may be done by others, however, I'll add only this quiet endorsement. I would appreciate receiving a copy of the final report.

Sincerely yours,

Donald W. Webster
Director

DWW:fmt

Universities

The University of Connecticut

STORRS, CONNECTICUT 06268

COLLEGE OF AGRICULTURE
AND NATURAL RESOURCES
Department of Agricultural Economics

November 20, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

Many thanks for sending me a copy of Energy and Economic Impact of Mandatory Deposit for comment and review. Your letter of October 10 mentioned a deadline for comments of November 14. I was away from my office for three weeks which is why the response is a little late. I trust that my comments will still be of use to you.

Your Report is a valuable contribution to the growing literature on the subject of beverage containers, a subject which is highly controversial yet of great public concern. Your study confirms most of the conclusions of earlier studies, namely that significant energy and resource conservation will probably result from the reuse and recycling of beverage containers. A mandatory deposit is probably the best mechanism for achieving a high rate of return of the containers. At the same time, the deposit system does not discriminate against any package type, although it undoubtedly will alter the relative competitive structure in the packaging industry and possibly also in the beverage industry.

According to your report, a mandatory deposit system could decrease the nation's annual demand for energy by about 200 trillion BTU by 1980. This is equivalent to the combined output of some 12 1,000 MW nuclear power plants. A significant potential saving for supplying about the same quantity of beverage at a probably lower price, but at some loss in convenience to the consumer than would be the case if the present unconstrained system were to continue.

My detailed comments are attached. Thank you for the opportunity to review your report.

Sincerely,

Carlos Stern

Carlos D. Stern
Assistant Professor
Environmental Economics

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Comments on the Review Copy (October 1975) of Energy and Economic Impacts of Mandatory Deposits, by Tayler H. Bingham, et al, Research Triangle Institute, North Carolina.
by Carlos Stern, Assistant Professor of Environmental Economics, University of Connecticut, Storrs, Connecticut. November 24, 1975

1. Capital Requirements

The Report states that the refillable bottle system is the most capital intensive; indeed that its capital requirements will be more than twice that of any other package type. This finding is almost certainly wrong because the Report did not consider the capital requirements of the packaging industry in its computations. In light of the fact that the entire purpose of the Report is to study packaging as it relates to beverages, it is difficult to understand why this basic sector of the industry was omitted; even though for the energy and labor analyses it was included, as it should be, for any meaningful understanding of the implications of Federal action in this area.

On p. 3-15, the rationale for the omission is stated; namely that the container industries are expected to have unutilized capacity for the next ten years, a fact that flies in the face of all recent experience. The aluminum industry, the can industry, and the glass bottle industry have all had above average growth rates over the past two decades. Merely because the recent economic downturn has resulted in some excess capacity is of no consequence in this type of analysis. In fact, it is quite probable that at least the same amount of excess capacity exists in the beverage and trucking industries for the same reason.

Much of the growth in the aluminum and glass industry has been a result of the shift to disposable packaging, and therefore without any question the one-way package must be debited with a share of the capital requirements in those industries. This share, to be consistent, must not be based on the present percentage of output going into beverage containers, but rather should be allocated on the basis of the marginal contribution, i.e. the relatively more rapid growth of the packaging sector than the average over the same period for the steel, aluminum, glass bottle, can and paper industries. The final Report must deal with capital requirements from the basic metals and materials industry through to the retailer in a manner consistent with the labor and energy data. When this comprehensive analysis is done, it will be apparent that the refillable bottle system is the least rather than the most capital intensive of the packaging options.

2. Allocating the Capital Costs of the Float

The Report recognizes that a float is not a normal capital investment since a significant percentage, usually at least one-half of the value of each container, is recouped almost immediately through the deposit collected from the market. Thus, the actual out-of-pocket investment is only about one-half of the cost of the new bottles. In addition, this is a one-time capital outlay; thereafter, except for expansion of the float through growth in volume, replacements—because of breakage—will be an operating cost, and will be paid for out of the normal revenues of the

firm, rather than from new capital. Parenthetically, the Table on p. 3-29 indicates that the annual profits under mandatory deposit legislation are quite likely to be greater than without legislation. This point should be stated more specifically in the summary and conclusions.

3. Inflationary Effect of a National Deposit Bill

A question is raised on p. 3-20 about the likely inflationary effects from the increase in demand for various beverage-related equipment following deposit legislation. Apart from the fact that the demand for trucks is likely to be trivial in relation to the national production of trucks, and therefore the inflationary effects on this item must certainly be near zero, the general inflationary effects from such a specific area of demand should not be seen as a cost to the economy, but merely as a transfer of profit on a one-time basis from the beverage industry to the vendors of equipment.

4. Capital, Labor and Retail Price

On page 3-16 it is stated that the refillable bottle system is considerably more capital intensive than the one-way can and bottle. On page 3-24 the Report indicates that the refillable system is also the most labor intensive. Yet, on p. 31-6, the Report concedes that "...the refillable bottle system experiences savings that result in lower shelf prices than either of the one-way containers..." or, to paraphrase the Report, the most labor intensive system, at the same time the most capital intensive system is nonetheless the least cost of all the systems. As my next point will confirm, the shelf price of refillable containers is, indeed, the lowest. Thus, at least one of the conclusions must be in error; refillables cannot be both most labor intensive, most capital intensive yet least in cost.

5. Retail Price for Soft Drinks

The Table which follows was taken from the Statistical Profile. The Soft Drink Industry of the United States, 1974, published by the National Soft Drink Association, Washington D. C. The Table charts the average price for six twelve-ounce containers, i.e. 72 oz. for two types of soft drink, cola and fruit drink, over a four-year period for twenty-three major cities. Almost without exception, the shift from refillable to one-way packages causes an immediate and sharp price increase. New York, for example, experienced a 50% price rise for cola between 1971 and 1972 when the industry moved from refillable to one-way packaging. Similarly, Seattle with NR packaging was 50% more expensive than San Francisco which had refillables. This information, compiled by the soft drink industry, shows quite unequivocally that the refillable bottle is by a very wide margin the least expensive package for soft drinks. I do not have access to comparable information for beer, but at least for those states which I have analyzed the refillable package is the least expensive, although the difference is by far not as great as it is in soft drinks.

It is important to add here that the refillable is the least cost package despite the fact that without national impetus such packaging has a limited, and at present declining, share of the market, is not universally available, and is in general discriminated against by most retailers. Thus, those economies that might result from

TABLE 12
Soft Drink Retail Prices by City - Annual Averages 1970 1973
(¢ per 72 oz carton)

	1970		1971		1972		1973	
	Cola 72 Oz.	Fruit Drink 72 oz.	Cola 72 oz.	Fruit Drink 72 oz.	Cola 72 oz.	Fruit Drink 72 oz.	Cola 72 oz.	Fruit Drink 72 oz
Atlanta	59.1	58.8C	64.9	65.3	65.2	65.0C	69.4NR	69.1C
Baltimore	68.6	72.3C	*	79.4	102.5	71.2C	103.9NR	69.6C
Boston	93.0NR	73.5C	95.8NR	77.6C	95.6	76.0C	97.4NR	80.4C
Buffalo	71.3	75.8	70.4	78.8	73.0	79.2	72.9	82.6
Chicago	77.0	76.4[1]	78.2	78.3[1]	*	*	99.3[5]	100.7C
Cincinnati	71.4	71.6[1]	73.5	75.5[1]	73.1	79.3[1]	77.1	83.7[1]
Cleveland	70.8	70.5	77.6	74.6	78.9	72.5	79.5	79.9
Dallas	65.5	65.7	64.9NR	66.3NR	65.2NR	68.3NR	66.6NR	70.2
Detroit	95.5NR	94.7NR	99.4	103.6NR	102.2	102.2	101.8NR	107.0
Honolulu	81.3	84.2	88.0	85.1	89.7	85.8	93.4	87.2
Houston	58.7	54.6	62.3	57.6	63.1	60.2C	65.8	63.1C
Kansas City	76.5	70.4	81.6	69.0	84.8	64.7C	87.0	63.0C
Los Angeles	78.2	78.0	79.8	79.0C	81.6	76.5C	84.4[5]	82.5C
Milwaukee	67.1	65.4C	71.8	66.6C	*	68.3C	87.4[5]	69.6C
Minn/St. Paul	75.4	79.2C	77.6	83.4C	78.5	81.0C	87.4	81.8C
New York	71.2	63.1C	71.7	65.4C	112.2NR	63.9C	117.8NR	63.7C
Philadelphia	90.7NR	50.8C	95.8NR	55.6C	96.8NR	58.1C	99.8	59.3C
Pittsburgh	64.9	62.1C	68.6	70.3C	73.3	74.9	75.5	79.1
St. Louis	73.2	70.8C	74.0	68.7C	77.2	58.1C	79.0	60.9C
San Diego	70.0	69.4	70.3	73.4	68.4	75.6	72.9	73.8
San Francisco	70.5	72.8NR	74.0	77.9NR	*	76.1NR	87.8	77.8NR
Seattle	104.9NR	105.3NR	105.4NR	102.7NR	110.2NR	106.6NR	111.0NR	109.8NR
Washington,DC	78.4	90.7NR	96.8NR	100.4NR	110.7NR	103.1NR	112.8NR	102.2NR
U.S. Average	72.6*	69.1[3]	75.8[2]	72.6[3]	83.3[2]	73.2[4]	86.1[3]	75.5[3]

LEGEND
* Prices Not Comparable Throughout Year
C - Cans
NR - Non-Returnables
If no container designation, price refers to soft drinks in returnables

1 - Concentrate Bottles are 16 oz all other are 12 oz
2 - Based on Monthly Prices For a Varying Number of Cities
3 - Based on Survey of 43 Cities
4 - Based on Survey of 44 Cities
5 - 8-16 oz Bottles

U S Average is the average price for a 72 oz carton weighted by the population of each city from a sample of 56 cities
SOURCE U S Department of Labor, Bureau of Labor Statistics, Estimated Retail Food Prices by Cities, 1970-1973

more widespread application, innovation, and other improvements are not at pre being realized. Under national deposit legislation even greater savings to co mers might be attainable.

6. Inter-Industry Transfers

The Report recognizes that with lower prices to consumers, demand for bev may increase, and this in turn would offset some of the expected energy savin However, this reasoning is fallacious. The Report ought not concern itself wi ultimate disposition of any consumer surplus that might result from savings fr less expensive package.

Consumers purchase a full range of goods and services in the market, one which happens to be packaged beverages. It is impossible to analyze just what fers might be taking place as a result of changes in the price of beverages. transfer could go into more energy intensive items or into less energy intens items, but such an analysis is certainly beyond the scope of this Report.

One method might be to consider the average energy content of all goods and services in the GNP, and assume that transfers to and from the beverage industry would be evenly distributed across the entire economy. In that event, transfers to the beverage industry will probably result in energy savings.

In my opinion the Report should avoid estimating retail price shifts, the resulting change in quantity demanded, and the energy consequences of that shift; but should rather analyse the energy implications of providing an identical quantity of beverage under different packaging systems.

7. Elasticity of Demand

The section in the Report dealing with beverage consumption trends (Appendix A) indicates that modest price changes will have relatively little effect on total consumption. In other words, the demand for beer and soft drinks is price inelastic. Available data are not adequate to enable one to make such a prediction with confidence. Since in both beer and soft drinks the larger sellers are in the higher-priced brands consumers can respond to price increases either by "trading down"—buying a less expensive brand and maintaining their quantity consumed—or by "trading out"—substituting some other products for beer and soft drinks. We were unable to find recent analyses that would enable one to predict which of these two options consumers would exercise. The Report assumes that deposit legislation will reduce the demand for beer and soft drinks (p. 2-44). However, insofar as refillable containers help to lower the price of the beverage, demand may actually be increased.

8. Forfeited Deposits

There has been a good deal of discussion about the relative importance of convenience as compared with price as it affects the beverage industry. Proponents of the NR system justify it as being desirable, though higher in price, because it frees the customer from the obligation to return the container.

Seen from this vantage point, it can be argued that some customers—perhaps even a majority—would be unwilling to return the container regardless of the size of the deposit. For this group, placing such a high value on convenience, a mandatory deposit is equivalent to a tax and could cause them to buy less.

On the other hand, as the Oregon and Vermont experiences show, most of the containers will be returned by someone, if not the original purchaser. Seen this way, a deposit system will result in some redistribution of income which in turn may create a new class of customers. Where returnables are marketed, return rates are sufficiently high to demonstrate that the economic incentive is operating.

9. Economies of Scale in Beer

On page 2-39 the Report attributes the reduction in the total number of breweries to the economies of scale in beer production. However, a distinction should be made between the size of the brewing company and the size of an individual brewery. The economies of scale of an individual plant of a national brewery company also can be reached by some local breweries. Rather, it is the aggregated market power of the

national firms, utilized in heavy promotion investments, that has led to their dominance, not price competition or economic efficiency. The largest-selling beers are the higher priced brands. The same certainly applies in the soft drink market where it is advertising power, rather than operating efficiency and resulting lower prices that count.

An important point that is not mentioned in the Report is that the entire market structure as it relates to the beverage industry, from the primary metals and glass sector to the containers and on to the soft drink and beer industries, are classic oligopolies. This means that all these sectors can be characterized by having prices above marginal costs, heavy expenditures in advertising, and excess capacity. There will also be strong aversion to price competition. Economies of scale may therefore not be relevant in the usual sense.

10. Return Rates Under a National Deposit System

A key question is what the return rate on deposit-bearing containers will be. Prior to passage of the Oregon bill, the opponents argued that return rates would fall once the deposit became mandatory. The logic ran that under the earlier optional system economy shoppers and environmentalists were the primary customers of returnables. Once an all-deposit system was enforced, it was argued, the average return rate would fall. The actual experience in Oregon and Vermont was the opposite; return rates improved with passage of the legislation. As far as a national bill is concerned, there are three factors that will affect return rates:

1) Convenience of redemption. Under a mandatory system all retailers and quite possibly redemption centers as well will accept empties. This fact will increase return rates over what they are today where not all stores will redeem returnables.

2) Size of the deposit. The size of the deposit will act as an economic incentive either for the actual consumer or for some other party to return the container.

3) The development of an automated system for receiving cans. The introduction of something like a "reverse vending machine" which could accept cans and issue refunds would facilitate can recycling. With such a system in place, the can would retain most of its convenience, being easier for the shopper to carry and to store. Under such circumstances the metal can, quite possibly the aluminum can, could become the dominant package. Such a system has not yet been developed and, as a result, the can is currently at a competitive disadvantage in Oregon and Vermont. It is important not to project these limited results nationwide into the 1980's.

11. Improved Technology for Refillable Glass Bottles

The Report seems to have assumed a very static technology for manufacturing refillable glass bottles. Historically, this has certainly been true, since the industry had little incentive to improve the competitive position of the refillable container vis-a-vis the one-way bottle. Under a national bill, the increased demand for refillable bottles would probably stimulate improvements that would increase the efficiency in transportation and filling, and prolong the life of the bottle.

The Report assumes (pD-121) that the inefficient shapes currently used in beer and soft drink refillables would be retained through the 1980's. In beer, the classic shape for refillables has been the so-called "export" or "bar" bottle, which is unusually tall and heavy in relation to its volume. It is possible that the beer

industry may wish to stay with this shape because of its distinctiveness, but it is certainly not necessary to make a refillable bottle in that particular shape. Both Olympia and Coors, to mention only two breweries, are having success refilling a bottle very similar in design and in weight to the NR bottle. The same holds true for soft drinks where bottlers sometimes select a highly inefficient design because of its distinctiveness and not for its refillability requirement.

In sum, the Report should deal specifically with the potential for significant improvements in refillable glass bottles.

12. Average Size for Refillable Bottles Under a Deposit System

On p. 3-22 the Report states that the average size of an NR bottle is going to be about twice that of a refillable bottle by the 1980's. Although this describes the present situation, it should not be projected to the future since under a mandatory deposit system, the NR bottle will be virtually eliminated and the refillables will have to be provided in the sizes demanded by consumers. The average size of glass bottles then, should not be significantly altered by deposit legislation.

13. Reusable Packaging

It is quite likely that with a national deposit bill six-pack carriers and other packaging materials could be made reusable. The Report concedes that associated packaging might make several trips, but does not analyze the energy-resource savings of this option. Under a national deposit system the bottles and cans will probably be brought back in the cartons and packages in which they were originally purchased, making these materials also available for reuse, or at least for recycling. The potential energy savings from this should be included in the final Report.

14. Resource Recovery and Deposit Legislation

In my opinion, the Report gives too much emphasis to the potential for resource recovery within the period of analysis. It is highly unlikely that by 1985 more than a very small fraction of post-consumer waste in the United States will be reprocessed. In any case, a very significant conclusion is stated on p. 3-31 which should be given more prominence in the Report since it is an issue of some controversy. The Report states that "even completely eliminating beverage container waste from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal of situations."

15. Transportation Costs for Returning Empty Bottles

The question of transportation costs and the associated energy requirements is an especially difficult one because of the complex structure of the beverage industry. For instance, in our study, we found that although one could map the location of breweries, container manufacturers, and wholesalers quite accurately, one could not with confidence relate these differences to additional transportation that would be required under a refillable container system, for the simple reason that some firms use a fleet of brewery or bottler-owned trucks which travel empty in the one direction and could therefore transport empty bottles at little extra cost in energy.

On the other hand, other firms use contract shippers or back-haul, and would therefore have to make special trips to transport empties. In all, estimating additional transportation requirements for a refillable system is one of the more difficult aspects of any study predicting the consequences of mandatory deposit legislation.

16. Transportation Distances for Beer

In calculating the energy and resource requirements of a refillable system for beer the Report has assumed that refillable bottles would be shipped from breweries that are on the average 425 miles by truck and 600 miles by rail from the wholesaler, contrasted with NR bottles and cans which average only 235 miles by truck or 350 miles by rail. No explanation is given as to why refillables will, in 1980, have to travel nearly twice as far from brewery to wholesaler than one-way containers. Indeed, simple economics would suggest the reverse, refillables are more sensitive to transportation costs because they are heavier and must make the extra return journey. There may be one brewery for which these figures apply; but it is certainly no basis for extrapolation to the national level in the post-1980 period. Not only is the difference between NR's and refillables almost certainly in error, but the absolute distances are highly improbable.

In our study, (Stern et al, (see page R.-2)), we found that 85% of the beer being shipped into Connecticut (Connecticut having virtually no brewing capacity), was shipped from within 150 miles and by 1980 over 97% of the beer will originate from within that distance if the present market shares of the individual firms is retained. It seems probable that most metropolitan areas are predominantly served by breweries within the same distance. This is certainly the case in Oregon and New York.

In an earlier section, p. 2-44, the Report concedes that a shift to refillable will favor breweries closer to the market. The final Report should recalculate the transportation requirements, reducing the transportation distances to about 100 miles, a reasonable average, and recognize that some trucking and perhaps even rail shipping is being done in cars that are presently returning empty to the brewery. Finally, the Report should consider the fact that by 1980 refillable beer bottles may well be standardized such that even if some beer is shipped in from a greater distance it may be the local brewery that reuses the bottle.

17. The Returnable Plastic Bottle

The Report asserts on p. 2-45 that imposing a mandatory deposit will inhibit the introduction of the plastic beverage bottle. No explanation is given; in fact the opposite may well be the case. The plastic bottle is probably desirable only to the extent that it will be returned either for refilling or for remolding. It would not make any sense to introduce a new container, manufactured from scarce petrochemicals, merely to be discarded after one trip. The plastic industry realizing this is suggesting a voluntary redemption system for 15¢ per pound, and is hoping for a high return rate. The question therefore is not whether the plastic bottle will be returned; that point seems already to have been decided, but rather, what the economic incentive should be, where the container should be returned, and what the return rate could be. On all these counts, a mandatory deposit system could only enhance the competitive position of the plastic bottle relative to other containers.

18. Refillable Plastic Bottles

The Report dismisses too casually, in my opinion, the potential for refillable plastic bottles. On p. D-62 the Report lists the important advantages of such a container, the significant potential for energy reductions, its high-filling speeds, savings in transportation and in supplementary packaging, virtual unbreakability, etc. and then concludes with a non sequitur that the "development of the refillable plastic bottle technology... is dependent upon proven development and use of non-refillable plastic bottles first." Thus, according to the Report, "..any forces which affect the market potential of non-refillable plastic bottles will also hinder the development of refillable plastic bottles."

If the plastic bottle has important advantages over glass, there will be every incentive to develop such a package whether it is preceded by a one-way plastic bottle or not. It is quite possible that under a national deposit system a refillable plastic bottle could well be the most competitive and socially advantageous type of package.

19. Primary Fuels for Electric Generation

The Report differentiates the energy types by source for the primary purpose of crediting aluminum electric consumption with the fact that some percentage of it is generated from hydroelectric power. (Pages D-80-85) in this respect, the Report reflects the position put forward by Dr. Robert Testin of Reynolds Aluminum Company. In my opinion, this distinction by fuel is unrealistic and confuses rather than clarifies the issue from the standpoint of energy conservation. Granted that aluminum production has taken place traditionally in areas enjoying low-cost hydroelectric power, this does not imply that continuing sources of baseload of hydroelectric power will be developed. In fact, the opposite is true. The trend is to convert existing hydroelectric installations to peaking use and to generate baseload electric power thermally, either with nuclear or with coal as fuel. By 1985, it is likely that very little baseload hydroelectric power will be available and there certainly will be no new baseload capacity of this type. Thus, it is unreasonable to project the historic electric generation mix into the future.

20. Electric Energy Conservation and the Interchangeability of Fuels

An even more important problem with the extrapolation from the present generating mix is that it assumes that any electric energy conserved by producing a certain percentage of the aluminum from scrap rather than from bauxite will reflect the existing generating mix on a regional basis. However, this is clearly not the case. The units shut down when demand is reduced are those which are most costly to run and which utilize the most expensive fuel. The notion that water will be spilled rather than passed through the turbines at hydroelectric installations is simply not realistic. What this study needs to do is to examine the electrical dispatch models used by each regional grid. From that one can derive the fuel type and heat rate of the marginal unit; that is, those units whose operation would be cut down if some energy conservation of a baseload nature were implemented. It is virtually certain that it will neither by hydroelectric nor nuclear operations that would be curtailed, but rather less efficient oil or natural gas-fired units.

If fuels cannot be substituted one for another, there can be no national energy policy. Obviously, a gallon of gasoline cannot be directly replaced by a miligram of uranium. That is not the issue. At the margin, all fuels are interchangeable which is why conservation of any form of energy is in the national interest.

21. Heat Rates and Transmission Losses

The use of average heat rate for purposes of electrical energy conversion is not strictly adequate because of the associated transmission losses. In the past, aluminum reduction plants were usually located close to a particular hydroelectric facility; but as the regional grids become more interconnected, and as thermal plants replace hydroelectric plants for baseload generation, greater transmission losses are being incurred, and some penalty, probably about 10%, should be added to the overall heat rate to account for transmission losses. This will be true especially in the 1985 period, when it is likely that new thermal facilities will be located even farther from the load centers than was previously the case.

An argument could be made for debiting the heat rate of nuclear plants by an additional 5% since the uranium enrichment process requires about 5% as much electric energy as is ultimately available from the fuel.

It is important to emphasize that energy conservation has a pay-off greater than the BTU saved directly because it requires an expenditure of energy to operate, process, refine, and otherwise power the system that makes energy available to the end-user. In other words, there is a multiplier effect, which compounds the BTU's saved by some ratio. FEA should have calculated the various multiplier coefficients for each form of energy which would enable the authors of the Report to compute the total amount of energy the nation would conserve under the various scenarios presented in the document.

The University of Connecticut

STORRS, CONNECTICUT 06268

COLLEGE OF AGRICULTURE
AND NATURAL RESOURCES
Department of Agricultural Economics

December 31, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

On November 20, 1975 I wrote you a set of comments on your study Energy and Economic Impact of Mandatory Deposits. My comment number one dealt with capital requirements and I made the case that the capital requirements for the entire beverage industry must include the capital requirements of the energy sector, the primary metals industry, the packaging industry, and any other sectors supplying the beverage industry to the point where the beverage is delivered to the retailer and beyond that, to the ultimate solid waste disposal. The draft report only considered the capital requirements of the beverage and retail sectors, although the energy and labor considerations were continued back to the primary suppliers.

The rationale given in the draft report for stopping the analysis at the brewery-bottler level was that there was sufficient "excess capacity" in the primary metals, energy and packaging industries through 1985 to satisfy all the requirements for cans and bottles with no expansion necessary.

I took issue with this assumption at the time and since having written you enough additional information has come to hand—albeit of a specific nature; I have not had the time to do an aggregate analysis, to show that the excess capacity assumption is not valid.

1. I have already sent you separately a brief extract from the N.Y. Times announcing a $20 million beer can plant to be constructed by Miller Brewing Co. in upstate New York. To my acknowledge both a glass bottle plant and an additional can plant are planned for the Schlitz brewery also in upstate New York.

2. The primary aluminum industry has been continually expanding its capacity since the Second World War. In the ten-year period, 1963-1973, primary aluminum capacity increased by 94%. It is probable that this same rate of expansion will continue to 1985. [Source: The Aluminum Association, Inc. Aluminum Statistical Review, 1973, p. 33].

Aluminum used in containers and packaging has experienced a far higher growth rate than total aluminum. In fact, it was the fastest growing use of aluminum by far. Between 1963 and 1973, aluminum for this end-use increased 315%, or 3½ times faster than the aluminum industry as a whole. In 1963, packaging consumed 7.8% of total aluminum; in 1973 this had grown to 15.2% of the total.

Of the aluminum markets listed in the same report by the Aluminum Association, metal cans grew at a faster rate than any other sector of the industry, between 1967 and 1973, a 225% expansion in only 5 years. Clearly, the aluminum can has been a major factor in the growth of the aluminum industry.

At the margin, the aluminum can will probably be responsible for a significant percentage, possibly in excess of 20%, of the planned expansions in primary aluminum capacity, since packaging is already 15.2% and the can is growing at over three times the rate of the aluminum industry as a whole.

I have not been able to find any evidence that the aluminum industry considers its present capacity adequate for the next decade. In fact, the annual corporate reports of the major companies describes their planned expansion. I have just received the annual report for 1974 of Alcan Aluminum Ltd. which shows that company investing $268 million for [illegible] new plant, the highest in that company's history. The average for the years before 1974 was in excess of $100 million annually. Despite the fact that it is a Canadian company, Alcan has facilities in the United States and is now the fourth largest aluminum fabricator in the U. S.

Alcoa, the largest U. S. aluminum company invested $356 million in 1974 as part of its long-term expansion program. Reynolds spent $125 million. Of course the growth in capital outlay was not confined to the aluminum industry. American Can invested $114 million, Owens-Illinois $165.5 million, and Brockway Glass $41 million in 1974.

These annual reports to stockholders contain much documentation regarding the role of the container in the company's growth and expansion program. For example the Brockway Glass 1974 report states

> "...for 1975 your directors have approved the largest capital spending budget in Brockway history. This proposed program of approximately $41 million represents more than twice the amount of capital spending we have averaged over the past five years. Our primary objectives are to increase the capacity and improve the productivity of our glass container manufacturing facilities..." ..."the glass container division still accounts for about 86 percent of the company's total annual sales."

Along the same lines here is an extract from the Crown Cork and Seal Company Inc., 1974 annual report,

> "Capital expenditures amounted to...$37,716.00 within the United States. 90% of this amount was for the installation of additional lines for the making of drawn and ironed cans."

All these dollar investment amounts are for the single year, 1974, and would need to be projected through 1985, the period of your study.

3. It is very important that when the capital requirements for the different packaging options are computed that the capital cost of the energy supplies for those options be included as well. The draft report studied the energy needs on a BTU basis and concluded that approximately 0.2 Quads (10^{15} BTU's) might be conserved as a result of mandatory deposit legislation.

According to data supplied to the Securities and Exchange Commission, the incremental capital required to deliver one quad of electric energy per year is $56 billion. On that basis, the 0.2 Quads that deposit legislation might help conserve could also save slightly over $11 billion of associated capital. It is essential that your final report incorporate the capital requirements of the energy sector under the various scenarios. [The $56 billion figure is taken from Weekly Energy Report, Vol. 3, No. 48, December 1975, p. 8].

4. There seems to be a discrepancy between the figure used in your report on page D-157 of the percentage of aluminum cans recovered in 1973 and the statistics compiled by the industry. Your report states this percentage as being 16.8%. On the other hand, the Aluminum Statistical Review of 1973 published by the Aluminum Association Inc., gives data which would put the recycled percentage as nearer 4.5%. The Review gives shipments in 1973 of metal cans as 654,000 tons (page 23) and a recycle of only 1.6 billion cans, equivalent to 34,000 tons (page 38). On this basis only 4.5% rather than 16.8% should be used as the recycle rate. Is it possible that Franklin Associates used the tonnage figure for all post-consumer scrap aluminum and converted this aluminum can equivalents? After all, in 1973 very few areas of the country had active aluminum recovery centers and none had municipal separation programs in operation.

I hope that these comments are of use to you and trust they will be included in the final report.

Sincerely,

Carlos D. Stern
Assistant Professor
Environmental Economics

CDS/dl

The University of Connecticut

STORRS, CONNECTICUT 06268

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
Department of Agricultural Economics

March 4, 1976

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

In my letter of December 31, 1975 on page 3 I took issue with the percentage of aluminum cans being recycled in 1973 as stated on page D-157 of the Draft Report.

I suggested that the figure might be nearer 4.5% rather than 16.8% used in the report. I had based my estimate on the tonnage of can sheet shipped by the Aluminum industry but it has been brought to my attention that the total tonnage would include both the 30% excess that is left after the can bodies have been stamped out and the usage of can sheet for ends on steel cans. Since I don't know how many tons of aluminum sheet are used as ends on steel cans I am unable to derive the tonnage committed to all-aluminum cans in 1973. I therefore would like to withdraw my comment, (point 4 page 3 of my letter of 12/31/75).

Sincerely,

Carlos D. Stern
Assistant Professor
Environmental Economics

CDS/dl

c.c. Dr. William Franklin

University of Illinois at Urbana-Champaign

Graduate College
CENTER FOR ADVANCED COMPUTATION
Urbana, Illinois 61801

November 4, 1975

RECEIVED
NOV 7 1975
ECONOMICS DEPARTMENT

Taylor Bingham
Research Triangle Institute
Box 12194
Research Triangle Park
North Carolina 27709

RE: Comments on "Energy and Economic Impacts of Mandatory Deposits," October 1975.

Dear Mr. Bingham:

1. The report does not clearly address the cost to the consumer of beverages from the various systems, including such externalities as waste disposal. It should do so in the summary. The report appears to be an assessment of some of the impacts of the change to refillable containers on the production system. As such it confuses the real issue: what are the total system demands in terms of dollars, energy, capital and labor, for the various alternative delivery systems.

2. Having estimated the total system costs you would have been clearly faced with the proposition of disposal of the dollar savings resulting from a shift from throwaway to refillable containers. Had the consumer spent these savings in an average way, how would he have imported the labor, capital and energy demands? Your report does not say and yet I know these effects to be larger than the effects within the industries themselves.

3. You calculate the capital costs required to change the system to refillables, the major portion of which is the cost of the "float" of refillables themselves. You then ignore similar container costs for the all aluminum, highly recycled system. But this is an error in concept. If the float is capital in the returnable system then the "float" of aluminum (as cans, ingot and can stock) is also capital--if the plan is to recycle aluminum containers, you must be consistent in your definitions and their application. There is an additional danger to which I see you tending. That is, the comparison of initial capital costs per unit of energy saved per year, for different container systems. This is an erroneous comparison because the different systems

have different rates at which capital investments (or energy investments) will be paid off. A more appropriate form of comparison would be the energy cost of the capital per unit of energy saved per year in the change from one system to another.

4. Why do people obviously prefer refillables and yet overwhelmingly not buy them? Why have governmental bodies been unable to act to control the industry in the face of such consumer desires? Does the packaging variety, pricing policy and availability of the beverage in various container forms effect consumer choice? Are consumers lying about their real preferences? These questions deserve answers in your study.

5. Is the energy cost of a special trip to a recycle center for aluminum cans counted in your report? If you did not count it by assuming that the beverage sellers will accept the empty cans, how do you square this assumption with retailer behavior in Oregon where they simply refused to sell the beverage in cans?

6. In Table 2-9, compare the energy cost of infinite trip bottles with 100 percent aluminum can recycling. Also I generally agree with your energy costs per ounce, but not the energy savings for a national change to refillables. I got nearly twice the net energy savings. In general you do not compare your results with other previous studies. RTI was by no means the first institution to do an analysis of this problem (nor unfortunately will you likely be the last).

7. In Table 2-14 and 2-16 you obscure the most important point: what is the container cost per filling at the bottler level and what is it as a fraction of the other costs, for each delivery system?

8. You assume increased can recycling as refillables fade from use but not increased trippage as they become the dominant container. What is the basis for this logic?

9. Table 3-11 has a units error.

10. The results of your refillable trippage model are considerably lower than those calculated by COKE USA and by the Glass Container Manufacturing Institute. How do you justify these disparities?

11. The most specious argument of all is that which indicates a reduction in the value of the solid waste stream due to a reduction in aluminum (can) content if we switch to a refillable system. Would you have those who mine and beneficiate iron ore leave some iron in the ore waste so that it is less economically inefficient to process ore mine wastes? Would you have each person swallow a little

platinum to increase the value of sewage so that the sewage treatment plant operates at lower economic inefficiency? Shall we leave oil in the oil fields to make tertiary oil recovery more attractive? Of course not. Your view stems from the myopia of the "solid waste manager" – Increase overall system costs so as to improve the economic efficiency of a particular element. It is the classic error produced by suboptimizing and I am surprised that you fell into the trap.

12. You did not evaluate the alternative, for the beer industry or for the large soft drink bottlers, of dispersing their filling facilities (while maintaining central brewing or syrup facilities) and using refillable bottles exclusively. This would probably be the least system cost solution. In other words you have not calculated the effects of the long term trends of centralizing the production facilities, the importance of the throwaway containers in capturing distant markets and the increasing demands for energy as this process occurs.

Respectfully,

Bruce Hannon

Bruce M. Hannon, Director
Energy Research Group

cc: Roger Sant
Mike Power
Mo Zussman

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Summer Field Program

November 25, 1975

RECEIVED
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ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Energy and Environmental
Research Division
P. O. Box 12194
Research Triangle Park, NC 27709

Dear Mr. Bingham:

I am sorry to be late in responding to your draft study: "ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS." Unfortunately, I had not planned on a case of the flu and hence have not had time to do as thorough an analysis as I had hoped. I have reviewed the comments being offered by Ms. Patricia Taylor and Mr. Forest Golden. Essentially they point out the same questions that I would raise.

Generally, my major concern is that your study deals with bits and pieces of the system and lacks a unity of a true systems analysis. To deal with capital costs from only the producer, distributor and retailer points of view is unacceptable. Any meaningful analysis should include all of the costs--to the consumer, to other industries who must share the energy and material resources with the beverage industry, and to the tax payer who must bear the ultimate burden of resource shortages, litter abatement, etc., etc.

I am enclosing a copy of the most recent issue of the Conservation Foundation Letter. Rather than ask you to take any more time reading my response, I would ask that you read this report. I think it speaks eloquently to the problem before you.

Thank you for the opportunity to review the study and I will look forward to seeing the final product.

Very truly yours,

David L. Hanselman, Associate Professor and
Coordinator, Educational Communications

Enc.

Conservation Foundation Letter

October 1975

[illegible], New York 10210

File No. [illegible]

Net Energy Analysis Can Be Illuminating

SUMMARY: Energy analysis is an emerging methodology used to better understand our current energy and economic problems and to facilitate the discovery of solutions. It involves *computations of "net energy" derived* from a system — the amount of energy remaining when energy inputs have been subtracted from energy outputs. It is particularly relevant since we have grown into an industrial society based on intensive use of energy — and since it is taking more and more energy to produce energy. Analytical techniques must be used carefully, however. Different forms of energy have different uses and values to society. They cannot always be massaged together. It is also difficult to establish the boundaries of energy analysis. Energy analysis can be a useful supplement to economic analysis. In the long run, however, social constraints may be the most obstinate of all.

For a long time, the chief criteria for decision-making in our society have been economic — values defined in dollars, cost-price mechanisms, profits. But now another measure of value has taken on great importance: energy.

We are accustomed to asking: How much will it cost, and how great will the profit be? Now there are other relevant questions: How much energy does it use, and how much energy will be saved or returned?

Speaking of nuclear power projects, W. Kenneth Davis, a vice president of Bechtel Power Corp., has said there is "an energy investment just as there is a financial investment and there is a necessity to show an energy profit."[1]

There is now emerging a rather specialized methodology for measuring and understanding the energy flows in a given project, process or product. It is *energy analysis*. It is used, for example, to calculate the energy inputs and outputs, or the "net energy" derived in a system. It has been called energy accounting, energy cost evaluation, net energy analysis and other labels. (Last year, at a meeting in Sweden, an international group of pioneers in the field agreed to stick to the term energy analysis.)

It is not viewed as a substitute for economic analysis, but as a complement to it. In some respects, to be sure, energy and economic costs are inseparably fused. Rising energy costs have been permeating the system, generating higher economic costs and inflation. This is one reason why many companies recently have balked at going ahead with grandiose energy projects they planned — oil shale development, coal gasification, nuclear power plant construction and the like. And why some pollution control projects are in trouble as well.

How did we drift into our present energy dilemma? In large part because we took for granted an endless supply of cheap fossil fuel energy. As Dr. Howard T. Odum, a professor of environmental engineering at the University of Florida, has noted: "Only the last two centuries have seen a burst of temporary growth made possible by the one-time use of special energy supplies that accumulated over long periods of geological time."[2]

These bountiful energy supplies offered a means to boost *labor productivity and profitability*. So industries were seduced into squandering energy and shifting to capital and energy-intensive processes at the expense of labor.

The United States' highly mechanized agriculture is a conspicuous example. (It has been estimated that the agriculture industry consumes more than five times the energy content of the food it produces.[3])

So we have locked ourselves into an economy heavily dependent on intensive use of energy, and we can expect to have considerable trouble making necessary adjustments.

"Energy in a system can be tracked in the form of materials as well as pure energy forms."

"Beware of gross calculations."

To understand how energy analysis can aid public and private decision-making in these days of energy constriction and rocketing costs, it is important to examine some basic facts about energy. In the first place, an energy transaction can seldom be measured with the same neat precision as an economic transaction expressed in dollars. There are different kinds of energy, different sources, different uses and different ways of measuring.

For one thing, we have energy stored in structural states — in the chemical structure of a lump of coal, in the cellulose of a piece of wood, in the hydrogen atom, in the water in a reservoir. And we also have energy in kinetic states — such as electricity, heat and motion.

Energy is constantly being transformed from structural to kinetic states (coal changed into electricity) or vice versa (sunlight embodied in a plant). So energy in a system can be tracked in the form of materials as well as pure energy forms.

Rice Odell, Editor

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Under the First Law of Thermodynamics, the law of conservation, the total amount of energy is constant. But its forms change, and there are differences in the amount of work and types of work that can be done by various forms. Oil is a highly valued energy species. You can run cars on it. Natural gas is even more desirable. It can be easily piped back and forth and can be used for many purposes, including electricity generation, home heating and industrial processes. Electricity can run computers.

So there are major differences in the value per Btu of energy forms. And, under the Second Law of Thermodynamics, the law of entropy, there will always be, in any energy transaction or transformation, a net overall loss in the *quality* of the energy (even though part of the output, such as electricity generated from coal, may be of higher quality). Entropy can be defined as an increase in the inability to do work.

There is zero entropy in gravitation. But terrestrial waste heat has lost almost all its ability to do work. As changes occur in the universe, energy continually slides down the scale, and entropy increases.[4]

The most frequent and well-known use of energy analysis is to calculate the total energy cost of producing and operating something, and then compare it with alternatives. This has been done in analyses of manufacturing,[5] agriculture,[6] transportation[7] and energy production itself,[8] as well as in studies of materials,[9] appliances,[10] bottles (returnable vs. throw-away"[11]) and other products.[12]

"In general, a more efficient device will cost more energy to produce," says Milton D. Rubin, of the Raytheon Co. "However, usually it will be found that the extra energy necessary to produce the more efficient device will be paid for very rapidly in the operating savings."[13]

The air conditioner provides a theoretical example: to double the energy efficiency it would perhaps be necessary to double the weight and thus the energy needed for manufacture, but the extra energy cost might be saved by six months of operation. (The monetary cost could be another matter.) But in the case of the automobile, as Rubin points out, a smaller, lighter car will not only consume less energy in operation, but require much less to manufacture. (And cost less as well.)

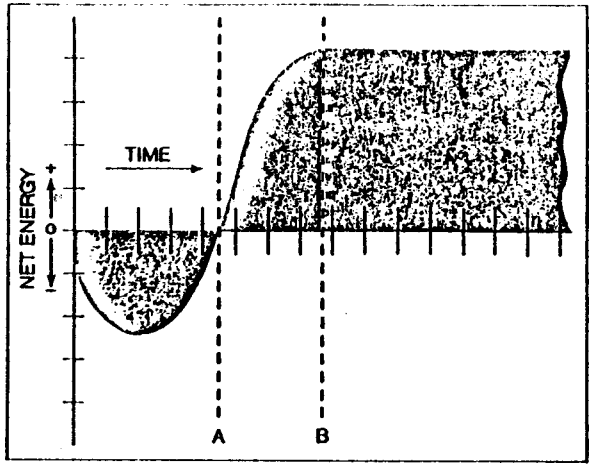
Energy analysis has often been used to quantify in energy units the value of natural systems. For example, the calories of sunlight that fall on an area, or that are captured by plants through photosynthesis. But analysts must beware of gross calculations of energy that is not really available or usable, and there is some disagreement among them over methodology. Dwain Winters, program analyst with the Environmental Protection Agency, explains a widely accepted technique using solar energy and wind as examples:

"Although nature provides us with vast quantities of solar energy every day, this does not necessarily make an abundant energy source. For the energy to serve the needs of technological society, it must be subject to concentration and storage. Therefore, the measure of solar energy's availability lies in the relationship between the energy cost of the equipment used to concentrate and store the energy and the gross energy output of that equipment." He adds that analysis now in progress suggests that a signifi-

amount of net solar energy probably will be available.

"For people who dry clothes on a line, the wind is an important source of energy," says Winters. "You could figure out the total kinetic energy of the wind. But that would not be its energy value to society. What we need to know is its energy opportunity cost. That is the amount of energy that would be needed to do the same work by a substitute method, such as a clothes dryer. So the value of the wind is not fixed, but varies with the energy cost of the technology that is used to replace the wind's function.

"The methodology applies equally well to any energy sources."



From the start of planning to the completion of construction (at line A), an energy production plant takes a certain amount of energy from society. At some point after the plant has begun operation, it will have paid back an amount equal to what it borrowed. That point is at Line B. Thereafter, the net energy gain to society depends on how long the plant is kept in operation.

It has been noted that different energies have different values. One indication of value is the kind and amount of work the energy can do. Another is its relative availability — how abundant is the energy, and how easy to extract.

This points to one of the problems which must be considered in an energy analysis — the "mixed fuels problem." Says Winters: "If we take 1,000 Btu's of natural gas and compare it with 1,000 Btu's of oil or coal, we can see that they are not of equal value to society. They are not interchangeable in their work tasks, nor does their use create equal environmental or social costs. In some cases, adding different energy species together raises serious questions about what the results really mean."

The search for higher quality energy can lead to perfectly rational decisions to accept a very small net energy gain or even "negative net energy." For an example, Winters takes an imaginary energy analysis of oil shale. "Suppose it showed oil shale to be a negative net producer. Ignoring for the moment the environmental and economic aspects, we still might want to go ahead with oil shale production if society places a high enough value on the resulting liquid hydrocarbon fuel.

"In such a case, oil shale might be particularly attractive if it could be subsidized by an abundant energy source such as coal, and if it represented a more efficient way to convert coal to synthetic oil than direct coal liquification."

It should be remembered, however, that while it may be practical to have a significant net energy loser in an energy system, the system as a whole must deliver a high net yield.

There can be reasons other than energy quality to accept less net energy. One is geographic. Society may justify a heavy expenditure of energy to extract and transport fuel to a distant city where it is most needed. Another consideration is time. Society could condone a net energy loss to gain time to develop a promising new source. Thus the United States can be viewed as encouraging nuclear power in the hope that it will tide us over until fusion, solar energy or some other technique is readily available.

Much energy analysis, in fact, is focused on the costs of obtaining energy itself. One study concluded that in the United Kingdom, five energy industries (coal mining, oil refining, coke, gas and electricity generation) jointly consume more than 30% of the UK's total energy input."

Of course the problem is exacerbated in the U.S. as reserves such as oil and gas become increasingly unyielding and costly to extract (not the case with coal stripped from land in the West, to be sure), and as more primary fuels are converted to secondary energy sources (gasification of coal, for example). "Many proposed alternative energy sources would take even more energy feedback than is required in present processes," says Odum.[3]

Winters points out that if we are planning on shifting to a solar or nuclear economy, "we need to know to what extent such an economy is self-sustaining and where it is dependent on fossil fuels. If we're going to make these transitions, we want to make sure we've made the appropriate use of our fossil fuels to get us from here to there."

Winters notes that during the planning and construction of any energy production facility, the project is borrowing energy from society. "When the plant begins operation it starts paying back this debt. If the plant is a net energy producer, eventually it will pay back this debt and then contribute a net energy gain to society until the plant wears out. For any energy process, there is this period during which it is a net energy sink. Just how long the period lasts should be of considerable interest."

The chart on page 3 illustrates a theoretical energy sink, payback period, and net gain in energy. "We need to know the payback period relative to different energy species," says Winters.

The length should be of particular interest with regard to nuclear power technologies. For even if a nuclear plant should turn out to be a substantial net energy gainer, it could still create a net energy problem. If nuclear plants are built in too rapid succession, there might be temporary energy shortfalls because of the immediate demand for energy to build the plants.

A workshop of the International Federation of Institutes for Advanced Study (IFIAS) offers this example (with the figures picked for illustrative purposes):

"Consider a country embarked on a program of nuclear reactors. Suppose such reactors to have a 30-year life, and to have a capital energy requirement to build them equal to 10% of the total energy production in their life; that it takes six years to build a reactor, and one new reactor is started each year . . . For many years the country will incur a net energy deficit (11 years), and 20 years will elapse before the cumulative energy production exceeds the cumulative energy investment."[3]

Two parallel debates over nuclear power are being waged — one over its energy efficiency and one over its cost efficiency. Davis, of Bechtel Power, estimates that all the energy invested in a nuclear plant is repaid after 2.3 months of full power operation.[4] Similarly, many utility executives have touted nukes as great cost savers over coal-fired plants.

Nuclear critics, on the other hand, charge that industry calculations are carefully tailored, and don't include all the money and energy costs (or subsidies) associated with mining uranium ore, enriching nuclear fuel, reprocessing, research and development, insurance, safety, plant decommissioning, and long-term waste disposal and safeguarding.

"When all energy inputs are considered," says energy consultant E. J. Hoffman, "the net electrical yield from fission is very low."[5]

Much of the difference between the various estimates lies in what the analysts include in their accounting and what they leave out. In other words, where they draw their system boundaries. And that is a critical decision in any energy analysis. "If you let me draw the system boundaries wherever I want, I can make almost any project look good or bad," says Winters. "That's the nature of the game."

He says the boundary is determined in part by the question you're trying to ask. "You may be interested only in the energy you're borrowing from society as opposed to the amount you're returning. You may be interested in the rate at which you're depleting a resource . . . In that case, what you do is put the resource that's in the ground within the system boundary of society."

Or, in accounting for the energy cost of an automobile, do you include the gas an assembly line worker uses getting to the job? The energy used to make *his* automobile? The gas used by those who made it? Perhaps the most important thing an analyst can do is make very clear what his boundaries are.

"Energy can be a more sensitive indicator than money."

Energy analysis can help identify the most fruitful conservation strategies. It can compare the savings from home insulation with the energy costs of making and installing the insulation. It can pinpoint ways to reduce the energy intensiveness of a manufacturing process and thereby lower the energy input per unit.

Winters says that an overall conservation strategy is suggested by the fact that some 70% of all energy used by a final consumer is in the form of goods and services, rather than species of energy such as electricity and gasoline. "So if we really want to cut down our consumption, there's probably more room to attack that sector than there is in how much gasoline we use or how much we heat our houses. What this implies is somehow changing the product mix." Such as shifting to returnable bottles or smaller cars.

Energy analysis, says the IFIAS workshop report, is a means of identifying the constraints of a system. "For example, by means of thermodynamic calculations one may establish the theoretical energy requirements for a process, and compare them with those of present technology. This gives one a feel for the extent to which a given technology could be developed — a limit not identifiable by economic methods."

Energy analysts certainly don't see their techniques as a replacement for economics — though the limitations and failures in trying to apply economic analysis and operate a market economy have been all too obvious. (One thinks of the widespread anti-competitive prac-

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tices and arrangements, including OPEC; *the natural monopolies* like public utilities; the government regulation induced by varied corporate abuses; the distorted flow of information; the failures to account *for external effects such as pollution*; and the many subsidies provided by taxpayers. The effects include social inequities, environmental degradation, resource scarcities, recession and *inflation.*)

Winters suggests that an economic analysis can be made of an individual technology — or a mix of technologies — to check feasibility, and this can be followed by an energy analysis to ascertain efficiency.

The IFIAS group is particularly interested in the use of energy analysis to understand price changes and other factors in the economic system. It can be a "means of injecting physical variables into economic theory," the workshop report said. "It can be a more sensitive indicator than money."

The IFIAS group is planning a follow-up conference "to consider the interface between energy analysis and economics."

Winters sees at least five "gates" through which a decision-making process must pass to show that a project will work: political, economic, cultural, environmental and energetic.

"The two primary parameters that are currently being used are what is politically feasible and what is economically feasible," he says. "They don't always overlap. These are the two areas in which most of the arguments over weeding out the various energy alternatives takes place." But the constraints of the other three gates must be satisfied in order to conform to human behavior, to maintain the stability of the environment, and to be thermodynamically, or physically, possible.

There is reason to believe that the energy gate is one of the narrowest of all the gates for society's options to pass through. So if limited funds are available to evaluate options, it is logical to ascertain early what will

INDUSTRIES ARE JUDGED BY ENERGY THEY USE AND JOBS THEY CREATE

These days particularly, there is good reason to factor into energy analysis the effects on employment. Because typically, reductions in energy use generate more jobs. John P. Holdren, assistant professor at the University of California, Berkeley, says that the energy producing industries themselves comprise the most capital-intensive and least labor-intensive major sector of the economy.

"Accordingly," he says, "each dollar of investment capital taken out of energy production and invested in something else, and each personal consumption dollar saved by reduced energy use and spent elsewhere in the economy, will create more jobs than are lost."" (Whether that dollar helps or hurts the energy situation would depend on where it's spent.)

Much valuable work in this area has been done by Bruce Hannon, of the Center for Advanced Computation, University of Illinois at Urbana-Champaign. One case study showed that returnable bottles demanded less energy and more labor than throwaways."

But Hannon has gone much further. He has plotted on graphs the relationships in 363 industries between dollar value added, energy use and employment."

One chart shows the tradeoffs in the economy as a whole resulting from a 10% growth in specific industries, if total GNP is held constant. For example, it indicates that growth in railroad car manufacture would have an overall impact of increasing energy use by almost 4.5 trillion Btu's and decreasing employment by more than 2.5 million jobs. Toward the other end of the scale, a 10% growth in making wood furniture would lower energy demand by more than a trillion Btu's while increasing jobs by more than 2.5 million.

Such analyses suggest that it is possible to make intelligent plans to shift from enterprises that are negative in terms of energy consumption, environmental effects and job formation, to enterprises that better serve society's needs.

In some cases, existing industries, by eliminating waste and altering products, could make desirable transitions. In most cases, perhaps, change would be extremely difficult. Ecologist and author Barry Commoner has long stressed the need for shifting away from products — such as plastics — that involve heavy pollution and energy consumption. But he notes that with some industries, such as the petrochemical makers, "the intensive use of energy is built into the very design of the enterprise in order to eliminate human labor.""

Even if a large net gain in employment is indicated, the type of labor or its location could be radically different and pose an additional dilemma. Of the shift to returnable bottles, Hannon says: "Jobs would be lost in the highly organized, high-wage can makers' plants and gained in the low-wage, relatively non-organized retail sector." Thus the opposition to the plan by organized labor."

"That's something that labor will have to deal with," says Nick Apostola, coordinator of a new organization, Environmentalists For Full Employment (EFFE), located in Washington, D.C. He suggests that labor "seize the opportunity to boost up those low-level jobs so they'll be higher paid." In a recent policy statement, EFFE said:

"Modern technologies that are excessively capital intensive and energy wasteful simultaneously destroy the environment, deplete resources, and cause structural unemployment. These problems must be attacked concurrently and such technologies must be rejected."

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"An ecosystem is governed by its energy cybernetics."

"Lions are in a highly ordered state, tending toward disorder."

fall through the energy gate.

Winters notes that perhaps environmental considerations should sometimes be *grounds for rejecting* energy options, but may not carry the necessary political clout. "Whereas, if one took those environmental objections, and at the same time noted that something is energetically impractical, one might be better able to implement environmental criteria."

One of the more interesting questions raised by net energy analysis is what are the cybernetic (feedback control) properties of an energy system. *If it takes energy to* make energy, to what extent do these energy subsidies control those functions outside the control of economic forces?

In the past, such influences may have been minor, but in a period of resource scarcity, their influence could be *dominant*. To illustrate how we might better understand and manipulate to our advantage these cybernetic functions, Winters uses a hypothetical ecosystem as an example. (An ecosystem is a highly complex energy system which is governed by its energy cybernetics.)

"You can think of any animal as an energy storage. Take for example a group of *lions in a closed* ecosystem. They are in a highly ordered state, tending to go toward disorder — an example of the law of entropy at work. And so they must have an energy source to *maintain* their order. Otherwise you have fewer lions, or emaciated lions.

"Suppose they pick zebras for an energy source. In order to utilize the zebra energy — since zebras don't just walk into the lions' mouths — the lions are going to have to expend some energy to *run down* the zebras. I used to be a zookeeper and have some appreciation for the task the lion has before him.

"If our lions are to survive, they must make sure they get more energy out of zebra hunting than they put in. Let's say they put two energy units in and get 10 out.

"A lion will be competing with some other carnivore in that ecosystem for an energy source. Maybe the leopard. And one factor that determines who will win the competition is who has the most efficient return on his investment. If another carnivore in competition with the lion could reinvest at a rate of one unit in for 10 out, then he would end up being the dominant species.

"In the ecosystem, no two animals occupy the same niche, competing for the same energy source. There's always at least a slight difference. And the relationship becomes very complex. Finding the niche with the best reinvestment ratio becomes a major key to species survival.

"It carries with it a risk, however, for if our lions should become solely dependent on zebras, then what happens when there is a zebra plague? The answer, of course, is that the lions eat something else. To be able to compete for other prey, however, means that the lions have had to maintain an ability to hunt for animals which did not yield a maximum return on their investment. And if we examine lion habits, we see that they have done exactly that.

"This makes the problem most interesting, for it implies that there is a force in addition to net energy efficiency directing lion evolution. This force is called diversity. Diversity, in the case of lions, is seen in their varied feeding habits. It enables them to survive environmental changes. So we see two antagonistic forces operating upon lions: one, hunting efficiency strengthening their chance for survival in the present and two, diversity enhancing chances of survival in the future.

"A given organism has to find a compromise between how much energy it's going to tie up in reinvestment and how much in diversity. If it ties up in reinvestment it may become a dominant member of the ecosystem at any given time, but may also end up the way of the *dinosaur*.

"The application to man's technological system, I think, is direct. We should choose energy systems which show a good net energy gain, but we must balance this with a diversity of interchangeable technology which will help protect us from the unforeseen problems that always interrupt the best-laid plans of men and lions."

> **"Operating in the American economy is a *negative* force which reinforces the energy-intensive economy; the desire to avoid economic crisis. This force generates the dominant policy of increasing supplies first and curtailing waste second."**
>
> —Richard A. Walker and David B. Large, Ecology Law Quarterly, Vol. 4, No. 4, 1975.

Winters points out that man, throughout history, has periodically improved his reinvestment *ratio*. He learned to use rocks to break bones and get the marrow. And there was agriculture, and fire, and so forth, up through the stream of innovations in the Industrial Revolution. But after each of the earlier innovations there

appears to have been a long plateau, so that energy crises were more the rule than the exception.

Where are we now? At one of the "little wrinkles" of a major growth spurt that will continue for a long time? Or are we approaching a leveling spot of one of the broad plateaus, in a situation where we have begun to exceed the total productive capacity of our energy systems?

Winters says that to maintain our growth rate in energy supply, the technological innovations must be bigger and come in more quickly than in the past. Energy analysis may tell us the theoretical upper limits of available energy, but physical limits apparently are not the prime constraint. "If we look at today," says Winters, "we know we're not at our physical limits in terms of what we could do theoretically. It looks as if social and cultural limits always begin to impede the system before the technical limits are reached.

"The question may not at all be, Can we build a fast-breeder reactor? Or can we get nuclear fusion? It may well be, Can we construct social institutions which can maintain the dynamic stability of the cultural, political and economic processes that are needed to maintain such a technology?"

As a matter of fact, Winters suggests that the social structure we have come to depend on — with its standard of living and complex, centralized system of organization — may itself demand a lot of energy to maintain.

"There is an interesting paradox — and this is pure supposition and beyond the level of measurement. If we believe there is some relationship within a given system between the complexity of a social order and the energy base (and one culture may require more energy than another), then in order to get total cooperation at any larger level of complexity, a broader energy base is required." An example would be the need to achieve affluence before people cooperate in population control.

"If it takes affluence to induce cooperation, and you can only do this by increasing the energy base (a necessary but not sufficient cause for affluence), then it would seem that the only way to increase the energy base is through greater cooperation. So you've just got yourself in a self-stultifying situation."

Footnotes:

[1]Atomic Industrial Forum, "Info," March 1975.

[2]Not Man Apart, mid-August 1974.

[3]The Sciences, New York Academy of Sciences, October 1973.

[4]Entropy is discussed by Nicholas Georgescu-Roegen at length in the magazine Ecologist, June 1975, and at greater length in *The Entropy Law and the Economic Process*, Harvard University Press, 1971.

[5]*Energy Consumption in Manufacturing*, by The Conference Board, a report of the Ford Foundation's Energy Policy Project, Ballinger, 1974.

[6]For example, "Energy Use in the U.S. Food System," by John S. Steinhart and Carol E. Steinhart, Science, April 19, 1974; "Food Production and the Energy Crisis," by David Pimentel, et al, Science, November 2, 1973; "Energy Subsidy as a Criterion in Food Policy Planning," by Malcolm Slesser, Journal of the Science of Food and Agriculture, November 1973.

[7]"Conservation and Efficient Use of Energy," joint hearings of House Government Operations subcommittee on conservation and natural resources and Science and Astronautics subcommittee on energy, Part 2, July 10, 1973; and *The Energy Conservation Papers*, edited by Robert H. Williams, a report of the Energy Policy Project, Ballinger, 1975.

[8]"Systems of Energy and the Energy of Systems," by Thomas A. Robertson, Sierra Club Bulletin, March 1975; "The Energy Cost of Fuels," by P. F. Chapman et al, Energy Policy, September 1974.

[9]"The Energy Costs of Materials," by P. F. Chapman, Energy Policy, March 1975.

[10]"Hidden Waste," by David B. Large, The Conservation Foundation, 1973.

[11]"Reduce," a booklet of the League of Women Voters Educational Fund, 1975; "Bottles, Cans, Energy," by Bruce M. Hannon, Environment, March 1972.

[12]For example, "Goods and Services," by David J. Wright, Energy Policy, December 1974.

[13]American Association for the Advancement of Science, annual meeting, January 30, 1975.

[14]"The Energy Cost of Fuels," by P.F. Chapman et al, Energy Policy, September 1974.

[15]"Energy Analysis," Workshop Report No. 6, IIASA, Guldsmedshyttan, Sweden, August 25-30, 1974.

[16]Quoted in "It Takes Energy to Get Energy," by Wilson Clark, Smithsonian, December 1974.

[17]New York Times, July 23, 1975.

[18]"Options for Energy Conservation," reprinted in Technology Review, February 1974.

[19]"The Energy Crisis — All of a Piece," Center Magazine, March-April 1975.

[20]"Energy Conservation and the Consumer," Center for Advanced Computation, University of Illinois, October 1974.

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A Visit With Sir Frank Fraser Darling

By William K. Reilly, President of the Conservation Foundation

In 1972, after 13 years as vice president of The Conservation Foundation, Sir Frank Fraser Darling retired to his native Scotland, not to the Western Islands where he spent several years and wrote pathbreaking ecological analyses, but to the gentler climate of Lochyhill, where annual rainfall is the lowest in Scotland. Until my recent visit with him, I had known him only as one of the pioneering ecologists of the 20th century and for a warm note he sent me shortly after I became CF's president in 1973. "The issues that concern you," he wrote then, referring to my work in land use and urban growth, "are not ones in which I have much expertise. But I recognize them as among the most important problems of our time and I wish you Godspeed."

Sir Frank, who is now 72, lives on a high knoll with a commanding view of Moray Firth, surrounded by peacocks, Pekinese, canaries, and a lifetime's collection of art and books. The day I arrived, he and his wife Christina were particularly concerned with one house plant. That night, I was told, was the one night of the year that the night-blooming cereus was expected to blossom.

We spent two leisurely days together, mostly walking through the countryside. Along the way Sir Frank off-handedly pointed out trees and plants and butterflies of special appeal, occasionally referring to them by the names they're called in America. From the knoll, we could see the opening of the Moray Firth waters that lead into Niggs Bay where British Petroleum has constructed two of its steel platforms for drilling in the North Sea. "I have no problems with oil development," he said. "There is, of course, a right way and a wrong way. I have seen something of the wrong way in many parts of the world, but it's being done well here and the country needs it."

After a visit to two medieval abbeys, he asked me if I had ever considered the relationship between conservation and religion. We discussed the careful husbandry of medieval Benedictines, which he admired, and he suggested that the Foundation would do well to direct attention to religious values as they support conservation ethics. Later, he showed me an exquisite 700-year-old Chinese plate on which a branch of phragmites was delicately represented and he implied a similarly organic relationship between conservation and art. His mood was often reflective during my stay. During such moments I was aware of his reverent sensitivity to nature's regenerative powers, its beauty and its complex symmetry. One of the formative experiences of his life, he told me, was reading *The Origin of Species*. "There," he said, "was the ecological vision."

Sir Frank is a renowned naturalist, knighted for his contributions to ecology; he is also a thoughtful humanist with a deep knowledge of art and religion. Perhaps the strongest single impression he left with me was of a man who delights in the interplay of nature and culture, whose vision integrates the two harmoniously and acknowledges that each ennobles the other. He views with regret the declining quality of life in Britain and speaks critically of the rows of look-alike houses crowded onto tiny lots. He is troubled by the spread of the world's great cities, which he regards as ecologically dangerous and socially destructive.

"I have never been a catastrophist," he said. "I have always had great faith in the ability of rational human beings to understand their problems, to see and deal with them before they become crises. But as I look at the world population growth, I don't see any way out. I am becoming a catastrophist."

Turning easily from the cosmic to the personal, he asked me about my family. I told him that I had recently become the father of a little girl. His response was what by now I had come to recognize as typical — an instinctive draw on a large private reservoir of observed natural truths. "The female of a species," he said gently, "is always the more difficult to rear."

Conservation Foundation Letter

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ECONOMICS DEPARTMENT

November 12, 1975

Mr. Taylor H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, NC 27709

Dear Mr. Bingham:

Our congratulations on what appears to be a quite workmanlike analysis, particularly given the short time that you were able to devote to this study. In the very brief period allowed for review, we have not been able to corroborate or evaluate the accuracy of most of the parameters you have developed, but, with the few exceptions explained below, their relative magnitudes appear reasonable.

The greatest contribution of your study is that it provides aggregation across all sectors of the economy for the nation as a whole. Up until now, this has been lacking in that most studies have attempted to look at capital, labor, and other variables within the boundaries of a single state. Your aggregate data will be most useful for analysis of economic and other effects on the total society.

Our major suggestion would be that you make complete use of the wealth of data that you have gathered and add to your summary chapter the development of annual costs of the various scenarios to the nation as a whole. Your preliminary report contains almost all the data necessary for this. The additional data needed to complete it is quite minor and should be easily available.

As is detailed later in this communication, we have what we consider to be very valid suggestions for refinement of some of your data. If you accept these changes, the overall economic impacts shown below can easily be altered to reflect them. Using the data as given in the preliminary report, however, and adding what we believe to be conservative estimates of missing variables, the annual economic impact to the nation would be a saving of energy as you have shown, an increase in employment and payrolls as you have shown and an economic impact ranging from a higher cost of 473.7 million dollars to a saving of 1,785.7 million dollars. The mid-range saving to the economy is 725.5 million dollars annually. This saving is achieved at the cost of some labor dislocation and a loss of profit and overhead coverage by container manufacturers. The latter element is also a dislocation, not a cost to the economic system. At 10% of decreased sales, this would amount to approximately 150 million dollars for the mid-range scenario.

ANNUAL ECONOMIC IMPACT ON THE TOTAL ECONOMY
(in millions of dollars)

	Extreme Parameter Values			Oregon Parameter Values	Mid-Range Parameter Values
	No Change in Can Market Share		Metal Can Market Share Falls to Zero		
	Zero return rate for metal cans	100% return rate for metal cans			
Equipment & Space Amortization[1]	80	120	410	360	210
Interest Cost[2]	44	66	225.5	198	115.5
Bottle Float Replacement[3]	236	236	883.5	759.5	463.5
Packaging Float Replacement					
Carriers[4]	(44.2)	(44.2)	195.9	158.9	45.4
Cartons[5]	10.7	10.7	(36.5)	(24.5)	(1.3)
Crowns and Labels[6]	0	0	181.3	153.5	68.3
Other Transportation Costs[7]	21.5	21.5	276.4	238.0	118.4
Container Cost Savings[8]	(684.0)	(684.0)	(4,249.0)	(3,694.0)	(1,989.0)
Labor Earnings[9]	84.5	747.7	(35.6)	64.9	243.7
Total Cost (Savings)	(251.5)	473.7	(1,779.5)	(1,785.7)	(725.5)

Footnotes - Annual Economic Impact Table

(1) Investments from Table 1-3, p 1-8. Assumes 10 year depreciation schedule as average for combined equipment and space investment.

(2) Interest assumed at 10% annually resulting in 5.5% on basis of decreasing value over 10 years.

(3) Increase in returnable bottle purchases from Table 3-2, p. 3-7. Prices from Table F4, p. F-5.

(4) Assumed carrier cost for returnable bottles is 24¢ per case higher than for cans. Assumed trippage of 3 results in $.0033 higher cost per filling. Assumed NR carrier cost = 15¢ per case = .00625 per filling results in cost saving of .00292. Fillings from Table 3-2, p. 3-7.

(5) Soft drink shell prices from Table F4, p. F-5. Assumed 100 trips yields .0009 per filling. Assumed can carton price of .07 per case yields .0029 per filling. Hence, refillable shell cost is .002 per filling less than for cans. Assume no NR cartons results in cost of .0009 per filling greater for returnables.

Beer carton prices from Table F4, p. F-5. Assuming 8 trips results in returnable costs of .0034 per filling. Assumed can carton price of .07 per case yields .0029 per filling. Hence, returnable cost is .0005 greater than for cans. Assumed NR carton price of .07 yields .0005 greater cost for refillables.

(6) Crowns and labels assumed to cost .06 per case. Cost differential applies to replaced cans only.

(7) Transportation costs in addition to labor assumed to be equal to truck driver earnings for beer (approximately .09 per case), and equal to 50% of distribution labor cost for soft drinks (Bingham & Mulligan, p. 173).

(8) Reduction in container purchases from Table 3-2, p. 3-7. Prices estimated as .05 per can and .04 per NR for both beer and soft drinks.

(9) Labor earnings from Table 1-3, p. 1-8.

As for refinement of data, it would appear that this preliminary report contains a few misprints, errors, and/or errors in assumptions. As stated previously, time has not been available to subject these points to definitive analysis, but the following items appear questionable.

Labor:

Beverage production: Table 3-9, p 3-21 shows beverage production labor as identical for all types of containers in each sector. Bottles, however require more labor on filling lines and returned bottles require labor for washing and sterilizing. (We assume that warehousing of returned bottles and the higher cost of loading bottles vs. cans is included in distribution costs). Considering only filling and washing, the returnable system must be more labor intensive than both cans and NRs. Further, Table 3-11, p 3-25 shows decreases in beverage production labor of 16,000 jobs under all scenarios. Even using the erroneous assumption of equal labor costs, this decrease could not occur without significant decreases in beverage consumption which are not indicated in Table 3-2, p 3-7.

Beverage Distribution: The assumption (pF-9) that beer wholesalers' distribution costs are the same as those for soft drink bottlers is incorrect. Soft drink distribution includes handling and sorting of many more flavors and sizes, servicing vending machines, and generally, fewer cases per delivery. If, however, you have included loading and trucking from the brewery to wholesaler in this figure, as well as return transportation of empties, the differentials shown in Table 3-9 would appear to be reasonable.

We can not understand, incidentally, the difference shown in Table 3-9 between can and NR distribution costs in the soft drink sector.

Retail Labor: In Table 3-9, can you justify the higher labor usage for beer vs. soft drinks? On p F-9, you imply that costs are identical.

Indirect Industries

Your inclusion of indirect labor inputs to container manufacturing is readily understandable in view of the easy accessability of this data. Failure to include other indirect inputs, however, can lead to serious misunderstandings. For example, it would appear that a 100% can system is more labor intensive than any other system. This surely is unsupportable. We realize that input - output tables will not yield indirect labor figures for the use of different containers by the beverage industry. It would seem however, that readily identifiable differences should be recognized -- at minimum the labor for production of crowns and labels, for production of the additional packaging material used in a returnable system, and for the additional outbound and inbound transportation of returnables should be included.

Return Rates:

Your footnote concerning Oregon return rates is credited to (ref. 1) which we cannot find. We would submit that it is in error and suggest that, at the least, you show other findings. The conclusion is apparently from the ADS study, but this same study shows an increase in returnable beer bottle

usage of 212% (ADS p II - 89) and an increase in replacement returnable bottle purchases of 5.7% (p II - 153). It further shows an increase in soft drink returnable bottle usage of 50.9% (p II - 29) and an increase in replacement returnable bottle purchases of 6.4% (p II - 153). This obviously confirms that return rates in both sectors have increased substantially.

Float Requirements:

Your comments on cautious treatment of this capital expenditure (p 3-19) are well taken. Our suggested treatment of annual economic costs will, we believe, help in putting this cost in proper perspective. If, however, you do not incorporate this approach in your final report, we would submit that expenditures for all containers should be incorporated under capital cost figures. In last analysis, we are speaking of money required to purchase containers whether the trippage is 1 or 20. If the cost of purchasing returnables is to be listed as a capital requirement, then the offsetting saving of not purchasing cans and NR's must be seen as a reduction in the need for funds for the economy as a whole.

Capital Investment:

Storage space: From Table F-1, p F2, storage space for empties represents a substantial portion of the greater capital cost for refillable containers. In view of the fact that a change to more refillables would require added space, not alternative use of existing space, it would seem rational that this space be constructed for the purpose intended. This then implies that $22 per square foot cost for added space to store empty bottles is excessive.

Filling Lines: Table F 2, p F3 indicates that filling lines for refillables are significantly more costly than those for NR's. Since the process is identical, this does not appear to be accurate unless the refillable line includes washing and sterilizing equipment. If it does, this further emphasizes the oversight of not including washing and sterilizing labor in the estimates of production costs.

Distribution equipment: The assumption on p F-4 that equipment requirements per 10^6 oz are the same for beer wholesalers and soft drink bottlers can not be supported. Again, because of the greater number of brands, flavors, sizes, etc. we should expect that soft drink equipment requirements would be greater. Since, however, you do not estimate equipment requirements for shipment from the brewer to the wholesaler, the over-estimation helps to rectify this omission.

Total Capital and Energy Relationship:

In order to put the overall summary into a readily understood context, we would suggest that it be pointed out that the capital required to change to a returnable system is less than that needed to produce the equivalent amount of energy saved. For example, the cost of putting generators on line in the 1980's is estimated as app. $35-$40 per million BTU annual capacity. Using the lower estimated energy saving of the mid-range scenario

of 123.8×10^{12} BTU from Table 1-3, p 1-8, and excluding float investment (from reasoning discussed above), the capital cost is app. $17 per million BTU annually. This would seem to be a most economical approach to obtain this portion of future energy needs.

We sincerely hope that these comments will be helpful in developing your final report. We would appreciate your contacting us prior to publication on any questions that these comments might raise. Could we also request two copies of your final publication? Again, our commendation to your staff on an over-all creditable job.

Sincerely,

Charles M. Gudger, Ph.D.
Associate Professor

mh

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November 14, 1975

RECEIVED
NOV 17 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
P.O. Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

Thank you very much for sending me the review copy of the study "Energy and Economic Impacts of Mandatory Deposits". I asked one of my colleagues who is an economist and who spends some time working in the Environment Center to review the document because it was impossible for me to spend time on this before December. He just returned the copy to me but had no specific comments other than to agree with me that the report seems very well done, especially in comparison with other similar studies that have been made in the past. It is extremely important to have this new information so that state and federal public policy decisions can be made on the basis of improved information.

I regret that I have not had a chance to review the document in detail and will therefore be unable to make your deadline.

Sincerely,

John H. Gibbons

John H. Gibbons, Director
UT ENVIRONMENT CENTER

JHG/bpm



Environmental Organizations

6215 Stoneham Road
Bethesda, Maryland 20034
December 2, 1975

Mr. Tayler Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, N.C. 27709

Dear Mr. Bingham:

Enclosed please find a copy of my comments on your report Energy and Economic Impacts of Mandatory Deposits, which were previously submitted to Morris Zusman of the Federal Energy Administration. I trust that these will be addressed in the final report. Your assistance is appreciated.

Sincerely,

Steven A. Frank

Steven A. Frank, Chairman
Environmental Afairs Committee
Allied Civic Group, Inc.

RECEIVED
DEC 5 1975
ECONOMICS DEPARTMENT

6215 Stoneham Road
Bethesda, Maryland 20034
November 28, 1975

Mr. Morris Zusman
Federal Energy Administration
Conservation & Environment
New Post Office Building, Room 6509
Washington, D. C. 20461

Dear Mr. Zusman:

The draft report by Research Triangle Institute on the impacts of minimum deposit legislation on leisure beverage containers is an interesting and more comprehensive exercise on the subject than I have previously read. It is a generally realistic and professional approach to a difficult subject, trying to cover the impacts on energy, capital, labor, labor earnings, and resource recovery. There are, however, a number of places where I feel the assumptions were not totally realistic or consistent, and others where some salient issue or data was not given as thorough coverage. Since it is presumed that any area not covered is basically satisfactory, I shall limit my comments to those portions in which I feel beneficial changes to the report could be made. Comments shall generally follow the order of the report. They are made with a realization and appreciation of the extensiveness and difficulty of the task being undertaken.

. Energy differentials are presented in Btu's which is confusing since most energy conservation figures are presented in barrels of oil per day or per year to facilitate comparisons. Additionally, a breakdown of fuels could be important since much of the savings and consumption are either in electricity (which is not terribly energy efficient except for hydroelectric power) and petroleum, both of which are scarce but represent different orders of magnitude because of the benefits of direct consumption. Additionally, some indication should be made about how the total energy savings from the proposed legislation compares to the energy savings and capital outlays from other conservation measures which have been proposed.

. The emphasis on convenience for nonrefillables and the high rate of switching to these containers may be illusory.

Many beverages are purchased in nonrefillables because they simply are not sold in refillable containers, as a trip to most supermarkets would validate. Legislation of the type being examined would increase the availability of beverages in refillables and, when combined with the lower cost, may cause consumer switching beyond that considered in the report. This has been the experience in various areas around the country to the best of my knowledge.

. The report's use of "Oregon parameters" is not an accurate representation since all the Oregon parameters are not included. It does not seem correct to use those parameters which are desired, and write off interrelated data on trippages as being aberrations. The actual experience of Oregon (and Vermont) should be used as they exist or not used at all. Using one set of parameter values and another set of trippage values is not dissimilar from using energy consumption from metal can production and trippage rates from refillable bottles.

. The set of parameters described as "mid-range" is based on the Coors experience of return rates of 50 percent on metal cans, primarily aluminum. Coors pays an average of 0.75 cents per can, up from about 0.50 cents per can due to the increasing value of aluminum. The proposed legislation would place a value of at least 5.0 cents on each can, more than six times larger. Clearly, this should induce greater return rates than those which exist under the much lower valuation.

. Virtually no consideration is given to the highly energy intensive plastic bottles. The industry apparently feels that these will have a major impact and will account for several percent of the total supply within the next decade. Omission of the plastic nonrefillable container does injustice to the comprehensive coverage aimed at by the report.

. Line one on page 1-8 refers to the "zero return rate" column as column two. Unless the description column is considered, which is not normal procedure, the referenced data is in column one.

. Decisions seem to have been made about various industry data which may or may not be consistent; there is no supporting information to assess how they were made. Thus, it appears that the "float" figures given by the industry were discounted and a larger float figure used. On the other

hand, several outside parties consider the industry estimates of when energy saving processes and devices will be online to be highly optimistic in light of the high cost considerations and the need for virtual abandonment of some existing capital, but these appear to have been accepted with no indication about personal interpretation by the authors. Additionally, if float is considered a capital cost, similar emphasis should be given to the cost of recycling operations, equipment, or resource recovery systems. The result is a possible bias favoring the industry, and not the conservative approach which it was indicated would be taken. Furthermore, it would be helpful if the authors would present both a conservative scenario and their estimate of the most probable scenario, not necessarily a "mid-range" scenario for which there is no estimate of the likelihood.

. Paragraph one of page 1-9 indicates that, although more jobs will be created than destroyed, the dislocation will be significant. This is a relative value and the implication may be inappropriate. The Alaskan pipeline and drilling are causing significant changes but are deemed worthy of pursuit. An electric economy will cause similar alterations. The "significance" of the job displacement can only be perceived in the context of other energy programs and these have not been considered, or compared.

. In considering the impact of beverage container legislation on municipal solid waste, it was indicated that the revenue potential was reduced by 22 percent, on page 1-9, but no information was given about reductions in costs caused by lower plant and equipment needs for processing, and by reduced landfill needs. Actually, the report states "...it appears that even completely eliminating beverage containers from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal of situations." This is not the impression given by the statement on page 1-9. Additionally, the costs of alternative resource recovery systems are not mentioned or included in any calculations, although the energy savings they would accumulate are presented.

. Appendix D, which calculates energy utilization requirements of beverage containers, states that its conclusions about the comparability of refillables and one-way containers "could be altered if use of durable reusable carriers and cases are adopted for refillable containers before 1985." Under this scenario there could be major

savings for refillables. While such a carrier now exists and is being tested at the current time, no consideration was given to its existence (referred to as "ancillary packaging on page 2-24) although processes still being tested for saving energy on one-way containers were assumed to be online by 1985. Major use of such carriers should be considered in the final calculations about container comparability.

. Page 1-12 refers to a report entitled Resource and Environmental Profile Analysis of Wine Beverage Container Alternatives. Presumably the "Wine" should be "Nine".

. Separate emphasis should be given to the consumer attitude toward the proposed legislation, and the expected impact on all consumers of such legislation to permit comparison with consumer attitudes toward other methods of conservation. This may be additionally important since some conservation measures, such as increased insulation, may cost the consumer large amounts whereas the proposed legislation has the potential of reducing consumer costs similar to turning down thermostats.

. Page 2-15 outlines five reasons for a trend toward larger containers for soft drinks. The first four of these were available more than twenty years ago when large soda bottles existed, the entire family consumed soda, large bottles were a convenient method for purchasing large quantities, and the bottles could be resealed with special bottle caps which most families possessed. The remaining reason is "the availability of the resealable cap" which is hardly likely by itself to have caused the trend. Either there are additional reasons or the stated ones should be further explained.

. The energy, capital, labor and labor earnings findings presented in the summary and body of the report are for the "early 1980's". This data, however, is based on a linear extrapolation of the findings of Appendix D which presents the data for 1985. Some of the calculations may be very dependent on the type of curves used since much of the equipment is highly capital intensive and may not be coming online until the end of the time period. Explanation and justification of the methods used to get the "early 1980's" data should be thoroughly presented.

. With respect to refillable bottles, nonrefillable bottles, and metal cans, the following statements are made respectively on pages 2-15 through 2-19:

1. "The average size of refillable beer bottles has been a fairly constant 11-12 ounces over the last 26 years. The average size of soft drink refillable bottles has increased slightly and is currently about 10 ounces.

2. "The average size of nonrefillable beer bottles has declined since 1947, reaching about 12 ounces in 1973. ...For soft drinks, the average size has been fairly stable since 1960..."

3. "...the average size metal can used to package beer declined slightly...in 1973."

From these facts decisions made were to:

1. Use the constant size for refillable beer bottles and an increasing size for refillable soft drink containers, consistent with the past history;

2. Use a stable size for nonrefillable beer bottles and an increasing size for nonrefillable soda bottles, both contrary to their stated history, and

3. Use a stable size for metal cans, again contrary to immediate history. The reasons for following their history for refillables and reversing it for nonrefillable bottles and cans are not clear.

. Questions have been raised about the ability of municipalities to invest in highly capital intensive resource recovery systems over the next decade, particularly in light of the fiscal situation many of the major cities are increasingly finding themselves in. Since these represent the areas with the highest probability of implementing large scale resource recovery systems, the optimistic increase in expected aluminum recycling rates from 16.7 percent to 35.1 percent seem unlikely. Data should be presented to substantiate this, and to indicate the expectations for such resource recovery systems which are assumed by the study and their derivation. If the source was another report, perhaps this should be updated or the assumptions given.

. Page 2-39 states that there are four types of bottlers and canners: franchise brands, warehouse brands, independent local bottlers, and private-label brand producers. It then

describes three of the four but omits the independent local bottler. Such a description should be made including their prevalence, type of merchandise, type of market, and other information presented for the other bottlers.

. Container clearinghouses are mentioned on page 2-43. There is a history of such clearinghouses and their success which could be found and may already be in the possession of the authors, Since the alternative is raised, a better idea of how clearinghouses have been implemented, whether they have worked, and any reasons for their success or failure, would be helpful to the reader attempting to assess the option.

. Reference is made to expenditure of large amounts of capital for machinery and equipment to implement a system of container deposits. Do these expenditures include funds which would have been spent in any case to replace older machinery? Are they gross expenditures or are they net of tax accelerated benefits from depreciation and other writeoffs?

. Values for "1" are defined on page B-3 as "twice the 1973 value of f(t) or 1.0, whichever was lower." It should be pointed out that, under the subheading soft drinks, "1" values for nonpackaged drinks and nonrefillable bottles are high. Twice the 0.200 for nonpackages is 0.400 and not 0.500. Twice the 0.455 of nonrefillables is 0,910, which rounds to 0.9 and not 1.0, Furthermore, since the market share is carried to three decimal points, consistency would show that the "1" value for metal cans should be 0.73 and not 0.7.

. In assessing the impacts of the alternative systems of deposit or nondeposit, it was found that a deposit system created more jobs but these were generally lower paying. A brief analysis should be made to determine separate multipliers for indirect benefits since more of the income to the higher paying jobs under the nondeposit system would be discretionary, whereas the lower paying jobs are more likely to spend greater portions of their pay.

. Under the two systems, transportation energy savings were considered by Franklin Associates as to their relationship to the container production and distribution under present conditions. Some factor should be added to assess the impact of deposit legislation since this would probably also lead to an increase in local bottlers, and thereby decrease energy used for transportation. On page D-23 all that is indicated is that a 15 percent reduction was estimated due to "increased fuel efficiency in mobile engines and

increases in route efficiency stimulated by energy conservation measures..." It is not apparent that more localized distribution because of the legislation being considered was included in these calculations. On the contrary, on page D-131 indications of high transportation values are related to the centralized nature of the industries and the bulk of the glass container.

I trust that the final report will address all these comments and look forward to receiving a copy.

Sincerely,

Steven A. Frank

STEVEN A. FRANK, Chairman
Environmental Affairs Committee
Allied Civic Group, Inc.

CRUSADE for a CLEANER ENVIRONMENT

November 14, 1975

RECEIVED
NOV 20 1975
ECONOMICS & ENVIRONMENT

Mr. Tayler H. Bingham
Research Triangle Institute
Energy and Environmental Research Division
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Thank you for the opportunity to review Energy and Economic Impacts of Mandatory Deposits. As you requested, we are returning our review copy, along with the comments contained in this letter.

There are four specific areas which concern us in the report: (1) choice of "scenarios" for analysis, (2) estimates of capital costs for a return to returnables, (3) calculation of energy conservation achievable by the early 1980's, and (4) the lack of attention given to consumer savings or expense.

Before addressing these specific problems, however, we wish to make the general comment that the summary section is not up to the high standards we have come to expect from Research Triangle reports. In some instances, the summary is in fact misleading and could lead a casual reader into erroneous assumptions. For example, on page 1-9, the conclusion of the report is stated to be, "The revenue potential of municipal solid waste would be decreased by 22%" if mandatory deposit legislation were enacted. On page 3-31, however, the report states a quite different fact: "It appears that even completely eliminating beverage containers from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal of situations." We are particularly concerned by the misleading conclusion in the summary because this particular issue is one which greatly concerns state and local legislators considering mandatory deposit laws, and the threat of decreased revenues from municipal solid waste treatment facilities is one of the "scare tactics" most frequently used by bottle bill opponents.

Turning to the specific criticisms, we believe that the scenarios chosen for analysis are unrealistic. Why, for instance, are the Oregon "parameter values" used in one scenario, but not the Oregon trippages? Two other scenarios should be examined -- a 50/50 split between refillable bottles and nonreturnables (bottles and cans), and a 75/25 split, with the higher percentage in refillables. For both of these scenarios, trippage rates

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of both 10 and 18 trips per bottle should be examined. As you undoubtedly are aware, some bottlers average close to 30 trips per bottle, with some going as high as 50 trips. A trippage rate of perhaps 25 or 27 therefore should also should be studied.

A second area of concern is the calculation of capital costs. Since RTI decided to include bottle, shell and carrier float as capital investments for the refillable bottle system, capital costs of the nonreusable systems also should be included for comparative analysis. Specifically, the "float" of raw materials for container manufacture and recycling should be considered, as well as the capital costs of recycling equipment, transportation and separation to achieve the projected rates of recycling. As an example, the calculation of retailers' relatively small needs for returned metal cans assumes the use of the mechanical "can eater" for crushing the cans, but nowhere is the cost of the "can eater" included in calculations of capital requirements.

Another concern is RTI's calculation of capital costs using a "point in time" method. This analysis does not take into account the possible modification of existing equipment to fulfill the needs of the refillable bottle system, nor does it allow for depreciation, write-offs and other methods of reducing the after-tax impacts of capital expenditures.

Turning to energy conservation, the report appears to overstate the beverage industry's potential savings while understating the requirements for achieving it. The methodology is at fault here -- rates of energy conservation potential developed by the Federal Energy Administration back in 1972 are applied to the most recent energy consumption data for the beverage industry. The fact that the most easily achievable conservation measures have already been taken in the three-year interim is not taken into account, thus distorting both the magnitude of further reductions possible, and the degree of difficulty in achieving the conservation goals.

Finally, we are concerned that the report does not calculate consumer savings or expense for each of the scenarios. If the report is to be used by legislators and administrators considering the imposition of mandatory deposit systems, then it should include a calculation of consumer savings resulting from a return to returnables making 10, 18 and higher numbers of trips. The possibility of higher consumer spending in other sectors of the economy as a result of this saving also should be included in calculating the employment impacts of the various scenarios.

We hope these comments are useful in your revision of the RTI report. We look forward to receiving the final version in the near future.

Sincerely,

Betsy Greer

Betsy Greer
Director

National Environmental Lobby Dirty Dozen Election Campaign Environmental Action Magazine

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1346 Connecticut Avenue, N.W. Suite 731 Washington, D.C. 20036
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November 24, 1975

RECEIVED
DEC 1 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Thank you very much for the opportunity to comment on your draft study, "Energy and Economic Impacts of Mandatory Deposits," prepared for the Federal Energy Administration. Below, please find the comments of our organizations, divided into three sections. The first is an overview of the report, the second an examination of major areas of concern, and the third specific comments on Sections 1 and 2 of the report. As you will note, there are many changes which Environmental Action and the Technical Information Project feel are essential for the production of a sound final report.

L-57

On a procedural matter, it seems important that you identify in your final report the receipt of any review letters when a reviewer doesnot wish to have their comments duplicated in the final report. This is especially important if any changes are made in the draft report as a result of a particular individual or organization's comments.

I. General Comments

Mandatory deposit legislation is no longer a theoretical scheme for dealing with the dramatic impact of throwaway beverage containers on the nation's litter, solid waste, energy and materials problems. Two states in the United States, Oregon and Vermont, as well as three Canadian provinces, have extensive experience with this type of legislation. The state of South Dakota and numerous municipalities have also passed legislation dealing with beverage containers. Less than 10 years ago,the majority of beer and soft drinks sold in the United States were packaged in refillable glass bottles.

Yet, despite these very real experiences on which a report such as the one that Research Triangle Institute has prepared should draw with the assistance of affected industries and independent research organizations and public interest organizations, a highly theoretical analysis of unlikely occurrences dominates the report. This is particularly disturbing when analysis of consumer behavioral characteristics, sprinkled throughout the report, completely contradict all available information from areas with mandatory deposit legislation. There is a body of information from which to draw upon, yet, instead of using this information, tremendously convoluted methodologies are utilized to come up with "new" numbers on an issue which has been studied in so many facets. The tone of the report reflects this highly theoretical analysis of the issue of returnable beverage container use, and is deeply disturbing.

This stationery is printed on 100% recycled paper.

II. Areas of Particular Concern

1. Presentation of Data. I found the draft report particularly difficult to read and would suggest the following changes in chart and table presentation:

A. Combine all beer and soft drink numbers. Appendix breakdowns. (Notate where in body of report, information is available in Appendix.)

B. Combine all on- and off-premise beer numbers. Appendix breakdowns. (Notate in body of report, where information is available in Appendix.) The refillable beer market share is only 20%, 85% of which is on-premise, so distinction has little value for body of report.

The summary did not properly reflect the body of the report. This is particularly distressing because many people will be unwilling and/or unable to read the entire report, especially when one considers the length and complexity of data presentation. These readers will rely on the summary.

For example, the first national consumer attitude survey on this issue is not even included in the summary. The fact that 73% of the people surveyed favor the very action FEA is studying should receive prominent discussion in the findings. On page 1-9, the general conclusions of the report appear. These are too vague and undefined. A range of energy savings capital requirements, etc., would be more beneficial to most readers.

Conclusion No. 5 does not reflect the findings in the body of the draft report concerning the impact of returnable beverage container use on resource recovery. On page 3-31, the statement, ".... it appears that even completely eliminating beverage containers from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal of situations," appears. Yet, the summary statement in Item 5, "The revenue potential of municipal solid waste would be decreased by a maximum of 22%," leads the reader to believe that there would be a strongly negative impact on the potential for resource recovery by the use of returnable beverage containers, completely contradicting the findings in the body of the report. Furthermore, the state of the art of resource recovery technology does not even indicate that there is a danger of intensive facility construction by 1980, let alone 1985, thus allowing for the planning and design of facilities around the parameter of reduced beverage container waste.

Another confusing and perhaps misleading area in data presentation is the use of two end-times for evaluating long-term impact of mandatory deposit legislation. The Franklin numbers on energy use are generally for 1985, ref. Tables 2-7 and 2-11. Yet, the economic and employment impact data is all for the early 1980s. Besides being confusing, this may also be misleading as in the case of Table 2-11. 1985 recycling rates for steel cans in particular are projected to dramatically increase between 1980 and 1985. The 1985 data, which stays in the reader's mind, as a very high rate of recycling, does not correspond with the data presented further on in the report concerning economic impact. I would suggest using the same years as end points throughout the report.

Another issue is the lack of comparison of your results with the results of similar studies that have been conducted in the past. Readers need a reference point because of the tremendous number of studies that have already been conducted in this area. It would also be useful for the reader if information was documented throughout with footnotes in both the summary and the chapters at the end of each section. Throughout the report, more clearly identifying where additional data and support background materials is available on what is being disucssed would be extremely valuable.

2. Choice of scenarios for evaluation. The scenarios which have been developed for analysis do not appear to be realistic. I appreciate the necessity and difficulty in setting bounds for analyzing the impact of the proposed legislation. There are certain factors which must be considered, however, and should lead to a more realistic presentation of scenarios.

The beverage industry asserts that mandatory deposit legislation will ban cans. Thus, the outer range of an all-refillable system has been presented. The Oregon legislation discouraged the use of cans for the reasons you outlined on page 3-4, as well as having a two-tiered deposit system. Yet, cans have not totally disappeared from the Oregon market, although the market share of cans has been substantially reduced. The proposed national legislation does not include the provisions of the Oregon law mentioned above and therefore would probably have lessof an impact on can market share. Therefore, a realistic outer-bound should be the Oregon experience with the Oregon trip rates.

There has been no evidence to indicate that a mandatory deposit bill will not result in a shift of some magnitude to the use of refillable glass bottles. Therefore, the scenarios of no change in metal can market share with 0 and 100% return rates for metal cans seems unrealistic for evaluation. In any case, the Coors' experience with return rates at 0.75¢ per can bounty indicate that can return rates should be in the 80-90% range with a higher refund value of 5¢ on all cans. Eliminating the 0 and 100% return extremes and choosing a high return rate would be more realistic. Thus, I would like to suggest the other bound for your analysis be a case with 50% refillable glass and 40% returnable can and 10% plastic container system. The can market would be predominantly aluminum because of the value of the material and ease of recoverability.

Then, a mid-range case between these two bounds could be chosen. The additional scenarios that you have evaluated do not provide assistance for someone attempting to analyze the impact of mandatory deposit legislation. If they could be appendixed and a more realistic set of data presented, it would be very helpful. In addition, it would be most helpful to the reader if baseline data was always presented with the analyzed scenario data so that the reader has a point of reference.

3. Calculation of capital costs. Bottle, shell and carrier float is considered as capital investment in the draft report for the refillable bottle system. In some studies, and even in some parts of the industry, they have not been so designated. The decision to include them requires that capital costs of the compared nonreusable systems also be included. Thus, the "float" of raw materials for container manufacture and recycle needs to be included for the categories of nonreusable containers. Similarly,

the capital costs of recycling equipment should be included in the analysis, as well as any other costs that will be necessary to achieve the projected rates of recycling, if the capital costs of bottle washing equipment are to be included in the analysis.

It would be most desirable to exclude the bottle, shell and carrier float from consideration as a capital expenditure. However, if that is not possible, an equivalent capital item in the quantity of material "float" is necessary to insure the equal treatment of container systems.

A second concern is the calculation of capital costs in a "point-in-time" analysis. The real costs of capital equipment are not the original price paid for the equipment, but the after-tax impact of the purchase -- allowing for the inclusion of depreciation and write-off. The "point-in-time" analysis does not take into account the highly conceivable modification of currently available equipment to meet the needs of a refillable beverage container system.

A third concern is the calculation of retailer space and equipment capital requirements. It is highly inconceivable that retailers will utilize valuable in-store storage space for the handling of returned cans and bottles. Rather, retailer demands for more frequent servicing form distributors and the use of enclosed outdoor storage space (of lower cost) would be more likely to occur. Concerning metal can requirements, the Coors Container Co. data referenced in Table F-1, Page F-2, for storage at the retail level assumes the use of mechanical systems for crushing cans, thus reducing the quantity of space required for can storage. It is highly unlikely that the "can eater" will be the predominant means of handling metal cans. If that is an assumption, however, than the capital costs of "can eater" purchases should then be included in the capital requirement calculations.

4. Estimates of conservation achievable by early 1980s. The significant quantity of energy savings -- 180.2×10^{12} BTUs -- that the draft report states are achievable throughout the industry is much too high. By utilizing the most recent energy consumption data for the beverage industry and applying it to the rates of energy conservation potential developed by the Federal Energy Administration in 1972, the industry's conservation potential was dramatically overstated. The most easily achievable energy conservation measures have been implemented in the interim period -- thus, while overstating the conservation potential, the analysis also understates the requirements for achieving further conservation in the industry.

An industry-wide switch from bi-metallic to D&I cans is often cited as one of the predominant means for instituting conservation in the throwaway steel can sector. However, a March 22, 1974 article in Beverage Industry predicts, "continued growth in 3-piece can through 1978," the latest year predicted. While the article also predicts growth for the D&I can, the substitution of D&I cans for the 3-piece can by the early 1980s does not seem likely at all.

In addition, the capital requirements for implementing any of the conservation measures have been totally excluded from the report. Inclusion of these figures is imperative for a realistic evaluation of the costs and potential for conservation in the beverage industry.

5. Consideration of the plastic bottle. According to industry predictions, the plastic bottle will achieve 10% of the throwaway beverage market by 1980. Given this dramatic inroad by this date, the plastic bottle must be included in your analysis. The energy requirements of the container are very similar to other throwaways on the market. The plastic bottle is newly designed and therefore utilizes the most recent energy conservation methods in its design and production. Yet, the containers' requirements are still equivalent with glass and can throwaways now on the market, indicating a lack of potential for future conservation in the short-term. Furthermore, the plastic bottle's rapid introduction will most certainly have an impact on employment in the beverage container industry. It is a primary competitor of the glass container, and will also potentially challenge steel and aluminum throwaways. The impact of the plastic bottle on these industrial workers must be included in your baseline scenario, as well as scenarios under mandatory deposit legislation.

6. No section devoted to consumer impact. Throughout the draft report, scattered discussion of consumer attitudes, consumer purchasing patterns, return patterns and possible savings are present. Yet, there is no calculation of consumer savings, aside from the footnote on page 1-4. A calculation should be made of consumer savings under mandatory deposit legislation, utilizing the various scenarios. This information should then be utilized to calculate the impact on labor of increased consumer spending throughout the economy. An entire section of the report should be designated to the consumer and that should be reflected in the summary.

7. Inclusion of direct industries in labor analysis. Although the potential job loss in indirect industries may be an important consideration this section once again is an example of the method of analysis used throughout the report. While evaluating indirect industries' impact, the draft report has not calculated consumer savings, and thereby, positive indirect labor impact of beverage container deposit legislation. If this calculation is not made and included in the report, then the inclusion of indirect industries information is not a true reflection of the impacts of deposit legislation. Without this additional calculation, a spurious picture of the labor impact is given.

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III. Comments on text of report.

Page 1-2, Figure 1-1. This format for the first presentation of different beverage container systems' energy requirements is misleading. Figure 1-1 is a presentation of the energy conservation impact of refilling and/or recycling at present rates of energy consumption in the various container systems. A presentation of 1975 energy requirements of the different container systems -- energy consumed per container type, with present refill or recycle rates -- would be a more appropriate presentation of the energy requirements of the different systems. I do not object to the comparison of return rates for refill and recycle. However, Figure 1-1 is not a presentation of 1975 energy use. Further, in light of the paragraph following Figure 1-1, the potential for energy conservation from aluminum can recycling does not extend linerally below the 87% mark. Therefore, to even chart in Figure 1-1 above the 87% recycle rate is misleading and inaccurate.

Figure 1-1, appearing in a different part ofthe study, could be clarified by the combination of all nonrefillable soft drink and beer (glass) and refillable soft drink and beer (glass). Otherwise aluminum and steel should also be broken out according to type of beverage packaged.

The qualifications in Para. 1 on page 1-3, that "direct comparisons between refillable bottle return rates and metal can recycling rates should be made with care," further points out the need to choose a better method for describing and presenting the present energy requirements of the various container systems. Also, in this paragraph, no mention is made of the maximum return rate for refillable bottles -- only metal cans.

On page 1-5, Para. 2, why use the word "currently" in discussing R/R prices? Is there an expectation of future change in pricing structure of R/R vs. NRs? If not, why qualify?

Page 2-1, A comparison of beverage packaging consumption growth rate with beverage consumption growth rate over this time period provides a better reference point for the reader. Without this information, the growth in packaging can be assumed to parallel a growth in beverage consumption, a case which would not be as disturbing in terms of energy and materials consumption.

Page 2-1, Para. 2-3. This entire section appears to be a discussion of the benefits of single use beverage packaging. If that is the case, it should be clearly stated. Then, a separate section on the benefits of refillable packaging should be made. Enclosed, please find Attachment A , which is a discussion by our organization of the disadvantages of single use packaging trends, from which we would be willing to let you present the other side of this issue. The introduction, as it now stands, confuses the issues surrounding beverage packaging. The debate is not over whether or not there should be a package for beverage distribution. Rather, the debate is over what type of package. Similarly, a discussion of the negative impact of refillable vs. single use packaging should take place.

Page 2-2, 2.12, Para. 2. The discussion of the proposed federal legislation should note the similarities between S. 613 and the amended Vermont legislation (Attatchment B), which it more closely resembles, as well as the Oregon legislation.

Page 2-2, Public Attitudes. The survey of the amount of deposit to be placed on the container does not appear to be relevant in terms of consumer attitudes towards the issue of beverage containers. Rather, it is information that could and should be utilized in the drafting of legislation. There is no further discussion or data presentation concerning the level of deposit in the report where this information is utilized. Therefore, this information should be appendixed for referral for legislators.

Page 2-6, Para. 1. In this paragraph, you state that beverage consumption will continue to grow in the absence of "government intervention." Why is lack of government intervention a parameter in discussing beverage consumption trends? Can you predict a decline in consumption as a result of deposit legislation? In the previous paragraph, you state that it is your estimate that beverage consumption is price and income inelastic. Does that mean that consumption is package elastic? In Para. 2.3.1.1. Beer, consumption of beer is not related to the type of package. These comments above for beer are the same for soft drinks. How can you use package type as a parameter when you've not established it as such?

Page 2-7. Beverage packaging trends. The inclusion of date range for when changes in types of packaging occurred would be useful, i.e., when were beverages first preunitized/when did R/R take majority of market share/ when did NRs take majority of market share?

Also, clarify what changes are being discussed., i.e., R/Rs to NRs, not bulk to R/R. I strongly disagree with the list of reasons given for the switch to throwaway container use.

Reason 1: The consolidation of brewries and soft drink plants was possible only because of the throwaway container. Refillable beverage container use, because of the necessity of returning empty containers for refilling, required regional and local faciltiés. Therefore, the reason to switch to throwaways was not to increase distribution distances, but to consolidate brewing and soft drink facilities. Increased distribution distances were a result of the consolidation.

Reason 2: I've never seen any data that would support this as a reason. All available price data (including a recently completed League of Women Vot s survey)indicate a significant price advantage for R/Rs ove r NRs.

Reason 3: The analysis you present of the capital costs of the different container systems later on in the report contradict this reason.

Reason 4: I would rephrase this to state, the desire of retailers to lower labor costs associated with the handling of returned containers. This reason ranks very closely with a re-worded Reason 1, and should be including the switch to private label brands by large retail concerns.

Reason 5: I would change this by adding increased advertising and promotion of convenience and other attributes of NRs. I would also add decreased advertising, promotion and innovation in R/R packaging.

In addition to these changes, one important reason for the switch to throwaways has been deleted from your analysis: the desire on the part of glass, can and now plastic manufacturers to produce beverage containers. The use of the R/R package precluded any can maker participation and restricted glass manufacturer participation in the higly profitable, high growth throwaway market.

Page 2-8. Refillable Bottles. Why are you qualifying all of your statements about consumer cost vis-a-vis refillable bottles? I'm sure you are aware that today in many markets it's cheaper to buy beer (by the case because that is the only way it is offered for sale) in R/RS and not return the case than it is to buy the same quantity of beer in throwaways. A similar situation exists for some brands of soft drinks. Also, why do R/Rs "potentially" reduce container cost per filling? Do they or don't they? I know of no case where a R/R package of the same brand of beverage in the same size container is more expensive in a R/R than in a NR.

In this same discussion, an important point has been deleted in the analysis of consumer reasons for preferring beer in refillable bottles. The consumer must make a special effort to purchase beer in refillable containers. With the exception of one brand, Falstaff, beer is generally available only by the case in retail sales. In addition, beer in refillable bottles is most often sold unchilled, with poor brand choice (i.e., only 1 or 2 brands are available) and is not prominently displayed. Thus, because the consumer is discouraged by the retailer and beer distributor from purchasing beer in refillables, the consumer has to be highly motivated to make the choice of beer in refillables. I believe this marketing discouragement is the reason for the difference in responses to why people prefer refillables for environmental reasons. The 48% of the public buying beer in refillables have to put up with a lot of inconvenience and retailer resistance in making the choice of refillable beer bottles.

Page 2-17. Para. 1. One of the most important factors affecting trip rates is advertising and consumer awareness. The experiences in both Oregon and Vermont, as well as foreign countries with mandatory deposit legislation, document the fact that when consumers know that beverage containers are to be returned for redemption of a deposit, be the container a can or a bottle, they will bring them back. Another important factor which ties in closely with advertising and consumer awareness is the market share of different container types. If, as in the case of Oregon and Vermont, the returnable market share is 100%, then there is a high return rate.

Thus, taking information from Table 2-11, in 1960, the market share of R/R soft drinks was about 95%, and the trip rate was about 18. In 1965, the market share was about 75%, and the trip rate 15, and in 1970, the market share was about 40% and the trip rate about 13.

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Was an analysis of trip rate as a function of market share of returnable containers conducted? If not, it would seem to be the most important parameter affecting consumer return rates -- affecting advertising, grocer attitudes and consumer habits -- and worthy of inclusion in the study.

In light of the above comments, I am very concerned about your choice of per capita disposable real income as a variable to explain the decline in trip rates. The areas in which throwaway containers have been most predominant and were initially introduced and promoted are primarily urban, while suburban and rural communities have maintained a stronger refillable container mix. Factors such as market size in urban areas, thus assuring a big enough sales base to support the capital requirements of investing in throwaway manufacturing equipment, self-service merchandising trends in urban centers and other factors which identify marketing trends in urban areas rather than per capita disposable real income would seem to influence the production and expanded use of throwaways to a great extent. Thus, the densely populated New England-East Coast corridor has a very high concentration of throwaway container use.

Because of my concern over the use of this calculation, if it is not deleted from the study, or modified as a parameter by inclusion of market share of returnables as an influence in trip rates, it is essential that you identify areas where later on in the report, other variables have been taken into account affecting trippage at this point in the text.

Page 2-19. Metal Cans. I believe this is probably the most difficult area in which to make predictions about market shares. However, in any case, there is no evidence to indicate that bi-metallic cans will be replaced by D&I cans by 1985.

Page 2-23. Refillable Bottles. The on-premise and off-premise beer bottles are the same package. Only one company, the Falstaff Brewing Co., offers beer in another type of package - the 12-bottle case. Therefore, there can be no difference in energy requirements between the on- and off- premise consumption beer bottle.

Table 2-9. Per-unit energy requirements. The refillable beer bottle should be the on-premise bottle, because there is no difference in ancillary packaging, as noted above. Furthermore, since 85% of the refillable beer bottle sales are on-premise, the on-premise figure more fairly represents the energy requirements of the refillable beer bottle. The all-steel can should be excluded from this chart of 1975 energy requirements because of its low market share. If included, plastic bottles should also be included.

Also, aluminum should not be broken down into zero and 100% recycling. On page 2-25, footnote, it states that aluminum recycling rate is 17%. This figure should be the aluminum recycling rate shown. If 100% is kept in, then infinite trip refillable bottles should also be included, along with 100% rate of recycle for bi-metallic cans. These comments on the type of containers analyzed hold for Table 2-10.

Page 2-37. Table 2-13. Attached please find two sources of more recent data onbeer company market shares. (Attatchments Cand D).

Page 2-39. Para. 1. The one-way container has made possible the decline in the number of breweries in the U.S. The economies of scale you mention are possible only with the throwaway container and you have reversed the cause and effect as in the Section on beer packaging trends.

2.4.2. Analytical Framework. There appears to be one important market missing from your analytical framework and that is the beverage sales outlet, the primary consumer of the beverage. Deletion of this important element upsets the framework you have established, for often the final consumer purchases are heavily influenced by what is offered for sale, how a product is offered for sale, thus upsetting the equilibrium. When consumers are discouraged from purchasing an item in a particular package -- such as beer in refillable bottles -- by retailers as well as the promotional efforts of brewers and container manufacturers, there can be no equilibrium. The consumer is definitely outweighed by other forces. Retailers are maximizing their profits by reducing the workforce required to handle returned containers and shifting that cost on to the taxpayer in the form of litter and solid waste collection costs. Even though the retailer would be offering the consumer the beverage at a lower price if selling only in the R/R container. Beverage producers are consolidating their facilities with a throwaway container system and laying off workers in regional brewing and soft drink plants. Between 1958 and 1974, 26,000 workers lost their jobs in the malt liquor industry. In the soft drink industry, 1970 marked the turning point in the consolidation movement. Between 1970 and 1974, 7,900 workers lost their jobs in the soft drink industry.

As plastic throwaway bottles are promoted and take over their projected 10% market share by 1980, thousands of glass and possibly steel workers will lose their jobs. The baseline projection is not any different from that of government intervention in terms of on-going job dislocations, changing capital investment requirements, etc. The situation in the beverage packaging industry is not a static one, but rather will result in changes which "may be felt far beyond the beverage industry sector of the economy" as the description of government intervention indicates for that situation alone.

Page 2-40. I wholeheartedly agree with your analysis concerning the nonrefillable glass bottle under a mandatory deposit system.

Page 2-43. Para. 1. Do you have any reason to believe that the return rate will fall after the imposition of mandatory deposits? If so, they should be documented. The concluding sentence of this paragraph is extremely confusing. Are you talking about the shelf price plus deposit? If not, then there is no reason to assume that raising the level of the deposit to increase the rate of return is going to influence the consumers' purchasing decision. Once everything has a deposit, no matter what the level, people will know when looking at beverage prices what the cost of a particular beverage is.

Page 2-44. You have not demonstrated that beverage consumption will decline after imposition of mandatory deposit legislation. You have not even demonstrated that beverage consumption will not continue to grow at

present rates. With 73% of the people surveyed favoring deposit legislation, with the return rates of Oregon and Vermont as high as they are and with a shift in the industry's multi-million dollar annual advertising budget to promotion of returning returnables, I can easily envision noodecline in beverage consumption.

Page 2-45. What about the plastic refillable bottle? It is a perfect competitor to the glass refillable bottle. With mandatory deposit legislation, its introduction and use seem highly likely.

Thank you once again for this opportunity to review the draft report. I hope that our comments will be of use to you in the preparation of your final report. If there are any questions that you have concerning our comments, please don't hesitate to contact us.

Sincerely,

Patricia Taylor

Patricia Taylor

Arthur Purcell

Encl.

Advertising costs for beer, ale and malt liquor

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Sales of brewers whose 1974 output exceeded 1,000,000 bbls. related to the amount invested by each in general magazines, spot radio, network and spot tv, newspapers and outdoor. These figures are not offered as complete records of expenditures: brewers spent large sums in point of purchase materials and other non-measured media (including newspapers, in 1971). Sales figures were taken from Beer Wholesalers' News, the monthly bulletin of the National Beer Wholesalers' Assn. of America, copyright 1975. Expenditures were compiled from figures supplied by Leading National Advertisers; Radio Expenditure Reports; Broadcast Advertisers Reports; Institute of Outdoor Advertising, and Newspaper Advertising Bureau (compiled by Media Records).

BREWER and (brands)	1974	1973	1972	1972	(Five media total*) 1971	1970	1970	1969	1968	1967
ANHEUSER-BUSCH INC. (Budweiser, Budweiser malt liquor, Michelob, Busch Bavarian)										
1,000 bbls. sold	34,100	29,887	26,522	26,522	24,309	22,202	22,202	18,700	18,400	18,500
Ad investment	$17,839,935	$20,522,602	$25,025,606	$24,737,600	$23,715,800	$18,466,465	$18,686,798	$16,057,638	$14,609,872	$16,980,767
Ad cost per bbl.	52¢	69¢	94¢	93¢	98¢	83¢	84¢	86¢	79¢	$1.09
Ad cost per case	3¢	4.9¢	6.7¢	6.6¢	7¢	5.9¢	6¢	6.1¢	5.6¢	7.8¢
JOS. SCHLITZ BREWING CO. (Schlitz, Schlitz malt liquor, Old Milwaukee, Primo, Encore)										
1,000 bbls. sold	22,661	21,343	18,906	18,906	16,708	15,129	15,129	13,700	† 11,602	10,220
Ad investment	$20,910,940	$19,722,864	$20,699,446	$20,646,600	$17,165,900	$16,412,600	$16,703,792	$16,423,596	$17,556,628	$16,311,026
Ad cost per bbl.	92¢	92¢	$1.09	$1.07	$1.03	$1.08	$1.10	$1.20	$1.51	$1.59
Ad cost per case	6¢	6.5¢	7.8¢	7.6¢	7.4¢	7.7¢	7.9¢	8.6¢	11¢	11¢
PABST BREWING CO. (Pabst, Blue Ribbon malt liquor, Andeker Supreme, Eastside lager, Red White & Blue)										
1,000 bbls. sold	14,287	13,128	12,600	12,600	11,787	10,517	†† 10,817	††† 10,225	10,910	10,050
Ad investment	$8,449,274	$7,219,051	$6,128,132	$6,053,200	$6,596,400	$6,212,740	$6,428,563	$5,217,382	$5,527,808	$8,473,773
Ad cost per bbl.	59¢	55¢	49¢	48¢	56¢	59¢	61¢	51¢	78¢	84¢
Ad cost per case	4¢	3.9¢	3.5¢	3.4¢	4¢	4.2¢	4.4¢	3.6¢	5.6¢	6¢
ADOLPH COORS CO. (Coors)										
1,000 bbls. sold	12,400	10,950	9,785	9,785	8,525	7,277	7,277	6,350	5,333	4,600
Ad investment	$1,611,931	$1,374,929	$1,902,409	$1,862,800	$1,862,800	$1,762,000	$1,762,000	$1,021,328	$786,316	$1,216,706
Ad cost per bbl.	12.9¢	13¢	19¢	19¢	22¢	24¢	24¢	16¢	15¢	26¢
Ad cost per case	0.9¢	0.9¢	1.4¢	1.4¢	1.6¢	1.7¢	1.7¢	1.1¢	1.1¢	1.9¢
MILLER BREWING CO. (Miller High Life, Miller Lite, Gettelman, Miller ale, Miller malt liquor, Meister Brau, Lite, Buckeye, Milwaukee Extra)										
1,000 bbls. sold	9,066	6,919	#5,353	5,353	5,200	5,150	5,150	5,190	4,850	4,575
Ad investment	$13,556,133	$10,914,623	$11,078,707	$11,014,600	$13,468,300	$10,850,600	$10,927,735	$9,483,172	$8,901,219	$8,829,471
Ad cost per bbl.	$1.50	$1.58	$2.07	$2.06	$2.59	$2.11	$2.12	$1.83	$1.83	$1.92
Ad cost per case	10¢	11.2¢	14.7¢	14.7¢	18.5¢	15.1¢	15.1¢	13.1¢	13¢	14¢
FALSTAFF BREWING CO. (Falstaff, Krueger, Narragansett, Ballantine ale and beer)										
1,000 bbls. sold	5,800	6,009	**6,200	6,200	5,150	5,386	5,386	6,200	6,300	6,632
Ad investment	$6,213,812	$6,876,796	$5,135,920	$4,949,800	$6,324,300	$7,889,600	$8,136,798	$6,565,067	$8,464,961	$8,337,100
Ad cost per bbl.	$1.07	$1.14	83¢	80¢	$1.23	$1.46	$1.48	$1.06	$1.34	$1.25
Ad cost per case	7¢	8.1¢	5.9¢	5.7¢	8.8¢	10.4¢	10.6¢	7.6¢	9.6¢	8.9¢

& M. SCHAEFER BREWING CO. (Schaefer)

[illegible]	$4,290,180	$4,376,481	$4,884,833	$4,561,700	$6,069,300	$6,583,600	$6,928,691	$4,449,433	$4,796,945	$4,423,425
Ad cost per bbl.	89¢	78¢	88¢	82¢	$1.08	$1.15	$1.20	87¢	95¢	91¢
Ad cost per case	6¢	5¢	6.2¢	5.9¢	7.7¢	8.2¢	8.6¢	6.2¢	6.8¢	6.5¢
STROH BREWING CO. (Stroh's)										
1,000 bbls. sold	4,364	4,645	4,231	4,231	3,676	3,276	3,276	2,939	2,536	2,403
Ad investment	$4,383,095	$4,452,915	$4,525,348	$4,448,300	$4,407,700	$3,798,478	$3,882,200	$2,465,669	$3,648,641	$3,791,655
Ad cost per bbl.	$1.00	96¢	$1.07	$1.05	$1.20	$1.16	$1.19	84¢	$1.44	$1.57
Ad cost per case	7¢	6.8¢	7.6¢	6¢	8.6¢	8.3¢	8.5¢	6¢	10¢	11¢
G. HEILEMAN BREWING CO. (Blatz, Old Style, Drewry's, Pfeiffer, Sterling, Weidemann, Kingsbury, Mickey's malt liquor, Jacob Schmidt)										
1,000 bbls. sold	†††† 4,300	4,420	*3,675	3,675	2,820	3,000	3,000	2,298	1,726	1,310
Ad investment	$2,666,400	$3,356,043	$5,146,090	$5,115,700	$3,710,700	$3,534,400	$3,534,400	$2,854,250	$890,800	$1,244,400
Ad cost per bbl.	62¢	76¢	$1.40	$1.39	$1.32	$1.18	$1.18	$1.24	52¢	94¢
Ad cost per case	4¢	5.4¢	10¢	9.9¢	9.4¢	8.4¢	8.4¢	8.8¢	3.7¢	6.7¢
OLYMPIA BREWING CO. (Olympia)										
1,000 bbls. sold	4,300	3,636	3,330	3,330	3,094	3,379	3,379	3,350	3,074	2,866
Ad investment	$3,892,676	$3,258,529	$3,417,865	$3,330,900	$4,332,900	$4,317,900	$4,389,710	$3,215,219	$3,483,678	$3,418,707
Ad cost per bbl.	90¢	90¢	$1.03	$1.00	$1.40	$1.28	$1.30	96¢	$1.13	$1.19
Ad cost per case	6¢	6¢	7.4¢	7.1¢	10¢	9.1¢	9.3¢	6.8¢	8.1¢	8.5¢
C. SCHMIDT & SONS (Schmidt's, Prior)										
1,000 bbls. sold	3,490	3,520	3,194	3,194	3,162	3,040	3,040	2,941	2,816	2,660
Ad investment	$3,538,155	$3,789,655	$2,167,398	$2,143,000	$2,674,700	$2,936,100	$2,936,100	$2,355,563	$2,706,194	$2,079,671
Ad cost per bbl.	$1.01	$1.08	68¢	67¢	85¢	97¢	97¢	80¢	96¢	78¢
Ad cost per case	7¢	7.7¢	4.9¢	4.8¢	6.1¢	6.9¢	6.9¢	5.7¢	6.8¢	5.5¢
CARLING BREWING CO. (Black Label, Red Cap ale, Heidelberg beer, ale and light pilsner, Canadian Gold, Carlsberg, Stag, Tuborg)										
1,000 bbls. sold	3,400	3,800	4,222	4,222	4,535	5,000	5,000	5,440	6,020	4,900
Ad investment	$383,101	$6,915,629	$5,868,203	$5,642,325	$8,242,600	$6,384,400	$6,487,200	$5,109,909	$6,703,024	$9,918,132
Ad cost per bbl.	11.2¢	$1.82	$1.39	$1.34	$1.82	$1.28	$1.30	94¢	$1.33	$2.02
Ad cost per case	0.8¢	13¢	9.9¢	7.5¢	13¢	9.1¢	9.3¢	6.7¢	9.5¢	14¢
THEODORE HAMM CO. (Hamm's, Burgie, Waldech, Burgermeister)										
1,000 bbls. sold	3,100	3,400	3,800	3,800	3,700	4,045	4,045	4,180	4,311	4,311
Ad investment	$4,609,140	$5,116,067	$2,748,198	$2,737,200	$6,687,500	$5,962,900	$5,976,930	$3,791,764	$4,774,494	$7,402,766
Ad cost per bbl.	$1.48	$1.50	72¢	72¢	$1.81	$1.47	$1.48	91¢	$1.11	$1.71
Ad cost per case	10¢	10.7¢	5.1¢	5.1¢	12.9¢	10.5¢	10.6¢	6.5¢	7.9¢	12¢
RHEINGOLD CORP. (Rheingold, Knickerbocker, Ruppert, Gablinger's)										
1,000 bbls. sold	2,455	2,888	3,150	3,150	3,525	3,417	3,417	3,570	3,400	3,600
Ad investment	$841,930	$1,485,682	$2,386,537	$2,242,100	$3,829,300	$3,724,200	$3,853,216	$2,818,718	$2,209,107	$6,944,601
Ad cost per bbl.	34¢	51¢	76¢	71¢	$1.09	$1.09	$1.07	79¢	65¢	$1.92
Ad cost per case	2¢	3¢	5.4¢	5.1¢	7.8¢	7.8¢	7.6¢	5.6¢	4.6¢	13¢
NATIONAL BREWING CO. (Altes, Colt beer, National Premium, National Bohemian ale and beer, Regal, A-1, Colt .45 malt liquor, Malt Duck)										
1,000 bbls. sold	2,112	2,196	2,154	2,154	2,202	2,262	2,262	2,218	2,138	2,082
Ad investment	$2,830,532	$2,918,174	$3,182,992	$3,073,700	$3,678,900	$3,389,400	$3,398,796	$3,088,322	$3,535,689	$3,454,728
Ad cost per bbl.	$1.34	$1.33	$1.48	$1.43	$1.67	$1.49	$1.50	$1.38	$1.65	$1.65
Ad cost per case	9¢	9¢	10.6¢	10.2¢	11.9¢	10.6¢	10.7¢	9.8¢	11¢	11¢
GENESEE BREWING CO. (Genesee beer and ale, Fyfe & Drum)										
1,000 bbls. sold	2,025	1,850	1,725	1,725	1,575	1,475	1,475	1,448	1,440	1,430
Ad investment	$1,753,700	$2,018,800	$2,284,601	$2,284,601	$2,185,700	$1,614,500	$1,614,500	$1,327,440	$1,359,655	$2,111,866
Ad cost per bbl.	86¢	$1.09	$1.32	$1.32	$1.39	$1.09	$1.09	92¢	94¢	$1.47
Ad cost per case	6¢	7.7¢	9.4¢	9.4¢	9.9¢	7.8¢	7.8¢	6.6¢	6.7¢	10¢

(Continued on Next Page)

Act No. ——

H. 228

ATTACHMENT B

An act to amend 10 V.S.A. §§ 1521, 1522, 1523, 1524, 1525 and to add 10 V.S.A. §§ 1522a, 1526 and 1527 relating to beverage containers.

Sec. 1. 10 V.S.A. § 1521 is amended to read:

§ 1521. DEFINITIONS

For the purpose of this Chapter:

(1) "Beverage" means beer or other malt beverages and mineral waters, soda water and carbonated soft drinks in liquid form and intended for human consumption.

(2) "Biodegradable material" means material which is capable of being broken down by bacteria into basic elements.

(3) "Container" means the individual, separate, bottle, can, jar or carton composed of glass, metal, paper, plastic or any combination of these materials containing a consumer product. This definition shall not include containers made of biodegradable material.

(4) "Distributor" means every person who engages in the sale of consumer products in containers to a dealer in this state including any manufacturer who engages in such sales.

(5) "Manufacturer" means every person bottling, canning, packing or otherwise filling containers for sale to distributors or dealers.

(6) "Recycling" means the process of sorting, cleansing, treating and reconstituting waste and other discarded materials for the purpose of reusing the materials in the same or altered form.

(7) "Redemption center" means a store or other location where any person may, during normal business hours, redeem the amount of the deposit for any empty beverage container labeled or certified pursuant to Section 1524 of this Title.

(8) "Refillable" means a beverage container which can be refilled at least five times and is so certified by type by the secretary.

(9) "Secretary" means the secretary of the agency of environmental conservation.

Sec. 2. 10 V.S.A. § 1522 is amended to read:

§ 1522. BEVERAGE CONTAINERS; DEPOSIT

(a) A deposit of not less than five cents shall be paid by the consumer on each beverage container sold at the retail level and refunded to him upon return of the empty beverage container.

(b) A retailer or a person operating a redemption center who redeems beverage containers shall be reimbursed by the manufacturer or distributor of such beverage containers in an amount which is at least twenty percent of the amount of the deposit returned to the consumer.

(c) The secretary may promulgate rules and regulations necessary to implement this chapter.

(d) The secretary shall prepare and print suitable posters for sale at cost, to persons who wish to post the hours during which containers will be redeemed at their places of business. Containers shall be redeemed during no fewer than 40 hours per week during the regular operating hours of the establishment. The poster shall be substantially in the following form:

NOTICE TO CUSTOMERS

In accordance with the provisions of Section 1523a of Title 10, Vermont Statutes Annotated, this store will redeem clean beverage containers during the following 40 or more hours of each week

Monday .....
Tuesday .....
Wednesday .....
Thursday .....
Friday .....
Saturday .....
Sunday .....

.....
(Name of store or establishment)

.....
(Operator, manager, or owner)

Sec. 3. 10 V.S.A. § 1522a is added to read:

§ 1522a. LITTER LEVY

(a) A levy is hereby exacted on all vinous and spirituous beverage containers sold in the state intended for resale, use or consumption in this state at the rate of 4 mills on each container sold. As used in this section "beverage" includes vinous and spirituous beverages as defined in Section 2 of Title 7.

(b) The levy provided in this section shall be paid by every manufacturer or distributor to the commissioner of taxes. Whenever a retailer, group of retailers or retail chain contracts for, receives consignment of, or in any other manner acquires vinous or spirituous beverages in beverage containers outside of the state for sale, use or consumption in the state, the levy exacted pursuant to this section shall be paid to the commissioner of taxes by such retailer, retail group or chain. The commissioner of taxes shall adopt and publish all forms and regulations necessary for the purpose of this chapter.

Sec. 4. 10 V.S.A. § 1523 is amended to read:

§ 1523. ACCEPTANCE OF BEVERAGE CONTAINERS

(a) Except as provided in Section 1522 of this title:

(1) A retailer shall not refuse to accept from any person any empty beverage containers of the kind, size and brand sold by the retailer, or refuse to pay to that person the refund value of a beverage container as established by section 1522 of this title, except as provided in subsection (b) of this section.

(2) A manufacturer or distributor may not refuse to accept from a retailer or a person operating a redemption center any empty beverage containers of the kind, size and brand sold by the manufacturer or distributor, or refuse to pay the retailer or a person operating a redemption center the refund value of a beverage container as established by section 1522 of this title.

(b) A retailer, with the prior approval of the secretary, may refuse to redeem beverage containers if a redemption center or centers are established which serve the public need.

(c) A retailer or a person operating a redemption center may refuse to redeem beverage containers which are not clean.

(d) A retailer or group of retailers may petition the secretary for the establishment of a redemption center.

(e) The secretary shall, upon due notice to the public and other affected parties, hold a public hearing upon the petition. After investigation and hearing, the secretary, after determination of need and service to be provided by the establishment of a redemption center, shall issue his order authorizing the distributors or retailers affected and servicing the community or area involved to establish a redemption center or alternate method of redemption, or shall deny the petition if found adverse to the public need.

Sec. 5. 10 V.S.A. § 1524 is amended to read:

§ 1524. LABELLING

(a) Every beverage container sold or offered for sale at retail in this state shall clearly indicate by embossing or imprinting on the normal product label, or in the case of a metal beverage container on the top of the container, the word "Vermont" and the refund value of the container in not less than one-quarter inch type size.

(b) This Section shall not apply to beverage containers which are certified as refillable by the secretary.

Sec. 6. 10 V.S.A. § 1525 is amended to read:

§ 1525. PROHIBITIONS

No beverage shall be sold or offered for sale at retail in this state:

(1) in a metal container designed and constructed so that part of the container is detachable in opening the container, or in a glass beverage container which has not been certified as refillable by the secretary.

(2) in containers connected to each other with plastic rings or similar devices which are not classified as biodegradable by the secretary.

Sec. 7. 10 V.S.A. § 1526 is added to read:

§ 1526. EDUCATIONAL PROGRAM

(a) State informational material such as travel pamphlets, road maps and similar publications submitted for printing on or after July 1, 1975 shall bear information relating to this chapter. This information shall take the form of a standard public statement relating to the deposit law provided by the secretary.

(b) The department of education may incorporate information on this chapter in educational material which it normally distributes to primary and secondary educational institutions within the state. The department may cooperate with the agency of environmental conservation in distributing any additional informative material on this chapter to schools in the state.

Sec. 8. 10 V.S.A. § 1527 is added to read:

§ 1527. PENALTY

A person who violates a provision of this chapter shall be fined not more than $1,000.00 for each violation.

Sec. 9. This act shall take effect July 1, 1975, except that Section 5 of this act shall take effect September 1, 1975 and section 6 of this act shall take effect January 1, 1977.

2.3 Number of Breweries Operated in U.S. and Michigan 1952-1974.

The table below shows the historical decline in the number of breweries operated.

Table 2.1

NUMBER OF BREWERIES OPERATED 1952-1974

Year	United States	Michigan
1952	357	18
1953	329	14
1954	310	14
1955	292	14
1956	281	13
1957	264	13
1958	252	12
1959	244	11
1960	229	10
1961	229	10
1962	220	9
1963	211	9
1964	204	8
1965	197	7
1966	187	7
1967	176	6
1968	163	5
1969	158	5
1970	154	5
1971	148	5
1972	147	5
1973	129	5
1974	126	4

Source: "Alcohol and Tobacco Summary Statistics", U.S. Treasury Department, Internal Revenue Service.

2.4 Production of Malt Beverages: 1960-1973

The production of malt beverages in U.S. and Michigan is presented in Table 2.2.

Table 2.19 (a)

Employment Trends in Bottled and Canned Soft Drink Industry: U.S.
(Sic 2086)

Year	All Employees (000)	Production Workers (000)	Man-Hours Per Production Worker (000)	Wage Per Production Worker Man-Hours $	Value of Shipments Per Production Worker $1000	Value Added Per Production Worker Man-Hours $	Capital Expenditures ($ Millions)
1974	120.9*	44.3*	1.967*	3.840*	147.4*	34.01*	125.8*
1973	121.0*	44.7*	1.971*	3.480*	132.7*	29.42*	138.5*
1972	120.5	45.1	2.011*	3.332*	119.6*	25.45	152.5*
1971	121.1	45.9	2.052	2.994	110.0	23.59	168.0
1970	128.8	49.6	2.095	2.690	93.4	20.42	185.1
1969	128.5	49.3	1.984	2.632	82.4	19.86	154.6
1968	124.1	47.7	2.023	2.426	74.5	18.67	139.9
1967	123.3	46.6	2.045	2.301	68.1	17.62	168.1
1966	117.7	43.7	2.146	2.144	62.6	15.68	151.1
1965	113.9	42.1	2.140	2.028	59.5	15.24	111.0
1964	111.1*	41.0	2.176	1.937	58.8	15.56	110.8
1963	106.9	40.9	2.125	1.895	54.1	14.20	100.8
1962	105.4	41.4	2.244	1.704	49.1	12.14	81.4
1961	104.1	40.9	2.188	1.667	46.7	11.85	69.4
1960	103.3	41.1	2.175	1.614	43.9	11.25	76.4
1959	100.0	40.2	2.082	1.622	42.6	11.40	66.0
1958	97.1	39.5	2.025	1.643	39.5	10.78	64.2
% Change 1970-71	-6.0	-7.5	-2.0	11.3	17.8	15.6	-9.2
Average Rate 1958-71	1.7	1.2	0.1	4.7	8.2	6.2	7.7

*As of December 31 and Man Hours, value of shipments, value added and capital expenditures were projected by using average historical growth rate 1958-71.

Source: Annual Survey of Manufacturers; 1971 and Industrial Outlook 1975 p. 211.

L-65

Table 2.12

Employment Trends in Malt Liquor Industry - U.S.
(Sic 2082)

Year	All Employees (000)	Production Workers (000)	Man-Hours Per Production Worker (000)	Wage Per Production Worker Per Man-Hour $	Value of Shipments Per Production Worker ($1000)	Value Added Per Production Worker Per Man-Hour $	Capital Expenditures ($ Million)
1974	45.4*	29.9*	1.912*	7.11*	161.3*	34.22*	126.5*
1973	48.6*	32.1*	1.944*	6.58*	134.1*	31.90*	140.3*
1972	51.0	33.9	1.976	6.095	120.3	29.73	155.5
1971	57.0	37.2	1.925	5.659	111.3	30.41	160.2
1970	57.3	38.0	1.955	5.149	100.6	27.29	177.7
1969	57.3	38.6	1.922	4.844	88.6	24.09	249.8
1968	58.7	39.7	1.927	4.490	78.9	21.35	193.6
1967	59.6	40.0	1.920	4.315	73.2	20.13	172.9
1966	60.5	40.3	1.948	4.255	67.0	17.99	168.8
1965	60.4	40.6	1.938	3.944	61.5	17.28	115.4
1964	61.9	42.0	1.919	3.864	58.8	16.95	105.4
1963	62.6	42.7	1.918	3.691	54.2	15.70	86.2
1962	66.0	44.8	1.920	3.544	50.9	14.77	84.6
1961	68.2	46.2	1.894	3.402	47.6	14.25	89.9
1960	69.8	48.0	1.887	3.298	45.7	13.87	75.9
1959	70.9	48.0	1.915	3.184	43.7	13.06	64.9
1958	71.7		1.910	3.055	41.3	12.18	72.9
% Change 1973-74	-6.6	-6.9	-1.6	8.1	20.3	7.3	-9.8
Avg. Rate 1958-1971	-1.7	-1.9	0.1	4.9	7.9	7.3	6.2

Source: Annual Survey of Manufacturers, 1971 Industry Profiles and Industry Outlook 1975, p. 208.

*As of December 31; and Manhours, value of shipments, value added and capital expenditures were projected by using average historical growth rate for 1958-1971.

eco notes

EPA opens new office

The Environmental Protection Agency is establishing a new land use office — the first time the agency has "officially" dealt with land use issues.

The brainchild of EPA Administrator Russell Train, the office will initially be staffed by three or four people, although its functions, as envisioned by Train, are fairly broad. In a memo to agency employees, the EPA head said the office would coordinate state, local and regional government land use agencies, explain EPA's land use role to the public and private sectors, and help stimulate new initiatives in the land use policy.

Although the agency currently has an informal land use task force, the proposed office marks the first time the agency has committed itself to developing an official land use policy. Within EPA's air and water divisions, there are land use sections and there has been some opposition to the new office within those sections. The agency had been contemplating the establishment of a land use office for quite awhile, but, according to some sources, the defeat of federal land use legislation in the House of Representatives provided a final impetus to the announcement of the proposal.

Soviet citizen participation

A Soviet factory worker has charged that she was seized and held in a mental institution for more than a month following her public criticism of pollution control at a factory. The woman, who identified herself as Svetlana Shramko, made the charges in a call to the Moscow bureau of the *New York Times*.

Shramko said she had written the Central Committee of the Soviet government and the United Nations to complain that the Artificial Filament Plant 523 in Ryazan had no pollution control equipment and discharged hydrogen sulfide and other substances at more than five times permissible levels. The letter to the UN was delivered with the help of a tourist, she said.

On June 28, Shramko claimed, she was taken into custody at the factory and sent to a mental institution. More than a month later she was released on the condition that she would not write any more letters to international organizations.

Disposal plans hit

As the Reserve Mining Co. outlines plans for on-land disposal of millions of tons of taconite tailings from its Silver Bay, Minn., operation ("Eco notes," August 3), the governors of Minnesota, Wisconsin and Michigan have announced their opposition to the plan.

Terming Reserve's current proposal "a monumental environmental blunder," Minnesota Governor Wendell Anderson, along with Patrick Lucey of Wisconsin and William Milliken of Michigan urged the mining company to look into alternative sites besides one on Palisades Creek, about one-and-one-half miles from the Reserve's plant on Lake Superior. The governors represent the three states who are among the plaintiffs in the federal suit aimed at halting Reserve's taconite dumping practices.

The governors claim there are at least three other on-land sites that would be economically feasible for the company, although "Reserve officials have yet to seriously study alternatives to the Palisade Creek Area." Palisades Creek is in a forested area near Duluth, Minn., which has been considered for inclusion in the state park system. Reserve's plans call for the construction of a tailings dam "30 feet higher than Washington state's Grand Coulee dam, and half again as long," according to a Minnesota state Department of Natural Resources' official. No studies have been made as to whether "the dam could" hold 800 million tons of wastes that would be poured into the tailings basin over the next 40 to 60 years," the official said.

He added that a dam break could result in the pollution of Lake Superior with millions of tons of taconite-laden water and semi-fluid wastes. His department will not issue necessary construction permits to Reserve even if the federal court accepts the proposed dumping site, the official declared.

The wastes from the Reserve operation are closely related to asbestos, a known cancer-causing agent. The suit against Reserve was brought on the grounds that the dumping constitutes a major public health hazard.

savings is 42 percent of the energy presently being used for packaging materials nationwide.

Aside from product reuse, there are other methods of achieving source reduction. Increasing product durability and serviceability could substantially lessen materials and energy consumption. According to Robert Waterman of the University of Pennsylvania, if the lifetime of all tires were extended to 100,000 miles, an estimated 75 percent of all discarded tires would be eliminated annually. Extending tire lifetimes becomes especially important because the disposal of tires is a municipal headache: they are hard to landfill since they often rise to the surface and cannot be incinerated in large quantities because they damage incinerator walls. Therefore, many tires end up on roadsides in rural areas.

Approximately two to five percent of municipal waste – products such as tires, refrigerators and other appliances – could be redesigned to increase their useful lifetime. Encouraging the production of products which can be easily repaired, instead of thrown away, is a simple way of increasing product lifetime.

Product redesign to cut down production-related materials and energy requirements would also result in source reduction. Materials shortages and rapidly increasing raw materials prices have spurred industry's concern for these considerations. Bauxite price increases, for example, have already accelerated redesigning activities within the aluminum industry.

The introduction of source reduction policies will have an important impact on nationwide material and energy savings. However, many industries which produce wastes are urging state and local officials, as well as the U.S. Congress, to invest in facilities that would recycle their products as the alternative to source reduction policies. Industry's attitude has become increasing apparent as the movement for returnable/refillable containers gains strength around the country.

Source reduction and resource recovery can go hand-in-hand. It is only packaging manufacturers who place source reduction and resource recovery in an "either/or" context. Ideally, every method of waste reduction should be explored before resource recovery methods are implemented. Taxpayers should not finance resource recovery facilities designed to handle materials that need not have been produced in the first place.

Such "total systems resource recovery" processes have a frightening potential for institutionalizing waste generation. Already the City of New Orleans and the National Center for Resource Recovery (NCRR) have signed an agreement which essentially guaranteed that the city will continue to generate large quantities of waste – waste that will find its way into an NCRR-funded resource recovery system (*EA*, April 23, 1973). In Florida, the state legislature passed a state-wide resource recovery act which went into effect on July 1. The act specifically prohibits the "control by governmental rule, regulation or ordinance the packaging of products manufactured or sold in the state." Ostensibly directed at material recovery, these efforts include provisions purposely designed to circumvent the implementation of source reduction.

To promote resource recovery, American Can has developed its own system, Americology, which it eagerly offers to municipalities and regional governments. Americology enables American Can to present an alternative to beverage container legislation and other source reduction proposals. American Can stands to profit if its system ever becomes operational, because it will make money by processing the unnecessary waste it helps to generate.

Policies which have encouraged the rapidly expanding consumption of energy and raw materials must be reversed. We can no longer afford to ignore the broader implications of the solid waste disposal crisis facing cities across the country. It is a crisis of raw materials and energy management and policy-making that will affect the country for years to come.

Beverage container legislation is a start, but it is only the beginning. Redesigning products so they are more easily recycled, extending the lifetime of difficult-to-dispose-of products such as automobile tires and eliminating so-called "convenience" packaging come next. Recovery of non-reusable materials and the elimination of such outmoded and environmentally disastrous waste disposal methods as the open dump must also take place. All of these options must be explored if the nation is to "extend the conservation ethic to raw materials." ■

Patricia Taylor is Environmental Action's solid waste coordinator.

Pictures for this article were taken at a non-profit cooperative food store called Stone Soup in Washington, D.C. The store's operators avoid pre-packaged and over-packaged goods as much as possible. (Photos by Rhoda Baer)



bus$ines$$ brief$

Oil riggers to Ocala

A three-year battle over oil drilling in Florida's Ocala National Forest has been settled in favor of the oil producers. Secretary of the Interior Rogers Morton announced on July 24 that after consideration of a final environmental impact statement on the proposed drilling, he had decided to approve the project.

Amoco Production Company gained a lease in 1969 from the Bureau of Land Management for oil rights under 95 percent of the 430,000-acre forest. Many Florida citizens were outraged at the leasing and Interior Secretary Morton subsequently ordered a moratorium on exploratory drilling in the forest until an impact statement could be prepared and reviewed.

Morton said there would definitely be ill effects from the drilling and development, but that they were not serious enough to halt the project. The statement said there was danger to the Floridan Aquifier ("a significant subsurface water source"), to "several rare and endangered species of wildlife, including the alligator and southern bald eagle" and to "the general forest ecologic environment, including esthetic, archeological and historic resources." Morton added that "the greatest risk stems from possible surface of subsurface escape of hydrocarbons. . . ."

If a major discovery of oil is made, about 500 acres of the forest would be occupied, Morton said. Conservationists have charged that a major find could lead to total exploitation of the forest and the state's freshwater basin.

New antitrust drive?

Saying that inadequate competition may be costing the American public as much as $80 billion a year, the government's top antitrust enforcer has announced a new drive to break up monopolies and stop price-fixing.

Thomas Kauper, chief of the antitrust division of the Justice Department, made the surprisingly strong statement in his first major policy speech since succeeding Richard McLaren in the post two years ago. The effect of Kauper's announcement was unclear, however, since the Director of the Office of Management and the Budget, Roy Ash, made an earlier statement on antitrust which at least partially contradicted Kauper. Ash said the nation needs a "new framework of pro-competition" rather than antitrust action to "break up bigness because it is big." President Nixon has indicated he sympathizes with Ash's statement.

Kauper said antitrust enforcement could be a strong hedge against inflation and that even if his agency gets the extra $1 million he has required for 83 additional attorneys, that he can save the taxpayers money. If the new investigation does proceed, Kauper said it would make a broad review of major concentrated industries to discover instances of pricing that are "not explainable in terms of market conditions" as well as barriers to entry or "other anti-competitive behavior."

One of the sectors prime for investigation, Kauper said, is large agricultural cooperatives where the organizations "enhance food prices." He said the cooperatives are now exempt from regulation but that a size limitation may be necessary so the ventures "do not dominate national or regional food markets."

OILY INFLUENCE PEDDLING

Documents recently released by a Senate subcommittee reveal that the American firms which own the Arabian American Oil Company (Aramco) accepted and carried out "instructions" from the Saudi Arabian government to lobby U.S. government officials against increased support for Israel.

The disclosure was based primarily on documents submitted by Standard Oil of California (SoCal) to the Senate Foreign Relations Subcommittee on Multinational Corporations. The chairperson of the subcommittee, Senator Frank Church (D-Idaho), said SoCal and the three other Aramco owners (Exxon, Mobil and Texaco) embarked on an extensive propaganda and lobbying effort after being ordered to do so by King Faisal of Saudi Arabia. "The companies followed these instructions and reported on their activities to the King," Church said.

The campaign to influence U.S. officials against extending any further aid to Israel climaxed when the companies sent a joint memo to President Nixon, six days prior to the Arab oil embargo. In the message the chief executives of the corporations warned the President "that any actions of the U.S. government at this time in terms of increased military aid to Israel will have a critical and adverse effect on our relations with the moderate Arab producing countries."

When a staff member of the Senate subcommittee asked SoCal Vice President Jones McQuinn if he thought it was "inappropriate" to cooperate with the Arabs in such a manner, McQuinn replied, "we did not feel that it was."

The documents released by the subcommittee also revealed that high U.S. officials used the oil companies to influence the State Department and the President. James Akins, the U.S. ambassador to Saudi Arabia, asked Aramco officials to urge their U.S. corporate personnel to "use their contacts at highest levels" of the government "to hammer home the point" that oil restrictions would not be lifted until the political problems were resolved to the satisfaction of the Arabs, according to Frank Jungers, Aramco's chairman.

Senator Church said he was releasing the documents to show "the extent to which the companies are hostages of the Saudis and forced to operate at their beck and call." A subcommittee staffer asked the vice chairman of SoCal, George Keller, if the companies were trying to show King Faisal that they wanted to help "get the Arab side of the story across." Keller replied, "I think in retrospect that is probably a fair appraisal."

Source Reduction: stemming the tide of trash

ATTATCHMENT A

by PATRICIA TAYLOR



A call to "extend the conservation ethic to raw materials," is not unexpected when it comes from a disgruntled recycler, but when it comes from as unlikely a source as powerful Senate Public Works Committee head Jennings Randolph (D-W.Va.), a policy change may result. In recent committee hearings on five pieces of comprehensive solid waste legislation, Randolph caught environmentalists, as well as chagrined packaging manufacturers, by surprise with his enthusiasm for an environmental approach to energy and materials consumption. However, Randolph has not yet detailed the components of the new ethic, and it is not clear whether the Senate's campaign against solid waste will address symptoms of the solid waste problem or attack its causes.

What form this new conservation ethic will take is a subject of great concern to environmentalists, especially as waste-producing industries focus attention on improving disposal practices and energy and resource recovery systems as the solution to the solid waste problem. Industry's hesitancy to address the underlying causes of the solid waste disposal crisis threatens the proper evaluation of policy options. In order to find real "solutions," a superficial assessment of symptoms – open burning dumps, escalating disposal and collection costs, and decreasing rates of materials recovery – must be avoided.

Source reduction, or the conservation of energy and materials achieved by cutting down the amount of waste gener-

89-1

environmental action
Suite 731 1346 Connecticut Ave. NW Washington, DC 20036 (202) 833-1846

March 1, 1976

Tayler Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

Here is an updated and more complete list of the communities which have adopted some kind of beverage container legislation, amplified by the information which Pat Taylor recently passed on to me.

I am also enclosing for your information a copy of the report on the Dade County, Florida, Bottle Ordinance experience.

Municipalities:

New Hope, Minn.
Princeton, Minn. all 3 passed in 1972, not yet in effect.
Deephaven, Minn.

Troy, Mich.
Sterling Heights, Mich.
Northville, Mich.
Lake, Mich.
Ann Arbor, Mich.
Oberlin , Ohio -- passed 1/72

Counties:

Cayuga Co, N.Y.
Fairfax Co, VA
Montgomery Co, MD.
Loudon Co, VA -- recently overturned in court.

I understand that this list will be included in any discussion of public consideration of the issue of beverage containers.

Sincerely yours,

Pamela Deuel

Enc.

Packaging materials manufacturers have gladly met an ever-expanding demand for their products from the supermarkets. The American Can Company, best known for its strident lobbying efforts against beverage container legislation, is an excellent example of industry's response to the new demands for packaging materials. According to *Moody's Industrial Manual*, American Can's investment in the continued growth of packaging consumption extends beyond the one-way can. It now produces a wide range of packaging materials – from paper cartons and other materials used to package bread, butter, cheese, margarine and frozen foods to paperboard milk and cream cartons as well as products such as Northern and Gala paper towels, and Dixie cups, plastic silverware and paper plates. In addition to these products, American Can is protecting its other investments by fighting beverage container and source reduction legislation. Not only does the company produce the one-way container, it also manufactures and leases or sells the equipment used for filling, closing and handling American Can products to packaging industries.

The growth and diversification of companies like American Can Co. has been dependent upon their ability to externalize many of their business expenses by passing such costs on to the consumer and taxpayers, and into the environment.

At the supermarket, consumer options are almost completely limited to packages which are environmentally damaging and, often, expensive. For example, in a recent survey of the availability of beer in returnable packaging, Environmental Action intern Stan Pollack found that less than 15 percent of the 361 liquor stores in the District of Columbia carry beer in returnable bottles. Beer in returnables could be purchased only by the case and had to be requested because it was not prominently displayed, as were one-way glass and can containers. In his survey, Pollack found on the average an astounding 81 cent-per-case price differential between nonreturnables and returnables – evidence of the consumer savings possible with a low energy, resource conserving packaging system.

Because material use for packaging is growing rapidly – an estimated five percent per year – its environmental impact is exacerbated. According to the U.S. Environmental Protection Agency, if 1972 per capita packaging consumption had remained at the level existing in 1958, over 560 trillion BTUs of energy could have been saved, the equivalent of 267,000 barrels of oil per day. This energy





used, has become the center of controversy in the ongoing debate over federal waste policies. Industry is firmly opposed while most environmentalists endorse it. It is important because, as Eileen Claussen of the U.S. Environmental Protection Agency's Office of Solid Waste Management Programs puts it, "Most approaches to waste management have dealt with the means of disposing waste without considering the environmental pressures generated in the creation of waste material through to the final disposal stage."

Source reduction can be achieved through many means, but the most obvious is product reuse. The current battle between refillable and throwaway beverage container likewise raises the value of the reuse approach to source reduction. Under both systems, the consumer purchases the same product – be it a soft drink or beer – and the *only* difference is the container in which the product is delivered. Opponents of beverage container legislation are attempting to equate source reduction with the nationwide movement to enact mandated and mere beverage container legislation similar to Oregon's "Bottle Bill." However, the two are not identical. Beverage container legislation is only one example of a wide range of policies which could reduce the energy, resource and solid waste disposal impact of our current materials consumption patterns.

One of the primary targets for source reduction efforts in packaging. Over the past two decades, packaging consumption has grown dramatically. Packaging no longer protects a product, it has instead become an integral part of the advertising, promotion and display of consumer goods.

According to the U.S. Environmental Protection Agency, consumption of packaging materials grew 43 percent per person between 1958 and 1971 – from 412 pounds to 591 pounds per capita. Although packaging manufacturers claim the increase in packaging consumption has made delivery of goods to the consumer more efficient, a comparison of product consumption with packaging consumption tells an entirely different story.

For example, per capita consumption of fresh produce dropped 11.1 percent between 1958 and 1970, from 96.2 pounds per person to 86 pounds per person. During the same period, the packaging used to deliver fresh produce to the consumer rose from 5.3 pounds per capita to 7.1 pounds per capita, an increase of 37.7 percent. While consumers were purchasing less fresh produce, packaging consumption steadily rose over this 12 year period.

The Arthur D. Little Company, in a report commissioned by the Ad Hoc Committee on Packaging (composed of packaging material manufacturers), estimates that approximately 42 million of the 125 million tons of commercial and household refuse generated annually are packaging wastes. Comprising approximately 47 percent of all paper production, 14 percent of aluminum production, 75 percent of glass production, eight percent of steel production and 19 percent of plastic production, packaging is the largest single component of the municipal waste stream.

Less packaging would ease some of the environmental and economic strain placed upon many municipal governments by the collection and disposal of wastes. Local governments are well aware of the role increased material consumption has played in adding to their already over-loaded solid waste systems. A 1973 report prepared by the National League of Cities/Conference of Mayors entitled *Cities and the Nation's Disposal Crisis* urged the federal government to take an active role in solving the urban solid waste problem by implementing programs aimed at reducing the amounts of waste entering municipal dumps, landfills and resource systems. For city governments, solid waste problems translate into practical concerns relating to the cost of trash collection – more trash meant more trips to disposal sites, the need to hire more trash collectors, and the purchase of new equipment and disposal sites.

Source reduction can also result in the conservation of disposal space. According to Grant Merritt, executive director of the Minnesota Pollution Control Agency, "The greatest amount of waste is generated in highly populated areas where the value of land is high. . . . A program of source reduction would reduce the necessary land for waste disposal and increase the amount of land to be used for other purposes."

Packaging consumption has increased as a response to a number of factors. Some packaging manufacturers say they are only responding to consumer demand for "convenience." But the consumers that manufacturers say appreciate are not those who shop in supermarkets, but rather the retailers themselves. As the A.D. Little report *Packaging in Perspective* explains, "Self service retailing, an innovation directed at increasing labor productivity, is a very important aspect of our present society. . . . The package has played an important role in this development."

Increased packaging consumption is closely related to the substitution of raw materials and energy for labor in the manufacturing. This shift has affected both the environment and the labor force. Supermarket chains have cut labor costs by increasing their use of products in easily marked and handled packages which require less labor to place on the shelf or to move than traditional packages. This accounts for the array of over-packaged goods currently glutting supermarket and drug store – shampoos and toothpaste in plastic, metal or glass containers placed in individual boxes for easy marking, nails and other hardware items that are pre-weighed and packaged in cardboard and plastic containers, or cream cheese wrapped in foil and placed in cardboard boxes. These "time saving devices" save the supermarket chains money, they also provide benefits for other industries as well.

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SUMMARY REPORT

DADE COUNTY BOTTLE ORDINANCE

Prepared by

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BOTTLE ORDINANCE
DADE COUNTY, FLORIDA

An Ordinance to ban pop-tops and to place a minimum 5¢ deposit on all beverage containers failed to pass on a referendum vote here in Dade County, Florida on November 5, 1974. The Ordinance, identical to Oregon's Bottle Law, was rejected by the voters 58 to 42% (136,000-against, 100,000-for).

The history of the movement goes back to 1970. Harvey Ruvin, now a County Commissioner, first made reference to such an idea while serving as Vice President of Tropical Audubon Society.

Following unsuccessful attempts to introduce this legislation on a State level and with an eye toward the progress made in the State of Oregon, an Ordinance was introduced by Commissioner Ruvin in January, 1974. A first hearing was held in June of 1974, followed by a second hearing on September 5th.

The public hearing held on September 5th at the Dade County Courthouse was specially set as the only item to be considered that day and drew a packed audience. Aside from local environmental, civic and consumer organizations, the proponents offered testimony from leading experts around the country. Eileen Claussen, Chief of Solid Waste Management, Environmental Protection Agency; Don Waggoner, Oregon Environmental Council; Bill Moore, Chief Enforcement Officer of the Oregon Bottle Law; and Gene Norton, bottler from Corpus Christi, Texas, all offered extremely lucid and valuable experience and comment. The hearing was organized so that proponents and opponents alternated before the Metro Commission. This procedure was extremely effective as it gave each side immediate rebuttal opportunities and as a result, nearly every issue related to the Ordinance was actually discussed and rebutted.

The hearing lasted four hours, 45 minutes and according to persons who had testified numerous other times on the issue at all levels of government, the quality of the debate was probably the best of any yet had on returnable legislation.

The Ordinance passed on a 3-1 vote of the Commission. The legality of the vote was questioned, however, as two other Commissioners "abstained" and it was feared that their mere presence in the Chambers would necessitate including them as part of the quorum, thus making the affirmative vote only 3 out of the 6 present. This meant a possible tie vote if the Ordinance ever became a court case.

To avoid this possibility, a resolution was introduced on October 1, 1974 to place the whole matter on the November 5, 1974 general election ballot. If the Ordinance was acceptable to the voters, it would then become law.

Proponents agreed that the Ordinance would have great potential for:

1. Reducing litter
2. Saving energy
3. Conserving resources
4. Reducing cost of beverages
5. Saving tax money
6. Creating some additional local employment

Opponents, almost totally the beverage related industry, knowing that Dade County was the largest beverage selling area (greater than the State of Oregon) in the country to attempt this type of legislation, were most anxious to prevent this precedent setting kind of legislation. Battle lines were drawn. Dade County was about to experience in the five weeks preceding the

election, the largest, most expensive campaign blitz to influence the voters in the County's history.

As a guide to other jurisdictions in the country and for future reference here in Dade, a summary analysis will follow delineating the major components of the campaign. Major areas to be explained are:

1. Opponents
   a. who they are
   b. analysis of donations and expenditures
   c. types of advertising used in media blitz
2. Proponents
   a. who they are
   b. how they functioned
   c. donations and expenditures
3. Voting analysis
4. Post election information
   a. litter cleanup campaign
   b. news stories

OPPONENTS

As in Oregon, Dade County's proposed Ordinance would not have prevented the sale of beverages in non-reusable (throwaway) cans or bottles. However, a subtle but rapid change was expected to occur in the percentage sale of returnables. Only 10% of beverages in October, 1974 were sold in returnables. Ninety percent were sold in throwaway bottles and cans. Using Oregon's experience, these figures would have probably reversed themselves; i.e., 90% in returnables and 10% in throwaways.

There is virtually no beer (.3 of 1%) sold in returnables in Dade's markets, although it is manufactured, bottled and sold in market areas outside of Dade. None of the major brands of beer are sold in returnables, leaving little choice to the consumer. He either buys his favorite beer in throwaway cans or bottles or purchases an off-brand in returnables. Diet cola, although bottled and sold in other areas in returnables was sold only in disposable bottles and cans. Here the consumer had no choice whatsoever.

When requesting from store managers that a popular beer or a diet cola be stocked in returnables for purchase at their establishment, many store managers stated that they were not aware that it was bottled in returnables. Other managers knew that beverages were bottled in returnables, but said their lack of shelf and storage space would prevent them from selling and handling returnables.

While overall sales of beverages have increased yearly, both in Dade County as well as nationwide, a smaller percentage each year has been sold in returnables. We are rapidly approaching a nearly total "throwaway" system for beverage containers. Consumer demand is not necessarily the reason for turning

to a "throwaway system." As pointed out, in many cases the consumer does not even have a choice. Why then has industry made the choice for him? Their advertising approach has pushed the consumer (you and me) toward buying in non-returnables; convincing us that it's easier and more convenient, as well as less expensive. Beverages then are either not offered in returnables or the total "Madison Avenue" approach has convinced us that "throwaways" are better.

To get a clearer picture of why the beverage industry has turned to this approach, we must consider the economics involved. The number of breweries in the U. S. has declined from 735 in 1930 to less than 70 today. An individual brewers market area has thus greatly increased. In order to serve his area, he finds it less expensive and troublesome to ship in one-way disposable containers. It keeps him competitive with other brewers who also try to gain an edge and expand their market.

Furthermore, they found that profits could be made not only from the beverages they sold, but from the containers in which the beverage is sold. Expanding market and increased profits were ample reason for reducing the returnable container system and turning to disposables. From 15 billion containers in 1959 to 55 billion containers in 1972 is more evidence that we have been turned toward a one-time-use container system.

The beverage industry then had strong economic reasons for rejecting any proposal for reversing the trend toward throwaways. The small local brewery and soft drink bottler, having been placed at a disadvantage in the past several years by his distant, but big brother through economies of scale, would have been given a better chance for survival by this Ordinance. It would have made the large brewer/bottler/canner less competitive by increasing

his shipping and handling costs. With our present predominantly throwaway system the consumer must either throw away his used container (ends up as litter on beaches, roadways, parks and neighborhoods), add them to the solid waste system (garbage) or take them to a recycling center. The onus was on the consumer. The consumer has full responsibility now for hauling his throwaways (or pays taxes to have it done for him). Under this law, the beverage company would have to take the disposable container back and perform one of those three operations. Obviously, they would recycle. Distance, time and cost factors between all the various brewers/bottlers/distributors would have upset the status quo among them. The balance existing in this competitive field would tip. An unknown factor would leave them uneasy.

Not knowing the effects that this relatively small area (1% of U. S. beverage sales) of Dade County would have on the industry as a whole and fearing that this precedent might have far-reaching effects on the country, the Beverage Industry rallied together once again to defeat this issue. They worked behind the scenes for months, spoke against the issue at hearings and finally waged a media-blitz in the final days of the campaign after the issue was placed on the ballot.

A money raising campaign was quickly organized. From the very beginning it was clear that deception would become part of their opposition campaign. Under Florida law, monies collected for political campaigns by corporations must be listed with the State Attorney's office. The first eighteen contributors (October 9 to October 14) donated $60,300 of which $43,200 had to be returned as there is a $1,000 limit, by law, on contributions.

A key deceptive act by the organizational group of the Beverage Industry was to name their organization "Dade Consumer Information Committee."

Appendix-A is an analysis of this committee's donations and expenditures. Although it shows an expenditure of $150 for every dollar spent by the proponents, it does not reflect their total amount spent. Beverage plant employees making phone calls to voters; store clerk and bagboys placing signs, labels and other advertising on all "6-packs" of every type of beverage in Dade's vast grocery and convenience store system at no extra remuneration are examples of non-stated campaign costs.

Although it was frequently stated that the Dade Consumer Information Committee was open to all interested persons, virtually all donations (99.7%) can be traced directly to the Beverage Industry.

In their endeavor to defeat the Ordinance, the Industry collected over $180,000. Of this amount, $150,440 was collected in the name of "Dade Consumer Information Committee." Only 23% of the money donated to this committee came from Dade County. Out-of-State money was nearly 44% of the total.

As can be seen by Appendix-A, the largest expenditure of the Beverage Industry's "Dade Consumer Information Committee" (35.5%) went to the commercial advertising agencies who planned their campaign for them. One-fourth (25%) of the monies went for printing and mailing. The remaining 40% went to radio (10.6%), television (12.7%) and newspapers (16.2%). This Beverage Industry organization has filed data indicating they collected in donations, $150,440 and had expenditures of $136,055.49. Still in the committee's hand is nearly $14,000. It is unknown what has happened to this money. In addition, Winn Dixie declared donations of $30,000 and expenditures of $22,475.60 ($7,524.40 unaccounted for) in a separate opposition campaign.

The agency-directed opposition's campaign blanket coverage with their media blitz the final two weeks had a telling effect on the voters. It

started with 18 billboards on major highways and arteries. Any voter shopping in supermarkets or convenience stores the final two weeks could not fail to see the signs, posters, in-store stickers and inserts on bottles and shopping carts. Many three-quarter page ads were run in all the leading newspapers. Examples of these newspaper ads are found in Appendix-B. Both radio and television carried paid commercial messages the final seven days of the campaign. These commercial messages, paid for by the Dade Consumer Information Committee (beverage industry) and occasionally by Winn Dixie (supermarket chain) generally carried the same type of deceptive message. Although initially starting on a "scatter approach" the industry's campaign eventually settled on one major issue - cost. Their early advertising tried to "touch all the bases." Major reasons they suggested to voters for voting "NO" were:

1. The Ordinance is un-American and denies "freedom of choice"
2. Government is "forcing it on you"
3. It wastes energy
4. It wastes water
5. There's a better way of handling litter
6. Existing laws should be enforced.

In the final analysis, however, COST was their major weapon. The six major points of attack were generally handled in the multitude of radio and television debates, as well as in news articles from the local papers. Commissioner Ruvin could and did lay to rest many of these arguments in these debates through verbal use of common sense and logic.

Cost, however, caught the voter's attention. When he heard and read

repeatedly that this Ordinance would mean that he would "pay more" for his beverage, it was enough to sway his opinion to vote "NO."

In these trying times of inflation and recession, cost was the most difficult argument to counter in spite of the fact that it was not true. Oregon's experience indicated a savings to the consumer after the law was passed and sales of returnables greatly increased (as well as volume). A Beverage Cost Survey was done here in Dade County (as well as Collier County for comparative purposes) and it too indicated a cost savings to the consumer who purchases returnables of 20 to 41%. The last page of the Beverage Cost Survey (Appendix-C) indicates that the purchase of a returnable rather than a throwaway, depending on the type of beverage would save him up to 41%. In most cases, it is less costly to purchase a returnable and pay the deposit; still saving money EVEN if the consumer chose to dispose of the bottle rather than collect the refund.

None of the six reasons already listed were logical. They were contrary to fact and more easily disproved. Cost, however, was something that could take place in the future. Whereas a voter may reason logically that this law would:

1. Reduce litter
2. Save energy
3. Conserve resources
4. Save tax money,

it could very well eventually cost him more. This is seen then, as the Industry's major argument in the campaign.

PROPONENTS

Many organizations and environmental groups went on record as favoring this legislation. Appendix-D includes many of the names of these groups. Over 1,000 names were on a mailing list of those who favored this legislation.

The Proponents did manage to do many things at no monetary cost. Commissioner Ruvin carried the brunt of the attack by making nearly all the personal appearance and speaking engagements on radio, television and before the press. He made arrangements through various radio and television stations to carry Public Service announcements under the "Fairness Doctrine" of the Federal Communications Law. Tapes were cut and sent to most major stations. Constant contact and follow-up were required to see that the stations would accept the concept and eventually program the material given to them.

A study done by Tam Connell in December, 1974 and January, 1975 is shown in Appendix-E. It seems to indicate that some stations gave about 3 to 1 (3 minutes paid Industry commercial to 1 minute free public service announcement by proponents of the Ordinance). Her report indicates that most stations were reluctant to supply any evidence (invoices, log books, etc.) as proof of how much air time was used by either side and what the dollar value was. It is therefore questionable whether the Fairness Doctrine was adhered to. The press was called in on many occasions to refute charges made by opponents. Although they did not always respond with a news item, all major newspapers did editorially support this issue.

The League of Women Voters did much of the organizational work; had flyers printed and distributed and had two ads placed in the newspapers. The Recycling Center of the University of Miami acted as a collection agency

for donations, printed information sheets; organized a telephone campaign and made posters that were displayed along one of Dade's busy highways. Other groups "did their thing" by painting their cars for a "caravan ride" down streets, past parks and through shopping centers.

There was not enough general direction given to these people or groups, however. With the "person-power" available, perhaps a stronger organizational drive could have been fermented for more potent results.

In addition to the groups listed in Appendix-D that were proponents of this Ordinance, the Joint Center for Urban and Environmental Problems and Florida International University also assisted greatly. They funded a Beverage Cost Survey through the Department of Economics (Appendix-F). Presently they are funding this report which will be sent to interested parties in Dade County and across the nation.

Donations coming to the proponents of this Ordinance amounted to $1,741.50 of which $1,603.04 was spent. Most of the donations came from private citizens. Some came from environmental or politically oriented groups. All donations came from within Dade County. It was neither necessary nor even possible to raise enough money to pay for an amount equal to the free commercial time provided on radio and television or as an advertising replacement for the pro-editorials. Had more money been raised, however, it could have been used effectively for additional flyers, newspaper ads, posters, demonstrations, phone calling, speakers and a multitude of other uses. The Dade County Parks and Recreation Department made an effective series of slides showing the amount of litter in the County's Parks and neighborhoods and on its streets and the cost of cleaning up this litter. Unfortunately, about all this series of slides was used for was the hearing preceding the original vote by the

Commission. Had the series been strengthened with facts showing reasons for this law other than just the reduction of litter (i.e., energy savings, resource conservation and consumer cost savings) it could have been used to help make a strong visual presentation before many groups here in Dade. It would also have required advance planning and volunteer speakers familiar with the material.

Since the strength of the proponents lies in people rather than money, it is recommended that a far greater use of this resource (people) should be made. Stronger organization and advance planning is the key. The deceptive campaign waged by the Beverage Industry through a media blitz swayed a great number of people who received no personal contact from a proponent. Even using just the 1,000 people on the mailing list as active organized advocates could have swung the campaign in favor of the Ordinance. Had they converted just two more people a week during the last two months of the campaign the Ordinance would have passed.

VOTING ANALYSIS

On November 5, 1974, the voters in Dade County defeated the Bottle Ordinance at the polls. "NO" votes were 137,193 (57.7%) and "YES" votes were 100,596 (42.3%) of the total 237,789 votes cast (50% of registered voters). Following the election, an analysis was completed by Dade County's Management Information Systems Group. Only 13% of the precincts voting "FOR" the Ordinance were in a high SEC (Social Economic Characteristics - Income, Home Ownership, Years of Schooling Completed, Professional and Managerial Occupations) These areas were generally in Coral Gables and the near South Dade as well as the more affluent areas in Northeast Dade, Miami Shores, South Beach (although less affluent), Key Biscayne, Brickell Avenue, Perrine and Cutler Ridge.

Those precincts most heavily defeating the issue were generally in a low SEC area. These areas were frequently "Black," but generally the poorer areas of the County. The following sections voted at least 75% against the Ordinance:

NORTHWEST DADE			
PRECINCT #	% AGAINST	PRECINCT #	% AGAINST
1	82.4%	203	87.1%
20	75.5%	204	85.6%
105	77.8%	227	80.9%
202	75.0%	228	76.9%
	MODEL CITY - EDISON		
421	77.7%	453	91.1%
428	84.1%	455	81.0%
446	77.9%	456	79.6%
447	82.3%	465	82.3%
449	76.6%	466	75.7%
450	75.6%	468	79.2%
452	82.0%	469	82.7%

The vote in the above 20 precincts, representing 4.5% of the precincts, was 4,963-Against to 1,266-For; a loss of 3,702 votes (1.5% of the total).

Perhaps the most interesting results were with the absentee ballots. Many of these ballots were marked and sent in prior to, and without the influence of, the Industry's media blitz. Appendix-F is a comparison between the County vote and the Absentee Ballot vote on the seven State amendments and the Pop Top Ordinance. Although placed last in the long sequence of "wordy issues," the Pop Top Ordinance drew the largest number of votes; again showing the strength and importance of the issue. As can be seen, the vote by both the County and the Absentee Ballot followed the same pattern:

Both approved of Nos. 1, 3, 4, 5, 6 and 7 by comparable percentage

Both defeated No. 2 (43% and 46% votes "FOR")

Only in the Pop Top issue did the County differ from the Absentee Ballot

County defeated the issue by 57%

Absentee Ballot APPROVED the issue by 66%.

Perhaps the media blitz greatly influenced the final vote in the County but came too late to influence the already marked Absentee Ballots. It suggests that the proponents must either maintain a strong lead in the polls prior to a media blitz by the opponents or to develop a strong and effective counter-media blitz of their own.

Others have also suggested that the wording on the ballot (FOR or AGAINST) was confusing. Some said they voted "AGAINST" thinking it was "AGAINST" litter or Pop Tops. That issue is doubtful.

Another fact is quite obvious, however. The Bottle Ordinance was the hottest issue in the campaign. It was the most heavily financed and drew the greatest number of votes, both Countywide and on the Absentee Ballot, of any issue that went before the voters.

High SEC areas tend to approve of this issue, come to the polls in

greater percentage and vote in greater numbers on "wordy" issues. Perhaps this issue should be isolated in a special election and thus have a better chance of passing.

POST ELECTION INFORMATION

In the five months preceding the November 5, 1974 election on the Pop Top Ordinance there is a collection of 132 news articles and editorials from local newspapers. During the same period, 40 "Letters to the Editor" have been assembled in another document. Although this is probably a majority of the individual news items written during that 180 day period, many were no doubt missed. It does represent about one news item per day for five months prior to the election. The "Bottle Law" also received vast coverage on radio and television; particularly during the Commission Hearings and especially in the two weeks before the election. It not only received attention on newscasts, but was frequently the central topic on radio talk shows and was highlighted in many radio and television debates. Of course, as the November 5th election approached, the news coverage greatly accelerated. It's safe to say that half of the coverage mentioned above, during that five month period, came in the last three to four weeks.

On many radio and television shows, newscasts and commercials, as well as in newspaper articles, the Opposition Spokesman made several statements which are now being challenged publicly. A local industry leader, for example, had stated during the campaign that there was a better way to overcome the litter problem. "Enforcement of existing laws, education, motivation and organization were the proper ways of overcoming our litter problem," he said. At a press conference, three days before the election, the Industry unveiled a new top for a can that would replace the "pop top" throwaway in Dade County. Apparently a heavy piece of laminated plastic peels back, but not off, making it self opening without having to discard part of it. This "Flop Top" was to

be introduced early in 1975, making Dade County the first market area of the country to have this innovation.

Also suggested by some community leaders, Dade's Mayor included, was stricter enforcement of existing laws as well as new ordinances. The deputizing of park employees so that they could issue citations to litterers was recommended. Professional organization of a community-wide volunteer campaign for litter cleanup and maintenance was still another recommendation.

All of these are fine worthwhile suggestions. To date, however, very little has been done. The fact remains that:

1. Beverage container litter from Dade's 1½ million residents and 12 million tourists still abounds and is increasing.
2. The "flop top" has not been introduced.
3. There are no new ordinances to clean up litter.
4. There is no increased enforcement of existing laws.
5. Stores still refuse to sell many beverage products in returnables.
6. There has been no organized, community-wide effort for litter cleanup.
7. Because of the predominantly throwaway system, we continue to waste both energy and resources.
8. A considerable portion of our tax money still goes toward litter cleanup and solid waste disposal, unnecessarily.
9. There is still little incentive for people, in general, to pick up littered beverage containers.
10. Unable to purchase many beverages in returnables, the consumer must spend more money by purchasing his drink in a throwaway.
11. People who do purchase "returnables" are still frequently discouraged because of difficulties in taking bottles back to a store for a refund.

In short, Dade County is back where it started. We still have uncollected litter. We still are part of the system that wastes great amounts of energy and resources. We still are paying more than necessary for our beverages. We still see part of our tax money go toward a spotty and haphazard litter cleanup and for solid waste storage because of the overwhelming volume of throwaway containers sold and discarded here in Dade.

Existing laws are ineffective and unenforceable. New Ordinances have not been proposed for the same reason. Consumer demand for more returnables has not been effective because of Industry pressure to maintain at best, a status quo and at worst, a complete and total "throwaway" system. While "one shot" organized cleanup campaigns are helpful, they do not maintain the clean, beautiful, healthy surroundings we should come to expect.

We need a Bottle Law that will greatly help to keep our environment clean. This law will encourage the use of "returnables" and thus reduce the wasteful use of our dwindling energy supply as well as the aluminum and steel. This law will reduce the cost of beverages for the consumer while also stretching his tax dollar. Perhaps most important of all, the attitudes of people and industry alike will begin to change from the "throwaway syndrome" we have been sliding towards. Today our greatest problem is an inflationary caused recession. The problem is worldwide with much of the blame placed on the shortage and increased cost of oil. The definition of Conservation is the planned and careful management of a natural resource to prevent exploitation, destruction or neglect. How can we continue then to justify the continued use of precious commodities like oil and aluminum for the production of a product that is used one time and then discarded? The proven system, a glass bottle, would help to reduce the use of these resources that could be put to far better uses.

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APPENDIX A DADE CONSUMER INFORMATION COMMITTEE DONATIONS AND EXPENDITURES

DONATIONS BY CATEGORY

	SOFT DRINK BOTTLER	BREWER	BEER WHOLESALER	FOOD HANDING	CAN MANUFACT	GLASS MANUFACT	PACKAGING MANUFACT	REAL ESTATE RENTAL	VEHICLE RENTAL	BEVERAGE RELATED	UNIDENTIFIED	TOTALS
Amount Donated	$35,250	$6,300	$44,000	$7,250	$15,550	$7,500	$13,060	$ 3,000	$ 4,000	$22,870	$460	$159,040
Percent of Total	16.6%	4.2%	29.5%	5%	10%	5%	9.2	2%	2.6%	15.2%	.3%	100%

EXPENDITURES BY CATEGORY

	PRINTING MAILING	NEWSPAPERS	TELEVISION	RADIO	TOTALS
Amount Spent	$ 46,271.36	$33,887.74	$22,091.58	$ 17,301.43	$14,503.38	$136,055.49
Percent of Total	35.5%	25.0%	16.2%	12.7%	10.6%	100%

DONATIONS $ 150,040

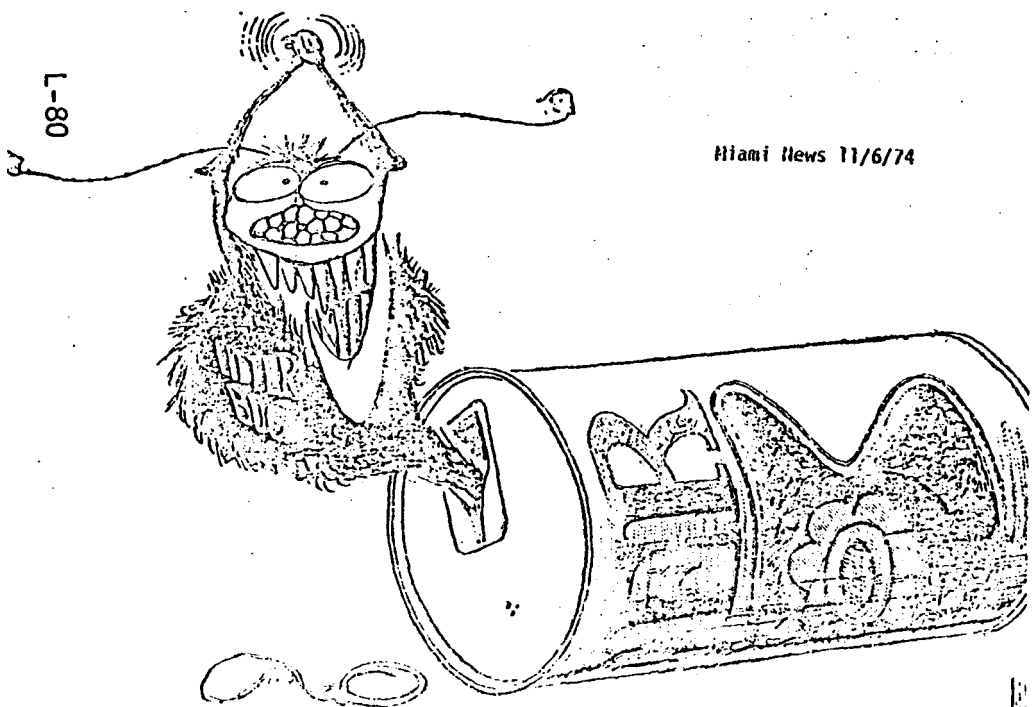
EXPENDITURES - $ 136,055

$ 13,985 UNACCOUNTED FOR

APPENDIX B

The following advertisements were placed in most of the newspapers here in Dade County. They were run as full page or three-quarter page ads and have been reduced in size for this publication. Each advertisement was run on several occasions in many different newspapers. All of them were in the newspapers during a five day period prior to the election. It was difficult to counter this advertising because of the shortness of time. The ad suggesting that "fruit drinks" would fall under this Ordinance came just three days before the election, for example. There was little opportunity, therefore, to dispel this false information.

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Miami News 11/6/74

Metro Has Gone Too Far This Time . . .

If the beverage deposit law is approved on November 5, we'll have to pay a cash deposit on every can!

That's right. No more freedom to choose the type of beverage container you prefer. A cash deposit on every beverage CAN and bottle. And complete abolition of the pop-top can. Why did they have to lump all of those items together? What it amounts to is this – they're going after the good citizen instead of the litterbug. We've got strong anti-litter laws on the books. Metro should try enforcing those laws before it penalizes the vast majority of good citizens for the littering of a few. Stopping litterers by outlawing no-deposit containers is like stopping firebugs by outlawing matches. It just doesn't make sense. I urge you to vote AGAINST County Proposal Number One on November 5.



Jackson G. Flowers
Former Dade County Safety Director
Former regional vice president, National Safety Council.
Dade resident for 40 years.

Vote against the forced deposit ordinance Tuesday, November 5

FREE TRANSPORTATION TO THE POLLS
PHONE: 635-6273-635-6434

APPENDIX C

REPORT OF BEVERAGE CONTAINER SURVEY

This survey was taken to determine the cost of various types and kinds of beverages to the consumer. Soft drink and beer prices sold in returnable bottles, glass throwaways and cans were surveyed in both Dade and Collier Counties.Prices of these beverages were recorded during the period of October 2nd to October 6th, 1974.

The purpose of this survey is to determine the present comparative cost between beverages sold in throwaway bottles, those sold in disposable cans and those sold in returnable bottles. A determination will then be made to see if the purchase of returnable bottles does in fact represent a savings over throwaways to the consumer.

The survey was necessitated by the Bottle Ordinance which is proposed for Dade County and will be decided by the voters on November 5, 1974. Proponents of this ordinance indicate that this ordinance, similar to Oregon's Bottle Bill, will have the following effect:

1. Reduce roadside and beach litter. Up to 88% less visable containers from beverages are now found in Oregon is their claim. This would also mean a reduction in litter collection costs.

2. Less solid waste storage cost. Other surveys indicate a reduction of 5 to 7% by volume if returnable bottles are used. Another savings to the taxpaying consumer is the claim of the proponents.

3. Since throwaways use three times the energy as returnables (during their lifetime) a tremendous saving in energy would acrue if we return to the use of reusable bottles. Adoption of this ordinance nationally would save 279,000 barrels of oil per day. President Gerald Ford, in his October 8th report to Congress, stated that if Americans drove 5% less it would save 250,000 barrels of oil per day. That's 29,000 less than the savings that would be realized if we produced reusable bottles rather than energy-sapping throwaways. Another projection used by proponents indicate the savings in oil would heat five percent of America's homes.

4. Proponents also claim that this ordinance would greatly conserve natural resources other than fuel and electricity. The one time use of throwaway bottles and cans is a great waste of our natural resources, especially imported aluminum. The too costly and mostly ineffective process of recycling will not ever be as effective in saving resources as the use of returnable and reusable bottles.

5. Finally, contrary to the Beverage Industry's claim of a possible reduction in employment, Oregon has experienced an increase in beverage related employment. A shift has occured from cannery employment to a local level in beverage storage and transportation. Meanwhile, beverage sales have increased in that state.

The consumer has been paying for more than just the cost of hi beverage. Proponents of the Bottle Ordinance claim that the cons has also paid the price for solid waste collection and litter cl He's also paid the added cost of unnecessary use of fuel and ene whichare in short supply. He's paying an increasing additional a unnecessary cost for resources that are used one time and then di posed of, instead of using a returnable bottle that can be reused several(8-15) times with a corresponding savings in energy and ot production costs.

Proponents of the Bottle Ordinance claim that the consumer is bearing INDIRECT COSTS in wasteful use of resources, energy, soli waste collection and litter collection. What are the DIRECT and measurable costs. What is the cost to the consumer for the beve he purchases in the three types of containers most commonly used: cans, disposable bottles and reusable glass containers? It is to this question that this survey addresses itself.

This survey of beverage prices in the three types of container already mentioned was made in Dade and Collier County.A variety o stores from Major Supermarket to Convenience Store was checked. Prices were recorded for containers that held from 6½ ounces to 64 ounces. The most popular brands as well as some "store brands were checked in each store when they were available. Specific beverages that were not sold in individual stores were marked "n/ on survey sheets and in the following table.

		SOFT DRINKS			BEER		
NAME OF STORE	COUNTY	RETURNABLE	N.R.	CAN	N.R.	CAN	RETURNABLE
Grand Union	Dade	13.1	17.1	22.0	26.8	26.8	21.1
Winn Dixie	Dade	13.6	21.6	22.8	25.2	25.3	n/a
A & P	Dade	15.0	20.4	23.2	29.0	27.6	n/a
Pantry Pride	Dade	13.4	20.6	22.4	24.7	26.4	n/a
Publix	Dade	12.0	20.0	22.9	28.2	26.8	n/a
Avg. cost per 12 ounces:		13.42	19.94	22.66	26.78	26.58	21.1
Returnable purchase savings			33%	41%	22%	21%	
U Tote M	Dade	17.9	24.6	28.5	33.7	34.3	n/a
7 Eleven	Dade	16.7	27.4	30.8	35.3	35.3	27.5	
Li'l General	Dade	17.3	21.4	27.5	34.9	35.3	n/a
Crafts	Dade	15.8	19.2	25.0	n/a	31.5	n/a
Avg. cost per 12 ounces:		16.21	23.15	27.95	34.63	34.1	27.5
Returnable purchase savings			27%	40%	21%	20%	
TOTAL DADE							
Avg. cost per 12 ounces:		15.17	21.54	25.30	30.71	30.34	24.3
Returnable purchase savings			30%	40%	21%	20%	
Grand Union	Collier	11.6	15.7	22.1	26.5	27.8	21.6
Winn Dixie	Collier	14.1	16.1	20.5	29.5	27.7	n/a
Publix	Collier	13.5	16.7	21.3	27.9	27.9	18.5
Avg. cost per 12 ounces		13.06	16.16	21.3	27.97	27.8	20.5
Returnable purchase savings			20%	39%	27%	27%	
Sunshine Superex	Collier	15.1	17.5	22.5	32.0	29.9	n/a
Food Bank	Collier	13.2	18.2	22.5	24.2	26.5	n/a
7 Eleven	Collier	17.9	21.5	26.3	34.2	34.6	n/a
Avg. cost per 12 ounces		15.4	19.07	23.77	30.13	30.33	n/a
Returnable purchase savings			19%	35%	n/a	n/a	
TOTAL COLLIER							
Avg. cost per 12 ounces:		14.23	17.62	22.54	29.05	29.07	20.5
Returnable purchase savings			19%	37%	27%	27%	

The above table indicates the cost of 12 ounces of beverage to the consumer. It assumes he will return any "deposit bottle" for a refund. Each store surveyed sold many beverages in containers of varying sizes. Prices of popular brands such as Coke, 7Up, Pepsi, Canada Dry ginger ale and R.C. in soft drinks and Busch, Nicholob, Miller and Regal in beer were recorded. Since beverages in various size containers (6½,7,10,12,16,28,32,48 and 64) were priced, we wished to make it more meaningful by reducing each to a per ounce cost first and then standardizing this cost to a common 12 ounce basis.

The table is divided into major chain stores and convenience type stores in both Dade and Collier Counties. The figures following each store is its average 12 ounce price for popular beverages sold in varying size containers. Following each category of stores are Average cost per 12/ounces of beverage and the Returnable purchase savings expressed in a percentage. This is the percent savings that would be realized if the consumer purchased his beverage in a returnable deposit container rather than in a throwaway. The three main [illegible] "returnables" (glass bottles), "N.R." (Non Returnable Bottles) and "Cans" (non returnable).

APPENDIX D

LIST OF ORGANIZATIONS FOR MANDATORY DEPOSIT ORDINANCE

League of Women Voters.

Florida South Chapter American Institute of Architects.

Legal Assistance for Consumers, Inc., University of Miami School of Law

Key Biscayne Property Texpayers' Association, Inc.

Howard Drive Homeowner's Association, Inc.

Florida Audubon Society

Tropical Audubon Society, Inc.

South Dade Civic Council, Inc.

Presidents' Council of Miami Beach.

Sierra Club, Florida Chapter

FAIA, Mr. Alfred Browning Parker and staff

Attorney Eileen Campion, Consumer Advocate

Friends of the Everglades

Environment-Recycling Center, University of Miami

Mangowood Estates Citizens Association

Dade County Surfing Association

Dade County Academy of Family Physicians

Florida International University

Boy Scout Troop # 21

Milledge and Bell, Atorneys

Zero Population Growth, Miami Chapter

Federal Executive Board, Consumer Protection Committee

County Club Grove Civic Association

Old Cutler South Association, Inc.

Hialeah Environmental Control Board

Beautification Council of South Dade

City of Miami Committee on Ecology and Beautification

Coconut Grove Civic Club

Coral Reef Estates Civic Association, Inc.

Colonial Drive Citizens Association

Nashta Island Association, Inc.

Kendale Lakes Homeowners Association, Inc.

Redland Citizens Association

Kendale Point Homeowners Association, Inc.

Pinecrest Civic Association

City of North Miami

City of West Miami

Hialeah Improvement Association

American Civil Engineering Association

Pollution Revolution

Rucks Park Homeowners' Association

Health and Ecology Committee Miami Beach High School

Congress of Senior Citizens

FAIA and Sierra Club

APPENDIX E

REPORT ON RADIO - TV TIME/EXPENDITURES BY PROPONENTS AND OPPONENTS OF THE POP-TOP ISSUE

Tam Connell, FIU

In order to determine if the opposition to the Pop-Top Ordinance was able to dominate the radio and television airways with its paid campaigning, it was decided that a survey be done of two radio and two television stations that accepted a substantial amount of paid advertising. WFAB and WIOD were the radio stations chosen and WTVJ and WPLG were the television stations surveyed.

Each radio and television station surveyed for this report was told by phone that a paper was being written on the Pop-Top issue, and data on the campaigning for each side was requested. This data included the amount of time paid for by the opposition versus the amount of time given for free for the proponents.

Four weeks have passed since the initial telephone calls, and only three of the stations have replied. WIOD allowed the surveyor free access to the information requested that was kept in a public file. As can be seen from the attached table, the ratio of paid commercial time to free time was approximately one to one for this station.

WFAB's general manager submitted the information personally, but the only information available was the commercial time bought by the opposition. The data containing the amount of time given for the proponents as public service was not available, for it was in paper work that would require, "too much time to dig out."

This station was proud that it had given equal time to the proponents of the Pop-Top issue when it aired two one-hour debates on the issue. This was the interpretation given to Commissioner Ruvin's letter to all the stati

requesting some time be given to the proponents in relation to the commercial time paid for by the opposition. In response to an inquiry that asked what estimation could be made as to the proportion of the paid ads to the free time given, the estimate was three to one. This was certainly an estimate, since there was no written record on hand to account for it.

WTVJ would not permit the surveyor to examine the records personally, saying it was felt that its clients' business deserved to be treated confidentially. The station's reply by telephone gave the information that time was given to both sides of the issues in the ratio of three paid ads to one free. Also given was the amount of money spent by the opposition in purchasing commercial time and the value of the commercial time given to the proponents.

As can be seen from the attached table, there is a large discrepancy between the amount of paid advertising accepted by WFAB that was shown to the surveyor and that which was actually declared as paid by the opposition. The difference cannot be accounted for.

Judging from the information obtained so far and assuming that the other stations would follow a similar pattern, it is not possible to determine how much time was actually given to the proponents as a public service and, therefore, to conclude that the opposition to the Pop-Top issue did dominate the radio and television airways with its advertising. It is to be hoped that the fairness of WIOD is not exception among the radio and television stations in Dade County.

PUBLIC SERVICE TIME FOR PROPONENTS

DOLLAR VALUE

	ACTUAL INVOICE	ESTIMATE ONLY	TIME (minutes) ACTUAL	TIME (minutes) ESTIMATE	INVOICE	ESTIMATE	TIME (minutes) ACTUAL	TIME (minutes) ESTIMATE	RADIO OPPONENTS PROPONENTS
[illegible]	$519.20		14		$ 553.20		13		14/13
[illegible]	$1,287.75		63		N/A	$675.00	N/A		3/1 Est.
[illegible]		$8,760.00 $2,040.00 *	N/A		N/A	$5,240.00	N/A		3/1 Est.
** [illegible]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

* [illegible]

** After five weeks of waiting for a reply to the initial telephone call made to WPLG, the surveyor was finally told to contact the advertising agencies who had handled the campaigning for the opposition in order to get the information requested. This station was unable to supply the surveyor with the amount of time given as public service for the proponents, because, again, that information would be too difficult to "dig out." Therefore, the figures for this station are incomplete in the table, and no ratio of paid ads to free ones can be developed.

APPENDIX F

COMPARISON BETWEEN COUNTY VOTE AND ABSENTEE BALLOT

SEVEN STATE AMENDMENTS AND POP TOP ORDINANCE

	COUNTY VOTE (IN THOUSANDS)				ABSENTEE BALLOTS			
AMENDMENT	TOTAL	FOR	AGAINST	%	TOTAL	FOR	AGAINST	%
1	209	142	67	69%	3391	2592	799	76%
2	198	86	112	43%*	3222	1510	1712	46%*
3	198	115	83	58%	3326	2118	1208	63%
4	189	133	56	70%	3258	2678	580	82%
5	189	149	40	79%	3334	3035	299	91%
6	179	100	79	55%	3106	1773	1333	57%
7	204	164	40	80%	3475	3173	302	91%
POP TOP	238	101	137	42%*	3490	2313	1177	66%

* Defeated by voter (except on Absentee Ballot)

PRECINCT VOTING RESULTS ON

POP TOP ORDINANCE

# FOR	%	# AGAINST	%	TOTAL PRECINCTS
56*	13%	385	87%	440

* Includes Absentee Ballot

11/11/1975

FOREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.
AUBURN, NEW YORK 13021
PHONE 252 7755

TAYLER BINGHAM
R. T. I.
POST OFFICE BOX 12194

RESEARCH TRIANGLE PARK, N.C. 27709

RE: ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS REPORT.

DEAR MR BINGHAM,

ATTACHED ARE COMMENTS BY ME ON THE SUBJECT REPORT ON BEHALF OF THE C.C. ENVIRONMENTAL MANAGEMENT COUNCIL.

I RESPECTFULLY REQUEST MORE TIME TO COMPLETE MY COMMENTS AND ADD TO THOSE ATTACHED.. FURTHERMORE ILL ENDEVOR TO TRY AND GET AN IMPROVED TYPED COPY OF THE EXISTING COMMENS TO YOU TOGETHER WITH A SUITABLE COVER LETTER PRIOR TO NOV. 28.

IT IS AN EXCELLENT DRAFT, WITH A FAIR AMOUNT OF ADDITIONAL WORK IT CAN BE MADE INTO A SUPERB REPORT.

SINCERLY,

Forest Golden

FOREST GOLDEN, P.E.
VICE CHAIRMAN, CAYUGA COUNTY
ENVIRONMENTAL MANAGEMENT COUNCIL

P.S. PLEASE ACKNOWLEDGE RECEIPT OF THE COMMENTS.

RECYCLE - REUSE;
THEY DON'T ALWAYS
MEAN THE SAME THING

RECEIVED
NOV 17 1975
ECONOMICS DEPARTMENT

COMMENTS: REVIEW COPY ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS

10 NOV. 1975

FOREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.
AUBURN, NEW YORK 13021
PHONE 252 7727

BY ORDER, PAGE # AND TABLE #

1) TITLE PG. TITLE SHOULD READ: ENERGY - - - IMPACTS OF BEVERAGE CONTAINER MANDATORY MINIMUM DEPOSIT LEGISLATION..

AND IF THE LABOR ELEMENT IS TO BE LEFT OUT OF THE TITLE WHY IS IT IN THE REPORT ?

2) 1-3 SECOND PARAGRAPH SPELLS OUT " THE REFILLABLE BOTTLE SYSTEM IS THE MOST CAPITAL - INTENSIVE OF THE THREE CONTAINER SYSTEMS IF ONLY THE CAPITAL REQUIREMENTS OF BEVERAGE PRODUCERS, ETC. ARE CONSIDERED " THIS IS PERHAPS THE MOST FLAGRANT OMMISION IN THE ENTIRE REPORT. EITHER THE ENTIRE CAPITAL REQUIREMENTS FOR THE INTIRE BEVERAGE SYSTEM INCLUDING THE CONTAINER PRODUCERS SHOULD BE GIVEN OR NONE AT ALL. FOR EITHER THE ENTIRE SYSTEM (ECONOMIC) MUST BE STUDIED OR NONE AT ALL. BASICALLY ALL THE CAPITAL MUST COME FROM THE CONSUMING PUBLIC. LIKEWISE THE PROFITS TO PAY FOR THE CAPITAL COSTS COME FROM THE CONSUMING PUBLIC. THUS THE BASIC QUESTION IS WHICH SYSTEM (OR MIX OF SYSTEMS) IS MOST ECONOMICAL OVER ALL TO THE CONSUMING PUBLIC. NATURALLY THE CAPITAL COSTS ARE A PORTION OF THE TOTAL COSTS TO THE CONSUMER BUT ONLY A PORTION. EQUALLY EXPENSIVE (TO THE TUNE OF 3.5 BILLION DOLLARS PER YEAR IS THE COST OF N.R. CONTAINERS (1974)) IT IS ANALOGOUS TO COMPARING ONLY THE ENERGY REQUIRED TO TRANSMIT (TRANSPORT) THE CONTAINERS AND GIVING THAT AS THE RELATIVE ENERGY REQUIRENMENTS.

AS INDICATED ABOVE GIVING ONLY THE CAPITAL COSTS DISTORTS THE TRUE PERSPECTIVE EVEN IF THE CAPITAL COSTS FOR THE CONTAINER MFG WERE INCLUDED. IF AN ECONOMIC STUDY IS TO BE MADE AN ANALYSIS MUST BE GIVEN FOR THE REVENUES GENERATED TO AMORTIZE THOSE CAPITAL COSTS. WITHOUT THAT, CAPITAL COSTS ALONE IS LIKE STATING A COMPARISON OF

RECYCLE - REUSE; THEY DON'T ALWAYS [illegible]

FOREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.
AUBURN, NEW YORK 13021

THE SWISS NAVY WITH THE AMERICAN NAVY INSTEAD OF THE AMERICAN NAVY WITH THE RUSSIAN NAVY, OBIVIOULSY A COMPARISON OF THE SWISS NAVY WITH THE AMERICAN NAVY IS ABSURD AND SO IS AN "ECONOMIC" STUDY THAT DOSNT INCLUDE TOTAL SYSTEM COSTS. CAPITAL IS ONLY ONE ECONOMIC COST. LABOR AND THOSE EXPENSIVE AL. CANS (MATERIAL COSTS) ARE OTHER EQUALLY VALID COSTS.

3) 1-6 LAST PARAGRAPH: "A SET OF PARAMENTER VALUES DERIVED FROM THE OREGON RESPONSE TO MANDATORY DEPOSITS (ALTHOUGH NOT THE OREGON TRIPPAGES)".

WHY NOT THE OREGON TRIPPAGES ? LATER YOU INDICATE THAT COORS IS CURRENTLY OBTAINING AN APROXIMATE " 50 PERCENT RETURN RATE BY PAYING .75 CENTS PER CAN".(PP 1-7) NOW COORS COVERS THE MEGAOPOLIS OF L.A. AND SANFRANSICO AND HAS A FORTY PERCENT MARKET SHARE IN THOSE AREAS. IF THE 50 PER CENT IS TRUE (AND I DOUBT THAT IT IS) IT IS TRULY REMARKABLE THAT PEOPLE IN A PROMIENTLY THROWAWAY SOCIETY WOULD BUY CANS (HIGHER PRICED AT THAT) FOR THE CONVIENCE AND THEN FIFTY PER CENT OF THEM WOULD GO CLEAR OUT OF THERE WAY TO ONE OF THE FEW REDEMPTION CENTERS (COORS ONLY HAS 225 FOR THERE INTIRE AREA , 11 or so STATES,) AND GET 75 CENTS FOR FOUR CASES WORTH ! ! THAT HARDLY PAYS FOR THE GAS FOR THE CAR TRIP. NOW HOW ABOUT THE VALUE OF A PERSONS TIME WHICH YOU LATER USE TO CALCULATE RETURN RATES ? SINCE THE COORS TERRITORY IS CERTAINLY REPRESENTATIVE OF AMERICA IT MUST BE TAKEN SERIOUSLY. YET FIFTY PER CENT RETURN WHEN PEOPLE CANT TAKE THEM TO THE LOCAL GROCERY STORE LIKE THEY CAN IN OREGON ! AND IN AREAS THAT ARE TOTALY THROWAWAY SOCIETY ORIENTED. YET IN OREGON WHERE WE HAVE A TOTAL RETURNABLE SOCIETY NOW BY LAW AND IT IS CONVIENT TO RETURN CANS THE RETURN RATE MUST BE HIGH, you give the impression that you use a lower value. IF YOU DONT STATE THE VALUE YOU USE IN THE SUMARY. ON PAGE 3-7 IT is NOTED THAT THE VALUES OF .76 FOR CANS HAVE BEEN CHOSEN. THIS IS FAIR AND SHOULD BE INDICATED ON PP 1-6.

[illegible] REUSE
THEY [illegible] ALWAYS
MEAN THE SAME THING

FORREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.

4) 1-7 COORS EXPERIENCE FIRST PARAGRAPH. " 50 % RETURN RATE" THIS IS JUST NOT TRUE. FIFTY PER CENT OF THE CANS ARE NOT COMING BACK. TO UNDERSTAND THIS ONE MUST ONLY OBSERVE A COORS OR REYNOLDS REDEMPTION OPERATION. BESIDES CANS; AL. LAWN CHAIRS, AL. TOOLS, AL. SCRAP ETC. IS ALL REDEEMED. TO LEAVE THIS FACT OUT OF THE SUMARY AND LET THE NAIVE READER THINK THAT FIFTY PERCENT OF THE ACTUAL CANS ARE COMING BACK IS NOTHING SHORT OF FRAUDULENT. FURTHERMORE ON PP2-29 THE REPORT STATES THAT THE RETURN RATE WILL BE 40 PER CENT NATIONALLY WITHOUT A DEPOSIT LAW AND THAT THE BULK OF THE RETURNS WILL BE THROUGH REDEMPTION CENTERS. ALONG WITH THIS THE REPORT ECHOES THE ALUMINUM ASSOCITION THAT IN 1974 17% OF ALL AL CANS WERE RECOVERED. IN THE FINE PRINT IT SAYS BY WEIGHT BASIS ! NOW WHAT DOES THAT MEAN ? DOSNT IT MEAN THAT NON CAN SCRAP IS BEING EQUATED TO CAN SCRAP ? AND IF THAT IS THE CASE ISNT THE ALUMINUM (AL.) CAN INDUSTRY TAKING ENERGY CREDITS FROM ANOTHER INDUSTRY AND USING THEM TO MAKE THE CAN INDUSTRY LOOK GOOD AT THE EXPENSE OF THE AL INDUSTRY THAT IS NOT IN THE CAN MARKET. TAKING THEM IS A POLITE STATEMENT. STEALING THE CREDIT IS MORE LIKE IT. MUCH INDUSTRIAL SCRAP FINDS IT'S WAY INTO THESE REDEMPTION CENTERS FOR THE PRICE PAYED IS FIFTY PERCENT HIGHER THEN THE TRUE MARKET VALUE. REFERENCE WHAT SCRAP DEALERS PAY FOR AL. scrap. CARRYING THE ENERGY/AL. RETURN CREDIT SCHEME USED IN THE REPORT TO THE EXTREME IF THE "CAN RECYCLING " RATE EXCEEDED 100% (IT CAN SINCE NON CAN AL. IS COUNTED AS CANS) WOULD THE AL CONTAINER BE A SOURCE OF ENERGY ? OBVIOUSLY IT HAS TO STAND OR FALL ON ITS OWN CAN RETURN RATE AND NOT ON THE OTHER NON CAN SCRAP MIXED IN WITH IT. The RATIONAL FOR NOT ALOWING THE NON CAN SCRAp TO BE CREDITED TO THE AL. CAN INDUSTRY IS THE FOLLOWING. IT IS A TEMPORT SUBSIDIZED OPERATION,

L-87

Attachment #1

RECYCLE - REUSE;
THEY DON'T ALWAYS
MEAN THE SAME THING

FORREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.
AUBURN, NEW YORK 13021

THE SUBSIDY IS PURPOSELY FIFTY PER CENT HIGH TO DRAW AL. AWAY FROM THE NORMAL SCRAP CHANNELS TO INFLATE THE FIGURES OF THE CAN REDEMPTION CENTERS. LATER ON IF THE CAN INDUSTRY WINS THE DEPOSIT LEGISLATION BATTLE THE PRICE WILL SETTLE DOWN TO MARKET LEVELS AND THE RETURN RATES WILL DROP ACCORDLINGLY. AUBURN HAS A SCRAP DEALER WHO IS OPEN EIGHT HOURS A DAY 26 DAYS A MONTH AND THE DEALER PAYS 10 CENTS A POUND. REYNOLDS COMES TWICE A MONTH FOR TWO HOURS PER TIME AND PAYS 15 ¢ A POUND. REYNOLDS PAYS A TRUCK DRIVER FULL TIME PLUS GAS COSTS TO CHASE ALL OVER THE STATE PLUS SUBSTANTIAL ADVERTISING COSTS. THE SCRAP DEALER HAS A VERY LOW INCREMENTAL OVERHEAD FOR HIS AL. AS HIS MAIN PRODUCT IS IRON. WHEN HE SHIPS IT HE USES CAR LOAD LOTS AND THUS HIS PER UNIT COSTS ARE MIMINAL. YET HE CAN ONLY PAY 10¢ PER POUND AND REYNOLDS PAYS 15¢ WHY ? IF WE ALLOW THE AL. CAN MFG. TO CREDIT NON CAN SCRAP DONT WE HAVE TO DO THE SAME TO THE STEEL PEOPLE ? THE RESOURCE RECOVERY CENTERS STEEL RECOVERY IS PRIMARLILY NON CAN SCRAP. SHOULDNT WE TAKE ALL THE STEEL IN THE RESOURCE RECOVERY PLANT OPERATION AND CREDIT IT TO THE STEEL CAN ENERGY VALUES ? BLACK IS BLACK, AND WHITE IS WHITE. CANS ARE CANS AND NON AL CANS ARE JUST THAT. TO TAKE THE AL. ASSOCITION UNAUDITED RECYCLING VALUES AT FACE VALUE IS LIKE APOINTING THE WOLF TO GUARD THE CHICKEN COOP.

5) 1-7 TRIPPAGE VALUES GIVEN FOR 1980's (bottom of second paragraph) ARE RATHER LOW PARTICULARLY FOR BEER. RETURNABLE BEER IS PRIMARLILY FOR ON SITE TAVERN CONSUMPTION. THIS TENDENCY FOR THE ON SITE BEER CONSUMPTION TO BE A GROWING PER CENTAGE OF ALL OF THE RETURNABLE BEER CONSUMPTION PORTION OF BEER PKG. SALES IN THE 1980'S WILL ACTUALLY MAKE BEER TRIPPAGE INCREASE FROM ITS PRESENT VALUES. AS ON SITE RETURN RATES ARE EXTREMELY HIGH ! IN FACT IF YOU TAKE THE TIME TO PERSONALLY CALL SOME NON-MEMBER U.S. B.A.

RECYCLE - REUSE;
THEY DON'T ALWAYS

FOREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.

BREWERYS YOU WILL FIND THAT THE TRIPPAGE TODAY FOR BEER IS MUCH HIGHER THEN STATED IN THE REPORT. IF YOU WISH I CAN GIVE YOU SOME NAMES TO CALL.

6) 1-8 " FOR ALL FIVE SCENARIOS THE ENERGY IMPACTS WERE CALCULATED ASSUMING THE SECULAR REDUCTION IN PER UNIT ENERGY REQUIREMNTS PROJECTED DUE TO EXPECTED ADOPTION OF ENERGY CONSERVING MFG. AND PRODUCT DESIGN - -"

THE CAN MFG'S CREDIBILITY IS NOT VERY GOOD . FOR INSTANCE DURING THE CAMPAIGN TO DEFEAT THE 1974 DADE COUNTY DEPOSIT REFERENDUM THE CAN INDUSTRY PROMISED DADE COUNTY RESIDENTS A PUSH TOP CAN ACROSS THE BOARD FOR JUNE OF 1975. JUNE IS LONG GONE AND DADE COUNTY RESIDENTS ARE STILL STUCK WITH FLIP TOPS ALONG THE BEACHES WITHOUT A SIGN OF PUSH TOPS ON THE GROCERY STORES YET. REFERENCE COMMISSIONER HARVEY RUVIN, DADE COUNTY LEGISLATOR, FLORIDA. SUGGEST YOU TALK WITH HIM.

1-88

WHAT ARE THE CAPITAL COSTS OF THIS ENERGY ~~CONVERSION~~ CONSERVATION ~~CONSERVATION~~? (conversion?) SEEMS ITS A VALID PART OF THE ECONOMIC PORTION OF THE STUDY ?

7) 1-9 LARGEST CAPITAL INVESTMENT (FIRST PARAGRAPH TOP OF PAGE.)
SEE MY COMMENT # TWO. THIS IS SHOWING A BIAS BY NOT PUTTING IN TOTAL CAPITAL REQUIREMENTS AND REPEATING THIS STRAW MAN ARGUMENT THUS GIVING ADDED STRENGTH TO A BASIC WEAKNESS OF AN OTHER WISE FINE IMPARTIAL REPORT.

8) 1-9 THIRD PARAGRAPH "RESOURCE RECOVERY PLANT - - -$1.73 IS DUE TO BEVERAGE CONTAINERS".
THE REPORT AGAIN MAKES AN ERROR OF OMISION. IF RESOURCE RECOVERY AND THE SOLID WASTE PROBLEM IS TO BE BROUGHT INTO THE PICTURE THEN THE INTIRE SOLID WASTE SYSTEM MUST BE LOOKED AT AND NOT JUST THE FINAL

RECYCLE - REUSE;
THEY DON'T ALWAYS
MEAN THE SAME THING

6

FOREST GOLDEN
PROFESSIONAL ENGINEER
36 S. MARVINE AVE.

END OF THE SOLID WASTE STREAM, IE, THE RESOURCE RECOVERY PLANT. THE COLLECTION COSTS ARE FAR HIGHER THEN THE DISPOSAL COSTS. THUS GETTING RID OF THE MUNICIPAL COST OF NEARLY SEVEN PER CENT OF THE COLLECTION COSTS OF SOLID WASTE HAS TO BE INCLUDED IN ANY DISCUSION OF SOLID WASTE SYSTEMS. AS ITS A TAX PAYER COST AS IS THE OPERATION OF RESOURCE RECOVERY PLANTS, MORE OVER WITH NEARLY FIFTY PER CENT OF THE GLASS REMOVED FROM A SOLID WASTE SYSTEM; ASSUMING A RETURNABLE SYSTEM, THEN THE LIFE AND MAINTENANCE COSTS OF THE SHREDDER WOULD BE CONSIDERABLY INHANCED OVER THE CASE WITH THE ABRASIV GLASS PORTION OF THE SOLID WASTE IN THE SYSTEM. THUS THE SYSTEM COSTS OF SOLID WASTE HANDLING WITH AND WITH OUT THE DEPOSIT LAW SHOULD BE INCLUDED OR THE INTIRE SUBJECT SHOULD BE DELETED FROM THE REPORT.

FURTHERMORE NO MENTION IS MADE IN THE SUMARY AS THERE IS IN THE BODY OF THE REPORT THAT ~~DELTION~~ deletion OF THE THE CONTAINER PORTION OF THE SOLID WASTES WOULD NOT MATERIALY EFFECT THE ECONOMICS OF SOLID WASTE RESOURCE RECOVERY SYSTEMS. THIS ES A SERIOUS OMMISION.
IN ADDITON NO MENTION IS MADE OF THE ECONOMIC SAVING THROUGHOUT THE NATION OF LITTER COLLECTION ~~COLLECTION COSTS~~. SEEMS THAT SHOULD BE MENTIONED IF THE CONTAINER INDUSTRYS FAVORITE SMOKE SCREEN THE RESOURCE RECOVERY PLANT IS GOING TO BE GIVEN PROMINENT MENTION IN THE SUMERY.

9) 1-9 "THE FOLLOWING GENERAL CONCLUSIONS----------" 1-5
SHOULD BE AT THE BEGOINING OF THE SUMARY. SUMARY # 2 IVE DISCUSSED ABOVE. SUMARY #4 SHOULD BE REWORDED TO SIMPLY STATE THAT FOR FOUR OUT OF FIVE SCENERIOS THERE WOULD BE A NET INCREASE IN LABOR EARNINGS. LEAVE METAL CAN OUT OF IT. THE REPORT HAS A VERY TINNY FLAVOR.

RECYCLE - REUSE;
THEY DON'T ALWAYS
MEAN THE SAME THING

COMMENTS CONTD: ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS PP. 7 7

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#5 SINCE THE REPORT CONCLUDES ON PAGE 3-31 THAT EVEN COMPLETELY ELIMINATING BEVERAGE CONTAINERS FROM THE SOLID WASTE STREAM WOULD NOT ALTER THE DECISION TO INSTALL RESOURCE RECOVERY PLANT EXCEPT IN ~~THE~~ the MOST MARGINAL SITUATIONS" IT APPEARS THAT EITHER THAT STATEMENT SHOULD BE SUBSTITUED FOR CONCLUSION # 5 OR CONCLUSION # 5 should BE DELETED. FOR OBVIOUSLY IT IS OF ONLY PERIPHERAL INTEREST BY THE REPORTS OWN ADMISSION.

CONCLUSION #3 AGAIN SHOULD LEAVE REFERENCE TO CANS OUT AND SAY FOR ALL ~~SCENERIOS~~- SCE'NERIOS THERE WOULD BE A NET INCREASE IN THE LABOR REQUIREMEN TS. SINCE DISLOCATIONS IN THE JOB MARKET ARE NATURALLY OCCURING FACTS OF THE RISK CAPITALISTIC SYSTEM, IT IS REDUNDANT TO ADD IT UNLESS YOU DISCUSS IT AT SOME LENGTH WHICH THE REPORT DOSNT. FURTHERMORE THE DISLOCATIONS ARE CURRENTLY BEING DEVELOPED BY THE CONTAIJNER INDUSTRY AS THEY DRIVE FOR THE plastic ~~PLASTIC~~ CONTAINER AND THE CAN OVER THE N.R. BOTTLE. ANY MENTION OF FUTURE JOB DISLOCATIONS SHOULD MAKE MENTION OF THE INDUSTRYS OWN EFFORTS TO CREATE DISLOCATIONS IN THE JOB MARKET. IF NO MENTION OF THE QUANITATIVE VALUE OF THE DISLOCATIONS IS STUDIED THEN NO VAGUE MENTIONS OF DISLOCATIONS SHOULD BE MENTIONED. SINCE DEPOSIT LEGISALTION PER SAY DOSNT BAN ANY PRODUCTS IT IS VERY LIKELY THAT JOB DISLOCATIONS WILL BE MINIMAL AS THE PRODUCT SHIFTS WILL TAKE PLACE VERY GRADUALLY AS EQUIPMENT BECOMES FULLY DEPRECIATED.

ONE FINAL THOUGHT ON CONCLUSION # 5 ANY REFERENCE TO SOLID WASTE COSTS SHOULD INCLUDE THE ~~ENTIRE~~ intire SYSTEM COSTS OF SOLID WASTE DISPOSAL AND COLLECTION COSTS.

10) 2-1 SECONDPARAGRAPH "BEVERAGE PACKAGING --------" SOUNDS LIKE A MARKETING STATEMENT FROM A CAN COMPANY EXECUTIVE. FINE, KEEP IT, PUT BEEF UP THE PARAGRAPH BELOW IT TO MAKE THEM AT LEAST EQUAL IN LENGTH ! SECONDLY SUGGEST YOU REDUCE BOTH OF THEM AND PLACE ~~THE~~- THEM SIDE BY SIDE . OHTERWISE IN THE INTERREST OF FAIRNESS YOU SHOULD CONDENSE THE SECOND PARAGRAPH AND CHANGE ORDER WITH THE THIRD ONE.

RECYCLE - REUSE,
THEY DON'T ALWAYS
MEAN THE SAME THING

7A

COMMENTS CONTD: ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS pp 7A

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11) 2-25 FOOT NOTE AT BOTTOM OF PAGE: "ALUMINUM CAN RECOVERY FOR RECYSLING WAS ACTUALLY AT 17 PERCENT FOR 1974." SEE MY COMMENT #4 pp 3. ALSO SEE ENCLOSURE FROM THE N.Y. STATE ENVIRONMENT # 1 , A PUBLICATION OF THE N.Y. STATE DEPARTMENT OF CONSERVATION THAT REYNOLDS PAYS 15 CENTS "FOR CLEAN, HOUSEHOLD AL. . THIS INCLUDES , FOIL, BEVERAGE CANS , FROZEN DINNER TRAYS, CONTIANERS, AND ALUMINUM LITHO PLATES." ! ! I WASNT AWARE THAT AL. LITHO PLATES ARE A HOUSEHOLD ITEM..... FURTHERMORE I RESENT THE INSULT TO MY INTELIGENCE THAT SOMEHOW LITHO PLATES ARE CANS. DOES THAT MEAN THAT REYNOLDS IS TRYING TO TELL THE AMERICAN PUBLIC THAT BLACK IS WHITE AND VICE VERSA ? THIS LITANY OF THE BEVERAGE CAN INDUSTRY HAS NO PLACE IN AN OBJECTIVE REPORT FORMAT. PERHAPS ITS EFFECTIVE PUBLIC RELATION: BUT ITS HARDLY OBJECTIVE.

WHO AUDITS THE AL. ASSOCIATION ASSERTIONS ? CAN YOU TAKE THERE NUMBERS AT FACE VALUE ? I THINK NOT. THE OBJECTIVITY OF THE REPORT WILL BE SERIOUSLY DEGRADED IF INDUSTRY ASSOCIATIONS STATISTICS ARE USED WHOSE OBJECTIVITY IS KNOW TO BE ABSENT. AT BEST THE 17 % VALUE CAN ONLY BE A CLAIMED VALUE AND THEN IF ONLY MODIFIED BY AN ACKNOWLEDGEMENT OF THE NON-CAN PORTION OF AL. IT CONTAINS.

11A) 2-45 TOP PARAGRAPH " IN THE CONTAINER INDUSTRIES COMPETITION MAY BE REDUCED ----- - DEPOSITS IS TO SHIFT THE ECONOMESS TOWARD THE REFILLABLE BOTTLE." ON THE CONTRARY IT WILL REOPEN THE COMPETETION THAT HAS BEEN LACKING FOR THE REPORT SHOWS THAT WITHOUT LEGISLATION THE CAN AND PARTICULARLY THE AL, CAN WILL ESSENTIALLY TAKE THE LION SHARE OF THE BUSINESS BY 1985. FURTHERMORE IT WILL GIVE PLASTIC AN EDGE IT DIDNT HAVE OVER THE CAN AS IT IS REFILLABLE. WITNESS THE REFILLABLE PLASTIC MILK BOTTLE. FINNALY AS THE REPORTS AUTHORS MUST KNOW THE PRICE HAS LITTLE TO DO WITH MARKET SHARE. IF PRICE OF THE DELIVERY SYSTEM WAS PARAMOUNT THE N.R. CAN WOULD NOT BE WER- WHERE IT IS TODAY. THE REAL DETERMINING FACTOR IS WHICH SYSTEM FAVORS THE CENTRALIZation OF THE INDUSTRY AND MAKES IT EASIER For the Big To GROW Bigger & the expense of the small Bottler and Brewer. 7A

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12) 3-15 CAPITAL COSTS: TABLE 3-6 SEE MY COMMENTS OF PP1, COMMENT #2. TOTAL SYSTEM CAPITAL REQUIREMENTS OR NONE AT ALL.

13) 3-15 SECTION 3.5 ECONOMIC IMPACTS: NO MENTION IS MADE OF THE IMPACTS ON CONSUMER PRICING OR CONSUMER COSTS. WHY ? IT IS A MAJOR OMMISION AND RESULTS IN UNDERSPECIFING THE LABOR IMPACTS. FOR THE ADDED PRUCHASING POWER THAT THE CONSUMERS WOULD HAVE WOULD BE SPENT AS DISCREATIONARY INCOME, THUS PRODUCING ADDITONAL LABOR REQUIREMENTS ON A NATIONAL SCALE. THIS STATEMENT IS BACKED BY THE REPORTS STATEMENT ON PAGE 1-4 IN A FOOTNOTE THAT THE REFILLABLE BOTTLE SYSTEM IS THE LEAST EXPENSIVE . SURELY THE EFFECT ON THE AMERICAN CONSUMERS POCKETBOOK SHOULD BE A # ONE PRIORTY ITEM FOR ANY ECONOMIC STUDY.

1-90

14) 3-30 TABLE 3 -14 REVENUE POTENTIL OF INORGANIC SOLID WASTE. GLASS VALUE AND STEEL VALUES ARE GIVEN WITOUT ANY QUALIFYING STATEMENTS THAT, IN PARTICULAR FOR GLASS, THE TRANSPORTION COSTS CAN EASILY MAKE RECYCLING OF GLASS AND ITS RECOVERY UNECONOMIC . THIS IS STATED IN section D 9.2.2 pp D 151 AND pp153. THUS STATING THE MARKET VALUE ALONE GIVES A UNEVEN PICTURE, ONE MIGHT SAY MISLEADING. SINCE THE STEEL AND GLASS VALUE OF THE CONTAINER PORTION NEARLY EQUAL THE AL. VALUE THIS IS SIGNIFICANT. THE AVERAGE NATIONAL VALUE OF THE RECOVERED GLASS AND STEEL SCRAP FROM RESOURCE RECOVERY ' L PLANTS IS FAR LOWER THEN THAT STATED DUE TO THE EFFECT OF TRANSPORT - ion COSTS.

ALSO NO MENTION IS MADE OF THE BENIFICIAL EFFECTS THAT DEPOSIT LEGISLATION WOULD HAVE ON RESOHRCE RECOVERY PLANT OPERATION. BY REMOVING SIGNIFICANT PORTIONS OF GLASS, WHICH IS AN ABRASIVE', THE SHREDDER LIFE IS SIGNIFICANTLY INCREASED AND [illegible]

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MAINTENANCE COSTS ARE REDUCED. TO BE COMPLETELY OBJECTIVE THIS SHOULD BE SO STATED.

15) D 3 TOP OF PAGE. " _- - - NET ENERGY REDUCTION OF 10 TO 40 % . THIS IS VERY OPTIMISTIC CONSIDERING THAT ELSEWHERE IN THE REPORT IT IS STATED THAT FOR GENERAL INDUSTRY AS A WHOLE ONLY A 15% ENERGY REDUCTION IS EXPECTED. SINCE PLASTIC CASES FOR RESUABLE BOTTLES IS COMING INTO WIDE USAGE TODAY WHY IS THERE ANY DOUBT THAT NATIONAL DEPOSIT LEGISLATION WOULD BRING MORE DURABLE SIX PAK CARTONS ? THE FOOTNOTE ON PP D 3 SHOULD BE ASSUMED IN THE SCENARIO AS A HIGH PROBABILITY OCCURENCE.

ON PAGE D 122 THE REPORT STATES THAT THE REFILLABLE BOTTLE ENERGY REDUCTION WILL ONLY BE TEN PERCENT AS COMPARED TO TWENTY PER CENT FOR THE N.R. BOTTLE THIS IS STARTLING. FOR THE REFILLABLE BOTTLE HAS THE MOST FAT TO BE TAKEN OUT BY FAR AND HAS HAD THE LEAST TECHNOLOGY APPLIED TO IT DURING THE LAST DECADE. IT IS A WELL KNOW FACT THAT IN VERMONT, AT LEAST ONE BREWERY, HAS BEEN REUSING NON-RETURNABLE BOTTLES SUCCESSFULLY ! THAT IS THEY THE N.R. BOTTLES HAVE BEEN REFILLED AND REUSED. BUT THERE IS MORE CONCLUSIVE EVIDENCE YET THAT THE TECHNOLOGY IS HERE TODAY TO MAKE A LIGHT WEIGHT REFILLABLE BOTTLE. CONSIDER THE CANADIAN 11½ OUNCE STUBBY BOTTLE. ITS ONLY 8% HEAVIER THEN THE AMERICAN 12 ounce N.R. AND IT CONTAINS ½ OUNCE (4 ½) LESS BEER. THE AMERICAN REFILLABLE LONG NECK BOTTLE IS 24% HEAVIER THEN THE AMERICAN NR BOTTLE AND ABOUT 50% GREATER VOLUME WISE VS ABOUT ZERO VOLUME DIFFERENCE FOR THE CANADIAN STUBBY DESIGN. THUS YOU ARE PROJECTING THE AMERICAN REFILLABLE BOTTLE TO BE IN 1985 LESS ENERGY EFFICIENT THEN THE PRESENT CANADIAN TECHNOLOGY ! SURELY THIS ASPECT OF THE REPORT MUST BE RECONSIDERED, IT ITS CRITICAL AS BECAUSE ON PPS D-134&135 TABLE D.8.7 THE IMPORTANCE OF TRANSPORTATION ENERGY REQUIREMENTS CAN BE SEEN FOR THE RETURNABLE CASE. THIS POINT IS SPELLED OUT ON THE BOTTOM OF PAGE D-135. HOW REALISTIC IS IT TO CONSIDER THAT THE ANCIENT INEFFICIENT LONG NECKED EASTERN BEER REF.

pp 10 C

COMMENTS CONTD: ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS pp 1

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through 1985
BOTTLE WOULD BE AROUND IF NATIONAL DEPOSIT LEGISLATION WERE TO BE PASSED ?

1) D-18 SECOND PARAGRAPH. "EXCELLENT COOPERATION WAS RECEIVED FROM THE THE VARIOUS INDUSTRIES IN SUPPLYING DATA, WITH SOME INDUSTRIES EXERTING CONSIDERABLE ORIGINAL EFFORT TO SECURE DATA "FOR THIS PROJECT."

THIS STATEMENT MAKES THE CASUAL READER WONDER. WHAT IS MEANT BY ORIGINAL EFFORT ? KNOWING HOW ABLE THE CONTAIJNER INDUSTRY IS IN DREAMING UP ORIGINAL ARGUMENTS TO CONFUSE THE PUBLIC ONE WONDERS HOW ORIGINAL THEY WERE IN TRYING TO MASK FACT FROM FANTASY ! ENOUGH SAID.

COMMENTS TO DATE 11/11 1975 ; MORE TO BE MAILED.

L-91

FOREST GOLDEN, P.E.

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Pg 10

Attachment #1

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NYS Environment

Aluminum Collections More than Double

According to Reynolds Aluminum Company's latest figures, aluminum collections are up 2½ times over last year's total and more than $8 million has been paid this year in its consumer recycling program.

The company pays 16 cents a pound for clean, household aluminum. This includes foil, beverage cans, frozen dinner trays, containers, and aluminum lithographic plates. Aluminum is easily detected with a magnet, it is not attracted by a magnet. In addition, there is a 95 percent energy saving when new aluminum products are made from recycled aluminum. This alone is one major reason for Reynolds' drive to recycle.

Check in your local newspapers for a schedule of collections in your area.

November 1975

No7

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N.Y.S. D.E.C.
ALBANY NY

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SUBJECT: BEVERAGE CONTAINER LEGISLATION

RESOURCE RECOVERY

NET COST: $ 8.17/ton
TAXPAYER SUBSIDIZED
BY U.S. EPA GRANT.

Emerging Technologies . . .

TESTING OF THE REFUSE disposal system at Union Electric Co., St. Louis, shows that the idea of burning refuse in electrical generating boilers is successful, indicates Midwest Research Institute, Kansas City, Mo. Estimated costs for burning "normal" refuse (120,000 tons per year) are $6.18 per ton for the processing plant and $1.79 per ton for the powerplant. But the value of the fuel content will recover a portion of that. At St. Louis the value is $1.80 per ton, but it runs to $2.80 per ton in Minneapolis and $5 per ton in the Middle Atlantic area, researchers indicate. Results have been promising enough to inspire Union Electric officials to plan expansion to an area-wide refuse collection and burning system by mid-1977.

INDUSTRY WEEK / June 2, 1975

TURNING SOLID WASTE TO GOLD ?

September-October 1975 — GENERAL ELECTRIC Monogram — Volume 52, Number 5

Trashpower – Lynn makes it work

General Electric's River Works in Lynn, Massachusetts, has cut its fuel oil consumption nearly 60%, by using steam made from burning refuse. The new power source saves about 70,000 gallons of oil every day.

This boon to the Company as well as the environment was made possible by the opening, on October 1, of a privately financed, technologically sophisticated refuse-fired steam generator that produces superheated steam each day by burning approximately 1200 tons of trash and garbage produced by the 300,000 residents of a dozen nearby communities.

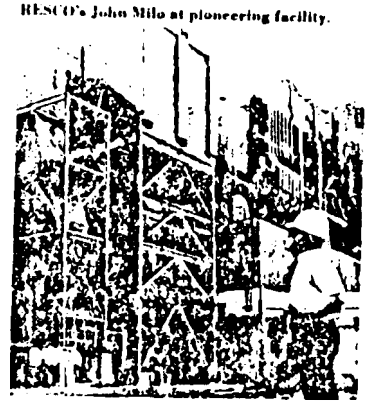
Dubbed RESCO (for Refuse Energy Systems Company), the $45 million project is a joint venture of Wheelabrator-Frye Inc., a New Hampshire-based international engineering firm, and the M. DeMatteo Construction Co. RESCO is the largest refuse-to-energy project ever undertaken without government subsidy of any kind.

NO GOVERNMENT SUBSIDY, PRIVATELY FINANCED.

GE is buying all of the 825-degree F. steam RESCO produces and is using it for plant and process heating, as well as for aircraft jet engine and steam turbine testing and for generating electricity. Some of the electricity is fed to the RESCO operation to power its lights and various conveyor drive motors and controls that guide the burning rubbish through huge boilers.

With stricter anti-pollution laws adding to the problems of solid waste disposal, area communities are eagerly signing 20-year contracts with RESCO, which charges a competitive $13 per ton to dispose of refuse.

RESCO's John Milo at pioneering facility.



Credit for holding the cost down for participating communities, however, belongs to GE, according to John F. Milo, RESCO's general manager.

"If GE won't purchasing the steam, we'd have to charge the communities $7 more per ton," he says. Milo, a 33 year GE veteran and former manager of the River Works Utility Operation, opted for early retirement last year in order to accept the RESCO job.

NET COST: $ 13/ton -- INCLUDES ENERGY VALUE

IS RESOURCE RECOVERY ECONOMIC WITHOUT A GOVERNMENT SUBSIDY ?

MORE: OVER - - - -

L-92

SUBJECT: BEVERAGE CONTAINER DEPOSIT LEGISLATION

RESOURCE RECOVERY
- CONTINUED -

WHAT WILL THE TAXPAYER END UP PAYING TO GET RID OF HIS BEER CANS ? 8, .13, 17 DOLLARS PER TON ? SANITARY LANDFILL* COST IS BETWEEN $2.50 AND $6.00 PER TON. PLUS WHO PAYS FOR THE GARBAGE COLLECTION AND HAULING OF THE SEVEN % OF THE SOLID WASTE THATS MADE UP OF BEVERAGE CONTAINERS ?

RESOURCE RECOVERY DOUBLE THE COST OF SANITARY LANDFILL. JUDGE FOR YOURSELF.

$16 MILLION FIRST ROUND

MONEY IN RECYCLING AL. CANS, ONLY FOR THE CAN MFG. ..... NOT FOR THE TAX PAYER WHO PAYS THE BILL FOR THE RESOURCE RECOVERY PLANT.

50 % COST OVERRUN

*AVERAGE LANDFILL COSTS(NATIONAL):
LOCAL SANITARY LANDFILL $ 2.57/ton
REMOTE SANITARY LANDFILL 5.94/ton
SOURCE:

PP 61 RESOURCE RECOVERY, THE STATE OF TECHNOLOGY, PREPARED FOR THE COUNCIL ON ENVIRONMENTAL QUALITY BY MIDWEST RESEARCH INSTITUTE. FEBR. 1973

The New York Times Record 28, 1972

Market Place

Thermal Transfer's Bond Problems

By JOHN H. ALLEN

Investing in the municipal bond market, it has become obvious this year, can no longer be taken for granted. With greater frequency, bondholders are discovering they can be faced with problems.

Yesterday, a Tennessee non-profit company, the Nashville Thermal Transfer Corporation, published a status report that certainly was disquieting reading for investors who purchased the organization's $16.5-million of tax-exempt bonds in June, 1972.

Nashville Thermal Transfer, which was formed in 1970, had high hopes of becoming the first organization in the United States to produce steam for heating and cooled water for air-conditioning by burning garbage and producing electricity.

●

To get under way, Thermal, as the company likes to be called, negotiated its $16-million financing through a group of underwriters headed by Equitable Securities Morton & Co., a subsidiary of the American Express Company. The bonds were sold to "hundreds" of investors, with perhaps 10 to 12 institutions purchasing $10-million of the total, Robert F. Stamps, a Nashville investment banker who headed the negotiations, said yesterday.

Thermal disclosed yesterday that it has enough money in the till to pay interest due Dec. 1, but after that it will run short. "Unless additional financing is obtained," Thermal warned, "it is doubtful that the bonds can be serviced thereafter."

The additional financing that the corporation needs is $8-million, Ferris A. Deep, president, told bondholders in his report yesterday. For a $16.5-million project, $8-million of additional costs is difficult to understand.

●

When the bond issue was sold, Thermal used $390,000 for financial and legal fees and set aside $13.14-million for construction and $2.97-million to pay interest during construction and to establish a one-year interest reserve fund.

Last January, the project was substantially completed, but several things went wrong. The incinerators failed to meet pollution-control standards, boiler tubing failed to work properly, one of two refrigerators vibrated excessively and, finally, Thermal was unable to get enough garbage to burn.

To solve these problems, Thermal will need to spend about $3-million over the next two years on capital improvements, including new emissions control equipment, Mr. Deep said. In addition, the corporation has incurred an estimated cumulative deficit of $4.7-million as operating expenses of the system have far outstripped revenues.

●

Sales have not lived up to engineer estimates, and a customer recently filed a suit to set aside two rate increases. If Thermal loses the suit, it would hurt the company's efforts to get its deficit under control.

Duff & Phelps, Inc., a management consultant firm, is preparing a report—based on income projections, operations and maintenance estimates and other data—to determine whether Thermal can service both its outstanding bonds and the additional financing. This report is to be completed Sept. 1.

Part of the $8-million that Thermal needs is to pay $1.5-million of unpaid construction bills, a number of which are past due. One creditor of $600,000 is threatening to sue if he isn't paid by Sept. 30.

●

When the bonds were sold in mid-1972, Moody's gave the issue a "Conditional-A" rating, and Standard & Poor's rated it BBB. Recently both services have downgraded the bonds one rating.

The $16.5-million issue included $7.2-million of serial bonds priced to yield from 4 per cent on those maturing in 1977 up to 5.75 per cent on those due in 1992. The total also included $9.3-million of 6 per cent term bonds maturing in 2002.

There has been no trading in the bonds for several months, Mr. Stamps reported yesterday as he gave an uncomforting assessment of the Company's outlook. "I'm satisfied it will continue to operate," he said, but he added: "You can't tell what financial crises it could go through."

15/11/1975

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SUBJECT: COMMENTS ON THE DRAFT STUDY OF THE ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS

DEAR MR BINGHAM,

MY DETAILED COMMENTS ARE ATTACHED FOR YOUR CONSIDERATION.

THE REPORT AS IT NOW STANDS IS STRONGLY BIASED TOWARD THE PREVAILING INDUSTRY VIEWPOINTS. IT LACKS OBJECTIVITY IN SOME AREAS SUCH AS TRANSPORTATION COSTS AND RECOVERY OF ALUMINUM. IN OTHER AREAS IT IS DEFICIENT IN THE EXTENT OF THE ANALYSIS: THIS IS ESPECIALLY TRUE OF THE ECONOMIC AREA WHICH IS INCOMPLETE AND SKEWED TO FAVOR THE NON RETURNABLE SYSTEM OVER THE RETURNABLE. THE CAPITAL COSTS ARE NOT COMPLETE AND THE ABILITY TO PAY THE CAPITAL COSTS IS COMPLETELY LEFT OUT. THE WHOLE QUESTION OF THE EFFECTED BUSINESS INVENTORY REQUIREMENTS IS TREATED ON THE LEVEL OF A COLLEGE FRESHMAN ECONOMIC MAJOR ~~WHOLE~~ who IS NOT FAMILIAR WITH ECONOMICS AND COMPARITIVE SYSTEMS.

THE TREATMENT OF RESOURCE RECOVERY IS FAIR AND THE CORRECT CONCLUSION IS REACHED YET THE SUMARY DOSNT REFLECT IT !

INDUSTRY ASSOCIATION FIGURES ARE IN PLACES TAKEN AT FACE VALUE . THIS GREATLY UNDERMINES THE CREDIBILITY OF THE REPORT AS WELL AS ITS OBJECTIVITY. ITS LIKE HAVING THE WOLF GUARD THE CHICKEN COOP. THE ONLY BETTER WAY TO UNDERMINE THE CREDIBILITY OF THE REPORT IS TO HAVE HAD IT WRITTEN BY INDUSTRY ASSOCIATION SOURCES. THIS PROBLEM IS PARTICULARLY BAD IN THE REPORTS COVERAGE OF ALUMINUM RECYCLING, BEER TRANSPORTATION AND ENERGY REDUCTION ACHIEVEMENTS FOR NON RETURNABLE CONTAINERS.

IN SUMMARY THE REPORT NEEDS A GOOD DEAL MORE EFFORT TO BRING IT UP TO A HIGH LEVEL OF NON-PARTISIAN OBJECTIVITY.

SINCERLY,

FOREST GOLDEN, P.E.

L-93

NOV 21 [illegible]

RECYCLE · REUSE
THEY DON'T ALWAYS
MEAN THE SAME THING

COMMENTS: REVIEW COPY ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS

NOV. 10, 1975

BY ORDER, PAGE # AND TABLE #

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1) TITLE PAGE: TITLE SHOULD READ: ENERGY ---IMPACTS OF BEVERAGE CONTAINER MANDATORY MINIMUM DEPOSIT LEGISLATION.....

AND IF THE LABOR ELEMENT IS TO BE LEFT OUT OF THE TITLE WHY IS IT IN THE REPORT?

2) 1-3 SECOND PARAGRAPH SPELLS OUT "THE REFILIABLE BOTTLE SYSTEM IS THE MOST CAPITAL - INTENSIVE OF THE THREE CONTAINER SYSTEMS IF ONLY THE CAPITAL REQUIREMENTS OF BEVERAGE PRODUCERS, ETC. ARE CONSIDERED" THIS IS PERHAPS THE MOST FLAGRANT OMMISION IN THE ENTIRE REPORT. EITHER THE ENTIRE CAPITAL REQUIREMENTS FOR THE ENTIRE BEVERAGE SYSTEM INCLUDING THE CONTAINER PRODUCERS SHOULD BE GIVEN OR NONE AT ALL. FOR EITHER THE ENTIRE SYSTEM (ECONOMIC) MUST BE STUDIED OR NONE AT ALL. BASICALLY, ALL THE CAPITAL MUST COME FROM THE CONSUMING PUBLIC. LIKEWISE THE PROFITS TO PAY FOR THE CAPITAL COSTS COME FROM THE CONSUMING PUBLIC. THUS, THE BASIC QUESTION IS WHICH SYSTEM (OR MIX OF SYSTEMS) IS MOST ECONOMICAL OVER ALL TO THE CONSUMING PUBLIC. NATURALLY, THE CAPITAL COSTS ARE A PORTION OF THE TOTAL COSTS TO THE CONSUMER, BUT ONLY A PORTION. EQUALLY EXPENSIVE (TO THE TUNE OF 3.5 BILLION DOLLARS PER YEAR IS THE COSTS OF N.R. CONTAINERS (1974).

IT IS ANALOGOUS TO COMPARING ONLY THE ENERGY REQUIRED TO TRANSMIT (TRANSPORT) THE CONTAINERS AND GIVING THAT AS THE RELATIVE ENERGY REQUIREMENTS

AS INDICATED ABOVE GIVING ONLY THE CAPITAL COSTS DISTORTS THE TRUE PERSPECTIVE EVEN IF THE CAPITAL COSTS FOR THE CONTAINER MANUFACTURE WERE INCLUDED. IF AN ECONOMIC STUDY IS TO BE MADE AN ANALYSIS MUST BE GIVEN FOR THE REVENUES GENERATED TO AMORTIZE THOSE

CAPITAL COSTS. WITHOUT THAT, CAPITAL COSTS ALONE IS LIKE STATING A COMPARISON OF THE SWISS NAVY WITH THE AMERICAN NAVY INSTEAD OF THE AMERICAN NAVY WITH THE RUSSIAN NAVY. OBVIOUSLY, A COMPARISON OF THE SWISS NAVY WITH THE AMERICAN NAVY IS ABSURD AND SO IS AN "ECONOMIC" STUDY THAT DOESN'T INCLUDE TOTAL SYSTEM COSTS. CAPITAL IS ONLY ONE ECONOMIC COST. LABOR AND THOSE EXPENSIVE ALUMINUM CANS (MATERIAL COSTS) ARE OTHER EQUALLY VALID COSTS.

3) 1-6 LAST PARAGRAPH: "A SET OF PARAMETER VALUES DERIVED FROM THE OREGON RESPONSE TO MANDATORY DEPOSITS (ALTHOUGH NOT THE OREGON TRIPPAGES)"

WHY NOT THE OREGON TRIPPAGES? LATER YOU INDICATE THAT COORS IS CURRENTLY OBTAINING AN APPROXIMATE" 50 PERCENT RETURN RATE BY PAYING .75 CENTS PER CAN" (PP 1-7) NOW COORS COVERS THE MEGALOPOLIS OF L.A. AND SAN FRANCISCO AND HAD A FORTY PERCENT MARKET SHARE IN THOSE AREAS. IF THE 50 PERCENT IS TRUE (AND I DOUBT THAT IT IS) IT IS TRULY REMARKABLE THAT PEOPLE IN A PREDOMINANTLY THROWAWAY SOCIETY WOULD BUY CANS (HIGHER PRICED AT THAT) FOR THE CONVENIENCE AND THEN FIFTY PERCENT OF THEM WOULD GO CLEAR OUT OF THERE WAY TO ONE OF THE FEW REDEMPTION CENTER (COORS ONLY HAS 225 FOR THEIR ENTIRE AREA, 11 or so STATES,) AND GET 75 CENTS FOR CASES WORTH!! THAT HARDLY PAYS FOR THE GAS FOR THE CAR TRIP. NOW HOW ABOUT THE VALUE OF A PERSON'S TIME WHICH YOU LATER USE TO CALCULATE RETURN RATES? SINCE THE COORS TERRITORY IS CERTAINLY REPRESENTATIVE OF AMERICA IT MUST BE TAKEN SERIOUSLY. YET, FIFTY PERCENT RETURN WHEN PEOPLE CAN'T TAKE THEM TO THE LOCAL GROCERY STORE LIKE THEY CAN IN OREGON! AND IN AREAS THAT ARE TOTALLY THROWAWAY SOCIETY ORIENTED. YET, IN OREGON, WHERE WE HAVE A TOTAL RETURNABLE SOCIETY NOW BY LAW AND IT IS CONVENIENT

1-94

TO RETURN CANS, THE RETURN RATE MUST BE HIGH, YOU GIVE THE IMPRESSION THAT YOU USE A LOWER VALUE. YOU DON'T STATE THE VALUE, YOU USE IN THE SUMMARY. ON PAGE 3-7 IT IS NOTED THAT THE VALUES OF .76 FOR CANS HAVE BEEN CHOOSEN. THIS IS FAIR AND SHOULD BE INDICATED ON PP 1-6.

4) 1-7 COORS EXPERIENCE FIRST PARAGRAPH. "50% RETURN RATE" THIS IS JUST NOT TRUE. FIFTY PERCENT OF THE CANS ARE NOT COMING BACK. TO UNDERSTAND THIS ONE MUST ONLY OBSERVE A COORS OR REYNOLDS REDEMPTION OPERATION. BESIDES CANS: ALUMINUM LAWN CHAIRS, ALUMINUM TOOLS, ALUMINUM SCRAP ETC. ARE ALL REDEEMED. TO LEAVE THIS FACT OUT OF THE SUMMARY AND LET THE NAIVE READER THINK THAT FIFTY PERCENT OF THE ACTUAL CANS ARE COMING BACK IS NOTHING SHORT OF FRAUDULENT. FURTHERMORE ON PP 2-29 THE REPORT STATES THAT THE RETURN RATE WILL BE 40 PERCENT NATIONALLY WITHOUT A DEPOSIT LAW AND THAT THE BULK OF THE RETURNS WILL BE THROUGH REDEMPTION CENTERS. ALONG WITH THIS THE REPORT ECHOES THE ALUMINUM ASSOCIATION THAT IN 1974 17% OF ALL ALUMINUM CANS WERE RECOVERED. IN THE FINE PRINT IT SAYS BY WEIGHT BASIS! NOW WHAT DOES THAT MEAN? DOESN'T IT MEAN THAT NON CAN SCRAP IS BEING EQUATED TO CAN SCRAP? AND IF THAT IS THE CASE ISN'T THE ALUMINUM CAN INDUSTRY TAKING ENERGY CREDITS FROM ANOTHER INDUSTRY AND USING THEM TO MAKE THE CAN INDUSTRY LOOK GOOD AT THE EXPENSE OF THE ALUMINUM INDUSTRY THAT IS NOT IN THE CAN MARKET. TAKING THEM IS A POLITE STATEMENT. STEALING THE CREDIT IS MORE LIKE IT. MUCH INDUSTRIAL SCRAP FINDS ITS WAY INTO THESE REDEMPTION CENTERS FOR THE PRICE PAYED IS FIFTY PERCENT HIGHER THAN THE TRUE MARKET VALUE. REFERENCE WHAT SCRAP DEALERS PAY FOR ALUMINUM SCRAP. CARRYING THE ENERGY/ALUMINUM RETURN, CREDIT SCHEME USED IN THE REPORT TO THE EXTREME IF THE "CAN RECYCLING" RATE EXCEEDED 100% (IT CAN, SINCE NON CAN

ALUMINUM IS COUNTED AS CANS) WOULD THE ALUMINUM CONTAINER BE A SOURCE OF ENERGY? OBVIOUSLY IT HAS TO STAND OR FALL ON ITS OWN CAN RETURN RATE AND NOT ON THE OTHER NON CAN SCRAP MIXED IN WITH IT. THE RATIONAL FOR NOT ALLOWING THE NON CAN SCRAP TO BE CREDITED TO THE ALUMINUM CAN INDUSTRY IS THE FOLLOWING:
IT IS A TEMPORARILY SUBSIDIZED OPERATION, THE SUBSIDY IS PURPOSELY FIFTY PERCENT HIGH TO DRAW ALUMINUM AWAY FROM THE NORMAL SCRAP CHANNELS TO INFLATE THE FIGURES OF THE CAN REDEMPTION CENTER. LATER ON IF THE CAN INDUSTRY WINS THE DEPOSIT LEGISLATION BATTLE, THE PRICE WILL SETTLE DOWN TO MARKET LEVELS AND THE RETURN RATES WILL DROP ACCORDINGLY. AUBURN HAS A SCRAP DEALER WHO IS OPEN EIGHT HOURS A DAY 26 DAYS A MONTH AND THE DEALER PAYS 10 CENTS A POUND, REYNOLDS COMES TWICE A MONTH FOR TWO HOURS PER TIME AND PAYS 15¢ A POUND. REYNOLDS PAYS A TRUCK DRIVER FULL TIME PLUS GAS COSTS TO CHASE ALL OVER THE STATE PLUS SUBSTANTIAL ADVERTISING COSTS. THE SCRAP DEALER HAS A VERY LOW INCREMENTAL OVERHEAD FOR HIS ALUMINUM AS HIS MAIN PRODUCT IS IRON, WHEN HE SHIPS IT HE USES CAR LOAD LOTS AND THUS, HIS PER UNIT COSTS ARE MINIMAL. YET, HE CAN ONLY PAY 10¢ PER POUND AND REYNOLDS PAYS 15¢. WHY? IF WE ALLOW THE ALUMINUM CAN MANUFACTURER TO CREDIT NON CAN SCRAP, DON'T WE HAVE TO DO THE SAME TO THE STEEL PEOPLE? THE RESOURCE RECOVERY CENTERS' STEEL RECOVERY IS PRIMARILY NON CAN SCRAP. SHOULDN'T WE TAKE ALL THE STEEL IN THE RESOURCE RECOVERY PLANT OPERATION AND CREDIT IT TO THE STEEL CAN ENERGY VALUES? BLACK IS BLACK, AND WHITE IS WHITE. CANS ARE CANS AND NON ALUMINUM CANS ARE JUST THAT. TO TAKE THE ALUMINUM ASSOCIATION UNAUDITED RECYCLING VALUES AT FACE VALUE IS LIKE APOINTING THE WOLF TO GUARD THE CHICKEN COOP.

5) 1-7 TRIPPAGE VALUES GIVEN FOR 1980's (BOTTOM OF SECOND PARAGRAPH) ARE RATHER LOW PARTICULARLY FOR BEER. RETURNABLE BEER IS PRIMARILY FOR ON ON-SITE TAVERN CONSUMPTION. THIS TENDENCY FOR THE ON-SITE BEER CONSUMPTION TO BE A GROWING PERCENTAGE OF ALL OF THE RETURNABLE BEER CONSUMATION PORTION OF BEER PACKAGE SALES IN THE 1980's WILL ACTUALLY MAKE BEER TRIPPAGE INCREASE FROM ITS PRESENT VALUES, AS ON-SITE RETURN RATES ARE EXTREMELY HIGH! IN FACT, IF YOU TAKE THE TIME TO PERSONALLY CALL SOME NON-MEMBER U.S. B.A. BREWERYS YOU WILL FIND THAT THE TRIPPAGE TODAY FOR BEER IS MUCH HIGHER THAN STATED IN THE REPORT. IF YOU WISH, I CAN GIVE YOU SOME NAMES TO CALL.

6) 1-8 "FOR ALL FIVE SCENARIOS, THE ENERGY IMPACTS WERE CALCULATED ASSUMING THE SECULAR REDUCTION IN PER UNIT ENERGY REQUIREMENTS PROJECTED DUE TO EXPECTED ADOPTION OF ENERGY CONSERVING, MANUFACTURING, AND PRODUCT DESIGN --".
THE CAN MANUFACTURE's CREDIBILITY IS NOT VERY GOOD. FOR INSTANCE, DURING THE CAMPAIGN TO DEFEAT THE 1974 DADE COUNTY DEPOSIT REFERENDUM THE CAN INDUSTRY PROMISED DADE COUNTY RESIDENTS A PUSH TOP CAN ACROSS THE BOARD FOR JUNE OF 1975. JUNE IS LONG GONE AND DADE COUNTY RESIDENTS ARE STILL STUCK WITH FLIP TOPS ALONG THE BEACHES WITHOUT A SIGN OF PUSH TOPS IN THE GROCERY STORES YET. REFERENCE COMMISSIONER HARVEY RUVIN, DADE COUNTY LEGISLATOR, FLORIDA. SUGGEST YOU TALK WITH HIM. WHAT ARE THE CAPITAL COSTS OF THIS ENERGY CONSERVATION, DOESN'T IT SEEM TO BE A VALID PART OF THE ECONOMIC PORTION OF THE STUDY?

7) 1-9 LARGEST CAPITAL INVESTMENT (FIRST PARAGRAPH TOP OF PAGE.) SEE MY COMMENT # TWO. THIS IS SHOWING A BIAS BY NOT PUTTING IN TOTAL CAPITAL REQUIREMENTS AND REPEATING THIS STRAW MAN ARGUMENT THUS,

GIVING ADDED STRENGTH TO A BASIC WEAKNESS OF AN OTHERWISE FINE IMPARTIAL REPORT.

8) 1-9 THIRD PARAGRAPH "RESOURCE RECOVERY PLANT ----$1.73 IS DUE TO BEVERAGE CONTAINERS."

THE REPORT AGAIN MAKES AN ERROR OF OMISSION. IF RESOURCE RECOVERY AND THE SOLID WASTE PROBLEM ARE TO BE BROUGHT INTO THE PICTURE, THEN THE ENTIRE SOLID WASTE SYSTEM MUST BE LOOKED AT AND NOT JUST THE FINAL END OF THE SOLID WASTE STREAM, (IE. THE RESOURCE RECOVERY PLANT.) THE COLLECTION COSTS ARE FAR HIGHER THAN THE DISPOSAL COSTS. THUS, GETTING RID OF THE MUNICIPAL COST OF NEARLY SEVEN PERCENT OF THE COLLECTION COSTS OF SOLID WASTE HAS TO BE INCLUDED IN ANY DISCUSION OF SOLID WASTE SYSTEM. AS IT'S A TAXPAYER COST (AS IS THE OPERATION OF RESOURCE RECOVERY PLANTS.) MOREOVER WITH NEARLY FIFTY PERCENT OF THE GLASS REMOVED FROM A SOLID WASTE SYSTEM, (ASSUMING A RETURNABLE SYSTEM.) THEN THE LIFE AND MAINTENANCE COSTS OF THE SHREDDER WOULD BE CONSIDERABLY ENHANCED OVER THE CASE WITH THE ABRASIVE GLASS PORTION OF THE SOLID WASTE IN THE SYSTEM. THUS, THE SYSTEM COSTS OF SOLID WASTE HANDLING WITH AND WITHOUT THE DEPOSIT LAW SHOULD BE INCLUDED OR THE ENTIRE SUBJECT SHOULD BE DELETED FROM THE REPORT.

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FURTHERMORE, NO MENTION IS MADE IN THE SUMMARY (AS THERE IS IN THE BODY OF THE REPORT) THAT DELETION OF THE CONTAINER PORTION OF THE SOLID WASTE WOULD NOT MATERIALY EFFECT THE ECONOMICS OF SOLID WASTE RESOURCE RECOVERY SYSTEMS. THIS IS A SERIOUS OMISSION. IN ADDITION, NO MENTION IS MADE OF THE ECONOMIC SAVING THROUGHOUT THE NATION OF LITTER COLLECTION COSTS. SEEMS THAT SHOULD BE MENTIONED IF THE CONTAINER INDUSTRY'S FAVORITE SMOKE SCREEN, THE RESOURCE RECOVERY PLANT, IS GOING TO BE GIVEN PROMINENT MENTION IN THE SUMMARY.

9) 1-9 "THE FOLLOWING GENERAL CONCLUSIONS --------." 1-5 SHOULD BE AT THE BEGINNING OF THE SUMMARY. SUMMARY #2 I'VE DISCUSSED AVOVE. SUMMARY #4 SHOULD BE REWORDED TO SIMPLY STATE THAT FOR FOUR OUT OF FIVE SCENERIOS THERE WOULD BE A NET INCREASE IN LABOR EARNINGS. LEAVE METAL CAN OUT OF IT. THE REPORT HAS A VERY TINNY FLAVOR. #5, SINCE THE REPORT CONCLUDES ON PAGE 3-31 THAT "EVEN COMPLETELY ELIMINATING BEVERAGE CONTAINERS FROM THE SOLID WASTE STREAM WOULD NOT ALTER THE DECISION TO INSTALL RESOURCE RECOVERY PLANT EXCEPT IN THE MOST MARGINAL SITUATIONS" IT APPEARS THAT EITHER THAT STATEMENT SHOULD BE SUBSTITUED FOR CONCLUSION #5 OR CONCLUSION #5 SHOULD BE DELETED. OBVIOUSLY IT IS OF ONLY PERIPHERAL INTEREST BY THE REPORT'S OWN ADMISSION CONCLUSION #3 AGAIN SHOULD LEAVE REFERENCE TO CANS OUT AND SAY FOR ALL SCENERIOS THERE WOULD BE A NET INCREASE IN THE LABOR REQUIREMENTS SINCE DISLOCATIONS IN THE JOB MARKET ARE NATURALLY OCCURING FACTS OF THE RISK CAPITALISTIC SYSTEM, IT IS REDUNDANT TO ADD IT UNLESS YOU DISCUSS IT AT SOME LENGTH, WHICH THE REPORT DOESN'T. FURTHERMORE, THE DISLOCATIONS ARE CURRENTLY BEING DEVELOPED BY THE CONTAINER INDUSTRY AS THEY DRIVE FOR THE PLASTIC CONTAINER AND THE CAN OVER THE N.R. BOTTLE. ANY MENTION OF FUTURE JOB DISLOCATIONS SHOULD MAKE MENTION OF THE INDUSTRIES OWN EFFORTS TO CREATE DISLOCATIONS IN THE JOB MARKET. IF NO MENTION OF THE QUANTITATIVE, VALUE OF THE DISLOCATIONS IS STUDIED THEN NO VAGUE MENTION OF DISLOCATIONS SHOULD BE MENTIONED. SINCE DEPOSIT LEGISLATION PER SAY DOESN'T BAN ANY PRODUCTS IT IS VERY LIKELY THAT JOB DISLOCATIONS WILL BE MINIMAL AS THE PRODUCT SHIFTS TAKE PLACE VERY GRADUALLY AS EQUIPMENT BECOMES FULLY DEPRECIATED. ONE FINAL THOUGHT ON CONCLUSION #5: ANY REFERENCE TO SOLID WASTE COSTS SHOULD INCLUDE THE ENTIRE SYSTEM COSTS OF SOLID WASTE DISPOSAL AND COLLECTION COSTS.

10) 2-1 SECOND PARAGRAPH "BEVERAGE PACKING --------" SOUNDS LIKE A MARKETING STATEMENT FROM A CAN COMPANY EXECUTIVE. FINE, KEEP IT, BEEF UP THE PARAGRAPH BELOW IT TO MAKE THEM AT LEAST EQUAL IN LENGTH! SECONDLY SUGGEST YOU REDUCE BOTH OF THEM AND PLACE THEM SIDE BY SIDE. OTHERWISE, IN THE INTEREST OF FAIRNESS YOU SHOULD CONDENSE THE SECOND PARAGRAPH AND CHANGE ORDERS WITH THE THIRD ONE.

11) 2-25 FOOT NOTE AT BOTTOM OF PAGE: "ALUMINUM CAN RECOVERY FOR RECYCLING WAS ACTUALLY AT 17 PERCENT FOR 1974." SEE MY COMMENT #4, pp3. ALSO SEE ENCLOSURE FROM THE NEW YORK STATE ENVIRONMENT #1, A PUBLICATION OF THE NEW YORK STATE DEPARTMENT OF CONSERVATION THAT REYNOLDS PAYS 15 CENTS "FOR CLEAN, HOUSEHOLD ALUMINUM. THIS INCLUDES, FOIL, BEVERAGE CANS, FROZEN DINNER TRAYS, CONTAINERS, AND ALUMINUM LITHO PLATES." !! I WASN'T AWARE THAT ALUMINUM LITHO PLATES ARE A HOUSEHOLD ITEM..... FURTHERMORE, I RESENT THE INSULT TO MY INTELIGENCE THAT SOMEHOW LITHO PLATES ARE CANS. DOES THAT MEAN REYNOLDS IS TRYING TO TELL THE AMERICAN PUBLIC THAT BLACK IS WHITE AND VICE VERSA? THIS LITANY OF THE BEVERAGE CAN INDUSTRY HAS NO PLACE IN AN OBJECTIVE REPORT FORMAT. PERHAPS, ITS EFFECTIVE PUBLIC RELATIONS BUT ITS HARDLY OBJECTIVE.

WHO AUDITS THE ALUMINUM ASSOCIATION ASSERTIONS? CAN YOU TAKE THEIR NUMBERS AT FACE VALUE? I THINK NOT. THE OBJECTIVITY OF THE REPORT WILL BE SERIOUSLY DEGRADED IF INDUSTRY ASSOCIATIONS STATISTICS ARE USED, WHOSE OBJECTIVITY IS KNOW TO BE ABSENT. AT BEST THE 17% VALUE CAN ONLY BE A CLAIMED VALUE AND THEN IF ONLY MODIFIED BY AN ACKNOWLEDGEMENT OF THE NON-CAN PORTION OF ALUMINUM IT CONTAINS.

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11A) 2-45 TOP PARAGRAPH " IN THE CONTAINER INDUSTRIES COMPETITION MAY BE REDUCED ------DEPOSITS IS TO SHIFT THE ECONOMICS TOWARD THE REFILLABLE BOTTLE." ON THE CONTRARY IT WILL REOPEN THE COMPETITION THAT HAS BEEN LACKING FOR THE REPORT SHOWS THAT WITHOUT LEGISLATION THE CAN AND PARTICULARLY THE ALUMINUM CAN, WILL ESSENTIALLY TAKE THE LION SHARE OF THE BUSINESS BY 1985. FURTHERMORE, IT WILL GIVE PLASTIC AN EDGE IT DIDN'T HAVE OVER THE CAN AS IT IS REFILLABLE. WITNESS THE REFILLABLE PLASTIC MILK BOTTLE. FINALLY AS THE REPORT AUTHORS MUST KNOW, THE PRICE HAS LITTLE TO DO WITH MARKET SHARE. IF PRICE OF THE DELIVERY SYSTEM WAS PARAMOUNT, THE NON-RETURNABLE CAN WOULD NOT BE WHERE IT IS TODAY. THE REAL DETERMINING FACTOR IS WHICH SYSTEM FAVORS THE CENTRALIZATION OF THE INDUSTRY AND MAKES IT EASIER FOR THE BIG TO GROW BIGGER AT THE EXPENSE OF THE SMALL BOTTLER OR BREWER.

12) 3-15 CAPITAL COSTS: TABLE 3-6 SEE MY COMMENTS OF PP1, COMMENT #2. TOTAL SYSTEM CAPITAL REQUIREMENTS OR NONE AT ALL.

13) 3-15 SECTION 3-5 ECONOMIC IMPACTS: NO MENTION IS MADE OF THE IMPACTS ON CONSUMER PRICING OR CONSUMER COSTS. WHY? IT IS A MAJOR OMMISSION AND RESULTS IN UNDERSPECIFYING THE LABOR IMPACTS. FOR THE ADDED PURCHASING POWER THAT THE CONSUMERS WOULD HAVE, WOULD BE SPENT AS DISCREATIONARY INCOME, THUS, PRODUCING ADDITIONAL LABOR REQUIREMENTS ON A NATIONAL SCALE. THIS STATEMENT IS BACKED BY THE REPORTS STATEMENT ON PAGE 1-4 IN A FOOTNOTE THAT THE REFILLABLE BOTTLE SYSTEM IS THE LEAST EXPENSIVE. SURELY THE EFFECT ON THE AMERICAN CONSUMERS POCKETBOOK SHOULD BE A # ONE PRIORITY ITEM FOR ANY ECONOMIC STUDY.

14) 3-30 TABLE 3-14 REVENUE POTENTIAL OF INORGANIC SOLID WASTE.
GLASS VALUE AND STEEL VALUES ARE GIVEN WITHOUT ANY QUALIFYING STATEMENTS THAT, IN PARTICULAR FOR GLASS, THE TRANSPORTATION COSTS CAN EASILY MAKE RECYCLING OF GLASS AND ITS RECOVERY UNECONOMIC. THIS IS STATED IN SECTION D 09.2.2. pp 151 and pp153. THUS, STATING THE MARKET VALUE ALONE GIVES AN UNEVEN PICUTRE, ONE MIGHT SAY MISLEADING. SINCE THE STEEL AND GLASS VALUE OF THE CONTAINER PORTION NEARLY EQUAL THE ALUMINUM VALUE THIS IS SIGNIFICANT. THE AVERAGE NATIONAL VALUE OF THE RECOVERED GLASS AND STEEL SCRAP FROM RESOURCE RECOVERY PLANTS IS FAR LOWER THAN THAT STATED DUE TO THE EFFECT OF TRANSPORTATION COSTS.
ALSO NO MENTION IS MADE OF THE BENEFICIAL EFFECTS THAT DEPOSIT LEGISLATION WOULD HAVE ON RESOURCE RECOVERY PLANT OPERATION. BY REMOVING SIGNIFICANT PORTIONS OF GLASS, WHICH IS AN ABRASIVE, THE SHREDDER LIFE IS SIGNIFICANTLY INCREASED AND MAINTENANCE COSTS ARE REDUCED. TO BE COMPLETELY OBJECTIVE THIS SHOULD BE SO STATED.

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15) D-3 TOP OF PAGE. "----NET ENERGY REDUCTION OF 10 TO 40%. THIS IS VERY OPTIMISTIC CONSIDERING THAT ELSEWHERE IN THE REPORT IT IS STATED THAT FOR GENERAL INDUSTRY AS A WHOLE ONLY A 15% ENERGY REDUCTION IS EXPECTED. SINCE PLASTIC CASES FOR REUSABLE BOTTLES IS COMING INTO WIDE USAGE TODAY, WHY IS THERE ANY DOUBT THAT NATIONAL DEPOSIT LEGISLATION WOULD BRING MORE DURABLE SIX PAK CARTONS? THE FOOTNOTE ON ppD-3 SHOULD BE ASSUMED IN THE SCENARIO AS A HIGH PROBABILITY OCCURENCE. ON PAGE D-122 THE REPORT STATES THAT THE REFILLABLE BOTTLE ENERGY REDUCTION WILL ONLY BE TEN PERCENT AS COMPARED TO TWENTY PERCENT FOR THE NON-RETURNABLE BOTTLE. THIS IS STARTLING, FOR THE REFILLABLE BOTTLE HAS THE MOST FAT TO BE TAKEN OUT BY FAR AND HAS HAD THE LEAST TECHNOLOGY APPLIED TO IT DURING THE LAST DECADE.

IT IS A WELL KNOWN FACT THAT IN VERMONT AT LEAST ONE BREWERY, HAS BEEN REUSING NON-RETURNABLE BOTTLES SUCCESSFULLY ! THAT IS THEY, THE NON-RETURNABLE BOTTLES HAVE BEEN REFILLED AND REUSED. BUT THERE IS MORE CONCLUSIVE EVIDENCE YET THAT THE TECHNOLOGY IS HERE TODAY TO MAKE A LIGHT WEIGHT REFILLABLE BOTTLE. CONSIDER THE CANADIAN 11½ OUNCE STUBBY BOTTLE. ITS ONLY 8% HEAVIER THAN THE AMERICAN 12 OUNCE NON-RETURNABLE BOTTLE AND IT CONTAINS ½ (4%) OUNCE LESS BEER. THE AMERICAN REFILLABLE LONG NECK BOTTLE IS 24% HEAVIER THAN THE AMERICAN NR BOTTLE AND ABOUT 50% GREATER VOLUME WISE VS ABOUT ZERO VOLUME DIFFERENCE FOR THE CANADIAN STUBBY DESIGN. THUS, YOU ARE PROJECTING THE AMERICAN REFILLABLE BOTTLE TO BE IN 1985 LESS ENERGY EFFICIENT THAN THE PRESENT CANADIAN TECHNOLOGY! SURELY THIS ASPECT OF THE REPORT MUST BE RECONSIDERED, IT'S CRITICAL BECAUSE ON pps D-134&135 TABLE D.8.7 THE IMPORTANCE OF TRANSPORTATION ENERGY REQUIREMENTS CAN BE SEEN FOR THE RETURNABLE CASE. THIS POINT IS SPELLED OUT ON THE BOTTOM OF PAGE D-135. HOW REALISTIC IS IT TO CONSIDER THAT THE ANCIENT INEFFICIENT LONG NECKED EASTERN BEER REFUND BOTTLE WOULD BE AROUND THROUGH 1985 IF NATIONAL DEPOSIT LEGISLATION WERE TO BE PASSED?

16) D-18 SECOND PARAGRAPH. "EXCELLENT COOPERATION WAS RECEIVED FROM THE VARIOUS INDUSTRIES IN SUPPLYING DATA, WITH SOME INDUSTRIES EXERTING CONSIDERABLE ORIGINAL EFFORT TO SECURE DATA FOR THIS PROJECT." THIS STATEMENT MAKES THE CASUAL READER WONDER. WHAT IS MEANT BY ORIGINAL EFFORT? KNOWING HOW ABLE THE CONTAINER INDUSTRY IS IN DREAMING UP ORIGINAL ARGUMENTS TO CONFUSE THE PUBLIC ONE WONDERS HOW ORIGINAL THEY WERE IN TRYING TO MAKE FACT FROM FANTASY! ENOUGH SAID.

16) D-146 NOTES AND REFERENCES #7 "PRELIMINARY DATA SUBMITTED ON A CONFIDENTIAL BASIS FROM GCMI. I DON'T BELIEVE THAT CONFIDENTIAL DATA HAS ANY PLACE IN A PUBLIC REPORT. CERTAINLY IF THE DATA IS FROM AN ASSOCIATION, THE PROBLEM OF INDIVIDUAL COMPETITION FACTORS IS NOT A PROBLEM. AS COMPANIES CAN BE MASKED THROUGH THE ASSOCIATION PROCESS.

17) D-146 NOTES AND REFERENCES #7 PROJECTIONS FOR 1985 MAY BE UPDATED AT A LATER TIME. WHAT IS THE SIGNIFICANCE OF THIS? DOES THIS MEAN THAT GCMI HAS THE "LAST LOOK" AND IF THEY DON'T LIKE THE WAY THEY STACK UP AGAINST THE CAN MANUFACTURERS THEY CAN CHANGE THEIR FIGURES TO SUIT THEIR WISHES BEFORE THE REPORT GOES TO PRESS. IT SOUNDS LIKE A CHINESE AUCTION TO ME. FRANKLY, GCMI'S CREDIBILITY IS VERY LOW WITH THOSE WHO HAVE STUDIED THEIR MATERIAL IN DEPTH. CERTAINLY THEIR OBJECTIVITY IS OPEN TO QUESTION. AS SUCH, THEIR DATA SHOULD ONLY BE TAKEN AS AN INDICATION OF WISHFUL THINKING AND CERTAINLY CAN NOT BE USED AS THE BASIS FOR AN OBJECTIVE NON-PARTISIAN REPORT.

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18) D-146 NOTES AND REFERENCE #11 "FOR REFILLABLE BOTTLES, THE DISTANCES ARE 600 MILES BY RAIL AND 425 MILES BY TRUCK." THESE VALUES WERE PROVI- PROVIDED BY THE US BREWERS ASSOCIATION."

TWO POINTS MUST BE BROUGHT OUT HERE AND A THIRD COMMON ONE ASKING AGAIN HOW DOES ONE TRUST AN ASSOCIATION THAT IN 1974 SPENT TWENTY MILLION DOLLARS TO DEFEAT LEGISLATION THAT THIS REPORT IS EVALUATING. THE TWENTY MILLION DOLLAR FIGURE IS ONE STATED BY BILL COORS OF COORS BREWERY.

FIRST: VIRTUALLY ALL REFILLABLES ARE INTERCHANGABLE WITHIN WIDE REGIONS FOR BEER BOTTLES (NOT SO FOR POP BOTTLES) THUS, IF BREWERY A IS IN PHILADELPHIA AND BREWERY B IS IN NEW YORK CITY WHEN BREWERY A'S BEER IS CONSUMED IN NEW YORK CITY, THE BOTTLES ARE RETURNED TO BREWERY B AND ARE NOT TRANSPORTED TO BREWERY A AS

THE BOTTLES ARE INTERCHANGEBLE BETWEEN BREWERIES AND ONLY THE PAPER LABELS DIFFERENTIATE THE BREWERYS. THUS, THE NEARLY TWICE THE MILEAGE FOR RETURNABLES AS NON-RETURNABLES IS GROSSLY OVER-STATING THE TRANSPORTATION REQUIREMENTS OF RETURNABLES. THIS IS PARTICULARLY THE CASE IF A DEPOSIT LAW WERE TO BE PASSED NATIONALLY AND ALL BREWERYS WERE TO INCREASE THEIR % OF REFILLABLES. THE HIGH MILEAGE FIGURE FROM U.S.B.A. IS ANOTHER CASE OF LETTING THE WOLF GUARD THE CHICKEN COOP.

THE REPORT HAS NOT MADE IT CLEAR HOW THE ENERGY CHARGES ARE ALLOCAT-TED FOR THE RETURN TRIP OF THE REFILLABLE BEER OR POP BOTTLE. MANY BREWERYS AND BEER DISTRIBUTORS DO NOT USE COMMON CARRIER TRUCKS BUT USE THEIR OWN FLEET. USING NON-RETURNABLES, THE TRUCKS RETURN TO THE BREWERYS EMPTY, OR IN THE CASE OF DISTRIBUTORS, DRIVE TO THE BREWERYS EMPTY. THE ADDITIONAL ENERGY REQUIRED FOR A TRUCK FULL OF EMPTYS VS AN EMPTY TRUCK IS SMALL AND CERTAINLY FAR LESS THAN THE ENERGY REQUIRED TO TRANSMIT A COMPLETELY EMPTY LOAD. FURTHER-MORE, IT IS FAR LESS THAN THAT REQUIRED FOR A FULL LOAD. ALONG THE SAME LINES, SINCE THE COMMON CARRIERS ARE NOT FREQUENTLY USED FOR TODAYS NON-REFILLABLES: HAS THE ENERGY REQUIRED FOR THE EMPTY RETURN TRIP BEEN ACCOUNTED FOR? THE WHOLE QUESTION OF THE ENERGY CALCULATIONS FOR TRANSPORTATION IS LEFT IN TO OBSCURE A MATTER IN THE REPORT. SPECIFIC DETAILS OF THE NON-REFILLABLE AND REFILLABLE ACCOUNTING SHOULD BE GIVEN FOR THE FILLED AND EMPTY TRIPS AS WELL AS THE RETURN TRIP WHERE THE TRUCK HAS ONLY EMPTY BOTTLES IN IT VS A COMPLETELY EMPTY TRUCK WHEN THE NON COMMON CARRIER TRUCK IS USED TO HAUL NON REFILLABLES. AS THE REPORT NOW STANDS EVERY THING IS LUMPTED INTO A SINGLE ENTRY: DISTRIBUTION ON TALBE D. 8-7 SINCE THE DISTRIBUTION ENERGY IS THE SINGLE LARGEST COMPONENT (37.4%) OF THE TRIPPAGE INDEPENDENT FACTORS THE ABOVE LACK OF SPECIFIC INFORMATION CITED IS PARTICULARLY SIGNIFICANT.

ONE HAS TO TRAVEL SEVERAL MILES OUT OF ONE'S WAY AND THEN WAIT IN LINE UP TO HALF AN HOUR SINCE THE REYNOLDS TRUCK ONLY IS IN ONE LOCATION TWO HOURS AT A TIME ONCE OR TWICE A MONTH AT THE MOST. (NOTE THE LINE SHOWN IN ENCLOSURE# TWO WAITING TO RECYCLE THE CANS.) YOU INDICATE THAT THE RECOVERY RATE WILL INCREASE FOR ALUMINUM AND YET DECREASE FOR REFILLABLES WHERE NO WAITING LINES ARE REQUIRED AND THE BOTTLES CAN BE BROUGHT BACK TO THE NEIGHBORHOOD STORE ON THE REGULAR WEEKLY SHOPPING TRIP WITHOUT REQUIRING EXTRA TIME OR AN OUT OF THE WAY THIRTY OR FIFTY MILE TRIP. THIS JUST CAN NOT BE. A PERSON'S TIME IS WORTH JUST AS MUCH WHEN BRINGING A BOTTLE BACK (REFILLABLE) AS AN ALUMINUM CAN, ONE CAN NOT SAY THAT RISING INCOMES ON THE ONE HAND WILL CAUSE A DECLINE IN THE RECOVERY RATE FOR REFILABLES AND YET AT THE SAME TIME PROJECT AN INCREASE FOR ALUMINUM. ADDING MORE CENTERS MAY MAKE HONEST THE EXISTING FIGURES THROWN ABOUT BY THE ALUMINUM ASSOCIATION, BUT IT WILL NOT ALLOW THE RECOVERY RATE TO GO ANYWHERE NEAR FORTY PERCENT FOR ALUMINUM. IT IS SUGGESTED THAT AN ANALYSIS BE DONE FOR ALUMINUM RECYCLING SIMILAR TO THAT DONE FOR REFILLABLE GLASS AS OUTLINED ON PAGE B-25. FURTHERMORE, A SIMPLE ANALYSIS OF THE POPULATION AND THE REYNOLDS VAN RECYCLING PROGRAM WILL SHOW THAT IT IS CURRENTLY IMPOSSIBLE FOR 17% OF THE ALUMINUM CANS TO BE RECYCLED. USING THEIR CURRENT PROGRAM.

CAYUGA COUNTY'S POPULATION 80,000

OF FAMILIES APPROXIMATELY 20,000

17% of 20,000 FAMILIES= 3,400

REYNOLDS TRUCK COMES 24 times/year

PEOPLE PER TRUCK STOP = 3,400/24 or 141

ROUNDING TO 100 (NOT ALL PEOPLE BRING BEER IN ALUMINUM CANS) LESS THAN A QUARTER OF THE PEOPLE INDICATED ABOVE SHOW UP

NOTE THE ENTRY FOR BEER CORRUGATED CONTAINER'S IN THE PERCENT OF TOTAL COLUMN IS GIVEN AS 40%. IT SHOULD BE 33.9%. THE 40% GIVEN MAKES THE PERCENT TOTAL ADD UP TO 106%.

IN REVIEWING TABLE D.7-9 THE TABLES FOR THREE PIECE STEEL CANS AND NON-REFILLABLE GLASS BEER BOTTLES ENERGY REQUIREMENTS FOR TRANSPORTATION, IT BECOMES APPARENT THAT THE RETURN EMPTY TRIP ENERGY REQUIREMENTS WERE NOT TAKEN INTO ACCOUNT AS THE ENERGY REQUIREMENTS ARE PROPORTIONAL TO THE WEIGHT OF THE CANS AND THE NON-RETURNABLE GLASS. (ie. THE BOTTLES ARE APPROXIMATELY THREE TIMES HEAVIER THAN THE CANS AND THE TRANSPORTATION REQUIREMENTS ARE LISTED AS BEING THREE TIMES GREATER.) IF THE RETURN EMPTY TRIPS WERE FACTORED IN, THE ENERGY REQUIREMENTS WOULD NOT BE IN PROPORTION TO THE WEIGHTS. A TRUCK THAT IS EMPTY HAS THE SAME ENERGY REQUIREMENTS REGARDLESS OF THE ENERGY REQUIREMENTS FOR THE FILLED END OF THE TRIP. THE REPORT GIVES THE SAME DISTRIBUTION ENERGY VALUES FOR THE D&I CAN VS THE THREE PIECE CAN AS THE RATIO OF THREE WEIGHTS. THE NET EFFECT OF THIS IS TO MAKE THE NON-RETURNABLE SYSTEM LOOK BETTER THAN IT SHOULD AS COMPARED TO THE REFILLABLE SYSTEM.

19) D-148 HAVE COMMENTED ALREADY ABOUT THE 17% RECOVERY RATE OF ALUMINUM CANS. THE ** FOOTNOTE VALUE SHOULD BE USED OR 11% SINCE 17% IS AN INFLATED NUMBER AND ONLY INCLUDED PART OF THE ALUMINUM CAN MANUFACTURER BUSINESS. EQUALLY SIGNIFICANT IS THE PROJECTION THAT "ALUMINUM RECOVERY WILL PROCEED MORE RAPIDLY THAN THE OTHERS ON THE BASIS OF EXPANDED OPERATION OF LOCAL COLLECTION CENTERS." EARLIER IN THE REPORT, THE RETURN RATE FOR REFILLABLES IS PROJECTED ON THE BASIS OF THE AVERAGE INCOME VALUES AND TIME IT TAKES TO RETURN THE DEPOSIT CONTAINERS. YET, WITH LIMITED RECYCLING CENTERS SO THAT

AT THE VAN. FURTHERMORE, THE ABOVE ANALYSIS IS PREDICATED ON ONE TRIP PER YEAR RECYCLING. HOW CAN THE APARTMENT OWNER STORE ALL THAT ALUMINUM FOR AN ENTIRE YEAR? ALSO NOTE FROM ENCLOSURE# 2 THAT BOTH ROCHESTER AND BINGHAMTON HAVE FEWER RECYCLING STOPS THAN AUBURN YET SERVE FAR LARGER POPULATION CENTERS. IN THE CASE OF ROCHESTER THE POPULATION BASE IS SIX TIMES GREATER THAN THAT SERVED BY AUBURN AND THE TRUCK OR VAN MAKES TWELVE STOPS PER YEAR!! (DEPOSIT LEGISLATION IS MORE ACTIVE IN AUBURN, WE PASSED A LAW)

20) D-157 TABLE D.9-5 ALUMINUM BEVERAGE CAN SHIPMENTS AND RECOVERY TABLE HEADING IS IN THOUSAND TONS. THIS IS NO DOUBT IN ERROR AS IT INDICATES THAT MORE WEIGHT OF ALUMINUM IS USED THAN STEEL CANS IN 1972.

21) D-158 SECOND PARAGRAPH --"CAN COLLECTION CENTERS ARE FORECAST TO ACCOUNT FOR 60% OF THE ALUMINUM CANS RECOVERED IN 1985 AND COULD BE HIGHER." HOW REALISTIC IS THIS STATEMENT IN LIGHT OF MY COMMENT #19? WITHOUT ANY BACKUP ANALYSIS THE FIGURE HAS TO BE TAKEN WITH A GRAIN OR SALT AND CANNOT BE USED IN A OBJECTIVE REPORT. A MORE LIKELY VALUE IS THIRTY PERCENT AND THAT IS GENEROUS. THE ONLY WAY IT COULD BE SIXTY PERCENT OR HIGHER IS IF THE ALUMINUM RESOURCE RECOVERY EFFORT COMPLETELY FAILS IN WHICH CASE THE WHOLE RECOVERY EFFORT IS A FAILURE.

L-101

22) F-1 THE CAPITAL COSTS IN APPENDIX F ALMOST SEEMS TO BE DONE AS AN AFTERTHOUGHT. THE DEPTH AND EXPLANTION OF THE METHODS USED SEEMS LACKING IN COMPARISON TO THE REST OF THE REPORT. IT IS NOT CLEAR EXACTLY HOW YOU COVERED THE COST OF THE FLOAT. SINCE CONSUMERS PAY FOR A GOOD DEAL OF THE FLOAT AS WELL AS DEALERS AND DISTRIBUTORS, THIS NEEDS GREATER EXPLANTION. FURTHERMORE, EVERY BUSINESS REQUIRES A FLOAT. ITS CALLED INVENTORY! NO MENTION OF THE COST OF THE CAN INVENTORY IS MADE IN THE REPORT. (CANS ARE NOW MORE EXPENSIVE THAN REFILLABLE BOTTLES, PARTICULARLY ALUMINUM CANS) SINCE THE BEER

COMPANYS MANUFACTURE AN INCREASINGLY LARGE SHARE OF THEIR CANS, SOME MENTION OF THE RAW AND IN-PROCESS INVENTORY PLUS FINISHED GOODS INVENTORY SHOULD BE MADE. ON THE BOTTOM OF PAGE 3-15 IT IS MENTIONED THAT THE CAPITAL REQUIREMENTS FOR THE CONTAINER AND METALS MANUFACTURING INDUSTRIES ARE NOT DEVELOPED SINCE REDUCTIONS IN CONTAINER PRODUCTION ARE PROJECTED FOR ALL SCENARIOS. YET ON PAGE 3-19 THE CAPITAL REQUIREMENTS ARE DISCUSSED COMPARING THE WITHOUT - FROM THE WITH- GOVERNMENT-INTERVENTION PROJECTIONS OF CAPITAL REQUIRED. NOW THE WITHOUT-GOVERNMENT INTERVENTION REQUIRES: INCREASED PRODUCTION OF CONTAINERS.

THE SUMMARY DISCUSSES THE DIFFERENCES BETWEEN THE WITH AND WITHOUT GOVERNMENT INTERVENTION. THUS, THE CAPITAL COSTS OF BEVERAGE CONTAINER MANUFACTURING MUST BE TAKEN INTO ACCOUNT FOR COMPLETENESS SAKE.

23) SUMMARY: OVERALL COMMENT. IT, IS POORLY LAID OUT AND VERY CONFUSING. A SUMMARY SHOULD BE NO MORE THAN FOUR PAGES LONG AND SHOULD BASICALLY STATE THE CONCLUSIONS, PERIOD. THUS, TABLE 1-1, TABLE 1-3 AND TABLE 1-2 SHOULD BE DELETED ALONG WITH FIGURE 1-1, TABLE 1-3 IN MODIFIED FORM SHOULD APPEAR WITHIN THE FIRST THREE PAGES OF THE SUMMARY. THE CONCLUSIONS NOW FOUND ON PAGE 1-9 SHOULD APPEAR WITHIN THE FIRST FOUR PAGES. FINALLY THE SCENERIOS FOR THE SUMMARY SHOULD BE LIMITED TO THREE. THEY ARE: OREGON PARAMETER VALUES, MIDRANGE, AND NO GOVERNMENT INTERVENTION.

IN SHORT, A SUMMARY SHOULD BE SHORT, CONCISE AND EASY TO FOLLOW ONI GIVING THE VERY MAJOR CONCLUSIONS.

THE DETAILS AND HOW THE CONCLUSIONS WERE REACHED SHOULD BE LEFT TO THE MAIN BODY OF THE REPORT.

FOREST GOLDEN
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Phone;: 252-7755

Attachment #1

FOREST GOLDEN
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L-102

NYS Environment

November 1975

Aluminum Collections More than Double

According to Reynolds Aluminum Company's latest figures, aluminum collections are up 2½ times over last year's total and more than $8 million has been paid this year in its consumer recycling program.

The company pays 15 cents a pound for clean, household aluminum. This includes foil, beverage cans, frozen dinner trays, containers, and aluminum litho plates. Aluminum is easily detected with a magnet; it is not attracted by a magnet. In addition, there is a 95 percent energy saving when new aluminum products are made from recycled aluminum. This alone is one major reason for Reynolds' drive to recycle.

Check in your local newspapers for a schedule of collections in your area.

NOTE

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CITIZEN ADVERTISER AUBURN, N.Y. JAN 75

Reynolds Mobile Aluminum Recycling Unit Pays 15¢ a pound for All-Aluminum Scrap



DON'T Say Cans!

Please Don't

Bring your clean All-Aluminum Scrap to:

KINGSTON, NEW YORK 11AM 2PM Kingston Shopping Plaza (East Side)	January 14, 28 February 11, 25 March 11, 25	WATERTOWN, NEW YORK 1PM 3PM Stateway Plaza	January 24 February 7, 21 March 7, 21
SCHENECTADY, NEW YORK 3PM 7PM Mohawk Mall	January 15, 29 February 12, 26 March 12, 26	ELMIRA, NEW YORK 11AM 7PM Elmira	January 17 February 14 March 14
ROME, NEW YORK 10AM 1PM Mohawk Acres Shopping Center (Halfway between main entrance & exit near traffic light facing Black River Road)	January 18 February 1, 15 March 1, 15, 29	CORTLAND, NEW YORK 11AM 2PM Cortlandville Mall	February 4 March 4
		BINGHAMTON, NEW YORK 11AM 2PM Conklin Shopping Center	February 4 March 4
GENEVA, NEW YORK 10AM NOON Town and Country Plaza	January 21 February 4, 18 March 4, 18	ONEONTA, NEW YORK 11AM 2PM Victory Market (Rear right side of store)	January 22 February 19 March 19
AUBURN, NEW YORK 1PM 3PM Auburn Plaza (Near Barker Store)	January 21 February 4, 18 March 4, 18	ROCHESTER, NEW YORK 11AM 2PM Wegmans Shopping Plaza	February 6 March 6
VESTAL, NEW YORK 11AM 2PM Vestal Shopping Plaza (Near Side exit)	January 22 February 5, 19 March 5, 19	SYRACUSE, NEW YORK 11AM 2PM Green Hills Farms (Rear entrance parallel with Salina Street)	January 31 February 28 March 28
DEWITT, NEW YORK 10AM 1PM DeWitt Shopping Town Near Cinema National Theatre	January 23 February 6, 20 March 6, 20		
WATERTOWN, NEW YORK 10AM NOON Seaway Plaza (in front of Kinney Drugs)	January 24 February 7, 21 March 7, 21		

Reynolds Aluminum We Recycle Cans

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National Wildlife Federation

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November 18, 1975

RECEIVED
NOV 21 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Energy and Environmental
Research Division
Research Triangle Institute
P.O. Box 12194
Research Triangle Park,
North Carolina 27709

L-103

Dear Mr. Bingham:

As you requested, Peters Willson on my staff has reviewed the review copy of the report, "Energy and Economic Impacts of Mandatory Deposits," which RTI has prepared for the Federal Energy Administration, and the National Wildlife Federation comments are attached. They focus primarily on the organization of the report and the presentation of the material it contains and secondarily on the adequacy of the data and the methodologies employed.

We appreciate the opportunity you have provided the Federation to contribute to the development of this important document.

Sincerely,

Thomas L. Kimball

THOMAS L. KIMBALL
Executive Vice President

Enclosure

cc: Mike Loube, EPA
Roger Sant, Assistant Administrator for Energy and Environment, FEA
Rep. Fred B. Rooney, Chairman, House Subcommittee on Transportation & Commerce
Sen. Philip A. Hart, Chairman, Senate Subcommittee on Environment

National Wildlife Federation

1412 16TH ST., N.W., WASHINGTON, D.C. 20036 Phone 202-483-1550

Comments on the Draft RTI Report,

"Energy and Economic Impacts of Mandatory Deposits"

Organization Problems

In testimony presented to the House Subcommittee on Transportation and Commerce on April 15, FEA's Assistant Administrator for Energy and Environment, Roger Sant, explained that RTI had been contracted to analyze and report on several questions relating to mandatory deposit legislation. According to Mr. Sant, FEA intends to develop its policy on this legislation based on the final report. In short, the purpose of the report is to serve as the basis for policy-making by analyzing data and clarifying unresolved issues.

We believe that the report, as currently drafted, fails to do this. It is poorly organized and difficult to read, even for the individual who is familiar with the issues and problems of beverage container control. As a result, it fails to clearly identify the questions raised by FEA and the answers RTI determined.

A very good example of the report's organizational weaknesses is the presentation of its general conclusions. These are the most important part of the report, for they will have the greatest single impact on both FEA officials and other policy-makers in the Administration and Congress. However, the general conclusions in this report are located obscurely on page 1-9. Although they identify the net increases and decreases in energy, capital, and labor requirements which could be expected from the institution of mandatory deposits, they do not assess the magnitude of such changes, let alone indicate what magnitude of change in each case would be most reasonable to expect.

The conclusions contain no reference to the impacts of nationwide mandatory deposits on consumers, although this is essential to any determination of public policy. This omission reflects the report's overall failure to address systematically and comprehensively both the impacts of such a program on consumers and the interest of consumers in the institution of a mandatory deposit. The latter is especially important, since it will affect significantly the trippage rate for returns as well as the market distribution of the different types of beverage containers.

The statement in the general conclusions on the effect of the deposit system on the revenue potential of resource recovery is misleading in two respects. First, it implies that that potential could be fully realized, although there now are substantial economic and technological restrictions on resource recovery in many areas. Second, it implies that mandatory deposits conflict with resource recovery as an approach to solid waste management. However, the report itself states on page 3-31: "Since landfill costs are currently $6-8 per ton while incineration is $12-16 per ton, it appears that even completely eliminating beverage containers from the solid waste stream would not alter the decision to install a resource recovery plant except in the most marginal situations."

Another illustration of the possible misleading impressions created by the report's organization is Figure 1-1 on page 1-2, which depicts the per-unit energy requirements of beverage containers. The graph depicts energy requirements for cans recycled at a rate of 0.9 and 1.0. However, on page 1-3, the report states: "And, even if returned or recovered, only an estimated 87 percent of the returned containers can be recycled, since there are losses in handling and shipment plus melt losses in converting containers to molten materials. Thus, the maximum feasible metal can recycling rate from metal can stock is .87 . . ." Contrary to the graph, the per-unit energy requirements are not linear with respect to the recycling rate for metal cans and the return rate of refillable bottles.

To be an effective tool of policy making, the report should be reorganized. The opening chapter should list sequentially each of the separate issues or questions analyzed, followed by the conclusions drawn by RTI from its analysis. Essential to the statement of the conclusions on each of the different impacts of mandatory legislation is an indication of not only the range of magnitude of the impact that might be expected, but also the most reasonable magnitude which might be expected. This should be followed by conclusions on the impacts on the consumer -- availability of products, per unit cost, convenience, etc.

Following this, there should be separate chapters which discuss in detail the analysis of each of the issues: the data used and why, the methodology employed, the findings of the analysis, and RTI's interpretation of them. Terms such as trippage, float, velocity, and others should be defined in an appendix as well as in footnotes.

Data and Methodology

Although we are not able to analyze the data and methodology used by RTI in detail, we ask the following questions:

(1) As stated on page B-20, "The trip-life of refillable bottles is a critical variable." It goes on to state that there are no empirical analyses of the variables that influence the average trippage of refillable bottles. This section then proceeds to determine the effect of the deposit on the return rate in terms of the value the consumer places on his or her time.

Why does the report contain neither a discussion of the other variables which affect trippage or an explanation of why there is no empirical analysis of them, when they are important to projecting impacts of deposits on trippage, a key component in the analysis of all other impacts?

For example, certainly public opinion will play a role in return rates. On page 2-3, the report states that according to a nationwide survey prepared by Opinion Research Corporation in February 1975, 73 percent of the public favored a law requiring all soft drinks and beer to be sold in returnable containers. The Applied Decision Systems' study of public attitudes in Oregon concludes that the public support for the 'Bottle Bill' is "overwhelming". There should be a discussion of the potential impact of popular attitudes nationwide relative to the popular attitudes in Oregon and Vermont before and after their legislation was passed.

In our opinion, if certain information is essential to understanding the problem but is not available, it is important for policy-makers to understand what that information is, how it might be important, and why it is not available.

(2) Why are parallel sets of information not always used to determine the impacts of mandatory deposits on different containers? For example, capital costs for refillable bottles include the bottle, shell, and carrier float capital requirements. But no corresponding capital requirements are provided for unreturned or unrecycled cans. This imbalanced calculation of capital requirements is especially significant in view of the fact that on page 3-19 the report warns that estimates of the float capital requirements are likely to be overstated and not borne entirely by beverage producers and distributors. Another example is the failure of the report, in calculating the impacts on labor and employment, to include the effect of savings enjoyed by consumers who use returnables and spend their savings in other sectors of the economy, stimulating production and increased employment opportunities.

In conclusion, the Federation would recommend a re-evaluation of the data used to make sure that the different containers' impacts are analyzed in terms of comparable variables, and that the report be reorganized to provide a more lucid presentation of its conclusions, which accurately reflect its major findings.

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November 26, 1975

Mr. Taylor Bingham
Research Triangle Institute
Research Triangle Park, N.C. 27709

Mr. Taylor Bingham

Please find enclosed NRDC's comments on the draft of your report, Energy and Economic Imparts of Mandatory Deposits.

If you have any questions, please feel free to contact us.

Sincerely yours,

Thomas Fenner

Thomas Fenner
Legal Assistant

Richard Cotton
Staff Attorney

L-105

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COMMENTS OF THE NATURAL RESOURCES DEFENCE COUNCIL

ON R.T.I.'S DRAFT REPORT,

ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS

Prepared by Thomas Fenner
Richard Cotton

1) INTRODUCTION

The Natural Resources Defense Council has reviewed the Research Triangle Institute's draft, "Energy and Economic Impacts of Mandatory Deposits" prepared for the Federal Energy Administration. Although the picture painted in this study of beverage container legislation is unquestionably a positive one, the positive benefits of a deposit law are actually understated.

In the past, much misinformation has been provided to those governmental units that have considered enacting "Bottle Bills". Studies that purported to describe the effects of returning to a deposit system have relied on methodological techniques and assumptions that foreclosed any possibility of an objective analysis. The following facts are now clear:

1. ENERGY: given the proper container mix, a return to a deposit system could result

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in an energy savings of greater than 0.3% of total U.S. energy use.

2. JOBS: a mandatory deposit system would result in a net increase of jobs and labor earnings.

3. THE ENVIRONMENT: a refillable bottle system -- such as would be encouraged by a deposit law -- is environmentally far superior to any of the present no-deposit, no-return systems.

4. LITTER: a minimum deposit law in Oregon resulted in a reduction of beverage container litter of 72% (a reduction of 35% of total litter, by volume) during the first year, and reductions of 83% and 47%, respectively, during the second year of the law.

5. CONSUMERS: consumers overwhelmingly support minimum deposit legislation.

6. RECYCLING: requiring a deposit on a non-refillable container is the best way to guarrantee effective recycling.

2. PROBLEMS AND OMISSIONS IN DRAFT REPORT

In general we believe the R.T.I. study is accurate and rigorous, as far as it goes. However, several serious

flaws and omissions in the study that result in understating potential benefits must be corrected before the R.T.I. study can make an effective contribution to a cost-benefit analysis of container deposit legislation.

A. ENERGY:

1) First, estimates of energy conservation that the industry might achieve by the 1980's without deposit legislation seem unrealistically high. Further, the capital requirements necessary for implementing these conservation measures have been totally excluded from the report.

2) Second, in determining the trippage rates for refillable bottles in 1985, too little weight is given to the experience of the state of Oregon, and to the educational effects of a mandatory deposit system. Trippage for 1985 is predicted at 10.4 for soft drink bottles, and at 6.4 for beer -- and the energy figures are calculated accordingly. Even the so-called "high trippage" determination uses only a trippage rate of 18. And yet, the trippage rate in Oregon, where the effects of deposits reflect actual experience rather than hypothetical flow charts, is 24 for soft drink bottles and 20 for beer. Returning bottles has once again become a habit and

and this education effect is spilling over to the area of secondary packaging as well. To ignore this educational effect and focus on disposable real income to predict trippage flies in the face of the experience in Oregon -- where 2¢ deposit beer bottles are being returned at a rate (95%) almost equal to 7¢ and 10¢ deposit soft drink bottles (96%). [Waggoner, Oregon's Bottle Bill: Two Years After]. To the extent the experience of Oregon is discounted, the energy savings projected in the study are too low.

3) Third, the baseline energy projections for 1985 should clearly take into account the increases in energy transportation requirements due to a trend toward centralization within the beer and soft drink industries that is expected to continue through 1985.

4) Fourth, it would be appropriate for the study to acknowledge, if not actually to quantify the energy savings which accrue from reduced litter and solid waste pick-ups as a result of a mandatory deposit law.

5) Fifth, translating the projected energy savings into its equivalent in barrels of oil, or percentage of oil imports or percentage of total U.S. requirements in the summary would assist the reader to quickly realize the potentially

great impact of a deposit law.

B. BEVERAGE PRICES

The study mentions that beverages in refillable bottles cost less than beverages in throwaways (p 2-

At this point, it would be appropriate to insert a brief economic sketch of the savings that result to brewers and bottlers from reusing containers rath than buying new ones -- savings which are passed on to consumers in the form of lower prices. The following explanation was offerred by N.E. Norton, president of Royal Crown -- Dr. Pepper:

> "While costs of cans and bottles vary, depending on frieght costs, volume, design of the container, etc., we can assume approximate costs to the bottler of 4¢ for a throwaway bottle, 6¢ for a can, and 10¢ for a refillable bottle. In marketing soft drinks in a throwaway bottle or can, the bottler must include the cost of the container – 4¢ or 6¢. On the other hand, if the bottler markets his product in refillable bottles, and obtains the national average of 15 trips per bottle, his container costs are fractions of a cent.* If his bottle washing costs are 1¢ or 2¢, he can supply a soft drink in a refillable bottle to the retailer at ¾¢ to 1¢ less than he can in a throwaway bottle or can. Then if it costs the retailer 1¢ or 1½¢ to handle returnables, the consumer can still purchase a soft drink in a refillable bottle from 2¢ to 3¢ less than he can in a throwaway bottle or can."[66]

C. ENVIRONMENTAL EFFECTS

In section 2.2.1, in discussing the reasons favoring beverage container legislation, the environmental costs of throwaway containers (as opposed to returnable - refillable bottles) should be acknowledged in greater detail. Inserting the following data from the M.R.I. study, "Resource Environmental Profile Analysis of Nine Beverage

Container Alternatives" would be appropriate:

COMPARISON OF FIVE DIFFERENT CONTAINERS FOR DELIVERING 1000 GALLONS OF BEVERAGE

Environmental Impact	10-Trip Glass (Returnable)	All Steel	Bi-Metallic Can	One-Way Glass	Aluminum Can
Energy (million BTUs)	22	30	54	84	76
Virgin Raw Materials (lbs)	1680	2722	2746	7641	1666
Water Volume (thousand gals.)	16	30	34	37	15
Waterborne Waste (lbs.)	26	18	34	56	59
Atmospheric Emissions (lbs.)	94	146	222	261	323
Post-Consumer Solid Wastes (cubic feet)	12	3	3	41	3
Industrial Solid Waste (cubic feet)	9	106	93	33	36

Note: All containers are 12 ounces (beer); the bottles are capped with steel closures; solid bleached sulfate paperboard carriers are included with bottles; plastic ring carriers are included with cans. Source: Midwest Research Institute under EPA contract, R.E.P.A., Table 7, p. 21.

D. RESOURCE RECOVERY

1. The summary to the report notes that if beverage containers were removed from the waste stream, the revenue potential of solid waste would be reduced a maximum of 22%.

2. This statement in the summary is misleading in that it fails to acknowledge the conclusion on page 3-31 that even completely eliminating beverage containers from solid waste would not alter the decision to install a resource recovery plant.

3. The report might also wish to point out to the casual reader the anomaly of the position taken

by some Bottle Bill opponents that in order to solve our solid waste problems, we must contin to throw away valuable resources -- so as to make resource recovery systems profitable.

E. LABOR

1) In the study's calculations of the labor requires and earnings under a mandatory deposit system, it is not clear whether the baseline projections for 1985 take into account the job loss and dislocation trend that is already taking place in the beer and soft drink industries. This job loss is due to the gradual centralization of these industries made possible by the advent of one-way containers. Information such as the following should be included to indicate that greater job dislocation may occur if no action is taken to stem the flood of throwaways:

YEAR	BREWERIES	EMPLOYEES
1949	440	78,704
1953	329	84,849
1960	229	69,838
1966	187	60,508
1971	148	57,000

Source: Table 20, General Statistics for U.S. Malt Beverage Industry, as cited in OSPIRG, P

2) While R.T.I. has calculated the negative indirect labor impact of a deposit law, it has not calculated the positive indirect labor impact flowing from consumer savings that will be diverted to spending in other areas.

F. CONSUMERS

1) Since the ultimate economic impact of a mandatory deposit law will be borne by the consumer, findings concerning the views of consumers deserve special prominence in the report, and should be included in the summary. Too little emphasis is given to the important survey showing that 73% of those interviewed favor a deposit law, and to the conclusion that 91% of the people of Oregon support deposit laws. These facts are buried in the findings and deserve more prominent display.

2) In calculating the market share for non-returnable containers in 1985, based on present trends, the study tacitly assumes that container mix accurately represents the preference of the consumers -- i.e. that if 65% of consumers are buying beer in metal cans, it is because they

prefer such containers to refillable bottles. This assumption overlooks the fact that in many parts of the country, the consumer is no longer given the choice of buying beverages in deposit bottles. In Palo Alto, California, for instance, beer is only available in no-deposit, no-return containers, leaving the ecologically-minded consumer without a "vote". If the projections for 1985 overlook the fact that the market in these areas do not necessarily reflect consumer choice, those projections may be inaccurate.

F. CAPITAL COSTS

1) Since R.T.I. included the float for the refillable bottle system as capital investment, it must include the "float" of raw materials and recycling equipment required by non-refillalbe container systems as well in order to present an accuarate picture. The exclusion of recycling equipment from estimates of capital investment required by throwaways when bot washing equipment was included as investment required by returnables is a particularly troubling flaw.

2) The report should acknowledge that the cost of capital is passed on to the consumer as any other cost -- and that therefor a very practical measuremen of increased capital expenditures is their effect on consumer prices. The report should then indicate

that neither the Gudger-Bailes nor the ADS study found any price increase attributable to the Bottle Bill.

3) Although the Hatfield bill does not include a certification provision designed to stimulate the use of standardized bottles, it would be appropriate for the study to comment on the potential effects of such a provision. In Oregon, an overwhelming percentage of the beer sold is packaged in either an 11 ounce stubby or a quart bottle, both of which can be used by several different brewers. Such a system has significant effects on the capital and labor outlays of affected industries (particularly retailers), and deserves notice.

L-110

OREGON ENVIRONMENTAL COUNCIL
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NOV 14 1975
ECONOMICS DEPARTM

November 12, 1975

Taylor H. Bingham
Energy and Environmental Research Division
Research Triangle Institute
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Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

We appreciate the opportunity to review the copy of t "Energy and Economic Impacts of Mandatory Deposits" which you provided to the Oregon Environmental Counci

There are several specific areas in the report which we believe warrant further study as follows:

Capital Requirements

General conclusions listed on page 1-9 include the statement "There would be a net increase in the capital requirements". This conclusion would appear to rest upon the statement on 3-15, "Capital requirements for the containers and metals manufacturing industries were not developed since reduction in container production are projected for all scenarios" The scenarios are listed on page 3-7 as:

Scenario 1 - Without government intervention
Scenario 2 - With government intervention, no change in metal can market share and zero return rate for metal cans
Scenario 3 - With government intervention, no change in metal can market share and 100% return rate for metal cans
Scenario 4 - With government intervention, metal can market share falls to zero,
Scenario 5 - With government intervention - Oregon Parameter values
Scenario 6 - With government intervention, mid-ran parameter values

The conclusions on page 1-9 appear in the main to be a comparision between Scenario 1 and Scenarios 2 - 6

Under Scenario 1, with the large increases in metal can packaging between 1980 and 1985 as shown in figure 26 on page 214, there would clearly be a significant increase in plant investment required to support this growth. It is therefore suggested that the difference in capital requirements between Scenario 1 and the other Scenarios should be the capital required to fund the entire soft drink and beer systems over this 1980 - 1985 period compared to the capital requirements in the event of government intervention as dealt with in Scenarios 2 - 6. It will then be possible to make a more complete and accurate determination of the total capital requirements for the various Scenarios.

This modified approach may well change some of the conclusions found on table 1-1 as well as the second paragraph of page 1-3 where the refillable bottle system is stated to be the "most capital-intensive of the container systems."

Return Rates

Although Scenario 5 the "Oregon Parameter" Scenario is included in a number of tables (table 3-2, 3-3, 3-5 and 3-7) the specific parameters which are used as the basis for the computations do not appear to be set out explicitly in the text. On page 1-6, item 2 it is stated that (Scenario 5 is) "a set of parameter values derived from the Oregon response to mandatory deposit (although not the Oregon tripages)." Table 3-2 where Oregon Parameter return rates for refillable bottles of 90% for beer and 84% for soft drinks are stated contains a similar statement.

There does not appear to be any discussion of the reason for selection of these numbers rather than the 93% and 96% respectively for beer and soft drink refillable bottles which recent Oregon experience indicates. Although the sensitivity analysis of energy requirements projection shows a relatively small change in energy usage for beer based on varying trippages--there is a somewhat larger change for soft drinks as shown on figure 2-19. The change would probably be even greater for soft drinks if the Oregon experience of 25+ trips were used instead of the 7 trips shown under case number 1 for soft drinks.

Aluminum Can Return Rates

We have heard varying reports about the Coors Container Company's metal can recycling program. It is stated on page 1-7 that Coors obtained approximately 50% return rate by paying 3/4 of a cent per can. We have heard some suggestions that this is based on a return by weight which could consequently include non-cans. It has also been suggested that the return rate is calculated by comparing total aluminum can returns in a given area (which include significant quantities of non-Coors cans) and comparing these returns to total sales by Coors in that same area. Has the Research Triangle Institute been able to

obtain an independent judgement regarding the validity of this 50% return rate?

Enactment Date

On page 2-2 it is stated that "Oregon's Bottle Bill" was enacted in that state in 1972. The bill was passed during the 1971 legislature and became effective on October 1st, 1972.

Aluminum Scrap Value

The market value of aluminum recovered from a resource recovery system is estimated in table 3-14 to be $300 per ton or 15¢ per pound FOB. It is not stated where the FOB point is but it is presumably the resource recovery station. Since this calculation is very central to the conclusion found on page 1-9 that "the revenue potential of municipal solid waste would be decreased by a maximum of 22%.," it is felt that there should be some additional documentation for this relatively contaminated aluminum scrap. Current scrap rates paid in Oregon are approximately $180 per ton for clean scrap.

We appreciate the opportunity to be able to review this report and provide the above comments which we hope will be of interest and use to you.

Sincerely,

Don Waggoner

Don Waggoner

DAW:kg

Corporations

ADOLPH BEVERAGE CORPORATION

PHONE 307 - 347-4201

821 PUBLIC AVENUE
POST OFFICE BOX 726
WORLAND, WYOMING

November 12, 1975

Honorable Clifford P. Hansen
United States Senate
Room 3107, New Senate Office Building
Washington, D. C. 20510

Dear Senator Hansen,

Thank you for your letter of November 6 and the copy of Rese
Triangles Study entitled "Energy And Economic Impacts of Ma
Deposits."

At the outset it seems apparent the limited number of copie
available(3) and the late mailing date would preclude any
industry wide response. By the same token, respons. on our
is limited by the time factor involved.

Our immediate thoughts and impressions of the study are:

1. The study assumes a need for a deposit in the Beverage industry only. This seems somewhat unrealistic in that we, as an industry, consume less than 1/5 of 1% of the total industrial energy requirement. Also, we now have the only returnable bottle system in the retail food cycle.

2. The study assumes a deposit to be the only viable method of effecting recovery of resources used in containers. Little thought is given here to existing recycling and resources recovery systems, funded by industry, now in existance.

3. The study assumes a consumer desire for a deposit system, when in fact all but two States have, year after year, refused to enact deposit legislation.

4. The study is self limiting and without validity in that far too many "assumptions", "estimates", and "projections" are used in place of hard facts.

All in all we conclude the study is mis-directed, ill conce
and of little practical value when related to the entire sc
of the energy problem. We would refer you instead to sever.

industry studies relative to energy use in the packaging industry in the 1980's. Find enclosed one such study done for American Can Company. Also, any one of the many municipal solid waste programs now in full swing would provide answers of better depth than the Triangle study.

Join us in resisting any and all piece-meal and/or temporary legislation such as Beverage Container Deposits.

Sincerely,

ADMIRAL BEVERAGE CORP.

Frank K. Bowers,
General Manager

FKB/lc

enclosure

cc: Honorable Gale McGee
cc: Honorable Teno Roncalio

L-114

[illegible]

United States Senate

COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS
WASHINGTON, D.C. 20510

November 18, 1975

Frank Zarb, Administrator
Federal Energy Administration
New Post Office Building
12th and Pennsylvania Avenue
Washington, D.C. 20461

Dear Frank:

Earlier, I wrote you about the returnable beverage container study done for FEA, and the fact that the study was not readily available for public inspection and comment.

One of the three copies I obtained was sent to the Admiral Beverage Corporation in Wyoming, and I am enclosing that company's comments on the study.

I would appreciate it if Mr. Bowers' letter, together with the attachments, could be made part of the record on this matter and if his comments could receive full consideration.

Thank you for your assistance.

Sincerely,

Clifford P. Hansen
U. S. S.

CPH:pjhw
Enclosure
cc: Frank Bowers

[redacted]
Greenwich, Conn. 06830

Contact: Fleming Nielsen
(203) 552-2223

Subject: New Energy-Use Trends in Beverage Packaging

GREENWICH, Conn., Nov. 7 -- American Can Company today reported highlights of a study of energy and material consumed in the production of beverage containers that shows significant new trends. Dr. Leon Katz, vice president, Research & Commercial Development, presented a summary of the study today at a Michigan State University seminar entitled "Environmental and Economic Impact of Packaging on the Food Industry." Dr. Katz said the review differs from previous industry and academic studies in that it projects the impact of developing technology on the energy component of various packaging systems.

Among the findings are the following:

1) Energy consumption per container will decrease significantly for all container materials over the next five years (see table).

2) Differences in energy needs among the various materials will be substantially narrowed.

3) Ultra-lightweight metal beverage containers coming into production shortly will be equivalent to 10-trip returnable bottles in total energy consumed. Where bottles have a life of as little as 3 or 4 trips, as in major metropolitan areas, the new metal beverage containers would be less energy-intensive.

4) Material efficiency will improve substantially, with reductions in material use ranging from 15 to 20 per cent.

Dr. Katz said, "Since the mid-1930s when beverage cans first became available, engineers have reduced the metal needed by 50 per cent. New technology now available for ultra-lightweight cans gives a great potential for substantial additional savings."

He emphasized that "continued development of least-energy-intensive containers will require that options remain open for use of all materials -- glass, plastic, steel, and aluminum -- since techaical changes are likely."

The company's summary is based on an internal review of existing and developing materials and technology. Portions of the complete study are proprietary, but the report can be made available for independent confirmation

# # #

11/14

(Editor: Please see the attached table.)

Energy Requirements for 12-Ounce Beverage Container Systems
(In million BTUs per thousand containers
from mine to point of consumption)

	1974	1980	% Reduction
Aluminum 2-piece	7.20	3.35	53.5
Steel 2-piece	3.91	2.40	38.3
Glass non-returnable	4.81	4.06	15.6
Glass 10-trip returnable	2.60	2.44	6.2
Plastic	4.96	3.32	33.1

Energy reduction is accomplished by:

1) Source reduction. Each system makes use of 15 - 20 per cent less raw material.

2) Resource recovery. A level of 50 per cent recycle is assumed through municipal waste management systems.

3) New process technology in container manufacture. The use of water base and/or ultraviolet cured coatings minimizes energy consumption.

4) Less paperboard. In the case of metal containers, 6-pack overpackaging is eliminated.

ENERGY AND TECHNICAL DEVELOPMENT

TWO OF THE MORE POPULAR PUBLIC MOVEMENTS WHICH HAVE EMERGED IN RECENT YEARS ARE ENERGY AND SOURCE REDUCTION. IN EACH INSTANCE THE PRIME GOAL IS CONSERVATION BASED ON THE PREMISE OF FINITE EXHAUSTIBLE RESOURCES. ONE OF THE INITIAL TARGETS BY PROPONENTS OF THESE MOVEMENTS TO REDUCE ENERGY AND RESOURCE USE IN THE MANUFACTURING SECTOR HAS BEEN AIMED AT PACKAGING - IN PARTICULAR, BEVERAGE CONTAINERS. TO SUPPORT THEIR PROGRAM OF LEGISLATIVE ACTION, A LARGE NUMBER OF STUDIES HAVE BEEN PUBLISHED BY BOTH THE ACADEMIC AND INDUSTRIAL COMMUNITIES DETAILING THE ENERGY, RESOURCE USE AND ENVIRONMENTAL EFFECTS ASSOCIATED WITH THE VARIOUS BEVERAGE PACKAGING SYSTEMS, INCLUDING GLASS, PLASTIC, STEEL AND ALUMINUM. THE STUDIES EMBRACED THE TOTAL SYSTEM FROM THE PRODUCTION OF BASIC RAW MATERIALS THROUGH TO DISTRIBUTION, RECYCLING AND DISPOSAL. THE STUDIES, HOWEVER, DEALT WITH THE CURRENTLY AVAILABLE CONTAINERS AND NEGLECTED TO PROJECT THE IMPACT OF TECHNOLOGY ON THE SPECIFIC SYSTEM. WE ARE ALL AWARE OF THE RAPID DEVELOPMENT OF NEW TECHNOLOGY AND THE SPEED WITH WHICH IT IS COMMERCIALIZED. BECAUSE THIS IS HAPPENING IN THE PACKAGING INDUSTRY AND INDUSTRIES TANGENTIAL TO PACKAGING, THE ENERGY COMPONENT OF THE PREVIOUS STUDIES HAS BEEN EXTENDED TO REFLECT THE ENERGY IMPACT OF NEW TECHNOLOGY DEVELOPED IN THE LABORATORIES OF AMERICAN CAN COMPANY AND THE RELATED INDUSTRIES. WE ELECTED TO STUDY

ENERGY ALONE, SINCE IT VERY CLOSELY PARALLELS RESOURCE USE AND OTHER ENVIRONMENTAL FACTORS.

THE RESULTS OF OUR STUDY ARE TABULATED IN TABLE I. THEY CLEARLY DEMONSTRATE THE DRAMATIC CHANGES WHICH TECHNOLOGY WILL BRING - CHANGES WHICH WILL BE REFLECTED IN COMMERCIAL INSTALLATIONS BEGINNING IN 1975 AND ACCELERATING IN THE YEARS TO COME. THE FOLLOWING TRENDS ARE CLEAR:

1. ENERGY CONSUMED BY EACH PACKAGING SYSTEM WILL BE REDUCED SUBSTANTIALLY.
2. THE RELATIVE ORDER OF THE LEAST ENERGY INTENSIVE SYSTEM CHANGES - STEEL CONTAINERS ARE EQUIVALENT TO THE RETURNABLE GLASS BOTTLE, WHICH IS ASSUMED TO MAKE TEN TRIPS.
3. THE SPREAD IN ABSOLUTE ENERGY BETWEEN MAJOR SYSTEMS NARROWS CONSIDERABLY.

TABLE I

ENERGY IN MM BTU'S/M CONTAINERS FOR 12 OZ. BEER CONTAINER SYSTEM

	1974	1980
ALUMINUM 2-PIECE	7.20	3.36
STEEL 2-PIECE	3.91	2.49
GLASS NON-RETURNABLE	4.81	4.06
GLASS 10-TRIP RETURNABLE	2.60	2.44
PLASTIC	4.96	3.32

THE REDUCTION IN ENERGY IS ACCOMPLISHED BY THE FOLLOWING:

1. SOURCE REDUCTION - EACH SYSTEM MAKES USE OF 15-20% LESS RAW MATERIALS/M UNITS.
2. RESOURCE RECOVERY - A LEVEL OF 50% RECYCLE THROUGH MUNICIPAL WASTE MANAGEMENT SYSTEMS IS ASSUMED TO HAVE BEEN ATTAINED.
3. NEW PROCESS TECHNOLOGY IN CONTAINER MANUFACTURE - THE USE OF WATER BASE AND/OR ULTRAVIOLET CURED COATINGS MINIMIZES ENERGY CONSUMPTION.
4. LESS PAPERBOARD - IN THE CASE OF METAL AND PLASTIC CONTAINERS, 6-PACK PAPERBOARD OUTERPACKAGING IS ELIMINATED.

SINCE THERE IS NO IDEAL CONTAINER FOR BEVERAGE WHEN ONE CONSIDERS ALL FACTORS INCLUDING WEIGHT, SIZE, CLARITY, SAFETY, ENERGY, ENVIRONMENT, ECOLOGY AND CONVENIENCE, IT IS IMPORTANT TO ENSURE THAT AN ENVIRONMENT PREVAILS WHICH WILL ENCOURAGE THE CONTINUED COMPETITION BETWEEN THE SYSTEMS. A FREE MARKETPLACE, UNENCUMBERED BY LEGISLATION WHICH FAVORS ONE SYSTEM, WILL LEAD TO CONTINUED TECHNOLOGICAL CHANGE, WHICH IN TURN WILL GUARANTEE LOWER ENERGY AND RESOURCE USE IN THE TOTAL SYSTEM.

THE PRIMARY PURPOSE OF OUR STUDY WAS TO DEMONSTRATE AS POSITIVELY AS WE COULD THAT TECHNOLOGY MUST BE CONSIDERED WHEN ONE IS CONCERNED WITH MAKING DECISIONS WHICH AFFECT THE FUTURE. THE FACT THAT STEEL 2-PIECE

CAN LOOK AS ATTRACTIVE NEAR TERM AS 10-TRIP RETURNABLE GLASS WITH RESPECT TO ENERGY IS NOT AS IMPORTANT AS THE FACT THAT NEW TECHNOLOGY GUARANTEES THE DEVELOPMENT OF LEAST ENERGY CONSUMING PACKAGES OF ALL TYPES. IT IS ENTIRELY POSSIBLE THAT IN 1980 AS WE GLANCE AHEAD INTO THE FUTURE AN ADDITIONAL FIVE YEARS, WE MAY SEE A DIFFERENT LEAST ENERGY INTENSIVE PACKAGE - BUT WE WOULD BE WILLING TO WAGER THAT ALL PACKAGING SYSTEMS WOULD CONSUME LESS ENERGY UNITS IN 1985 THAN IN 1980 AND THAT ONCE AGAIN THE GAP BETWEEN SYSTEMS HAD NARROWED. THIS MUST OF NECESSITY OCCUR, SINCE SOURCE REDUCTION IS NOT NEW TO MANUFACTURERS; IT IS A MAJOR MEANS OF PROVIDING A COMPETITIVE EDGE. ONE MINIMIZES SCRAP, UTILIZES LESS MATERIAL AND INCREASES EFFICIENCY OF PROCESS WITH CONCOMITANT SOURCE REDUCTION AND ENERGY CONSERVATION. THE ISSUES OF ECOLOGY AND ENVIRONMENT ONLY PROVIDE US WITH ADDITIONAL FORCEFUL REASONS TO INCREASE OUR EFFORTS IN THIS AREA.

THE SECONDARY AND EQUALLY IMPORTANT PURPOSE OF THE STUDY WAS TO POINT UP THE IMPACT THAT RECYCLING HAS ON THE TOTAL SYSTEM. WHETHER RESOURCES ARE AVAILABLE OR FINITE, WASTE IS UNCONSCIONABLE. A TRULY ORGANIZED SYSTEM OR VARIETY OF SYSTEMS WHICH ESSENTIALLY CLOSES THE LOOP OF RAW MATERIAL TO PACKAGE, TO CONSUMER, TO WASTE AND BACK TO RAW MATERIAL/ENERGY MUST BE THE SELF-EVIDENT ANSWER TO ALL THOUGHTFUL PEOPLE. THIS APPROACH IS A RATIONAL ANSWER TO MAKING THE WORLD'S RAW MATERIALS GO FURTHER WHILE MINIMIZING THE NEED FOR ADDITIONAL ENERGY. A FREE ENVIRONMENT FOR R. & D. EFFORT IN THIS VITAL FIELD IS ALSO ESSENTIAL IF WE ARE TO DEVELOP THE MOST EFFICIENT AND

ECONOMICALLY ATTRACTIVE SYSTEM. TAKING OUT THE VALUABLE FERROUS FRACTION ARISING FROM FOOD AND BEVERAGE CONTAINERS BY LEGISLATION PRESENTS A UNIQUE DILEMMA FOR RESEARCHERS AND PLACES CONSTRAINTS ON VARIOUS SOLUTIONS TO THE SOLID WASTE MANAGEMENT PROBLEM.

RECENT PUBLICATIONS HAVE TAKEN ISSUE WITH THE PREMISE OF "FINITE INEXHAUSTIBLE RESOURCES." THE COUNTER THEORY IS THAT RESOURCES ARE AVAILABLE FOR THE LONG TERM, BUT AT HIGHER COST AND POSSIBLE GREATER ENVIRONMENTAL IMPACTS. THE DEVELOPMENT OF NEW TECHNOLOGY IN THE EXTRACTIVE AND REFINING INDUSTRIES WILL GO FAR TOWARD SOLVING THE COST AND ENVIRONMENTAL ISSUES. ADDITIONALLY, THIS SAME TECHNOLOGY COULD FAVORABLY IMPACT THE ENERGY USED IN THE PACKAGING SYSTEM, SINCE SUCH A HIGH PERCENTAGE OF THE TOTAL ENERGY IS ASSOCIAT WITH THE REFINING OF RAW MATERIALS AS SHOWN IN TABLE II.

TABLE II

PERCENTAGE OF ENERGY IN PACKAGING SYSTEM ATTRIBUTED TO RAW MATERIAL ACQUISITION

	In %
ALUMINUM 2-PIECE	85
STEEL 2-PIECE	70
GLASS NON-RETURNABLE	74
GLASS 10-TRIP RETURNABLE	48
PLASTIC	63

SOURCE REDUCTION HAS BEEN A CONSTANT EFFORT OVER THE YEARS BY ALL MANUFACTURERS. AS A PRELUDE TO TODAY'S DISCUSSION WE WOULD LIKE TO SHOW YOU HOW METAL HAS BEEN MINIMIZED AND TIN PRACTICALLY ELIMINATED OVER THE YEARS IN A STANDARD FOOD CONTAINER. THIS IS SHOWN GRAPHICALLY IN TABLE III.

USING THE 303 x 406 CORN CAN, WE SEE THAT METAL HAS BEEN REDUCED BY 25 PERCENT FROM 1952 TO 1974 WITH FURTHER IMPROVEMENTS FORECAST FOR 1980. THE ACTUAL SAVINGS ARE GREATER IF WE LOOK AT NET POUNDS PER THOUSAND CANS, SINCE THE SCRAP WHICH AMOUNTS TO 22 POUNDS IN 1952 IS RECYCLED AUTOMATICALLY. THE SAVINGS IN TIN USAGE ARE DRAMATIC FROM 1952 TO 1974, AND WE EXPECT TO ELIMINATE TIN USAGE IN MANY FOOD CONTAINERS BY 1980.

IN ADDITION, WE HAVE A FEW EXAMPLES OF SAVINGS MADE IN PAPERBOARD PACKAGING.

TABLE IV

MATERIAL SAVINGS

(LB./REAM)

	1964	1974	ANNUAL SAVINGS
WAX TV DINNER CARTON	20	9	1,750,000 LBS.
PAPERBOARD - TV DINNER CARTON	185	162	1,818 TONS
PAPERBOARD - BACON	211	181	3,200 TONS

TABLE IV SHOWS THE EFFECT OF REDUCING THE WEIGHT OF POUNDS OF WAX/REAM FROM 20 POUNDS TO 9 POUNDS IN THE LAST TEN YEARS IN DINNER CARTONS. THIS REDUCTION SAVED 1,750,000 POUNDS OF WAX ANNUALLY. SIMILARLY IN TV CARTONS AND BACON CARTONS, A TOTAL OF 5,018 TONS OF PAPERBOARD IS CONSERVED ANNUALLY BY REDUCING THE WEIGHT PER REAM THE REDUCTION IN RAW MATERIALS IS DIRECTLY RELATABLE TO A REDUCTION IN ENERGY USE.

WITH THE ABOVE AS BACKGROUND, WE WOULD LIKE TO DISCUSS WITH YOU IN GREATER DETAIL ENERGY USE AND TECHNICAL DEVELOPMENT INTERACTION VIS-A-VIS BEVERAGE CONTAINERS, WHICH WAS SHOWN IN TABLE I. WE WILL BE REFERRING TO MIRAFORM II WHICH IS OUR NAME FOR A NEW BOTTOM GEOMETRY WHICH ALLOWS WEIGHT REDUCTION OF ABOUT 15 PERCENT OVER CONVENTIONAL 2-PIECE CANS; ABOUT BUTTON DOWN END WHICH IS A RETAINED TAB CONCEPT WHICH WAS DEVELOPED AS AN ANSWER TO PULL TAB LITTER; AND ABOUT THE EFFORTS TO MINIMIZE ENERGY IN CAN MAKING BY THE USE OF ULTRAVIOLET CURING AND THE USE OF WATER DILUTABLE COATINGS. OUR PRESENCE HERE TODAY IS NOT TO DISCUSS THESE AMERICAN CAN COMPANY DEVELOPMENTS IN ANY DETAIL, BUT RATHER TO SHOW THEIR IMPACT ON ENERGY CONSUMPTION. SIMILARLY, AS WE PRESENT OUR ENERGY STUDY, WE WILL MENTION OTHER TECHNOLOGY DEVELOPMENTS ARISING IN OTHER LABORATORIES WHICH HAVE BEEN TAKEN INTO CONSIDERATION IN PROJECTING THE ENERGY USE IN 1980.

WHILE WE HAVE CONCENTRATED OUR EMPHASIS TODAY ON THE TECHNOLOGY/ENERGY INTERACTION AS IT PERTAINS TO BEVERAGE CONTAINERS, WE WOULD BE REMISS IF WE DID NOT POINT OUT THAT SIMILAR INNOVATIONS ARE BEING PUT INTO PRACTICE IN THE FOOD CONTAINER SECTOR. IN ONE OF THE EARLY TABLES YOU SAW THAT TWO-PIECE FOOD CONTAINERS UTILIZE LESS METAL THAN CONVENTIONAL THREE-PIECE. TECHNOLOGY TO EXTEND THE EFFICIENCY OF METAL UTILIZATION IN FOOD IS A CONTINUING EFFORT IN THE LABORATORIES OF ALL CAN MAKERS.

OUR STUDY OF ENERGY AND FUTURE TECHNOLOGY IMPACT STARTS WITH THE DATA ALREADY DEVELOPED FOR THE BASIC PROCESSES INVOLVED IN THE MANUFACTURE OF CONTAINERS. WE ADOPTED THE "HOLE IN THE GROUND" APPROACH AS DID OTHER STUDIES AND MADE USE OF SUITABLE BUILDING BLOCKS OF ENERGY FOR STANDARD OPERATIONS. IN EACH CASE WE HAVE BEEN VERY PRECISE ON THE SPECIFICATIONS OF EACH CONTAINER IN THE RESPECTIVE CONTAINER SYSTEM. THROUGHOUT THE STUDY WE HAVE US BTU'S/M CONTAINERS AS THE ENERGY MEASURE, CONVERTING TO THIS UNIT WHENEVER NECESSARY. IN ORDER TO SIMPLIFY OUR STUDY WE DEALT ONLY WITH THE STANDARD 211 X 413 METAL CONTAINER FOR 12 OZ. OF BEER AND THE CORRESPONDING 12 OZ. SIZE BOTTLE IN EITHER PLASTIC OR GLASS.

THE FOLLOWING CONTAINERS WERE SELECTED FOR STUDY:

1. ALUMINUM DRAWN AND IRONED CAN
2. STEEL DRAWN AND IRONED CAN
3. ONE-WAY GLASS BOTTLE
4. RETURNABLE GLASS - 10 TRIPS
5. PLASTIC BOTTLE.

IN EACH INSTANCE AS THE STARTING PACKAGE WE ASSUMED THAT EACH CONTAINER SYSTEM WAS BEING SOLD AS A SIX PACK IN A PAPERBOARD OUTER-PACKAGE. AS WE DEVELOPED OUR ENERGY PROFILES FOR THE CURRENTLY AVAILABLE CONTAINERS AND COMPARED OUR VALUES WITH THOSE OBTAINED IN PREVIOUS STUDIES, THE CORRELATION WAS EXCELLENT. THIS HAD TO BE, SINCE WE ADOPTED THE PREVIOUS DATA BASE AND ONLY IMPOSED UPON IT OUR OWN SPECIFICATIONS AS TO CONTAINER SIZE, SHAPE AND OUTERPACKAGING.

IN OUR STUDY WE BROKE OUT THE ENERGY OF THE SYSTEM INTO THE FOLLOWING SIX CATEGORIES AS DEMONSTRATED IN TABLE V WHICH SHOWS THE ENERGY FOR THE 1974 ALUMINUM DRAWN AND IRONED CAN:

BODY MATERIAL
CLOSURE MATERIAL
CONTAINER MANUFACTURE
FILLING AND PACKAGING
TRANSPORTATION TO RETAIL AND WASTE RECLAIMING, WHEN APPLICABLE.

IT IS READILY APPARENT THAT IN THIS CONTAINER THE BULK OF THE ENERGY, 85 PERCENT, RESIDES IN THE REDUCTION OF ALUMINUM OXIDE ORE TO MAKE THE METAL SHEET FOR THE BODY AND THE CLOSURE. IT FOLLOWS THEN THAT LIGHTWEIGHTING AND RECYCLE OF CANS HAS THE MOST PROFOUND EFFECT ON THE REDUCTION OF ENERGY IN THE TOTAL SYSTEM. THIS IS SHOWN CLEARLY IN TABLE VI. A REDUCTION IN WEIGHT OF ALUMINUM FROM 34 POUNDS/M TO 28 POUNDS/M IS EQUIVALENT TO A REDUCTION OF .86MM BTU'S. IF ONE COUPLES THIS WEIGHT REDUCTION WITH RECYCLING AT A 50 PERCENT RATE, AN OVERALL REDUCTION OF 2.4 BTU'S IS ACHIEVED. SINCE SO MUCH OF THE ENERGY IS CONSUMED IN THE METAL PORTION OF THE CONTAINER, ANY TECHNICAL IMPROVEMENT IN THE REFINING PROCESS WOULD BE REFLECTED IN A LOWER CONSUMPTION OF ENERGY. IN OUR PROJECTION WE HAVE TAKEN COGNIZANCE OF THE NEW "CHLORIDE PROCESS" FOR ALUMINUM WHICH IS REPUTED TO BE 30 PERCENT LESS ENERGY INTENSIVE, BUT IT SHOULD BE EMPHASIZED THAT THIS IS NOT A COMMERCIAL PROCESS AS YET. OTHER AREAS FOR ENERGY REDUCTION ARE SHOWN IN TABLE VII. IT IS POSSIBLE TO SAVE APPROXIMATELY .3MM BTU'S BY CONVERTING FROM A PAPERBOARD OUTER SIX PACK TO THE PLASTIC SIX-PACK CARRIER PUT OUT BY CONEX. IN ADDITION, UTILIZATION OF ULTRAVIOLET CURED COATINGS AND INKS AND/OR THE USE OF WATER DILUTABLE COATINGS LEADS TO ENERGY SAVINGS OF ANOTHER .3MM BTU'S. WHEN ONE LOOKS AT THE ENERGY IN THE SYSTEM IN 1980, AS SUMMARIZED IN TABLE VIII, THERE IS A DRAMATIC REDUCTION IN ENERGY CONSUMPTION, WHICH IS LESS THAN HALF OF THAT CONSUMED IN 1974. OF GREAT IMPORTANCE IS THE FACT THAT

ALL THE TECHNOLOGICAL IMPROVEMENTS CITED ARE COMMERCIALLY PROVEN WITH THE EXCEPTION OF THE NEW "CHLORIDE PROCESS" WHICH IS NOW IN THE PILOT PHASE; THE LIGHTWEIGHT MIRAFORM II CONTAINER WILL BE COMMERCIAL IN 1975; ULTRAVIOLET CURING AND WATER DILUTABLE COATINGS ARE ALREADY COMMERCIAL IN MANY PLANTS AND RECYCLING AT 50 PERCENT LEVELS IS ACKNOWLEDGED BY MOST TO BE ATTAINABLE BY 1980.

IN A SIMILAR MANNER WE STUDIED THE ENERGY INVOLVED IN THE STEEL DRAWN AND IRONED CAN SYSTEM. HERE, 70 PERCENT OF THE ENERGY OF THE SYSTEM RESIDES IN REFINING THE ORE TO THE SHEET METAL FOR BODY AND CLOSURE (TABLES II AND IX). IN TABLE X A PARALLEL SAVINGS OF ENERGY, AS IN THE CASE OF THE ALUMINUM D. & I. CAN, IS ACHIEVED BY LIGHTWEIGHTING, UTILIZATION OF NEW PROCESSING TECHNIQUES AND RECYCLING. IN TABLE XI WE ILLUSTRATE THE POTENTIAL SAVINGS ATTAINABLE BY UTILIZING A STEEL EASY OPEN END IN PLACE OF AN ALUMINUM EASY OPEN END - A SAVINGS OF APPROXIMATELY 1.0MM BTU'S IS ACHIEVED. IN OUR LABORATORIES WE HAVE PRODUCED ON A SEMI-COMMERCIAL BASIS A STEEL RETAINED TAB END CALLED "BUTTON DOWN," WHICH IS SUITABLE FOR USE ON A STEEL DRAWN AND IRONED CAN. IN ADDITION TO ENERGY REDUCTION, THIS END ALSO PROVIDES A CONTAINER WHICH IS EASIER TO RECYCLE BY MAGNETIC MEANS AND WHICH IS AN ANSWER TO THE PROBLEM OF LITTER FROM PULL TOP CONTAINERS. TABLE XII SUMMARIZES THE ENERGY RESULT AS A FUNCTION OF THESE DEVELOPMENTS, A SAVINGS OF 37 PERCENT.

THE STUDIES ON THE ONE-WAY GLASS SYSTEM ARE SHOWN IN TABLES XIII - XV. IT IS PERTINENT TO POINT OUT THAT THE HIGH ENERGY COMPONENT IS IN THE CONTAINER MANUFACTURE SECTOR, SINCE THIS IS THE ENERGY NECESSARY TO MELT THE INORGANIC MATERIAL TO FORM THE MOLTEN GLASS. REDUCTION OF ENERGY FOR THE 1980 CONTAINER COMES PRIMARILY FROM THE ASSUMPTION THAT THE KERR-HEYE LIGHTER WEIGHT BOTTLE PROCESS WILL BE COMMERCIAL AND ALLOW A 20 PERCENT SAVINGS IN GLASS PER UNIT. IT IS NOT PRACTICAL AT THIS TIME TO PROJECT ANY FURTHER SAVINGS IN THE PAPERBOARD SECTOR. THE 1980 ENERGY PROFILE IS SHOWN IN TABLE XV WHEREIN A 15 PERCENT ENERGY SAVINGS IS PROJECTED.

IN TABLES XVI - XVIII ARE PRESENTED THE ENERGY DATA ON A 10-TRIP RETURNABLE GLASS BOTTLE, WHICH HAS A STEEL CROWN AND WHERE WE HAVE ASSUMED, AS IN THE CASE OF THE ONE-WAY GLASS BOTTLE, THAT A PAPERBOARD SIX-PACK IS USED IN EVERY TRIP. THE PRIMARY SAVINGS IN 1980 VERSUS 1974 ARISES ONCE AGAIN FROM THE ADOPTION OF THE KERR-HEYE LIGHTWEIGHTING PROCESS.

IN TABLE XVII WE HAVE ALSO SHOWN FOR COMPARISON PURPOSES THE ENERGY ASSOCIATED WITH AN "ON PREMISE" DISTRIBUTION SYSTEM WHEREIN A 24-BOTTLE CASE OF BEER IS THE CONVENTIONAL PACKAGING UNIT. IN THIS INSTANCE THERE IS NO NEED FOR A SIX PACK AND THE OUTER CASE CAN MAKE THREE TRIPS. IF, HOWEVER, ONE ASSUMES THAT THE SIX PACK WILL CONTINUE TO BE THE MAJOR RETAIL SALES UNIT, THEN THE 1980 ENERGY PROFILE IS THE ONE PORTRAYED IN TABLE XVIII.

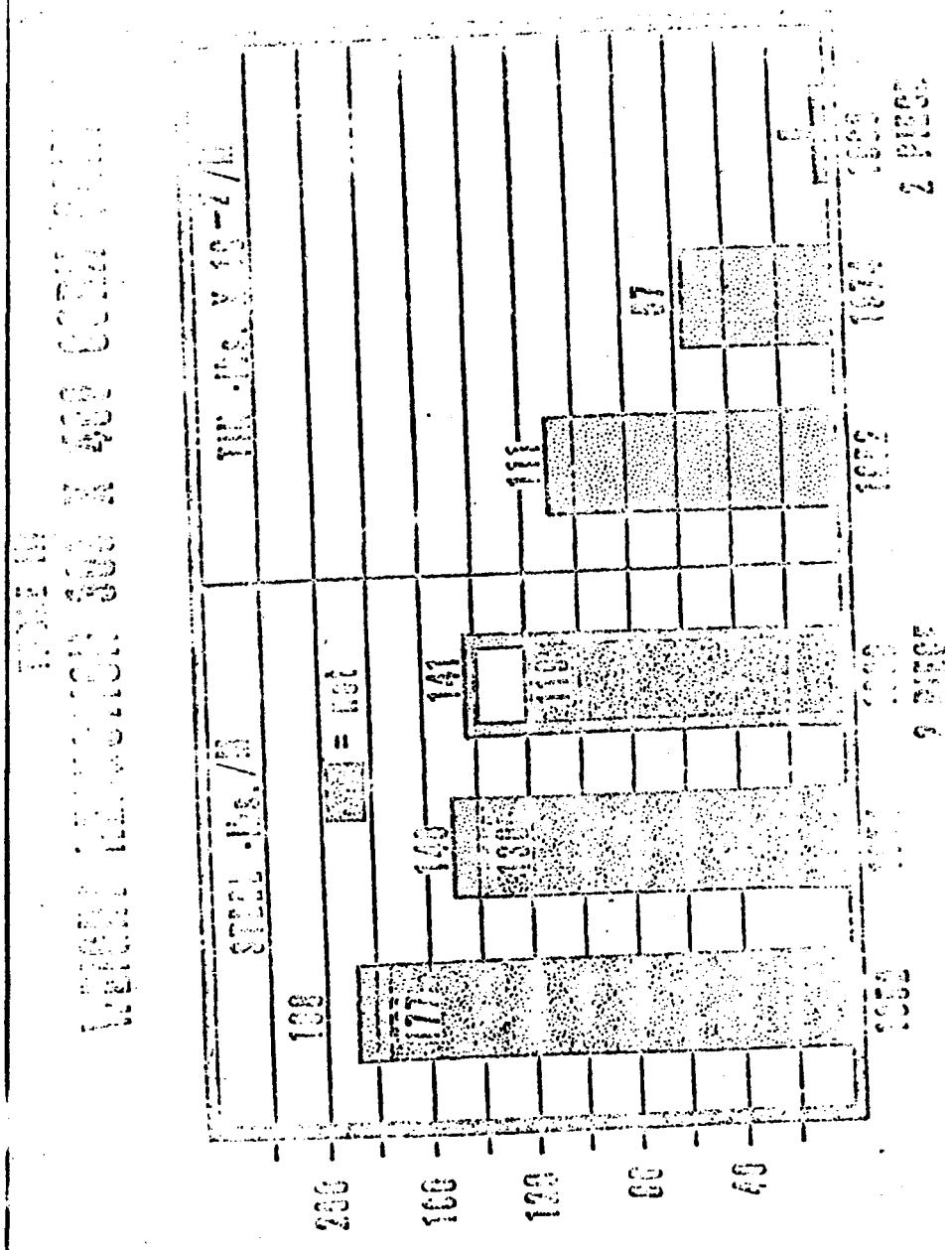
IN TABLES XIX - XXI THE ENERGY ASSOCIATED WITH THE PLASTIC BEER CONTAINER, WHICH IS AN EMERGING PACKAGE, IS PRESENTED. THERE ARE A WIDE VARIETY OF SHAPES PROPOSED FOR THIS CONTAINER; HENCE, WE HAVE HAD TO ASSUME AVERAGE WEIGHTS BASED ON DATA OBTAINED IN OUR OWN LABORATORIES AND FROM SAMPLES GATHERED FROM THE FIELD. SAVINGS IN ENERGY ARE PROJECTED VIA THE ROUTE OF LIGHTWEIGHTING - WE FEEL THAT 20 PERCENT IS A REASONABLE SHORT TERM GOAL THROUGH STRUCTURAL ORIENTATION. ADDITIONAL SAVINGS ARE ATTRIBUTED TO A PLASTIC CARRIER SIMILAR TO THE HI-CONE MATERIAL USED ON CANS, AND FUEL CREDIT IS TAKEN FOR THE RECYCLED PLASTIC. THE SUMMATION OF THESE SAVINGS IS SHOWN IN TABLE XXI WHERE A 33 PERCENT DECREASE IN ENERGY IS PROJECTED.

THE SUMMATION OF ALL THESE INDIVIDUAL STUDIES IS PRESENTED IN TABLE XXII WHERE THE REMARKS MADE EARLIER ARE GRAPHICALLY DISPLAYED. THE FOLLOWING TRENDS MENTIONED EARLIER ARE UNMISTAKABLE:

1. ENERGY ASSOCIATED WITH EACH SYSTEM DECREASES SIGNIFICANTLY BY 1980.
2. THE SPREAD IN ENERGY BETWEEN THE VARIOUS SYSTEMS NARROWS BY 1980.

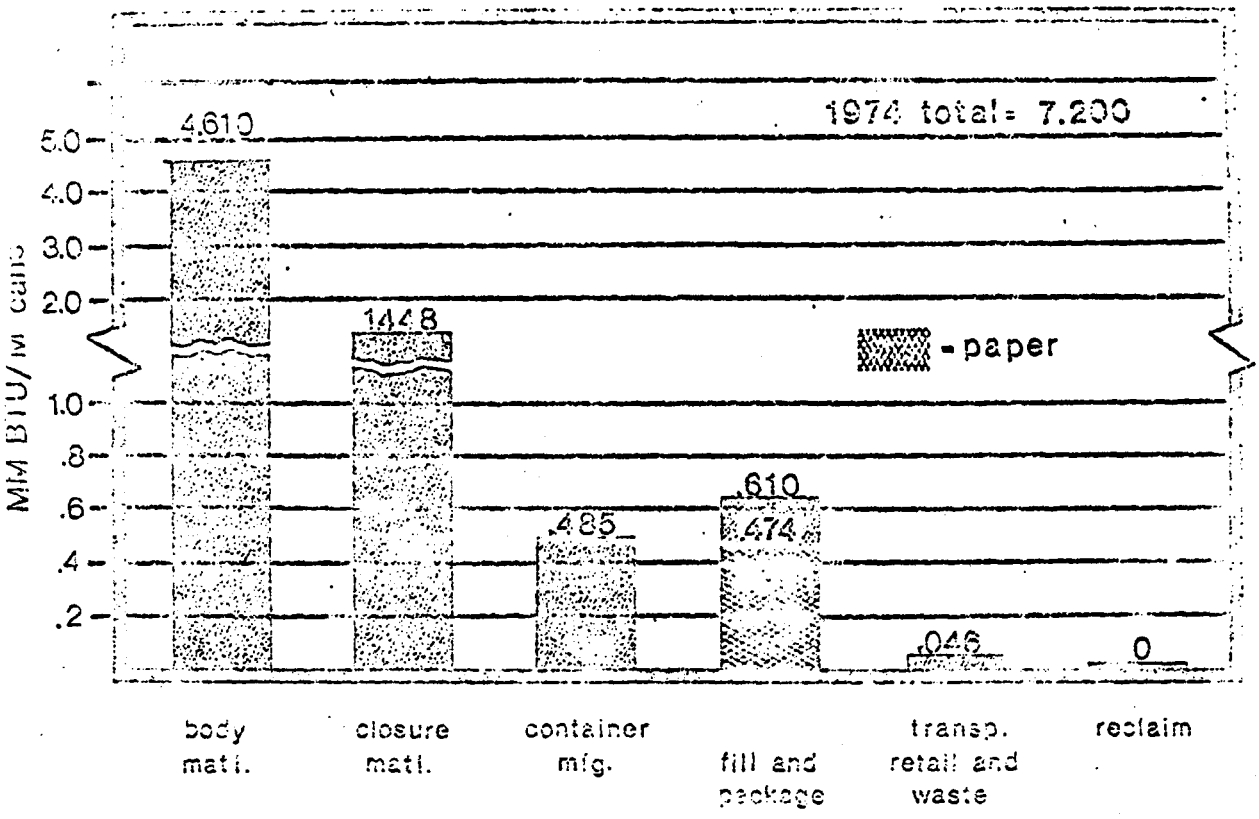
3. STEEL DRAWN AND IRONED CONTAINERS WILL BE EQUIVALENT TO TO-TRIP RETURNABLE GLASS BEFORE 1980.

WE RECOGNIZE THAT OUR STUDY ON TECHNOLOGY AND ENERGY CONSUMPTION IS NOT ALL INCLUSIVE, BECAUSE WE ARE NOT PRIVY TO ALL THE DEVELOPMENTS COMING TO FRUITION IN THE LABORATORIES OF SUPPLIERS AND OTHER CONTAINER MANUFACTURERS. HOWEVER, THE TRENDS ARE CLEAR; AND TO THE EXTENT THAT MANY OF THE UNKNOWN DEVELOPMENTS ARE LOWER CONSUMERS OF ENERGY, OUR STUDY IS ACTUALLY CONSERVATIVE. THE RESULTS OF OUR STUDY DO, HOWEVER, PROVIDE A COMPELLING REASON TO ALLOW TECHNOLOGY TO CONTINUE WITHOUT LEGISLATIVE BIAS TO DEVELOP LOWER ENERGY PACKAGING SYSTEMS. LEGISLATIVE ACTION TO FORCE A SOLUTION WOULD BE COUNTERPRODUCTIVE IF THIS ACTION IS BASED UPON INSUFFICIENT KNOWLEDGE OF R. & D. DEVELOPMENTS.



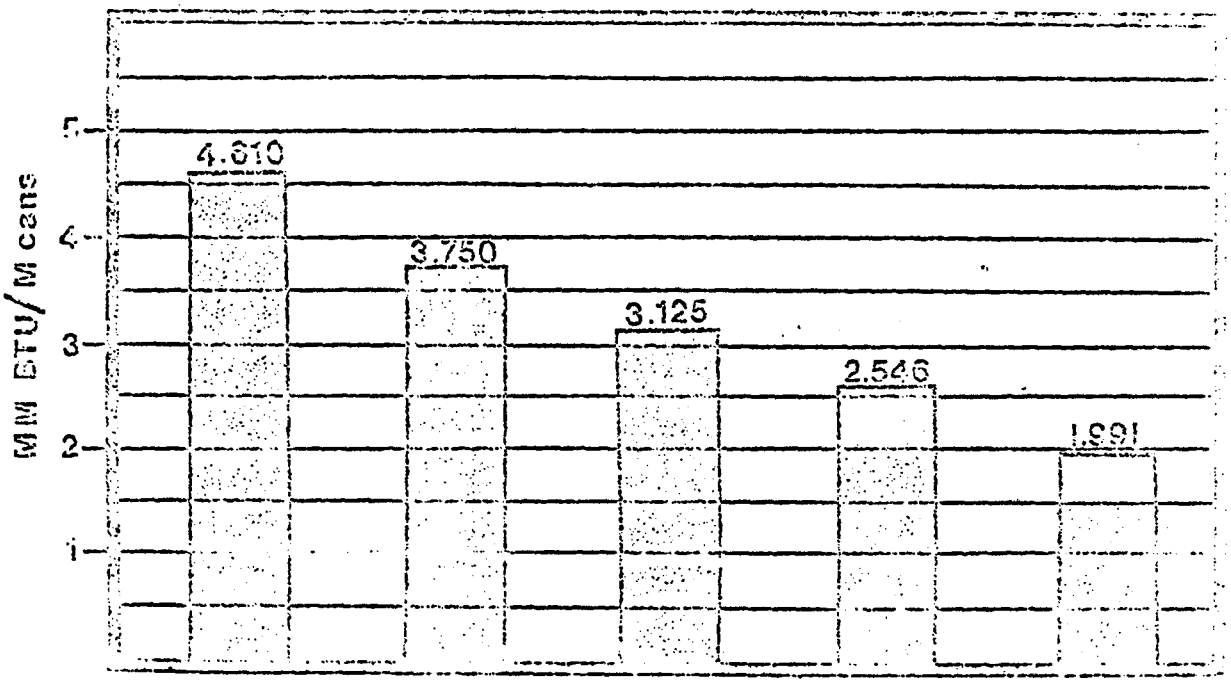
aluminum beer cans

energy detail



aluminum D&I cans

energy reduction body material



all aluminum D&I can
energy reduction

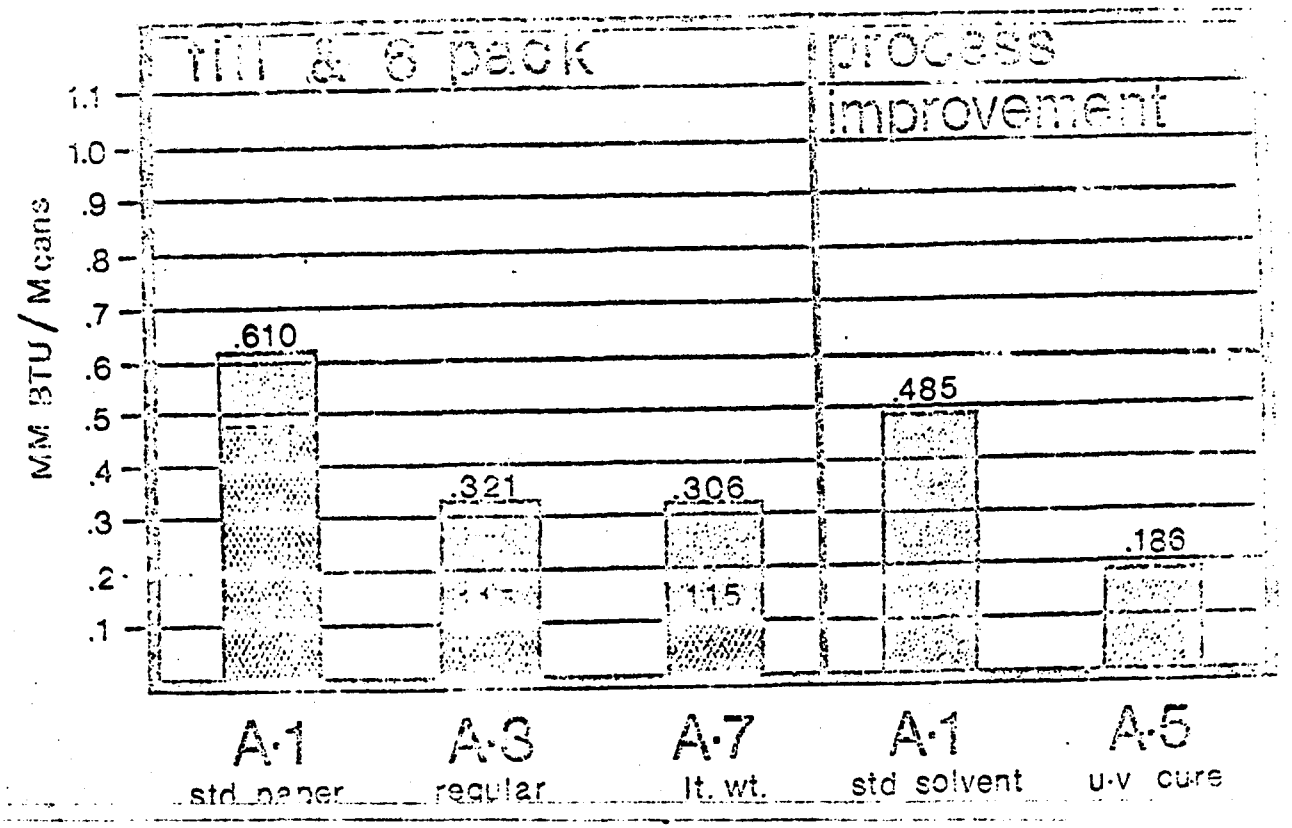


TABLE VIII

all aluminum D&I can
energy detail

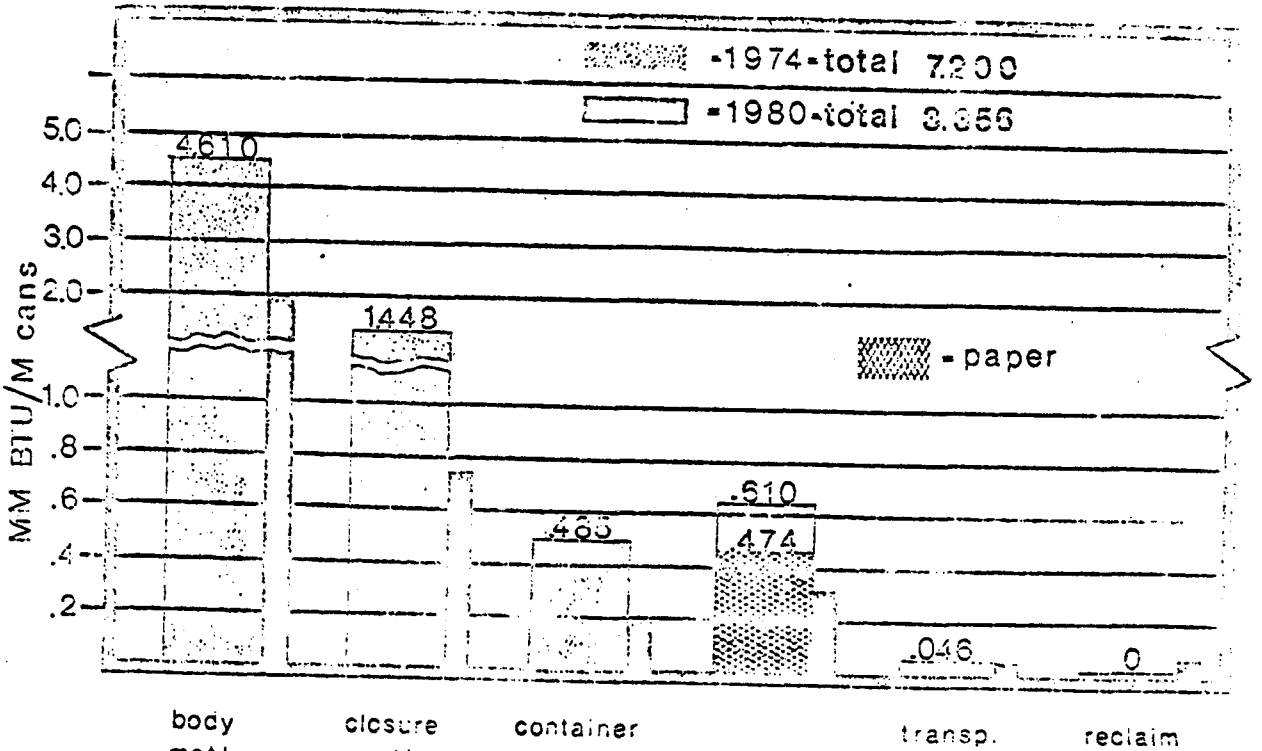


TABLE IX

steel D&I

energy detail

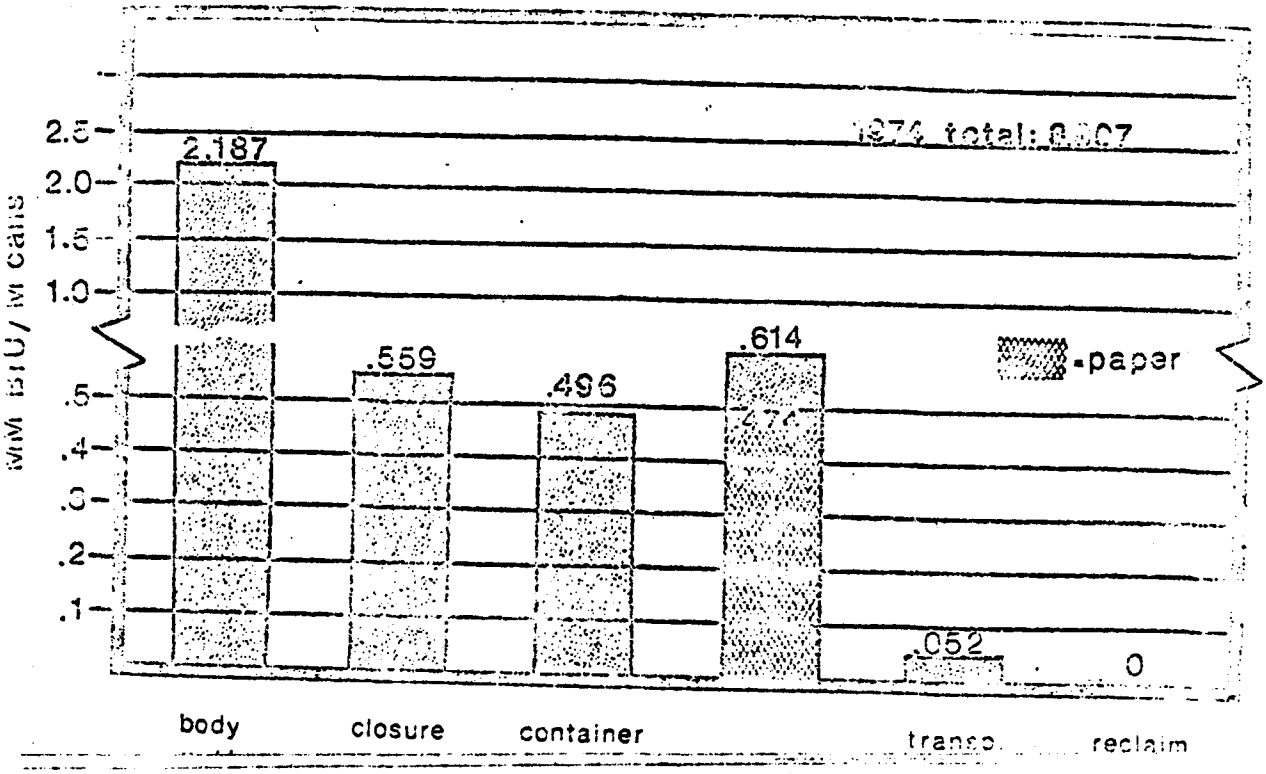
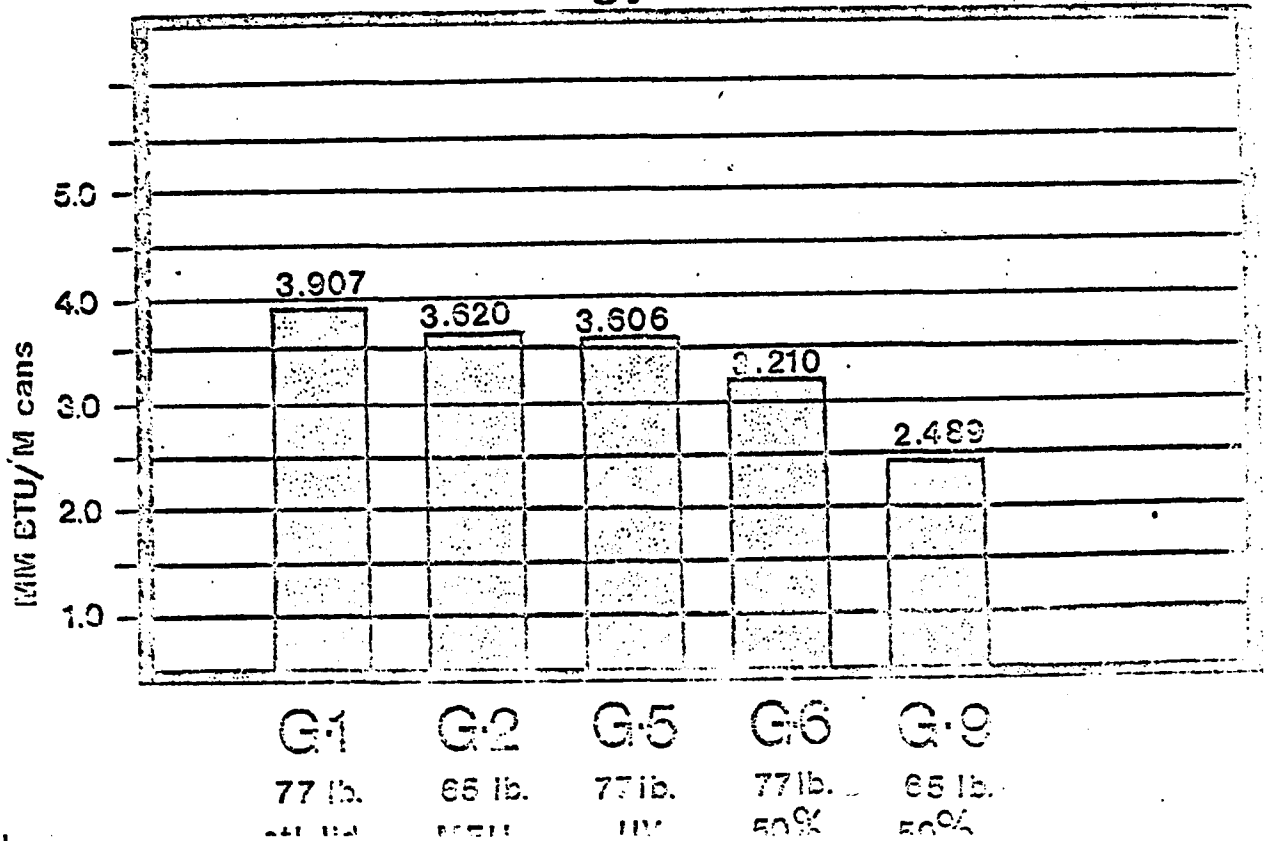


TABLE X

steel D&I

energy reduction



energy reduction

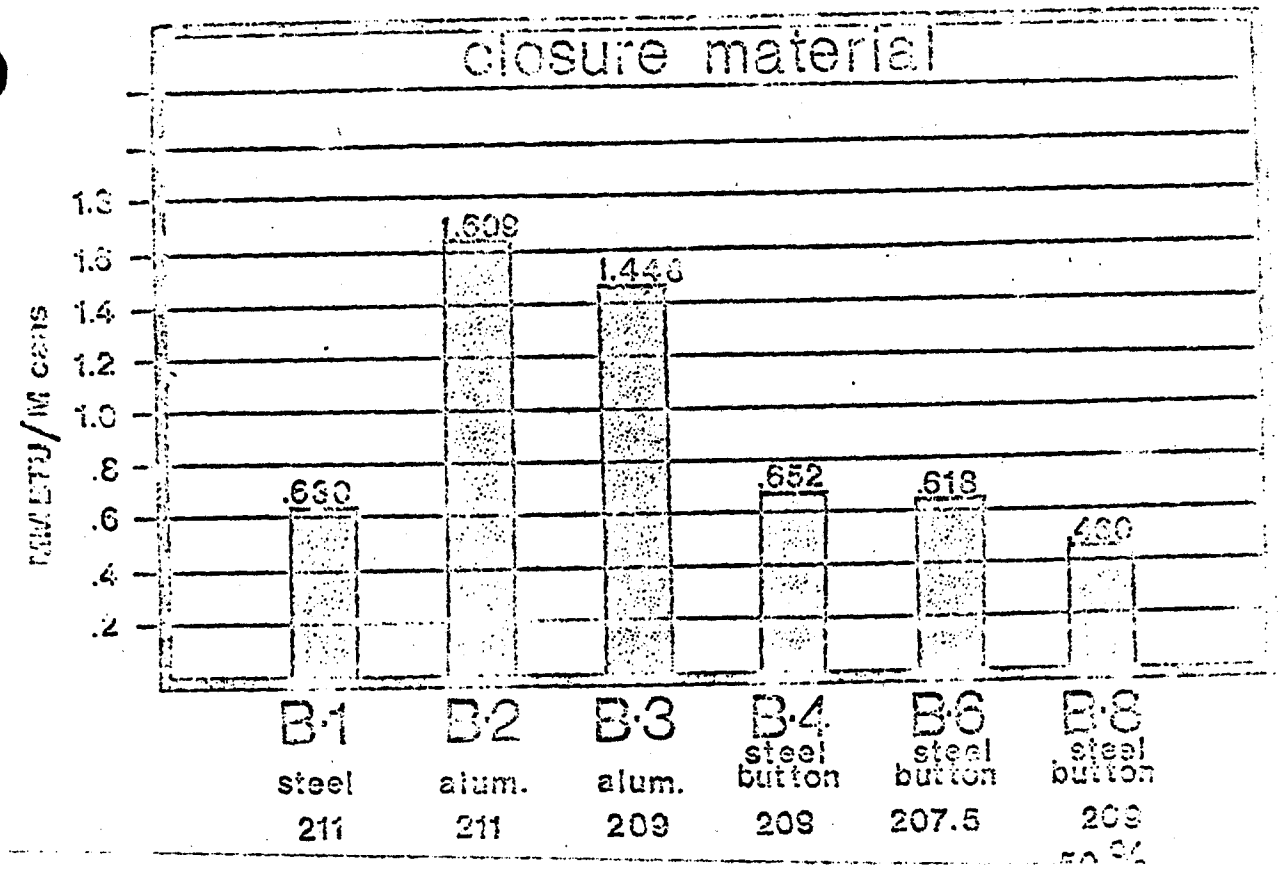
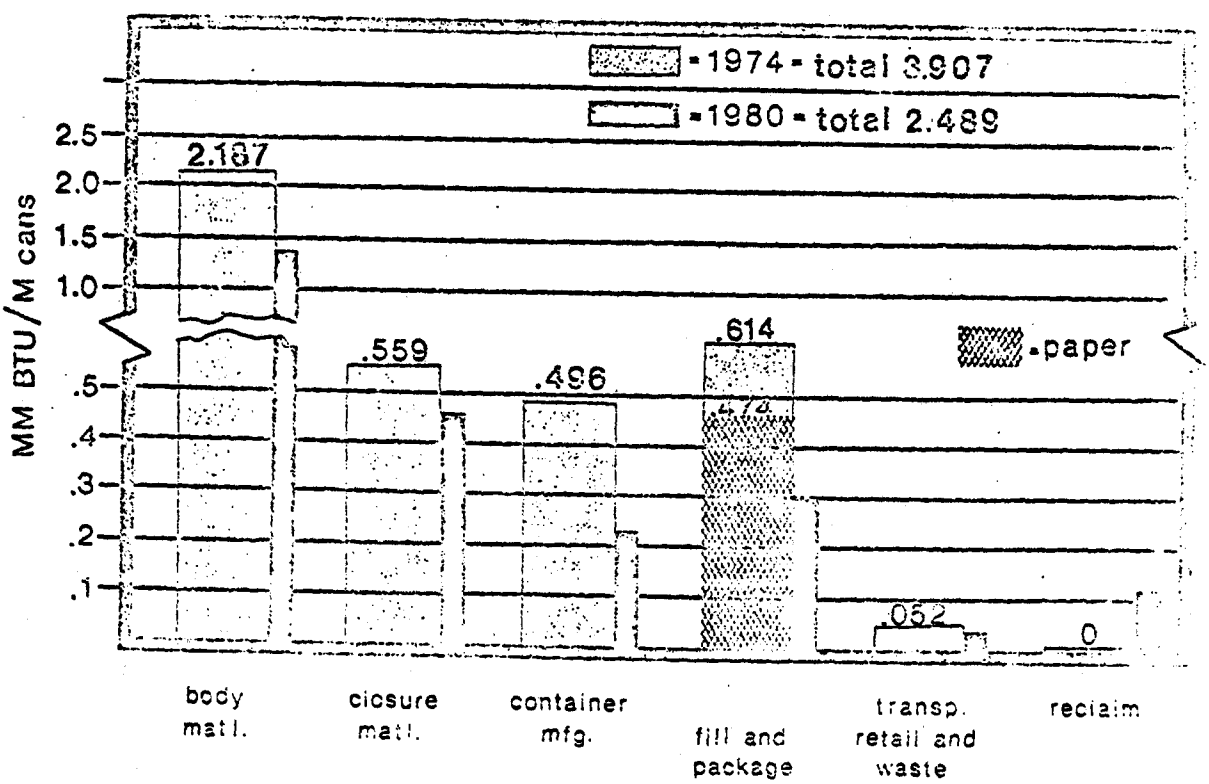


TABLE XII

steel D&I energy detail



one way glass energy detail

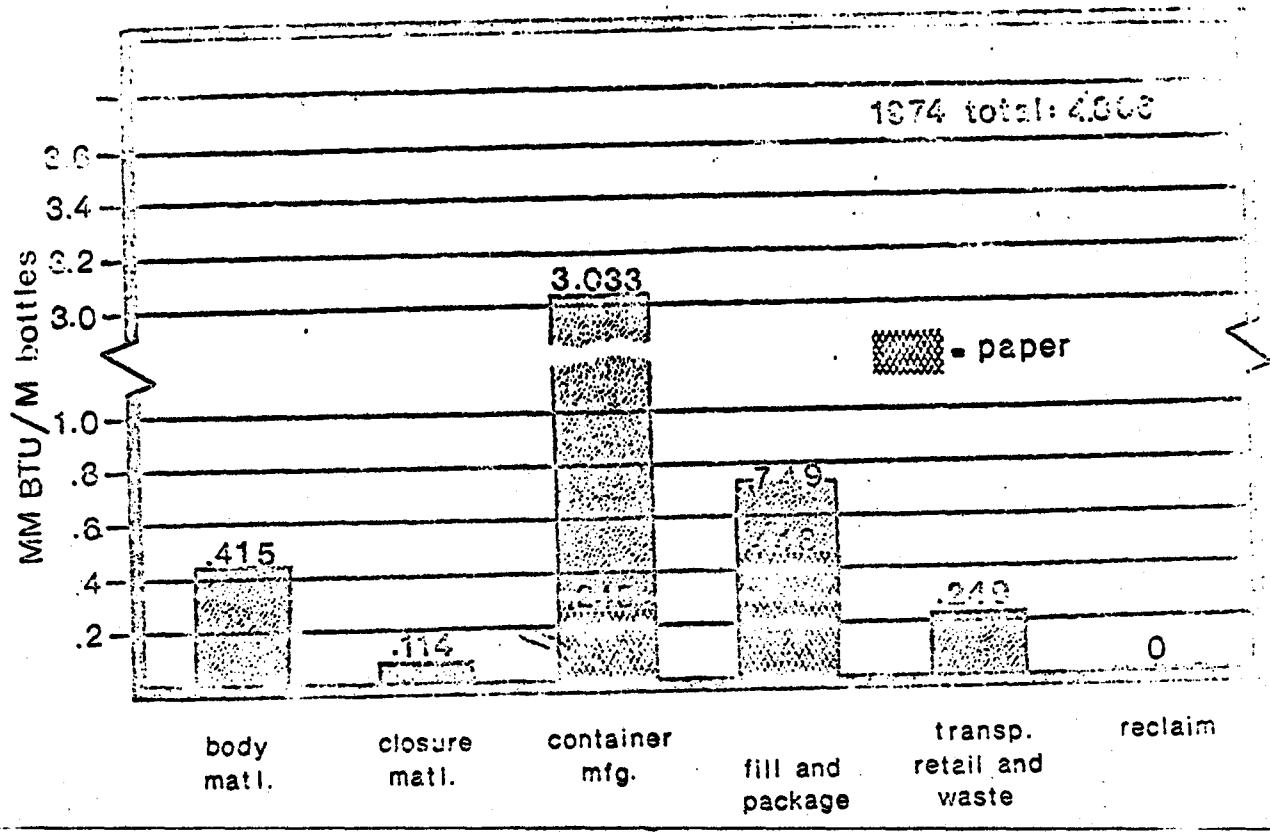
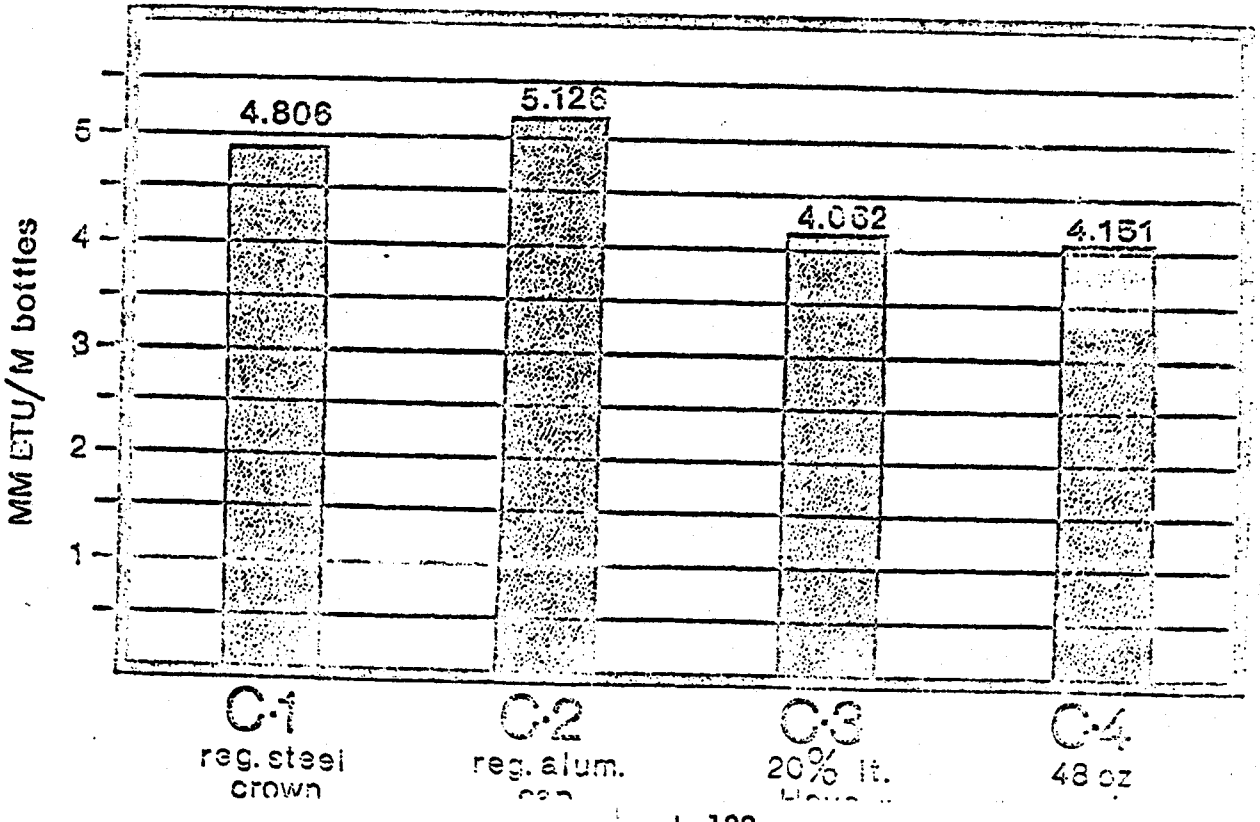


TABLE XIV

one way glass energy reduction



one way glass
energy detail

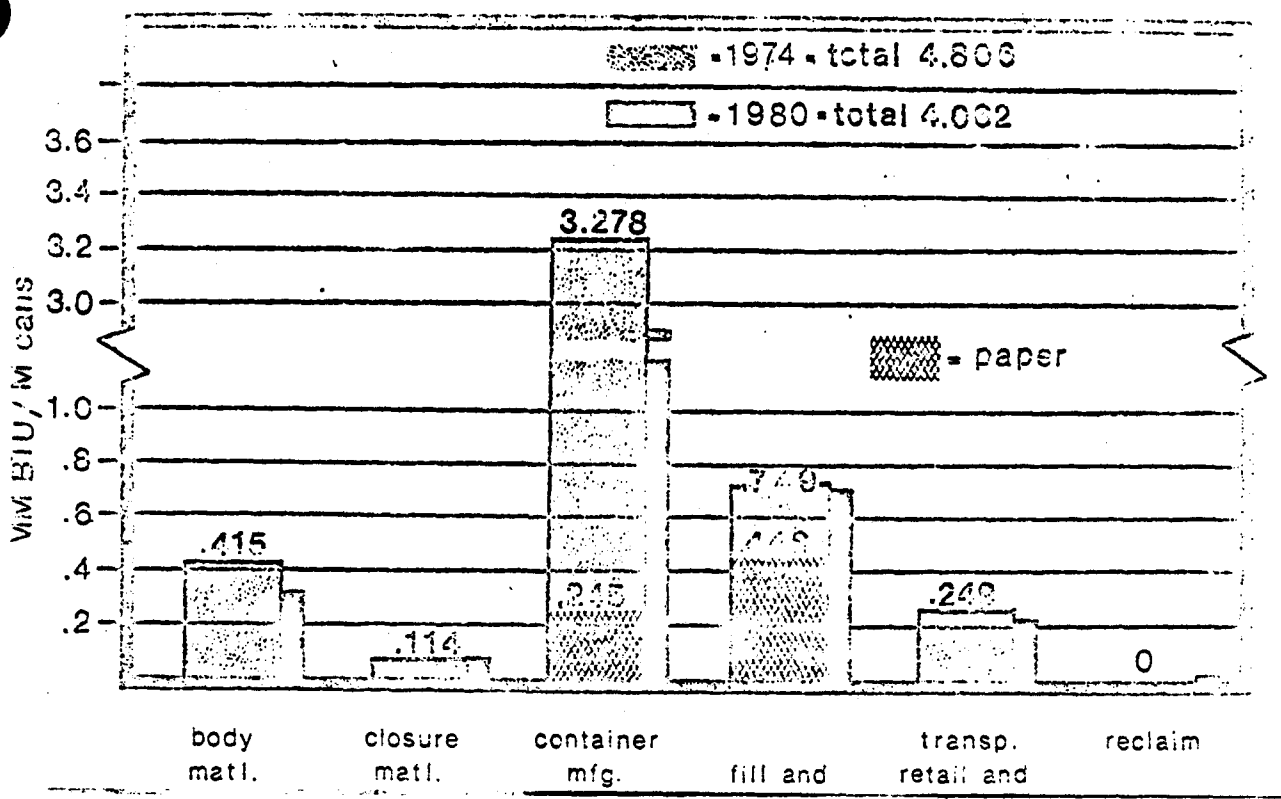
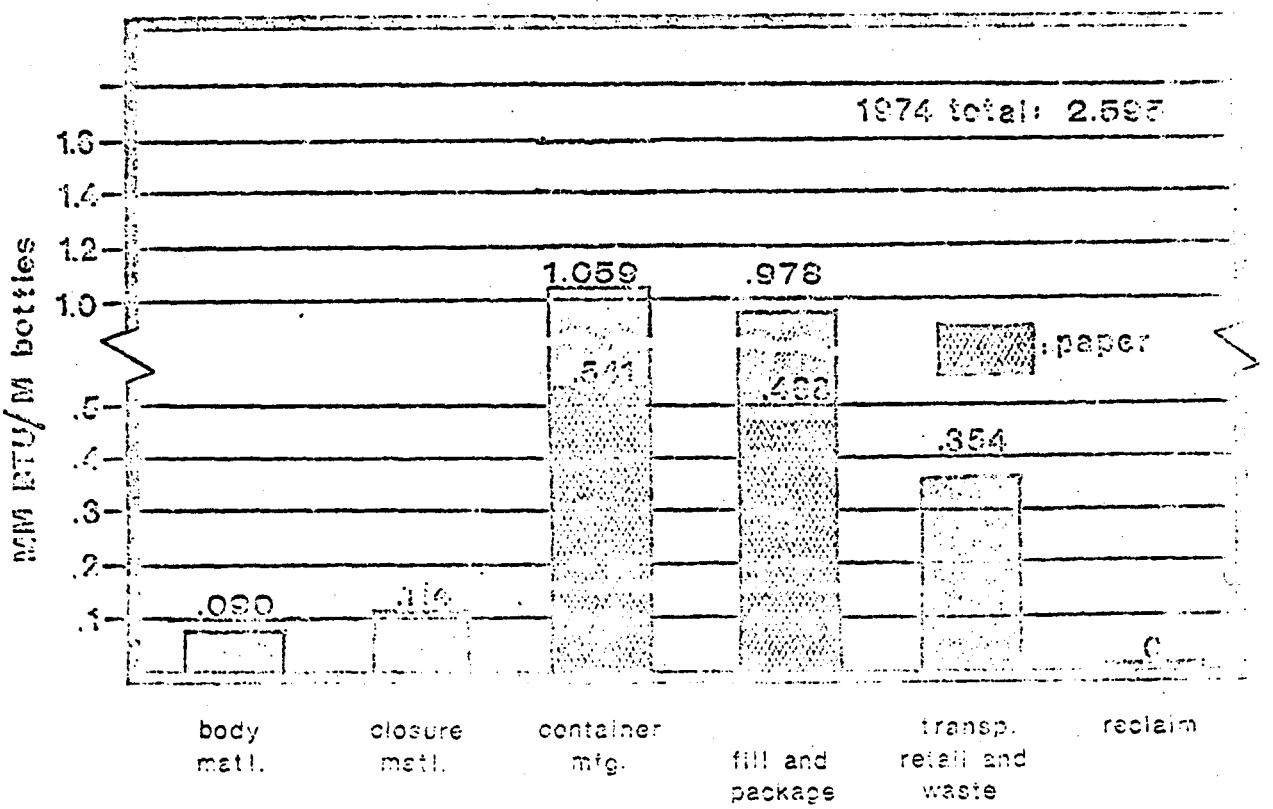


TABLE XVI

refill glass-10 trips
energy detail per trip



refill glass – 10 trips
energy reduction

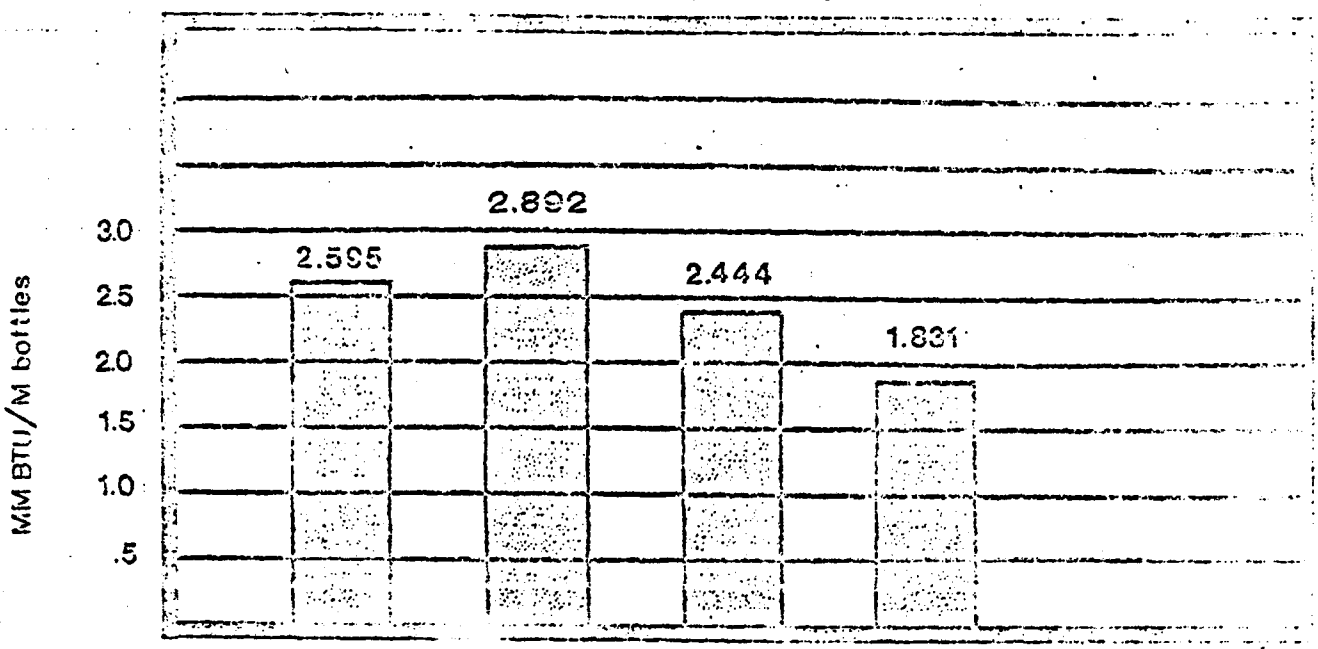
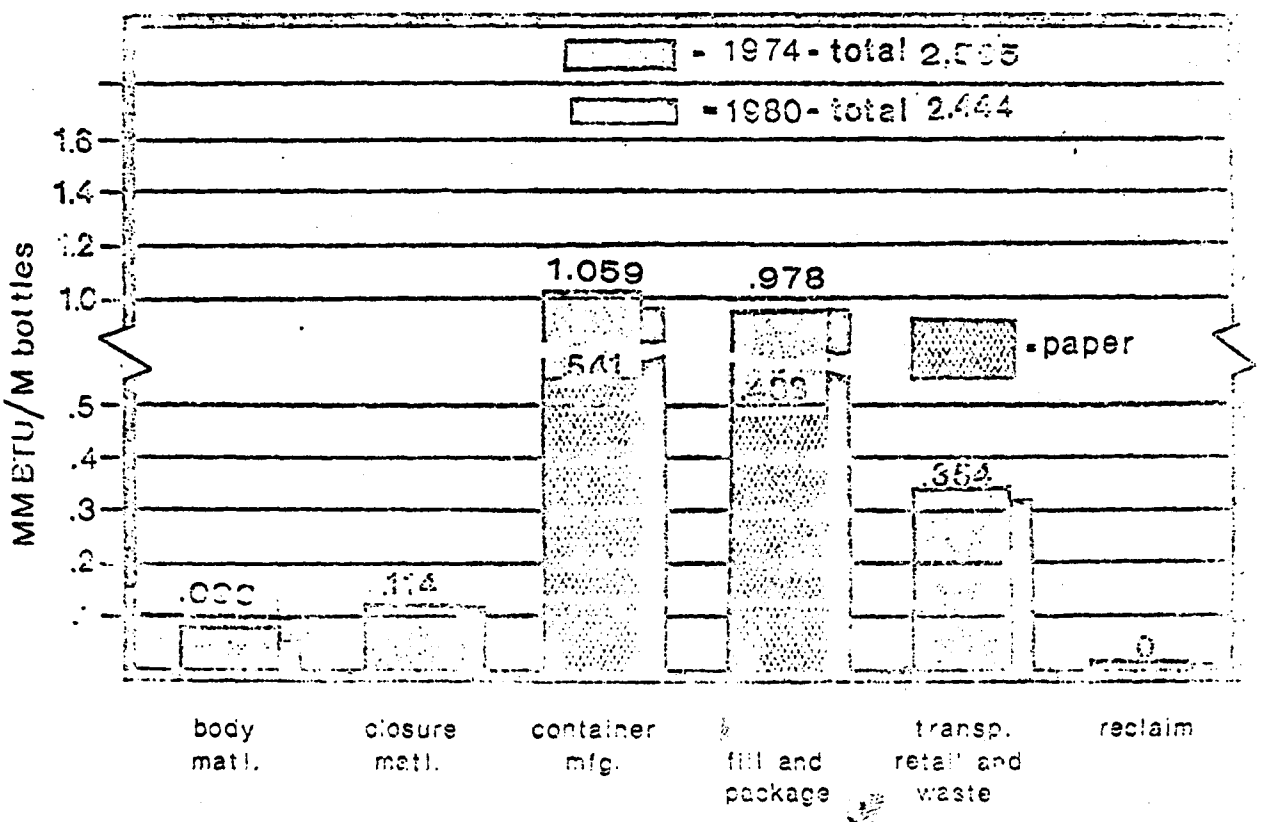


TABLE XVIII

refill glass-10 trips
energy detail per trip



plastic bottle
energy detail

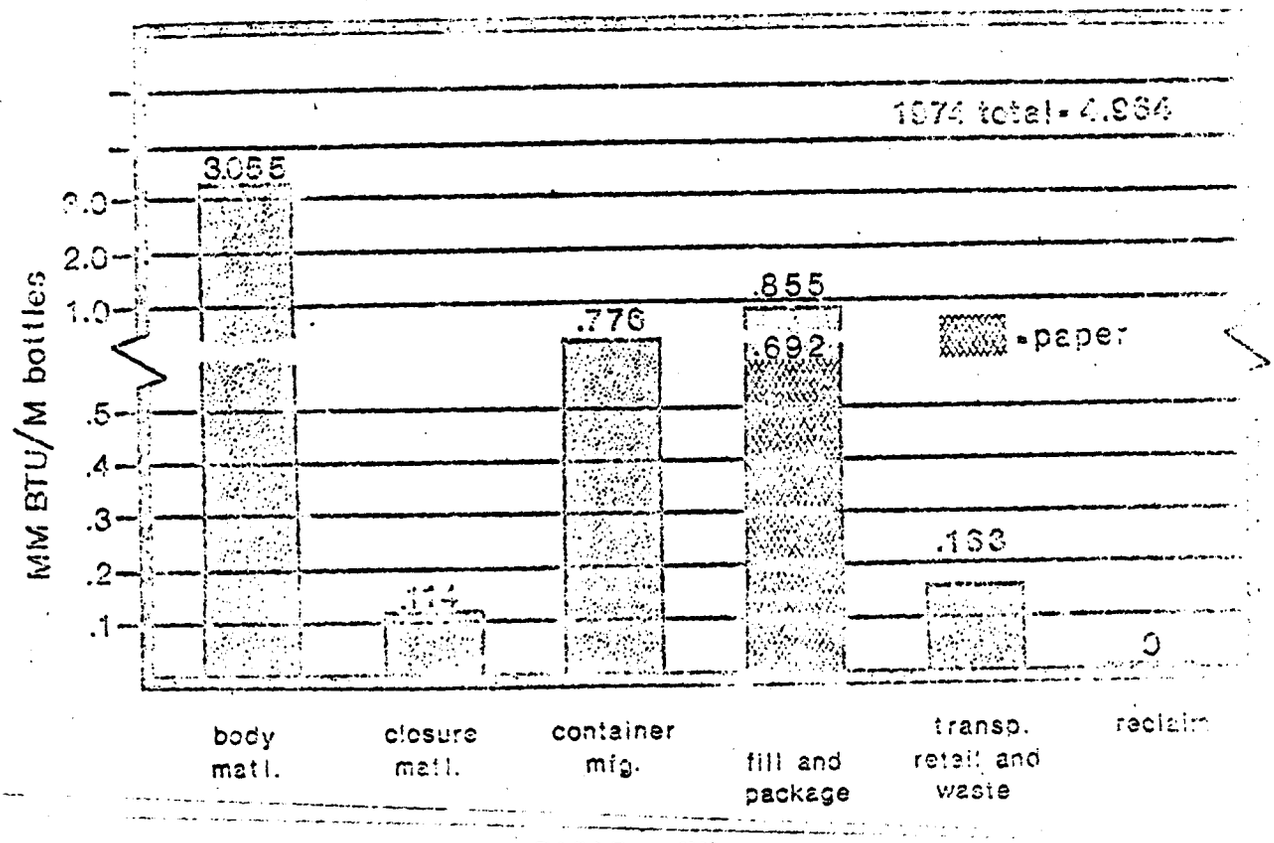
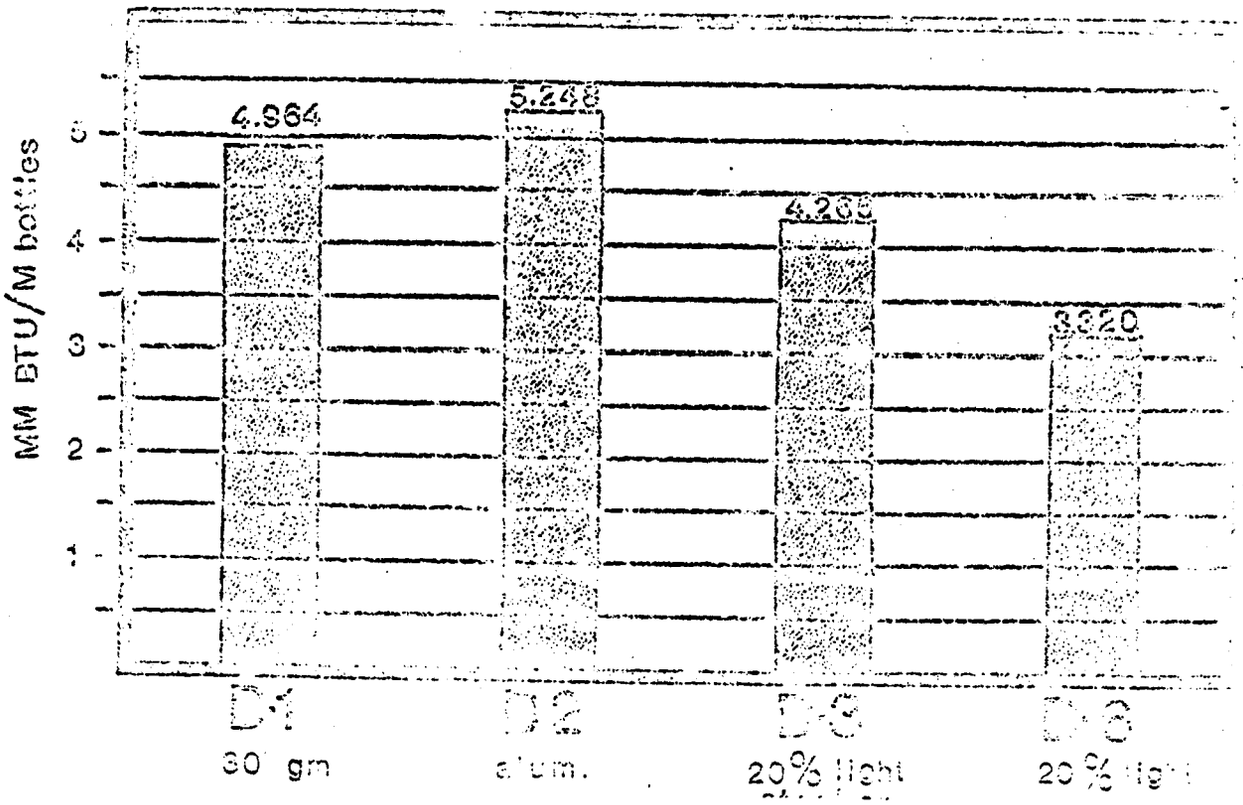
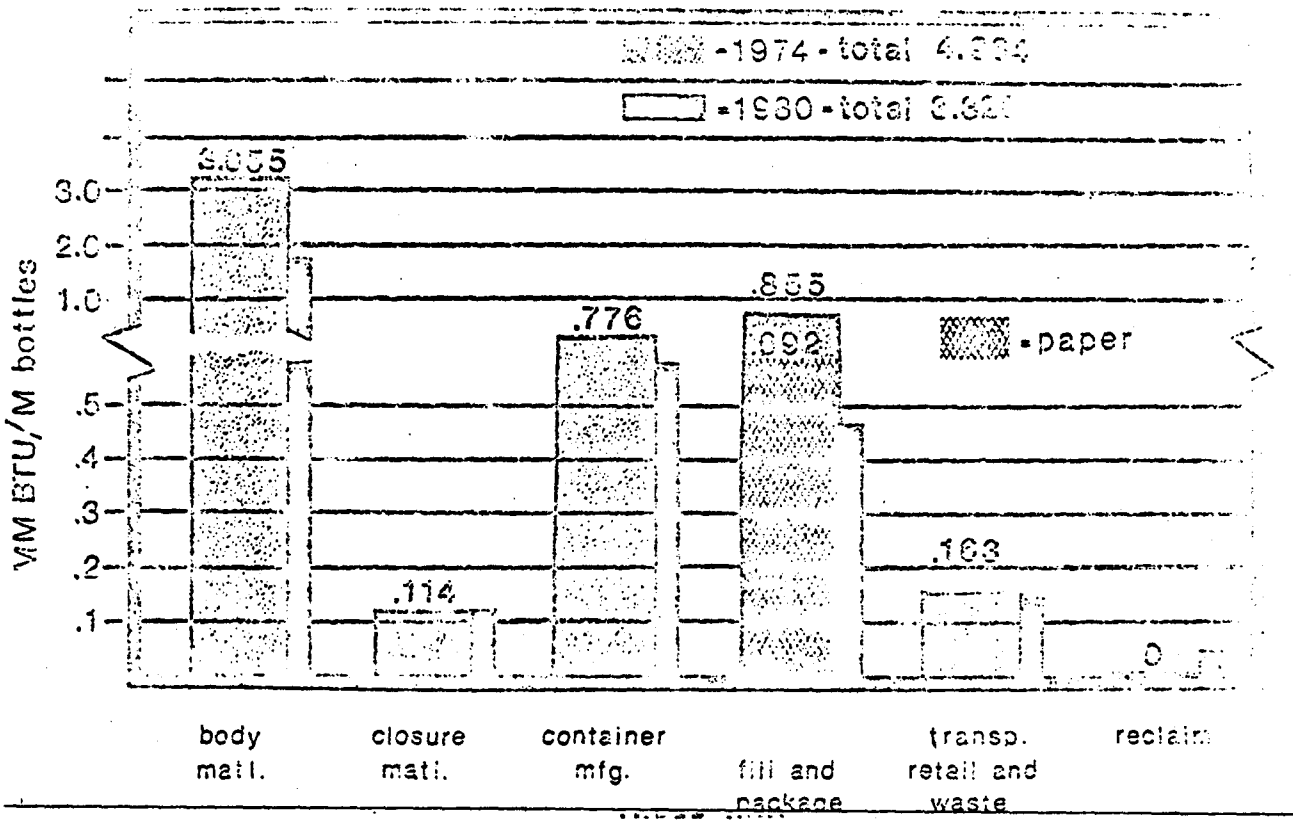


TABLE XX

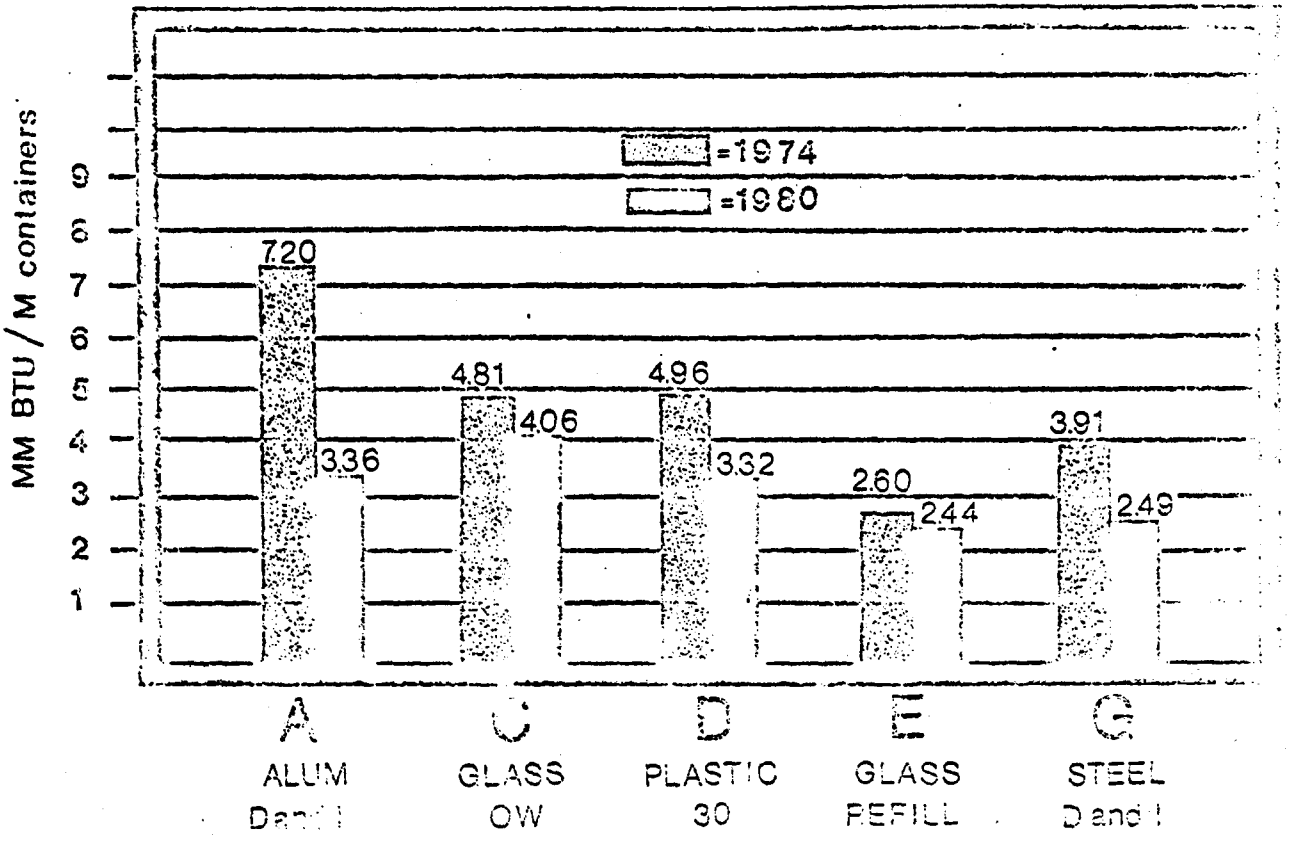
plastic bottle
energy reduction



Plastic Bottle
energy detail



comparison of 1974 vs. 1980
energy for total system - 12 oz. beer



ALUMINUM COMPANY OF AMERICA

ALCOA BUILDING · PITTSBURGH, PENNSYLVANIA 15219

ALCOA

November 25, 1975

RECEIVED
DEC 1 1975

Mr. Taylor H. Bingham
RESEARCH TRIANGLE INSTITUTE
P. O. Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

We have reviewed the draft report, "Energy and Economic Impacts of Mandatory Deposits." Alcoa has provided data for an industry critique of the study that will be forthcoming from The Aluminum Association. In addition, there is one specific point that we would like to emphasize.

The report claims there is energy to be saved by a government-mandated national deposit system. What it doesn't show is that this is one of the most expensive ways to save energy.

In fact, the capital required for equipment, space and a huge bottle inventory is five to six times higher than the initial investment needed to produce new gas and oil; build nuclear power plants; or pollution-free, coal-fired power plants.

A simple ten-cent washer inserted in the showerheads of 60 million households to reduce the flow could save the same amount of energy as a mandatory deposit law -- at a small fraction of the cost. The washer reduces water consumption and the fuel to heat the water. The capital investment for this energy-saving option would be less than a penny per million BTUs saved annually. That compares with $28 to $32 per million BTUs saved by a government-mandated national deposit system.

We feel strongly that the report should put into proper perspective the cost of any possible energy saving as it relates to other available energy options.

It's clear to us that a mandatory nationwide deposit system is not a cost-effective way to save energy.

Sincerely,

J. Tyson Kennedy
Marketing Manager, Packaging

JTK:dsw

cc: Mr. Roger Sant
Assistant Administrator
Federal Energy Administration

Mr. Samuel L. Goldsmith, Jr.
President
The Aluminum Association

American Can Company

H. Blair Smith Vice President
Corporate Environmental Affairs

American Lane
Greenwich, Connecticut 06830

November 26, 1975

RECEIVED
DEC 1 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
RESEARCH TRIANGLE INSTITUTE
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

L-134

Thank you for sending American Can Company a review copy of your very thorough study of the Energy and Economic Impacts of Mandatory Deposits. Although we may differ somewhat with your assumptions and conclusions, we commend you on the overall methodology and sense of fairness that was evident throughout the report. Our comments, most of them general in nature, follow:

1. First, we agree with your observation on page 1-12 that the beverage industry is extremely complex and that packaging has a critical effect on the system. Applying varying assumptions to a rigorous econometric model such as you employed is most difficult and we are grateful you recognized and acknowledged this fact.

2. Opinion Research Corp. reported an overwhelming amount of consumers would favor a law requiring all soft drinks and beer to be sold in returnable bottles and cans. We do not doubt or challenge those statistics. However, the two-way system is a very emotional, complex issue associated with litter and an overall cleaner environment. It is hard to be "against" a cleaner environment.

   We suggest that when the consumer is given a chance, for instance at the polls, she will vote for convenience, economy and the right to freedom of choice. Eight (8) referenda have proposed either a deposit or other form of restrictive legislation and all eight were voted down. The purchasing decision is an extremely complex one. We have become increasingly convinced that a vote at the polls is far more indicative of buying habits and

preferences than any reply given to a pollster. If our opinion is supported in the marketplace, trippage will continue its historical pattern of decline and energy usage will increase.

3. We believe your basic volume or consumption projections have been well-researched and are mostly consistent with other industry projections we have seen. Your soft drink compounded growth rate of 4.9% is perhaps too optimistic; we think 4% growth is more realistic. We think packaged soft drinks will grow at an annual rate of 4-5%, but the large size package will take a disproportionate share of this growth.

   These differences although seemingly insignificant, may very well influence some of your investment considerations. More important though, is the impact of a mandated deposit system on overall consumption trends. To repeat, we continue to firmly believe that the projected growth curves of both industries would be curtailed under such a system.

4. Capital requirements are particularly difficult to precisely define; much of your data approximates others we have studied. However, we do think that you have underestimated the capital (and operation) costs in the retail sector. Recent data that we have studied indicates that the retailer, particularly the small grocer and specialty store, is financially ill-prepared to accept a returnable system today.

5. American Can Company commercially manufactures our trademarked Miraform II two-piece steel can in San Antonio, Texas, and Milwaukee, Wisconsin. These cans (less tops and coating weights) weight 66 pounds per M. Table D 7-1 on page D-92 describes a two-piece steel can weighing 78.8 lbs. per M (less tops, but including coatings). We are convinced that all two-piece steel cans will weight in the range of 66 pounds certainly by 1985. We sincerely request that you change your tables to reflect this oversight.

6. In general, we believe your energy statistics are well conceived and documented and we are grateful that you recognized technology and lighter weight containers where appropriate. We do disagree with your calculations for BTU's required for 50% recycled steel. You use a figure of 13,126 BTU's per pound and our figure (supported by one of our primary steel suppliers) is 8,500. This is a substantial difference when measuring the energy savings for recycled or reclaimed material.

You are familiar with the American Can Company energy study presented in April, 1974. We respectfully offer to share data and assumptions with you.

7. Your report certainly favors a returnable system particularly if industry fails to achieve its resource recovery goals. We submit that the energy advantage is so much dependent on consistent trippage rates that this factor must be considered just as thoroughly as resource recovery probabilities.

Finally, we again commend you on a well-documented report. Our goals and objectives for society are really not that much different. We simply question the value of disrupting the world's most efficient food distribution system to perhaps save (depending on trippage) a portion of the 0.5% of the nation's energy that this industry uses. Thank you for giving us the privilege of responding to your report before final publication; we hope that our comments are considered objective and helpful.

Very truly yours,

AMOCO

Amoco Chemicals Corporation
200 East Randolph Drive
Post Office Box 8640 A
Chicago, Illinois 60680
Marketing Division

RECEIVED
DEC 4 1975
ECONOMICS DEPARTMENT

December 1, 1975

Mr. Taylor H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

Amoco Chemicals Corporation, a subsidiary of Standard Oil Company (Indiana), is involved in the manufacture and marketing of chemicals, polymers, and fabricated plastic products for a variety of industries and applications including the beverage industry. Via our consolidated vantage point, we have a good understanding of all aspects of plastics packaging, from the oil well to the finished package. Energy and economic considerations are of prime importance to us.

Consequently, your work with the Federal Energy Administration on "Energy and Economic Impacts of Mandatory Deposits" is of extreme interest to us. We have reviewed your draft report, with emphasis on the energy requirements, and find that your conclusions, on the whole, complement very nicely data which we have generated on beverage packaging and specifically on PET bottles which is our primary interest in this market. I think you and your people are to be commended for the fine job you obviously have done on this very difficult and complex subject.

There are, however, several points in the summary which we would like to bring to your attention and have attached a list of these points, by page number, along with our comments. Please do not take these comments as negative criticism for they are presented in the spirit of refinement for an already excellent report.

In addition, it appears that the materials flow on this chart is not balanced. The materials going into TPA production total 963 pounds and only 1053 pounds flow into PET resin production. This difference is no doubt oxygen but with recycled flows the point is not perfectly clear. For example, the acetic acid used in TPA manufacture could be erroneously assumed to flow to PET resin production.

The above comments would also hold true for the chart on Page D-3F.

Page D-36
Reference the careful drying of PET plastic before remelting. This is also true for AN/S, although likely not to the same degree. In fact, any material that has been ground and washed should be thoroughly dried before remelting.

Pages D-39 & D-45
We don't understand how you arrived at the different percentages of energy recovery for PE, PET, and AN/S at 91 per cent, 80 per cent, and 87 per cent respectively. Could you explain that in more detail?

Page D-50
Closures--it appears that you have assumed that 48 ounce containers will have a 38 mm neck finish. This is not a necessary assumption. PET bottles with 28 mm finishes will be marketed in 32, 48, and 64 ounce sizes.

Page D-51
Polyethylene Carrier-44 pounds--To what does this refer? If it is the PE shrink wrap for the pallet, it should be closer to 22 pounds/ 1000 gallons. The corrugated trays at 147 pounds also appears high.

Standard Oil Company (Indiana)
1000 Sixteenth Street, N.W.
Washington, D.C. 20036
202-638-1196

Howard Pyle
Washington Representative

RECEIVED
DEC 9 1975
ECONOMICS DEPARTMENT

October 23, 1975

Mr. Fred K. Nieman MC-4408
Amoco Chemicals Company
P.O. Box 8640 A
Chicago, IL 60680

Dear Sir:

Attached is a copy of the study entitled "Energy and Economic Impacts of Mandatory Deposits" which was mentioned in early discussions about possible federal actions on throw-away containers. This study was developed under contract with FEA which has required the contractors to solicit comments.

Therefore, I am forwarding to you this copy of the study for your comments which sould be submitted to Research Triangle Institute by November 14th. Our transmittal letter containing our comments will be reproduced in one of two appendices in the final report. The attached letter to me from RTI is self-explanatory.

Should you have any additional questions you may reach me on Chicago extension 5287.

Sincerely,

Howard Pyle

Howard Pyle

mlw/attachments

cc: Richard H. Leet, ACC, MC-4406A
Paul Pavey, STD, MC-3705

bcc: Tayler H. Bingham, RTI

ANCHOR HOCKING
CORPORATION

C. J. ARNSBARGER
VICE PRESIDENT
DIRECTOR OF PUBLIC AFFAIRS

RECEIVED
NOV 10 1975
ECONOMICS DEPARTMENT

Lancaster, Ohio 43130

November 7, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

Thanks very much for sending me a review copy of the study Energy and Economic Impacts of Mandatory Deposits. I am returning the copy per your request.

As you suggest, I will incorporate my comments and reactions to this study into the response you will be receiving from GCMI - Glass Container Manufacturers Institute.

Sincerely,

ANCHOR HOCKING CORPORATION

C. J. Arnsbarger

mr
Enc.

L-137

ANGELUS SANITARY CAN MACHINE COMPANY

4900 PACIFIC BOULEVARD, LOS ANGELES, CALIFORNIA 90058
(213) 583-2171 · CABLE ADDRESS "ANGELMACO" · TELEX 0674288

November 15, 1975 - Our Sixty-fifth Year

RECEIVED
NOV 18 1975
ECONOMICS DEPARTMEN

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park,
North Carolina 27709

Dear Mr. Bingham:

Enclosed is copy No. 110 of the Energy and Economic Impacts of Mandatory Deposits Study, which you kindly forwarded to us for review.

We have reviewed the study with interest and are returning the copy with no comments.

Since we are returning the study without comment, it is obviously pointless to have our transmittal letter included in the Appendix to your report.

Thank you for the courtesy of providing us with a review copy.

Yours very truly,

H. E. Schellenberg
Vice President of Sales

Encl:

HES:hh

COORS CONTAINER COMPANY

GOLDEN, COLORADO 80401
303-279-6565

November 25, 1975

Mr. Taylor H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, NC 27709

Dear Mr. Bingham,

The RTI report Energy & Economic Impacts of Mandatory Deposits may represent the most thorough and comprehensive report of its kind to date. Much time and effort are evidenced in the preparation of the study and RTI can be commended for the results achieved in a limited amount of time.

We do not feel that adequate time has been made available to allow the detailed energy and economic review merited by this study in light of its probable impact on many sectors of industry, government, and the consumer nation wide. Therefore, we cannot support the conclusions drawn nor the validity of the data presented.

The comments to follow relate to our own experience or position as assembled during the limited review period and should not be interpreted as the conclusions of the more comprehensive studies now underway within our organization, the results of which will follow in the near future.

We feel that a study of this nature is long overdue and that with appropriate modification can significantly contribute to the understanding of this complex issue.

Sincerely,

COORS CONTAINER COMPANY

E. G. ANDERSON
Vice-President,
Quality Assurance

RQ/cb

Enclosures

[illegible]
C 1 1975
ECONOMICS DEPARTMENT

COORS CONTAINER COMPANY'S

COMMENTS ON RTI REPORT

Report page number I-2

Relating bottle trippage to an appropriate recycle rates allows comparison of beverage package systems on a common graph. This is a reasonable approach and one supported by Dr. Carlos Stern in his study for the State of Connecticut.[1]

Report page number I-2

The energy level represented for glass at 5 trips and less is in significant contrast to earlier EAP data (EPA/530/SW-91c) which shows these levels to be 100 percent higher (at 5 trips). We feel the magnitude of this change must be questioned in light of the thoroughness of the earlier presentation and that the new data must be clearly and concisely justified.

Report page number I-5

The statement is made that the one-way glass container is "not as expensive as the beverage marketed in a metal can." While they may reflect existing marketplace prices,[2] it may not accurately portray a true cost comparison between these container systems. It is our feeling that the glass container may be inadvertently but widely subsidized by the beer and beverage industr It appears likely that the glass package cost structure may not accurately include adequate internal margins or handling/filling costs by those industries which package in both glass and metal containers. A realignment of cost-pricing structure may alter earlier assumptions as to price difference evidenced between these systems.

Report page number I-7

The "mid range parameter values" assume that "half the metal cans will be returned after imposition of mandatory deposits." It is inaccurate to say

---

[1] "The Impact of Beverage Container Legislation on Connecticut, and a Revi of the Experience in Oregon, Vermont, and Washington State" (March 20, 1

[2] "Study of the Effectiveness and Impact of the Oregon Minimum Deposit Law ADS October, 1974 (Table II-14, page II-53)

that this is based on the experience of Coors Container Company. It should be made clear that the recycling efforts of the Adolph Coors Company are completely based on the voluntary (i.e., non-legislated) return of containers at 0.6¢ per can and we fully expect this rate to be much higher if higher return incentives are provided. The significance of the return rates Coors now experiences is that they have been accomplished through the efforts of our Company without benefit of deposits on the containers.

Report page number 1-9

The "revenue potential" of a typical ton of solid waste recovered in a resource recovery plant is stated as being $8 including $1.73 due to beverage containers. This should be clarified. Are revenue potentials "net" reflecting operating costs of the center or heat-values of the non-metallic wastes, or simply the secondary scrap value of recoverable resources? It should be noted that the recycling value of beverage containers (glass, steel, and aluminum) is diminished by inclusion in the solid waste stream as a result of contaminants and the expense associated with their recovery.

Report page number 2-29

Table 2-11 makes projections as to probable recycling rates of metal beverage containers through 1985. It is unclear whether the rates anticipated (35.1 percent for aluminum) are with or without benefit of mandatory deposit legislation. The experience in Oregon[3] has shown metal can return rates of 62 percent initially after enactment of legislation and projects for higher rates as evidenced by the continuing growth of this figure since passage of the deposit law. Coors' experience in providing regional redemption centers has led to 60 percent recovery of aluminum containers for recycling (some 60 million pounds in 1975). While we do not defend this regional approach from an energy conservation standpoint, we have demonstrated conclusively that it is ludicrous to assign any lower anticipated can return rates.

---

[3] "Study of the Effectiveness and Impact of the Oregon Minimum Deposit Law", ADS October, 1974 (Table II-14, pg. II-53)

Report page number 2-42

In reference to the value of recycled metal can scrap as related to eventual container cost (shelf prices): it should not be inferred that "secondary scrap markets" would pose the most profitable disposition of this material. To derive the greatest economic benefit as well as maximize the energy savings, this material should be utilized by the beverage manufacturer as a source of container raw material insuring both continued supply and price stability. The value of the recycled container materials is then more appropriately compared to the cost of virgin metal and represents the most appropriate use of this resource.

Report page numbers 2-43, 2-44

The position of the Adolph Coors Company in regard to deposit legislation is accurately recorded in Modern Metals Magazine (December, 1975)
"If we had a choice, we'd prefer a free market -- no legislation at all. But we don't believe that's going to be the case. Our position is that if there is going to be mandatory deposit or ban-the-can legislation, we would like to help guide that legislation in a manner that is acceptable to industry. In fact, we have developed a closed-loop program and have discussed it in Washington. We also believe that if each state enacts its own law with different provisions, it will be almost untenable for any company in interstate commerce. So, our position is that if we must have such laws, it is better to have national legislation."

Many factors have to be considered, including the plight of the retailer. He is going to end up with the bulk of the work and we are concerned that he won't be able to handle it. That's why we are developing the "can eater". This is a system that would be installed at the retail outlet. It would take a steel or aluminum can, record whatever the deposit might be, crush the can, and issue a chit for the refund. It would make the job easier for the retailer. The important thing is to let all types of containers find their place in the market. Now there is also solid waste management. We agree that it is necessary. But don't put the beer and beverage can in the solid waste. We don't think it is right to legislate any container out of the market."

We have spent considerable effort in defining the elements which might constitute a viable recycling system under deposit legislation and must insist that these elements be accurately described if the concept is identified with the Coors Container Company. Enclosed is a copy of Coors' Closed-Loop Uniform Deposit System for your use which accurately describes the system and its advantages. If you are unable to modify your report to match our proposal, then we request you to take the Coors Container Company name off the credit on page 2-44 of your report.

Our objections to the proposal as described on pages 2-43 and 2-44 include:

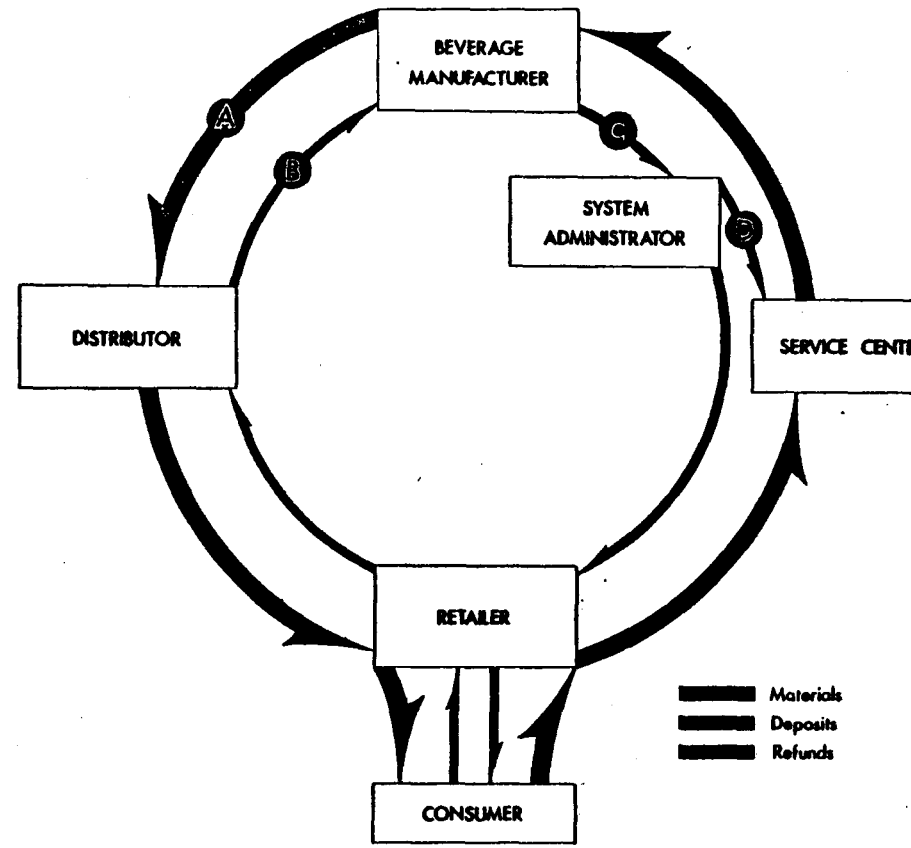
1. The cost of operation of service centers should be born by the litterer through forfeited deposits.

2. The pressures to reduce the price of the beverage container should come directly from the value of the scrap materials to the manufacturer not via the forfeited deposit of the consumer.

RQ/cb
11-26-75

Enclosure

CLOSED LOOP
UNIFORM DEPOSIT SYSTEM



A. MATERIAL FLOW
Originating at beverage manufacturer. Material ownership retained by manufacturer thru recycle loop.

B. CONTAINER DEPOSIT
Originated by beverage manufacturer. Passed on to consumer by distributor and retailer.

C. CONTAINER REFUNDS
Beverage manufacturer forwards all collected deposits to a system administrator. Retailer applies to this activity for reimbursement of deposit paid by consumer.

D. SERVICE CENTER
Fund accumulations from unredeemed deposits would finance this activity. Assessments to beverage manufacturers would be made if required to cover operating costs.

THE ADOLPH COORS COMPANY

CLOSED LOOP UNIFORM DEPOSIT SYSTEM

FOR METAL BEVERAGE CANS

PREFACE

In the brief outline to follow, it is our intent to summarize key elements of this Legislative concept which we strongly feel has merit for the beer and soft drink industry.

In light of the alternatives at hand; i. e., waste resource recovery, bottle oriented legislation, source reduction to include the ban on the metal container, a uniform deposit format is the only one to offer cost advantage to the beer and soft drink manufacturer and, in turn, a lower shelf price to the consumer.

September 18, 1975

I. Background necessary to the consideration of uniform deposit legislation for metal beverage cans.

There is ample precedent and experience in deposit administration, as it has been applied for years to glass bottles.

The three most important elements of the uniform deposit concept are:

A. A Uniform Deposit applied to bottles and cans alike, does not discriminate as to package type, and allows the consumer to continue to express his preference.

B. The deposit is initiated by the brewery or soft drink manufacturers, and as such, they retain control of the metal package material. It is the control and leverage inherent in ownership of the scrap cans that brings about financial advantage to the beverage manufacturer.

C. The deposit concept penalizes the consumer who litters. Cans not returned for refund of deposit create deposit monies available to support a recycle and recovery system.

At a 5 cent deposit level on all beer and soft drink cans and bottles, unrefunded deposits may well allow for the recovery of recyclable metal containers at no cost to the beer and soft drink manufacturer.

We should also state that the legislation to bring this concept about should occur at the federal level, as state by state variations would be untenable.

II. Tracing the Flow of Can Deposits

A. Legislation establishes the value of the deposit for the beer and soft drink industry. Presume this is 5 cents per unit regardless of the type of package; metal, glass, plastic, etc.

The brewery or soft drink manufacturer add 5 cents per unit to his selling price and collects the deposit from the wholesaler.

B. The wholesaler adds 5 cents to his selling price and collects the deposit from the retailer.

C. The retailer add 5 cents to his selling price and collects the deposit from the consumer.

The beer and soft drink manufacturer retains control of the metal can throughout all transactions including consumer purchase. The manufacturer is obligated to place deposits collected in the control of an administrative body.

D. The "System Administrator" heads an office established for the collection and administration of deposit funds received from the beer and soft drink industry. The office could be made up from representatives of the beer and soft drink industry, established as a governmental agency or represent some combination of industry and government under provisions of the legislation.

E. The consumer returns metal cans to a participating retailer for refund of his deposit.

F. The retailer submits necessary documentation and applies to the "System Administrator" for reimbursement of deposits given the consumer.

III. "Closed Loop" control over recyclable metal cans

A. Incorporation of the retailer in the "Loop" for the return of metal cans requires that receipt and handling of cans be an attractive proposition for the retailer.

B. Under provisions of the Legislation, franchised or licensed "Service Centers" are established throughout the country in a sufficient number of locations necessary to remove cans from the retail stores.

The "Coors Can Eater" program has produced prototype equipment that is the key to efficient and sanitary redemption of metal cans at retail locations. Consumers feed cans into the device. The machine detects if it is a legitimate steel or aluminum beverage can, and crushes the can for storage in an internal hopper. A deposit receipt is issued the consumer with the total number of cans accepted and the refund due.

Service Centers supply "Can Eaters", remove cans from the stores having the machine, consolidate cans to a central processing point.

The Service Center does not own the recyclable cans, but only performs a removal and processing operation. These centers are profitable and are able to furnish "Can Eaters" at no charge to retailers for a service charge of approximately 9 to 12 cents per pound of aluminum or steel cans handled.

C. The profitable operation of a franchised Service Center is monitored by the "Systems Administrator's" office.

D. Service Centers are paid for from unrefunded deposits.

This may obviate the need for any assessment to the beverage manufacturer to cover costs of the Service Centers.

Should no assessment or a small supplemental assessment be required, the beverage manufacturer controls scrap packaging material at no cost or at nominal cost.

E. Service Centers distribute processed scrap back to the beverage manufacturer, based on share of market for canned product.

The beverage manufacturer can direct car load quantities of his scrap to be recycled into new packaging material.

IV. "Closed Loop" benefits to the beer and soft drink industry.

A. The low cost acquisition of a high volume of can scrap yields excellent opportunities for lowering the cost of can sheet and finished cans. This benefit accures to the beer and soft drink manufacturer who controls the scrap under this concept.

B. Relative scrap values of aluminum and steel will figure heavily in the advantage to the beverage manufacturer for lowering his packaging costs, and the shelf cost to the consumer.

V. Advantages of "Closed Loop" Uniform Deposit System

A. Maximum conservation and recycling of packaging materials (90 percent or better returns).

B. Maximum conservation of energy.

C. Maximum reduction of litter and solid waste.

D. Those who litter or refuse to recycle pay for operation of the system.

E. Lowest consumer cost system.

RQ/cb

DOW CHEMICAL U.S.A.

P. O. BOX 1847
2040 DOW CENTER
MIDLAND, MICHIGAN 48640

November 19, 1975

RECEIVED
NOV 24 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

In response to the invitation issued in your letter of October 10, 1975, the purpose of this letter is to provide your group and the Federal Energy Administration with the thoughts of Dow Chemical U.S.A. on the draft report Energy and Economic Impact of Mandatory Deposits (RTI Project Number 41U-1125).

Our review of the draft report suggests the following:

1. The systems that were studied to develop energy consumption estimates were examined in a most professional manner. We do have concerns about two basic assumptions.

2. This study will probably be a major reference document. We believe more work is needed on the impact of configuration on energy requirements on plastic alternatives.

3. The conclusion that mandatory deposit legislation will save energy is logical only in light of the systems studied. If the scope of the study is expanded to include other systems then it may be shown that mandatory deposit legislation will destroy the opportunity to develop systems with a lower net energy use than those that will be used in a distribution system governed by mandatory deposit legislation.

   We urge your firm to review with the Federal Energy Administration our belief that, before this draft report is published, certain basic assumptions be reviewed and the scope of the study be expanded to include the very significant configurational improvements that are available to plastics.

AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

To expand our comments:

1. Two basic assumptions concern us:

   1.1 The energy content of wood fiber used in making boxes, partitions, etc. does not appear to be added to the total system energy used per unit volume of beverage transported. Although the stated bases do not make this clear, the mentality of not counting the BTU content of wood fiber (except for the wood burned in the manufacture of wood products) has been the pattern in most previous studies. It is our belief that, in energy accounting, the inherent BTU content of all products that have alternate fuel value should be counted.

   1.2 No energy penalty is taken for the transportation of returnable bottles from the home back to the point of purchase. The implicit assumption is that most people will take bottles back when they do their routine shopping so that the energy for that part of the return trip is incremental. A more thorough examination of that assumption might reveal that a significant percentage of bottle returning will be a monthly or quarterly specific trip with little true incrementality.

2. We believe the final study will become a major resource document for federal and state legislative and regulatory groups plus special interest groups concerned with this subject. In this draft report, conversion energy and configuration (container weight per fluid ounce) improvements were estimated for 1985 for glass, steel and aluminum. In the case of plastics, configuration improvements were not assumed even to the degree of commercially proven technology.

To illustrate our point more fully, consider the following information. Table A shows a comparison of energy requirements for beverage containers. We recognize the potential pitfalls of amalgamating two studies but feel the data are reasonably consistently derived. It is particularly important to note that these data are not based on futuristic extrapolations of plastics configurational capability but on proven commercial systems.

Table A

Comparative Energy Requirements for Beverage Containers

Container	10^6 BTU's/1000 Gallons
Ten Trip Glass	22[1]
Non Refillable Glass	64[1]
Conventional Steel Can	54[1]
Aluminum Can	75[1]
Plastic-Conventional	60[1]
Plastic-Rigello®*	30[1]
Plastic-Merolite®**	20[2]

[1]Midwest Research Institute Project 4021D
[2]EIAR filed with FDA by ICI United States on Merolite®
*Trademark of Rigello Pak AB
**Trademark of ICI United States

These data show the major impact of configuration of plastic alternatives (three fold reduction) even if considerations are limited to proven technology.

3. The data in Table A also suggest that additional study is needed before concluding that mandatory deposit legislation will save energy. The data indicate, in fact, that mandatory deposit legislation might deter commercial development of packaging systems that can save energy. In the attached Appendix, Reference I, we have reviewed this subject in greater detail. We hope that a review of Table A and Reference I will cause you to share our conclusion that more study is needed.

We appreciate the opportunity to comment on this excellent draft report. We hope that our concerns can be mitigated before the final report is published. If you have any questions or comments, please contact Hollis Brower of our Washington office (296-1915) or me.

Sincerely,

R. W. Dupree, Director
Government Relations/Public Issues
Olefin/Sytrene Plastics Departments

APPENDIX

Reference I

This reference will elaborate on the need for expansion of the draft report to include a consideration of the potential impact of configuration of plastic beverage container alternatives. In this reference, we will attempt to synthesize a relationship between three studies - MRI 4021D, RTI 41U-112 draft and the EIAR by ICI United States on Merolite. Such a synthesis is fraught with potential inconsistent bases but can give a ball park perspective to let one decide if further study is justified.

Table I is a comparison of the energy requirements of beverage alaternatives as estimated in the three reports. The estimates indicate that, although the absolute numbers differ because of the different bases of the study, the ratio between the numbers for each container type is essentially the same except for non-refillable glass.

Table I

Comparative Energy Requirements for Beverage Containers

Container	10^6 BTU's/1000 Gallons			
	EIAR on Merolite®	MRI 4021D	RTI 41U-1125 1975 Technology	Ratio Of MRI To RTI
Ten Trip Glass	---	22	18	(1.2)
Non-Refillable Glass	---	64	41	(1.6)
Conventional Steel Can	---	54	44	(1.2)
All Steel Can	---	39	Not Estimated	---
Aluminum Can	---	75	64	(1.2)
Plastic-Conventional	---	60	Not Estimated	---
Plastic-Rigello®	---	30	Not Estimated	---
Plastic-Merolite®	20	Not Estimated	Not Estimated	---

Using the RTI estimates for 1975 and 1985 technology, one can establish the following relationships.

Table II

Comparative Energy Requirements for Beverage Containers

RTI Study 41U-1125

Container	10^6 BTU's/1000 Gallons		
	1975	1985	A÷B
Ten Trip Glass	18	14	1.3
Non-Refillable Glass	41	34	1.2
Conventional Steel Can	44	Not Estimated	---
All Steel Can	Not Estimated	30	---
Aluminum Can	64	51	1.3
Plastic-Conventional	Not Estimated	36	---
Plastic-Rigello®	Not Estimated	Not Estimated	---
Plastic-Merolite®	Not Estimated	Not Estimated	---

To put the various studies in perspective, we will ratio numbers from study 4021D by MRI and from the EIAR filed by ICA United States when draft report 41U-1125 does not contain a 1975 base case. This will give us numbers to compare with the 1985 numbers contained in draft report 41U-1125. (Note well - this numerical exercise is not to develop "right" numbers but is an attempt to demonstrate the need to get some of the salient alternative packaging systems compared on the same basis.)

To develop Table III, we made the translation from estimates in study 4021D by MRI and the EIAR by ICI United States to a number equivalent to a 1985 projection dividing those numbers by 1.5 [the combination of the factor (1.2 - 1.6) between the MRI study to the RTI study for 1975 plus the factor (1.2 - 1.3) between the RTI 1975 estimate and 1985 estimate]. Granted this is a crude technique but again perspective not definitive numbers is the objective.

Table III

Comparative Energy Requirements for Beverage Containers

Container	10^6 BTU's/1000 Gallons		
	1975		Estimated 1985 Equivalent Number
	MRI 4021D	EIAR on Merolite®	
Ten Trip Glass	--	--	--
Non-Refillable Glass	--	--	--
Conventional Steel Can	54	--	36
All Steel Can	--	--	--
Aluminum Can	--	--	--
Plastic-Conventional	--	--	--
Plastic-Rigello®	30	--	20
Plastic-Merolite	--	20	13

In the development of Table IV, we took the 1985 estimated numbers from Table III plus the 1985 numbers that were estimated in RTI 41U-1125 and, using the ratios for energy recovery and recycle from the tables in RTI 41U-1125 we guesstimated the energy impact of energy recovery and recycle.

Table V

Comparative Energy Requirements for Beverage Containers

1985

Containers	10^6 BTU's/1000 Gallons		
	100% Virgin Materials	100% Energy Recovery	100% Recycle
Ten Trip Glass	14	N/A	14
Non-Refillable Glass	34	N/A	31
Conventional Steel Can	36	N/A	29[1]
All Steel Can	30	N/A	24
Aluminum Can	51	N/A	18
Plastic Conventional	36	29	21[1]
Plastic-Rigello®	20	16	12[1]
Plastic-Merolite®	13	10	8

[1]Estimated by ratioing with RTI estimates of closest container type.

Thus one can see that, by making some "best guess" estimations the same general conclusions can be drawn from the RTI 41U-1125 study when supplemented with a look at the impact of potential configurational changes for plastics as are drawn from the combination of MRI 4021D and the EIAR by ICI United States (Table A).

FM-100-D

DU PONT

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED

WILMINGTON, DELAWARE 19898

FILM DEPARTMENT

RESEARCH AND
DEVELOPMENT DIVISION

RECEIVED
NOV 17 1975
ECONOMICS DEPARTMENT

November 11, 1975

Mr. Taylor H. Bingham
RESEARCH TRIANGLE INSTITUTE
P. O. Box 12194
Research Triangle Park, N.C. 27709

Dear Mr. Bingham:

Thank you for the opportunity to review and comment on your beverage container study entitled Energy and Economic Impacts of Mandatory Deposits.

On the whole, Du Pont believes that this study has been thoughtfully prepared and that its conclusions, with respect to current commercial beverage containers, are not inconsistent with similar analyses made by ourselves and others who are interested in this field. However, we wish to offer several comments which we feel are particularly relevant to the impact which the projected use of plastic beverage containers would have upon your conclusions.

Du Pont's interest in beverage containers lies exclusively in the commercialization of a polyethylene terephthalate (PET) bottle for soft drinks only and more particularly, because of economic factors, in larger-size bottles (32 ounce and greater). While your study does include data and comments in Appendix D of the Report applicable to plastic bottles, the Summary conclusions focus entirely on the effects of mandatory deposits on the present commercial beverage containers--that is, glass bottles and metal cans. Apparently, this is based on the assumption that plastic bottles will not achieve significant market penetration prior to 1985. Since the Summary conclusions combine the effects of mandatory deposits for both beer and soft drinks, packaged for on- and off-premise sale and in all sizes of containers, we feel that the conclusions cannot adequately reflect the situation with respect to larger-size plastic soft drink bottles.

Du Pont does not dispute the conclusion that refillable glass bottles have lower energy requirements than all current one-way beverage containers, assuming that a certain minimum

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

trippage is maintained for the refillables. We do feel that this energy superiority has been overstated in the Summary conclusions by failure to consider the family size plastic soft drink bottle.

Examination of the details of Appendix D leads to the following summary comparisons:

	MM BTU/1000 GAL. SOFT DRINK	
	1975	1985
REF Glass 16 oz. - 6.4 trips	17.63	15.25
PET Bottles 48 oz. - O.W.	N.A.	23.22
Steel Cans 12 oz. - O.W.	43.7 (Bimetal)	29.1 (all steel; 11% recycl
NR Glass 16 oz. - O.W.	45.3	37.1
Aluminum Cans 12 oz. - O.W.	63.5 (17% recycle)	39.7 (35% recycle)

This table shows that a 48 oz. one-way PET bottle comes closer than any other beverage container to matching the energy requirements of refillable glass soft drink bottles at the 6.4 trips predicted in the Report for the early 1980's. From the tables in Appendix D, it is also readily calculated that the energy requirement of a 48 oz. PET soft drink bottle is identical to the current refillable glass bottle at 4.2 trips. Many experts believe that this is the approximate current trippage for soft drink bottles.

Thus, while the energy savings expected from mandatory deposits may be real with respect to beverage containers taken as a whole, this conclusion is much less significant with respect to larger-size PET soft drink bottles.

Our second concern with the Report is the handling of 1985 projections. While data and conclusions are developed for 1975 and 1985 for all current beverage containers, only 1985 data is presented for plastic bottles. Unfortunately, the latter data essentially reflects the current, i.e. 1975, technological status of plastic beverage bottles. The 1985 data for glass and

metal containers properly recognizes or anticipates significant technological innovations projected to occur in the next decade.

In the case of PET plastic bottles, no such improvements have been forecasted (other than an across-the-board energy utilization improvement which is forecasted for all beverage containers). This deficiency is not entirely the fault of the producers of the study (Franklin Associates), since industry, including Du Pont, provided most of the input for the energy calculations. Nevertheless, we submit that as the development of plastic bottles continues and once they are introduced into the market, substantial technical innovation can be expected and this will significantly alter the projected energy comparisons vis-a-vis returnable glass bottles. The plastics industry has a history for strong and rapid innovation especially when compared to the glass and metal industries.

One obvious innovation effecting energy requirements is "lightweighting." It is not known at this point how heavy or how thick a plastic bottle must be to remain functional, and bottle weight is by far the major factor in calculation of energy requirements. Also, just as for glass bottles, there is the problem of getting just the right amount of plastic in the right place for optimum weight and performance. While this has been achieved to a considerable degree, we confidently expect to make significant improvements; and, indeed, success in this area is almost dictated for economic viability.

Another anticipated energy savings is in the area of secondary packaging. Here we see an opportunity for substantial innovation but to date, literally no technical effort has been expended in this area because of the developmental status of the bottles themselves. We note in the report that the secondary packaging (paper and paperboard) for aluminum cans is less than that for plastic bottles. Compare, for example, Figures D.5-5 for PET corrugated trays and Figure D.6-4 for aluminum trays. (1985 values are 147 lbs. for PET bottles versus 86 lbs. for aluminum; note also the very substantial reduction from 133 lbs. to 86 lbs. for the aluminum can projected to occur between 1975 and 1985.) We find it difficult to understand why paperboard packaging requirements for PET bottles would be greater than for aluminum cans.

Thirdly, Appendix D correctly discusses: (1) the potential for refillable plastic beverage containers, (2) the effects of recycle on plastic containers, and (3) the fuel value of plastic containers as a component of solid waste. However, it was concluded that these all-important developments would not be important factors for plastic containers prior to 1985. While this may or

may not be so, it very well could be in the not too distant future. It is appropriate to quote from page D-62:

> "Thus, . . . the energy requirements of a refillable plastic compare favorably with currently available refillable containers. However, the development of refillable plastic bottle technology is dependent on proven development and use of nonrefillable plastic bottles first. Therefore, any forces (such as legislation, regulations, market competition, etc.) which affect the market potential of nonrefillable plastic bottles, also affect the possible future markets for refillable plastic containers."

We do not believe that the Report Summary adequately reflects these factors and conclusions.

Finally, we wish to comment on the scope of the study itself. The study attempts to measure only the energy and economic impacts of mandatory beverage deposits. However, there are other important environmental and safety impacts which deserve strong consideration in evaluating the desirability of a mandatory deposit system. When the environmental impacts (including their economic consequences) of raw material usage, water and airborne emissions, solid waste disposal and consumer safety are properly inserted into the equation, then PET bottles compare even more favorably with refillable glass bottles.

Frankly, we found it rather difficult to evaluate the analysis of the economic impacts of mandatory deposits as presente in the Report. The "scenario" approach may be the simplest way to cope with these complicated and interrelated effects, but it is difficult to select the most probable scenario to describe conditions in the marketplace created by a mandatory deposit law. At this time, we neither criticize nor endorse the economic effect conclusions in the Summary of the Report.

Sincerely,

P. J. Vanderhorst
PATENTS AND CONTRACTS

PJV:jdm

CC: Mr. Robert G. Hunt
Franklin Associates

Monsanto

FABRICATED PRODUCTS DIVISION

MONSANTO COMMERCIAL PRODUCTS CO.
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

RECEIVED
NOV 17 1975
ECONOMICS DEPARTMENT

November 13, 1975

Mr. Taylor H. Bingham
Energy & Environmental Research
Division
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N.C. 27709

Dear Taylor:

Thanks for the opportunity to review the draft copy of "Energy & Economic Impacts of Mandatory Deposits." Although I am not qualified to evaluate every facet of the document, my overall judgment is that it is a scholarly treatment of a very complex subject. You and your associates are to be congratulated.

As you know, I feel your inability to include plastic bottles in your evaluation a significant deficiency in the value of the report. I hope a sufficient number of others commenting on the report will be of a similar mind and funds can be made available to enable the inclusion of plastic bottles. Additionally, if this is possible, consideration should be given to the impact of refillable plastic bottles--an eventuality that is virtually assured in the absence of legislation which deters or prevents the development, now underway, to proceed unimpeded.

Because I had only a short time to review the document and meet your deadline for reply, I may have overlooked this, but have you considered the impact of energy demand in building up a float in refillable glass as NR glass is replaced? While this could be prorated over the use life of the bottle, the impact realistically would be at the time of production and consequently, it could be argued it should be charged to the year or years in which the float was being built.

a unit of Monsanto Company

Also, the new equipment required to accommodate a quantum increase in refillable bottles would result in an energy cost I did not see tabulated or considered. For example, NR bottles generally are rinsed, not caustic soaked and washed; additional warehouse space would be required, etc. The impact on the brewing industry would be even greater, especially if can lines were replaced by bottle lines. Perhaps this is outside the purview of your study or perhaps overall these impacts would be minor--but I think they warrant consideration.

While I have no objection to the publication of these comments, I doubt reproducing the letter would add significantly to your report.

Again, my compliments for an excellent treatment of a very difficult, complex subject.

Very truly yours,

F. D. Wharton, Jr.
Manager
Environmental Affairs
Container Business Group

FDW/maw
Enclosure

PEPSICO

PURCHASE, N.Y. 10577

RECEIVED
DEC 5 1975
ECONOMICS DEPARTMENT

December 2, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

I appreciate the fact that on Wednesday, November 26, 1975, you extended the period of time to submit our comments on the RTI Energy and Economic Impacts of Mandatory Deposits. The extra time was necessary, for as I told you telephonically, we did not receive our copy of the Study until October 23, 1975, even though your letter of transmittal was dated October 10, 1975.

We trust that objectivity will prevail on the extremely important mandatory deposit issue and that you will find our response helpful in arriving at proper facts in the final version of the FEA Study.

Our comments as an "interested party" are attached. Should you have any questions regarding them, we would, of course, want to be of assistance.

Sincerely,

Lloyd Curtiss

Lloyd Curtiss, Director
Environmental Affairs

LC:mlp
Attachments

COMMENTS

OF

PEPSI-COLA COMPANY

(DIVISION OF PEPSICO, INC.)

ON THE

RESEARCH TRIANGLE INSTITUTE STUDY

ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS*

AS PREPARED FOR

FEDERAL ENERGY ADMINISTRATION

*Draft report dated October 1975.

SUMMARY

Pepsi-Cola Company, division of PepsiCo, Inc., comments on the Research Triangle Institute Study Draft are divided into four sections:

- Market Structure and Sales Trends
- Impact of Mandatory Deposit Legislation
- Energy Requirements
- Bottler Operations and Economic Structure

The scope of our reply is primarily limited to soft drink industry related issues for which we possess a wealth of background information and benefit of insight into existing marketing trends and probable market developments. In fact, we have recently conducted an extensive study of the projected impact of national mandatory deposit legislation on the Pepsi-Cola Enterprise and entire soft drink industry.

In regard to the primary issue in the study, i.e. mandatory deposit legislation impact on energy consumption, the following summarizes our exceptions to RTI's findings:

1. Energy requirements without-government-intervention
   - Projected can share of package sales is highly overstated resulting in higher than expected energy requirements for the soft drink industry.
   - Nonrefillable plastic containers, currently in test-market and planned for market roll-out, promises significant energy savings which are ignored in RTI's projections of total system energy requirements.

2. Energy impact due to mandatory deposit legislation
   - RTI assumption that nonrefillable bottles will disappear from the marketplace is invalid. As a result energy savings are overstated.
   - Per-unit energy consumption estimates by container type within the bottler system significantly underestimate refillable container needs.
   - Reaching conclusions based on energy savings within the beverage industry alone is, in our opinion, inappropriate. Impact on total U.S. energy consumption should be analyzed in view of expected decline in beverage demand and energy needs for increased consumer expenditures for other products.

Incorporating the above points, net energy savings from restrictive packaging legislation are diminished. However, the soft drink and the packaging industries and their employees are severly damaged, and beverage consumer freedom of choice is compromised.

SOFT DRINK MARKET STRUCTURE AND SALES TRENDS

1. Volume Projections

There are some very basic differences we have with the approach and methodology RTI has taken in projecting total soft drink volume to 1985. RTI has not considered any of the marketing dimensions affecting soft drink sales in constructing their demand equation.

Variables that Pepsi-Cola Company think important in explaining historical soft drink growth are:

a. disposable consumer income
b. relative beverage pricing
c. total population and age mix shifts
d. changing consumer life-styles
   - away-from-home eating
   - faster pace of life
   - convenience orientation
   - meal-time beverage consumption habits
e. packaging trends
f. emergence of food chains with aggressive merchandising and promotion

Of these six variables RTI has developed a demand equation including three (a, b & c) but ignoring the three important

marketing variables (d, e & f). Agreed it is extremely difficult to quantify changes in consumer life-styles but their effect on sales should be considered qualitatively, at least.

The packaging variable may be the key explanation for the expanded rate of growth in volume since 1960. Exhibit I shows a plot of total soft drink package volume from 1947 to 1973 and mix by package type. One does not have to employ sophisticated statistical computer analysis techniques to see the sharp shift in volume trend around 1960 corresponding to the introduction and growth of convenience packages. In fact, the total bottle (returnable and non-returnable) volume trend seems to have remained fairly constant during this entire time period with can sales representing all incremental volume. Undoubtedly cans and, to some degree, non-returnable bottles have created new and expanded markets for soft drink consumption.

We are impressed with RTI's degree of ability to explain historical soft drink sales by their demand equation, but the forecasting value of this model is questioned. Already, after the first two years, forecasted soft drink sales significantly differ from actual results. Estimated 1974 and

1975 sales show a flat market, at best, compared to RTI's forecast of +13.4%.

2. Package Mix Projections

The approach taken by RTI in projecting soft drink package mix trends was simplistic and totally arbitrary. Though a sophisticated "S-curve" concept was employed as the forecasting model, asymptote values were chosen to be twice the present market share for no apparent reason at all. Completely ignored were any marketing variables and most recent sales data showing levelling off and reversal of previous trends. Compounding all these problems, when the actual data did not seem to fit the forecasting models developed, forecasting methodology was completely changed in a very forced and seemingly biased matter. Can share was projected to increase at a constant rate, equal to the growth experienced from 1969 to 1973, while market shares for returnable and non-returnable bottles were projected to decline in the same manner as for beer.

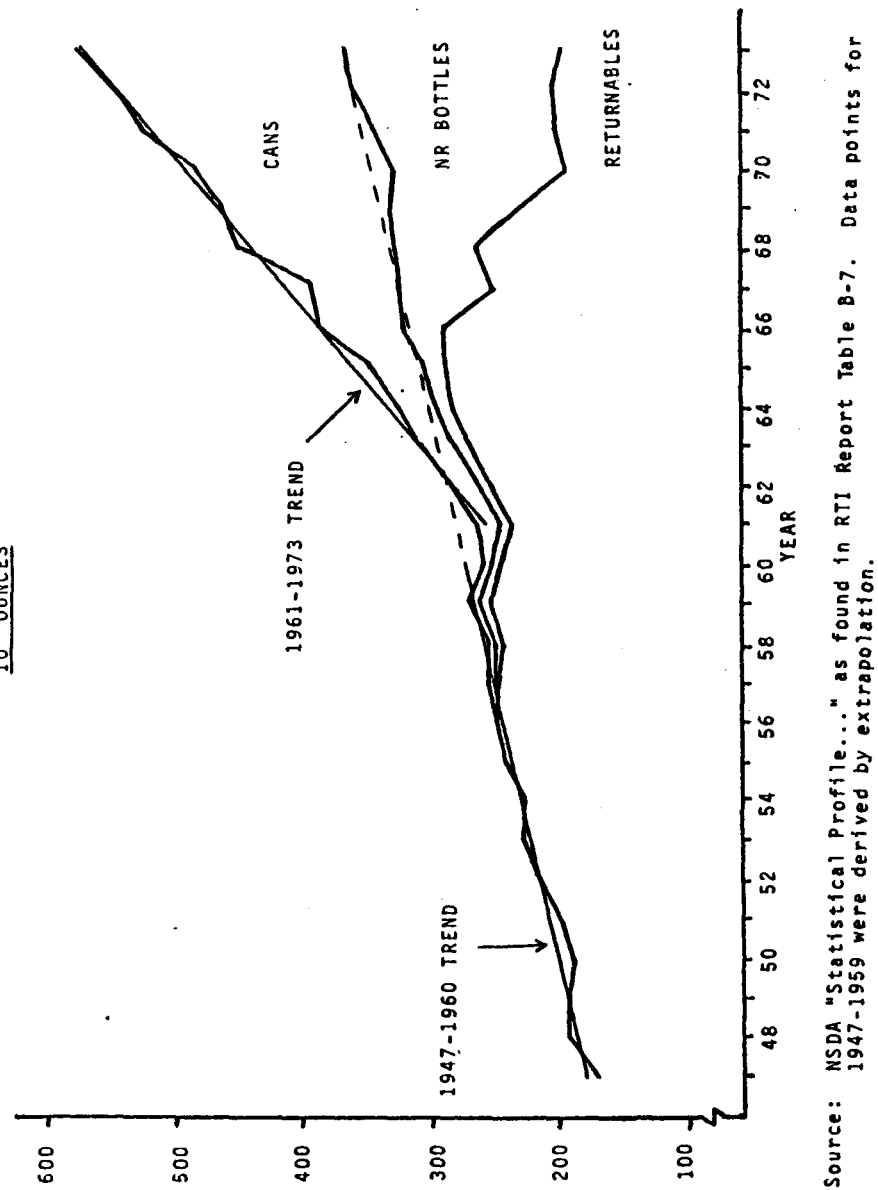
Projections of package mix are one of the most important variables in determining the effect of government intervention on energy requirements of soft drinks and beer. We feel that the projections made for the soft drink industry are complete

L-152

EXHIBIT I

SOFT DRINK INDUSTRY PACKAGE SALES BY CONTAINER TYPE, 1947-73*

10^9 OUNCES



*Source: NSDA "Statistical Profile..." as found in RTI Report Table B-7. Data points for 1947-1959 were derived by extrapolation.

wrong and overstate energy requirements in the absence of deposit legislation.

Unfortunately, the data base used by RTI extends only to 1973. A look at market shares by package type for 1974 and 1975 is very revealing and illustrates the dynamics taking place in the soft drink marketplace which are difficult for outsiders to comprehend. Exhibit II presents a reliable estimate of the soft drink sales mix by package type for the latest six years. This data only reflects sales through food stores, though food stores represent over half of soft drink package goods sales. During the last two years packaging trends have reversed. Returnable bottle share has increased 2.0% while cans share has declined 2.7% to 1970 levels.

As evidence that this data is reflective of the total market, Pepsi-Cola Company total soft drink package sales has experienced similar trends.

Are these trends only temporary? We think not. For the foreseeable future Pepsi-Cola Company expects a continued levelling off of previous packaging trends. The reasons for this are:

a. Returnable bottles offer a good value to the consumer in most parts of the country. Considering that soft drink prices (and all food prices for that matter) will probably

EXHIBIT II

TOTAL SOFT DRINK INDUSTRY PACKAGE MIX TRENDS

IN FOOD STORES

(8-OZ. EQUIVALENT CASES)

	PERCENT OF TOTAL PACKAGE SALES				
	1970	1971	1972	1973	1974	1975E*
RETURNABLES	47.0	43.9	43.7	43.0	43.0	45.0
NR BOTTLES	28.7	30.3	30.2	30.2	29.9	30.6
CANS	24.3	25.8	26.1	26.8	27.1	24.4

*1975 MARKET SHARES ESTIMATED BASED ON ACTUAL DATA FOR FIRST 10 MONTHS OF YEAR.

increase in the future greater emphasis will be placed on value shopping by consumers. Introduction and rapid growth of large size returnable bottles, such as Pepsi-Cola's 32-ounce return-reseal package and most recent 64-ounce size, have also boosted returnable bottle sales.

b. Non-returnable bottles have been growing in share over the past few years, helped by the introduction and growth of large sizes. This growth of large size containers is projected to continue for the next few years at least, especially the 64-ounce size. Large non-returnable bottle sizes offer the consumer both convenience and value, and there is no way that cans can compete against them in the take-home market. Another factor which may continue to increase non-returnable bottle sales beyond the next few years is the introduction of the plastic bottle, offering additional lightweight and unbreakable/safety features to the consumer.

c. Cans are an expensive package. The rapid growth in share over the past years has mostly taken place in the on-premise segment of the soft drink market. The convenience, unbreakable/safety features of the can have been the chief reasons for this. However, we feel that can sales in the on-premise market are reaching a saturation point in a declining growth segment of our business. In the take-home

market segment, can share growth is limited. For two reasons we feel that can share of sales will probably decline in food stores in the future:

(1) Inflation, with corresponding soft drink price increases, are causing consumers to be more price conscious.

(2) Trend to large size packages, both refillable and nonrefillable

3. Opinion Research Survey

The results of the national consumer attitude survey and use by RTI appear questionable. RTI states "when questione the public has consistently supported mandatory deposits." To the contrary, when the issue has been taken to the publi it has been overwhelmingly turned down by the consumer in the privacy of the voting booth. There have been eight ref erendums to date on the mandatory deposit issue since 1970:

Juneau, Alaska	1971
Bridgeton, Maine	1973
Washington State	1970
Coon Rapids, Minn.	1974
Crystal, Minn.	1974
Dade County, Fla.	1974
Ypsilanti, Mich.	1975
Eau Claire, Wisc.	1975

Each has been defeated by wide margins. The findings from the national consumer attitude survey differ from actual record. The answers to the questionnaire most likely reflect emotional, uneducated, initial feelings on the issue only. These consumers opted for freedom of choice in the marketplace, which is a carefully guarded concept of the free enterprise system.

Another area where the results from the survey significantly differ from the facts is in consumer preference for the three different soft drink package types. RTI states that of the 93% of soft drink consumers with package preferences 55% (51% of total responses) prefer returnable bottles. On the other hand, returnable bottles accounted for less than 35% of total soft drink package sales in 1973. Clearly there is some disparity here between these two numbers.

The findings from the Opinion Research survey are obviously misleading. Included in their numbers are package type preferences of people who probably never purchase soft drinks or only purchase them very infrequently. In addition, an incorrectly formulated questionnaire can invoke responses not necessarily reflecting true actions but rather imagined feelings of how people would like to act.

Because of these obvious inconsistencies between the survey's results and Pepsi-Cola Company's own marketing research information we find it difficult to accept some of the findings of the survey. For example, that 36% of soft drink consumers actually purchase returnable bottles for "ecology-related reasons" seems almost inconceivable from our standpoint.

IMPACT OF MANDATORY DEPOSIT LEGISLATION

1. Estimated Volume Impact

RTI concludes that "only nominal reductions from the without-government-intervention projections are projected in the annual rate of beverage consumption in the presence of mandatory deposits." We are in total disagreement with this result. In making this statement RTI has completely disregarded their own market survey showing a strong preference for soft drinks in non-returnable packages for convenience-related reasons, present consumer purchases of soft drinks in convenience packages representing 65% of total package sales, and the mechanics of the entire soft drink distribution system.

Pepsi-Cola Company has estimated the immediate negative impact of national mandatory deposit legislation on total soft drink industry package volume to be a minimum of 8%, with additional compounding negative impact on long-term growth.

The reasons for this are:

a. Relationship between expanded long-term soft drink volume growth and introduction and growth of convenience packages which will be reversed.

b. Present share of soft drink package sales in non-returnable bottles and cans of 65% reflecting obvious demand and preference for convenience-type packages. These consumers will not necessarily wish to buy soft drinks in returnable bottles.

c. Inability of present production and distribution systems for private-label and warehouse soft drink brands to handle returnable bottles which may cause their disappearance from the marketplace.

d. Expected loss in number of retail outlets carrying soft drinks because of undesirability and added cost of handling returnable containers versus non-returnables. This is particularly true for vending outlets.

e. Decline in retail inventories of soft drink because of the additional space requirements of returnable bottles and reduction in number of brand/package types available.

f. Switching by consumers to other type beverages due to increase in soft drink prices, coupled with loss of convenience type packages for soft drinks.

Negative impact on soft drink volume has been evidenced in both Oregon and Vermont where mandatory deposit legislation has been adopted. In Oregon, ADS found that soft drink package sales remained flat the first year after the law. This is a significant drop when compared to estimated previous volume growth of between 5 to 10% per year. In Vermont a volume decline of 27% in food stores was estimated in the first year after the law. In both instances, volume impact has been unequal brand to brand. Private-labels and warehouse brands volume losses ranged from 40% to over 80% while losses for major national brands were much lower than average.

2. Effect on Packaging Mix

RTI assumes that all present consumers of beverages in nonrefillable bottles will shift to refillable bottles and that nonrefillable bottles will disappear from the marketplace. We disagree with these assumptions. Nonrefillable bottles will remain a viable package in the event of mandatory deposit legislation. In present non-returnable markets, areas of the country where bottlers refillable bottle sales represents a very small part of their package mix, conversion to refillable bottles may not be practical. With a national trippage averaging 10 for soft drinks and projections that

it will decline to 6 by 1985, what trippage can be expected in markets where consumers are totally convenience packaging oriented and there is little demand presently for refillable bottles? Without guaranty of sufficient trippage bottlers will not make the tremendous capital investments required to convert their plant and equipment to handle refillable bottles. Why should they? At these expected low trippage rates, the net cost of nonrefillable bottles to consumers is lower than for refillable bottles, assuming the same bottler margins.

Another factor working to keep nonrefillable bottles from disappearing will be introduction of the plastic bottle. No other package will offer similar advantages to the consumer--unbreakable/safe, value/economy of large sizes and convenience.

Even in returnable or mixed markets, large size nonrefillable bottles will remain a viable package type. Unlike for small nonrefillable bottles, the deposit on a 64-ounce container will result in a relatively small price increase for the convenience-oriented consumer.

Because of the above reasons nonrefillable bottles will not disappear from the market. RTI should establish a new "transition model" explaining the effect of mandatory deposit legislation on package mix. With government intervention

present nonrefillable bottle sales will fall into one of the following categories:

a. Stay in nonrefillable bottles because refillable bottles were not introduced into the market.
b. Convert to refillable bottles.
c. Stay in nonrefillable bottles but trade-up to larger sizes.
d. Convert to can sales if and where nonrefillable bottles are not available in the market and convenience-type package is still preferred.
e. Opt for alternative type beverage in convenience container readily available in the food store beverage department.

Nonrefillable bottle customers for convenience-related reason (67%) will most likely choose either of the last three option

3. Impact of Existing Mandatory Deposit Legislation

In many analyses projecting the effect of proposed packaging legislation on state or national levels, results from Oregon' "Bottle Bill" have been used by researchers to make assumptions on probable sales volume and package mix impacts. Even if such assumptions were based on thorough, unbiased analyses of Oregon's experience they would not be valid. The Oregon soft drink market is not typical of the entire United States. Before the mandatory deposit legislation became effective in

Oregon, returnable bottle sales accounted for over half of all package volume.

So far, Vemont has not been used as a basis for making assumptions because of lack of available data. Unlike Oregon, Vermont's package sales were nearly 100% in non-returnable containers prior to the law. Exhibit III presents data that Pepsi-Cola Company has available showing the package mix before and after the law. Nonrefillable bottles have remained in the marketplace and cans have lost only 20% of their prior market share over the total market. We do not consider Vermont to be a typical market either, but offer the results from their mandatory deposit law to RTI for consideration in developing their "transition model."

Nonrefillable bottle sales in Vermont fell to a lower share of market after the law than we expected. Vermont bottlers do not have the capability of bottling large size packages (48-ounce and over) themselves. They have been purchasing these packages from out-of-state bottlers and, therefore, had smaller profit margins on them. After the law there was no incentive to market large size nonrefillable bottles as value packages.

The impact of existing legislation on total soft drink package

EXHIBIT III

IMPACT OF EXISTING MANDATORY DEPOSIT LEGISLATION ON PACKAGE SALES

STATE OF VERMONT

(% OF TOTAL PACKAGE VOLUME)

IN FOOD STORES

	BEFORE		AFTER	
	PEPSI-COLA CO.	INDUSTRY	PEPSI-COLA CO.	INDUSTI
RETURNABLES	-	-	65	73
NR BOTTLES	80	75	19	14
CANS	20	25	16	13

TOTAL MARKET

(PEPSI-COLA CO. ONLY)

	BEFORE	AFTER
RETURNABLES	-	44
NR BOTTLES	65	28
CANS	35	28

sales was very different for Vermont, compared to Oregon. While soft drink volume declined off trend by 5 to 10% in Oregon, volume loss exceeded 25% in Vermont.

ENERGY REQUIREMENTS

1. Soft Drink and Beer Energy Requirements

When using energy as a basis for considering mandatory deposit legislation, several facts should be highlighted and made clear.

a. The beverage industry is an insignificant user of energy in comparison to total United States energy usage. According to RTI's estimates total energy requirements of soft drink and beer systems were only 0.5% of United States energy consumption.

b. The beverage industry uses significantly less energy per $1 of retail sales in comparison to the average GNP dollar. In comparing energy usage of different industries the beverage industry is not a major offender.

c. The beverage industry will significantly reduce its energy requirements by itself through technological improvements. RTI projects total beverage energy requirements to increase less than 4% from 1975 to 1985 while package volume increases 34% over the same period. This is a net reduction in energy requirements per unit of volume of 22.5%,

even including the very high market share RTI projects for cans.

2. Total U.S. Energy Impact

The ultimate criteria for judging the benefits of mandatory deposit legislation from an energy usage standpoint should not be energy savings within the beverage industry alone, but rather the effect on total U.S. energy consumption. This should be the only true objective of the Federal Energy Administration. The RTI report fails to recognize this critical point. The energy savings projected within the beverage industry with mandatory deposit legislation may be totally negated by increased energy requirements of other industry sectors.

- As just mentioned, the beverage industry uses less energy per $1 of retail sales in comparison to the average GNP dollar.
- Consumer expenditures for soft drinks and beer will be reduced in the event of mandatory deposits because of decline in sales and lower cost of returnable containers.
- Therefore, consumers expenditures for alternative products will increase. Energy requirements will very likely be higher on average for these products than for beverages.

3. Introduction of Plastic Bottles

Despite the extensive analysis of energy requirements of the plastic bottle by Franklin Associates, Ltd. and favorable energy outlook for both refillable and nonrefillable plastic containers, RTI chose not to incorporate these results in projecting total energy requirements for the soft drink industry. The impact of plastic bottles on energy usage by the soft drink industry could be significant. Of the sizes presently considered for commercial use (16-ounce to 64-ounce) PET bottles require approximately one-half the total system energy of conventional nonrefillable glass bottles. We believe that the plastic bottle will eventually replace many of the larger size glass bottles, resulting in considerable energy savings.

4. Per-Unit Soft Drink Energy Consumption

Our analysis of the soft drink bottler system includes the three RTI Study subsystems: filling and washing, distribution and supplementary materials.

a. Refillable bottles (10 trips)

Significant differences between the results of our detailed analysis and RTI Study appear in all three subsystem areas. The RTI finding that refillable container distribution energy is lower than for nonrefillable

containers is simply wrong. The refillable system calls for additional handling of empty containers, special trips to collect empties from retail outlets and use of heavier and bulkier bottles--all contributing to much higher energy consumption.

Based on our experience, refillable bottles require more energy for secondary and tertiary packaging (supplementary materials). This is due to increased usage of multipacks, and low trippage on them.

Using our energy values for the bottler system instead of those of RTI would increase the per-unit energy consumption of the refillable container by 59%.

b. Nonrefillable Bottles

Here too, our analysis of the bottler system indicates somewhat higher energy requirements than those developed by RTI. Similar substitution of our results will increase the overall per-unit energy requirements by only +6% compared to the +59% found for the refillable container.

c. Metal Cans

RTI details energy requirements for three can containers: bi-metal, all steel and aluminum.

We cannot understand the reason why each of these containers has different energy requirements in the above mentioned bottler subsystems. This simply does not agree with actual experience in the soft drink industry.

In summary, RTI per-unit energy requirements for soft drink bottler system appear to be incorrect, and when used in generating total energy consumption, significantly underestimate the needs of the refillable system.

BOTTLER OPERATIONS AND ECONOMIC STRUCTURE

1. Capital Requirements with Mandatory Deposits

In arriving at their projection of additional capital requirements in the event of mandatory deposit legislation, RTI assumes that "capital already in place can be perfectly substituted for the desired capital equipment" with-government-interventions. This assumption is not correct for the soft drink industry and will result in a gross understatement of capital impacts with mandatory deposits for the following reasons:

a. Cans require a different type of equipment than do bottles. Can production lines and vendors (except for some recent convertible vendors) cannot be converted to handle bottles. This equipment will become obsolete and new equipment will need to be purchased.

b. Most soft drink bottlers because of their small size do not produce cans themselves. Either a group of bottlers have formed co-operative canning facilities in a centralized location, or, they purchase cans from larger neighboring bottlers who have sufficient volume to justify investment in a separate can line. Since shipping refillable bottles back and forth to centralized facilities is not practical, a shift in sales mix from cans to returnable bottles will result in a shift in production volume from centralized canning facilities to local bottlers. Entire canning facilities will become obsolete or, at least, unde utilized, requiring additional capital expenditures by local bottlers for plant and warehouse space, and manufacturing equipment.

c. As RTI recognizes, mandatory deposit legislation will make franchise bottlers more competitive with the regional, wa house brands and private-label bottlers and canners. Vol ume shifts will result. New capital investments will be required of franchise bottlers while capital already in place for these other bottlers will be unutilized.

2. Labor Requirements with Mandatory Deposits

The fact that RTI assumed no volume loss and total elimination of nonrefillable bottles in the event of mandatory deposit legislation critically affects the findings of their

analysis. Any projected volume loss will directly reflect itself in a reduction in RTI's projected labor requirements with mandatory deposits.

3. Bottler Operating Assumptions

In developing per-unit capital and labor requirements by container type, assumptions were made by RTI which are contrary to actual bottler operations:

a. Float requirements are not only a function of velocity and annual sales, but must be sufficient to meet peak demand periods including seasonality and promotions. For planning purposes Pepsi-Cola Company bottlers use 20-25% of annual sales in determining glass float needs.

b. Average returnable bottle basket carrier trippage is at most two, instead of 2-4 as RTI assumes.

c. Filling line specifications for the soft drink industry found in Table F-2 are not realistic when compared to present equipment of soft drink bottlers. The line speeds represent 72-valve lines. Few franchise bottlers have sufficient volume to justify a 72-valve line. As an average, 40-valve line may be more typical. RTI's use of 72-valve line understates per-unit capital investment requirements.

d. Estimate of manpower requirements for soft drink beverage production and distribution by container type are directionally wrong. RTI assumes that labor requirements for distribution are related to the number of containers and that production labor requirements are related to quantity of ounces packaged. Both of these assumptions are not valid. In reality, distribution manning is a function of the number of cases, and therefore, RTI's distribution manning requirements for nonrefillable bottles is substantially understated.

PEPSICO

PURCHASE N.Y. 10577

January 23, 1976

Mr. Taylor H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

We appreciate your follow-up letter to our reply asking for additional information. It certainly shows your interest in our comments, and we trust that industry viewpoints will now be incorporated into the final study draft. We are pleased to be of further assistance to you, and, hopefully, the following data will clarify the questions which you raised.

1. Energy requirements by container type.

Our analysis of the energy requirements per unit of soft drink within the bottler system was based on actual operating data, trippages and packaging specifications of typical Pepsi-Cola bottlers, and estimates of energy requirements per unit weight for different packaging materials as developed by Midwest Research Institute in their study for EPA, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives." Appendix A shows our estimates of energy requirements within the bottler system and for supplementary materials for four different soft drink containers.

Comparing these estimates to the per-unit energy requirements in Table 2-10 in your draft report reveals the following. RTI's energy requirements (BTU/ounce) for nonrefillable bottles, 28.30 for filling and distribution and 53.41 for supplemental materials, are reasonably close to our estimates considering the present package size mix of nonrefillables. However, RTI's energy requirements for refillable bottles are lower than our estimates. Within the bottler system RTI estimates energy requirements to be 29.61 BTU per ounce. Our estimate is 20-30% higher considering the present package mix. For supplementary materials RTI estimates energy requirements to be 23.82 BTU per ounce. Our estimate is greater by 78%.

2. Distribution labor requirements

The distribution unit for soft drinks is a case and not individual containers. Because of the increased weight of larger size bottles (over 16 oz.), cases are designed to hold fewer bottles. 16 oz. and smaller containers are packaged 24 bottles in a case while 32 oz. containers, for example, are packaged 12 bottles in a case.

Appendix B has been developed for your use in determining new distribution labor requirements by package type. Note that the sales volume per truck (expressed in 10^6 ounces) is essentially the same for nonrefillable bottles as for cans. Therefore, labor requirements for these two package types should also be the same, because the same functions are performed for each and man-hour requirements vary for the most part with the number of routes (which, in turn, is basically a function of the number of cases). This includes route salesmen, route managers, sales managers, merchandisers, helpers, swingmen, auto mechanics, checkers, loaders, and miscellaneous warehouse personnel. For refillable bottles the additional functions of unloading and sorting empties will somewhat increase the labor requirements per route.

Adjusting your estimate of distribution labor requirements for nonrefillable bottles in line with the estimate for cans will increase the estimated total number of jobs in the soft drink industry presently, and will reduce the projected increase in labor requirements with national mandatory deposit legislation.

3. Construction of forecasting model in projecting soft drink sales to 1985

Our criticism of your statistical forecasting model not including qualitative factors such as changing consumer life-styles was not meant to imply that we have developed such a model. Furthermore, we know of no statistical model that has been developed which we feel actually reflects marketing variables in explaining soft drink demand. For this reason Pepsi-Cola Company does not rely on statistical modeling techniques for long-range forecasting, only for short-range projections. Industry expertise and knowledge of the marketplace are used for long-range planning.

We would like to point out again that after only two years RTI's forecasted soft drink sales already significantly differ from actual results. Estimated 1974 and 1975 sales show a flat market, at best, compared to RTI's forecast of +13.4%.

We have a similar concern regarding your package mix projections, which are probably a more critical variable in determining the effect of mandatory deposit legislation on energy requirements. We feel that your statistical projections grossly overstate the market share for cans which should be expected by 1985. Our marketing reasoning is provided in the original comments beginning on page 7.

4. Projected mandatory deposit legislation impact on soft drink volume

The methodology we used in estimating the impact of national mandatory deposit legislation on soft drink volume followed a micro approach.

a. Pepsi-Cola Company bottlers were classified into different types of markets based upon their package mix (percentage share of returnable bottles, non-returnable bottles and cans).

b. These bottler classifications were analyzed considering the following additional variables:

   1) Competitive strength of franchise
   2) Demographic characteristics of franchise area
   3) Trade profile -- retail outlet composition
   4) Importance of vending sales

c. Marketing scenarios were developed for each classification with expected volume impact on total package sales and mix. Actual sales results from Oregon and Vermont were utilized as was our marketing knowledge and experience in constructing the scenarios.

d. Projected sales impacts for the different classifications were summed to get in an estimate of impact on total U.S. Pepsi-Cola bottler all products sales.

e. Projected sales impact on other major and regional brands was developed by comparing the relative market shares and strength of these various brands versus Pepsi-Cola Company in the different bottler classifications.

f. Private label and warehouse brands were examined separately with a marketing scenario constructed estimating the probable impact of mandatory deposit legislation on a national basis.

You asked for a copy of our study of the projected impact of national mandatory deposit legislation on the Pepsi-Cola Enterprise and entire soft drink industry. This study was intended for internal use only. Due to the competitive nature of our industry we would like to retain the confidentiality of the complete sutdy. Specific results have been shared with you and our reply was based on its findings.

If we can be of any further assistance to you please do not hesitate to ask. We look forward to receiving a copy of your study in final draft.

Sincerely,

Lloyd Curtiss

Lloyd Curtiss, Director
Environmental Affairs

LC:df
Attachments

APPENDIX A

PER-UNIT ENERGY REQUIREMENTS FOR SOFT DRINKS

(BTU Per Ounce)

	Package Type			
	Refillable Bottles		Nonrefillable Bottles	
	10 Oz.	32 Oz.	10 Oz.	32 Oz.
Bottler System:*				
Production and Distribution	41.8	27.6	33.5	24.6
Supplementary Materials:**				
Secondary Packaging***	37.6	39.4	46.9	15.9
Tertiary Packaging	4.7	3.1	28.9	25.0
Total	42.3	42.5	75.8	40.9

*Based on actual bottling plant data for different type container systems. Does not include heating and lighting.
**Based on trippage and packaging specifications of typical Pepsi-Cola bottlers, and energy requirements per unit weight for different type of packaging materials as developed by Midwest Research Institute in their study for EPA, "Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives."
***Includes closure, basket and plastic carriers.

APPENDIX B

SOFT DRINK DISTRIBUTION (VOLUME PER TRUCK)

Package Type	Annual Cases Per Truck*	Ounces Per Case**	10^6 Ounces Per Truck
Refillable bottles	46,500	299	13.9
Nonrefillable bottles	65,750	327	21.5
Cans	72,000	288	20.7

*From RTI report, Table F-3.
**Developed by Pepsi-Cola Company from NSDA's "1974 Sales Survey" estimated breakdown of sales volume by package size for each package type and industry standards for number of bottles per case for different package sizes.

REYNOLDS ALUMINUM
REYNOLDS METALS COMPANY · RICHMOND, VIRGINIA 23261

RECEIVED
DEC 4 1975
ECONOMICS DEPARTMENT

December 1, 1975

Mr. Tayler H. Bingham
Research Triangle Institute
Post Office Box 12194
Research Triangle Park, NC 27709

Subject: Study of the Engineering and Economic Impacts of Mandatory Deposits

Dear Mr. Bingham:

Thank you for sending review copies of the subject study to me and Mr. R. F. Butler of Reynolds Metals Company.

As suggested in your cover letter, we have worked through the Aluminum Association which is coordinating the aluminum industry comments on this study.

Mr. Butler and I would appreciate being kept informed of any additional activities in this important area.

Sincerely,

Robert F. Testin
Director
Environmental Planning

RFT/blp
CC: R. F. Butler

Industrial Associations and Organizations

the Aluminum Association
Incorporated

750 Third Avenue, New York
N.Y. 10017

(212) 972-1800

December 1, 1975

RECEIVED
DEC 3 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
RESEARCH TRIANGLE INSTITUTE
P. O. Box 12194
Research Triangle Park,
North Carolina 27709

Dear Mr. Bingham:

This is in response to your letter of October 10, 1975, requesting comments on the draft report on the Energy and Economic Impacts of Mandatory Deposits for Beverage Containers, prepared by Research Triangle Institute.

It is the opinion of the aluminum industry that the RTI draft report has serious shortcomings and we feel there are several problems that must be corrected before issuance of the final report. The attachment details these problems and suggested changes. In summary these are:

Cost Benefit Analysis
Nowhere in the report is an overall assessment made of the capital cost required to save energy by the various scenarios. It is imperative that this report not be released without inclusion of such an analysis. Estimates, using RTI's draft report on capital requirements as the basis for computation, indicate the cost of fuel potentially saved from mandatory legislation would be 2.6-6.0 times the actual fuel value.

Fuel Components
The summary section of the report does not include an analysis of the availability of different fuels for each container. The summary must be expanded to present the consumption of each type of fuel by each container system. Fuels in critical supply (natural gas and petroleum) should be separated from fuels in non-critical supply (coal, hydro, nuclear, etc.) for each container system to provide data for determining the comparative energy impact of containers.

The Mark of Aluminum



Metal Can
The report presents energy and other data in the summary section on a composite metal can. It is paramount that data for aluminum be presented separately for the reasons discussed in the attachment under the headings: Recyclability, Material Balance, Resource Recovery, Labor Cost and Trippage.

Overall U. S. Energy Impact
RTI should present energy data in quads, rather than trillions of Btu's, to illustrate the minimal impact containers have on the national energy usage.

Consumer Attitude Material
Complete documentation and description of consumer attitudes should be included in the report. The report should also include discussion and documentation that this issue (mandatory legislation) has come before the public as a referendum on eight occasions and has been soundly defeated each time.

Material Balance
Contrary to the 16.7 percent loss used by RTI for the aluminum container recycling system, the industry's current experience is 7.8 percent, equivalent to a trippage of 11-12 for aluminum rather than the 5-6 developed in the RTI draft. Expected future improvement in recovery from 92.2 percent to 95-96 percent will result in losses of 4-5 percent and a trippage potential of 18-20. The material loss figure needs to be corrected and the resulting net aluminum energy consumption figures in the report need to be adjusted accordingly.

Recycling
The draft RTI report limits the recycling of aluminum to 50 percent. To provide a mid-range scenario for aluminum, recycle rates of 80-90 percent for aluminum cans should be included.

Labor Requirements
The aluminum industry finds no basis for the high labor requirements shown for recycled metal cans. The figures in the report should be reworked to reflect the actual exceptional labor efficiency being realized in recycling aluminum.

Effect on Resource Recovery Systems
In analyzing the impacts a shift to mandatory deposits would have on resource recovery, RTI states that removal of half the recoverable amount of glass and aluminum from the solid waste stream would result in a 22 percent reduction in the revenue potential of solid waste recovery. This statement should be qualified as the least possible impact. Data included in the RTI report lead to the conclusion that the reduction in revenue potential could easily be 40 percent.

Conclusions
It is mandatory to modify the word "conclusions" used in the RTI draft report to "observations based on the assumptions and scenarios considered." In addition, the specific items listed in this paragraph should be reworded to correctly indicate what the study shows.

We trust you will receive these comments in the spirit of constructive criticism. We urge that they be given careful consideration and that the final report reflect the recommendations made. If there is any question on any of the points, we would be pleased to discuss them with you. We would be pleased to provide any additional information or help that you request.

Most sincerely,

THE ALUMINUM ASSOCIATION

J. J Goldsmith

S. L. Goldsmith, Jr.
President

SLG/nm
Attachment

cc Mr. Roger W. Sant, Assistant Administrator
Conservation & Environment
Federal Energy Administration

COMMENTS ON DRAFT REPORT ON

ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS FOR

BEVERAGE CONTAINERS

PREPARED BY RESEARCH TRIANGLE INSTITUTE

The Federal Energy Administration, Research Triangle Institute and Franklin Associates, Ltd. are to be commended for their efforts to examine in depth the energy and economic factors relating to beer and soft drink containers. This study is perhaps the most exhaustive of all of those conducted to date on this issue. We are hopeful that the proper use and interpretation of the data will correct much of the misinformation and many of the preconceived conclusions of the past.

With several clarifications, corrections and additions, the aluminum industry feels that the report would be considerably improved. As you will note, the majority of our analysis and comments relate to those portions of the report dealing with aluminum.

CONCLUSIONS (OBSERVATIONS)

It is inappropriate to call the five numbered items on page 1-9 "Conclusions" since all possible scenarios and variations of assumptions were not considered. Further, the items should be revised to correctly indicate what the study shows. It is suggested that the paragraph be revised to read: "Based upon the scenarios considered, the assumptions made, and the limitations of the mathematical models, one may observe the following possibilities:

1) There will perhaps be a net decrease in direct energy requirements.

2) There will be a substantial increase in capital requirements.

3) There will be dislocations in the job market with potential increases in the labor requirements over the short-run, but possibly decreases over the long-run.

4) There may be a net increase in labor earnings for most metal can market shares and metal can return rates.

5) The revenue potential of municipal solid waste may be decreased significantly thus having impacts on the municipal solid waste market and cost effectiveness of municipal waste energy recovery processes.

FUEL COMPONENTS

RTI is to be complimented on its attempt to assess natural gas, petroleum, coal, etc., with regard to their utilization in the beverage industry.

With regard to pages 2-30 through 2-33, the material is marginal in that it only gives the two dimensional aspects of the question. To complete this analysis and presentation, it would be of considerable use in the decision-making process to know how the various fuels are used in the production of each of the containers. That is, for aluminum can production, how much petroleum, natural gas, coal, etc., is used for each of the production levels assumed? With such information, particularly as to the energy which is derived from domestic energy production, one would not only have better decision-making material, but better material for verification by industrial practice.

Indeed, the key issue involved is the impact of mandatory deposits upon the potential for saving petroleum and natural gas. It is therefore recommended that more detailed presentation be given and analysis made of the fuels used for the various containers. Without such additional analysis and presentation in the summary chapter, the findings such as those in Table 2-9 on page 2-27 are deemed to be somewhat misleading and exception is taken to inclusion of it.

METAL CAN

Inclusion of aluminum and steel together as a "metal can" in the summary section does not present the advantages of aluminum as a separate material. It is paramount that the data be presented showing steel and aluminum as separate containers for the reasons discussed under the following headings: Recyclability, Material Balance, Resource Recovery, Labor Cost and Trippage.

RECYCLABILITY

Recycling of aluminum cans has been demonstrated as a viable system. In 1974, 17 percent of the all-aluminum cans sold in the U. S. market were recovered in 1,300 recycling centers across the country. In the absence of deposit legislation,

the aluminum industry projects that aluminum can recycling will reach as high as 50 percent by 1980 and as high as 70 percent by 1985 on the basis of current economics. The likelihood of reaching these projections is demonstrated by the fact that in the first nine months of 1975, more than 22 percent of the all-aluminum cans sold in the U. S. market were recovered.

It is necessary to reflect this information in the report and correct other data indicated to properly present the advantages of aluminum as a separate material.

MATERIAL BALANCES

Through an apparent misunderstanding, the material balance for the production of primary aluminum and the reclamation of recycled aluminum is substantially in error. This needs to be corrected and the resulting aluminum energy figures adjusted accordingly.

Page 1-3 of the report states with regard to metal cans "only an estimated 87 percent of the returned containers can be recycled since there are losses in handling and shipment plus melt losses in converting containers to molten material." This is also discussed on page 2-29. This figure apparently represents a composite between aluminum and steel and penalizes aluminum in the analysis. The figure was apparently derived from a steel recovery of 89.9 percent and an aluminum recovery of 83.3 percent. The aluminum loss was erroneously derived as:

handling loss percent 6.7 percent
melt loss percent 10.0 percent
total loss percent 16.7 percent
recovered metal = 100 percent less 16.7 percent
or 83.3 percent

The correct melt loss percent for aluminum is 3.1 percent and the total recovered percent is 96.9 percent on an input basis. As indicated in our material balance submitted on June 30, 1975, the total aluminum loss is only 7.8 percent on an output basis. Thus, 100 percent recycle would result in a 92.2 percent recovery on an output basis, equivalent to a 11-12 trippage rate. Anticipated industry improvement in recovery from 92.2 percent to 95-96 percent will result in equivalent trippage of 18-20.

For the reasons stated above the material balances shown on pages D-68 and D-69 of the report are in error.

Steel and aluminum recoveries should be separated in the report and the aluminum figures should be corrected. This will also alter the net aluminum can energy and economic figures.

RESOURCE RECOVERY

In analyzing the impacts a shift to mandatory deposits would have on resource recovery, the draft fails to consider that glass and aluminum recovery could be uneconomic if half the recoverable amount of glass and aluminum were eliminated from the waste stream. On page 1-9 the statement is made that "mandatory deposits...result... 22 percent reduction ($1.73 per ton) in revenue potential of solid waste." That is the least impact, and it could easily be 40 percent ($3.17 per ton of refuse) not 22 percent using the figures presented on page 3-30 and assuming glass and aluminum recovery would be uneconomic without nonreturnable beverage containers.

The draft concludes on page 3-31 that only in the "most marginal of situations" would elimination of beverage containers from solid waste (a loss of revenue of 22 percent) alter the decision to install a resource recovery system. This statement is in error. Clearly a reduction of 40 percent in expected revenue will affect more than the "most marginal of situations."

LABOR COST

Table 1-3 on page 1-8 of the summary shows high labor requirements for reprocessing metal cans. This is discussed further in the fourth paragraph on page 3-22. Such figures that show high labor requirements for handling returned aluminum cans are not consistent with actual industry experience. Today the industry collects and reprocesses aluminum cans for about eight manhours per ton and remelts and recovers aluminum can stock ingot for another two manhours per ton of recovered product. This total industry expenditure of about ten manhours per ton, exclusive of the time required to collect and deliver them to the recycling center is, in fact, equal to the approximate ten manhours per ton required to produce primary aluminum metal from alumina. When the manhour requirements for bauxite mining, alumina processing, and related ancillary operations (e.g., coke and electrolyte production) are included, the production of aluminum via the recycling process is much more labor efficient than the already labor efficient primary metal production process.

Steel and aluminum recoveries should be separated in the report and the aluminum figures should be corrected. This will also alter the net aluminum can energy and economic figures.

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TRIPPAGE

To present the 6.4 and 10.4 trip experience as a floor for trippage for soft drinks and beer respectively cannot be substantiated under a mandatory deposit system. The concept that deposits on refillables will be raised to get to these trippages cannot stand alone. It must be included in the overall economic analysis and factors such as the effect on consumption must be included.Figure 2-8 on page 2-16 projects by the early 1980's trippage of returnable bottles will decrease from 13 to 10.4 for beer and from 10 to 5.4 for soft drinks. In analyzing the sensitivity of these projections, RTI chose to consider only what would happen if the projected return rates increased to 18. A similar sensitivity analysis should be made considering return rates of 5-6 for beer and 3-4 for soft drinks. In addition to a sensitivity analysis, RTI should also calculate the impact of lower trippage on energy, capital and labor requirements as currently shown in Tables 3-5, 3-7 and 3-10 respectively, on pages 3-14, 3-18 and 3-24.

COST BENEFIT EVALUATION

Nowhere in the report is an overall assessment made of the capital cost required to save energy by the various scenarios. It is surprising to find such an assessment omitted from a report as important as this one. The FEA certainly would want to weigh the benefit of any conservation option against the capital cost required especially as it would affect consumers. It is imperative that this report not be released without inclusion of such an analysis. Based on capital requirements in the RTI draft report, a barrel of fuel potentially saved from mandatory legislation would cost 2.6-6.0 times its actual value or $26.00 to $60.00 per equivalent barrel of oil using a current market value of $10.00 per barrel.

CONSUMER ATTITUDE MATERIAL

Based upon the title of the study and its objective, there would appear to be little need for inclusion of material on public attitudes. If such is to be included, then considerably more material should be given than is presented. On page 2-2, it is stated that when questioned, the public has consistently supported mandatory deposits. In the body that follows, only two surveys are noted. Two studies would hardly be considered the basis of consistent support. Further, the material presented is both inadequate to describe the findings of the

total studies and misleading without more complete information. Unless the public attitude material can be demonstrated as germain to this particular study, and unless it can be substantiated with adequate material to give it statistical validation, then it should be deleted. It is recommended that, at a minimum, the consumer attitude section include the fact that this issue has come before the public as a referendum on eight occasions and has been soundly defeated each time.

ECONOMIC AND ENERGY IMPACTS

Exception must be taken to the presentation of information such as Table 1-3 on page 1-8 which reportedly presents a summary of the net energy and economic impacts of mandatory deposits. Exception is taken on the basis of:

1) Insofar as the report is concerned, the energy values presented are for direct energy only. They do not include either the indirect energy associated with the overhead operation of the industries involved or the indirect energy associated with the capital expenditure or labor requirements. Since either of these cases would materially effect the values given in Table 1-3, as well as their back up in the body of the report, it is believed that these values are misleading. It is quite possible that all values will be positive when these additions are made thus indicating that all of the scenarios considered will have deleterious effect on the economy and on our energy resources;

2) the capital requirements are estimates based upon economic modeling and not based upon real industrial situations. To adequately evaluate the capital requirements necessitates a complete and total survey of all industries involved with their verification of funding necessary; and

3) the labor requirements are not in line with standard industrial practices. To adequately evaluate the labor requirements also necessitates a complete and total survey of all industries involved with their verification of necessary labor.

It is strongly recommended that this Table be modified in accordance with the above comments.

DATA PRESENTATION

The RTI report, by presenting data in terms of trillions of Btu's, perpetuates the notion that beverage container systems

require a great deal of energy. It would be highly desirable, we believe, for the Federal Energy Administration to put this in perspective by indicating what percentage of the national energy consumption would be saved by the various packaging alternatives discussed in this report. It is also suggested that data be presented in quads of Btu's which is the accepted terminology in measuring energy on a national level.

DOCUMENTATION

There are numerous tables, flow graphs and charts which are not documented sufficiently to enable verification. For example, reference to page number and publication should be given rather than simply: "Source: U. S. Department of Labor, Bureau of Statistics."

We would be pleased to amplify on the above comments.

W. W. Pritsky
Energy Manager
The Aluminum Association
December 1, 1975

CMI
CAN MANUFACTURERS INSTITUTE

1625 MASSACHUSETTS AVENUE, N.W., WASHINGTON, D.C. 20036 ☐ 202/232-4677

November 26, 1975

RECEIVED
DEC 1 1975
ECONOMICS DEPARTMENT

Research Triangle Institute
Research Triangle Park,
North Carolina 27709

Gentlemen:

The Can Manufacturers Institute finds it extremely difficult to comment substantively on the Research Triangle Institute draft report "Energy and Economic Impacts of Mandatory Deposits," because the report is in its essence confusing. As we have been attempting to state since this issue was first raised several years ago, each of the possible impacts of container deposit legislation is so complex that a delineation of effort in terms of numbers is little more than a guessing game.

Nonetheless, we will discuss briefly five specific areas:

(1) It is difficult to challenge survey findings gathered by a firm as distinguished as Opinion Research Corporation without knowing the questions asked. However, our experience with other mandatory deposit questions is that they play on emotional issues by implying that the return to a two-way system would reduce or eliminate highway litter and result in a cleaner environment.

People uninformed about beverage consumption habits neglect to take into account that a commitment to a particular container (once or repeatedly) involves many real factors (economy, convenience, safety, space requirements and cooling efficiency) which influences consumer's attitudes toward containers and container purchasing decisions. Thus a question which elicits a response based solely on one issue can produce misleading information.

A perfect example of this surfaced in Dade County, Florida. Some months prior to the vote on the referendum, consumers were surveyed on a similar question and the results were overwhelming in favor of a mandatory deposit.

When exposed to the real issue at the polls the consumers of Dade County voted against the deposit. This same scenario with minor variations has been repeated in all seven other localities where referenda gave the consumer a free choice to vote -- 1970, Washington State; 1971, Juneau, Alaska; 1973, Bridgeton, Maine; 1974, Coon Rapids, Minnesota; 1974, Crystal, Minnesota; 1975, Ypsilanti, Michigan; 1975, Eau Claire, Wisconsin.

(2) Generally, we found the volume projections and comments for beer to be consistent with ours. However, some areas of considerable difference occur in carbonated beverages.

Soft drink consumption is projected to rise at a compound rate of 4.9 percent for the period 1973-1985. We feel an approximate 4 percent level is more accurate. We feel packaged soft drink consumption growth will average 4-5 percent per year versus the 3.28 percent.

We cannot dispute the assumptions made by the contractor with respect to consumption under a mandated deposit system, but it must be emphasized that there are indeed assumptions and without technical basis.

The R.T.I. report indicated can growth of 6.73 percent per year through 1985. We estimate growth closer to 4 percent due to the anticipated continued inroads of large-size packages.

(3) Table D.7-1 on page D-92 describes a two-piece D&I steel body weighing 78.8 pounds in 1985. We are sure this is a misprint but are concerned that perhaps this figure was unintentionally used in calculating future energy usage. We know that you are aware that although the nominal weight of most D&I steel can bodies today is about 77 pounds, there are two commercial can-making operations producing, very successfully, a 66 pound steel two-piece can. Did you use the can of the future weight, 66 pounds, which is being commercially produced today in your energy calculations?

(4) We would now like to compare two of the many scenarios and sensitivity analyses developed in the forecast model which includes not only energy and economic factors but societal considerations.

The present complex beverage system is characterized in the report as requiring 367×10^{12} BTU's of energy per year, which is approximately 0.5 percent of the total U. S. demand for energy.

We feel it is appropriate to compare that scenario with the scenario in the report that calls for mandatory deposit legislation in 1980. The can manufacturing community believes such legislation would force the beverage can to near obscurity in the marketplace. Therefore, the scenario which predicts all trippage return rate (in the range of 13-18 round trips) must be considered. That scenario, according to the report, will reduce the beverage systems energy needs from 397×10^{12} BTU's per year to 144×10^{12} BTU's per year in 1980.

Based on current forecasts without any Government intervention, the total energy required for the beverage system would be 397×10^{12} by 1980 or approximately 0.49 percent off the projected annual U. S. demand for energy. The energy demand will be slightly less in 1980 than it is in 1975. This will reflect both an increase in production and a decrease in metal brought about by technological advances. No Government intervention is necessary nor new major capital expenditures or societal behavioral changes are required to achieve this.

(5) An additional $6.8 billion in new capital will be necessary to support an all returnable system. That is double what the present system will require by 1980. If $6.8 billion is invested in the "all returnable system," the payback on that investment would be 10.5 years, with all types of energy equated to barrels of crude oil at $15/barrel.

If the difference in annual energy requirements of the two beverage systems is 253×10^{12}, we believe it imperative to consider the economic and capital requirements of other types of conservation goals forecast by FEA.

Compare the 253×10^{12} BTU'S per year gain from the all returnable system to FEA's conservation goal reported to be $9,000 \times 10^{12}$ BTU's per year. If the other types of conservation programs are as capital intensive as the all returnable system, the capital required will total approximately $253 billion or 10 percent of all the capital required for all purposes in the 1980-1985 period.

It is not appropriate to consider the total energy requirements of the two systems as crude oil equivalency. You must emphasize the specific types of fuels required in each of the two systems. Of the total purported energy goals in the all-returnable beverage system, 41 percent of any gain is in coal as the primary energy source, which is generally conceded to be the most abundant energy resource within the U. S.

We appreciate the opportunity to comment but had great difficulty in our sincere effort to be helpful.

Sincerely,

Barclay T. Resler

Barclay T. Resler
Manager, Government Relations

Glass Bottle Blowers Association
of the United States and Canada (AFL-CIO)
608 EAST BALTIMORE PIKE • MEDIA, PENNSYLVANIA 19063

Harry A. Tulley
International President
James E. Hatfield
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Lee W. Minton
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International Vice President
Willard L. Cox
International Vice President

January 16, 1975

Mr. Morris Zussman
Deputy Administrator
Federal Energy Administration
Old Post Office Building
12th & Pennsylvania Aves.
Washington, D.C. 20401

Dear Mr. Zussman:

I have recently checked the Research Triangle Institute study done for the F.E.A on energy.

This report is no better than the many other energy reports done on energy. It is not surprising though when they used information from the EPA, or biased information paid for by the EPA (with tax dollars), Ouija Board professors, etc.

I would like to point out some areas which were not even considered by these people, probably because they didn't know what they were looking for in the first place.

1. Job losses: (Bottle Manufacturing)
A. Immediate Impact:

Because of the added weight required for a returnable vs. a non-returnable bottle the manufacturing process must operate at a much slower rate for the following reason:

(1) It takes longer for the actual forming of the container.
(2) The annealing process must be greatly reduced for the added time to gradually reduce the temperature of the bottle.

Because of the slowing of the process, much less manpower is needed at all points in the manufacturing process from the unloading of the raw meterials, mixing of the materials, forming machine operators and upkeep men, inspecting and packing personnel lehr unloading personnel, quality control personnel, and shipping personnel.

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William W. Russum
James M. Thompson
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Gilbert Shepherd, Jr.
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Samuel R. Horton, Jr.
Edward M. Owan
Robert L. Mallars
Billy F. Webb

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B. Long Term:

Once the "float"* is established the need of total personnel has been projected to decrease 40.5% below the present work force (based on a trippage of 15).

C. Mold Makers are highly skilled personnel requiring a 4-year apprenticeship. There would not be sufficient mold-makers to supply the thousands of new sets of molds and new personnel would not move into the apprenticeship knowing that, in a few short years (probably less than the total time of the apprenticeship), that there would be no use for their skills because there would be no need for a large amount of bottles because of the returnable system.

D. We are fearful that the multi-million dollar metal container industry will not "roll over and play dead" when they are put out of business by non-returnable legislation but will come out with some new type of container. Because metal cans are less labor intensive (per gross) this could very well put our industry in deep trouble.

2. Energy Consumption:
A. Immediate Impact:

Thousands of sets** of molds and mold equipment would be useless as heavier molds and equipment must be used for heavier containers and the markings indicating them as "no deposit, no return" would also render them useless. These molds weigh from 50 to 125 pounds each. They are made of cast iron and must be shaped from raw blanks. The equipment used with each set of molds are also made of iron and must be molded and machined. The total energy used in the mixing, melting, forming and machining of these thousands of sets of molds and equipment would be astronomical.

(1) The forming time of heavier bottles is longer. The molds and equipment are heavier. All this requires more (heat) energy.

(2) The longer periods of heating and the extra heat required reduces the life span of the molds and equipment and the replacement is expensive and energy consuming.

*(Bottles needed to fill the pipeline in the returnable system).
**Sets range from 8 molds for a Section Machine (single gob) to 38 molds for a 10 Section (triple gob) Machine.

To Sum Up:

The immediate impact on job loss would be much more severe than you have projected. The future impact on jobs could be much greater than you have projected.

The immediate impact on energy would be astronomical. And this at a time when the crunch is at its worse. The future impact on energy would be greater than you have projected.

Sincerely,

Harry L. Moore
Director of Legislation

HLM:dds

L-177

Glass Bottle Blowers Association
of the United States and Canada (AFL-CIO)
909 EAST BALTIMORE PIKE • MEDIA, PENNSYLVANIA 19063

Mr. Morris Zussman
Deputy Administrator
Federal Energy Administration
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February 9, 1976

Mr. Morris Zussman
Deputy Administrator
Federal Energy Administration
Old Post Office Building
12th & Pennsylvania Aves.
Washington, D.C. 20401

Dear Mr. Zussman:

L-178

I have received a letter from Mr. Bakke requesting comments on the R.T.I. study. This is the fourth letter I have written on the subject. One to the R.T.I., one to Mr. Bakke and two to you. I only mention this to you because Mr. Bakke indicated that the F.E.A. had not received comments from me.

As I stated before, I feel the R.T.I. study is full of suppositions, erroneous materials furnished by very biased individuals and organizations, inconclusive, a waste of tax payers money and isn't even a good shot-gun guess. First I call your attention to the R.T.I. study done for the EPA in July 1972, in which they state:

P. 14 - 2.2.5 Energy: (quote) In a recent study the energy requirements of the current beverage container systems were estimated at 0.34 percent of the total U.S. energy demand. (unquote) It further quotes - If the industry converted entirely to refillable containers, this would reduce the beverage containers share of total U.S. energy demand to about 0.19 percent. (unquote)

P. 17 - (quote) It does not appear reasonable to describe the beverage container problem as a problem of natural resource or energy utilization. It is a small user of these resources both absolutely and when compared to other consumer items. This is not meant to imply, however, that natural resources and energy are not being consumed too rapidly. They may be; however, a more complete approach would be to examine the present and future demand and supply conditions for our resources and then establish a policy regarding their overall rate of use rather than controlling one product class. (unquote).

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Billy F. Webb

The EPA didn't like this report. It did not coincide with what they had been preaching so they had other studies done (at tax payers expense) with input more suitable to arriving at their desired results. Not one time did these people ask us for our opinions.

Now we have another R.T.I. study and I say to you that it isn't worth the paper it is written on. In considering the energy used, or to be used, by the container industries you must look at the "total" picture. The R.T.I. study does not do this. They have simply taken a lot of "ouija board" data arrived at by some of the most biased, unqualified people in the country and, using their own "ouija board" came up with a study that even contradicts their own earlier report.

As I pointed out to you in an earlier letter, the report completely ignores the devastating effect on the immediate consumption of energy that would be required to convert to a returnable container in the areas of molds and mold equipment machinery, annealing time for heavier containers, and the equipment and materials and transportation required for A.C.L.* processes.

I go into details much deeper in the attached document which, by the way, shows the results of 10 energy studies as compiled by the Colorado School of Mines Research Institute. I hope you will take a good look at this material. It will prove to you how ridiculous the studies that have been done on energy have been. It is pretty bad when we are asked to make decisions based on opinions that differ from 40% to 154%. And I might add that the "Testin" study included data compiled by the Midwest Research Institute after the R.T.I. report was junked by EPA.

I again suggest that you accompany me to a plant to show you first-hand where the studies are in error. I honestly believe that, I as a layman, could prove to you how worthless the studies are and give you some concrete basis to make decisions on.

Sincerely,

Harry L. Moore

Harry L. Moore
Director of Legislation

HLM:dda
attachment

*Applied Color Labeling (A.C.L.).

ENERGY AND NON-RETURNABLES

How accurate are energy studies? Can we afford to take a chance on the livelihood of thousands of families on the basis of "energy" studies?

Would you want to put your family's livelihood on the line with a 154% chance of being wrong?

The Colorado School of Mines Research Institute took 10 energy studies.* The difference of opinion on the energy used for 7 different beverage containers ranged from 40% to 154%; and ranged up to 2676 B.T.U.'s (difference) for one container. With millions of containers being made the error in their calculations could run into trillions of B.T.U.'s.

The following table shows the author of the study. The highest and lowest calculations for the seven containers and the difference of opinions changed to percentages.

12 oz. Container

10 trip Glass

American Can Co. (1974) -	2595	B.T.U.
Food and Drug Adm.(1975)-	1023	"
Difference	1572	" or 154%

One-Way Glass

Testin (1974) -	6704	B.T.U.
Monsanto Co. (1973) -	4200	"
Difference	2504	" or 60%

Steel Can

Hannon (1972)	5455	B.T.U.
American Can (1974) -	3907	"
Difference	1548	" or 40%

Aluminum Can - (16% Cycle)**

Testin (1974) -	7928	B.T.U.
Owens-Illinois -	5672	"
Difference	2256	" or 40%

*Many of these studies are being used by environmental groups to lobby for legislation banning non-returnable containers.

**Percent Recycled.

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Plastic Coated Glass

Testin (1974) -	6338	B.T.U.
Owens-Illinois -	4481	"
Difference	1857	" or 41%

Plastic Bottle

Testin (1974) -	6749	B.T.U.
Food and Drug (1975) -	4073	"
Difference	2676	" or 66%

Aluminum Can (50% Cycle)

Haller (1973) -	5831	B.T.U.
Berry & Makino (1974) -	4163	"
Difference	1668	" or 40%

The 10 Studies were done by: (compiled by C.S.M.R.I.)

Atkins (1973)
Haller (1973)
Hannon (1972)
Berry & Makino (1974)
Owens-Illinois
Midwest Research Institute (1974)
Food and Drug Administration (1975)
American Can Co. (1974)
Testin (1974)
Monsanto Co. (1973)

Although these studies include energy usage from the mining of the ore to the final use of the container, they do not include the tremendous effect that the conversion to a returnable system would have on energy. A few of the many effects not considered are:

1. Thousands of molds used in the manufacturing of non-returnable glass containers would become useless and would have to be junked and replaced with new and heavier molds for the manufacturing of returnable containers. These are made from iron. Following the same procedure of calculating of energy use from the digging of the ore to the melting, forming and machining of these molds, ranging in weight from 25 to 125 lbs. per mold, and the added heat needed to maintain higher temperatures of these heavier molds for longer periods of time (because of the added weight of the container), the energy consumption would be astronomical.

2. Added to the above would be the additional energy needed to maintain temperatures in the annealing ovens which must be run much slower because of the time needed to anneal heavier returnable containers and you have another astronomical increase in B.T.U. consumption.

3. Relabeling or ACL* decorating labeling of returnables consumes a tremendous amount of energy. The manufacturing of paper labels and the manufacturing of paints, the transporting of containers to the ACL areas, the unpacking and repacking of containers, the energy used in running ACL machinery, the energy used in the heating of the firing in lehrs, the operating of the lehrs and the retransporting of the labeled containers consumes tremendous amounts of energy not used for the non-returnable system.

All facets of a change over to a returnable system and the usage of energy must be considered. When this is done, the energy picture completely changes and the returnable system would consume much more energy than has been predicted and at a time when we can least afford to increase our consumption.

Harry L. Moore
Glass Bottle Blowers Association, AFL-CIO

*ACL - Applied Color Lettering.

November 28, 1975

Mr. Morris Zusman
Office of Energy Conservation
and Environment
Federal Energy Administration
Washington, D. C. 20461

Dear Mr. Zusman:

By notice published in the Federal Register on October 20, 1975 and by extension notice published on November 18, 1975, thirty-nine (39) days were allowed for comment " . . . on a study of economic and energy impacts of mandatory beverage container deposit legislation. . ."

The study, performed by Research Triangle Institute, was intended to:

> "Perform research to analyze the energy and economic impact of eliminating one way soft drink and beer containers and obtain and rebut, where necessary, comments from industry." 1/

Seven tasks were set forth in the contract for the study, which will be discussed subsequently.

Confronted with the apparent bias expressed on the face of the contract and numerous previous studies in these areas which were based on questionable assumptions and incomplete data, the Glass Container Manufacturers Institute deemed it necessary and appropriate to call upon the assistance of an independent research organization of world-wide reputation. It was further felt that such expert assistance was required because of the time constraints whereby Research Triangle Institute was allowed the grossly inadequate period of four months to perform all seven tasks.

1/ Contract No. CO-04-50175-00, dated March 27, 1975.

Accordingly, GCMI retained the services of Stanford Research Institute to conduct their own 1985 energy profile of the glass container industry and to critique the work of RTI. Two draft documents are attached, one entitled: "Prospects for Energy Savings in Glass Beverage Container Systems by 1985."

At an early date in their work, both RTI and Messrs. Franklin and Hunt were informed that we were unwilling to make unresearched and unsupported projections as to the 1985 energy profile of the glass container industry. We also informed them that we had retained SRI to assist us in constructing such a profile, and we provided an opportunity for Messrs. Franklin and Hunt to meet with technical people from our industry and with SRI.

While the RTI draft on the energy aspects of glass containers does not appear excessively erroneous, we do have objections to many aspects of it and we request that the enclosed work of SRI be incorporated into the final RTI study in terms of all 1985 projections in the glass container profile, and that the entire SRI report be included as an appendix in accord with the intent of Task Seven of the contract.

The second SRI document attached is entitled: "Evaluation of Review Draft of Report Titled 'Energy and Economic Impacts of Mandatory Deposits' sponsored by the Federal Energy Administration under contract with Research Triangle Institute."

Due to the time constraints (i.e., thirty-nine days for review and comment) and the unavailability of background material such as computer programs, SRI was unable to provide a page by page critique of the economic aspects and projections of the RTI draft report. Accordingly SRI has limited its comments to the major overall shortcomings of the RTI report.

We believe that the comments made and the questions raised by SRI are of such substance as to put in question the credibility and usefulness of the RTI report. SRI states that the " . . . work treats only a few of the major considerations which must be weighed in judging the consequences of such legislation", "predictability of the actual consequences of the proposed legislation is quite limited. This is the most important conclusion about the report as it substantially lessens the credibility of all the

analytical work involved" and "the capital write-offs and operating adjustments costs of several industries have been omitted. . ." (Again, we request that this second SRI draft document of evaluation and review of the RTI study be included in the appendix.)

In the light of these and other questions and comments by SRI, we urge that the FEA reject the RTI report as inadequate and non-responsive to the contract. (The non-responsive aspects are set forth hereinafter.)

Further, we would like to note that neither SRI nor GCMI nor any company in the industry to our knowledge was at any time approached or solicited for specific information germane to the economic aspects of the RTI draft report, although an offer of such assistance was made by myself and Mr. Ken Van Tine on behalf of the industry at two meetings with Mr. Taylor Bingham.

As to the contract itself, and as to the Seven Tasks specified, we wish to make the following observations.

On page seven the following representation appears:

> "The Contractor represents that he is not now performing, has not previously performed, and does not at this time contemplate performing for any other public or private agency, effort that duplicates work described in this contract."

Unless the work "duplicates" is stretched to extraordinary lengths, we question whether this condition is met by the contractors.

As to the Tasks themselves, they have not been completed. For example, Task Four regarding regional methodologies has scarcely been touched, as is the case with Task Two, examination of " . . . factors relative to current supply and availability of raw materials, sales outlooks and trends, cost of raw material price history and trends, and identification and demands of major users for both non-returnable and returnable containers."

The omissions and partial performance are readily attributal to two factors; there simply wasn't time in four months to even begin to cohesively collect, correlate, and understand - if indee

it is possible to do so at all -- all the matters comprehended in Task Two; and secondly, the contractors are dependent upon the affected industries, suppliers, distributors, etcetera to provide them with the relevant facts, information and opinions. When these entities are not even asked for such input, obviously no intelligible study can be performed.

Perhaps these observations are harsh, but they should be. The RTI "study", despite all its fallacies and shortcomings, will, in the weeks and months ahead, be cited time and time again as "gospel," paid for and approved by the Federal Energy Administration of the United States Government.

But, simply to reject this study in not sufficient. The whole cannot be put down to a wasted exercise, because certain inescapable conclusions must be reached by the FEA: (1) the economic and energy consequences of deposit legislation cannot realistically be "studied" in this manner; (2) the economic costs in terms of loss of employment and capital are of a major magnitude and the full disruptive consequences cannot be predicted; (3) the industries will make substantial energy use savings in the next five to ten years because of increased fuel costs and competitive pressures.

Sincerely,

William W. Sadd

William W. Sadd
President and General Manager

Enclosures

Glass Container Manufacturers Institute, Inc.

December 23, 1975

Mr. Morris Zusman
Office of Energy Conservation
and Environment
Federal Energy Administration
Washington, D. C. 20461

Re: Comments on RTI Report "Energy and Economic Impacts of Mandatory Deposits"

Dear Mr. Zusman:

We begin these comments with a quotation from the RTI Report "In evaluating the results presented in this report, the reader should keep in mind that the beverage production and distribution is very complex and that packaging has a critical effect on the system. Any attempt to describe the system in terms of only three markets each for beer and soft drinks (the refillable bottle, non-refillable bottle, and metal can markets) as is done in this study, is bound to ignore many factors that will influence the final set of impacts that will obtain if mandatory deposit legislation is enacted on a national scale. Furthermore, the set of impacts analyzed in this study, while they include some of the more important issues, do not necessarily provide the complete set of impacts required for a comprehensive cost/benefit evaluation of mandatory deposits . . ." (Pages 1-2, 1-3).

This paragraph appropriately sets the tone for GCMI's comments and, for that matter, should for most other reviewers of this report. GCMI agrees with the above paragraph wholeheartedly as far as it is quoted, for it is an acknowledgement by the writers of their inability to perform the task.

We cannot, however, agree with the final sentence of the paragraph which seeks to expiate the admission by adding, "Nevertheless the material presented can provide an important input to an informed decision-making process." Even if the material that was presented could provide an important input to a decision-making process, the probability that only fully informed people capable of making a decision will be reading this report is very remote.

Further we do not believe that the report can provide input for an informed decision because of the many erroneous comments, the important ommissions and the host of assumptions. Therefore, the following 9 comments need to be emphasized by discussion. We shall later call attention, page by page, to certain statements given as fact which are erroneous, not documented, or are highly controversial even among the most informed investigators.

1. Assumptions

In attempting to determine the number of assumptions made in this study, one need only underline each time the word "assume" is used in the first chapter (that is where we stopped counting since we were finding two or three to the page), to come to the startling conclusion that this whole report is based on many unsubstantiated assumptions. A model that has not been validated cannot be used for any intelligent purpose, and we feel that not only has this model not been validated, but it cannot be validated because of its incomplete nature and the complexity of the problem.

2. Flexibility

The report fails to take into consideration the fact that the glass container industry by virtue of the abundant natural resources used and its overall production system, has many opportunities for accomplishing savings in energy. This has lead to a concept of flexibility perhaps unique to this industry. This flexibility can best be understood by referring to the SRI Report, "Prospects for Energy Savings in Glass Beverage Container Systems by 1985", Page 16-17, Table 3, where many fuel saving opportunities are listed. For example, we have flexibility in the raw materials (all of which are non-critical resources), of our processes, flexibility in the manufacturing processing itself, flexibility in the type of fuel that is used in certain process steps, and flexibility in meeting market trends and demands with less energy-intensive glass containers. To accomplish the "predicted savings" by SRI of 23% by 1985, or even the "achievable savings" of 44%, it is not necessary as pointed out by SRI for all of the items listed to be completed or perfected - there is, as stated, inherent flexibility.

3. Investment Capital

The RTI writers seem to misunderstand or misapply the nature of investment capital, as illustrated on many pages of the report. As one example, on Page 3-19 it is stated: "Also, subtracting the without- from the with-government-intervention projections of capital requirements assumes that the capital already in place can be perfectly substituted

for the desired capital equipment." The statement is confusing, but whatever interpretation is given to it, it is highly impractical to make this assumption. Any government intervention which restricts one portion of the beverage system and promotes another is obviously going to result in extensive capital outlays and losses. One commodity which may be in even shorter availability than energy in the United States is investment capital. Many of the options studied by RTI would require tremendous capital investment to bring about the needed production and use of certain of the packaging systems being considered. To restrict one industry and expand another by mandatory regulation at the cost of investment capital is a dubious procedure. Whenever the capital requirements to accomplish possible savings in energy results in expenditures far in excess of projected energy savings, the intervention is clearly unjustified. For example, when energy costs increase two or three times over present costs (equivalent $25 a barrel oil) then, the expenditure becomes self defeating. An attendant result could be critical reduction of investment capital which could much better be utilized in oil exploration, coal conversion, and energy conserving measures.

The magnitude of the capital costs involved versus the value of energy saved, certainly casts considerable doubt on the economic feasibility of mandatory legislation--- especially in the perspective of potentially serious constrai on investment capital availability for both private and public needs in the decade ahead.

4. National Fuel Policy

Apparently the analysis and findings of this study are based on the current fuel situation and the assumption that the mix of fuels used by the various packaging systems will remain constant to 1985. In view of the projected shortages of fuels such as natural gas and the absence of a cohesive national energy policy at this time, this is a very questiona assumption. Regulation, allocation and research authority for energy matters is fragmented. Government-imposed allocations, artificial cost structures, cost restraints on production and other actions dramatically affect the prices and availabilities of various fuels as well as system energy use characteristics. An assessment of these problems and their ramifications is fundamental to any projection of 1985 energy usage by this or any industry.

While the writers cannot be expected to know the future U.S. Fuel Policy, this does not mean that the reader should be left unaware of the tremendous importance of such factors as they relate to the question of government intervention

being addressed by the report. Future costs and availability of energy may follow quite different courses over the next 10 years than the status quo outlined. If mandatory government intervention results in the saving of BTU's which are excessively costly in economic terms and in expenditures of investment capital, it is highly doubtful that such a mandatory course should be taken by government.

It should be emphasized that in spite of the simplistic approaches used in many reports, "A BTU is not just a BTU" - some are much more costly than others and the availability and utility of the energy form must be considered.

5. Size Mix

The report in considering the energy requirements for various packaging systems frequently makes use of "average size" containers for beer or for soft drink. As a matter of fact the concept of "average size" is unsupportable. There are various trends in sizes which will have a measurable effect on energy considerations in the future. While the report sometimes addressed these in discussion paragraphs, they have not always been considered in calculations. As reported by SRI, the use of 64-ounce non-returnable soft drink glass containers has tripled over the past two years while total non-returnable glass soft drink container shipments has decreased. As shown in Table I of the SRI Report, there are significant energy savings per gallon involved in use of these larger-sized containers. Since there is every expectation that such market changes will continue to develop, container size mix considerations warrent special recognition in all energy requirement projections for the glass container industry.

6. Trippage

As discussed on Page II-5 of the SRI "Evaluation of the RTI Review Draft" and on Pages 12-13 of the SRI "Prospects for Energy Savings in Glass Beverage Container Systems by 1985", the trippage factors assumed by RTI are not realistic and are unsupported. Trippage directly affects almost all the energy calculations for refillable bottles and cannot be treated lightly. GCMI feels that calculations based on an unsupported trippage assumption are also unsupported, and the writer might just as easily go directly to his conclusions, pick his desired results, and work backwards to the trippage.

7. Secondary Packaging

The secondary packaging materials used for the various packaging systems in the RTI Report appear to be limited primarily to those presently in use with minor savings in energy predicted for the future. This is entirely too narrow a concept when considering the glass container packaging system as is pointed out in the SRI Report. Continuing efforts are being made to reduce the use of those materials which are energy intensive. For example, the amounts of paperboard used per 1000 gallons of beverage has decreased in recent years and a continuing decrease is anticipated. But beyond these efforts, it must be realized that advances are rapidly made in physical distribution systems some of which may eliminate nearly all of the non-reuseable materials. Complete handling systems involving advances in palletizing and automation of materials handling and warehousing are on the horizon.

It is recognized that secondary packaging may constitute only about 10% of the total energy for a given packaging system, but this still represents a sizeable energy savings which should not be overlooked. The glass container packaging system has good flexibility in this regard (see Page 16, 17, 26, and Page 44, Table 18(a) of the SRI Report).

8. RTI Proposed Returnable Beverage System

This possible system based on the "Clearing House" scenario is discussed in detail on Page 2-43 and Figure 2-21 on Page 2-44 and Page 2-45 of the RTI Report. Immediately it should be pointed out that a very similar system was set up in British Columbia, Canada and resulted in a failure. It is reported that operating, shipping and other costs exceeded revenues by at least ten times and the project was therefore economically infeasible. The system as outlined on Page 2-44 by RTI is based on many unsupported assumptions. Indeed, the scenario as outlined is frightening in its implications of bureacuracy, government control, and intervention and dictatorial attitude. To support the above, we point out below in outline form the results indicated by just one paragraph of the RTI scenario (underlining ours):

"After Government Intervention:

(1) The market share of metal cans can be expected to decline to a nonzero level,

(2) The market share of nonrefillable bottles will decline to or near zero,

(3) The market share of refillables will increase,

(4) Because convenience is an attribute of value to consumers and because the price of convenience (i.e., the shelf price plus the forfieted deposit) will probably rise after the imposition of mandatory deposits, beverage consumption will probably be somewhat less than in the absence of government intervention.

(5) Changes in beverage consumption and in the packaging market shares in turn will trigger energy utilization shifts and economic dislocations."

The above opinions offer "nothing new" and have been postulated many times in the past (e.g. 4 years ago in Oregon). The fact is that there are still no accurate figures available as is evident by RTI's use of the term "non or near zero". GCMI will agree, however, that there will be large energy utilization shifts (not necessarily decreases) and economic dislocations as a result of government intervention.

We contend that the RTI report is too incomplete and too flimsy a document for FEA to base such far reaching encroachments on personal choice and industry control. Particularly is this so in view of the many assumptions referred to earlier in this letter, and the unconvincing arguments as to the outcome of "triggering energy utilization shifts and economic dislocations." Which direction will energy utilization shift? Who is going to take care of the economically dislocated humans? While these questions are addressed in the RTI Report,they are superficially treated.

Restrictions on production of certain containers will of necessity effect the cost to the consumer of all those produced. A further question to be raised with reference to this type of government intervention is the question of discrimination by government in the market place. A mandatory system which raises the cost to the consumer of carbonated beverages gives a definite advantage in the market place to the competitive non-carbonated products which are using the same types of containers - metal, glass, paper and plastics.

9. Packaging System Electrical Energy

It is apparent that the RTI Report (Page D-20) has used different electrical conversion factors for the aluminum packaging system in contrast with the conversion factor used for the other packaging systems. The explanation for this, given on Page D-20, and D-80, is unsatisfactory and contradicts the concept of the national electric grid

that is already in existence. We cannot understand how one manufacturing process such as aluminum, can be allocated the energy saving advantages of a government sponsored regional system which has now been connected into a national grid. Already forecasts show that the Northwest is running out of cheap hydroelectric power. The latest plan calls for at least 13 large 1,200 Megawatt nuclear and coal plants between now and 1985. (See Wall Street Journal article attached).

The following quote from the Wall Street Journal article is significant. "Bonneville has lost a major lawsuit brought to compel it to write an environmental statement justifying its energy planning. It faces, among other things, another serious legal challenge brought by complainants who say Bonneville has defied its congressional charter by serving private industry at the expense of the public." Obviously, if the aluminum manufacturers did not use this "Low BTU electrical energy", this energy would become available to any other of the packaging systems or the public through the national grid. FEA, of all agencies, should act to clarify this discrepancy in energy reporting and in studies of comparative energy packaging systems. Some logic must be developed to bring uniformity to comparative studies. As you know the electrical conversion factors may vary from each other by a ratio as high as 3.1/1. While RTI uses some mathematical maneuvers to adjust these factors, we believe they have only further confused the situation.

Other Comments

Other comments relative to specific pages of the RTI Report are as follows:

Page 2-17

The first paragraph states than an attempt was made to explain the decline in the historical trippage estimates on the basis of increases in per capita disposable real income. It is our feeling that there is no relationship between trippage and per capita disposable real income and that variations in trippage relate to location (e.g. rural, urban, suburban), type of housing, and many other factors that have been ignored.

The fourth paragraph discussed average sizes for soft drink and beer containers. We feel it is extremely misleading to discuss average sizes for beer and soft drink containers since such an approach can lead to conclusions that neglect energy savings that can be realized as the sizes in the marketplace change.

Page 2-24

The second paragraph discusses the small opportunities they see for energy conservation for soft drink bottle manufacture as against that for beer, because "the soft drink bottle must be a stronger container". GCMI disagrees with this and believes that the percent savings for each product container would be approximately the same.

The third paragraph on the same page states that neither glass recycling nor container size would have a significant impact on energy requirements. GCMI believes that this is inaccurate and that glass recycling can save as much as 8 to 12%. Container size could also have a significant effect on energy requirements, particularly in larger sizes such as 64 fluid ounces, as is shown on Page 2 and 3 of SRI's Report "Prospects for Energy Savings in Glass Beverage Container Systems by 1985".

Page 2-25

The second paragraph notes that aluminum recycling offers the opportunity to reduce the energy requirements by 66%, but does not validate this statement by citing any reference, nor do they mention that cans must be made from virgin materials.

Page 2-29 - Second Paragraph

GCMI doubts that aluminum cans will both be recovered through resource recovery systems and returned to collection centers. If one system becomes prevalent the other probably will not.

Page 2-41 - Paragraph 2-3

GCMI feels that government intervention will result not only in changes in the conditions, but may cause consumer shifts to products that are far more energy intensive than those products being restricted. The result would be a net gain in energy consumption.

Page 2-41 - Paragraph 5

GCMI feels that the imposition of mandatory deposits will not create an additional consumer choice, since the consumer already has that choice of whether to discard or return bottles. Changing the style of bottle will not change the consumers' choices.

Page 2-42 - Second Paragraph

GCMI feels that the intrinsic qualities of the refillable and non-refillable bottles are not the same from the consumers' perspective and that the consumer has always recognized the difference between these two types of container In the third paragraph, GCMI questions the assumption that unit costs of production are unaffected by output levels. We know the reverse is true since overhead would be spread over smaller production, and process and production inefficiencies would be introduced. Cost would therefore rise for the restricted containers and for all other container as well. In the next to the last paragraph, GCMI questions how competitive the marketplace would be if the government eliminates many of the products that create such competition. We further feel that the shelf cost might not necessarily be driven down by the amount of the deposit, if mandatory deposits were enacted.

Page 2-43 - Third Paragraph

The concept of a clearing house has been tried in British Columbia, and such a concept has proven totally unrealistic as mentioned previously. We feel that such a concept should not even be considered at this point, and should be stricken entirely from the report.

Page 2-44 and 45

GCMI disagrees with some of the conclusions discussed in the summary, however, we would stress the last sentence of the first paragraph, and would like such a sentence to be written in bold letter. That is, "Changes in beverage consumption and in the packaging market shares in turn will trigger energy utilization shifts and economic dislocations." We feel that these energy utilization shifts would not necessarily yield energy utilization savings, and will only have a deleterious effect on this nation as a whole.

Page 3-5 - Third Paragraph

It should be noted at this point that in a national system, based on the Coors concept, a method of returning cans of all types and alloys would not be feasible since separation of the various materials would be a major problem. The Coors example cited by RTI is a unique case which exists due to a peculiar distribution situation in a limited market.

Page 3-9 - First Paragraph

The last sentence states that no attempt has been made in this study to project a shift within metal cans between steel and aluminum, however, such comparisons have been made repeatedly throughout the study.

Page 3-19 - Last Paragraph

It is impossible to determine that capital already in place can be "perfectly substituted" for the desired capital equipment. Such a determination is untenable, and patently impossible.

Page 3-26 - First Paragraph

GCMI disagrees with the statement that the labor impact should be interpreted as representing the labor requirements in a "frictionless, fixed-relationship economy", rather than as predictions of actual outcomes. Such an assumption would be similar to assuming a frictionless surface in a mechanics problem, and such an assumption, while making the calculations considerably easier, has no validity in the real world or with the real people who will be affected.

We hope you will seriously take these discussions and comments into consideration when revisions are made in the final report or when you are forming opinions regarding the conclusions. If you have any questions regarding this letter please contact me.

Sincerely,

W W Sadd

W. W. Sadd
President and General Manager

WWS:drh

THE WALL STREET JOURNAL, WEDNESDAY, DECEMBER 17, 1975

VOL. LVI NO. 46 ★★

Electric Debate

Federal Power Firm, A Boon to Northwest, Runs Into Opposition

Fight by Environmentalists Affects Bonneville's Plan For Coal and Atom Plants

'A Small, Arrogant Faction'

By HERBERT G. LAWSON
Staff Reporter of THE WALL STREET JOURNAL

SEATTLE—Prof. William Brewer, a geologist and engineer at the University of Washington, recently paid his home electricity bill to the city-owned utility: $36 for two months. He calculates that if he had used the same energy in New York, Consolidated Edison would have charged him $180.

Electricity is a bargain throughout Washington, Oregon and Idaho, thanks to abundant and cheap hydroelectric power harnessed in part by federal dams and marketed by an unusual federal agency, the Interior Department's Bonneville Power Administration. By orchestrating the output of energy from the mighty Columbia River and other streams and channeling it to more than 100 private and public utilities, Bonneville has become the power broker and energy planner for the Northwest.

It operates the nation's largest network of high-voltage long-distance transmission lines. It transmits 80% of the high-voltage power in the Northwest and sells half the electricity. And its low rates are a key factor in luring huge electroprocess industries; one-third of all U.S. aluminum is produced in the Northwest.

Fighting Back

For years, Bonneville hummed along out of the spotlight. But in recent months it has landed in hot water—and in almost daily headlines in the region's press. Bonneville has lost a major lawsuit brought to compel it to write an environmental statement justifying its energy planning. It faces, among other things, another serious legal challenge brought by complainants who say Bonneville has defied its congressional charter by serving private industry at the expense of the public.

Bonneville has lashed back hard. In a series of speeches to civic groups, Donald Hodel, Bonneville's administrator and chief executive, has charged that environmentalism has become "a crusade to stop all development in this country." In rhetoric heard around the region, he called environmentalists "a small, arrogant faction which is dedicated to bringing our society to a halt."

This sledgehammer attack stunned observers in an area where ecology is akin to motherhood. "I've never seen anything like it in the Northwest—a bureaucrat lashing out at environmentalists with Spiro Agnew-type speeches," says Larry Williams, executive director of the Oregon Environmental Council, a coalition of groups.

If the Bonneville dispute is regional, the issues it raises are national. How real are projected energy deficits? Who should decide how much power a region needs, how it will be supplied and to whom it will go on the most favorable terms? Are environmental laws being used unfairly to harass utility planners?

Bad News for Industry

The answers to such questions are critical to carrying out the Northwest's 20-year Hydro-Thermal Power Plan, developed under Bonneville's aegis to bring the region into the era of nuclear- and coal-fired generation. For the Northwest is running out of sites for new hydroelectric plants. The power plan calls for at least 13 large, mostly 1,200-megawatt, nuclear and coal plants between now and 1989 at a cost of more than $10 billion. These plants would boost Northwest generating capacity by about 50%, or some 14,000 megawatts. Additional plants are planned beyond that.

Whatever else happens, the latter dispute here almost surely will lead to restrictions on the historically generous long-term contracts written by Bonneville to provide dependable power supplies to aluminum makers and other industrialists. Under existing contracts expiring in 10 years or so, Bonneville can interrupt, or shut off, only 25% of the power it has agreed to deliver to these contractual customers. To deal with projected shortages, Bonneville had proposed to convert the contracts to 20-year agreements under which fully 75% of the power, under certain conditions, could be interrupted.

Pending a broad study of the future of Northwest energy needs, a federal court is holding up the signing of new contracts. In any case, Mr. Hodel says, projected power shortages and legal challenges mean "the chances are we won't sign any further contracts (with industry) when present contracts expire in the mid-1980s." This would force Alcoa, Kaiser Aluminum and others to purchase power on the open market on a far more tenuous basis than at present.

Cutbacks and Blackouts?

Mr. Hodel and industrialists are clearly unhappy with this prospect. Mr. Hodel says that delaying tactics of environmentalists, along with labor and technical problems in plant construction, soon may create massive power deficits. For at least four of the next 10 years, Bonneville expects shortages of 2,000 megawatts or more, nearly 10% of the area's average power load. "Either homes will be cold and dark or factories will close or both because the deficits are no longer manageable," Mr. Hodel has warned audiences in recent months.

Many environmentalists disbelieve him. They think that, to the extent Bonneville and its allies are successful in selling their master power plan, the Northwest will be overloaded with high-cost, high-pollution energy production. Prof. Brewer, acting director of the University of Washington's energy-research center, figures that nuclear power will cost five to 10 times as much as hydroelectricity does now.

Forecasting power needs is central to the debate. Bonneville, using research of its own and of a handful of large utilities, justifies new power plants on its estimates of growth in power demand. Hector Durocher, power manager for Bonneville, says the agency and

Please Turn to Page 13, Column 1

Electric Debate: U.S. Power Firm Is Opposed by Environmentalists

Continued From First Page

area utilities this year lowered their 20-year forecast to a 3.1% yearly compound rate of growth in demand, down from the 5.8% rate that was previously forecast.

But the new forecast, he says, provides for no new industry except for a controversial, proposed aluminum plant that already has a contract with Bonneville. And, he says, the forecast fails to consider electricity demand from people who convert their homes from natural-gas heating as gas gets scarcer; already, 90% or more of new homes in the Northwest are heated electrically.

Although the 3.1% rate seems low to Mr. Durocher, it seems much too high to some other energy experts. The Energy Policy Council, a broadly based Washington group whose members are appointed by the governor, predicts annual electrical-load growth "in the range of 3% at the most," based on what the group sees as a new conservation consciousness among electricity consumers and the prospect of only moderate growth in industry and population.

Even one of Bonneville's own experts, senior economist Myron Kuta, says that "I don't see 3% growth myself." Although past forecasts by utility companies have been accurate, he says, they appear "too high" now.

The disagreement over forecasting leads some people to suggest that it should be turned over to an independent group, perhaps under the auspices of the states. "Obviously, for credibility, it would seem we need some independent authority to forecast loads," says David Stephens, energy adviser to Gov. Dan Evans of Washington. But Mr. Stephens says his state has no authority now to assume the forecasting role. Mr. Hodel of Bonneville thinks that the states should "validate" forecasts. But he adds, "I believe that our forecasts are the best available."

The threat of shortages that Mr. Hodel raises has led some environmentalists to challenge plans by Bonneville to provide power to an aluminum plant that Alumax Inc. wants to build at Umatilla, Ore. Alumax is a joint venture of Japanese interests and Amax Inc. Alumax has been trying to get started on its controversial plant for 18 years. The plant would turn out 187,000 tons of aluminum ingot yearly, making it one of the largest plants in the Northwest. The plant would require an immense electric load, 320 megawatts, roughly enough capacity to supply the 84,000 residents of Eugene, Ore.

A federal judge in Portland recently ruled that the Alumax contract with Bonneville requires Bonneville to prepare an environmental-impact statement, not dealing merely with the impact of the Umatilla plant but with the environmental impact of the entire Northwest Hydro-Thermal Power Plan.

The decision was shocking to Bonneville executives. They had defeated other lawsuits aimed at forcing broad environmental studies of the consequences of increased power demand by new plants. Mr. Hodel says the 1,000-page study required by the Alumax decision will cost Bonneville $2 million and two years to produce. "And," says Ray Folleen, Mr. Hodel's deputy, "we feel we'll be sued anyway when the two years are up." Environmentalists, he thinks, then will launch a new attack on the adequacy of the study.

Bonneville men consider the Alumax case a prime example of the obstructionist strategy of environmentalists. But Bonneville's critics believe that Bonneville consistently has tried to evade the National Environmental Policy Act, or NEPA, which requires studies by federal agencies on any of their major actions that may affect the quality of the environment.

Among those who sued Bonneville over the Alumax plant is the Natural Resources Defense Council, a nonprofit national group that often goes to court for environmental causes. "Two years ago," says Roger Beers, a Palo Alto, Calif., attorney for the council, "we pointed out to Bonneville (in private discussions) that an impact statement was required." Bonneville officials say this is true, and they say they rejected the advice.

Bonneville may find itself in deeper legal trouble over charges that it is illegally favoring private industry in selling power. The 1937 New Deal act that created the agency directed its administrator to give preference in the sale of electricity to public utilities and power cooperatives. Mr. Hodel says the agency has always done just that, negotiating contracts with private industry to dispose of its surplus power.

But a freshman Congressman from Oregon, Democrat Jim Weaver, disagrees. He has filed suit against Mr. Hodel and Bonneville to prevent the agency from negotiating any more contracts with industrial customers. And he has been joined as a plaintiff by a group trying to create a public-utility district in Lane County, Ore. This group hasn't been able to get a commitment for power from Bonneville. "At the same time (Bonneville) is extending contracts to the aluminum companies," Mr. Weaver charges, "it is denying cheap power to public-power agencies and other retailers."

Roger Leed, an attorney for the Washington Environmental Council, says Bonneville officials "knew there wasn't enough power to go around" when they signed the Alumax contract. "They were simply violating the Bonneville Act in a wholesale way," he asserts.

The hero—or villain—of the Bonneville dispute, 49-year-old Donald Hodel, remains cool and collected. A former chairman of the Oregon Republican Party and a former attorney for Georgia-Pacific Corp., he talks about returning to private legal practice someday and perhaps finding more time for skiing. "When I leave this job, and it may be soon if I make another speech, I'd like to become a ski bum for a while," he says half-seriously.

Asked whether he regrets his now-notorious attack on environmentalists, he reflects a moment and says, "No. Basically, if I had to do it over again, I'd do it. A relatively small number of people under the present law are able to raise the same issues over and over again, with the result of causing confusion and delay." Donna Klemka, a Sierra Club staffer in Seattle, sums up the environmentalist view: "The times are changing, and we need more than Bonneville's one-angle vision."

SRI STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 · U.S.A.

November 24, 1975

EVALUATION OF REVIEW DRAFT OF REPORT

Energy and Economic Impacts of Mandatory Deposits

RTI note:
RTI reviewed the preliminary draft of this study submitted by GCMI and not this final report. However, GCMI informs us that there are no significant changes between the preliminary and final report. Therefore, at their request, the final report is reproduced here.

Prepared for:

THE GLASS CONTAINER MANUFACTURERS INSTITUTE, INC.
WASHINGTON, D.C.

SRI Project 4389

CLIENT PRIVATE

I-88

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I INTRODUCTION

The Glass Container Manufacturers Institute requested assistance from SRI in making an objective review of the Federal Energy Administration (FEA) draft report, "Energy and Economic Impacts of Mandatory Deposits." The report concerns potential energy use and the economic adjustments that would be involved if federal regulatory measures were passed to require mandatory container deposits on sales of packaged beer and soft drinks. The FEW has invited such reviews from industry and public interests before preparing the report in final form.

The FEA report is one of several similar analyses made by government and industry interests in the past five years of the resource usage and environmental impact characteristics of beverage container systems. The report focuses only on comparative energy usage of several systems and on the potential impacts on energy use, industries, and the economy as a whole that would result from proposed legislation for a mandatory deposit system.

The report's study content differs from that of several of the previous analyses in that it attempts to develop a ten-year projection of the beverage markets and industries--including technological developments. Also, under a range of scenarios, it seeks to measure the possible impact of deposit legislation on packaging patterns and the implications thereof to the economy.

This evaluation is focused on the general findings of the FEA study as presented in the summary report and on the presentation of specific data and comments relevant to the glass system profiles. The evaluation is limited greatly by the response time of one month scheduled by the FEA for submission of these industry reviews.

The size of the report also limited the evaluation. The report, including the appendix supporting material upon which the findings are based, consists of more than 300 pages of quantitative data and its analysis. Furthermore, many of the more significant data presentations are derived from computer runs, and the time limit for the review did not permit making new computer runs under different assumptions from those made in the report. The FEA report as a whole shares the shortcomings of other similar analyses in that the several industries involved are quite

complex in their operational makeups, and it is most difficult to completely assess the ramifications of regulatory actions which significantly affect their present structures.

Therefore, this evaluation must be considered a "best effort" review by SRI of the contents of the report.

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II SUMMARY

The following summary statements are pertinent to the study as a whole and are expanded in subsequent sections of this report.

- The primary purpose of the FEA study is to assist the agency in taking a position concerning the feasibility of mandatory deposit legislation. It does not significantly add to the findings of similar past studies about the resource use of characteristics of the several systems, or to information on the general nature of disruptions to the economy potential from regulatory measures similar to the Oregon Bill.

- As the report authors state, beverage production/consumption systems are quite complex. The report treats only a few of the major considerations which must be weighed in judging the feasibility of such legislation. Omitted are such important factors as impacts on critical raw material usage, the cost/price effects of potential changes in present packaging systems and patterns, consumer convenience, and the capital write-offs of many of the industries involved.

  In addition, the impacts on industry structures and abilities to service their nonbeverage packaging and other end markets is an extremely critical area that is not treated. Not only are other packaging markets affected--such as the food, drug, chemical, and household product markets--but also the many nonpackaging markets served by such industries as basic steel and aluminum.

- It is evident, from the very nature of the methodology utilized in the study, that predictability of the actual consequences of the proposed legislation is quite limited. There are simply too many variables and uncertainties involved, especially since the report considers a ten-year outlook. This is the most important conclusion about the report, as it substantially lessens the credibility of all of the analytical work involved. This difficulty is well demonstrated by the extremely broad range of alternative scenarios considered--from a complete shutdown of the beverage can industries and the nonreturnable glass container sector, to situations relatively unchanged from the present patterns of

beverage system usage and trends. Therefore, the study does not significantly improve on past efforts seeking to assess the future "real life" impacts of such legislation.

- This problem with predictability raises the question as to whether any analytical approaches can be employed which would yield reasonably accurate estimates of the potential impacts of the proposed legislation. The several analytical efforts to date have certainly not resolved this question.

- The analysis and findings of this study are focused on present packaging systems utilizing steel, aluminum, and glass. Yet the report implies strongly that these systems will meet strong competition from the plastics industries within the ten-year forecast period:

  > "In the future, other materials, notably plastics, are expected to dominate the beverage market."*

  As with other similar allusions to plastics, this assumption is not supported by documentation in the report. This fact severely weakens the whole context of the study and its purpose. If this outlook has considerable validity, it implies that existing container systems will soon be obsolete, and the validity of a report concerning existing systems comes into question.

- The foregoing raises a further question: if either a significant change (such as that anticipated for plastics) or any new systems occur, might not many of the potentially large-scale adjustments that would be caused by the proposed legislation evolve naturally and with much less economic disruption as a result of normal interindustry competition for these packaging markets? A corollary here is that the proposed government intervention can lead to economic and competitive circumstances which can preclude or hamper future progress.

- In estimating the potential economic costs of the proposed legislation, the capital write-offs and operating adjustment costs of several industries have been omitted; it is also likely that these costs have been quite understated in past studies. Examples of these costs are those the glass

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*FEA draft report, "Energy and Economic Impacts of Mandatory Deposits," pp. 2-7.

container manufacturing sector would absorb to adjust to only refillable bottle production, and the losses steel and aluminum mills producing can sheet would absorb in adjusting to major losses of plant volumes.

Furthermore, the possibility exists that the future costs of energy and capital investment in plant and equipment may follow quite different courses over the next 15 years from those predicted in the report. Thus, the estimates implied in the study may be subject to considerable change in the years ahead.

- The text and appendix material about employment and wage earnings impacts is not presented in sufficient detail to determine if all of the significant ramifications of adjustments in these areas have been recognized, especially in communities highly dependent on those industries which are threatened by the proposed legislation. One question involved concerns the methodology employed, because if gross input-output data are utilized, such data cannot recognize the infinite number, intensity, and configuration of dislocations occurring at the microlevel.

- In respect to the data and its analysis for the glass systems, the following points must be recognized:

  - Certain plastic-coated glass systems which dominate the large-size bottle market today have not been included in the analysis and warrant treatment similar to that given the other existing systems.

  - Whereas the nonrefillable bottle market in this study has been characterized by a 16-ounce size, the actual "real life" situation is a mix of sizes from 7-ounce to 64-ounce capacities. Today, the average approximates 21 ounces, and there exists a strong market trend in soft drinks to larger containers which have significantly lower energy-use characteristics; the future implications of this change in container size mix have not been accorded adequate recognition in the draft report.

  - Further, any attempt to describe the nonrefillable glass container soft drink sector by an "average-size" container does not accurately reflect the operations of this industry.

  - Data concerning the 1985 energy saving potentials of the glass-based systems could not be developed by the FEA in time to meet the draft report schedule and have been submitted now for review prior to inclusion in the final report.

These new data indicate that the glass systems have significantly higher energy-saving potentials than reflected in the review draft.

  - The projections of glass system markets without government intervention do not take into account all of the variables affecting such a situation; these variables include some current trends which are divergent to those developed in the scenarios.

  - Any consideration of a returnable container system must be predicated on the number of refillings. Variations in the number of times the bottle is utilized significantly impacts returnable energy requirements. However, it is difficult to accurately measure current trippage rates, because of a highly complex set of market-oriented forces which cannot be projected with any confidence. Therefore, this is another aspect of the predictability problem faced throughout the study.

- The possibility exists that analysts may attempt to develop cost/benefit analyses based on the summary estimates presented in the report. The magnitude of the capital costs involved in comparison with the value of energy saved--even if the data were accepted as within reasonable limits of probability--casts considerable doubt on the economic feasibility of such legislation, especially in the perspective of potential serious constraints on investment capital availability for both private and public needs in the decade ahead.

- Finally, this and similar studies can only represent a set of incomplete inputs regarding a number of very complex, interrelated energy, economic, and social matters involving major public and private interests.

III EVALUATION OF GENERAL FINDINGS

A. Statement of General Findings

All of the summary findings of the report are presented in a range of six scenarios for the year 1982 concerning container packaging patterns, and are based on the assumption that the same level of fillings would be involved in all cases. These scenarios are as follows:

(1) The first scenario concerns the estimated future market situation which would develop without government intervention.

(2) Two scenarios, based on government intervention, include the assumption that the metal can market share would be unchanged from the scenario in (1). In the first scenario of this group zero can returns is assumed. In the second, 100% returns is assumed. All nonrefillable glass containers are assumed to be eliminated in both instances.

(3) Two scenarios, based on government intervention, include assumptions of reduction in the metal can share. The first assumes that the share will be eliminated completely, and the second that it will be eliminated almost entirely, as has been the Oregon Bill experience. Again, all nonrefillable glass containers are assumed to be eliminated in these scenarios. Refillable glass containers will dominate the markets.

(4) A final scenario based on government intervention is labeled "mid-range" and tends to assume a position between the two sets of extreme cases.

Some of the more significant data resulting from the summary analyses are presented in Table 1. SRI's interpretation of the general implications of these findings, assuming they are soundly based in fact and methodology, follows:

- The report postulates that the refillable glass bottle system offers the greatest potential for energy savings of the four container systems encompassed in these analyses: the refillable glass bottle and the single use glass, aluminum, and steel

Table 1

SUMMARY OF SELECTED DATA FOR FEA REPORT SCENARIOS
TOTAL BEVERAGE SYSTEMS, 1982

	Scenario*					
	(1)	(2)	(3)	(4)	(5)	(6)
Container production (10^3)	90.6	76.8	77.3	11.6	21.5	52.4
Refillable bottles	2.4	4.6	4.6	11.6	10.4	7.2
Nonrefillable bottles	15.6	--	--	--	--	--
Steel cans	42.0	41.9	41.9	--	7.2	27.1
Aluminum cans	30.6	30.3	30.8	--	3.9	18.1
Energy requirements (10^{12} Btu†)	397	346	259	183	198	268
Petroleum	139	115	112	70	76	98
Gas	97	81	67	70	70	74
Coal	125	118	59	28	36	71
Nuclear and hydrogen	25	24	14	3	5	15
Wood	10	8	8	12	12	10
Labor requirements (10^3)	483	491	587	485	497	518
Container manufacture	82	64	64	25	31	49
Metal manufacture	22	22	23	--	4	14
Producers and distributors	237	246	245	299	291	265
Retailers	31	58	153	144	143	120
Indirect industries	112	101	101	17	30	69

*Scenario descriptions follow:

(1) Without government intervention.

(2) With government intervention; metal can share unchanged; can returns zero.

(3) With government intervention; metal can share unchanged; can returns 100%.

(4) With government intervention; all refillable bottle system.

(5) With government intervention; Oregon bill experience.

(6) With government intervention; mid-range position between two groups of Scenarios: (2) and (3), and (4) and (5).

†Btu = British thermal units.

systems. This finding has been noted in many similar previous studies. The refillable bottle system has become the dominant system in Oregon as a result of similar mandatory deposit legislation passed two years ago. However, SRI feels that the Oregon experience may not be indicative of the possible developments in a national situation with similar legislation.

- The report also concludes that if the refillable glass bottle system became the dominant system as a result of government intervention, it would involve by far: the largest new capital expenditures on the part of beverage producers, distributors, retailers, and the glass container industries; the greatest employment dislocations; and the most extensive capital write-offs by all of the container industries as well as the direct and indirect industries supporting the affected container manufacturing industries. Again, this finding has been recognized in previous studies of the subject.

- The report states that if such adjustment occurred, overall employment and earnings in the soft drink and beer industries as a whole might not be significantly affected by government intervention because the losses in container manufacturing and the supporting industries would be balanced by increased employment requirements at the filling and distribution levels to accommodate container returns. This conclusion has also been developed in previous studies. However, the report's summary analysis does not highlight an at least equally significant issue, dislocation impacts.

- The report suggests that the total national energy savings under the most energy-saving case, the all-refillable bottle system, could approach the theoretical equivalent of 37,000,000 barrels of oil annually in 1982. Table 2 summarizes the findings in terms of this measure for all of the cases and the potential value of the savings under two cost assumptions. It is noted, however, that under the all-refillable bottle case, the theoretical savings of petroleum and gas, the most critical fuels, contribute only about 16,000,000 barrels of the total annual estimated energy saving potential of 37,000,000 equivalent barrels of oil. The difference results primarily from decreased use of coal. This point may merit special consideration in any cost/benefit analyses.

As described earlier, these are considered the more significant deductions to be made from the summary data of the report. However, if metal cans continued to hold a significant share of the market with the proposed government intervention, the energy-savings potentials and

Table 2

ENERGY REQUIREMENTS OF ALTERNATIVE FEA REPORT SCENARIOS 1975, 1982, 1985

	Scenario*							
	1975	1982						1985
	n.a.	(1)	(2)	(3)	(4)	(5)	(6)	(1)
Total annual energy Btu† 10^{12}	367	397	346	259	183	198	268	380
Equivalent oil (MM bbl‡)	62.7	67.9	59.2	44.3	31.0	33.9	45.8	65.0
Savings from Scenario (1) (MM bbl)	--	--	8.7	23.6	36.9	34.0	22.1	--
Petroleum and gas Btu 10^{12}	222	236	196	179	140	146	172	220
Equivalent oil (MM bbl)	37.9	40.4	33.5	30.6	23.9	24.9	29.4	37.6
Savings from Scenario (1) (MM bbl)	--	--	6.9	9.8	16.5	15.5	11.0	--
Annual value of energy savings ($10/bbl oil)								
Total ($ MM)	--	--	87	236	369	340	221	--
Petroleum and gas ($ MM)	--	--	69	98	165	155	110	--
Annual value of energy savings ($20/bbl oil)								
Total ($ MM)	--	--	174	472	738	680	442	--
Petroleum and gas ($ MM)	--	--	138	196	330	310	220	--

*Scenario descriptions follow:

(1) Without government intervention.

(2) With government intervention; metal can share unchanged; can returns zero.

(3) With government intervention; metal can share unchanged; can returns 100%.

(4) With government intervention; all refillable bottle system.

(5) With government intervention; Oregon bill experience.

(6) With government intervention; mid-range position between two groups of Scenarios: (2) and (3), and (4) and (5).

†Btu = British thermal unit.

‡bbl = barrel.

economics dislocations would be reduced. This is the most critical question, and the study findings do not assist appreciably in narrowing the range of possible happenings.

B. Evaluation of General Findings

As indicated earlier, the report's general findings do not contribute significantly to the results of past analyses of the subject. The basic data available to the authors concerning the energy characteristics of the several systems are undoubtedly more refined than those previously available. This is especially true because of input from more intensive studies by the industries involved. The most significant question, however, is, "What level of economic and social cost will be involved in a government-initiated mandatory deposit program that seeks any given amount of energy-savings potential?" This question probably cannot be answered by the type of study presented in the report for reasons such as the following:

- Predictability of the actual consequences is quite restricted, especially over a ten-year time period.
- The soft drink and brewing industries are extremely complex, and the ramifications of impacts on them cannot be fully explored by simplified analyses considering a limited number of impact areas.

1. Predictability Problem

The problem of predictability is noted by the report authors throughout the report and in the methodologies employed to develop summary findings. The more unpredictable areas which can significantly affect gross conclusions include the following:

Demand for Soft Drinks and Beer--The report developed a case situation for future demand over the ten-year period showing 1982 container production requirements of 91 billion units, compared with 67 billion in 1975. In view of the many uncertainties involved in such outlook projections, a range in the projection would seem a more satisfactory approach. If actual demand proved to be substantially lower than the case situation, all of the data summaries would be altered significantly.

Demand Under the Alternative Scenarios--The case scenarios imply no anticipated changes in total beverage consumption with or without government intervention. This is an assumption area subject to considerable

debate, with few facts to support the report's position. However, it is possible that the need for "returns" could, over time, cause some reaction in demand as well as raise consciousness among beverage consumers about the amounts they spend on such discretionary purchases.

Packaging Patterns, with Government Intervention--The report authors recognized the unpredictability of this major factor, as can be seen by the range of possible happenings encompassed in their analysis.

Advent of New Beverage Container Systems and Operational Practices--The report's recognition that plastic containers may well assume a dominant market position within the ten-year forecast period is an especially pertinent illustration of the major uncertainties involved in such analyses.

Furthermore, a great many other unforeseeable developments are certain to emerge over any ten-year future span that will probably significantly affect present energy outlook predictions and associated economic impacts. Such operational areas as beverage distribution and packaging are likely to undergo important changes in response to energy concerns.

Another important consideration is that American industry has needed time to concentrate its scientific and technical resources on the new need for energy conservation. Most likely a similar review of the energy-saving potentials of these systems made two years hence would reveal substantial changes in their characteristics and estimated outlooks in response to cost/price and competitive pressures.

Future Costs of Energy and Capital Investment in Plant and Equipment--Efforts to develop cost/benefit conclusions about the feasibility of proposed legislation based on future conditions are particularly vulnerable to the uncertainties of future petroleum prices as well as the impact of continued inflation on capital plant and equipment costs. Thus, in the future, relationships between costs of energy and costs of capital plant and equipment may change radically.

In addition, current continuing SRI studies imply that major changes may occur in future competitive cost positions of the several container raw materials, which would affect their market acceptability and share of market positions, and would support new capital investment in the years ahead.

2. Complexity of Assessing Economic Impacts

A thorough analysis of the methodology used in the report to assess the capital and labor impact costs of the various scenarios required considerably more time than was available to the reviewers; it would also require access to the detailed data utilized. However, several questions are raised concerning the approach; they need clarification, particularly in view of the importance of this cost assessment to the overall question of cost/benefits of the proposed legislation. The principal questions raised follow:

- The model plant approach utilized is possibly the only approach available to develop capital/output ratios for beer and soft drink production and distribution. However, can it yield a reasonably accurate estimate of the "real life" characteristics and potential adjustments of the thousands of firms involved which, although within the same industries, exhibit different operating patterns?
- Is it valid to compare the 1982 capital requirements of the beverage filling and distribution industries with and without government intervention? Would not some time period be allowed as a transitional span which would alter the actual capital investment positions of the industries by 1982 in the event government intervention were mandated?
- Is it valid, in government-intervention scenarios, to omit the costs of capital additions, write-offs, and other operational adjustment costs of the container manufacturing industries and their supporting industries? Can these costs be accurately assessed without much more exhaustive investigations?
- To what extent does the assumption that "capital already in place can be perfectly substituted for the desired capital equipment" understate the probable situation?

C. Cost/Benefit Analyses

If the data summaries of the report were accepted as reasonable, it would be possible to develop a crude cost/benefit analysis of the net new capital investment required in the various scenarios that include government intervention. Table 3 presents such an analysis and indicates an investment of $15 of new capital per dollar of annual energy value saved if the returnable bottle system should become the dominant scenario.

Table 3

COST/BENEFIT ANALYSIS OF SUMMARY DATA, 1982

	Scenarios*					
	(1)	(2)	(3)	(4)	(5)	(6)
Annual energy use (Btu† 10^{12})	397	346	259	183	198	268
Equivalent annual barrels of petroleum (MM bbl‡)	67.9	59.2	44.3	31.0	33.9	45.8
Annual energy savings with government intervention (MM bbl)	--	8.7	23.6	36.9	34.0	22.1
Value of annual energy savings @ $12 per barrel ($ MM)	--	$104	$283	$442	$408	$265
Cost of potential savings ($ MM)						
Net capital investment, producers and distributor-retailer level	$6,611	$8,082	$8,504	$13,415	$12,589	$5,965
Net change from Scenario (1) without government intervention	--	$85	$748	$(36)	$65	$244
Total net change in capital investment from Scenario (1) ($ MM)	--	$1,556	$2,641	$6,768	$6,043	$890
Net capital investment per dollar of energy value saved	--	$15	$9	$15	$15	$3

*Scenario descriptions follow:

(1) Without government intervention.

(2) With government intervention; metal can share unchanged; can returns zero.

(3) With government intervention; metal can share unchanged; can returns 100%.

(4) With government intervention; all refillable bottle system.

(5) With government intervention; Oregon bill experience.

(6) With government intervention; mid-range position between two groups of Scenarios: (2) and (3), and (4) and (5).

†Btu = British thermal unit.

‡bbl = barrel.

A rough attempt was made to incorporate the costs of capital write-offs into this analysis, and, as shown in Table 4, a $19 capital cost per dollar would be involved in this instance.

As noted earlier, savings of the critical fuels--petroleum and gas--represent 50% or less of the total energy savings involved in the principal government-intervention scenarios presented. Thus the investment cost per dollar value of these fuels saved would be at least double the amounts shown above.

The magnitude of such capital requirements in comparison with the value of the savings, if the data given are reasonable, casts considerable doubt on the economic feasibility of the proposed legislation.

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Table 4

COST/BENEFIT ANALYSIS, INCLUDING POTENTIAL CAPITAL WRITE-OFFS, 1982

	Scenario					
	(1)	(2)	(3)	(4)	(5)	(6)
Scenario data ($ MM)						
Value of annual energy savings @ $12 per barrel	--	$104	$283	$442	$408	$265
Additional capital investment required	--	1,556	2,641	6,765	6,043	890
Possible capital investment write-offs involved ($ MM)*	--	--	--	1,500	1,300	600
Capital costs including write-offs ($ MM)	--	1,556	2,641	8,268	7,343	1,490
Net capital investment per dollar of energy value saved if write-offs are included	--	$15	$ 9	$19	$18	$ 6

Note: Write-off data in source report noted adjusted roughly for inflation and assumed higher level of production.

* Research Triangle Institute, "Analysis of Beverage Container Problem," prepared for U.S. Environmental Protection Agency - Research Triangle Park, North Carolina, p. 74 (July 1972).

IV EVALUATION OF THE SUMMARY REPORT

A. Chapter 1: Summary

Page 1-2--Figure 1-1, which sets forth 1975 per unit energy requirements of the several systems under variable return and recycling rates, shows the aluminum can system approaching within moderate range of the refillable bottle system. This figure should be footnoted to reflect the discussions in Appendix pages D 80 to D 84, that the estimate of aluminum energy use is an important and controversial issue in this analysis (involving three alternative methods of calculation), and that the method used appears to present the lowest energy-use case, which places this system in its most favorable light. The 1985 assumptions appear to have been developed from the same base.

Page 1-3--Throughout this report, the capital requirement data exclude container manufacturing and their supporting industries. It does not seem valid, therefore, to denote any one container system as "capital-intensive" (second paragraph), in view of this omission.

Page 1-4--The data presented in Table 1-1 and discussed here is not comparable because the "labor employment" and "labor earnings" data include the container manufacturing and supporting industries thereto, whereas the capital data excludes these important sectors.

Page 1-5--The reasons that consumers buy specific types of packaged beverages are considerably more complex than indicated here (reference poll data presented on pages 2-10 through 2-13). For example, the statement that "the intrinsic qualities of the refillable and nonrefillable bottles are virtually the same from the consumer's perspective" does not appear to be factually substantiated in the report. If this assumption cannot be substantiated, all of the scenarios under government intervention must be questioned.

Pages 1-8 and 1-9--Again, the discussion of capital requirements fails to recognize the write-offs of the container and supporting industries. Also, the actual costs of layoffs exceeds the earnings included in the jobs because of social insurance and several other types of costs inherent in the situations of unemployed workers.

B. Chapter 2: Introduction

Page 2-3--In presenting the data of Table 2-1, the question remains as to why consumers have not used the available refillable bottle system in the same proportions as reported in this poll but, instead, have increasingly preferred the single use containers?

Pages 2-6 and 2-7--As noted previously, these beverage consumption estimates should have been presented as a range in recognition of the many uncertainties involved in such forecasts. The projections made represent a quite optimistic case and therefore result in an upper level of demand from which all of the impact measurements under the government intervention scenarios are made. Such impacts, therefore, may be distorted.

Page 2-7--The sentence "In the future other materials, most notably plastics are expected to dominate the beverage-packaging market" and other similar allusions to plastics throughout the report severely weakens the whole context of the study and its purpose. Such statements imply that the existing container systems should be disregarded because they will soon be obsoleted by new systems using other types of materials. If this outlook has considerable validity, the validity of a report concerning the existing systems comes into question.

Pages 2-10 through 2-13--Tables 2-4, 2-5, and 2-6 tend to raise several questions which can only be answered by access to the complete survey reports of these consumer polls. SRI does not wish to describe these questions further until the complete survey is made available.

Pages 2-10 through 2-13--Current information indicates a substantial increase in the number of ounces packaged in nonrefillable beer bottles. These data conflict with the report's assumption that metal can competition will reduce the glass container nonrefillable beer market share by 1985.

Pages 2-23--The following statement appears in the final sentence, "The reason for the expected declines (in per unit energy requirements of the systems) is the recent and anticipated future increases in the relative price of energy resources." The statement overlooks the fact that historically there have been many energy-saving improvements in containers for reasons other than energy prices, and there will continue to be such developments in the future. Many of these developments have been responsive to normal competitive pressures.

Page 2-24--In contrast to the FEA stated views, SRI studies show significant differences in energy requirements by container size range. Furthermore, at this time, there are inadequate data to judge the effects of glass recycling or materials acquisition energy.

Page 2-25--Table 2-7 must be revised in accord with new final data submitted to the report authors concerning 1985 energy-saving potentials of glass systems. All other relevant tables and discussions will also need review.

Page 2-27--The considerable degree of interchangeability of glass systems' use of petroleum or gas should be recognized in the fuel use discussion. This capacity for flexibility in fuel use is a very advantageous characteristic of the glass systems.

Page 2-27--Table 2-9 needs revision to incorporate final glass data. Also, is the statement that "metal can systems are less dependent on natural gas and fuel oil" supported by Table 2-9 in the case of the aluminum system? This table and Table 2-10 should also show aluminum under the 17% recycling assumption to permit "real life" comparison.

Page 2-28--Data are not provided which assess the impacts of a predominantly all-refillable system on the present transport and container usage characteristics of brewers and wide-radius soft drink distributors.

Page 2-29--All data for aluminum recycling involving collection centers fails to include consumer energy expenditures involved in transport of used containers to the collection centers. The validity of this assumption needs to be investigated much more thoroughly.

Page 2-31--All forecasts of container packaging patterns without government intervention neglect consideration of the importance of the system costs to the users. Significant changes may occur in the relative cost positions of the several container systems over the next ten years as well as in traditional demand influences.

Pages 2-32 and 2-33--As noted previously, these projections should have been established on a range of consumption estimates.

Page 2-39--The complexity of the soft drink distribution system as described in the third paragraph makes it difficult to utilize an "average situation" approach in the analysis.

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Page 2-41--The statement "if the changes are significant enough, the readjustments may be felt far beyond the beverage industry sector of the economy" warrants considerable expansion.

Page 2-42--The premise "unit costs are unaffected by output levels" contains inconsistencies. Also, the rationale for judging the future of nonrefillable bottles needs much greater substantiation.

Pages 2-44 and 2-45--Potential structural changes in soft drink and brewing industries deserve considerable expansion in treatment. For instance, many national brewers already have extensive regional operations.

Pages 2-44 and 2-45--These summation statements concerning the possible impacts of government interventions are not supported by the text material in this chapter or elsewhere.

C. Chapter 3: Energy and Economic Impacts

Page 3-1--The assumption that "unit costs are assumed constant over all ranges of output" again reflects the lack of attention to the economic positions of the several systems when assumptions involve significant changes in output and other variables such as raw material prices.

Page 3-3--The last statement, "But the data available from which to estimate them [metal can shares] is very limited" again reflects the predictability problem of the whole analysis.

Page 3-5--The Coors' can recycling system should be presented in much more detail in relation to the operational economics of this program--especially in view of its inclusion in a scenario. Also, the Coors situation is possibly unique and nontransferable to an industry-wide situation.

Pages 3-12 and 3-13--All glass-system energy estimates for the 1980s must be revised in accordance with new data. Also, the movement toward larger container sizes in soft drinks should be more fully assessed. At present, metal systems are not competitive in the larger sizes, and the trend to larger sizes may have a significant impact on metal can market share potentials in the 1980s.

Page 3-15--As stressed previously, the final sentence, "Capital requirements for the container and metals manufacturing industries were not developed since reductions on container production are projected for all scenarios" completely overlooks an issue which has substantial potential economic impact, particularly in a capital-short economy.

Page 3-19--The entire treatment of capital impacts illustrates the uncertainties involved in attempting to evaluate this subject and the subsequent matters of labor and labor earnings impacts.

Page 3-26--Earnings impacts of labor dislocations involve many indirect "ripple effects" which may not be adequately recognized here: e.g., government welfare costs for unemployment insurance, food stamps, and other forms of relief; costs to the financial institutions of defaults on home mortgages and other loan payments; and losses of tax revenues.

V EVALUATION OF REPORT APPENDIX

Several appendices are included with the report. They primarily present supporting material for the treatment of beverage consumption, beverage packaging, system energy profiles, and economic measure coefficients. All comments concerning these subjects in the body of the report are relevant to their treatment in the appendices and will not be repeated at length in this section. The most extensive treatment given in this chapter is to the new glass-system energy profiles, because of new data generated recently which will be incorporated into the final draft. The limited time allowed for review of this draft report prevented extensive analysis of much of the appendix material.

A. Appendix A: Beverage Consumption

The general economic forecasts underlying this section are based on the projections of the U.S. Department of Labor in Bulletin 1831 released in 1975. These projections are based on such assumptions as (1) an implied rate of growth in real GNP of 4.7% for the 1972-1980 period, slowing in the 1980-1985 period to 3.3%; (2) personal consumption expenditures in constant dollars at slightly faster rates over GNP (at about a 0.2% difference); and a 4% unemployment rate. It would seem advisable to develop an alternative set of forecasts with more conservative assumptions about the general outlook of the U.S. economy. In addition, it would seem useful to develop a more conservative case for per capita beverage consumption trends over the ten-year outlook, as these markets may not continue to grow in relation to traditional economic indicators.

B. Appendix B: Beverage Packaging

These projections are affected by the consumption estimates, and this matter is discussed above.

C. Appendix D: Beverage Systems Energy Profiles

1. Plastic Systems

On page D-31, the bottle weights are presented; SRI believes the weight of the 16-ounce A/S (acrylonitrile/styrene) bottle is understated, because industry information indicates that an AW/S bottle should weigh more than a comparable PET (polyester) bottle under current construction techniques. A more reasonable estimate is 39 grams instead of the 32 grams noted. This change, if validated, would significantly increase the system's energy requirements.

2. Metal Can Systems

The energy use economics of recycling aluminum under the collection center method would benefit by more explicit data concerning consumer transport energy use and the logistics involved in present operations of these centers. Another factor in future metal can system outlooks that is not treated in the report is that of future raw material costs of steel and aluminum. Aluminum prices particularly may be subject to considerable escalation in the future due to higher bauxite as well as domestic energy prices.

3. Glass Systems

The Franklin Associate's appendix report was compared with its earlier draft version, dated August 4, 1975, and the SRI report "Prospects for Energy Savings in Glass Beverage Container System by 1985" dated November 24, 1975. The comparison was made to ascertain if there are any major differences among the three reports' findings, and if so attempt to explain them. Some conclusions are drawn, comparing the different container systems.

a. 1975 Data

From a total-system standpoint, data in all three reports do not vary significantly from each other. However, the two Franklin Associates reports do vary to a notable degree in the following areas:

- Raw material amounts and energy requirements for materials acquisitions and transportation were increased by 15% and 11% respectively for the final draft (Table D. 8-3).

- For the refillable 12-ounce beer bottle, bottle manufacturing energy was increased by 33% compared with the earlier draft (Table D. 8-7).
- For the refillable 16-ounce soft drink bottle, Franklin Associates' energy required for secondary packaging appears to be low. It is 1.8, compared with SRI's 5.1 and its own figure for the 16-ounce nonrefillable case of 5.02.

It is noteworthy that the Franklin Associates and SRI reports vary only 1% to 2% with respect to comparable data on 90% of total system energy in 1975 (i.e., total system energy, less about 10% for filling, distribution, and waste disposal).

b. 1985 Data

The Franklin Associates and SRI reports differ only about 2% for nonrefillable beer and soft drink bottle systems, and 6% and 7% for refillable beer and soft drink systems when SRI's "expected" forecasts are used. However, SRI's "achievable" forecasts are 13% to 24% less than those in the Franklin Associates report.

There are notable differences between Franklin Associates and SRI data on secondary packaging with regard to figures for both nonrefillable and refillable systems. These differences arise mostly from different container weights assumed. However, these differences are not very significant in terms of the total system, and they are relatively unimportant.

c. Bottle Size

SRI researchers made comparisons, using data in the SRI report, of system energy requirements as a function of bottle size for all-glass bottles (see Table 5). The following conclusions can be drawn:

- The largest savings, 26%, occur when the size of refillable soft drink bottles is increased to 32 ounces from 12 ounces. A 23% saving results from increasing to 32 ounces from 16 ounces.

Table 5

ENERGY REQUIREMENTS AND SAVINGS WITH INCREASED BOTTLE SIZE*
10^6 Btu†/1000 Gallons; Percent

	12 oz Bottle Requirements	12 oz to 16 oz Savings Differential	16 oz Bottle Requirements	16 oz to 32 oz Savings Differential	32 oz Bottle Requirements	32 oz to 48 oz Savings Differential	48 oz Bottle Requirements	48 oz to 64 oz Savings Differential	64-oz Bottle Requirements
Nonrefillable									
Beer									
1975	37.1	2%	36.5	13%	31.9				
1985									
Expected	30.0	3	29.0	13	25.2				
Achievable	20.5	0	20.5	13	17.8				
Soft drink									
1975			40.6	7	37.6	(7%)‡	40.2	11%	35.7
1985									
Expected			33.0	10	29.8	(6)	31.6	10	28.3
Achievable			23.4	9	21.4	(6)	22.7	10	20.4
Refillable (1 trip)									
Beer									
1975	57.7	4	55.4	21	43.6				
1985									
Expected	46.8	3	45.4	23	35.1				
Achievable	33.2	3	32.2	24	24.5				
Soft drink									
1975			72.5	17	60.2	3	58.4	10	52.5
1985									
Expected			60.1	18	49.5	3	47.8	9	43.4
Achievable			44.0	18	36.1	4	34.6	9	31.6

*Includes materials extraction, bottle export, bottle manufacture, closure and labeling, and secondary packaging.

†Btu = British thermal unit.

‡Numbers in parentheses represent increased energy requirements with increasing bottle size.

- A substantial savings--18%--occurs in increasing the size of refillable soft drink bottles to 32 ounces from 16 ounces.
- The next largest savings--16% and 13%--can be found in nonreturnable beer bottle systems when bottle size is increased to 32 ounces from 12 ounces and from 16 ounces, respectively.
- The 48-ounce bottle has only a marginal energy advantage over the 32-ounce size--at most, 3% for refillable soft drink systems--and exhibits a loss of 6% in nonrefillable soft drink systems.
- The 64-ounce bottle (compared only for soft drink systems) shows about a 10% savings over the 48-ounce bottle.

Three plastic-coated bottle sizes were also compared, revealing a 1% to 6% savings in the 48-ounce size over the 32-ounce size, and a 0% to 10% savings when size is increased from 48 ounces to 64 ounces.

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Final Report *December 1975*

PROSPECTS FOR ENERGY SAVINGS IN GLASS BEVERAGE CONTAINER SYSTEMS BY 1985

Prepared for:

THE GLASS CONTAINER MANUFACTURERS INSTITUTE, INC.
WASHINGTON, D.C.

SRI Project 4389

RTI note:
RTI reviewed the preliminary draft of this study submitted by GCMI and not this final report. However, GCMI informs us that there are no significant changes between the preliminary and final report. Therefore, at their request, the final report is reproduced here.

STANFORD RESEARCH INSTITUTE
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Final Report *December 1975*

PROSPECTS FOR ENERGY SAVINGS IN GLASS BEVERAGE CONTAINER SYSTEMS BY 1985

By: S. M. HAUSER

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I INTRODUCTION

This memorandum report summarizes the results of a study conducted by SRI for the Glass Container Manufacturers Institute (GCMI). Its purpose is to quantify the possible savings that are expected to occur between 1975 and 1985 in the total energy required to manufacture and deliver glass soft drink and beer packaging systems to bottlers' plants. Investigated sources of anticipated energy savings included improvements in the process technology for glass bottles, changes in materials, reductions in weights, and similar factors.

To meet GCMI's need for immediate information, the scope of the research was confined to interviews of various glass container manufacturers (including cooperating nonmembers of the GCMI), equipment suppliers, other industry experts, and appropriate members of SRI's own expert staff. Since there was not sufficient time to conduct original research, the important or critical quantitative data were validated from a number of sources; minor or less critical data were validated from at least two independent sources. Consequently, the results reported here represent a consensus summary of the findings from all of these sources.

Previous studies, for example, Reference (1),* have extensively described the various components of the resource, energy, and pollution inputs and outputs of beverage systems and their respective product life cycles. These detailed process and component descriptions will not be repeated here as the audience for the present report is already well versed with this general background material and the specific technologies and processes of glass bottle manufacture and distribution.

The scope of the study was defined as exploring possible energy savings in the following components of the total glass beverage container system:

- Mining and transport of raw materials used in glass manufacture (including bottle transport to bottling companies).
- Bottle manufacturing.
- Closures (i.e., caps and crowns) and labels.
- Secondary packaging materials (i.e., boxes, carriers).

*References appear on page 59.

Other components of glass container system energy consumption, particularly those not under the direct control or influence of the glass container manufacturing industry, were not covered. These excluded factors include:

- Bottle washing and filling
- Distribution to retail outlets
- Recovery and disposal of postconsumption waste, including glass.

The portions of container-system energy associated with these factors normally constitute a small portion (about 10%) of the total container-system energy which can be associated with single-trip container systems, and any energy savings among these factors are not likely to represent a significant portion of total possible savings.

The entire analysis presented in the body of this report is defined by and limited to the study specifications set forth by the Federal Energy Administration (FEA) for the glass container manufacturing industry, and to those operational areas which are basically under the control of this industry. Excluded are several vital areas of impact which rest outside of the energy-use issue as well as certain equally significant operational areas involved in the total system energy configurations which are beyond the control of the glass container industry. These latter areas include:

- Container size mix, which affects all estimates of present and future total system energy requirements as set forth in the FEA 1975 summary report draft, "Energy and Economic Impacts of Mandatory Deposits."
- Trippage considerations for the refillable bottle systems.
- Future national energy policies bearing on the availability and costs of fuels.
- Capital investment/energy-saving trade-offs involved.

With respect to the container size mix, for example, the use of 64-ounce nonrefillable soft drink glass containers has tripled over the past two years, while total nonrefillable glass soft drink container shipments have decreased. As shown in Table 1, use of these larger sized containers results in significant energy savings per gallon consumed. Since such market product mix changes are expected to continue, this savings potential warrants special recognition in all energy requirement projections for the glass container industry.

Table 1

COMPARATIVE 1975-1985 ENERGY SAVINGS FOR GLASS CONTAINER SYSTEMS
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume (oz)	1975 Energy Requirement	1985 Energy					
			Expected Savings			Achievable Savings		
			Energy Requirement	Savings over 1975		Energy Requirement	Savings over 1975	
				Amount	%		Amount	%
NR Beer	7	47.9	38.6	9.3	19	26.6	21.3	45
	12	37.2	30.0	7.2	19	20.5	16.7	45
	16	36.5	29.0	7.5	21	20.5	16.0	44
	32	31.3	25.0	6.3	20	17.8	13.5	43
NR Soft Drink	10	46.9	38.1	8.8	19	26.9	20.0	43
	16	40.6	33.0	7.6	19	23.3	17.3	43
	32	37.7	29.8	7.9	21	21.4	16.3	43
	48	39.5	31.3	8.2	21	22.5	17.0	43
	64	35.7	28.3	7.4	21	20.4	15.3	43
REF Beer	7	70.3	57.1	13.2	19	40.7	29.6	42
	12	57.6	46.8	10.8	19	33.2	24.4	42
	16	55.9	45.4	10.5	19	32.2	23.7	42
	32	42.9	34.8	8.1	19	24.5	18.4	43
REF Soft Drink	10	101.7	84.3	17.4	17	61.8	39.9	39
	16	72.5	60.1	12.4	17	44.0	28.5	39
	32	60.2	49.5	10.7	17	36.1	24.1	40
	48	57.5	47.4	10.1	18	34.5	22.9	40
	64	52.5	43.4	9.1	17	31.6	20.9	40
NR Plasti-shield®	32	33.0	25.9	7.1	22	19.3	13.7	42
	48	31.0	24.4	6.6	21	18.4	12.6	41
	64	31.7	25.5	6.2	20	18.4	13.3	42
NR Plastic coated	32	34.7	27.1	7.6	22	20.6	14.1	41
	48	32.6	25.6	7.0	21	20.0	12.6	39
	64	32.8	26.5	6.3	19	19.3	13.5	41
REF Plastic coated	32	57.9	47.2	10.7	19	33.6	24.3	42
	48	55.4	45.3	10.1	18	32.0	23.4	42
	64	49.5	40.6	8.9	18	30.0	19.5	39

Notes: Energy-savings data reflect glass container system processes from mining to delivery to bottling plants. The data are totals of component data from Tables 12, 18, 20, and 21.

Btu = British thermal unit.

NR = Nonrefillable bottles.

REF = Refillable bottles--those manufactured for multiple recleanings and refillings. Data are for 1-trip case, and therefore reflect higher energy levels than would occur in actual system.

To reach valid conclusions regarding the refillable container system, consideration must be given to the trippage factor, for variations in the number of times the bottle is utilized significantly impacts the refillable system requirements. However, there is great difficulty in accurately measuring current trippage rates, and projections are made doubly difficult because of a highly complex set of market-oriented forces operating within the beverage container industry.

No cohesive national energy police presently exists. Regulation allocation and research authority for energy matters is fragmented. Government-imposed allocations, artificial cost structures, cost restraints on production, and other factors dramatically affect the prices and availabilities of various fuels as well as system energy-use characteristics. An assessment of this problem and its ramifications is fundamental to any projection of this industry's 1985 energy usage.

The glass container industry has a diversity of opportunities for energy savings, some of which will require substantial capital investment. The extent to which such investment will be made is highly sensitive to the cost of capital, the costs of fuels, and government policy.

The author wishes to acknowledge the significant contributions and support provided by the staff members of the GCMI, several of its supporting corporate members, and many other organizations and individuals that are associated with glass technology and manufacturing.

II SUMMARY AND CONCLUSIONS

Quantitative Findings

Project research results are summarized in Table 1 for the 27 categories of glass beverage containers that could be in use in 1985. Glass container system energy and savings in system energy are both expressed in terms of millions of Btu (British thermal units) per 1000 gallons of beverage (10^6 Btu/1000 gallons), to accommodate the practice used in Reference (5). Total glass system energy requirements in 1985 are expected to be lower by 17% to 22%--depending on the specific container type--compared to 1975 values, while achievable savings could be as large as 38% to 45%. SRI anticipates that the actual reductions in system energy consumption by 1985 will lie somewhere between the two cases presented in Table 1.

The differences between the expected and achievable system energy savings are discussed below.

Expected Savings

Expected savings are reductions which will result from the extension of changes that are now developing or evolving in existing process technologies, actual changes in raw materials (e.g., batch composition), modest weight reductions in components, and related actual or evolving developments. SRI concludes that these expected savings have an 85% to 95% probability of occurring by 1985; many will be in use by 1980.

The 17% to 22% savings expected by 1985 will be due to the following:

- Conversion to 100% natural soda ash.
- An up to 9% reduction in bottle manufacturing energy requirements resulting from a number of sources of savings.
- An average bottle weight reduction of 8%, resulting from extending existing manufacturing technology, which requires no changes in individual bottle shape, to all bottle sizes.

- Conversion to all-steel closures from aluminum, resulting in a 10% reduction in closure manufacturing energy.*
- A 25% reduction in secondary packaging weights and a 6% reduction in packaging material manufacturing energy.

Other minor factors are described in the detailed analyses in the next chapter.

Achievable Savings

Achievable savings are reductions which could result from the evolution of new process technologies (some of which are now being explored but are as yet commercially unproved), significant changes in the batching process, and similar reductions in other manufacturing areas which may be necessary to offset possible future increases in energy cost and to counter increased competition from other container systems. SRI assigns a 45% to 55% probability that these achievable savings will be realized by 1985.

The 38% to 45% savings achievable by 1985 are based on the following assumed conditions:

- Conversion to 100% natural soda ash.
- Reduction in bottle manufacturing energy up to 21% from a wide spectrum of savings possibilities.
- Reduced bottle weights in the range of 20% to 30%, due to new forming technologies and to bottler acceptance of a quasi-standard bottle shape.
- An average 3% improvement in pack-to-pull ratios due to overall process improvements throughout the bottle manufacturing process.
- Conversion to all-steel closures.
- A 75% reduction in secondary packaging weights due to entirely new packaging technologies and systems, including several concepts involving reuse.

*It is possible that other less energy-intensive closures will be introduced between 1975 and 1985.

Energy Distribution in the Glass Beverage Container System

The distribution of total system energy and the savings in system energy among the four components of the total glass container energy system as defined in this study is summarized in Table 2 [(a), (b), (c), and (d)] for four sizes of beverage bottles; seven additional sizes are tabulated in Appendix A. In 1975, "container manufacturing" energy represents two-thirds or more of total system energy, and by 1985 will increase slightly as a percentage of the total for both the expected savings and achievable savings cases. "Closure and Label" energy represents the smallest energy consumption component of the glass container system (between 1% and 6% in 1975); it will also increase slightly as a proportion of the total by 1985, but will remain at less than 10% of the total by 1985, even for smaller bottles. "Materials Acquisition and Bottle Transport" energy represents between 17% and 20% of total system energy, and percentage reductions in this energy component will generally follow that of "Container Manufacturing" because both are highly affected by bottle weight.

There are different considerations in "secondary packaging" energy requirements. In general, larger containers require less paper packaging per container than smaller containers. Consequently, "Secondary Packaging" energy may be as much as 20% of total system energy for small containers (e.g., the 12-ounce nonreturnable beer bottle) but drops to under 7% for the larger containers (e.g., the 48-ounce refillable soft drink bottle). Because significant weight reductions in secondary packaging are anticipated, energy consumption in "Secondary Packaging" will be a smaller portion of total system energy in both the expected savings and achievable savings cases in 1985.

Clearly, therefore, energy reduction efforts will result in greater payoffs if concentrated on container manufacturing and less if applied to closure and labels.

Fuel Availability for Glass Container Manufacturing

Energy source utilization inquiries were undertaken under the aegis of the GCMI in 1975 among several major glass container manufacturers. The results, shown below, are believed by industry sources to represent the range of 1975 energy source usage patterns:

Table 2

COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(a) Container: 12-Ounce Nonrefillable Beer Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
			Energy				Energy		Savings Over 1975	
	Total	%	Requirement	%	Amount	%	Requirement	%	Amount	%
Materials acquisition and bottle transport	5.2	14.0%	4.1	13.7%	1.0	19%	3.5	17.1%	1.7	33%
Container manufacturing	22.0	59.3	18.4	61.3	3.7	17	13.1	63.9	8.9	40
Closure and label	2.2	5.9	2.0	6.7	0.2	10	2.0	9.8	0.2	10
Secondary packaging	7.7	20.8	5.5	18.3	2.3	30	1.9	9.3	5.9	77
Total	37.4	100%	30.0	100%	7.2	19%	20.5	100%	16.7	45%

Note: Btu = British thermal unit.

Table 2

COMPARATIVE 1975-1985 ENERGY ANALYSIS (Continued)
(Energies in 10^6 Btu/1000 Gallons Beverage)

(b) Container: 32-Ounce Nonrefillable Beer Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
			Energy				Energy		Savings Over 1975	
	Total	%	Requirement	%	Amount	%	Requirement	%	Amount	%
Materials acquisition and bottle transport	4.9	15.7%	3.8	15.3%	1.1	22%	3.3	18.5%	1.6	32%
Container manufacturing	21.4	68.4	17.4	69.9	4.0	19	12.7	71.3	8.7	41
Closure and label	0.8	2.6	0.7	2.8	0.1	10	0.7	3.9	0.1	10
Secondary packaging	4.2	13.4	3.0	12.0	1.2	29	1.0	5.6	3.2	76
Total	31.3	100%	24.9	100%	6.4	20%	17.8	100%	13.6	43%

Note: Btu = British thermal unit.

Table 2

COMPARATIVE 1975-1985 ENERGY ANALYSIS (Continued)
(Energies in 10^6 Btu/1000 Gallons Beverage)

(c) Container: 16-Ounce Refillable Soft Drink Bottle*

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
									Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	10.8	14.9%	8.6	14.3%	2.2	20%	7.3	16.6%	3.5	32%
Container manufacturing	55.3	76.3	46.7	77.7	8.6	16	34.3	78.0	21.0	38
Closure and label	1.3	1.8	1.2	2.0	0.1	10	1.2	2.7	0.1	10
Secondary packaging	5.1	7.0	3.6	6.0	1.5	29	1.2	2.7	3.9	76
Total	72.5	100%	60.1	100%	12.4	17%	44.0	100%	28.5	39%

Note: Btu = British thermal unit.

*Trippage amount not considered; data refers to a one-trip case.

Table 2

COMPARATIVE 1975-1985 ENERGY ANALYSIS (Concluded)
(Energies in 10^6 Btu/1000 Gallons Beverage)

(d) Container: 48-Ounce Refillable Soft Drink Bottle*

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
									Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	8.5	14.8%	6.8	14.3%	1.7	20%	5.7	16.5%	2.7	32%
Container manufacturing	44.3	77.0	37.4	78.9	6.9	16	27.5	79.5	16.8	38
Closure and label	0.7	1.2	0.4	0.8	0.3	45	0.4	1.2	0.3	45
Secondary packaging	4.0	7.0	2.8	5.9	1.2	30	1.0	2.9	3.0	76
Total	57.5	100%	47.4	100%	10.1	17%	34.6	100%	22.8	40%

Note: Btu = British thermal unit.

*Trippage amount not considered; data refers to a one-trip case.

Energy Source	Range (percent of total)
Natural gas	55 to 62%
Oil (all types)	23 to 14%
Propane	2 to 1%
Electricity	20 to 23%

In the analyses conducted here, it has been assumed that the family of fossil fuels used in glass container manufacturing will continue to be readily available in 1985, regardless of cost, and that electricity will not provide more than 20% to 23% of glass plant energy by then; that is, oil can replace some natural gas if supplies of the latter are restricted, and electricity will only be used as a backup incremental energy source. For example, the relative consumption rates of oil and gas could be completely reversed by 1985; however, there will be a continuing need for some gaseous fuels in certain manufacturing processes.

Fuel efficiency will not be degraded by 1985 as the result of using more oil and less natural gas because of the following factors:

- Oil can be interchanged for gas in most furnaces without degrading furnace fuel efficiency.
- When used in furnaces designed specifically for oil, net efficiency gains are obtained which, within the precision of measurement now available, approximately offset the slightly higher energy extraction costs for oil (described in Table 14).
- Furnaces will be designed and rebuilt at the ends of their campaigns between 1975 and 1985 for optimized operation with those fuels dictated by future circumstances.

Other Limitations of and Assumptions Made in SRI's Research

- None of the above estimates of savings or reductions in glass container system energy expected by 1985 consider the possible impact of trippage for refillable bottles. Trippage directly affects "Materials Acquisition and Bottle Transport" and "Container Manufacturing" energies (and those of "Secondary Packaging" in some cases), which factors jointly account for 80% to 90% of total container system energy. However, the quantitative impacts of trippage are difficult to quantify because they are derived

from highly imprecise and subjective assumptions. Consequently, trippage is not quantitatively analyzed as a source of specific energy savings in this study.

- The increasing use of larger containers is also expected to decrease overall energy usage of the industry.
- It has been assumed that regulatory constraints above and beyond those currently in effect will not be imposed on the manufacturing sector.

Applications of Report Methodology

The detailed tables of intermediate results which appear in the next chapter constitute a simplified but valid algorithm of the energy consumed in the production of a glass container system from the mining of raw materials up to delivery to the bottlers' dock. The format of these presentations should enable the interested reader to specify and apply alternative assumptions to the basic data to ascertain the potential reductions in glass container system energy consumption for these specific categories of containers.

III ANALYSIS AND RESULTS

1975 Base Data

A significant portion of the 1975 base data for glass container systems energy inputs was updated from SRI's earlier comprehensive study of glass and nonglass beverage container systems.* Typical industry data on 1975 glass container process or manufacturing energy and on major components weights, such as bottle body weights, were developed by GCMI working with several corporate members; these data are listed in Tables B-1 and B-2 of Appendix B. Other 1975 base data for manufacturing energy (expressed in terms of Btu per unit weight of material) were derived from data in Reference (1) and other industry sources for the following nonglass components and materials:

- Steel closures
- Aluminum closures
- Plastic closure liners
- Finished bottle transport
- Label and secondary packaging materials.

Since this project did not include original process research, several data sources (including interviews) were used to verify the validity of each significant piece of information used in the 1975 base data; usually two data sources were used to validate the less significant data. Where tabulated data was provided by GCMI, proprietary data from several glass container manufacturers and other industry sources were examined independently to validate the manufacturing energy values assigned to key processes or steps.

*See, for example, in Reference (1), the data in Table 4, page 7, on raw materials acquisition energy.

The 1975 glass container manufacturing energies and related data provided in Tables B-1 and B-2 warrant special comment here. In all previous studies of the glass container manufacturing process, industrywide average manufacturing energy figures (expressed as 10^6 Btu per ton of glass, melted and packed) which incorporated process data for all sizes and types of glass containers were typically computed. These earlier data combined manufacturing energy for low yield, low production volume bottle configurations with that for high yield, high production volume bottles. However, this current study is concerned with beer and soft drink bottles, both of which are relatively unique examples of containers that are typically produced under highly efficient conditions of energy consumption on dedicated production lines. Consequently, the energy required to manufacture this class of container is 15% to 30% less than that which has been estimated as an average for all glass containers.

Field Interviews for 1975 Forecasts

Table 3 contains a detailed list of possible sources of energy reduction in class container systems by 1985. The list was developed independently from a number of sources [but principally References (1) through (4)], augmented by suggestions from the GCMI and its corporate member representatives.

After the list was compiled, extensive field and telephone interviews were held with:

- Glass container manufacturers (including nonmembers of GCMI).
- Other glass product manufacturers.
- Equipment suppliers to the glass container industry.
- Other acknowledged industry experts.

The purposes of these discussions were to determine which list items were realist sources for 1985 energy reductions, and to quantify and qualify estimates of the anticipated gains.

Table 3

POSSIBLE SOURCES OF 1985 SAVINGS
IN GLASS CONTAINER SYSTEM ENERGY CONSUMPTION

Product and process changes
- Synthetic soda ash replaced with natural soda ash
- Soda ash replaced with caustic soda
- Increased use of foreign cullet*
- Increased incoming furnace air preheat (improved heat recovery from stack gases)
- Preheated and agglomerated batch
- Increased electric boosting
- Vertical melt electric furnaces
- All-electric melt furnaces
- Oxygen-enriched firing
- Submerged combustion
- Furnace improvements
  - Larger furnaces
  - Improved insulation
- Improved refractory materials
- Bottle lightweighting through improved forming techniques
- Standardized or optimized container sizes/designs (both nonrefillable and refillable bottles)
- Thermal and chemical strengthening
- Tempering
- Improved plastic coating
- Larger average container sizes
- Improvements in compressors
- Increased use of automated process control techniques
- Increases in pack-to-pull ratio

Changes in closures
- Aluminum closures replaced with all-steel closures
- Reduction in metal closure weight
- Use of other less energy-intensive closures

Secondary paper packaging changes
- Reduction in weight of all-paper packaging
- New secondary packaging and shipping concepts (e.g., metal carriers)
- Increased use of palletized loads
- Multiple use of paperboard containers
- Recycling of paperboard containers

*Foreign cullets = scrap glass obtained from sources outside of the glass manufacturing plant (usually recycling systems).

The following sources were identified as the feasible sources for which significant glass beverage container system energy reductions, quantified below, could be expected or achieved by 1985.

- Reduction in raw materials acquisition energy due to the anticipated industrywide conversion to 100% natural soda ash from synthetic soda ash and the increased use of foreign cullet.
- Reduction in the weights of existing glass bottles, the plastic coatings used in plastic coated bottles, and secondary packaging materials.
- Widespread use of large capacity bottles in both plastic coated or uncoated designs, and in sizes not yet manufactured or produced in high volumes.
- Reductions in furnace energy due to local combinations of:
  - The increased use of foreign cullet* in the batch.
  - Preheated and agglomerated batch.
  - Improvements in furnace design and operations/control.
- Reductions in forehearth and bottle forming energies.
- Reductions in annealing energy.
- Increases in pack-to-pull ratios due to overall plant process improvements.
- Conversion to all-steel metal closures and reductions in their weight and manufacturing energies.
- Reductions in the weight of secondary packaging materials or the introduction of new, reusable systems.

The remaining sources listed in Table 3 were generally not considered by the parties contacted to be realistic sources of savings in glass container system energy by 1985. A number of the unit process alternatives which have been discussed widely in the literature as representing potential energy savings were explored in some detail in the field interviews. The general consensus for the four most frequently mentioned possibilities follows.

*Foreign cullet is scrap glass obtained from sources outside of the glass manufacturing plant (usually recycling systems).

Further Increases in the Use of Electricity in Glass Melting--proposed increased uses include increased boosting, all-electric furnaces, and vertical melt electric furnaces. Electricity is an inefficient and expensive use of energy for the thermal steps in all manufacturing processes. Consequently, the increased use of electricity in glass manufacturing will result from requirements to meet other objectives, such as increasing incremental furnace throughput, eliminating pollution, or insuring against shortages in fossil fuel sources.

Submerged Combustion--The process is generally believed to be too unrefined and undeveloped to be considered as a serious glass melting technique by 1985. Significant additional research will be needed in fuel composition and burner design to produce glass of quality suitable for bottles.

Oxygen Enrichment--Like electric boosting, enrichment is generally felt to be a means of boosting furnace throughput at minimum capital cost without interrupting furnace campaigns. However, operating costs are increased significantly, offsetting as much as 20 times any savings in furnace energy money costs; therefore, economic costs far outweigh energy savings.

Additional Changes in Batch Composition--Changes in minor batch ingredients can have significant effects on glass manufacturing. However, industry sources generally agree that the identifiable changes in batch composition by 1985 will be limited to the conversion to 100% natural soda ash and the increased use of foreign cullet which will be available from the various resource recovery systems now in development.

General Approach

For this report, the glass beverage container system energy analysis was divided into the following four components:

- Raw materials acquisition and bottle transport* energy.
- Glass container manufacturing energy.
- Total closure system (cap and plastic liners) and label energy.
- Secondary packaging energy.

*Transport from container manufacturer to bottle filler/beverage distributor.

This division of the complete system is logical on a process basis and also corresponds to a format which is being used in other studies of anticipated 1985 beverage container systems energy savings [e.g., Reference (5)].

Several additional energy components of the beverage container system (bottle washing and filling, distribution, and postconsumption waste disposal) are beyond the control or direct influence of the glass container industry. Possible energy savings achievable from these factors were not analyzed here, but it is likely that significant savings can be achieved.

Methodology

A summary of analytical methodology follows:

- Forecasts of weight reductions were first developed from the field interview data for bottles (Table 4*), the plastic component of plastic coated bottles (Table 5), and secondary packaging (Table 6).
- The impacts of changes in batch composition due to the conversion to 100% natural soda ash and to various cullet levels on the total raw materials acquisition energy were first computed (Table 7) and then combined with the estimated reduction in bottle transport energy (Table 8) to determine a combined energy savings for these two factors, expressed as Btu per ton of glass packed.

  The resulting changes in the corresponding 1985 energies for individual bottles are listed in Table 9 in terms of 10^6 Btu per 1000 gallons of beverage, the standard unit of energy measurement adopted for this report.
- Quantitative estimates of energy savings for individual process steps of the entire glass manufacturing process are summarized in Tables 10, 11, and 12. The resultant 1985 glass manufacturing energies and attendant savings are listed for all bottles in Table 13.

*The rationales for quantifying the specific changes used for computing the reductions in component weights and energies are discussed in the list of Assumptions which accompany each table where they are required.

- The 1975 and 1985 energy impacts of the plastic component of plastic coated bottles on container manufacturing energy is taken into account in Table 14, and incorporated into the complete list of all containers in Table 15.
- Closure and label configurations for 1975 and 1985 are outlined in Table 16, and corresponding estimates of closure and label energy savings are listed in Table 17 for all bottle classes.
- The results of the corresponding energy reduction computations for secondary packaging materials are provided in Table 18.
- Total system energies for 1975 and 1985, and the attendant savings, are summarized in Table 1, page 3, for the complete glass beverage container system defined above for each bottle.

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Table 4

ESTIMATES OF 1985 GLASS CONTAINER WEIGHTS

Type Bottle	Fluid Volume (oz)	1975 Weight (oz)	1985 Expected Savings Weight (oz)	1985 Expected Savings Reduction over 1975 (oz)	1985 Expected Savings Reduction over 1975 (%)	1985 Achievable Savings Weight (oz)	1985 Achievable Savings Reduction over 1975 (oz)	1985 Achievable Savings Reduction over 1975 (%)
NR Beer	7	4.5	4.1	0.4	8	3.5	1.0	22
	12	6.1	5.6	0.5	8	4.8	1.3	22
	16	8.5	7.7	0.8	10	6.6	1.9	22
	32	15.5	14.0	1.5	10	12.1	3.4	22
NR Soft Drink	10	7.0	6.4	0.6	8	5.5	1.5	22
	16	10.0	9.2	0.8	8	7.8	2.2	22
	32	19.0	17.1	1.9	10	14.8	4.2	22
	48	30.0	27.0	3.0	10	23.4	6.6	22
	64	36.0	32.4	3.6	10	28.1	7.9	22
REF Beer	7	7.0	6.4	0.6	8	5.5	1.5	22
	12	10.0	9.2	0.8	8	7.8	2.2	22
	16	13.0	12.0	1.0	8	10.1	2.9	22
	32	20.0	18.4	1.6	8	15.6	4.6	22
REF Soft Drink	10	15.0	13.8	1.2	8	11.7	3.3	22
	16	17.0	15.6	1.4	8	13.3	3.7	22
	32	28.0	25.8	2.2	8	21.8	6.2	22
	48	40.0*	36.8	3.2	8	31.2	8.8	22
	64	48.0*	44.2	3.6	8	37.4	10.6	22
NR PCG†	32	15.0	13.5	1.5	10	12.0	3.0	20
	48	22.0	19.8	2.2	10	17.6	4.4	20
	64	29.0	27.0	2.0	7	23.2	5.8	20
REF PCG	32	22.0*	20.5	1.5	7	15.4	6.6	30
	48	32.0*	29.8	2.2	7	22.4	9.6	30
	64	38.0	35.3	2.7	7	28.5	9.5	30

Note: NR = Nonrefillable bottles.

REF = Refillable bottles--those manufactured for multiple reclosings and refillings--sometimes incorrectly referred to as returnable.

PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers in which the plastic covers the entire external surface of the container.

*See "1975 Weights" in the following "Table 4 Assumptions for 1985 Container Weight Reductions."

†Includes both Plastishield® and plastic coated bottles.

Table 4(b)

ASSUMPTIONS FOR 1985 CONTAINER WEIGHT REDUCTIONS

(1) 1975 Weights

Weights indicated by the asterisk (*) refer to bottles that are not in high volume production now or are not yet available. Consequently, the listed weights for these bottles represent best estimates of the weights that would be typical under high volume production conditions in 1975 with existing processes and technologies.

(2) 1985 Expected Savings

The emerging commercially available narrow neck press and blow process can be adapted to all sizes of bottles without further significant changes in technology. Some of these gains, which result in weight reductions, will be realized for certain bottles in 1976.

No changes in individual bottle configuration will be required; however, a 38 mm finish may be required on 48- and 64-ounce bottles.

(3) 1985 Achievable Savings

New forming technologies and systems now in development will be commercially available well before 1985.

Relatively standard bottle configurations will become acceptable to bottlers. The impetus will arise in part, from significant savings in the cost of lighter weight bottles.

The necessary improved hot end coating systems will be in use when needed.

No regulatory constraints will be imposed on bottle configuration.

Table 5(a)

ESTIMATES OF PLASTIC COATING WEIGHTS
USED IN NONRETURNABLE AND REFILLABLE PLASTIC COATED BOTTLES
1975 AND 1985

Type Bottle	Fluid Volume (oz)	Type of Plastic Coating	1975 Weight (g)	1985 Case Weight (g)	1985 Case Reduction over 1975 (g)	1985 Case Reduction over 1975 (%)
NR PCG	32	Plastishield®	5.0	3.8	1.2	25%
	48		6.0	4.5	1.5	25%
	64		7.0	5.3	1.7	25%
	32	Plastic coated	8.0	6.0	2.0	25%
	48		10.4	7.8	2.6	25%
	64		11.5	8.6	2.9	25%
REF PCG	32	Plastishield®	This type of bottle is not expected to be manufactured.			
	48					
	64					
	32	Plastic coated	21.0	15.8	5.3	25%
	48		28.0	21.0	7.0	25%
	64		31.0	23.3	7.7	25%

Notes: NR = Nonrefillable bottles.

REF = Refillable bottles--those manufactured for multiple reclean-ings and refillings.

PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers, in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers, in which the plastic covers the entire external surface of the container.

Table 5(b)

ASSUMPTIONS FOR PLASTIC COATING WEIGHTS FOR 1975 AND 1985
NONREFILLABLE AND REFILLABLE PLASTIC COATED BOTTLES

(1) 1975 Refillable Plastic Coated Bottles

Plastishield®: This type of coating is not suitable for recleaning because of purely mechanical problems. Therefore, refillable Plastishield® bottles are not expected to be manufactured.

Plastic coated: Developments are now under way that could lead to the commercial availability of refillable plastic coated bottles before 1980. The weights of coating for each refillable plastic coated bottle are expected to be 2.6 times existing nonrefillable plastic coating weights.*

(2) 1985 Weight Reductions

Weight reductions of 25% are now anticipated for two reasons:

New materials with improved properties are expected to become available before 1985 that will allow this level of weight reduction for both Plastishield and plastic coatings.

Improved application processes for existing materials will permit a more uniform coating wall thickness to be applied and a total reduction in total coating weight in the case of plastic coatings.

*Glass container weights reflect the impact of plastic coating.

Table 6(a)

ESTIMATES OF SECONDARY PACKAGING WEIGHTS PER CONTAINER
1975 and 1985

Type Bottle	Fluid Volume (oz)	1975 Weight (lb)	Expected Savings: Weight (lb)	Expected Savings: Reduction over 1975 (lb)	Expected Savings: Reduction over 1975 (%)	Achievable Savings: Weight (lb)	Achievable Savings: Reduction over 1975 (lb)	Achievable Savings: Reduction over 1975 (%)
NR Beer	7	0.033	0.025	0.008	25	0.0083	0.024	75
	12	0.043	0.032	0.011	25	0.011	0.032	75
	16	0.046	0.035	0.011	25	0.012	0.034	75
	32	0.062	0.047	0.015	25	0.016	0.046	75
NR Soft Drink	10	0.032	0.024	0.008	25	0.0080	0.024	75
	16	0.039	0.029	0.010	25	0.0098	0.029	75
	32	0.062	0.047	0.015	25	0.016	0.046	75
	48	0.098	0.074	0.024	25	0.025	0.073	75
	64	0.106	0.080	0.026	25	0.027	0.079	75
REF Beer	7	0.031	0.023	0.008	25	0.0078	0.023	75
	12	0.042	0.032	0.010	25	0.011	0.031	75
	16	0.053	0.040	0.013	25	0.013	0.040	75
	32	0.081*	0.061	0.020	25	0.020	0.061	75
REF Soft Drink	10	0.034	0.026	0.008	25	0.0085	0.025	75
	16	0.038	0.029	0.009	25	0.0095	0.028	75
	32	0.062	0.047	0.015	25	0.016	0.046	75
	48	0.088*	0.066	0.022	25	0.022	0.066	75
	64	0.105*	0.079	0.026	25	0.026	0.079	75
NR PCG	32	0.058	0.044	0.014	25	0.015	0.043	75
	48	0.070	0.053	0.017	25	0.018	0.052	75
	64	0.115	0.086	0.029	25	0.019	0.096	75
REF PCG	32	0.048*	0.026	0.012	25	0.012	0.036	75
	48	0.070*	0.053	0.017	25	0.018	0.052	75
	64	0.080*	0.062	0.018	25	0.021	0.059	75

Notes: NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple recleanings and refillings.

PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers in which the plastic covers the entire external surface of the container.

*See "1975 Weights" in the Assumptions for 1985 Container Weight Reductions for Table 4; these same comments apply to these secondary packaging weights.

Table 6(b)

ASSUMPTIONS FOR 1985 SECONDARY PACKAGING WEIGHT REDUCTIONS

(1) Expected Savings

SRI's field research findings agree with the expectations in Reference (5) that a 25% weight reduction in secondary packaging will take place by 1985 as the result of ongoing development work.

The gains will be achieved through several possible alternatives:

Optimized packaging design using existing technologies.

Modest impact due to glass container weight reductions.

Limited reuse of secondary packaging.

(2) Achievable Savings

Basic new secondary packaging and shipping combination concepts will be in widespread use by 1985, some of which are now being demonstrated. These concepts are aimed at significantly reducing or eliminating paper as a secondary packaging material. Possibilities include:

European secondary packaging and shipping concepts which use significantly reduced quantities of materials.

Returnable container racks which can also be used as retail racks in some cases.

Extensive reuse of cartons and boxes.

Table 7(a)

IMPACT OF CHANGES IN NATURAL SODA ASH AND CULLET ON RAW MATERIALS ACQUISITION ENERGY,* 1985 OVER 1975 (Energies in Terms of 10^6 Btu/Ton of Glass Packed)

	1975 Values for 75% Natural Soda Ash†		1985 Values for 100% Natural Soda Ash			
			20% Cullet		50% Cullet‡	
Material	Weight (tons)	Energy (10^6 Btu)	Weight (tons)	Energy (10^6 Btu)	Weight (tons)	Energy (10^6 Btu)
Sand	0.681	0.348	0.681	0.348	0.477	0.244
Limestone	0.186	0.097	0.186	0.097	0.130	0.068
Natural soda ash	0.153	1.028	0.219	1.471	0.153	1.030
Synthetic soda ash	0.066	0.775	0	0	0	0
Feldspar	0.050	0.027	0.050	0.027	0.035	0.019
Slag						
Dolomite	0.037	0.005	0.037	0.005	0.026	0.004
Other§						
Subtotal	1.173	2.280	1.173	1.948	0.821	1.364
Fusion loss	(0.173)	n.a.	(0.173)	n.a.	(0.121)	n.a.
Cullet						
In-house**	0.150	n.a.	0.150	n.a.	0.150	n.a.
Foreign††	0.050	n.a.	0.050	n.a.	0.350	0.581
Subtotal	0.200	n.a.	0.200	n.a.	0.500	0.581
Syatem Total	1.200	2.280	1.200	1.948	1.200	1.945

Notes: Btu = British thermal unit.
n.a. = not applicable.

*See Assumption 3 in the following Table 7(b) assumptions.

†See Assumption 1 in the following Table 7(b) assumptions.

‡Shown for illustrative purposes.

§See Assumption 2 in the following Table 7(b) assumptions.

**See Assumption 4 in the following Table 7(b) assumptions.

††See Assumption 5 in the following Table 7(b) assumptions.

Table 7(b)

ASSUMPTIONS FOR THE IMPACT OF CHANGES IN NATURAL SODA ASH AND FOREIGN CULLET ON RAW MATERIALS ACQUISITION ENERGY

(1) The 1975 base data for raw materials balance and acquisition energy were obtained from Reference (1), adjusted to reflect a 20% total cullet level (5% or more foreign cullet) and an increase in the level of natural soda ash to 70%.

(2) "Other" includes approximately 0.050 ton of refractory and mold losses.

(3) Value of raw material extraction energy. Includes an average energy extraction cost of about 7% as computed in Table 11.

(4) In-house cullet actually ranges from 17% to 11% as listed in Table B-2. The use of a nominal value of 15% for in-house cullet in this table does not have a detectable impact on the computation of total energy savings reported in Table 1.

(5) SRI assumes that the glass container industry will be "assessed" an energy acquisition charge for foreign cullet once the average portion of foreign cullet exceeds the present 5% level. For the purposes of this analysis, foreign cullet acquisition energy (expressed in terms of Btu per pound of material) is assumed to be comparable to the average acquisition energy for all other raw materials represented by the 100% natural soda ash case of Table 7 (that is, 1.948×10^6 Btu for 1.173 tons of materials, or 1.661 Btu per ton of cullet). Data from other studies indicates that this is a very conservative estimate.

Table 8

SUMMARY OF ENERGY REDUCTIONS IN RAW MATERIALS EXTRACTION AND FINISHED BOTTLE TRANSPORT, 1985 over 1975
(Energies in Terms of 10^6 Btu/Ton of Glass Packed)

Type and Quantity of Energy	1975 Energy: 20% Cullet; 70% Natural Soda Ash	Average 1985 Energy; 20% and 50%* Cullet; 100% Natural Soda Ash		
		Quantity	Reduction Amount	Reduction %
Raw materials extraction				
Quantity	2.28	1.95†	0.33	14%
%	90%	90%	n.a.	n.a.
Bottle transport				
Quantity‡	0.26	0.22	0.04	15%
%	10%	10%	n.a.	n.a.
Total				
Quantity	2.54	2.17	0.37	15%
%	100%	100%	n.a.	n.a.

Notes: Btu = British thermal unit.
n.a. = Not applicable.

*Shown for illustrative purposes.

†Average of corresponding values from Table 7.

‡The 1975 figure was computed from data provided in Reference (1), which was based upon actual field data provided by major glass manufacturers on average mileages to bottlers' plants and average diesel fuel consumption of truckers. A 15% reduction in transport energy by 1985 is also assumed.

Table 9

ESTIMATES OF ENERGY SAVINGS IN RAW MATERIALS ACQUISITION AND BOTTLE TRANSPORT
1985 over 1975
(Energies in 10^6 Btu/1000 Gallons Beverage)*

Type	Fluid Volume (oz)	1975 Energy Requirement	1985 Expected Savings: Energy Requirement	Expected Savings over 1975: Amount	Expected Savings over 1975: %	1985 Achievable Savings: Energy Requirement	Achievable Savings over 1975: Amount	Achievable Savings over 1975: %
NR Beer	7	6.5	5.2	1.3	20%	4.4	2.1	32%
	12	5.2	4.1	1.1	20	3.5	1.7	32
	16	5.4	4.2	1.2	22	3.7	1.7	32
	32	4.9	3.8	1.1	22	3.3	1.6	32
NR Soft Drink	10	7.1	5.7	1.4	20	4.8	2.3	32
	16	6.3	5.1	1.2	20	4.3	2.0	32
	32	6.0	4.7	1.3	22	4.1	1.9	32
	48	6.3	5.0	1.3	22	4.3	2.0	32
	64	5.7	4.5	1.2	22	3.9	1.8	32
REF Beer	7	10.2	8.0	2.1	20	6.9	3.3	32
	12	8.5	6.8	1.7	20	5.7	2.8	32
	16	8.3	6.6	1.7	20	5.6	2.7	32
	32	6.3	5.1	1.2	20	4.3	2.0	32
REF Soft Drink	10	15.2	12.2	3.0	20	10.3	4.9	32
	16	10.8	8.6	2.2	20	7.3	3.5	32
	32	8.9	7.1	1.8	20	6.0	2.9	32
	48	8.5	6.8	1.7	20	5.7	2.8	32
	64	7.6	6.1	1.5	20	5.2	2.4	32
NR PCG†	32	4.8	3.7	1.1	22	3.3	1.5	31
	48	4.7	3.6	1.1	22	3.2	1.5	31
	64	4.6	3.7	0.9	19	3.2	1.4	31
REF PCG	32	7.0	5.6	1.4	19	4.2	2.8	39
	48	6.8	5.5	1.3	19	4.1	2.7	39
	64	6.0	4.9	1.1	19	3.9	2.1	35

Notes: BTU = British thermal unit.

NR = Nonrefillable bottles.

REF = Refillable bottles--those manufactured for multiple recleanings and refillings.

PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers, in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers, in which the plastic covers the entire external surface of the container.

*Computed from the 1975 and 1985 glass container weights of Table 4 and the raw materials extraction and bottle transport energies of Table 8.

†Includes both Plastishield® and plastic coated bottles.

Table 10(a)

ESTIMATES OF GLASS CONTAINER MANUFACTURING ENERGIES
AND ENERGY SAVINGS, GLASS PORTION ONLY
1985 over 1975
(Energies in 10^6 Btu/Ton Glass Pulled)*

Bottle Type†	Manufacturing Process	1975§ Energy Requirement	1985 Expected Savings over 1975: Amount	Expected Savings over 1975: %	1985 Expected Savings: Net Energy	1985 Achievable Savings over 1975: Amount	Achievable Savings over 1975: %	1985 Achievable Savings: Net Energy
NR Beer, Soft Drink and PCG	Batch	0.2	0	0%	0.2	0	0%	0.2
	Tank and refiner§	5.4	0.7	12	4.7	1.4	25	4.0
	Forehearth and forming	2.0	0	0	2.0	0.4	20	1.6
	Annealing furnaces (Lehrs)	0.6	0.1	20	0.5	0.2	33	0.4
	Shrink wrap	0.5	0	0	0.5	0	0	0.5
	Handling	0.2	0	0	0.2	0	0	0.2
Total		8.9	0.8	9%	8.1	1.9	21%	7.0
(Corrected total)**		(9.5)	(0.8+)	(9%)	(8.7)	(2.0)	(21%)	(7.5)
REF Beer only	Fire finish	0.8	0	0	0.8	0	0	0.8
Total		9.7	0.8	8%	8.9	1.9	20%	7.8
(Corrected total)**		(10.4)	(0.8+)	(8%)	(9.5)	(2.0)	(20%)	(8.3)
REF Soft Drink and PCG (glass blank only)	Applied ceramic labeling	0.8	0	0	0.8	0	0	0.8
	Additional handling	0.1	0	0	0.1	0	0	0.1
Total		10.6	0.8	8%	9.8	1.9	18%	8.7
(Corrected total)**		(11.3)	(0.8+)	(8%)	(10.5)	(2.0)	(18%)	(9.3)

Note: Btu = British thermal unit.

*Sums may be different from stated totals due to rounding. Numbered footnotes are discussed in the Assumptions for Table 10.

†Subsequent bottle types include the process energies from those above.

§See Assumption (1) in Table 10 Assumptions, under "General Assumptions."

§See Table 12 for details on possible sources of furnace energy savings.

**See Assumption (2) in Table 10 Assumptions, under "General Assumptions."

Table 10(b)

ASSUMPTIONS FOR ESTIMATES OF 1985 GLASS CONTAINER MANUFACTURING ENERGIES AND ENERGY SAVINGS

General Assumptions

(1) Data for 1975 glass unit process energies are from Table B-2.

(2) As suggested in Reference (5), the true energy conversion factor for each fuel source should take into account the energy cost of extracting that energy source. Thus, the "Corrected Totals" of Table 10 were computed by multiplying the immediately preceding "Totals" in that table by 1.069, an aggregate energy correction factor which includes the energy extraction cost for the sources used in glass manufacturing. In applying this correction factor to the data developed in this study, the results of the analyses of this research can be compared directly to the results of similar studies, particularly those of Reference (5). The computation of this aggregate energy correction factor is shown in Table 11.

(3) SRI believes that this corrected energy conversion factor can be applied to all unit process energies without serious distortion of the results, although each fuel constitutes a different proportion of the total energy used in each process.

Assumptions for Savings in Forehearth and Forming Energies

(1) Forehearth

It is technically possible to reduce forehearth energy by at least 20% to 30% through better design and insulation, both of which require replacement or rebuilding of existing facilities. For example, there are existing operations in Europe where reheating is not used in the forehearth as the result of optimized designs to reduce fuel costs.

SRI concludes, however, that expectations are now low for accomplishing significant savings in forehearth by 1985; savings of as much as 20% (i.e., 0.10×10^6 Btu/ton pulled) could be achieved by 1985, but they will be controlled by equipment and facility replacement cycle rates.

(2) Forming Energies

The existing forming machines which will provide the "Expected Savings" in weight, described in the Assumptions for Table 4, do not also provide forming process energy savings. Consequently, no forming energy savings can be expected from the present technologies.

The new forming machines that will permit bottle weight reductions of 25% (described for the "Achievable Savings" in Table 4) can theoretically, produce 30% more bottles for the same amount of forming process energy. SRI concludes that perhaps 60% of the potential energy gain due to increased bottle production might be achieved or realized as forming energy savings (i.e., 18% or 0.27×10^6 Btu/ton pulled).

Assumptions for Savings in Annealing Energy

(1) It is now technically possible to obtain savings of up to 50% to 60% of lehr gas energy (normally two-thirds of total energy used in annealing) by incorporating existing and proven techniques, specifically:

- Internal belt returns.
- Enclosed loading end.
- Addition of automatic burner control.
- Optimized burner configurations.
- In some cases, annealing energy can be completely provided by the heat retained in the container body emerging from the forming process, assuming the cooling rate can be correctly controlled.

(2) SRI anticipates the following will constitute the range of savings in annealing energy for the United States by 1985.

Case	Savings Over 1975	
	%	Amount
Expected Savings	20%	0.12×10^6 Btu/ton
Achievable Savings	33%	0.20×10^6 Btu/ton

Table 11

COMPUTATION OF THE CORRECTION FACTOR TO ACCOUNT FOR THE ENERGY COST OF EXTRACTING ENERGY SOURCES

Energy Source	Distribution in Glass Mfg*	Unit	Energy Value (Btu/unit)			Computed Correction Factor	Net Distribution In Glass Mfg
			Extraction	Actual Usage	Total		
	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ = Ⓔ/Ⓓ	Ⓖ = Ⓐ × Ⓕ
Natural gas	0.55	SCF	56†	1,032†	1,088†	1.054	0.580
Oil‡	0.23	gal	19,900†	145,000†	164,900†	1.137	0.262
Propane	0.02	gal	19,900†	75,800†	95,700†	1.263	0.025
Electricity	0.20	Btu/kWhr	na	10,600§	10,716**	1.011	0.202
Total =	1.000				Computed Aggregate Energy Correction Factor	=	1.069

*Data provided from GCMI survey in September, 1975.

†Reference (5).

‡Average for all residual and distillate oils, Reference (5).

§See Assumptions for Table B-1.

**Reference (5). Includes averaged extraction costs of all fuel source components.

Table 12(a)

POSSIBLE SOURCES OF FURNACE ENERGY SAVINGS
1985 over 1975
(Energies in 10^6 Btu/Ton pulled)

Source of Savings	1985 Expected Savings			1985 Achievable Savings		
	Comments	Savings Over 1975 Amount	Savings Over 1975 %	Comments	Savings Over 1975 Amount	Savings Over 1975 %
Increased use of foreign cullet only	35% total cullet (15% increase)	0.18	3-4%	60% total cullet (40% increase)	0.48	8%
Agglomerated and preheated batch only	Applies to all of existing batch load	0.80	15	Applies to all of existing batch load	1.60	30
Optimized furnace design and operation	Applies to all furnace energy and above cases	0.25	5	Applies to all furnace energy and above cases; includes improved heat flows	0.43	8
SRI estimate of the range of energy savings		0.4 to 0.9	8 to 17		0.9 to 1.8	17 to 33
Nominal Value used in Analysis in Table 13		0.65	12		1.35	25

Notes: Btu = British thermal unit.
1975 Base: 5.4×10^6 Btu/ton pulled; the estimated energy reductions apply to this base value.

Table 12(b)

ASSUMPTIONS FOR POSSIBLE SAVINGS IN FURNACE ENERGY

(1) Increased use of Foreign Cullet*

The estimated energy savings resulting from increased cullet levels are conservative in light of recent experiments conducted in an actual on-line production furnace operating with 60% cullet load; that is, bottle quality glass can be produced from high cullet levels in the batch.

In 1985 a 35% total cullet load will require an increase in foreign cullet from today's average of 5% to 20%, and a 60% total cullet load will require an increase in foreign cullet to 40%. These levels of foreign cullet will depend on the availability of sorted and cleaned cullet from some type of resource recovery systems that can economically serve the major glass plants.

(2) Agglomerated and Preheated Batch*

Experimental work under way and verified to date supports the quantitative estimates listed for both the "Expected Savings" and "Achievable Savings" in Table 12(a); that is, preheated and agglomerated batch is technically realizable.

The widespread implementation of this type of batching by 1985 will result from purely economic factors (i.e., a combination of increased energy costs and the cost of air pollution abatement equipment).

The additional energy costs in batching are expected to be no more than 1% to 2% of energy saved.

(3) Optimized Furnace Design and Operation/Control

Energy Savings are technically realizable from factors such as:

Separate burner control.
More insulation as furnaces operate at lower temperatures due to factors (1) and (2) above.
Larger capacity furnaces (i.e., at least 800 square feet and larger).

Table 12(b) (Concluded)

Optimized design for specific fuels.
Possible recycling of hot in-house cullet to match variations in pull rate due to changes in product mix.
Improved load factor control.

The required increases in furnace capital investments leading to the energy savings are expected to result from increasing fuel costs through 1985.

Note: The most significant savings in furnace energy will occur in the three areas discussed in these Assumptions.

There are large numbers of different alternatives and possibilities available to glass plants to achieve net reductions in furnace energy. Local circumstances (e.g., supply and regulatory constraints) will dictate which combination of these factors will be introduced at any one location.

SRI concludes that the "Expected Savings" in furnace energy will be at least 12% by 1985, and "Achievable Savings" could be as large as 25%.

*Savings from increased cullet and agglomerated/preheated batch are not directly additive since increases in cullet levels reduce the portion of new batch materials.

Table 13

ESTIMATES OF CONTAINER MANUFACTURING ENERGY SAVINGS,
GLASS PORTION ONLY
1985 over 1975
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume oz	1975 Energy Requirement	1985 Expected Savings: Energy Requirement	1985 Expected Savings: Savings Over 1975 Amount	1985 Expected Savings: Savings Over 1975 %	1985 Achievable Savings: Energy Requirement	1985 Achievable Savings: Savings Over 1975 Amount	1985 Achievable Savings: Savings Over 1975 %
NR	7	27.5	22.9	4.6	17%	16.4	11.1	40%
Beer	12	22.0	18.4	3.6	17	13.1	8.9	40
	16	23.2	18.9	4.3	19	13.8	9.4	40
	32	21.4	17.4	4.0	19	12.7	8.7	41
NR	10	30.1	25.2	5.0	17	18.0	12.2	41
Soft	16	27.3	22.7	4.6	17	16.3	11.0	41
Drink	32	26.2	21.4	4.8	19	15.6	10.6	41
	48	28.0	22.8	5.2	19	16.6	11.4	41
	64	25.8	21.0	4.8	19	15.3	10.5	41
REF	7	46.8	38.8	8.0	17	28.2	18.6	40
Beer	12	39.4	32.7	6.7	17	23.7	15.7	40
	16	38.8	32.3	6.5	17	23.4	15.4	40
	32	30.2	25.1	5.1	17	18.2	12.0	40
REF	10	77.0	65.1	11.9	16	47.8	29.2	38
Soft	16	55.3	46.7	8.6	16	34.3	21.0	38
Drink	32	46.0	38.9	7.1	16	28.5	17.5	38
	48	44.3	37.5	6.8	16	27.5	16.8	38
	64	40.8	34.5	6.3	16	25.3	15.5	38
NR	32	20.7	16.9	3.8	19	12.6	8.1	39
PCG	48	20.5	16.7	3.8	19	12.5	8.0	39
	64	20.8	17.5	3.3	16	12.7	8.1	39
REF	32	36.1	30.9	5.2	15	20.1	16.0	44
PCG	48	35.5	30.3	5.2	15	19.7	15.8	44
	64	32.3	27.6	4.7	15	19.3	13.0	40

Notes and Assumptions:

Btu = British thermal unit.
NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple recleanings and refillings.
PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers in which the plastic covers the entire external surface of the container.
- See "1975 Weights" in the Assumptions for 1985 Container Weight Reductions for Table 4; these same comments apply to these secondary packaging weights.

See Table 4 for bottle weights. See Table 11 for the appropriate "Corrected Total" manufacturing energy. Pack-to-pull ratios have been increased by 0.01 for all bottles for "Expected Savings" and 0.03 for "Achievable Savings" to account for improvements in process control.

Table 14

ESTIMATES OF PLASTIC PORTION OF TOTAL CONTAINER MANUFACTURING ENERGY IN PLASTIC COATED BOTTLES
1973 and 1985
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume (oz)	Plastic Type	1975 Plastic Energy*	1975 Total Container Energy*	1975 Plastic % of Total	1985 Expected Savings: Plastic Energy	1985 Expected Savings: Total Container Energy	1985 Expected Savings: Plastic % of Total	1985 Achievable Savings: Plastic Energy	1985 Achievable Savings: Total Container Energy	1985 Achievable Savings: Plastic % of Total
NR	32	Plasti-	2.5	23.2	11%	1.9	18.8	10	1.9	14.5	13
PCG	48	shield	2.0	22.5	9	1.5	18.2	8	1.5	14.0	11
	64		1.8	22.5	8	1.3	18.8	7	1.3	14.0	9
NR	32	Plastic	4.0	24.7	16	3.0	19.9	15	3.0	15.6	19
PCG	48	coated	3.5	24.0	15	2.6	19.3	14	2.6	15.5	17
	64		2.9	23.6	12	2.2	19.6	11	2.2	14.8	15
REF	32	Plastic	10.5	46.6	23	7.9	38.7	20	7.9	28.0	28
PCG	48	coated	9.3	44.8	21	7.0	37.3	19	7.0	26.7	26
	64		7.8	40.1	19	5.8	33.4	17	5.8	25.1	23

NOTES: Btu = British thermal unit.
NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple recleanings and refillings.
PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers, in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers, in which the plastic covers the entire external surface of the container.

*Plastic weights are those listed in Table 5. An average plastic total manufacturing energy of 125 Btu/gram was used for both Plastishield® and Surlyn® on the basis of data from a major chemical industry supplier and Reference (1), covering previous SRI research on container systems.

†Total of the plastic energy shown here and the glass container energies of Table 13.

Table 15

ESTIMATES OF CONTAINER MANUFACTURING ENERGY SAVINGS, GLASS AND PLASTIC
1985 over 1975
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume (oz)	1975 Energy Requirement	1985 Expected Savings: Energy Requirement	1985 Expected Savings over 1975: Amount	1985 Expected Savings over 1975: %	1985 Achievable Savings: Energy Requirement	1985 Achievable Savings over 1975: Amount	1985 Achievable Savings over 1975: %
NR Beer	7	27.5	22.9	4.6	17	16.4	11.1	40
	12	22.0	18.4	3.6	17	13.1	8.9	40
	16	23.2	18.9	4.3	19	13.8	9.4	40
	32	21.4	17.4	4.0	19	12.7	8.7	41
NR Soft Drink	10	30.1	25.2	5.0	17	18.0	12.2	41
	16	27.3	22.7	4.6	17	16.3	11.0	41
	32	26.2	21.4	4.8	19	15.6	10.6	41
	48	28.0	22.8	5.2	19	16.6	11.4	41
	64	25.8	21.0	4.8	19	15.3	10.5	41
REF Beer	7	46.8	38.8	8.0	17	28.2	18.6	40
	12	39.4	32.7	6.7	17	23.7	15.7	40
	16	38.8	32.3	6.5	17	23.4	15.4	40
	32	30.2	25.1	5.1	17	18.2	12.0	40
REF Soft Drink	10	77.0	65.1	11.9	16	47.8	29.2	38
	16	55.3	46.7	8.6	16	34.3	21.0	38
	32	46.0	38.9	7.1	16	28.5	17.5	38
	48	44.3	37.5	6.8	16	27.5	16.8	38
	64	40.8	34.5	6.3	16	25.3	15.5	38
NR Plasti-shield®	32	23.2	18.8	4.4	19	14.5	8.7	38
	48	22.5	18.2	4.3	19	14.0	8.5	38
	64	22.5	18.8	3.7	17	14.0	8.5	38
NR Plastic coated*	32	24.7	19.9	4.8	20	15.6	9.1	37
	48	24.0	19.3	4.7	20	15.5	8.5	35
	64	23.6	19.6	4.0	17	14.8	8.8	37
REF Plastic coated*	32	46.6	38.7	7.9	17	28.0	18.6	40
	48	44.8	37.3	7.5	17	26.7	18.1	40
	64	40.1	33.4	6.7	17	25.1	15.0	38

Notes: Btu = British thermal unit.
NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple reclosings and refillings.
PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers, in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers, in which the plastic covers the entire external surface of the container.

*Data on Table 13, adjusted for the plastic coating or Plastishield® energies of plastic coated bottles, Table 14.

Table 16

CLOSURE AND LABEL CONFIGURATIONS
1975 and 1985

Type Bottle	Fluid Volume (oz)	1975 Closure System	1975 Label	1985, Changes from 1975: Closure System*	1985, Changes from 1975: Label
NR Beer	7	Steel/plastic liner	Yes	No change	No change
	12	Steel/plastic liner	Yes	No change	No change
	16	Steel/plastic liner	Yes	No change	No change
	32	Steel/plastic liner	Yes	No change	No change
NR Soft Drink	10	Steel/plastic liner	Yes	No change	No change
	16	Steel/plastic liner	Yes	No change	No change
	32	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
	48	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
	64	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
REF Beer	7	Steel/plastic liner	Yes	No change	No change
	12	Steel/plastic liner	Yes	No change	No change
	16	Steel/plastic liner	Yes	No change	No change
	32	Steel/plastic liner	Yes	No change	No change
REF Soft Drink	10	Steel/plastic liner	No	No change	No change
	16	Steel/plastic liner	No	No change	No change
	32	Aluminum/plastic liner	No	Steel/plastic liner	No change
	48	Aluminum/plastic liner	No	Steel/plastic liner	No change
	64	Aluminum/plastic liner	No	Steel/plastic liner	No change
NR Plasti-shield®	32	Aluminum/plastic liner	No	Steel/plastic liner	No change
	48	Aluminum/plastic liner	No	Steel/plastic liner	No change
	64	Aluminum/plastic liner	No	Steel/plastic liner	No change
NR Plastic Coated	32	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
	48	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
	64	Aluminum/plastic liner	Yes	Steel/plastic liner	No change
REF Plastic Coated	32	Aluminum/plastic liner	No	Steel/plastic liner	No change
	48	Aluminum/plastic liner	No	Steel/plastic liner	No change
	64	Aluminum/plastic liner	No	Steel/plastic liner	No change

Notes: NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple reclosings and refillings--sometimes incorrectly referred to as returnable.

*Other closure systems are likely to emerge by 1985.

See p. 43 for Assumptions.

Table 17

ESTIMATE OF CLOSURE AND LABEL ENERGY SAVINGS
1985 over 1975
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume (oz)	Requirement 1975	Requirement 1985	Savings over 1975 Amount	Savings over 1975 %
NR Beer	7	3.79	3.40	0.39	10
	12	2.21	1.98	0.22	10
	16	1.66	1.49	0.17	10
	32	0.83	0.74	0.09	10
NR Soft Drink	10	2.65	2.38	0.27	10
	16	1.66	1.49	0.17	10
	32	1.26	0.74	0.52	40
	48	0.84	0.50	0.34	40
	64	0.63	0.37	0.26	40
REF Beer	7	3.79	3.40	0.39	10
	12	2.21	1.98	0.22	10
	16	1.66	1.49	0.17	10
	32	0.83	0.74	0.09	10
REF Soft Drink	10	2.10	1.89	0.21	10
	16	1.31	1.18	0.13	10
	32	1.09	0.59	0.50	45
	48	0.73	0.39	0.34	45
	64	0.55	0.30	0.25	45
NR Plasti-shield®	32	1.09	0.59	0.50	45
	48	0.73	0.39	0.34	45
	64	0.55	0.30	0.25	45
NR Plastic Coated	32	1.26	0.74	0.52	41
	48	0.84	0.50	0.34	41
	64	0.63	0.37	0.26	41
REF Plastic Coated	32	1.09	0.59	0.50	45
	48	0.73	0.39	0.34	45
	64	0.55	0.30	0.25	45

Notes: See p. 43 for Assumptions.
Btu = British thermal unit.

Tables 16 and 17(b)

ASSUMPTIONS FOR 1985 CLOSURE AND LABEL ENERGY SAVINGS

(1) Steel caps will replace aluminum caps in all bottle sizes by 1985.

(2) The weights and manufacturing energies of individual components in 1975 are listed below.

Component	Weight per bottle (g)	Source	Manufacturing (Btu/lb)	Energy Sources
Steel cap	2.25	GCMI	23.8×10^3	Refs.(1), (5)
Aluminum cap	1.20	GCMI	85.8×10^3	Refs.(1), (5)
Plastic liner	0.43	Ref.(5)	48.0×10^3	Refs.(1), (5)
Label	1.11	Ref.(5)	17.7×10^3	Refs.(1), (5)

(3) SRI agrees with the assumption of Reference (5) that total energy costs due to closure systems and labels will be reduced by 10% by 1985.

Table 18(a)

ESTIMATES OF SECONDARY PACKAGING ENERGY SAVINGS
1985 over 1975
(Energies in 10^6 Btu/1000 Gallons Beverage)

Type Bottle	Fluid Volume oz	1975 Energy Requirement	1985 Expected Savings: Energy Requirement	Expected Savings: Savings Over 1975 Amount	Expected Savings: Savings Over 1975 %	1985 Achievable Savings: Energy Requirement	Achievable Savings: Savings Over 1975 Amount	Achievable Savings: Savings Over 1975 %
NR	7	10.2	7.2	3.0	30%	2.4	7.8	76%
Beer	12	7.7	5.5	2.2	30	1.9	5.8	76
	16	6.2	4.4	1.8	30	1.5	4.7	76
	32	4.2	3.0	1.2	29	1.0	3.2	76
NR	10	6 9	4.9	2.0	30	1.7	5.2	76
Soft	16	5.3	3.7	1.6	30	1.3	4.0	76
Drink	32	4.2	3.0	1.2	30	1.0	3.2	76
	48	4.4	3.1	1.3	30	1.1	3.3	76
	64	3.6	2.5	1.1	29	0.9	2.7	76
REF	7	9.6	6.7	2.9	30	2.3	7.3	76
Beer	12	7.6	5.3	2.3	30	1.8	5.5	76
	16	7.2	5.1	2.1	30	1.7	5.5	76
	32	5.5	3.9	1.6	30	1.3	4.2	76
REF	10	7.3	5.2	2.1	30	1.8	5.5	76
Soft	16	5.1	3.6	1.5	29	1.2	3.9	76
Drink	32	4.2	3.0	1.2	29	1.0	3.2	76
	48	4.0	2.8	1.2	30	1.0	3.0	76
	64	3.5	2.5	1.0	29	0.9	2.6	76
NR	32	3.9	2.8	1.1	29	0.9	3.0	76
PCG	48	3.1	2.2	0.9	30	0.8	2.3	76
	64	3.9	2.7	1.2	30	0.9	3.0	76
REF	32	3.2	2.3	0.9	30	0.8	2.4	76
PCG	48	3.1	2.2	0.9	30	0.8	2.3	76
	64	2.8	2.0	0.8	30	0.7	2.1	76

Notes: BTU = British thermal unit.
NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple reclenings and refillings.
PCG = Plastic coated bottles, of which there are two types:

- Plastic shielded containers in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic enveloped containers in which the plastic covers the entire external surface of the container.
- See "1975 Weights" in the Assumptions for 1985 Container Weight Reductions for Table 6; these same comments apply to these secondary packaging weights.

Table 18(b)

ASSUMPTIONS FOR ESTIMATES OF 1985 SECONDARY PACKAGING ENERGY SAVINGS

(1) Secondary packaging weights and weight reductions are from Table 6.

(2) An average manufacturing energy cost of 16.9×10^3 Btu/pound was assumed for secondary paper packaging components in 1975. The reduction in packaging manufacturing energy by 1985 is expected to be at least 6%. SRI estimates agree with those provided in Reference (5).

Table A-1 (Continued)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(b) Container: 48-Ounce Nonrefillable Soft Drink Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
					Savings Over 1975				Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	6.3	15.9%	4.9	15.7%	1.4	22%	4.3	18.9%	2.0	32%
Container manufacturing	28.0	70.9	22.8	72.8	5.2	19	16.6	73.1	11.4	41
Closure and label	0.8	2.0	0.5	1.6	0.3	40	0.5	2.2	0.3	40
Secondary packaging	4.4	11.1	3.1	9.9	1.3	30	1.1	4.8	3.3	76
Total	39.5	100%	31.3	100%	8.2	21%	22.5	100%	17.0	43%

Note: Btu = British thermal unit.

Table A-1 (Continued)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(c) Container: 12-Ounce Refillable Beer Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
					Savings Over 1975				Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	8.4	14.6%	6.7	14.3%	1.7	20%	5.7	17.2%	2.7	32%
Container manufacturing	39.4	68.4	32.7	70.0	6.7	17	23.7	71.4	15.7	40
Closure and label	2.2	3.8	2.0	4.3	0.2	10	2.0	6.0	0.2	10
Secondary packaging	7.6	13.2	5.3	11.3	2.3	30	1.8	5.4	5.8	76
Total	57.6	100%	46.7	100%	10.9	19%	33.2	100%	24.4	42%

Note: Btu = British thermal unit.

Table A-1 (Continued)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(d) Container: 32-Ounce Refillable Beer Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
					Savings Over 1975				Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	6.4	14.9%	5.1	14.7%	1.3	20%	4.3	17.6%	2.0	32%
Container manufacturing	30.2	70.4	25.1	72.1	5.1	17	18.2	74.3	12.0	40
Closure and label	0.8	1.9	0.7	2.0	0.1	10	0.7	2.9	0.1	10
Secondary packaging	5.5	12.8	3.9	11.2	1.6	30	1.3	5.3	4.2	76
Total	42.9	100%	34.8	100%	8.1	19%	24.5	100%	18.3	43%

Note: Btu = British thermal unit.

Table A-1 (Continued)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/Gallons Beverage)

(e) Container: 48-Ounce Nonrefillable Plastishield® Bottle)

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
					Savings Over 1975				Savings Over 1975	
	Total	%	Energy Requirement	%	Amount	%	Energy Requirement	%	Amount	%
Materials acquisition and bottle transport	4.6	14.9%	3.6	14.8%	1.0	22%	3.2	17.4%	1.4	30%
Container manufacturing	22.5	72.8	18.2	74.6	4.3	19	14.0	76.1	8.5	38
Closure and label	0.7	2.3	0.4	1.6	0.3	45	0.4	2.2	0.3	45
Secondary packaging	3.1	10.0	2.2	9.0	0.9	30	0.8	4.3	2.4	76
Total	30.9	100%	24.4	100%	6.5	21%	18.4	100%	12.6	41%

Note: Btu = British thermal unit.

Table A-1 (Continued)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(f) Container: 48-Ounce Nonrefillable Plastic Coated Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
			Energy Requirement		Savings Over 1975		Energy Requirement		Savings Over 1975	
	Total	%		%	Amount	%		%	Amount	%
Material acquisition and bottle transport	4.6	14.2%	3.6	14.1%	1.0	22%	3.2	16.0%	1.4	30%
Container manufacturing	24.0	73.8	19.3	75.4	4.7	20	15.5	77.5	8.5	35
Closure and label	0.8	2.5	0.5	2.0	0.3	41	0.5	2.5	0.3	41
Secondary packaging	3.1	9.5	2.2	8.6	0.9	30	0.8	4.0	2.3	76
Total	32.5	100%	25.6	100%	6.9	21%	20.0	100%	12.5	39%

Note: BTU = British thermal unit.

Table A-1 (Concluded)

ADDITIONAL COMPARATIVE 1975-1985 ENERGY ANALYSIS
(Energies in 10^6 Btu/1000 Gallons Beverage)

(g) Container: 48-Ounce Refillable Plastic Coated Bottle

	1975		1985							
	Energy Requirement		Expected Savings				Achievable Savings			
			Energy Requirement		Savings Over 1975		Energy Requirement		Savings Over 1975	
	Total	%		%	Amount	%		%	Amount	%
Materials acquisition and bottle transport	6.8	12.3%	5.5	12.1%	1.3	19%	4.1	12.8%	2.7	39%
Container manufacturing	44.8	80.9	37.3	82.2	7.5	17	26.7	83.4	18.1	40
Closure and label	0.7	1.3	0.4	0.9	0.3	45	0.4	1.3	0.3	45
Secondary packaging	3.1	5.6	2.2	4.8	0.9	30	0.8	2.5	2.3	76
Total	55.4	100%	45.4	100%	10.0	18%	32.0	100%	23.4	42%

Note: BTU = British thermal unit.

Appendix B

SELECTED 1975 BASE DATA

Table B-1

1975 GLASS CONTAINER BODY MANUFACTURING ENERGY FOR SOFT DRINK AND BEER BOTTLES MANUFACTURED IN HIGH VOLUME CONDITIONS
(Energies in 10^6 Btu/Ton of Glass Pulled or Melted)

Process Step	Container Type: NR Beer and Soft Drink	Ref. Beer	Ref. Soft Drink	Energy Sources
Batch	0.2	0.2	0.2	Electricity
Tank and refiner	5.4	5.4	5.4	Gas, oil, 10% electrical boost
Forehearth	0.5	0.5	0.5	Gas
Forming	1.5	1.5	1.5	Electricity (used by compressor)
Fire finish	0	0.8	0.8	Gas
Annealing	0.6	0.6	0.6	Gas (or electricity)
Applied ceramic labeling	0	0	0.8	Gas
Shrink wrap	0.5	0.5	0.5	Gas (or electricity)
Handling	0.2	0.2	0.3	Propane gas (or electricity)
Total	8.9	9.7	10.6	

Notes: NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple recleanings and refillings--sometimes incorrectly referred to as returnable.

Table B-1(a)

ASSUMPTIONS FOR 1975 GLASS CONTAINER BODY MANUFACTURING, SOFT DRINK AND BEER BOTTLES

(1) Table entries based on a survey conducted by GCMI among representative corporate members. Key data (i.e., furnace, forming, and annealing energies) were verified by SRI independently during the field research.

(2) Quantitative assumptions include the following:

- Bottles are produced on fully loaded, continuously pulled and dedicated production lines.
- Total cullet averages 20%; 5% or more is foreign.
- Ten percent of furnace energy is produced by electric boosting at 3 ft^2.
- Electrical power is assessed at 10,600 Btu/kWh.
- Wet batch employed, with fine grained materials (optimum sand grain size).
- Furnace is designed for fuel type used (gas or oil).

Table B-2

1975 WEIGHTS FOR COMPONENTS OF GLASS CONTAINER SYSTEMS*

Bottle Type	Fluid Volume (oz)	Glass Body Data: Glass Weight (oz)	Glass Body Data: Energy (10^6 Btu/ton pulled)	Glass Body Data: Pack-to-Pull Ratio	Glass Body Data: Energy (10^6 Btu/ton packed)	Secondary Paper Packaging Weight per Bottle (lb)	Closure: Metal	Closure: Weight (g)	Plastic Coating Weight (g): Plastic-shield	Plastic Coating Weight (g): Surface
NR Beer	7	4-1/2	8.9	0.89	10.0	0.033	Steel	2.25	n.a.	n.a.
	12	6-1/8	8.9	0.88	10.1	0.043	Steel	2.25	n.a.	n.a.
	16	8-1/2	8.9	0.87	10.2	0.046	Steel	2.25	n.a.	n.a.
	32	15-1/2	8.9	0.86	10.3	0.062	Steel	2.25	n.a.	n.a.
NR soft drink	10	7	8.9	0.88	10.1	0.032	Steel	2.25	n.a.	n.a.
	16	10	8.9	0.87	10.2	0.039	Steel	2.25	n.a.	n.a.
	32	19	8.9	0.86	10.3	0.062	Aluminum	1.2	n.a.	n.a.
	48	30	8.9	0.85	10.5	0.098	Aluminum	1.2	n.a.	n.a.
	64	36	8.9	0.83	10.7	0.106	Aluminum	1.2	n.a.	n.a.
REF Beer	7	7	9.7	0.89	10.9	0.031	Steel	2.25	n.a.	n.a.
	12	10	9.7	0.88	11.0	0.042	Steel	2.25	n.a.	n.a.
	16	13	9.7	0.87	11.1	0.052†	Steel	2.25	n.a.	n.a.
	32	20	9.7	0.86	11.3	n.a.†	Steel	2.25	n.a.	n.a.
REF soft drink	10	15	10.6	0.88	12.0	0.034	Steel	2.25	n.a.	n.a.
	16	17	10.6	0.87	12.2	0.038	Steel	2.25	n.a.	n.a.
	32	28	10.6	0.86	12.3	0.042	Aluminum	1.2	n.a.	n.a.
	48	n.a.†	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	64	n.a.†	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PCG	32	15	8.9	0.86	10.3	0.058	Aluminum	1.2	5.0	8.0
	48	22	8.9	0.85	10.5	0.070	Aluminum	1.2	6.0	10.4
	64	29	8.9	0.83	10.7	0.115	Aluminum	1.2	7.0	11.3

Notes: NR = Nonrefillable bottles.
REF = Refillable bottles--those manufactured for multiple reclosings and refillings--sometimes incorrectly referred to as returnable.
PCG = Plastic-coated bottles of which there are two types:
- Plastic-shielded containers, in which the plastic does not cover the entire bottle but is designed to cushion against impacts.
- Plastic-enveloped containers, in which the plastic covers the entire external surface of the container.

n.a. = Not applicable.
* = Grams.

*See Assumptions for Table B-2.
†See Assumptions for Table B-2, note 2.

Table B-2(a)

ASSUMPTIONS FOR 1975 COMPONENT WEIGHTS FOR GLASS CONTAINER SYSTEMS, TABLE B-2

(1) Table entries are averages based on a survey conducted by GCMI among representative corporate members.

(2) Significant high production volume data are not yet available for these referenced bottles for 1975. However, the glass container industry expects them to be in widespread use by 1980; the 32, 48, and 64-ounce refillable plastic-coated bottles are also expected to be widely used by 1980.

REFERENCES

1. F. A. Ferguson et al., "Description of Beverage Container Systems and their Environmental Impact Measurements," Volume 1, (prepared for Anchor-Hocking Corporation, Brockway Glass Company, Inc., and Owens-Illinois, Inc.), Stanford Research Institute, Menlo Park, California (December 1973).

2. J. R. Schoor et al., "Final Report on Industrial Energy Study of the Glass Industry" (prepared for the Federal Energy Administration and Department of Commerce, Battelle Columbus Laboratories, Columbus, Ohio (December 1, 1974).

3. The Conference Board, "Energy Consumption in Manufacturing" (prepared for the Energy Policy Project of the Ford Foundation), Ballinger Publishing Company, Cambridge, Massachusetts, 1974.

4. Interagency Task Force on Energy Conservation, "Project Independence, Volume 3," Federal Energy Administration Project Independence Blueprint Task Force Report, prepared by the U.S. Government Printing Office, Washington, D.C. (November 1974).

5. "Energy and Economic Impacts of Mandatory Deposits" (Review Copy), prepared for the Federal Energy Administration, Research Triangle Institute, Research Triangle Park, North Carolina (October 1975).

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L-234

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November 26, 1975

RECEIVED
DEC 1 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
Energy and Environmental Research Division
P. O. Box 12194
Research Triangle Park
North Carolina 27709

Dear Mr. Bingham:

This letter will convey our commentary on the review copy of the RTI analysis, "Energy and Economic Impacts of Mandatory Deposits", prepared for the Federal Energy Administration.

We believe it appropriate to background our specific comments with a statement which conveys our basic concerns relative to the dictation of marketing practice by governmental authority. Absent conditions of public safety and acute national need, interventions in the selection and availability of consumer products by government is anathema to the most basic beliefs of this industry. It is violative, in our view, of the fundamental rights of both the producers and consumers of those products; and it works near irrepairable harm to the social and economic fabric of this nation.

The impact of greatest magnitude wrought by such intervention is the debilitation it instills in the free market system and the economic benefits that system has shown it can produce. While we recognize that specific impact criteria were imposed upon your organization by the boundaries of the contract proposal, we also believe your analysis far too stringently confines those impacts, without consideration to secondary and tertiary levels of commercial and consumer behavior. Your conclusion of a capital requirement penalty in excess of 4 billion dollars for this industry in the event of government intervention, without consideration of (1) the sources of capital of that magnitude; (2) the availability of such funding; (3) the competitive capability of the industry to acquire it; and (4) the impact of the transfer of that sum from other social or economic uses, is but one example of this deficiency. The absence of inquiry into the basic question of whether industry components would even choose to raise so great a sum, relative to profit potentiality, to participate in a government dictated activity which consumers by choice are abandoning is a second example.

Because of beliefs that impacts from government intervention reverberate far more deeply into the social and economic systems of this country than RTI's analysis has portrayed, we are convinced the work in total is both deficient and misleading.

Our specific commentary is both general and detailed. The detailed remarks are technical in nature and for that reason are appended to this overall reply. Since some of them are directed to the validity of models used by RTI to derive conclusions, we would appreciate their consideration. Our general comments are those following.

We believe RTI has either failed to recognize or failed to understand the natural market segmentation which is in place and which is both indicative and predictive of consumer behavior. This failure is revealed by the use of an average return rate, irrespective of size, and therefore, results in an exaggerated estimate of energy savings.

At the present time, one-trip soft drink containers generally serve the single unit (drink) market. This condition represents a direct and positive response to the consumer practice of discarding single unit refillable containers under a near total deposit marketing system. Presently marketed refillable, deposit containers serve the multiple-unit market, and represent a response to the proclivity of the consumer to return larger package units for deposit.

Since the consumer adopted the practice of forfeiting the deposit on single drink products and returning larger deposit containers during the period the industry was deposit container dominated, there is substantial reason to believe the practice will continue under government dictated, mandatory deposits. Contrarily, there are few behavioral indices to indicate the consumer behavior under a government dictated deposit system will vary from behavior under a voluntary system.

This probability, that the consumer will continue to discard single unit containers, forfeiting the deposit as a price of convenience, implies that the industry may well be in the most energy conservative posture at the present time. It serves the returnable segment of the market with a returnable container; and it serves the convenience segment of the market with a one-trip container, largely the can. Substituting the more intensive energy package, a returnable bottle, into this one-trip segment of the market, will likely increase the total energy requirement.

We are of the opinion that RTI has embraced a simplistic and optimistically false profile of the industry in its future scenario. First, because of reasons provided in the technical attachment, sales volume forecasts are unreal. Industry economists nearly universally predict an industry volume loss of between 13 and 20 percent under government dictated deposits.

A large segment of industry volume, largely flavors, did not exist prior to the introduction of one-trip containers. This segment is estimated to be as large as 26% of total volume and it is produced and marketed by industry components who have never had, do not now have, and likely will not have, either the means, both productive and distributive, or the will to practice returnable container marketing. It is not hypothetically pragmatic to assume this industry component will survive a government dictated deposit system. Further, because this component consists

largely of retail owned brands, its demise will significantly alter the total store and shelf space allocation to soft drink beverages. The resulting reduction in product exposure to consumers will have a predictable and constraining effect on consumer purchasing behavior, at the expense of industry volume.

The sizable production of the house brand component is almost totally packaged in cans. Its almost certain demise implies that RTI's estimate of can share under government dictated marketing is unrealistic.

Failure to realistically assess volume change is further incorporated in RTI's unwillingness to embrace product substitutions as a significant consumer option under government dictated deposits. As the analysis correctly observes, the grocery store is the largest retail outlet for soft drink purchases. This same retailer offers consumers the widest selection of ades, punches, mixes, and ersatz soft drinks from which to choose. Since these products will be unencumbered by deposit penalty or inconvenience of container return, and because they offer the same basic satisfaction of refreshment need, it can be assumed with some logic that product substitution will take place to a significant degree.

Because volume - output levels - relates directly to every impact embraced by the analysis, this error in the work is felt to flaw every specific conclusion.

It is our opinion that RTI's acceptance of institutional container recovery systems -- or alternatively, some sort of independent clearing house activity -- is fatally optimistic. The initial weakness in such a system is the retailer. Since a universal deposit system last existed, the following changes have occurred: (1) volume of containers has tripled; (2) grocers have become the largest beverage outlet; (3) available grocery space to accommodate returned containers has shrunk by at least one-half. Therefore, since the system was last practiced, the magnitude of the task of returning containers is three times as great and the physical capacity to accomplish it has been halved. While physical disruptions and cost pressures resulting from this task in Oregon and Vermont can be examined, they are hardly better than indications, since soft drink sales in some metropolitan areas exceed the total sales of both those states, on an annual basis.

Both institutional reclamation systems and the clearing house concept are fatally defective in the reliance upon packaging scrap value being higher than processing and operating costs of either system, except possibly, in the exclusive case of aluminum containers. Even with aluminum containers only, it is doubtful that the economics of reclamation portrayed by RTI's generalized thesis can exist, except for highly integrated structures where the processor is also the fabricator and possibly, the beverage packer. Generally, the economic environment put forth by RTI could only exist where large scale municipal recovery installations are in close proximity to the beverage container recovery operation, a condition difficult to imagine throughout the 1800 communities where soft drink production is resident.

Most importantly, the entire concept of independent, returnable, non-refillable container recovery systems embraced by RTI presents a contorted imbalance of economic incentive. Because forfeited deposits are not only required, but would

represent the largest income source to the processor (clearinghouse) and its owners, there is in fact an economic disincentive to higher return rates. The lower the return rate, the greater the revenue potential to the processor.

We can only conclude that embracing a system as workable, which incorporates such features as (1) profitability tied to non-patronage; (2) a government dictated value of processed material 10 times greater than market value; (3) inherent operating costs ($63.57 per ton) approximately 5 times greater than present municipal systems; and (4) a consumer practice which imposes an inconvenience not associated with any other product, food or otherwise, presently consumed, reflects questionable logic and palpably implausible conclusions.

We are convinced that an optimistic confidence of consumer cooperation and acceptance to mandatory deposits pervades the analysis by RTI which is both falsely premised and therefore biases its conclusions. Our view is that actual consumer behavior is a more reliable index to future behavior than responses to an opinion poll, solicited in an economic vacuum.

For fifteen years consumers have had the option of choosing between lower priced, returnable containers and higher priced, convenience containers. In increasing numbers, at an accelerated rate, they have been electing the costlier, convenience package. Those selecting the returnable container have expressed their desire for convenience by failing to return it with increasing predictability.

Since 1970, consumers in eight widely dispersed jurisdictions have had the opportunity to go to the polls and express their desires with regard to mandatory deposits. In every case, armed with the explicit referendum authority to bring about mandatory deposits on cans and other beverage containers, they have rejected it by ballot. In no case has the electorate voted to impose a mandatory deposit system upon itself.

Finally, we are compelled to contradict RTI's conclusion that an estimated 22 percent loss in revenue potential to contemplated resource recovery systems would not act as a deterent to the installation of such system. Again, we believe the inherent flaw stems from the dependency in logic upon averages. It is correct that some individualized waste streams, because of the composition of the streams and the proximity of markets, could provide the basis for economic resource recovery absent beverage can content. It is also true that some waste streams could not provide economic recovery absent beverage cans. The accurate overall picture is that economic resource recovery is at a fledgling stage, subject to lack of experience and absence of hard operating data. Thus positioned, potential revenue loss is magnified in impact and enhanced as a deterring factor. Our view is that the removal of a 22 percent revenue source by government edict would result in widespread stagnation of the progress of this promising social endeavor.

We wish to express our gratitude to both Research Triangle Institute and the Federal Energy Administration for this opportunity to offer commentary. Our tech-

nical comments are attached, for which we solicit attention and consideration. We will be happy to elaborate to any extent they may provoke questions.

Cordially,

Executive Vice President

Attachment

cc: Mr. B. Zusman,
Office of Energy Conservation
and Environment

L-236

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November 26, 1975

Mr. M. Zusman
Office of Energy Conservation
and Environment
Federal Energy Administration
Washington, D. C. 20461

Dear Mr. Zusman:

Relative to the notices appearing in the Federal Register October 20, 1975 and November 18, the enclosed letter to Mr. Tayler H. Bingham of Research Triangle Institute is the response of the Soft Drink Industry to the economic and energy impact of mandatory deposits study conducted by them.

With kindest regards.

Cordially,

Executive Vice President

TFB:dst

Enclosure

RECEIVED
1975
ECONOMIC ENVIRONMENT

COMMENTS ON R.T.I. STUDY OF
ENERGY AND ECONOMIC IMPACTS OF MANDATORY DEPOSITS
NATIONAL SOFT DRINK ASSOCIATION
NOVEMBER 26, 1975

I. Energy Impacts

Energy savings resulting from government intervention are seriously overstated.

A. Future trippage projections (for soft drinks) (ref. p. B-20 to B-34) are biased upward due to the lack of completeness and inaccuracies in R.T.I.'s data and methodology of forecasting trippage. As a result, the energy savings that would result from switching to refillable bottles are overstated, particularly in the 1980-1985 time frame as trippage for small and medium sized (less than 16 ounce) bottles falls below 4 trips/bottle.

1. The model for estimating trippage (p. B-24) assumes a fixed velocity (annual fillings per bottle), which is calculated at 5.5 trips/year. In practice, this model should be parametric, treating both loss rate and velocity as variables and solving for a range of possible solutions.

2. The R.T.I. trippage model and data contain inaccuracies. However, these inaccuracies appear to have been self-cancelling in estimating historical trippage. First, the

fillings data are based on crown shipments which recently will tend to bias estimated fillings slightly upward and will tend to be very erratic. This is due to bottler inventorying of many types of crowns, use of promotional crowns, and introduction of roll-on closures. Second, the estimated velocity of 515 fillings/year/bottle is below industry judgment (closer to 7 fillings/year/bottle). The result of these inaccuracies apparently are compensating, producing current trippage estimates (9.8 in 1973) close to industry estimates.

3. However, the future projections of trippage are biased upward as a result of R.T.I.'s inaccurate belief of fixed deposit levels over the 1947-1973 period. In the soft drink industry, deposit prices generally were increased 50% to 150% from around 1967-1972. Second, since the R.T.I. trippage projections assume "ceteras paribus" except for personal income, these projections also assume continued deposit increases. But deposits cannot economically go above new bottle prices, and will probably stabilize before the 1982 period. Without the ability to raise deposits further, bottlers will be less able to combat declining trippage. For these reasons, it is likely that by 1985 refillable bottle trippage will decline further than R.T.I. indicates, likely reaching

Finally, trippage is product dependent, i.e. the many varieties of flavors and diet drinks on the market have about 25% lower trippage rates than average. In addition, these products are skewed towards convenience packages. The result is that as these products convert more to refillables, the average refillable trippage rate will be further diluted.

8. Because of these comments, we seriously question R.T.I.'s assertion (p. 1-7) that their calculated trippage values represent "floor" estimates. This is particularly ironic since the energy savings at 1982 levels used a projected 6.4 trippage while projected trippage to 1985 continues to decline to 5.7 trips.

B. The R.T.I./Franklin projections of 1985 energy requirements booth with and without government intervention presume continued improvements in unit energy inputs. In particular, steel cans are projected to have the best growth rate "due to the projected movement from the current bi-metal [three-piece] can to the all-steel [D&I two-piece] lightweight can by 1985" (p. 2025). However, the capital costs to convert from three-piece to two-piece are significant (around $9 million to equip a plant to product 18 million cases/year) and would not be invested in the anticipation of mandatory deposits.

Similar arguments could be made for other package categories, with particular re-emphasis on Franklin's statement on Page D-62:

> "... the energy requirements of a [hypothetical] refillable plastic compare favorably with currently available refillable containers. However, the development of refillable plastic bottle technology is dependent on proven development and use of non-refillable plastic bottles first. Therefore, any forces (such as legislation, regulation, market competition, etc.) which affect the market potential of non-refillable plastic bottles, also affect the possible future markets for refillable plastic containers."

Furthermore, such developments affect not only beverage markets but a broad range of packaging categories where improvements in beverage packaging are shared (e.g. two-piece soup cans, improved barrier properties of other plastic food containers).

For these reasons, it is contended that R.T.I. cannot validly use the 1982 energy profiles in a scenario of mandatory deposits and that the 1975 profiles are more realistic for this purpose.

C. The R.T.I. projections of the soft drink package mix to 1985 to not reflect current information and, as a result, overstate the industry's energy needs without government intervention in the 1980's and overstate the potential savings due to mandatory deposits.

Specifically, refillable packages gained in market share versus non-refillables in 1974 in food stores. Through the first half of 1975, metal can share of industry sales is off by 10%-15% versus a year ago. Although improvement in share trends for convenience packages is expected, it is likely that (a) previously projected share levels will not be attained and (b) previously projected rates of growth will not be experienced.

As a result, we question R.T.I.'s projection of a 54% metal can share in 1985 and suggest considering a projection in the 40% to 45% range.

D. Similarly, R.T.I. does not attempt to project the emerging plastic bottle technology into the 1982 scenario. This is in spite of their statement that "In the future other materials, most notably plastics, are expected to dominate the beverage-packaging market" (p. 2-7) and in spite of the concentrated attention devoted to plastics in the Franklin

energy study (35 pages, more than any other candidate container). Large size plastic bottles use significantly less energy than similar size current glass non-refillables.

E. Likewise for plastic-coated glass, which could save 20%-30% of the energy currently needed in bare glass non-refillables.

F. The net results of the above comments on trippage and energy would significantly reduce the real-world energy savings which could be expected as a result of mandatory deposits, as shown below:

WITHOUT GOVERNMENT INTERVENTION (1982) - (Soft Drink System)

Refillable Bottle at 5.0 Trips and 32% Market Share

Ounces (10^9)	259.3
BTU/Ounce	143.0
BTU (10^{12})	37.0

Non-Refillable Bottle With 25% Savings in Energy Requirements Per Ounce and With 27% Market Share

Ounces (10^9)	218.8
BTU/Ounce	232.0
BTU (10^{12})	50.8

Metal Can at Projected Unit
Energy Inputs But at 41% Market Share

Ounces (10^9)	332.3
BTU/Ounce	287.7
BTU (10^{12})	95.6
Total BTU (10^{12})	183.4
Average BTU/Ounce	226.3

WITH GOVERNMENT INTERVENTION (1982) - (Soft Drink System)

(Using "Mid-Range Parameter Values" Scenario)

Refillable Bottle at 3.0 Trips and 1982
Projected Unit Energy Needs

Ounces (10^9)	527.7
BTU/Ounce	129.0
BTU (10^{12})	68.2

Metal Can at 1975 Unit Energy Profile (Approximately 31% Above
1982 Profile) and at Projected 50% Return/Recycle Rate. (80% Steel)

Ounces (10^9)	277.7
BTU/Ounce	328.1
BTU (10^{12})	91.1
Total BTU (10^{12})	159.3
Average BTU/Ounce	197.8
Real-World Percent BTU/s Saved	13%

(Rather than 31% calculated

Initially by R.T.I.)

II. General Economic Impacts - Soft Drink Industry

Market conditions with mandatory deposits are inaccurately represented with total consumption and consumer prices being more than "nominally" effected.

1. The consumer behavior model (p. 3-2) is incomplete and leads to biased solutions. In the event of mandatory deposits, metal can customers may elect to: (a) switch to refillables, (b) buy and return metal cans, (c) buy and discard metal cans, or (d) not to buy at all. Consumer switching models must include the option of switching out of the category.

2. The can price/volume relationship outlined on Page 3-4 of a 14% volume decrease with a 10% price increase is valid for discarded cans only. Note that the Oregon experience indicates an elasticity algebraically less than -2.0.

3. The fact that Coors has an effective 50% return rate is rejected as a basis for assuming that national return rates will be at least this high. Because Coors is an atypical beverage producer, scrap processor, and package fabricator, this experience is not at all projectable to the nation as a whole.

4. R.T.I.'s price/income/demographic model of beverage consumption is invalid for forecasting sales in the event of mandatory deposits (p. 3-6 and A-10).

   a. The estimates were derived over a period of time in which convenience packaging was rapidly growing. This resulted in two concurrent effects: (1) higher volumes and (2) higher average prices per ounce. At the same time, incomes and key population segments grew at nearly identical rates.

      The net effect of these facts is a high degree of intercorrelation in the model and a lack of true predictive ability.

      The appropriate methodology for determining the price elasticity is via a close analysis of monthly/quarterly data, examining cross-sectional differences, or actual experimentation. The method of regression with annual data over such a long period of time is not appropriate for estimating the impact of the loss of convenience packaging.

   b. An alternate consumption model considering demography and convenience packaging as explanatory variables was

examined and found to be statistically as "good" as the R.T.I. model. This alternate model is as follows:

$$SQPC = -4387 + 20257 * SP1029 + 685 * CONVSH$$
$$(-6.48) \quad (8.66) \quad (2.76)$$

$$R^2 = 0.996$$

Data available from 1960 to 1974.

SQPC = Soft drink annual per capita ounces consumed
SP1029 = Proportion of population aged 10-29
CONVSH = Convenience (decimal) share, i.e. .65 in 1973, source: R.T.I., p. B-12.

The implications of this model are quite clear: loss of convenience packaging would result in a loss in per capita volume of (-.65)*(685) = -445 ounces per person per year, or -13% of industry sales in 1973.

By no coincidence, this figure tends to agree with statistics which evidence soft drink volume effects of -8% in British Columbia and -10% in Oregon following the imposition of mandatory deposits.

c. For these reasons, it in unfounded to believe that "only nominal reductions from the without-government intervention projections are projected" in the presence of mandatory deposits (p. 3-6)

6. R.T.I. assumes that the market for non-refillable bottles will vanish (p. 3-6). This may not be true for large size soft drink bottles (over 16 ounce), particularly plastic and plastic-coated bottles which offer weight and safety advantages over bare glass returnables. Hypothetically, these packages could exist with a 5¢ upcharge, nominal return rates, and healthy sales volumes.

7. Model assumption of fixed unit costs over all ranges of output (p. 3-1) is false and directly applies to this study, where volume losses will alter the existing cost relationships.

8. R.T.I. asserts that, with high return rates, beverages in aluminum cans would be priced about 2¢ cheaper than in steel cans due to salvage value (about 1¢) and handling costs. However, both aluminum and steel incur handling costs, so that the real difference should be only about 1¢.

III. Capital Requirements - Soft Drink Industry

On balance, R.T.I. appropriately reflects the staggering capital requirements caused by government intervention, noting that real-world costs will escalate further without a phase-in period allowing the industry to replace equipment as it wears out.

1. Scenarios of low metal can shares are more likely in the event of deposit legislation and these scenarios call for the greatest capital costs.

2. R.T.I. understates capital requirements in "intervention" Scenarios with high metal can shares. A functioning metal can return system is assumed in these scenarios (p. 1-7, 2-43), however, no capital requirements are formulated for storing, sorting, collecting, transporting, and crushing these returned cans. Furthermore, capital requirements of municipal solid waste systems would be minimally lessened. so that the can recycle system will, in fact, represent incremental capital needs.

3. Although the analysis considers gross capital stocks over time (p. 3-19), no consideration is made of those plants that cannot physically expand and would have to totally rebuild.

4. Float costs, despite the distribution of deposit revenues, are full capital costs to the economic system, which includes consumers (p. 3-19).

IV. Labor Requirements

R.T.I.'s analysis of labor requirements is confusing (divergent results), is based on aggregated input/output statistics, and assumes ideal "frictionless" labor markets. Although these factors make an assessment of this section both difficult and tenuous, it appears that R.T.I. overstates labor earnings under mandatory deposits.

1. Average filling size is a sensitive part of the labor computations (p. 3-22), although R.T.I. has not considered the significant reduction in average filling size for refillables in the event of government intervention.

2. It is believed that beverage container manufacturing (either unit or weight basis) is more labor efficient than other containers, resulting in some degree of bias in R.T.I.'s output ratios (p. F-6). Productivity in the metal supplying industries (Table F-12, p. F-11) may be erroneous due to misleading statistics of "cans per base box" (confounded by aluminum lids on steel bodies).

3. As indicated previously, overstating future metal can shares introduces possible errors in the case without government intervention.

4. Using R.T.I.'s figures at the "mid-range" scenario, government intervention results in a 15%-25% unemployment rate for the metal can industry. Also, the unemployment rate in the basic steel and aluminum industries would be worsened by 1% and 6%, respectively.

(Again, these "mid-range" estimates are believed to be optimistic, overstating can share and overstating total volume. Such realities would further reduce labor earnings.)

V. Impact on Resource Recovery Systems

R.T.I.'s cursory analysis of the impact on resource recovery systems leaves the impression that these systems are economically attractive even with mandatory deposits. However, resource recovery systems are currently subject to considerable economic risk (market demand, air quality problems, technology verification), and any significant loss in revenue potential (and 22% is felt to significant) would certainly affect the operational and economic sensitivity of resource recovery systems.

VI. Discussion of Proposed Closed Loop Uniform Deposit System for Metal Cans

The purpose of these comments and analyses is to assess the viability of a deposit/reclamation system for metal beverage cans under uniform mandatory deposit legislation. The thrust of this discussion will be to analyze the overall economics of such a proposal from a total systems viewpoint.

Detailed pro-formas were developed for a "typical market"

1. 20 million filled beverage can cases/year
2. 70% sold by distributors/wholesalers, rather than direct by manufacturer
3. Roughly even mix of aluminum and steel cans
4. One service center serves the entire market
5. 50% return rate

Findings and conclusions regarding reclamation systems:

1. The calculated operating cost (to society) of the system is $63.57/ton, based on conservative assumptions of handling costs, return rate, and operating costs. This approaches 5 times the average cost of disposal through current municipal solid waste systems.

2. The proposed system necessitates shredding, classifying by steel versus aluminum at the service center.

3. The proposed system is subject to inter-regional financial inbalances and would require a national organization (and overhead) to resolve these inequities.

4. Highly stringent auditing/control of service centers would be needed since they would be handling scrap metal valued at about $1,500/ton, or about 10 times market value. Since retailers are paid by a third party (System Administrator), there would be tremendous opportunities to corrupt the system, particularly in collusion with the service center collection.

5. There is no incentive for encouraging higher return rates. In fact, higher return rates drastically diminish the overall profitability of the System Administrator/Service Centers.

6. The "Can Eater" is not examinied since the economics and technology are yet unproven. However, one "Can Eater" would be needed for each medium-to-large volume retailer.

7. The proposal requires a strict reporting and audit system for canners. Self-manufacturing canners could easily "cheat" by shaving their filled can figures.

8. Considering the additional transport system that would be necessary, the net energy savings could be questioned.

9. Consumer costs are ultimately adjusted to reflect social costs. Since social costs would increase, so would consumer costs.

10. Experience in Canada and Oregon with depots/reclamation systems verifies the above thesis.

11. In summary, the fixed costs and high operating costs of such a system make it uneconomical and unviable as a broad means of disposing and/or recycling this single category of consumer solid waste.

National Solid Wastes Management Association

1730 RHODE ISLAND AVENUE, N.W. • SUITE 800 • WASHINGTON, D.C. 20036
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December 11, 1975

Mr. Tayler H. Bingham
RESEARCH TRIANGLE INSTITUTE
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Research Triangle Park, North Carolina 27709

Dear Mr. Bingham:

The National Solid Wastes Management Association, as the professional and industry organization for the solid wastes management field, appreciates the opportunity to submit the following comments on the Energy and Economic Impacts of Mandatory Deposits. We would like to address our comments to the impacts of mandatory deposits on the cost of disposal and resource recovery operations.

Beverage containers, both glass and metal, constitute less than ten percent of the municipal waste stream. Even with the total elimination of such products from the waste stream, it is unlikely that any substantial savings in waste disposal costs will result. The study states that for the programs to be economically feasible, the disposal costs avoided must be equal to or greater than the difference between the revenue generated from the recycled materials and the operating costs of the program to recover these materials. However, no data is presented to illustrate any substantial overall savings in waste disposal costs or reduction in amount of landfill area needed. In addition, the institution of a returnable system may require increased support packaging to protect the bottles from breakage and may also result in the development of a heavier glass bottle, both of which may add to the overall waste disposal problem. Also, while the total number of containers may be reduced as a result of imposing a mandatory deposit, all returnable containers will eventually end up in the waste disposal stream.

For resource recovery systems to be economically competitive, the costs of such systems must be comparable with landfill and incineration costs. This study excludes the capital cost involved in initiating a resource recovery system in computations of potential revenue loss. This deletion of a major cost item distorts the comparison between the costs of landfill or incineration versus resource recovery. Furthermore, while we do not dispute the national average given for the cost of landfill or incineration, these figures will vary considerably from area to area. We believe the decision

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• INSTITUTE OF WASTE TECHNOLOGY
  • CHEMICAL WASTE COMMITTEE
  • NATIONAL SANITARY LANDFILL COMMITTEE
  • RESOURCE RECOVERY COMMITTEE
• WASTE EQUIPMENT MANUFACTURERS INSTITUTE

to institute a resource recovery system should be based on a case-by-case basis on the individual community's landfill or incineration costs and most importantly, upon the market potential for the recycled material or energy. The decision to invest millons of dollars of taxpayer funds should not be based upon national averages.

The study further states that the revenue potential of municipal solid waste would be decreased by a maximum of 22% through a mandatory deposit program and that this percentage would not alter the decision to install a resource recovery system, except in the most marginal situations. This estimate is derived from combining the revenue potential from both materials recovery and energy recovery of a ton of municipal solid waste minus the expected revenue loss from beverage containers if a mandatory deposit was initiated. This fails to account for those systems which are designed solely for materials recovery. In those instances the potential loss of revenue will be over 30% since there will be no revenue from energy recovery to offset the loss in materials recovery revenue. Using the data provided in the study, the expected $4.93 revenue derived from the inorganic portion of a municipal ton of solid waste could be reduced by $1.73 through mandatory deposit legislation.

We also question whether even a 22% overall reduction in potential revenue should be considered marginal. The high capital cost of energy and resource recovery systems make the market value of the energy and recoverable waste materials the most critical considerations in the establishment of a viable resource recovery program. The capital costs of a resource and/or energy recovery facility will not be affected as a result of imposing a mandatory deposit system, however, the revenue potential of these facilities will be significantly reduced. The equipment necessary for materials recovery facilities, volume reduction or processing equipment, will be required for the inorganic portion of the waste stream in order to remove other noncombustible types of waste whether or not the beverage containers are eliminated through a mandatory deposit. Therefore, given that the capital and operating costs are likely to remain at the same or higher levels, a 22% loss in potential revenue should not be lightly considered.

We appreciate the opportunity to submit these comments for your consideration.

Sincerely,

Warren T. Gregory

Warren T. Gregory
Director of Legislative Affairs

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November 13, 1975

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Mr. Taylor H. Bingham
Research Triangle Institute
Post Office Box 12194
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North Carolina 27709

Re: Draft Energy and Economic Impacts of Mandatory Deposits; Federal Energy Administration; October, 1975

Dear Mr. Bingham:

Responsive to the invitation issued in your October 10, 1975 letter, the purpose of this communication is to provide your group and the Federal Energy Administration with the Comments of our client, The Society of the Plastics Industry, Inc. 1/ (SPI) on the above-referenced Draft Report.

SPI is generally recognized as the major national trade association of the plastics industry; the relevant segment of its membership has had intense interest in participating fully in any and all discussions relative to beverage containers, especially where the impact of mandatory deposit legislation such as S.613 is concerned.

1/ The Society of the Plastics Industry, Inc. is a corporation organized under the Not-For-Profit Corporation Law of the State of New York. It is composed of approximately 1200 member companies and individuals who supply raw materials; process or manufacture plastics or plastics products; engineer or construct molds or similar accessory equipment to the plastics industry; and engage in the manufacture of machinery used to make plastics products or materials of all types. SPI is the major national trade association of the plastics industry; its membership is responsible for an estimated 75% of the total dollar volume of sales of plastics in this country.

In reviewing those portions of the Draft Report dealing specifically with plastic beverage containers, we were most impressed with, what is in our view, your very professional analysis of the basic energy consumption issue and the effect of mandatory deposits on the future refillable plastic beverage container market. The calculation summaries for plastic beverage containers indicate that energy requirements for non-refillable plastic bottles are lower than for all other types of non-refillable beverage containers. Only returnable glass bottles which are refilled at least five times showed lower energy consumption and the Draft Report quite properly stated that refillable plastic bottles which are currently under development would be superior because of their low weight and break resistant characteristics.

It has been noted, however, that while "in the future other materials, most notably plastics, are expected to dominate the beverage packaging market", 2/ the Draft Report's impact analysis concerns itself solely with the traditional glass and metal beverage containers. The role of plastic beverage containers was not included in any of the overall conclusions drawn concerning the impact of mandatory deposits on the industry. Although energy requirement estimates were calculated for two types of plastic beverage containers, acrylonitrile (AN) and polyethylene teraphthalate (PET) and placed in the appendix, this information was not considered in reaching the conclusions the Report proposes to draw. In our view, the availability of the plastic beverage container alternative to conventional beverage packaging could significantly influence the Draft Report's conclusions.

The reason for the failure to include plastic beverage containers as an integral part of the Draft Report appears to be a difficulty in assessing the variables involved in such an energy impact projection, particularly the market penetration and container size of plastic bottles.

2/ Draft Energy and Economic Impacts of Mandatory Deposits Report, Page 2-7.

We would specifically point out that plastic beverage bottles in the 32 ounce and larger sizes have already been marketed by Coca Cola in Providence, Rhode Island and other companies have announced plans to start using them next year. Plastic bottle manufacturers have made substantial commitments of money, facilities and time anticipating that plastic bottles will replace approximately 10% of the market for conventional non-refillable beverage containers by 1985. Thirty-two ounces is generally estimated to be the average unit volume capacity of plastic beverage containers in the 1980's due to the obvious weight advantages in the larger sizes. Using the calculations for AN and PET bottles in Appendix D.5 of the Draft Report, this market impact for plastic bottles would substantially affect the comparison of refillable versus non-refillable beverage containers and the estimated value of mandatory deposits on energy consumption.

It is also our view that the Draft Report gives insufficient consideration to the effect of mandatory deposits on future beverage container technology, particularly in the area of plastics. Given a freely competitive market which does not exclude or make economically infeasible competing products, technology will continue to develop more energy efficient beverage containers.

An excellent example of this is the refillable plastic bottle which currently is under development here in the United States. 3/ The refillable plastic bottles will have energy and solid waste characteristics superior to glass refillables and, because of their lower weights, would result in additional savings in transportation and supplementary packaging. In Europe another more energy efficient beverage container has been developed in the form of thin walled plastic bottles and containers that

3/ For technological reasons, at present plastic beverage bottles can only be made so that they are returnable for recycling, but not refillable. This is because available plastic bottles have expansion and displacement characteristics which make uniform size for refillables unreliable.

weigh approximately one-third of the current plastic non-refillables. This product--manufactured by the ICI Corporation under the trade name Merolite--utilizes an advanced packaging configuration which results in substantial energy savings. An amalgum of preliminary data which we have reviewed from a variety of sources indicates that the Merolite container could be as energy efficient as a 10 trip refillable glass bottle if recycling or recovery is assumed. The ICI Corporation recently submitted a Food Additive Petition to the Food and Drug Administration for pre-marketing clearance of its beverage packaging material.

As the Draft Report recognizes at D.5.7, the development of refillable plastic bottle technology and, in fact, all future technological advances in non-refillable as well as refillable beverage containers is dependent on the maintainence of a market potential for all products. Since a mandatory deposit on beverage containers would have the effect of severely limiting, if not completely removing, non-refillable containers from the marketplace, these advances would be sacrificed.

With respect to the purely economic impact of restrictive national beverage container legislation, it is estimated there will be approximately 16,000 workers employed in manufacturing plastic beverage containers by 1985. Many more will be involved in the research and development of new plastic beverage container technology. Should a totally refillable beverage container system, in effect, be legislated by mandatory deposits, those jobs might never materialize. As with the other beverage container manufacturing industries, these are primarily skilled, high paying jobs which would not be replaced by the type of low paying, unskilled work a returnable system would create. The inclusion of these 16,000 plus workers in the Draft Report would materially alter the labor requirements and labor earnings data on which the conclusions in those areas are based.

As far as the effect of plastic beverage containers on the potential value of solid waste is concerned, it has

been the industry's plan for some time now to recycle the non-refillable plastic beverage bottles. In fact, such a recycling program is presently operating in Providence, Rhode Island where soft drinks are being marketed in plastic bottles. Recycling the plastic bottles reduces the quantity and cost of solid waste and litter, as well as the overall consumption of raw materials and manufacturing energy.

In addition to the reclamation of plastic bottles, it is also significant that when plastic bottles are incinerated instead of recycled, the energy value in the container is almost completely recovered. Where plastic bottles are simply burned with other refuse, the plastic serves as a supplementary fuel so that less energy is needed to start the fire and a minimum amount of additional heat is required to completely dispose of the discarded materials. In municipal incinerators which recover energy by burning refuse, plastic bottles provide an excellent heat source with their high energy return per pound of material. The value of solid waste is, thus, further enhanced by the inherent worth of plastic bottles as an efficient and useful fuel. In our view, these factors should also be included in the final Report.

It is submitted that if the beverage container industry's developing technology is left to accomplish the desirable energy and environmental objectives with which it is now challenged, the American public will benefit without extreme economic or environmental disruption. Plastic beverage containers will play a major role in that developing technology and in the beverage container industry.

In consideration of the foregoing Comments, SPI respectfully suggests that the final Federal Energy Administration Report on the Energy and Economic Impacts of Mandatory Deposits include a specific and detailed review of the effects which plastic beverage containers have now and will have in the future in reaching its conclusions.

By examining the beverage container market in this broader way, the final study will more accurately predict the true impact of national legislation which would mandate a totally refillable beverage container system.

If we can be of any further assistance to you relative to any aspect of the plastic beverage container, please do not hesitate to contact us.

Respectfully submitted,

Peter Thomas Smith

Assistant General Counsel
The Society of the Plastics Industry, Inc.

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HENRY B KING
PRESIDENT

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December 3, 1975

Mr. Taylor H. Bingham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Taylor:

As a follow-up to your telephone conversations and correspondence with Phil Katz, I am enclosing a copy of an analysis of your report which has been prepared for us by Robert S. Weinberg.

We would like to thank you and the FEA again for the opportunity to comment on this important study and trust that the enclosed materials will prove helpful. We are of course eager to follow through with you regarding any of this material and will welcome any questions or comments you may have concerning it.

Cordially,

Henry B. King

HBK:jr
Enclosures

cc: M. Zusman

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November 28, 1975

Mr. Henry B. King
President
U. S. Brewers Association
1750 K Street, N.W.
Washington, D.C. 20006

Dear Henry:

Reviewing RTI's recent study Energy and Economic Impacts of Mandatory Deposits is a difficult task. Having spent a grea deal of time over the past five years investigating various aspects of beverage container economics, I can appreciate the man problems they encountered during their study. I am honestly impressed with the ingenuity RTI has displayed in reducing an extremely complex analytical problem to workable proportions. major concern, however, is that the limited time that was available (i.e., the size of their contract with the Federal Energy Administration and FEA's project completion date) forced them t oversimplify their analysis to a point that it is of very limit value as a tool for policy planning.

In their introduction RTI clearly indicates that the obje tive of the study is "to provide a consistent set of projection of five possible impacts of mandatory deposit legislation if it were to be enacted on a national scale in 1980". Although I be lieve they have attained this objective, I do not know what the final results actually mean. RTI's projections appear to be cor sistent with their assumptions, and are of an order of magnitud within a range of possibility. The crucial question is: Are these projections a valid and sufficient basis for the developm of a national policy regarding mandatory deposit legislation? example, RTI has demonstrated that mandatory deposit legislatior could lead to an energy saving but, since their model is an "in complete system", their analysis does not demonstrate that mand tory deposit legislation would yield an energy saving. I will discuss this point more fully below.

What I am saying is that, despite an enormous amount of detail (which, unfortunately, the layman will mistake for "dept RTI has prepared a set of illustrative projections of what migh happen if their long chain of assumptions are correct, rather t a set of forecasts of what would happen under a mandatory deposi system. I do not believe this is good enough for policy plannir purposes.

In reviewing their study, I tried to understand their estimates and the logic of their development. With few exceptions RTI's presentation was so complete that this was not a difficult task. However, as far as the malt beverage production/distribution system is concerned, I just cannot understand most of RTI's employment, capital spending, and shelf price estimates, which are at great variance with those I have developed for my own study. (My study will be completed in January or February and I will send Taylor Bingham a copy.)

As you know, to obtain the basic data necessary for my study and the new Wharton School Study, the U.S. Brewers Association and the Brewers Association of America sent a detailed questionnaire to each of their members. A copy of this questionnaire and a brief summary of the responses are attached. We were both pleased and surprised with our responses. Useful, although not always complete, questionnaires were returned by 30 brewers whose 1974 sales accounted for approximately 85.0 percent of total malt beverage production in the United States.

In addition to RTI's capital spending, employment and shelf price estimates themselves, I am concerned with their technique of presentation.

In most cases, they have inserted the proper caveats but I fear that only a handful of professionals will even bother to read the small print much less understand what it means. For example, consider the capital requirement estimate shown on Table 3-7 (page 3-18). Without government intervention, they show the brewing industry would have to invest 610 million dollars for filling lines. With government intervention, they show a 981 million dollar investment requirement for filling lines if the metal can market falls to zero. This will lead the average reader to believe that under a refillable bottles only system the brewing industry would have to invest an additional 371 million dollars in filling lines (i.e., 981 - 610 = 371).

If I understand their analysis, they arrived at their 610 million dollar investment requirement by taking the consumption estimates by package type given in Table 3-2 (page 3-7) dividing them by the annual capacity factors shown in Table F-2 (page F-3) to obtain an estimate of the total number of lines required, and multiplying these line requirement estimates by the cost factor also given in Table F-2. That is:

Refillable bottles	90.6/2.041	= 44.39 x 3.1	= 137.61
Non-refillable bottles	98.9/2.138	= 46.26 x 2.4	= 111.02
Metal Cans	469.1/2.843	=165.00 x 2.2	= 363.00
Total Investment Requirement (millions of dollars)			611.63

The same calculation for a refillable-bottles-only system would be:

$$646.1/2.041 = 316.56 \times 3.1 = 981.34$$

If, however, the brewing industry is forced to convert from the present system to a refillable-bottles-only system, the new investment required would not be the additional 371 million dollars discussed above. Rather it would be from 693.5 to 843.7 million dollars, depending on whether or not the present non-refillable lines could be used for refillable bottles. The lower estimate presumes that they could. The higher estimate assumes these lines would have to be completely replaced. That is:

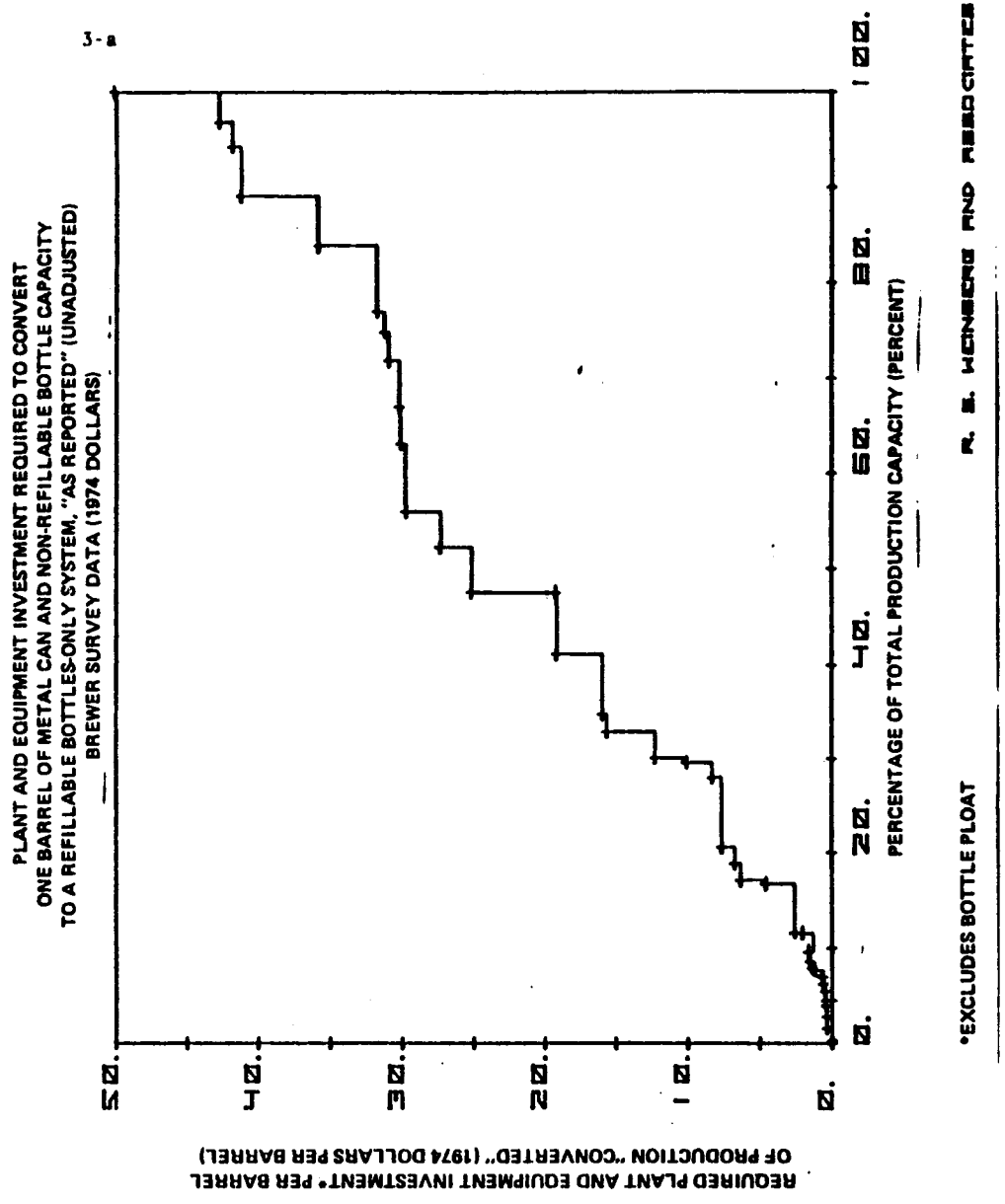
$$[646.1 - (90.6 + 98.9)]/2.041 = 223.71 \times 3.1 = 693.5$$

$$646.1 - 90.6/2.041 = 272.17 \times 3.1 = 843.7$$

I realize that they recognize this problem but, in my opinion, their caveat "subtracting the without - from the with-government-intervention projections of capital requirements assumes that the capital already in place can be perfectly substituted for the desired capital equipment" (page 3-19) is not enough.

Aside from this problem of interpretation discussed, I believe their estimates of the additional plant and equipment investment that the brewing industry would require under a refillable-bottles-only system are much too low. Our brewer survey asked each respondent to indicate the investment that would be required to convert each of his breweries to a refillable-bottles-only package mix. Since the same questionnaires included 1974 output by package type, we were able to combine these data to develop a set of estimates of the new plant and equipment investment (excluding bottle float) that would be required per barrel of metal can and non-refillable bottle malt beverage production converted to refillable bottles. An estimate was prepared for each brewery included in the survey. We then constructed a cumulated distribution relating the per barrel conversion investment requirement estimate to the brewery's total production capacity. A chart showing this distribution is attached.

Some of the investment requirement estimates taken directly from the survey response appeared questionable. In some instances, they appeared excessive, and in other instances they appeared too low. We went back to the individual brewers whose estimates were questioned and on the basis of discussions with them we either accepted or revised the original estimates. From this analysis we concluded that, for the brewing industry as a whole, an average investment of from $17.50 to $22.50 per barrel of malt beverage output converted would be required. Applying



these factors to RTI's estimate of 1982 conversion requirements (Table B-5, Page B-9) we obtain a total brewing industry investment requirement for new plant and equipment of from $2,505.3 to $3,221.2 million dollars. These estimates are in 1974 dollars.

RTI's final caveat in their discussion of capital requirements (Page 3-20) "the prices of the various capital components are assumed constant. However, a sudden increase in the demand for filling lines, trucks, refillable bottles, etc. would be likely to increase prices and hence increase the capital impacts of mandatory deposits" is extremely important. Relatively few manufacturers produce the bottle line and materials handling equipment used in breweries, and since the capacity of these producers is limited, I believe that the price of required capital equipment would be bid up by competing brewers. After reading the article on new plant and equipment costs in the current issue of Fortune Magazine, I wonder if it is even possible to forecast the future prices of plant and equipment expenditures. The thing that concerns me is that while the RTI estimates are logical and arithmetically correct, they are derived from a "frictionless" system with arithmetic precision which does not reflect the real world. As an economic adviser to the brewing industry for many years, I must confess that I have found it very difficult to solve many of the problems RTI has eliminated or avoided by various assumptions and caveats.

I do not believe their labor requirement estimates (Table 3-10, page 3-24) can possibly be correct. Without government intervention they show a beer system labor requirement for brewers and distributors of 22.6 thousand production workers and 78.2 distribution workers. Given government intervention, again assuming that the metal can market share falls to zero, production employment is shown decreasing to 20.1 thousand and distribution employment increasing to 115.2 thousand. Total labor requirements thus increase 34.5 thousand from 100.8 thousand to 135.3 thousand. They have derived these estimates by multiplying the labor-output ratios (Table 3-9, page 3-21) by the output by package type estimates (Table 3-2, page 3-7). I believe there is a computational error here. Using their projections and methodology, the total production labor requirement under their"without government intervention" case would be 20.5 thousand, and not the 22.6 thousand shown on Table 3-10: (i.e., 658.7(0.031150) = 20.52). Also following their discussion on page F-9, I cannot reproduce the 0.031150 production labor-output ratio for 1982. From Table F-7 (page F-8) the production labor-output ratio for 1972 is 0.060882 (not the 0.069 shown in

the text on page F-9). They state that they expect production worker productivity to increase at an average annual rate of 6.7 percent between 1972 and 1985. Under these assumptions the 1982 production labor-output ratio would be 0.031831, that is:

$$0.060882\ (1/1.067)^{10} = 0.031831$$

These points are minor compared to my concern over their basic methodology itself. Their statement "total distribution employment for 1967 was estimated at 49,833 employees" puzzles me. The Census of Manufactures shows total brewing industry (SIC 2028) employment in 1967 was 59.6 thousand employees, 40.0 thousand production workers and 19.6 thousand non-production workers. They appear to consider all of the 19,600 non-production workers as brewing industry distribution employment (page F-9). This is clearly incorrect. I am even more puzzled by their estimate of 30,233 employees in the wholesale beer distribution industry. The 1967 Census of Business; Volume III Wholesale Trade shows the following employment estimates for wholesale beer distribution (thousands of persons):

Merchant Wholesalers	53,425
Manufacturers' Sales Branches	3,229
Merchandise Agents & Brokers	528
Total Employment	57,182

The same estimates for the year 1972 are 59,174, 2,628, 489 and 62,291 respectively. They may have derived their 30,233 estimate by applying some "production workers" factor to the census data but if they did they should have indicated this in Appendix F. From time to time various industry and NBWA sources have estimated the delivery and warehouse workers account for some 53.0 to 56.0 percent of total wholesale wages and salaries.

As part of our brewer survey, we asked for employment data by job function. Our responses to this question were good and since these data were taken directly from employment records, I believe they are relatively accurate. For the purposes of analysis, I have classified all production worker jobs into four broad categories: (1) brewing, (2) engineering, (3) packaging, and (4) warehousing and distribution. While the employment mix varies between breweries as a function of age and size, the following total industry employment mix appears reasonable (percentage of total production workers employment):

Brewing	17.3
Engineering	25.7
Packaging	37.1
Warehousing & Distribution	19.9
TOTAL	100.0

Based on our studies of brewery operations, I would estimate that all packaging and warehouse and distribution jobs and from one half to three quarters of engineering jobs would be impacted by a shift to a refillable bottles-only system. This would imply that from 69.9 percent to 76.3 percent of all brewing industry production workers jobs would be affected. According to the 1973 Annual Survey of Manufactures (M73(AS)-1) total production worker employment in the brewing industry was 33.8 thousand workers. This would mean impacted work areas would account for some 23.6 thousand to 25.8 thousand jobs. On this basis, I would estimate that a shift to a refillable bottles-only system in 1973 would generate a requirement for at least 16.0 to 18.0 thousand and possibly 20.0 to 22.0 thousand new production worker jobs. I do not understand how they could possibly develop a set of estimates that show brewer production workers declining under a refillable bottles-only system.

I believe RTI's shelf price estimates need to be explained more fully. As you know, my 1971 USBA Study (examining the economics of the brewing industry in 1969) demonstrated that under a refillable bottles-only system, the retail price of malt beverages in refillable bottles would increase significantly and that the retail price of refillable bottles would actually exceed the current price of metal cans. I reach this counter-intuitive conclusion using a total system cost model. It is impossible to develop an estimate of the impact of change in packaging mix on retail prices without developing a complete systems cost model. Analytically, the crucial question is "how would the saving in direct container cost compare to the increases in (1) supplemental packaging material cost, (2) handling, filling and warehousing costs within the brewery, (3) cost of shipping the final product from the brewery to the wholesaler, (4) cost of warehousing, handling and delivering the finished product by the wholesaler, (5) and the cost of handling the product at the retail level?"

As far as malt beverages are concerned, RTI's very crucial assumption "the current price of each beverage by container type is assumed to cover the costs of production and distribution plus a normal return on investment" (page 3-1) is just not true. The relative prices for malt beverages in

convenience vs. returnable packages reflect a traditional pricing situation rather than true cost pricing. The efficiency of the convenience packaging system is, in fact, subsidizing the inefficient refillable bottles system.

If RTI's pricing analysis is essentially that described by Tom Neagle in the attached memorandum, I think they have an obligation to warn the reader of the specific narrow definitions they have used to develop their alternative shelf price estimates. This portion of the RTI analysis is extremely disappointing.

As I have noted in my criticism of the earlier work of Hannon and the EPA, I do not believe it is possible to forecast the changes in energy requirements that would result if we were to destroy our present malt beverage production/distribution system and replace it with a refillable-bottles-only system without first constructing a detailed and complete general equilibrium model. Here I agree with and applaud the recent work of Hannon and Herendeen. The RTI analysis reenforces my earlier concern.

Using RTI's estimates given in Tables 3-2 and 3-3 (pages 3-7 and 3-12), it is clear that a dollar spent for malt beverages, even packaged in aluminum cans, is less than 40 percent as energy intense as a dollar of GNP. Packaged malt beverages are not a very energy-intense (per dollar of consumer spending) commodity. Using RTI's estimates of unit sales and shelf prices, packaged malt beverages account for an extremely small fraction of total personal consumption expenditures. In 1982, packaged malt beverages sold for off-premise (i.e., at-home) consumption will account for approximately 0.46 percent (forty-six one-hundredths of one percent) of total personal consumption expenditures. The sale of packaged malt beverages for on-premise (i.e., bars, taverns, restaurants, and cocktail lounges) consumption will account for an additional 0.30 percent to 0.45 percent of total personal consumption expenditures. Since packaged malt beverages are (1) not energy-intense per dollar of consumer spending, and (2) a relatively small percentage of the consumer's total spending budget, RTI's "arithmetically derived" energy savings could easily disappear.

With the loss of convenience packaging, consumers could easily shift their consumption patterns, spending less money for malt beverages and more money on other far more energy-intense consumption items. Such a shift could easily dissipate any energy savings that might be expected in the malt beverage production/distribution sectors. RTI's projections for 1982 may be used to illustrate my point.

Consider first the situation without government intervention. In Table 3-3 (page 3-12) they show the following total energy requirements to support the beer production/distribution system (trillions of BTU's):

refillable bottles	10.8
non-refillable bottles	28.0
steel cans	48.7
aluminum cans	108.6
Total	196.1

In Table 3-2 (Page 3-7), they show the following demand projections for total packaged malt beverages (consumption, billions of ounces):

refillable bottles	90.6
non-refillable bottles	98.9
steel cans	184.8
aluminum cans	284.3
Total	658.6

The estimates shown above may be combined to derive an estimate of the energy required to produce and distribute one ounce or one 12-ounce container of malt beverages. Dividing the total energy requirement estimates by the total consumption estimates yields the following unit energy requirement estimates:

	BTU's per ounce	BTU's per 12-ounce container
refillable bottles	119.21	1,430.46
non-refillable bottles	283.11	3,397.37
steel cans	263.53	3,162.34
aluminum cans	381.99	4,583.89
Total	297.75	3,573.03

Since RTI shows shelf prices for each package type on Table 3-2 (page 3-7), we can compute an estimate of the energy required to support one dollar of malt beverage consumption. This computation is as follows:

	Shelf Price (dollars)	Units Per $ (units)	BTU's per Unit (BTU's)	BTU's per $ (BTU's)
refillable bottles	0.195	5.1282	1430.46	7,336
non-refillable bottles	0.211	4.7393	3397.37	16,101
steel cans	0.225	4.4444	3162.34	14,055
aluminum cans	0.225	4.4444	4583.89	20,373
Total	-----	------	-------	16,165*

*weighted average computed by author

Under RTI's assumption for government intervention with the metal can market falling to zero (i.e., a refillable-bottles-only system), total energy consumption would be 82.7 trillion BTU's, total packaged malt beverage consumption would be 646.1 billion ounces, and the shelf price would remain 19.5 cents per unit. Under these assumptions one dollar spent on packaged malt beverages would generate a requirement for 7877 BTU's of energy (i.e., 82.7/0.6461 = 128.00(12) = 1535.99 (5.1282) = 7877).

RTI indicates that without government intervention a dollar spent on malt beverages would generate an energy requirement of 16,165 BTU's. With government intervention and a refillable-bottles-only system (RTI's maximum energy savings case) they project an energy requirement of 7,877 BTU's per dollar of spending.

Consider now an estimate of personal consumption expenditures for packaged malt beverages. On Table B-12 (page B-18), RTI shows the following estimates of containers entering the malt beverage market during 1982 (millions of fillings or containers):

refillable bottles	7,552.63
non-refillable bottles	8,244.80
metal cans	39,094.20
Total	54,891.63

If we multiply these volume projections by the shelf-price estimates given in Table 3-2 (page 3-7), we may develop the following projections of total consumer spending (millions of dollars):

refillable bottles	0.195 (7,552.63)	= 1,472.8
non-refillable bottles	0.211 (8,244.80)	= 1,739.7
metal cans	0.225 (30,094.20)	= 8,796.2
Total		12,008.6

This is an underestimate of total personal consumption expenditures for packaged malt beverages, since we have priced all packaged malt beverages using off-premise retail prices. Since approximately 25.0 percent of total packaged malt beverages are sold in the on-premise market and, since on-premise retail prices are probably two to three times greater than the retail prices for the same containers in the off-premise market, a more accurate estimate, consistent with the RTI volume and retail shelf-price projections, would be from 15.0 to 18.0 billion dollars; that is, 9.0 billion dollars for off-premise consumption and from 6.0 to 9.0 billion dollars for on-premise consumption.

Using the projections developed in The Structure of the U.S. Economy in 1980 and 1985, (Bureau of Labor Statistics Bulletin 1831), RTI's source for the disposable personal income projections given in Table A-1 (pages A-2 and A-3), we see the total personal consumption expenditures in 1982 are projected to be 1,968.8 billion current dollars (i.e. applying exponential interpolation to the 1980 and 1985 estimates given in Table 12 (page 28) of the BLS bulletin).

On this basis, RTI expects that personal consumption expenditures for packaged malt beverages sold for off-premise consumption will be about 0.46 percent of total personal consumption expenditures. The consumption of packaged malt beverages in the on-premise market will account for from 0.30 to 0.46 percent of total personal consumption expenditures. All purchases of packaged malt beverages will account for from 0.76 to 0.91 percent of total personal consumption expenditures.

Assume that, as a result of government intervention, the metal can market share falls to zero (RTI's maximum energy-saving case). As shown above, a dollar spent on packaged malt beverages would generate a requirement for 7,877 BTU's of energy. This represents an 8.288 BTU reduction in energy requirements compared to the 16,165 BTU's per dollar of spending required under the present system (i.e., without government intervention). As discussed above, the RTI estimates show that packaged malt beverages are not an energy-intense commodity.

The table below compares total energy consumption in the United States with GNP for the past ten years:

	Total Energy Consumption (quadrillion BTU's)	Gross National Product (billions of current $$$)	Gross National Product billions of 1958 $$$)	Total Energy Consumption Per Dollar of GNP (BTU's per current $)	Total Energy Consumption Per Dollar of GNP (BTU's per 1958 $)
1965	53.3	684.9	617.8	77,822	86,274
66	56.4	749.9	658.1	75,210	85,701
67	58.3	793.9	675.2	73,435	86,345
68	61.8	864.2	706.6	71,511	87,461
69	65.0	930.3	725.6	69,870	89,581
1970	67.1	977.1	722.5	68,673	92,872
71	68.7	1,054.9	746.3	65,125	92,054
72	71.9	1,158.0	792.5	65,090	90,726
73	74.7	1,294.9	839.2	57,688	89,013
74	73.2	1,397.4	821.2	52,383	89,138

Sources: Total Energy Consumption — 1970-1974: Energy Perspectives, U.S. Department of the Interior, February, 1975, page 12
1965-1969: Statistical Abstract of the United States 1974, Table 852, page 514

Gross National Product — The Survey of Current Business, July, 1974, October, 1975

I recognize all of the problems associated with the interpretation of any measure as broad as an ENERGY/GNP ratio (i.e., see Berndt and Wood's interesting paper "An Economic Interpretation of the Energy-GNP Ratio" in Marcrakis (Editor), "Energy: Demand, Conservation, and Institutional Problems, MIT Press, Cambridge, Massachusetts 1974 (PP. 21-30); my point is merely that RTI's estimates of the energy intensity of one dollar of consumer spending for malt beverage are significantly below the energy intensity of one dollar for GNP.

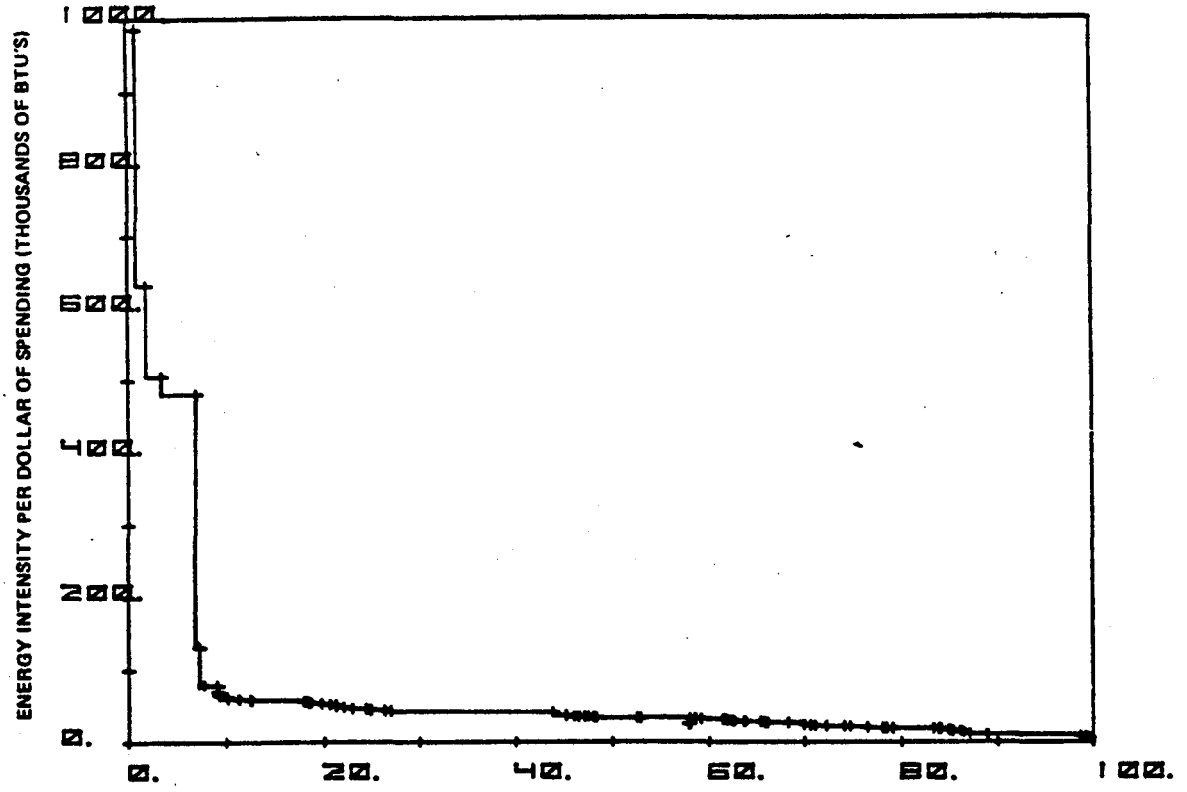
The only published estimates of the energy intensity of specific personal consumption expenditure items which I am aware of is Herendeen and Sebald's clever paper, The Dollar, Energy, and Employment Impacts of Certain Consumer Options, Volume I (CAC Document No. 97, April 1974, Center for Advanced Computation, University of Illinois at Urbana-Champaign). Using an input-output model Herendeen and Sebald estimate the energy required to support one dollar's worth of personal consumption expenditure for each of the eighty-three PCE expenditure-by-type-of-product categories published by the Income and Wealth Division of the Bureau of Economic Analysis, U.S. Department of Commerce (i.e., the NIA Table 2.5 estimates). If we combine the Herendeen and Sebald energy estimates with

the PCE by type of product estimate we may derive a distribution function measuring that fraction of PCE with an energy intensity of "N" or more BTU's per dollars of spending. Two charts showing this distribution function are attached. The first chart is a scatter diagram plotting eighty-three points, a point for each PCE product type. The vertical axis shows energy intensity measures in terms of thousands of BTU's per dollar of consumer spending. Our 83 observations have been ranked by energy intensity in descending sequence. The horizontal axis shows the cumulated fraction (i.e., percentage) of total personal consumption expenditures accounted for by products with an energy intensity of "N" or more BTU's. The second chart is the same as the first but the vertical scale has to be enlarged tenfold. To accomplish this the five PCE products with the highest energy intensity have been omitted from the plot.

The brief analysis which follows makes an extremely important point. The RTI report presents a set of illustrative projections to demonstrate that under a very specific set of assumptions, generally fully discussed in the various appendices, the total energy required to support a refillable bottles-only malt beverage production/distribution system would be about 58 percent less than the total energy required under the present system (Table 3-4, Page 3-13). Since the RTI model is not a complete system model a serious question arises. Since a dollar spent on malt beverages is not relatively energy intense would it be possible for a shift in consumer expenditures patterns to eliminate the potential energy savings the RTI researchers project? Until recently the data necessary to answer this question were not available, but the publication of the PCE energy factors discussed above makes it possible to approach this question in a relatively simple yet sensible manner.

ENERGY INTENSITY DISTRIBUTION, FRACTION OF TOTAL
PERSONAL CONSUMPTION EXPENDITURES WITH AN ENERGY INTENSITY OF "N"
OR MORE THOUSAND BTU'S PER DOLLAR OF SPENDING
(BASED ON THE HERENDEEN AND SEBALD ENERGY INTENSITY ESTIMATES)

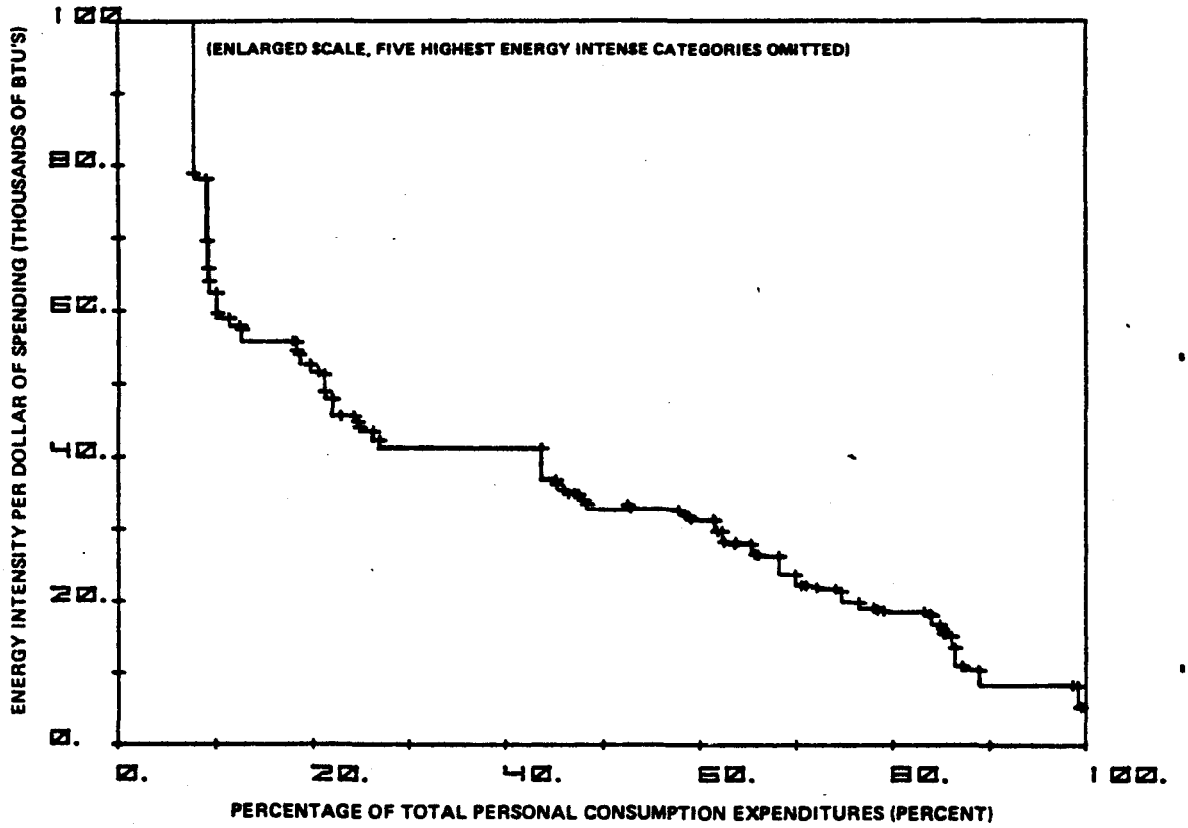
12-a

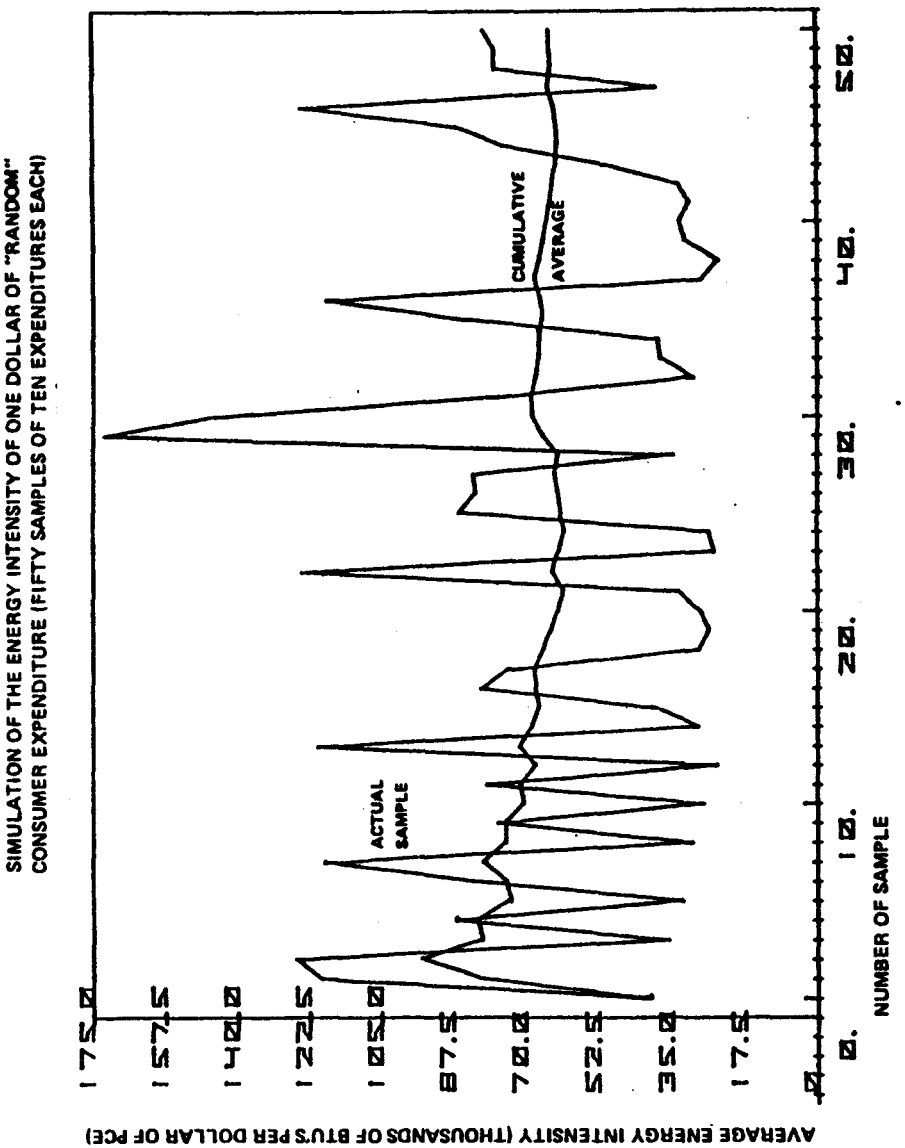


R. E. HEINBERG AND ASSOCIATES

ENERGY INTENSITY DISTRIBUTION, FRACTION OF TOTAL
PERSONAL CONSUMPTION EXPENDITURES WITH AN ENERGY INTENSITY OF "N"
OR MORE THOUSAND BTU'S PER DOLLAR OF SPENDING
(BASED ON THE HERENDEEN AND SEBALD ENERGY INTENSITY ESTIMATES)

12-b





We may develop a simple "monte carlo" simulation using the energy intensity personal consumption expenditure distribution discussed above. In this simulation, we assumed that the probability of a consumer spending an additional dollar on a personal consumption expenditure product with an energy intensity of "N" or more BTU's was proportional to that personal consumption expenditures share of total personal consumption expenditures. The attached chart shows the results for 50 such simulation "experiments." The average energy intensity of a dollar's worth of personal consumption expenditures stabilized in the 68 to 69 thousand BTU range after approximately 100 experiments. On the basis of this simulation, I think it is reasonable to assume that if a consumer were to spend one dollar less on malt beverages and a dollar more on some other personal consumption expenditure item, the average energy intensity of the new expenditure item would be 68 thousand to 69 thousand BTU's.

Since this is significantly more than RTI's estimate of the energy intensity of a dollar personal consumption expenditure for packaged malt beverages, it is reasonable to ask the question "could a shift in the consumers' purchasing patterns eliminate the energy savings RTI estimates might result from a shift to refillable bottles only?" We may use the estimates discussed above to derive an estimate of the decline in malt beverage purchases that would be required to offset RTI's hypothesized energy savings. If, for example, consumers were to spend less for beer and more for some other personal consumption expenditure items with an average energy intensity of 60,000, 65,000, and 70,000 BTU's per dollar of expenditure, the computation below shows that a decline of 15.9 percent, 14.5 percent, and 13.3 percent respectively in the consumer's expenditures for malt beverages would eliminate RTI's maximum case energy savings. That is:

60,000 BTU's:
(1-x) 7,877 + (x) 60,000 = 16,165 x = 0.1590

65,000 BTU's:
(1-x) 7,877 + (x) 65,000 = 16,165 x = 0.1451

70,000 BTU's:
(1-x) 7,877 + (x) 70,000 = 16,165 x = 0.1334

If government intervention is proposed as a strategy for saving energy, the crucial question becomes "will a shift to a refillable bottles-only system lead to a decline in malt beverage expenditures of the magnitude shown above?" Based on my own research, I think it would be quite reasonable to expect a 10 to

20 percent decline in malt beverage demand if convenience packaging was eliminated. While there are some relatively small specific markets, where a loss of convenience packaging might not affect total demand significantly (Oregon may be one of these markets) for the nation as a whole, I believe a loss of convenience would be accompanied by a decline in malt beverage consumption. Some of our detailed studies of malt beverage consumption indicate that the size of consumers' "home inventory" plays an important role in determining the level of malt beverage consumption. In addition to this, there are many specific beer drinking situations that would be lost without convenience packaging. In 1973, we prepared a study of the malt beverage market in Puerto Rico. In part of this study we discussed the theory of convenience packaging and malt beverage demand (The Malt Beverage Market in Puerto Rico - An Economic Analysis, June, 1973, pp. 39-47). A copy of this discussion is attached. My point is that the energy savings RTI projects could be dissipated by a relatively small shift in personal consumption expenditure patterns.

RTI's use of historic trends to estimate the return rate and average trippage for refillable bottles under a refillable bottles-only system seems very unreasonable to me.

On Table B-22 (page B-30) RTI shows the following projection of the return rate (BR) and the average trippage (BT) of a refillable beer bottle for the years 1975-1985:

	Return Rate	Average Trippage
1975	0.927244	13.7447
76	0.923929	13.1456
77	0.920450	12.5707
78	0.916803	12.0197
79	0.912981	11.4918
1980	0.908953	10.9833
81	0.906308	10.6733
82	0.903559	10.3690
83	0.900730	10.0736
84	0.897793	9.78403
1985	0.894798	9.50552

These projections would appear reasonable under normal ("ceteris paribus") conditions, but it would seem highly unreasonable to apply these projections under a refillable bottles-only situation. Indeed, the return rate and average trippage estimates for 1947 through 1973 given in Table B-20 (page B-28) would imply a significantly lower average trippage under a refillable bottles-only posture.

RTI correctly notes (Table A-4, page A-7) that the malt beverage market is a two-tier market, and that in 1973 about 64.5 percent of malt beverage sales were to the off-premise or "at-home" market and about 35.5 percent of malt beverage sales were to the on-premise or bar, tavern, restaurant and cocktail lounge market. On page 2-15 they state, "Most beer distributed in refillable bottles (an estimated 85 percent [ref. 10] is sold to bars and taverns for on-premise consumption where the return rate is very high". This is an extremely important point.

On page 2-8 they discuss refillable bottles and correctly state, "They offered, and continue to offer, enough integrity to make 50 or more trips, thus potentially reducing container cost per filling to a nominal amount".

A simple computation will illustrate my point. Consider the RTI data for 1973. As noted above, in Table A-4 (page A-7) they show that 354,092 million ounces of malt beverages were sold in the off-premise market and 195,273 million ounces of malt beverages were sold in the on-premise market. Total malt beverage sales were 549,365 million ounces. On Table B-1 (page B-4) they show that packaged malt beverages accounted for 477,505 million ounces or 86.9 percent of total malt beverage sales, and that draught sales accounted for 71,860.4 million ounces or 13.1 percent of total sales. If we assume that 99.5 percent of total draught sales are to the on-premise market, we can derive an estimate of total package sales in each of the two malt beverage markets (millions of ounces):

on-premise packaged sales:

$$195{,}273 - (0.995)\ 71{,}860.4 = 123{,}772$$

off-premise packaged sales:

$$477{,}505 - 123{,}772 = 353{,}733$$

Off-premise sales account for 74.08 percent of total packaged malt beverage sales. On-premise sales account for 25.92 percent of total packaged malt beverage sales.

On Table B-2 (page B-5) RTI shows that in 1973 100,299 ounces of packaged malt beverages were sold in refillable bottles. If, as discussed on page 2-15, 85 percent of refillable bottles sales are to the on-premise market, the distribution of refillable bottle sales would be 85,254 million ounces in the on-premise market and only 15,045 million ounces in the off-premise market.

Since there are two markets for malt beverages in refillable bottles, there are also two different return rates and two average trippage estimates. From Table B-20 (page B-28) we see that in 1973 the weighted average return rate and average trippage for both markets were 0.931282 and 14.5523, respectively. Given the average return rate and average trippage for both markets and the average return rate and average trippage for one of the submarkets, we may compute an estimate of the average return rate and average trippage for the other market. Since refillable bottles sold in the on-premise market are part of a closed loop system (i.e., the bottle does not leave the on-premise retail establishment), it is reasonable to expect that the average trippage in this market would approach the "physical" or "structural" life of the bottle. If we assume that the average trippage or bottle life in the on-premise market is 50 trips (RTI report, page 2-8), we may calculate an estimated 1973 average trippage for the off-premise market as follows:

$$0.85\ (0.98) + 0.15\ (x) = 0.931282$$

$$0.15x = 0.098282$$

$$x = 0.655213$$

$$\frac{1}{1.0 - 0.655213} = 2.900344 \text{ trips}$$

If 85.0 percent of refillable bottle sales are to the on-premise market, and if the average trippage in this market is 50 trips, then the average trippage rate of 14.5523 (Table B-20, page B-28) would imply an off-premise market return rate of 0.655213 and a corresponding average trippage of 2.900344 trips.

Assume that all packaged malt beverages sold in 1973 were packaged in refillable bottles and that the average trippage in the on-premise market was 50 trips and that the average trippage in the off-premise market was, as shown above, 2.9 trips. The average trippage for all refillable bottles would not be 14.5525, but only 3.8373. That is:

$$0.2592\ (0.98) + 0.7408\ (0.655213) = 0.739398$$

$$\frac{1}{1.0 - 0.739398} = 3.837266$$

If we assume that the same (i.e., current) return rate would prevail under a refillable bottles-only market, we are, under the assumptions outlined above, implicitly assuming that the return rate and corresponding trip life for a refillable bottle

sold in the off-premise market would increase from 0.6552 or 2.9003 trips to 0.9142 or 11.6599 trips. That is:

$$0.2592\ (0.98) + 0.7408\ (x) = 0.931282$$

$$0.7408x = 0.677266$$

$$x = 0.914236$$

$$\frac{1}{1.0 - 0.914236} = 11.659899 \text{ trips}$$

I think RTI has pulled a very large rabbit out of its hat. Table 3-1 in which they show energy requirements with government intervention and a trippage of 18, would imply that the off-premise market return rate would increase to 0.9320 and the off-premise trippage would increase to 14.7067 trips. That is:

$$0.2592\ (0.98) + 0.7408\ (x) = 0.944444$$

$$0.7408x = 0.690428$$

$$x = 0.932004$$

$$\frac{1}{1.0 - 0.932004} = 14.706713 \text{ trips}$$

If the current trippage life for refillable bottles is about 3 trips (my own research suggests it is probably 4 to 5 trips) I find it quite difficult to rationalize the changes in consumer behavior that would be necessary to increase trip life to 12 to 15 trips.

While I have not had sufficient time to evaluate Appendix D, I would like to comment on an important point that may be obscured in the great mass of data developed by Franklin Associat My point is that counting BTU's without considering the specific BTU source could easily lead to faulty suboptimization.

For purposes of comparing the energy intensity of various containers, RTI has reduced their energy requirements to the common denominator of BTU's. Although this reduction makes comparisons easy, the fact that some energy sources are scarce an some are abundant make comparisons misleading. For instance, sin natural gas and petroleum are scarce energy sources and coal is a

abundant energy source, a conservation program that substituted natural gas or petroleum for coal would be undesirable even if it reduced overall BTU consumption.

Hence, it is necessary to look at the individual energy source profiles of each beverage container given in Tables D-2-4 through D-2-8. Using estimates contained in these tables, it is possible to compare energy savings of a returnable bottle, assuming various trip lives, and other containers. One extreme example is a comparison between a returnable bottle and a steel can.

Measuring in units of million BTU per thousand gallons of beverage, a steel can uses 7.9 units of natural gas, 3.8 of petroleum, and 16.6 of coal. A 10-trip off-premise returnable bottle without recycling uses 4.45 units of natural gas, 6.79 of petroleum, and 2.44 of coal. A returnable bottle conserves 14.16 units of coal, 3.45 of natural gas, but requires 2.99 units more of petroleum. At four trips, an off-premise returnable bottle without recycling, requires 8.13 units of natural gas, 8.88 of petroleum, and 3.25 of coal. At four trips, a returnable bottle conserves 13.25 units of coal but requires 0.23 more units of natural gas and 5.08 more units of petroleum. At four trips or fewer, a returnable bottle fits the definition of an undesirable conservation program, i.e., one that substitutes scarce sources of energy for abundant ones.

It is interesting to note that a returnable beer bottle always consumes more petroleum than a steel can, no matter how many trips it makes or how often it is recycled. This occurs because, the trippage-independent consumption of petroleum (i.e., that petroleum consumed on each trip) is greater than the petroleum used in making the steel cans. It is also interesting to note that the "break even" point on natural gas between a returnable bottle and a metal can is between 4 and 5 trips. That is, at four trips for a returnable bottle, it uses more natural gas than four steel cans; but at five trips for a returnable bottle, it uses less natural gas than five steel cans.

Finally, if trippage for a returnable bottle declines to 3, it is about even with three aluminum cans on consumption of petroleum: 10.3 units for the aluminum can, 10.03 units for the returnable bottle.

In summary, much of the energy savings of a returnable bottle come from coal, an abundant resource. At four trips or fewer, a returnable bottle uses more energy from natural gas and

1985

CONTAINER	NATURAL GAS	PETROLEUM	COAL	NUCLEAR	HYDRO	WOOD
Aluminum	14.2	10.3	11.1	0.8	2.9	0.4
Steel	7.9	3.8	16.6	0.2	0.2	0.4
NRB	14.3	12.2	4.5	0.25	0.25	2.6
NRB Recycled	12.0	11.0	4.4	0.26	0.26	2.6
RB 10-trip (on-premise)	4.35	6.49	2.14	0.1	0.1	1.2
RB 10-trip (off-premise)	4.45	6.79	2.44	0.1	0.1	1.6
RB 18-trip (on-premise)	3.26	5.87	1.9	0.08	0.08	1.2
RB 18-trip (off-premise)	3.36	6.17	2.2	0.08	0.08	1.6
RB 5-trip (off-premise)	6.9	8.18	2.98	0.14	0.14	1.6
RB 4-trip (off-premise)	8.13	8.88	3.25	0.16	0.16	1.6
Recycled RB 18-trip (off-premise)	3.12	6.07	2.19	0.08	0.08	1.6
Recycled RB 10-trip (off-premise)	4.02	6.6	2.42	0.1	0.1	1.6
Recycled RB 5-trip (off-premise)	6.04	7.8	2.94	0.14	0.14	1.6
Recycled RB 4-trip (off-premise)	7.05	8.4	3.2	0.16	0.16	1.6

Units are in million BTU per thousand gallons of beverage

1985 OFF-PREMISE RETURNABLE BOTTLE

TRIPS	NATURAL GAS	PETROLEUM	COAL	NUCLEAR	HYDRO	WOOD
3	10.17	10.03	3.7	0.19	0.19	1.6
4	8.13	8.88	3.25	0.16	0.16	1.6
5	6.9	8.18	2.98	0.14	0.14	1.6
6	6.08	7.72	2.8	0.13	0.13	1.6
7	5.5	7.39	2.67	0.12	0.12	1.6
8	5.06	7.14	2.58	0.11	0.11	1.6
9	4.72	6.94	2.5	0.10	0.10	1.6
10	4.45	6.79	2.44	0.10	0.10	1.6
RECYCLED						
3	8.73	9.4	3.63	0.19	0.19	1.6
4	7.05	8.4	3.2	0.16	0.16	1.6
5	6.04	7.8	2.94	0.14	0.14	1.6
6	5.37	7.4	2.77	0.12	0.12	1.6
7	4.89	7.11	2.64	0.11	0.11	1.6
8	4.53	6.9	2.55	0.11	0.11	1.6
9	4.24	6.73	2.48	0.10	0.10	1.6
10	4.02	6.6	2.42	0.10	0.10	1.6

Units are in million BTUs per one thousand gallons of beverage

petroleum than a steel can. At five trips or more, it consumes less natural gas than a steel can, but it will always consume more petroleum, no matter how high trippage goes. (See Tables above.)

There are a number of points that RTI should give some more thought to. Their use of a simple logistic growth function to determine the long term package mix of malt beverage sales (pages B-1 to B-7) is "neat" in an academic sense but highly dubious in the real world. This method ignores the fact that different packaging materials-metal cans, non-refillable bottles, and refillable bottles-are constantly competing with each other in the user (i.e., the brewer's) marketplace. The brewer's selection of one packaging material over another will be based on a whole host of economic and marketing (i.e., cost, price, consumer preference, etc.) factors. Packaging materials sales during the first nine months of 1975 (i.e., the latest data currently available) will illustrate my point. If we compare the first nine months of 1975 with the first nine months of 1974, we find the can industry's shipments to the brewing industry declined by slightly less than 1.0 percent. At the same time, the glass container industry's sales of non-refillable bottles increased 13.9 percent (even the sales of refillable bottles increased 9.5 percent). Packaged malt beverage sales (i.e., taxpaid removals) increased about 1.7 percent. This represents a sharp reversal from historic trends. If the RTI staff wants to use this kind of model more realistically, I would suggest that they might want to review a recent RAND Corporation report Univariate and Multivariate Log-Linear and Logistic Models by Marc Nerlove and S. James Press (RAND Report R-1306-EDA/NIH December, 1973).

In summary, the RTI Report is far more impressive as a theoretical or academic analysis than it is as a guide for government policy making. RTI understands the true complexity of the problem and approaches to be followed in finding a true solution. Unfortunately, limited time and limited resources appear to have forced the RTI researchers to formulate a highly oversimplified analytical model and to prepare little more than a set of hypothetical illustrative projections rather than comprehensive forecasts of the impact of restrictive packaging legislation on beverage producers, their suppliers, their distributors, and the consumer. Too many questions remain to be answered.

Sincerely,

Bob

RSW/gca

Robert S. Weinberg

United States Brewers Association, Inc.

1750 K Street N.W. Washington D.C. 20006

(202) 466-2400

February 10, 1975

TO: USBA BREWER MEMBERS
AND MEMBERS OF THE BREWERS' ASSOCIATION OF AMERICA

FROM: HENRY B. KING, PRESIDENT, UNITED STATES BREWERS ASSOCIATION, INC.
WILLIAM M. O'SHEA, EXECUTIVE SECRETARY, BREWERS' ASSOCIATION OF AMERICA

RE: BREWING INDUSTRY PACKAGING QUESTIONNAIRE

Gentlemen:

At the United States Brewers Association Presidents Conference in Florida in October 1974, the Board of Directors approved the funding of an economic research project designed to provide brewing industry and supplier spokesmen and other interested organizations with all of the facts necessary to support our position in the container legislative threats throughout the country.

The research program is designed to provide short-term assistance in satisfying immediate fire fighting requirements and long-range goals with broad strategic guidance.

The short-term program is essentially designed to establish a defense of the convenience package system for malt beverages as the least cost production/distribution system and to show that its destruction will lead to higher consumer prices. Thus, part one of the short-term project is a study of total costs in producing and distributing malt beverages through the entire system to the ultimate consumer.

The second part of the short-term study is to analyze the feasibility of converting brewing packaging operations to a returnable bottles only system, both in terms of capital and equipment availability, and with particular emphasis on necessary conversion lead time.

RECYCLED WASTE

In regard to the second part, three related aspects should be considered and those are: (a) declines in tax revenues as a result of limited consumption through supply factors; (b) impacts on the competitive structure within the brewing industry; and (c) impacts on beer availability in regard to retailer shelf stocking requirements.

The third area is related to an investigation of the impact on total employment, employment mix and wages and salaries, while a fourth aspect is the development of relatively simple arguments pertinent to energy issues.

The fifth and last area in the short term is concerned with supplemental development of data showing energy and resource savings that can be generated through massive urban solid waste resource recovery, as described in Peter Stroh's testimony before the Randolph Committee.

The objective of the long-term research program is to consider the impact of possible new technologies on the resources required to supply the brewing industry, and on techniques and methods of distribution. Factors which will determine long-term demand for the malt beverages must be evaluated with emphasis on inflationary impacts and material shortages and their relationship to possible changes in beverage consumption habits. The study will also concentrate on new systems and uses of materials.

The methods utilized in the long-term project will require a fully integrated analysis using input/output techniques as they relate to the brewing industry and its suppliers and distributors over the next decade.

As was the case with other similar industry surveys, we request that the individual replies be returned in the enclosed envelope to:

Philip C. Katz
Vice President-Research & Information
United States Brewers Association, Inc.
1750 K Street, N.W.
Washington, D. C. 20006

The replies will be collated and totaled for the industry. Mr. Katz, who has continually worked with brewers, suppliers, and wholesalers on many economic surveys, will maintain the confidentiality of the data as has been customary in similar past surveys. He and Dr. Robert S. Weinberg will be working with outside research expertise necessary to implement the project.

RECYCLED WASTE

We would greatly appreciate it if you would complete the attached questionnaire for each plant location and return it as soon as possible.

If you have any questions concerning this matter or if there is anything you desire, please let us know.

Cordially,

Henry B. King

William M. O'Shea

Enclosure

CONFIDENTIAL

United States Brewers Association / Brewers' Association of America

Brewing Industry Packaging Questionnaire

Brewer's Name _____

Location of Brewery _____

_____

_____

Please Return to:

Philip C. Katz
Vice President
Research and Information
United States Brewers Association, Inc.
1750 K Street, N.W.
Washington, D.C. 20006

CONFIDENTIAL

1. How many of each of the following types of filling lines do you have within this brewery? (Do not count a line more than once)

Returnable Bottle Lines	_____
Non-returnable Bottle Lines	_____
Combination Returnable-N/R Lines	_____
Canning Lines	_____

2. How many of the returnable bottle lines are interchangeable with non-returnable bottle lines? (Only consider those lines which you designated as returnable bottle lines in you answer to question #1.)

____ lines

3. What is the maximum filling speed for an average type of filling line?

	units per minute
Returnable Bottle Lines	_____
Non-returnable Bottle Lines	_____
Canning Lines	_____

4. What is the annual capacity per line?

	Units
Returnable Bottle Lines	_____
Non-returnable Bottle Lines	_____
Canning Lines	_____

CONFIDENTIAL

5a. Please complete the following chart which provides information concerning the container mix actually used at this brewery over the past three years.

1974

	Total Number of Fillings	Total Barrels Filled in Container Type	Return
Returnable Bottles			
Non-returnable Bottles			-
Cans			-

1973

	Total Number of Fillings	Total Barrels Filled in Container Type	Return
Returnable Bottles			
Non-returnable Bottles			-
Cans			-

1972

	Total Number of Fillings	Total Barrels Filled in Container Type	Return
Returnable Bottles			
Non-returnable Bottles			-
Cans			-

5b. In 1974 what percent of cans filled at this location were self manufactur

6. Please complete the following chart on labor requirements for a single filling line

A Returnable Bottle Line

Title or Type of Position	Number of People Required	Contractual Hourly Wage Rate	Contractual Number of Hours in a Regular Workweek	Average Number of Hours Actually Worked Per Employee in 1974

A Non-returnable Bottle Line

Title or Type of Position	Number of People Required	Contractual Hourly Wage Rate	Contractual Number of Hours in a Regular Workweek	Average Number of Hours Actually Worked Per Employee in 1974

Canning Line

Title or Type of Position	Number of People Required	Contractual Hourly Wage Rate	Contractual Number of Hours in a Regular Workweek	Average Number of Hours Actually worke Per Employee in 1974

7a. Please provide a listing of all other brewery personnel including warehou and loading personnel, supervisors, inspectors, technicians, engineers, managers, etc. Exclude all administrative and marketing personnel.

Title or Type of Position

7b. Please indicate below pertinent information for positions shown in question 7a.

Title or Type of Position	Number of People Required	Contractual Hourly Wage Rate	Contractual Number of Hours in a Regular Workweek	Average Number of Hours Actually Worked Per Employee in 1974

8. If only returnable bottles could be used for packaging beer, how many additional returnable bottle lines would be required in order to maintain the same total barrelage production of packaged beer as was produced by this brewery in 1974? (Do not include in your estimate thos returnable lines which already exist in this brewery.)

____ lines

9. How much additional space would you require to accomodate an all returnable bottle system (assuming you maintain 1974 levels of packaged beer production) at this brewery site?

Bottle Lines ____ total square feet

Warehousing ____ total square feet

Sorting and Handling ____ total square feet

10. Do you have additional space available on the brewery site to make these expansions?

__ . Yes

____ No

If sufficient space is available, please provide estimates of the investments costs necessary to convert this facility so that it can handle an all returnable bottle system. Give a detailed cost breakdown wherever possible.

If sufficient space is not available, is there land available close to the brewery site which could be purchased for this expansion?

___ Yes

___ No

If land is available, please provide cost estimates for purchasing the necessary land and building the required facilities.

Number of acres required _____

Cost per acre _____

Building costs _____

11. Considering your answers to questions 8, 9, and 10, what is the maximum number of returnable bottle lines you could accomodate at this brewery site? (assuming you had the funds available to undertake the necessary expansions and acquisitions, and the brewery decided it was a worthwhile investment)

_____ lines

12. How many returnable bottles would you normally maintain as a working inventory to support this number of returnable bottle lines? Shown in question 11.

_____ bottles

13. What additional equipment is required to convert all of the non-return bottle lines to returnable bottle lines (with the same total capacity) at this brewery site? (e. g. sorting, handling, or cleaning equipment

Type of Equipment	Name of Manufacturer	Model Number	Number Required	Es

14. Can any of the existing canning line equipment be used for processing beer in returnable bottles?

_____ Yes

_____ No

If so, which equipment can be used on a returnable bottle line.?

Type of Equipment	Manufacturer's Name	Model Number

15. List the canning line equipment which would become obsolete at this brewery site (if beer was no longer packaged in cans), please provide the following information:

Type of Equipment	Number at Brewery	Total Original Cost	Percentage of Total Depreciated as of 1/1/75	Total Estimated Salvage Value

16. Assuming that you installed and operated the maximum number of returnable bottle lines that is feasible at this brewery site (as given by your answer to question #11), what additional equipment would be required to handle an all returnable bottle system? (e. g. fork lifts, etc.)

Type of Equipment	Name of Manufacturer	Model Number	Number Required	Estimated Cost

CONFIDENTIAL

17. Assuming this brewery had the same number of lines as was assumed in the previous question, what additional manpower requirements are nece to operate the additional lines and handle the additional returnable bottles? (include warehousing requirements in your consideration)

Title or Type of Position	Number Required	Hourly Wage Rate	Average Hours Required

SYNOPSES OF BREWER QUESTIONNAIRES

The following is an attempt to summarize in consistent form the current state and anticipated requirements of breweries responding to the USBA Returnable Bottles Questionnaire. Most of the statements are self-explanatory, but it should be pointed out that, in the last paragraph of each brewery synopsis, the expression "total conversion capital cost per barrel" refers only to barrels currently packaged in nonreturnable bottles and metal cans, not to all barrels produced.

Brewery A

This is a large, modern brewery. It currently contains one nonreturnable-bottle line, one combination line, and six canning lines. Current employment in packaging, warehousing, and distribution is estimated at 350 persons.

Under a returnables-only system, Brewery A estimates it would need 11 new lines with supporting building and equipment, at a cost of approximately $100,000,000. This figure does not include a float of returnable bottles amounting to 730,000,000 bottles. In addition, Brewery A would have to hire 380 new personnel in packaging, distribution, and engineering at a total annual cost of approximately $8,[illegible]0,000.

Brewery A has an implied construction cost of $25.58 per square foot, and an implied total conversion capital cost of $22.175 per barrel.

Brewery B

This is a large, older brewery. It contains four returnable bottle lines, three nonreturnable-bottle lines, and five canning lines. It employs approximately 420 people in production (other than brewing) and warehousing.

Under a returnables-only system, Brewery B estimates it would need six new returnable bottle lines which, together with additional building, would cost over $80,000,000. This estimate does not include a returnable bottle float inventory of 380,000,000 bottles. In addition, Brewery B would be required to increase its packaging and distribution work force by 42 percent.

Brewery B has an implied construction cost of $200 per square foot and an implied total conversion capital cost of $15.61 per barrel.

Brewery C

Brewery C is a large, modern brewery with one nonreturnable-bottle line, one combination line, and two canning lines. It employs approximately 200 people in its packaging, warehousing, and distribution operations.

Under a returnables-only system, Brewery C would need eight new returnable-bottle lines and supporting building and equipment at an estimated cost of $41,000,000. This estimate excludes a returnable bottle inventory of 367,000,000 bottles. Finally, Brewery C would have to approximately double the number of its employees in packaging, warehousing, and distribution.

Brewery C shows an implied construction cost of $23.02 per square foot and an estimated total conversion capital cost of $16.25 per barrel.

Brewery D

Brewery D is a medium-sized older brewery. It currently contains one returnable-bottle line, one combination line, and one canning line. Brewery D appears to employ approximately 105 workers in its packaging and warehousing operations.

Under a returnables-only system, Brewery D would need one new returnable-bottle line, 60,000 square feet of building space, and 4,800,000 returnable bottles in inventory, and approximately 10 additional workers.

Costs per square foot and per barrel are not available.

Brewery E

Brewery E is a medium-sized, older brewery. It contains two returnable-bottle lines, two nonreturnable-bottle lines, one combination line, and one canning line. Brewery E appears to employ approximately 161 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery E would spend approximately $3,700,000 for capital costs and would require 23,000,000 returnable bottles in inventory. Brewery E also would have to increase its work force by approximately 33 employees in packaging and warehousing.

Construction costs for Brewery E are calculated at $14.66 per square foot. Total conversion capital costs are estimated at $12.27 per barrel.

Brewery F

It is an older, medium-sized brewery with three returnable-bottle lines, one nonreturnable-bottle line, and one canning line. It appears to employ approximately 162 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery F would spend nearly $1,900,000 in capital costs, and would require an additional 4,800,000 returnable bottles for inventory. The brewery would increase its affected labor force by just under 25 percent.

Construction costs for Brewery F are zero; total capital costs per barrel converted amount to $1.49.

Brewery G

This is a large, modern brewery with one combination line and two canning lines. The brewery employs approximately 100 workers in packaging, warehousing, and distribution.

Under a returnables-only system Brewery G would require four more returnable-bottle lines, which with building and equipment would cost nearly $20,000,000. This estimate excludes 111,000,000 returnable bottles that would have to be added to inventory. Brewery also would add 117 employees in packaging and distribution.

Brewery G would incur construction costs of $27.45 per square foot and total conversion capital costs of $15.92 per barrel.

Brewery H

This is a medium-sized, older brewery with two combination lines and one canning line. The brewery appears to employ approximately 90 workers in packaging and warehousing and shipping.

Under a returnables-only system, Brewery H would not need any additional returnable-bottle lines. However, it would spend $500,000 for land and construction, excluding 1,200,000 returnable bottles for inventory. Brewery H would not hire any additional personnel.

Construction costs for Brewery H would amount to $5.71 per square foot, and total capital costs per barrel would be $1.16.

Brewery I

This is a small brewery. It contains one combination line and one canning line. It appears to employ 13 workers in its packaging operations. Since Brewery I is its own wholesaler, its warehousing operations are bound up with its wholesaling operations, which employ four people.

Under a returnables-only system, Brewery I would need no new lines, but would spend $40,000 for building and would purchase 2,400,000 returnable bottles for its inventory. Brewery I would hire 10 additional workers.

Brewery I has an implied construction cost of $4.00 per square foot, and an estimated total conversion capital cost of $0.67 per barrel.

Brewery J

This is a large, older brewery with four returnable-bottle lines, three nonreturnable-bottle lines, one combination line, and six canning lines. It employs approximately 900 workers in packaging and warehousing.

Under a returnables-only system, Brewery J would need 10 additional returnable-bottle lines; it did not estimate a total cost for this conversion, nor did it estimate additional labor requirements.

It is possible to infer construction costs of $64.00 per square foot, but not total conversion capital costs.

Brewery K

This is an older, medium-sized brewery with two returnable-bottle lines, one nonreturnable line, and one canning line. It employs approximately 180 persons in its packaging and warehousing operations.

Under a returnables-only system, Brewery K would need one additional returnable-bottle line, and would purchase 480,000,000 returnable bottles for inventory. No total cost figures were given.

It can be inferred that Brewery K would hire nearly 20 workers to convert to a returnables-only system.

There are no estimates of construction costs or conversion costs per barrel.

Brewery L

This is a large, older brewery with one returnable-bottle line, four nonreturnable-bottle lines, one combination line, and three canning lines. It employs nearly 440 packagers and warehouse personnel.

Under a returnables-only system, Brewery L would require six additional returnable lines (including four conversions of nonreturnable-bottle lines). The total capital cost would come to just under $100,000,000 and additional labor would require 310 more workers. Capital costs would include 324,100,000 returnable bottles.

Construction costs are estimated to be $64.00 per square foot, and total conversion capital costs to be $30.91 per barrel.

Brewery M

This is a large, older brewery with two returnable-bottle lines, three nonreturnable-bottle lines, one combination line, and one canning line. It employs approximately 350 bottling and warehousing workers.

Under a returnables-only system, Brewery M would require four additional returnable-bottle lines at an estimated total cost of $2,527,000, excluding the cost of 8,800,000 returnable bottles. It would not hire any additional workers.

Construction costs may be inferred at $20.26 per square foot. Total capital costs amount to approximately $2.03 per barrel converted.

Brewery N

This is a small, relatively new brewery with one combination line and one canning line. It appears to employ some 25 workers in packaging and warehousing.

Under a returnables-only system, Brewery N would require one additional returnable-bottle line at a cost of approximately $1,500,000, excluding 17,000,000 returnable bottles for float. It would hire six new packaging workers.

Brewery N would not incur any construction costs; it would incur total capital costs of $6.31 per barrel converted.

Brewery O

This is a large, older brewery with two returnable-bottle lines, three nonreturnable-bottle lines, three combination lines, and five canning lines. It employs just under 1,000 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery O would require nine additional returnable-bottle lines, and incur a total capital cost of $158,400,000, excluding the cost of 534,000,000 returnable bottles needed for inventory. Brewery O would hire approximately 550 new employees in packaging, warehousing, and distribution.

Construction costs for Brewery O may be inferred at $57.54 per square foot, and total conversion capital costs at $35.77 per barrel.

Brewery P

This is a large, relatively old brewery with one returnable-bottle line, one nonreturnable-bottle line, one combination line, and two canning lines. Brewery P appears to employ approximately 300 workers in packaging and warehousing.

Under a returnables-only system, Brewery P would need three more returnable bottle lines, including one conversion of a nonreturnable bottle line, at a total cost of approximately $72,200,000. This estimate excludes the cost of 247,100,000 returnable bottles purchased for float. Finally, Brewery P would hire approximately 130 additional workers in packaging and warehousing.

Construction costs are estimated at $64.00 per square foot, and total conversion capital costs are estimated at $29.73 per barrel.

Brewery Q

This is a large, older brewery with one nonreturnable-bottle line, two combination lines, and one canning line. Brewery Q appears to employ approximately 150 workers in packaging and warehousing.

Under a returnables-only system, Brewery Q would need four additional returnable bottle lines at a total capital cost of approximately $8,600,000. This estimate excludes a float of 132,300,000 additional bottles. Brewery Q also would hire 35 additional employees.

Construction costs are estimated at $31.97 per square foot; total conversion capital costs are $7.63 per barrel.

Brewery R

This is a large, modern brewery. Brewery R has one combination line and two canning lines, and seems to employ some 110 workers in packaging and warehousing.

Under a returnables-only system, Brewery R would require two additional returnable-bottle lines, for a total capital cost of $70,600,000. This estimate excludes 169,300,000 returnable bottles to be purchased for inventory. Brewery R also would need to add 156 workers.

Construction costs are given as $64.00 per square foot, and total capital costs are estimated at $42.68 per barrel converted.

Brewery S

It is a very small brewery, with just one line and 11 employees. It would incur no additional costs under a returnables-only system.

Brewery T

It is a large, older brewery that has been expanded. It currently contains four combination lines and four canning lines and employs some 200 bottling and warehousing employees in the winter, 300 in the summer.

Under a returnables-only system, Brewery T would have to add four more returnable-bottle lines at a cost of $15,200,000, excluding the purchase of 9,600,000 bottles for in-the-brewery returnable-bottle float. Brewery T would hire 134 new employees.

Construction costs are estimated at $75.00 per square foot, and total conversion capital costs are estimated at $4.55 per barrel.

Brewery U

This is a large, modern brewery. It has two returnable bottle lines, three nonreturnable-bottle lines, and three canning lines. Brewery U did not list the number of workers it employs under the present system.

Under a returnables-only system, Brewery U would need nine additional returnable-bottle lines at a cost of $80,000,000. The brewery estimates it would need to hire 300 more employees in packaging and distribution.

Brewery U gives an estimated construction cost of $26.53 per square foot, and estimated total conversion capital costs of $19.18 per barrel.

Brewery V

This is an older, relatively large brewery, with one combination line and one canning line. It employs approximately 90 men in its packaging and warehousing operations.

Under a returnables-only system, Brewery V would need two additional returnable-bottle lines, but does not estimate a cost for them or the number of additional workers it would need to hire.

No estimate of construction cost per square foot or of total capital cost per barrel converted is given.

Brewery W

This is a large, older brewery with one returnable-bottle line, eight nonreturnable-bottle lines, two combination lines, and four canning lines. It appears to employ some 670 workers in packaging and warehousing.

Under a returnables-only system, Brewery W would require 14 additional returnable bottle lines, including conversion of present nonreturnable-bottle lines, at a cost of $39,800,000, excluding a returnable-bottle float of 718,300,000 bottles. The brewery would hire 280 more employees in packaging and warehousing.

Construction costs may be inferred as $28.02 per square foot. Total conversion capital costs amount to $8.26 per barrel.

Brewery X

This is a large, modern brewery with one returnable-bottle line, one nonreturnable-bottle line, one combination line, and three canning lines. Brewery X appears to employ some 260 workers in packaging and warehousing.

Under a returnables-only system, Brewery X would require five new returnable-bottle lines (including conversion of its nonreturnable-bottle line). Total costs for the conversion, including an inventory of 348,400,000 returnable bottles, amount to $141,000,000.

Brewery X indicates construction costs of $64.00 per square foot and total conversion capital costs of $41.18 per barrel.

Brewery Y

This is an older, medium-sized brewery with two combination lines and one canning line. It seems to employ 170 workers in packaging and warehousing.

Under a returnables-only system, Brewery Y would require one additional returnable-bottle line, but gives no cost estimates. It apparently would need 15 more employees in packaging and 4,800,000 returnable bottles in inventory.

Construction and capital cost figures are not given.

Brewery Z

This is a small brewery with one returnable-bottle line and one canning line. It employs 15 workers in packaging and distribution.

Under a returnables-only system, Brewery Z would not need any new lines or any additional warehouse space. It would spend $300,000 on equipment, apparently including 7,000,000 returnable bottles for float, and it would hire three additional workers.

There are no construction costs for Brewery Z; its total conversion capital costs are estimated at $25.16 per barrel.

Brewery AA

It is an old, small brewery with one returnable-bottle line, one combination line, and one canning line. It appears to employ 30 workers in packaging and warehousing.

Under a returnables-only system, Brewery AA would need no new lines, construction, or employees. Its single expense would be the cost of adding 3,800,000 returnable bottles for inventory.

Conversion capital costs per barrel are not available.

Brewery BA

This is a large, modern brewery with one nonreturnable-bottle line, one combination line, and six canning lines. Brewery BA employs 350 persons in packaging and distribution.

Under a returnables-only system, Brewery BA would require 14 new returnable lines and would spend $141,700,000, apparently excluding the cost of 730,000,000 returnable bottles for inventory. It would expand packaging and distribution by 155 percent.

Total construction costs for Brewery BA are estimated at $26.43 per square foot, and total conversion capital costs at $30.39 per barrel.

Brewery CA

This is a medium-sized, older brewery with one returnable bottle line, one nonreturnable-bottle line, one combination line, and three canning lines. It appears to employ 120 persons in its current packaging and warehousing operations.

Under a returnables-only system, Brewery CA would require three additional lines and would spend approximately $7,700,000. It would also hire approximately 40 new workers.

Construction costs are given as $50.00 per square foot, and total conversion capital costs are calculated at $6.71 per barrel.

Brewery DA

This is a large, modern brewery with one nonreturnable-bottle line, one combination line, and two canning lines. It employs 220 workers in packaging and warehousing and distribution.

Under a returnables-only system, Brewery DA would require 11 new returnable-bottle lines and would spend $77,000,000, apparently excluding the cost of 367,000,000 returnable bottles for inventory. It would increase its packaging and distribution work force by 150 percent.

Construction costs would amount to $26.50 per square foot, and total conversion capital costs are calculated at $30.20 per barrel.

Brewery EA

This is a small, older brewery with two combination lines and one canning line. It employs 16 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery EA would need no additional bottling lines, but would build 11,000 square feet of warehouse space and hire two additional warehousemen. No estimate of returnable bottle float is given.

No costs are available.

Brewery FA

This is an old, small brewery with one nonreturnable-bottle line and one canning line. It appears to employ some 30 people in packaging and warehousing.

Under a returnables-only system, Brewery FA would require one additional returnable bottle line at a cost of $190,000. It would expand its warehouse space by 16,000 square feet and hire three more warehousemen.

No construction costs are available, nor are total conversion costs. Equipment and installation costs alone are estimated at $1.35 per barrel.

Brewery GA

This is a small, old brewery with two combination lines and one canning line. It appears to employ 36 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery GA would require no additional bottling lines, no additional construction, no new employees. It would require 15,000,000 returnable bottles in inventory.

No construction costs would be incurred; no capital costs are available.

Brewery HA

This is a small, older brewery with one returnable-bottle line, one nonreturnable bottle line, three combination lines, and one canning line. It employs approximately 50 workers in packaging and warehousing.

Under a returnables-only system, Brewery HA would require two additional returnable-bottle lines, both of which would be conversions of nonreturnable-bottle lines. There would be no construction involved. Brewery HA would require approximately 21,600,000 returnable bottles for float and would hire 10 more workers.

No estimate of total conversion capital costs is given.

Brewery IA

This is a medium-to-large, older brewery with one returnable bottle line, one nonreturnable-bottle line, three combination lines, and one canning line. It has approximately 170 employees involved in packaging and distribution functions.

Under a returnables-only system, Brewery IA would require two additional returnable lines and would spend $10,700,000, excluding 12,000,000 returnable bottles for inventory. It would increase packaging and warehousing employment 65 percent.

Construction costs may be inferred at $13.54 per square foot, and total conversion capital costs at $10.06 per barrel.

Brewery JA

This is a large, relatively older brewery with three combination lines and two canning lines. It employs 140 people in packaging and distribution.

Under a returnables-only system, Brewery JA would require three additional returnable bottle lines and would spend $33,200,000, apparently excluding some 300,000,000 returnable bottles for float. It would hire 230 additional employees in packaging and distribution.

Construction costs are estimated at $25.67 per square foot, and total conversion capital costs are estimated at $23.41 per barrel converted.

Brewery KA

This is an older, small-to-medium brewery with one returnable bottle line, one nonreturnable-bottle line, three combination lines, and one canning line. It employs 340 workers in packaging, warehousing, and distribution.

Under a returnables-only system, Brewery KA would require one additional returnable-bottle line, 60,000 square feet of space, 4,800,000 returnable bottles in inventory, and 15 new employees.

No dollar costs of any sort were given.

Brewery LA

This is a large, modern brewery with one returnable-bottle line, two nonreturnable-bottle lines, and four canning lines. It employs 390 workers in packaging and distribution.

Under a returnables-only system, Brewery LA would require eight new returnable-bottle lines and would spend $80,800,000, apparently excluding 500,000,000 returnable bottles for float. It would hire 340 additional workers.

Construction costs are estimated at $26.06 per square foot, and total conversion capital costs are calculated at $19.23 per barrel converted.

Brewery MA

This is a small, old brewery with one returnable bottle line; and no record of employment was given. It would incur no additional expenses under a returnables-only system.

Brewery NA

This is a small, older brewery with one combination line and one canning line. It appears to employ some 30 workers in packaging and distribution, including some wholesaling.

Under a returnables-only system, Brewery NA would incur no additional costs except for 290,000 returnable bottles in float.

Brewery OA

This is a small, old brewery with one line used for all packages and 20 employees in packaging and distribution.

Under a returnables-only system, Brewery OA would require only 1,500,000 returnable bottles and 5,000 square feet of added warehouse space.

Construction costs are calculated at $10.00 per square foot, and total conversion capital costs are calculated at $2.57 per barrel converted.

Brewery PA

This is a small, old brewery with one line used for all packages and eight employees in packaging and distribution.

Under a returnables-only system, Brewery PA would require 1,400,000 returnable bottles for inventory, but would incur no constructio or other capital costs. No workers would be added.

Brewery QA

This is an old, medium-sized brewery with one returnable-bottle line, two nonreturnable-bottle lines, and one canning line. It employs 100 people in packaging, but gave no employment figures for warehousing.

Under a returnables-only system, Brewery QA would need one additional returnable-bottle line, and would spend $900,000, excluding the cost of 11,000,000 returnable bottles for inventory. It would increase its packaging work force by 30 percent; distribution increases are not given.

Construction costs seem to be $5.26 per square foot, and total conversion capital cost amounts to $1.63 per barrel.

Brewery RA

This is a large, modern brewery with one combination line and two canning lines. It employs 120 workers in packaging and distribution.

Under a returnables-only system, Brewery RA would need three additional returnable lines and would spend $104,800,000, including cost of 200,000,000 returnable bottles. It would increase packaging and distribution labor by 154 percent.

Construction costs are set at $64.00 per square foot; total conversion capital costs are calculated at $50.15 per barrel.

Brewery SA

This is a small, old brewery with one combination line and one canning line. It appears to employ 10 people in packaging and wholesali

Under a returnables-only system, Brewery SA would require one additional returnable-bottle line and would spend $298,000, excluding the cost of 2,900,000 returnable bottles for inventory. Apparently it would not hire any additional workers, but would add 10,000 square feet of space.

Construction costs are not given, nor are total conversion capital costs per barrel.

Brewery TA

This is an old, medium-to-large brewery with three combination lines and two canning lines. It employs 140 workers in packaging and distribution.

Under a returnables-only system, Brewery TA would require four new returnable lines, and would spend $45,000,000, apparently excluding the cost of 295,000,000 returnable bottles for inventory. It would increase its packaging and distribution employment by 299 percent.

Construction costs are calculated at $26.06 per square foot, and total conversion capital costs are calculated at $31.74 per barrel.

Brewery UA

This is a large, modern brewery with one combination line and two canning lines. It employs 110 workers in packaging and distribution.

Under a returnables-only system, Brewery UA would need three additional returnable-bottle lines (including two conversions from nonreturnable bottle lines) and would spend $61,600,000, including purchase of 200,700,000 returnable bottles for inventory.

Construction costs are estimated at $64.00 per square foot, and total conversion capital costs are estimated at $31.21 per barrel.

Brewery VA

This is an old, medium-sized brewery with one returnable bottle line, one nonreturnable-bottle line, and one canning line. It employs 50 workers in packaging, but gives no employment figure for warehousing.

Under a returnables-only system, Brewery VA would require one conversion of a nonreturnable line to a returnable line at an estimated cost of $150,000. It would need 30,000,000 returnable bottles for inventory, and would increase packaging personnel by 80 percent.

Brewery VA would incur no construction costs. Total conversion capital costs would amount to $0.42 per barrel.

Brewery WA

This is a large, older brewery, with four returnable-bottle lines, three nonreturnable-bottle lines, and five canning lines. It appears to employ 360 workers in packaging and warehousing.

Under a returnables-only system, Brewery WA would require six additional returnable-bottle lines and would spend $82,000,000. This excludes the cost of 380,900,000 returnable bottles needed for inventory. Brewery WA would increase its packaging and warehousing employment by 50 percent.

Construction costs are inferred to be $200.00 per square foot, and total conversion capital costs are calculated at $27.33 per barrel.

Brewery XA

This is an old, medium-sized brewery with one returnable-bottle line, two nonreturnable-bottle lines, and one canning line. It employs 200 people in packaging and warehousing.

Under a returnables-only system, Brewery XA would need one additional returnable-bottle line, apparently a conversion of one of its nonreturnable bottle lines at a cost of $300,000. It would add 60,000 square feet of space, 4,800,000 bottles, and 20 workers in packaging.

Construction costs are not given. Total conversion capital costs would amount to $0.41 per barrel.

Brewery YA

This is an old, medium-sized brewery with one returnable-bottle line, two nonreturnable lines, and one canning line. It employs 170 persons in packaging and warehousing.

Under a returnables-only system, Brewery YA would need one additional returnable-bottle line, apparently a conversion of one of its nonreturnable-bottle lines, at a cost of $300,000. It would add 60,000 square feet of space, 4,800,000 returnable bottles, and 20 more workers in packaging.

Construction costs are not given. Total conversion capital costs amount to $0.47 per barrel.

Brewery ZA

This is an old, medium-to-large brewery with five nonreturnable bottle lines, one combination line, and three canning lines. It employs 470 persons in packaging, warehousing, and shipping.

Under a returnables-only system, Brewery ZA would require nine new returnable-bottle lines, including conversions of existing nonreturnable lines. It would spend $23,800,000 exclusive of the purchase of 511,800,000 returnable bottles for float. It would hire 150 additional workers.

Construction costs are calculated at $25.69 per square foot, and total conversion capital costs are calculated at $15.61 per barrel.

Brewery AB

This is a large, modern brewery with two combination lines and three canning lines. It employs approximately 130 workers in packaging and warehousing.

Under a returnables-only system, Brewery AB would require four additional lines and would spend $141,600,000, including the cost of 344,900,000 returnable bottles for inventory. It would increase packaging and warehousing employment by 220 percent.

Construction costs are given at $64.00 per square foot, and total conversion capital costs are calculated at $41.78 per barrel.

Brewery BB

This is a large, old brewery that has been added to and modernized, with three nonreturnable bottle lines and nine canning lines. It employs 430 workers in packaging. Warehousing employment figures are not available.

Under a returnables-only system, Brewery BB would need eight returnable lines and would spend $107,000,000, including the cost of 1,215,500,000 bottles for float. It would hire 2,050 additional workers.

Construction costs are not given. Total conversion capital costs are calculated at $9.51 per barrel.

THE MALT BEVERAGE MARKET IN PUERTO RICO:

AN ECONOMIC ANALYSIS

BY

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We may begin with a highly oversimplified model of a hypothetical malt beverage market.* Our model will assume that total malt beverage consumption in this market will be determined by four factors:

1) the market or customer base
2) the number of possible product use situations or drinking occasions
3) the use or participation ratio for each use situation or drinking occasion, and
4) the average consumption rate applicable for each use situation or drinking situation.

Assume that the market base consists of three segments: (1) the adult population 18 to 24 years of age, (2) the adult population 25 to 49 years of age, and (3) the adult population 50 years of age and older. Further assume that there are five different possible drinking occasions: (1) with lunch, (2) with dinner, (3) on picnics or similar outdoor events, (4) while watching sporting events on television, and (5) while visiting

*Note: The reader will recognize that the model developed below is unrealistically simple. Our objective is merely to show the factors which determine malt beverage sales and the interrelationship between these factors. An actual model of the Puerto Rican malt beverage market would probably consider 5,000 to 20,000 market segments. The adult population would be segmented according to age, sex, income, education, occupation, and place of residence, etc. If, for example, we use 6 age categories, 2 sex categories, 10 income categories, 5 educational categories, 10 occupational categories, and 3 place of residence categories, we would have a total of 18,000 market segments (i.e., (6)·(2)·(10)·(5)·(10)·(3) = 18,000). Similarly, it would not be unusual to consider 50 to 100 different use situations or drinking occasions in a real life situation.

bars, cocktail lounges, or other public drinking places. With 3 market segments and 5 use situations we have 15 different user/use situations to evaluate.

Assume that the total adult population is distributed as follows (number of persons):

Adult Population, 18-24	110,000
Adult Population, 25-49	860,000
Adult Population, 50 +	530,000
Total Adult Population	1,500,000

The number of possible use situations during the year are as follows (number of occasions per year):

With Lunch	365
With Dinner	365
Outdoors	35
Watching TV	175
At Bars, Etc.	260

Assume the following values for the use or participation ratio for each user/use situation (fraction of total possible user/use situations during which malt beverages are consumed):

	Users		
Use Situation	Adult Population 18-24	Adult Population 25-49	Adult Population 50 +
With Lunch	0.050	0.075	0.025
With Dinner	0.075	0.100	0.050
Outdoors	0.500	0.250	0.100
Watching TV	0.210	0.310	0.150
At Bars, Etc.	0.070	0.140	0.040

Finally, assume the following average consumption rate for each user/use situation or use occasion (number of 10 ounce equivalent servings):

	Users		
Use Situation	Adult Population 18-24	Adult Population 25-49	Adult Population 50 +
With Lunch	1.2	1.5	0.8
With Dinner	2.0	2.5	1.3
Outdoors	3.3	2.6	1.7
Watching TV	3.0	3.8	1.9
At Bars, Etc.	2.5	3.1	1.6

The estimates shown above may be combined to compute an estimate of total malt beverage consumption. These computations are as follows (the total number of 10 ounce servings):

a) For the 18-24 year old market segment:

$$110{,}000[365(0.050)(1.2)+365(0.075)(2.0)+35(0.500)(3.3)+175(0.210)(3.0)+260(0.070)(2.5)]=31{,}916{,}500$$

b) For the 25-49 year old market segment:

$$860{,}000[365(0.075)(1.5)+365(0.100)(2.5)+35(0.250)(2.6)+175(0.310)(3.8)+260(0.140)(3.1)]=407{,}685{,}150$$

c) For the 50 + years old market segment:

$$530{,}000[365(0.025)(0.8)+365(0.050)(1.3)+35(0.100)(1.7)+175(0.150)(1.9)+260(0.040)(1.6)]=54{,}849{,}700$$

d) For the total adult population:

18-24 year old market segment	31,916,500
25-49 year old market segment	407,685,150
50 + year old market segment	54,849,700
Total	494,451,350

In the example above, total malt beverage consumption is 494,451,350 10 ounce servings or 38,679,012 gallons.

The brewer/distributor marketing team has two broad marketing objectives: (1) developing the total market (i.e., increasing total malt beverage consumption), and (2) increasing or defending their own market share. A discussion of the second marketing objective is beyond the scope of the present analysis. The first marketing objective, however, is as important to the Commonwealth government as it is to the brewer/distributor marketing team. In fact, while the Commonwealth government collects $32.55 in excise taxes on each 31 gallon barrel of malt beverages sold in Puerto Rico, the most successful brewers in the United States earn only between $4.00 and $6.00 per barrel in net profits before taxes. There are few brewers in the United States with an average net sales greater than $32.55 per barrel.

The brewer/distributor marketing team will follow two basic market development strategies. They will use pricing incentives, advertising and sales promotion programs, the introduction of new and more convenient packaging, and the development of more efficient retail distribution channels to (a) increase the use or participation ratios for important use/user situations, and (b) increase the average consumption rate for each major user/use situation or occasion. Programs will also be developed to create new user/use situations or occasions.

The convenience package plays a critical role in each of these strategies. In most "at home" malt beverage drinking situations, supply will determine demand. That is, if malt beverages are available they will be consumed - an average consumer, for example, will be more likely to consume 3 cans of malt beverages in a given evening if 12 cans were in his initial home inventory than if only 6 cans were in his initial home inventory. Also, if malt beverages are at hand, new drinking situations will be "invented". Convenience packaging makes it possible for the consumer to maintain a larger home inventory. The ease of handling associated with convenience packages has also expanded the retail channels of distribution for malt beverages. Expanded retail distribution channels encourage the consumer to increase his purchases of malt beverages and, therefore, his use ratios and average consumption rates.

Using the example developed above, we can illustrate the impact of the withdrawal of convenience packaging from the market on total malt beverage demand. Assume that the consumer may no longer purchase his malt beverages in convenience packages. The market base and the number of possible use situations remain unchanged. The off-premise use ratios will decline and the corresponding average consumption rates will also be reduced. If we assume that the use ratios and average consumption rates shown above represent a situation where convenience packaging is well established in the marketplace (which is the case in Puerto Rico), we can assume that the probable negative impact of a returnable bottles-only system on the usage ratios and consumption rates will be related to the resulting increase in package weight and volume. In the United States, the full weight (i.e. beverage plus packaging material) of malt

beverages packaged in returnable bottles is 62.2 percent heavier than the weight of these beverages packaged in steel cans. The physical volume (measured in cubic inches) of a case or six pack of malt beverages packaged in returnable bottles is about 93.0 percent greater than malt beverages packaged in metal cans. A comparison between malt beverages packaged in non-returnable bottles and metal cans yields increases of 39.1 and 42.3 percent respectively.

Assume that a returnable bottles-only system would make it 40.0 percent more "physically inconvenient" to purchase malt beverages for off-premise consumption. Further assume that this increased inconvenience will lead to a 10.0 percent reduction in "at home" use ratios and a 20.0 percent reduction in "at home" consumption rates. Also assume that there will be a 20.0 percent reduction in "outdoor" use ratios and a 30.0 percent reduction in "outdoor" consumption rates. These loss assumptions are quite conservative and are intended to merely be illustrative. Under these assumptions the use ratios and consumption rates shown above would change as follows. Use or participation ratios for each use/user situation assuming a returnable bottles-only system (fraction of total possible user/use situations during which malt beverages are consumed):

Use Situation	Users: Adult Population 18-24	Users: Adult Population 25-49	Users: Adult Population 50 +
With Lunch (1)	0.049	0.073	0.024
With Dinner (2)	0.070	0.093	0.047
Outdoors	0.400	0.200	0.080
Watching TV	0.189	0.279	0.135
At Bars, Etc.	0.070	0.140	0.040

(1) assumes 70.0 percent of lunchs are away from home and 30.0 percent are "at home".

(2) assumes that 30.0 percent of dinners are away from home and 70.0 percent are "at home".

With a returnable bottles-only system the average consumption rates for each use/user situation would be as follows (number of 10 ounce equivalent servings):

Use Situation	Users: Adult Population 18-24	Users: Adult Population 25-49	Users: Adult Population 50 +
With Lunch (1)	1.13	1.41	0.75
With Dinner (2)	1.72	2.15	1.12
Outdoors	2.31	1.82	1.19
Watching TV	2.40	3.04	1.92
At Bars, Etc.	2.50	3.10	1.60

(1) assumes 70.0 percent of lunchs are away from home and 30.0 percent are "at home".

(2) assumes 30.0 percent of dinners are away from home and 70.0 percent are "at home".

Repeating the total malt beverage consumption computations shown above with the revised use ratios and consumption rates yields the following results (the total number of 10 ounce servings):

a) For the 18-24 year old market segment:

110,000[365(0.049)(1.13)+365(0.070)(1.72)+35(0.400)(2.31)
+175(0.189)(2.40)+260(0.070)(2.50)]=24,351,366

b) For the 25-49 year old market segment:

860,000[365(0.073)(1.41)+365(0.093)(2.15)+35(0.200)(1.82)
+175(0.279)(3.04)+260(0.140)(3.10)]=330,720,912

c) For the 50 + years old market segment:

530,000[365(0.024)(0.75)+365(0.047)(1.12)+35(0.080)(1.19)
+175(0.135)(1.92)+260(0.040)(1.60)]=48,291,268

d) For the total population:

18-24 year old market segment	24,351,366
25-49 year old market segment	330,720,912
50 + year old market segment	48,291,268
Total	403,363,546

With the revised assumptions, total malt beverage consumption will decline to 403,363,546 10 ounce servings or 31,512,777 gallons. This is a reduction of 18.4 percent in total malt beverage consumption. If we had assumed a more realistic set of impact factors, a 20.0 percent reduction in the "at home" use ratios and a 30.0 percent reduction in the "at home" consumption rate accompanied by a 30.0 percent reduction in the "outdoor" use ratios and a 40.0 percent reduction in the "outdoor" consumption rate, total malt beverage consumption would be 26,384,421 gallons, a 31.7 percent reduction from the initial total consumption level.

While the above examples are purely hypothetical, they are important since they illustrate the dynamics of the malt beverage market. With a very conservative set of loss impact assumptions, we have generated an 18.4 percent decline in total malt beverage sales. Using a set of more realistic loss impact assumptions, the model yields a 31.7 percent decline in total malt beverage consumption. Based on estimated 1973 sales and current excise tax rates, an 18.4 percent decline in malt beverage sales in Puerto Rico would cost the Commonwealth government $9,246,696 in excise tax revenue. A 31.7 percent decline in malt beverage sales would reduce 1973 excise tax collections by $14,207,523.

The progressive brewer/distributor marketing team will take maximum advantage of all new packaging innovations in their attempt to make it more convenient for the consumer to purchase, store, and consume malt beverages. In addition to capitalizing on new packaging innovations, the progressive brewer/distributor marketing team will develop new and highly original marketing, advertising and sales promotion programs to stimulate market development. An analysis of the Puerto Rican malt beverage market data shown on Tables 1 and 2 above clearly indicates that the brewers of "imported" malt beverages and their distributors have been more progressive and aggressive in developing the Puerto Rican malt beverage market than the local brewers have been. Since any ban or limitation on the use of convenience packaging would severely, if not completely, limit the marketing operations of the brewers of "imported" malt beverages and their distributors, these actions would have a significant negative effect on the future development of the malt beverage market in Puerto Rico. The analyses which

TO: Bob Weinberg

FROM: Tom Neagle

DATE: November 25, 1975

RE: Shelf Prices in Research Triangle Institute Study, Table 3-2

I have been able to discover the method used by the RTI staff in obtaining their shelf price estimates in Table 3-2 from their base case estimates, with one exception. I cannot determine how RTI calculated the price of 23.8¢ for steel cans under the scenario "100 percent return rate for metal cans".

My calculations were as follows: I first took the values reported for the scenario "Without government intervention" as the base case. I then noticed that there is never a price change for malt beverages purchased in returnable bottles. RTI assumes that as long as a returnable bottle continues to maintain its return rate of 0.90, it will maintain its current price of $0.195. This assumption is stated explicitly on page 3-1 of the study: "The current prices of each beverage container are assumed to cover the costs of production and distribution plus a normal return on investment". Hence, if return rates remain constant, there is no reason why a shift to more returnable bottles should affect the price one way or another. It always remains at $0.195.

The nonrefillable bottle is assumed to vanish from the marketplace under all scenarios except the base case. Hence there are no shelf price estimates for this container.

The metal cans have calculated shelf prices that are direct functions of their return rate, some fraction between 0 and 1.

Under the scenario "Zero return rate for metal cans", which would, in effect, give the present system, the authors state that retailers would receive a windfall profit of 5¢ on every bottle because of unrefunded deposits. More debatably, they assume that competitive pressures will force the complete refund of this profit to the consumer in the form of lower prices. Hence shelf prices will drop by 5¢, the full amount of the unrefunded deposit: 22.5¢ - 5¢ = 17.5¢, the price given for steel and aluminum cans under this scenario.

Under the scenario "100 percent return rate for metal cans", the authors list shelf prices of 23.8¢ for a steel can and 21.7¢ for an aluminum can. The latter is equal to the 22.5¢ of the base case minus 1.0¢ in salvage value plus 0.1¢ for handling costs to the retailer. There is 0.1¢ here which I cannot account for. The assumption is again made that retailers pass all savings (here, the net salvage value of the can) on to the consumer.

I am unable to reproduce the value of 23.8¢ for the shelf price of a steel can. Following the same method I used for the aluminum can yields a value of 22.7¢. This equals the 22.5¢ of the base case plus 0.2¢ handling charge per can, with negligible salvage value. The handling charge differs from the charge for aluminum cans because steel cans are heavier and there are fewer of them per pound.

This calculation leaves a gap of 1.1¢ (= 23.8¢ - 22.7¢) which I am unable to account for.

There are obviously no metal can prices for the scenario "Metal can market share falls to zero".

The last two scenarios essentially show return rates for metal cans somewhere between 0 and 100 percent. They show rates of return of 82 and 50 percent. This means that retailers incur handling costs and salvage value on 82 and 50 percent of the cans, respectively, and retailers receive windfall profits on unrefunded deposits on 18 and 50 percent of the cans, respectively.

The prices that RTI reports for these cans under these scenarios approximates the weighted average of the price under a zero return rate and the price under a 100 percent return rate. That is, with the price under a zero return rate being 17.5¢ for both steel and aluminum cans and the price under a 100 percent return rate being 21.7¢ for aluminum cans and 23.8¢ for steel cans, the prices under an 82 percent return rate are approximately 20.8¢ for aluminum (= .82 x 21.7¢ + .18 x 17.5¢) and 22.6¢ for steel (=.82 x 23.8¢ + .18 x 17.5¢). Similarly, for the final scenario, where the return rate for metal cans equals .50, the shelf price is 19.5¢ for aluminum (= .5 x 21.7¢ + .5 x 17.5¢) and 20.6¢ for steel cans (= .5 x 23.8¢ + .5 x 17.5¢). For each calculation, the error is less than 0.1 of 1¢.

These prices for bottles and cans all rest basically on three assumptions: (1) changes at the brewer and wholesale level account for no change in price; (2) trip life of a container is the sole determinant of shelf price; and (3) all unrefunded deposits kept by retailers are passed on to consumers in the form of lower prices. I find all of these assumptions worthy of examination.

First, the authors assume that occurrences at the brewer and wholesaler level do not affect the price to the retailer. This assumption is made in the face of stated incremental investment costs for the "beer system" of between $467 and $3,048 million for the various scenarios. These investment costs are stated net of the investment cost under the base case, "Without government intervention".

Many studies assume that savings in materials costs will offset the increased labor costs and capital investment costs, but this assumption is questionable. A 1971 study, "The Effect of Convenience Packaging on the Malt Beverage Industry 1947-1969", by R.S. Weinberg and Associates, predicted that increased costs to the brewing system would cause price increases to the consumer ranging from 7.2 percent to 12.9 percent, depending on trip life. In addition, in a 1975 study prepared for the District of Columbia, a consultant predicted that D.C. malt beverage consumers would pay $290,000 more under a mandatory deposit system than under the present system. In fact, every study that has considered the total system costs has indicated a price increase to the consumers.

Secondly, the authors appear to assume that trip life is the sole determinant of price. Furthermore, they never consider a trip life lower than 10.4 for returnable bottles. This trip life seems high because most returnable bottles are currently sold in the captive on-premise market, where the bottle never leaves the retail establishment (e.g., bars, restaurants). The return rate in the off-premise market (e.g., supermarkets) is much lower. Hence, as the off-premise market becomes a much larger percentage of the total returnable market (as it would in all scenarios) the return rate might be expected to decline. In addition, even if the return rate were the same for on- and off-premise accounts, costs to the wholesaler for delivery and collection would be higher for the off-premise accounts. Collections at on-premise accounts tend to be smooth and predictable. Collections at off-premise accounts are much more erratic, thereby requiring more slack in the wholesaler system and causing higher costs.

Finally, there is the assumption that competitive pressure will force a reduction in shelf price in the amount of unrefunded deposits. There are two flaws in this assumption. [redacted] Even if disposition of unrefunded deposits is up to the retailer, however, he may not pass it on to consumers. He may consider that he needs to be compensated for the additional work and trouble of

participating in a mandatory deposit system and that forfeited deposits are rightfully his. That is, in addition to his increased pecuniary costs, there are increased costs of time and effort which must be compensated for - perhaps by increased prices, perhaps by retaining unrefunded deposits.

In summary, I can duplicate the price changes in Table 3-2 (with one exception) and believe I understand how they were derived. However, they rest on three assumptions which I regard as dubious. I believe the price estimates of Table 3-2 underestimate consumer prices because of these assumptions.

One interesting quirk shows up in this table. Since the shelf price of steel cans under a zero return rate is 17.5¢ + 5¢ deposit = 22.5¢, and since the shelf price of steel cans under a 100 percent return rate is 23.8¢, it would pay consumers of malt beverages in steel cans never to return their cans for the deposit refund. Other scenarios' prices, being a weighted average of these two extremes, are likewise higher than the price of the zero return rate scenario.

TFN

TFN

Phone: (412) 562-2400

United Steelworkers of America
AFL-CIO-CLC
FIVE GATEWAY CENTER, PITTSBURGH, PA. 15222

Walter J. Burke
International Secretary-Treasurer

December 3, 1975

RECEIVED
DEC 8 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
Energy and Environmental
Research Division
Post Office Box 19194
Research Triangle Park, N. C. 27709

Dear Mr. Bingham:

I am writing you regarding the review copy of your study on the Energy and Economic Impacts of Mandatory Deposits which you forwarded to me. Your involvement in this project was first brought to my attention through a May 6, 1975 letter to our organization by Mr. Roger W. Sant, Assistant Administrator of the Federal Energy Administration. Subsequently on May 7, you wrote to us indicating a desire to contact us, or someone whom we designated, for the purpose of obtaining specific data or information regarding the proposed mandatory deposits legislation. On May 14, I wrote you suggesting that you contact Mr. Joseph E. Brady, Chairman of the National Coordinating Committee on the Beverage Industry, and Dr. Rocco A. Petrone, President of the National Center for Resource Recovery. I informed you that we had been working with these two organizations whose programs, in the main, represent our views on the issues under study.

I have been in contact with both Mr. Brady and Dr. Petrone and was quite surprised to learn that neither of them had been contacted by you or any other representative of Research Triangle Institute with regard to this study. I am at a loss to understand why no contact of this sort was made, in view of the statement, contained in your May 7, 1975 letter, to the effect that you would be very interested in receiving our views.

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Since we have not played a role in the development of this report, it should not be presented in such a manner as to convey the impression that it has our approval. If copies of the report are forwarded to Dr. Petrone and Mr. Brady for their review and we find the report to be consistent with our position on this matter, we will then be willing to lend our support to this report.

Sincerely yours,

WALTER J. BURKE
International Secretary-Treasurer

cc: Mr. Roger W. Sant
Mr. Joseph E. Brady
Dr. Rocco A. Petrone

I-209

Interested Parties

November 20, 1975

RECEIVED
NOV 24 1975
ECONOMICS DEPARTMENT

Mr. Tayler H. Bingham
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, N. C. 27709

Dear Tayler:

Thank you very much for sending me a copy of your study, Energy and Economic Impacts of Mandatory Deposits, prepared for The Federal Energy Administration. I appreciate the opportunity to comment on the report in its draft form.

I have reviewed the analysis in some detail and feel very strongly that some adjustments should be made prior to publication of the report as a final document. My specific comments are detailed below.

1. The choice of scenarios used to calculate mandatory deposit impacts do not reflect "realistic" potential outcomes.

   The scenarios selected for analysis in the report seem rather unrealistic. For example, you use three "extreme" scenarios which, while useful to set the bounds for potential impacts, seem out of place in a discussion of what might actually happen under national deposit legislation. Only two scenarios are purported to be realistic--the Oregon case and the "Midrange" case--and even those are peculiar choices. The Oregon case, for example, does not include Oregon trip rates. Why tamper with the one case where "real" data are available? And the "Midrange" case uses rather odd can return rates. It seems to me that if Coors can obtain a particular can return rate at 0.75¢ per can, this return rate would have to increase if the refund jumped to 5.0¢ per can.

   Perhaps your analysis should concentrate on three scenarios, all of which bear some relation to the real world. I would like to suggest the following as possibilities:

   a. The Oregon Case - Use current Oregon market shares trip rates and can return rates. This would be the case with the highest refillable bottle market share, average trip rates and relatively low can return rates.

   b. Medium Impact Case - Assume a 70 percent refillable bottle, 25 percent can (75% aluminum; 25% steel), and a 5 percent plastic bottle market. Bottle trip rates should be 1975 rates; can return rates should be between 80 and 90 percent. Be sure to use realistic recovery rate efficiencies for the cans (perhaps 85% for aluminum and 90% for steel).

   c. Low Impact Case - Assume a 50 percent refillable bottle, 40% can (70% aluminum; 30% steel), and 10 percent plastic bottle market. Bottle trip rates might be high for this case - say 18 trips - as might can return rates - say 90-95%.

   It seems to me that a range of scenarios like this would be more useful to the reader who is attempting to analyze the impacts of deposit legislation.

2. The methodology used to calculate capital expenditures is both incomplete and misleading.

   Here, there are a number of factors that need to be considered.

   a. Float - Float is included in the capital calculations for refillable bottles, even though some firms do not conduct their accounting in this manner. It seems to me that if you do include the cost of the float, you should also include the cost of the metal which is recycled to make cans. The same principles apply, after all.

   b. System Capital - Capital costs are calculated from the filler (bottler or brewer) through the retailer of the beverage. To be complete, it is essential to consider at least the capital required for container manufacture. Quite obviously, both the refillable and one-way container systems require significant capital for container manufacturer; leaving out this item is indeed misleading.

   c. Capital for Reuse and Reprocessing - Capital costs for bottle washers (required for refillable bottle reuse)

are included on the capital calculations. However, no capital costs are included for the equipment required to recycle the one-way containers. Since refilling and recycling are somewhat parallel operations, including one and not the other results in an incomplete picture.

d. Capital for "Energy Conserving Technology" - The installation of "energy conserving technology" is an important factor in the calculation of baseline energy consumption. Many of these technologies require significant capital investment. It seems to me that your calculations of capital expenditures must include these capital requirements if your comparative data are to be considered reliable.

e. Tax Impacts - It is somewhat unrealistic to base capital cost on purchase prices. A reasonable assessment of capital needs would be based on the after tax impact of the equipment purchases.

3. The assumptions regarding energy conserving techology are highly impractical.

The report assumes that all energy conserving technology will be on line by 1985. This does not under any circumstances seem to be a viable possibility. For example, less than 2 percent of all non-aluminum cans are drawn and ironed cans at the present time. The technology required to manufacture these cans is rather expensive, and three-piece steel cans are likely to dominate the steel beverage can market for some time to come. In fact, drawn and ironed cans will not realistically represent more than 30 to 40 percent of all steel beverage cans by 1985. So assuming a 100% d & i market is clearly off the mark.

The energy conserving technology data are not realistic on still another score. Some of this technology was put in place between 1972 and 1975. Thus use of 1972 Federal Energy Administration figures overstate the case for the 1975 to 1985 period.

4. The analysis used to assess theimpact of a mandatory deposit measure on resource recovery seems to be based on

a misunderstanding of the practicalities of recovery potentials and technologies.

In assessing the impact of national deposit legislation on resource recovery, the report fails to take several key factors into account:

a. Viability of Significant Recovery by 1985 - The analysis is based on a ton of solid waste recycled or reduced through deposit legislation. It does not take into account the fact that very little solid waste will likely be recycled by 1985. The total number of recovery plants that will be built will not be large, and the number of these plants that will recover steel, glass and aluminum will, based on current plans, be even smaller. It does not seem to me to be reasonable to use the "tonnage recycled methodology" in light of the practicalities of recycling by 1985.

b. Market Values - The market values for recycled materials seem to be based on "typical" figures. Surely this calculation is dubious at best. On what ranges of real market values are you basing these figures? The aluminum figure, for example, seems to be based on source separated aluminum can values. Surely you are not assuming that aluminum recovered from mixed waste could possibly be equal in value.

c. Variability of Data - In light of the inadequacy of data for these calculations, it is odd that you present a detailed, quantitative conclusion on the impact of deposits on recovery. In this case, the data are at least as questionable as the data in the rest of the report. Indeed, it is almost impossible to project recovery plant revenue to within $1 or $2 - the amount which you suggest might be affected. You should, it seems to me, be particularly cautious in your statements and calculations of this impact area. The data simply do not warrant a detailed conclusion statement.

5. The indirect employment effect data only represent a portion of the total indirect employment effects.

The analysis calculates indirect employment effect based on "backstream" employment impacts using input/output analysis. While these data may be useful, they are highly misleading in light of the fact that you do not calculate "upstream" employment effects. You do state, for example, that consumers will be paying less for beverages under a mandatory deposit system. What you need to do is apply these increases in disposable income toward additional consumer spending--which will, of course, generate additional employment and labor income. Calculations of one set of indirect employment effects without the other leaves a biased picture of the total impacts on labor. Either both should be included, or neither should be.

6. Beverage cost data are not given adequate coverage in the report.

One key economic effect of a mandatory deposit measure is the price impact on the consumer. This item is given what at best could be considered scanty coverage. Limited data on this subject are presented in Table 3-2, but there is no detailed discussion of this fact, and no conclusion relating to lowered consumer cost under a mandatory deposit system. Since final cost data are, as I understand it, contained in the model, neglect of this item is really outrageous.

7. The refillable bottle trippage rates used in the report are too limited and unrealistic.

The analysis of likely trip rates by the mid-1980's is based on admittedly shoddy historical data. In light of this, you might want to consider current industry opinion on actual trippage. For while these "feelings" are not well documented, they are probably far more accurate than what you have done based on an inadequate historical base.

It is also important to point out that while you agree that the trippages you utilize represent a "floor," you do not make a reasonable attempt to illustrate scenarios

with different, higher trip rates. Yet you do this for can return rates, where the data are also sketchy and speculative. It seems only reasonable to me that you employ different trip rates in different scenarios so the reader can obtain a better understanding of the effects of deposits.

8. Plastic Bottles are omitted from the analysis.

The omission of the plastic beverage bottle from the analysis is certainly peculiar, given that industry projects that plastic will comprise 1½ percent of the beverage container market by 1976 and 10 percent by 1980. This is particularly important in several areas of the analysis.

a. Energy Conserving Technology - To the extent that plastic bottles enter the market, the energy conserving technology estimates will be overstated. This is due to the fact that since the plastic containers are "new," they are likely to include all the energy conserving technologies possible. Thus the energy consumption data for plastic bottles in Appendix D will likely be "rock bottom" numbers, not subject to much change.

b. Labor Impacts - The introduction and use of plastic bottles will clearly impact upon container manufacturing labor in other material sectors. These impacts need to be calculated and presented in the report.

c. Container Recycling - Use of the plastic bottle will impact upon the recycling of glass and perhaps metal one-way containers. These impacts also need to be calculated and inserted into your figures on beverage container recovery.

9. The presentation of the results of the study, particularly, in the summary, is inadequate and misleading.

Experience has shown that in reports as filled with data as this one, the summary is often the only section read and quoted. It is therefore critical that the summary

section in particular (although this applies to the entire report as well) be clear and concise in its presentation of the findings of the study, and that all items be qualified as necessary based on the limitations of the data and the analysis. As it presently stands, the report is somewhat confusing, and the summary does not seem to reflect much of what is in the body of the report. Major points follow:

a. Conclusions - All the statements on the conclusion section are broad and non-quantitative, except for the one relating to resource recovery. I would like to suggest that all conclusion statements present a quantitative range, so that the reader can obtain a picture of the potentials of deposit measures.

   Additionally, the conclusion related to resource recovery is simply not reflective of your text (and even less reflective of my comments earlier in this letter). You indicate no real impact on recovery systems. That is the conclusion, not the 20 percent hypothetical revenue decrease.

b. Summary Tables - There are two major problems with the summary tables: (1) in order to judge the magnitude of the impacts, it is important that you include a baseline projection in each table; and (2) the extreme parameter value scenarios should not be included in the summary tables. They add much to the confusion and little to an understanding of mandatory deposit impacts.

c. Omissions from the Summary - There are two major omissions from the summary: (1) the results of the public attitude survey, and (2) an indication of the changes in consumer prices under a deposit system. These are both important issues and should appear in the summary.

These are the major criticisms I have with regard to the draft report. I have, of course, marked the text wherever I felt a point was not adequately made. I hope those textual comments are of value to you.

As you well know, the issue of mandatory deposits for beer and soft drink containers is a highly controversial one. It is therefore essential that this report be as accurate and free from bias as possible. I hope that all of my comments will assist you in making the changes necessary to assure that the report is as analytically sound and free from error as possible.

Sincerely,

Eileen Claussen

EC:gh

RECEIVED
NOV 10 1975
ECONOMICS DEPARTMENT

November 7, 1975

Tayler H. Bingham
Environmental Studies Center
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, North Carolina 27709

Dear Tayler:

I am in receipt of your letter and the enclosed review copy of Energy and Economic Impacts of Mandatory Deposits. Via this letter, I will give you my preliminary review. First, let me say that of all the studies on this issue, this one is perhaps the best. This is particularly true when one considers the limited funding and excellerated time scale which must have created substantial pressures on all organizations involved.

Overall, my comments are summarized as follows:

1) More material must be given concerning the overall model used. This is very confusing to the reader, and a special appendix giving the total model would perhaps remedy this situation. The computer model itself as presented is worthless in that it does not present any definitions or illustrations.

2) An overall flow graph showing the full material balance problem which was considered along with all input data and reference for the input data would improve the report.

3) It should be made very clear to the reader that all conclusions which are attempted are conclusions drawn with respect to these particular scenarios and that what may actually happen may not be in line with any of the scenarios.

4) It should be made very clear to the reader that the energy savings projections are direct and that indirect energy has not been considered.

5) It should be made very clear to the reader that you have given only expected values and that further analysis should be made to determine standard deviations and, in fact, probabilities of exceedence. Expected values in themselves mean little in many cases, and are often misleading to the reader.

6) A review of the literature and comparison of your results and models with others would help substantiate the claim that this is an improvement.

7) All flow graphs and data contained in them should be referenced relative to available literature sources.

8) There are many places where the conclusions drawn appear to be absolute and not based upon the assumptions of this particular set of scenarios. This should absolutely be remedied.

9) I do not, in general, agree with either the assumptions or the conclusions; however, that is within your right to present it as you see it. I would suggest that you say your interpretations rather than your conclusions are on page 1-9.

10) I believe a discussion on how you feel concerning the total model would be in order. Do you feel it actually is adequate for giving bases for decisions which have impact upon major sections of the U.S. economy? Do you believe the model is sufficient for objectively appraising the energy and economic savings necessary for multi-billion dollar decisions? (In my own opinion, I do not believe this.)

Tayler, the above comments are submitted to be constructive criticism. I realize they may seem a little harsh, and I realize that you have been, as I noted in the opening paragraph, under substantial pressure with a limited budget. Even this, I believe, should be noted when you qualify some of your findings. The problem you have attacked is a very significant problem, and I feel sure with the resources available, you have performed to the best of your capability.

I still do not believe that there is adequate information to make the decisions involved, and I feel very strongly that legislation considered is based more upon passions of the time than sound business judgment. If I can be of further assistance, please do not hesitate to write or call.

Sincerely yours,

Bill

A. W. Wortham

2608 Melba Circle
Bryan, Texas 77801

AWW:jrt

Appendix M: RESPONSES TO COMMENTS

M.1 Introduction

The reviewers' comments presented in Appendix L have been reviewed. Where appropriate and feasible, the suggestions, insights, and data presented in the reviewers' comments have been incorporated in the body of the report. However, in order to provide further clarification, all comments have been grouped into 23 major issues listed below. They are directly addressed in this chapter. All reviewers are identified by numbers shown in table M-1.

M.2 Beverage Consumption Baseline Trends
M.3 Beverage Packaging Trends
M.4 Beverage Prices
M.5 Capital Stock Requirements
M.6 Public Attitudes
M.7 Closed Loop System
M.8 Electrical Energy Requirements
M.9 Impact on Consumer Expenditures
M.10 Impact on Beverage Consumption
M.11 Effect of Container Size
M.12 Plastic Bottles
M.13 Vermont Experience
M.14 Energy Conservation
M.15 Steel Cans
M.16 Glass Bottles
M.17 Transportation
M.18 Use of Industry Data
M.19 Energy - Fuel Sources
M.20 Comparison with Other Studies
M.21 Impacts on Resource Systems
M.22 Labor Requirements
M.23 Estimates of Refillable Bottle Trippage
M.24 Aluminum Can Recovery and Recycling
M.25 Steel Can Recovery and Recycling
M.26 Plastic Bottle Recycling
M.27 Other Issues

Table M-1. Summary of parties providing comments on the draft study

Correspondence Number	Date		Page
		Federal Government	
1	11/18	Tennessee Valley Authority, Dr. Peter A. Krenkel, Director of Environmental Planning, Chattanooga, Tennessee	L-7
		Administrations/Agencies:	
2	12/5	Environmental Protection Agency, Office of Solid Waste Management Programs, John H. Skinner, Deputy Director, Resource Recovery Division, Washington, D.C.	L-7
3	11/21	General Services Administration, Dwight A. Ink, Acting Administrator, Washington, D.C.	L-15
4	11/20	United States Energy Research and Development Administration, James S. Kane, Deputy Assistant Administrator for Conservation, Washington, D.C.	L-14
		Departments:	
5	11/24	U.S. Department of Commerce, William V. Skidmore, Assistant General Counsel for Legislation	L-16
6	11/5	U.S. Department of Defense, George Marienthal, Deputy Assistant Secretary of Defense, Health and Environment	L-17
7	11/10	U.S. Department of Justice, Alfred T. Ghiorzi (Acting Chief, Pollution Control Section) and Walter Kiechel, Jr. (Acting Assistant Attorney General), Land and Natural Resources Division	L-18
		Congressional - House of Representatives	
8	10/20	Ike Andrews, 4th District, North Carolina	L-20
9	11/7 11/14	Les AuCoin, 1st District, Oregon	L-20 L-21
10	11/26	James M. Jeffords, Vermont	L-22
		Congressional - U.S. Senate	
11	11/3	Trenton Crow (for Jennings Randolph, (W.Va.), Chairperson, Committee on Public Works)	L-25
		State Governments	
12	11/10 11/25	State of Maryland, Ted Scheinman, Staff Economist, Governor's Council of Economic Advisors	L-27

Table M-1. Summary of parties providing comments on the draft study (con.)

Correspondence

Number	Date		Page
13	11/11	State of New York, Robert R. Quinn, Policy Analyst, Senate Task Force on Critical Problems	L-29
14	11/26	The State of Oregon, William R. Bree and Loren Kramer, Department of Environmental Quality, Recycling Information Office	L-31
15	11/10	State of Vermont, Donald W. Webster, Director, Agency of Environmental Conservation, Division of Environmental Protection	L-32
		Universities	
16	11/14 12/31 3/4/76	University of Connecticut, Carlos D. Stern, Assistant Professor, Environmental Economics	L-34 L-39 L-40
17	11/4	University of Illinois at Urbana-Champaign, Bruce M. Hannon, Director, Energy Research Group	L-41
18	11/25	State University of New York, David L. Hanselman, Associate Professor and Coordinator, Educational Communications, College of Environmental Science and Forestry	L-42
19	11/12	Oregon State University, Dr. Charles M. Gudger, Associate Professor, School of Business	L-47
20	11/14	University of Tennessee, John H. Gibbons, Director Environment Center	L-50
		Environmental Organizations	
21	11/28 12/2	Allied Civic Group, Inc., Steven A. Frank, Chairman, Environmental Affairs Committee, Bethesda, Maryland	L-52 L-52
22	11/14	Crusade for a Cleaner Environment, Betsy Greer, Director, Washington, D.C.	L-56
23	11/24 3/1/76	Environmental Action, Patricia Taylor, Arthur Purcell, and Pamela Deuel, (National Environmental Lobby), Washington, D.C.	L-57 L-68
24	11/11 11/15	Environmental Management Council, Forest Golden, Vice Chairman, Cayuga County, Auburn, New York	L-85 L-93
25	11/18	National Wildlife Federation, Thomas L. Kimball, Executive Vice President, Washington, D.C.	L-103
26	11/26	Natural Resources Defense Council, Inc., Thomas Fenner (Legal Assistant) & Richard Cotton (Staff Attorney), Palo Alto, California	L-105

Table M-1. Summary of parties providing comments on the draft study (con.)

Correspondence Number	Date		Page
27	11/12	Oregon Environmental Council, Don Waggoner, Portland, Oregon	L-110
		Corporations	
28	11/12	Admiral Beverage Corporation, Frank E. Bowers, General Manager, Worland, Wyoming	L-113
29	11/25	Aluminum Company of America, J. Tyson Kennedy, Marketing Manager, Packaging, Pittsburgh, Pennsylvania	L-133
30	11/26	American Can Company, H. Blair Smith, Vice President, Corporate Environmental Affairs	L-134
31	12/1	Amoco Chemicals Corporation, Earle R. Stout, (Subsidiary of Standard Oil Company, (Indiana))	L-135
32	11/7	Anchor Hocking Corporation, C. J. Arnsbarger, Vice President, Director of Public Affairs	L-137
33	11/15	Angelus Sanitary Can Machine Company, H. E. Schellenberg, Vice President of Sales, Los Angeles, California	L-137
34	11/25	Coors Container Company, E. G. Anderson, Vice President, Quality Assurance, Golden, Colorado	L-138
35	11/19	Dow Chemical, USA, R. W. Dupree, Director, Government Relations	L-143
36	11/11	E. I. Du Pont de Nemours & Company, P. J. Vanderhorst, Research and Development Division	L-146
37	11/13	Monsanto Commerical Products, F. D. Wharton, Jr., Manager, Environmental Affairs, Container Business Group	L-148
38	12/2 1/23/76	Pepsico, Inc., Lloyd Curtiss, Director, Environmental Affairs, Purchase, New York	L-149 L-163
39	12/1	Reynolds Aluminum, Robert F. Testin, Director, Environmental Planning, Richmond, Virginia	L-166
		Industrial Associations and Organizations	
40	12/1	The Aluminum Association, S. L. Goldsmith, Jr., President, New York, New York	L-169

Table M-1. Summary of parties providing comments on the draft study (con.)

Correspondence

Number	Date		Page
41	11/26	Can Manufacturers Institute, Barclay, T. Resler, Manager, Government Relations, Washington, D.C.	L-174
42	1/16/76 2/09/76	Glass Bottle Blowers Association of the United States and Canada, Harry L. Moore, Director of Legislation, Media, Pennsylvania	L-176 L-180
43	11/28 12/23	Glass Containers Manufacturers Institute, William W. Sadd, President and General Manager, Washington, D.C. with material developed by Stanford Research Institute	L-180 L-182
44	11/26	National Soft Drink Association, Thomas F. Baker, Executive Vice President, Washington, D.C.	L-234
45	12/11	National Solid Wastes Management Association, Warren T. Gregory, Director of Legislative Affairs, Washington, D.C.	L-247
46	11/13	The Society of the Plastic Industry, Inc., Peter Thomas Smith, Assistant General Counsel, (Keller & Heckman, Washington, D.C.)	L-248
47	12/3	United States Brewers Associations, Inc., Henry B. King, President, Washington, D.C.	L-251
48	12/3	United Steel Workers of America, Walter J. Burke, International Secretary-Treasurer, Pittsburgh, Pennsylvania	L-292
		Interested Parties	
49	11/20	Ms. Eileen Claussen	L-294
50	11/7	A. W. Wortham	L-298

M.2 Beverage Consumption Baseline Trends

• Model ignores some critical factors.

Two reviewers (38, 12) felt that the equation did not contain all the variables which may affect beverage consumption. Specifically, changing consumer lifestyles, packaging trends, and the emergence of food chains with aggressive merchandizing and promotion were identified, and the suggestion was made that beer and soft drinks be considered substitutes. Earlier attempts by RTI to estimate substitution between beer and soft drinks rendered no statistically significant results. Of the other factors mentioned above, which also may affect beverage sales, most are very difficult to quantify and, hence, are subject to a significant degree of individual interpretation. Secondly, to the extent that these variables correlate with any of the other variables in the model, e.g., income, their presence is implicitly included. The purpose of the equation was to provide the basis for developing long-run projections of beverage consumption. The three variables used in the model provide a high degree of explanatory power over the historical period. The approach used has been employed many times before (see especially Houthakker and Taylor, Consumer Demand in the United States, Harvard University Press, Cambridge, Mass., 1970).

• Soft drink projection is too high.

Two reviewers (30, 41) remarked that the soft drink growth rate was somewhat more optimistic than they anticipated. Both cited the belief that a 4-percent growth rate will be more likely than our 4.9 percent. No methodology or rationale for their projections were provided. Therefore no change was made in the approach.

• Values used for some independent variables incorrect.

One reviewer (43) suggests that alternative values for the income variable in the equation be used in order to estimate an alternative set of forecasts with alternative assumptions about the general outlook of the U.S. economy. The per capita consumption of beer was found to be fairly unresponsive to income, as shown in equation A-2. A 1-percent increase in income is estimated to increase per capita consumption of beer by .25 percent. For soft drinks, however, the demand is estimated to be income elastic, with a

1-percent increase in income causing a 1.47 percent increase in per capita consumption. Including other income projections would, however, significantly increase the number of necessary scenarios without substantially altering the implications of the study. For example, a halving of the 1975-85 soft drink growth rate would reduce the projected 1982 value of packaged beverage consumption by only 6 percent.

NSDA (44) suggests an alternative consumption model considering demography and convenience packaging as the only explanatory variables. It is not surprising to observe that NSDA's model performs as well as the RTI model, because it is theoretically predictable that the share of convenience packaging will be highly correlated with per capita income (see the detailed discussion on the relationship between per capita income and demand for convenience on page B-25). Therefore, if one is interested in explaining the historical trend of beverage consumption, it matters little which model is used.

However, it is not correct to infer from NSDA's estimated coefficient of convenience share variable that disappearance of convenience packaging would result in, say, 13 percent loss of industry sales in 1973 as they state. This is the problem of an auxiliary regression equation (see Huang [1970], pp. 150-153). When one omits from the regression equation by misspecification of the model a variable that is highly collinear with the others, the estimated coefficient of the included variable is always biased. In this case the coefficient estimate of convenience packaging is upward biased because it is positively correlated with the excluded variable, namely, per capita income. This is also true for the RTI model. The estimate of income elasticity is probably biased upward because other factors which affect consumption and correlate with income are ignored. This is why RTI never used the estimation results of the consumption model except in projecting beverage consumption trends. But perhaps most important, mandatory deposits would not require the use, or prohibit the use of, any container. Rather, it raises the price of discarding an empty container.

M.3 Beverage-Packaging Trends

- Can growth rate too high.

CMI (4) projects a can growth rate of 4 percent per year through 1985 rather than RTI's 6.73 percent. Requests for documentation of their methodology were not answered. NSDA (44) suggests that RTI's projection of 54 percent metal can market share for soft drinks in 1985 is somewhat optimistic and suggests a projection in the 40 to 45 percent range.

To the extent that the projected can market share for cans is too high, the baseline projections of energy consumption would be too high. Therefore, the impacts of a given percentage reduction in the can market share would also be overestimated.

• Selection of asymptote values arbitrary.

The asymptote values selected for the market shares were also criticized as arbitrary (12, 21, 38).

A modest share of the project resources were expended to explain the historical phenomenon of market shares by container type. Howerver, the S-model employed proved to be fairly satisfactory. We found that if one selects an asymptotic value which is less than twice the 1973 value of f(t), the regression did not prove to be a satisfactory or meaningful predictor. Furthermore, the smaller the asymptotic value chosen, the higher the R^2 of the regression. However, small differences in the asymptotic value had negligible influence on the explanatory power of the regression. Based on the above observations, two asymptotic values of 0.5 and 0.7 for market shares of nonpackaged soft drinks and soft drinks in metal cans were used in the regression respectively.

• S-model inadequate.

In the second part of section B.2 of appendix B, market share projections of each container type based on the S-model were compared with available industry projections. The comparison indicated that even though the S-model was satisfactory in explaining the historical trends of packaging mixes, it deviated significantly from the industry projections for some containers. Therefore, the S-model was used only to project the baseline market shares of packaged beer and nonpackaged soft drinks and the market shares of beer in metal cans because the results compared favorably with industry projections for the projection period.

Thus, the S-model was primarily used to explain the historical trend of package mixes, and it was used only as an auxiliary tool in projecting future trends in packaging mixes. The available industry projections were, however, used as the primary source of information for the projections.

M.4 Beverage Prices

• Refillables subsidize nonrefillables.

One brewer (34) has said that the prices for beer marketed in nonrefillable bottles or metal cans may not reflect the actual costs of the different

container systems and that the cost of distributing the beverage in non-refillable bottles may be somewhat higher than those of the metal can. The brewer's hypothesis gains support if one examines the Census of Manufactures data (see table M-2) and the Jack Faucett survey data for the state of New York (Jack Faucett Associates, Inc., "The Economic Impacts of Beverage Container Legislation in New York State," study prepared for New York State Senate Task Force on Critical Problems, January 1975.) After reviewing the argument and the data, we agree that our prices in the draft final report should be revised. Accordingly, in this final report, prices for beer in nonrefillable bottles and cans without government intervention have been set equal at $0.2583 based on the Faucett study.

A reviewer for the USBA (47) goes one step further and contends that the "efficiency of the convenience packaging system is, in fact, subsidizing the inefficient refillable bottles system." However, there are at least two reasons which could explain the situation.

The first and most obvious is that brewers may not have complete current knowledge regarding the distribution of their production and distribution costs across all containers. Therefore, they may have adopted a traditional pricing scheme which reflected actual, or estimated, costs in some previous time.

A second reason is somewhat more complex. Instead of maximizing profits on beer in each container separately, producers may maximize profits jointly. In such situations, it can be shown that if the elasticities of demand vary by container type, then profit-maximizing behavior would dictate that producers discriminate and charge higher prices for the product with the most inelastic demand (presumably beer in cans).

Regardless of the rationale, if the prices of beer do not reflect the opportunity costs of production and distribution, the incentive would exist for producers to enter the market and sell beer in cans below the prices established by the price-discriminating producers. To explain why this has not happened, if indeed it has not, one would probably have to identify significant barriers to entry.

If the hypothesis is correct, then the effect of shifts to refillables due to mandatory deposits may be to raise their price. However, the hypothesis

Table M-2. Beer prices, FOB brewery, including Federal and State excise taxes, 1967 and 1972

	1967*			1972†		
	$/bbl	¢/oz	12 oz. ¢/drink	$/bbl	¢/oz	12 oz. ¢/drink
Refillable bottle						
<12 oz	42.19	--	--	45.97	--	--
12 oz	37.56	0.94	11.35	43.04	1.0847	13.01
32 oz	36.53	0.92	29.45	37.85	0.9539	30.52
Nonrefillable bottle						
<12 oz	42.44	--	--	47.39	--	--
12 oz	40.43	1.01	12.22	44.29	1.1162	13.39
32 oz	38.29	0.96	30.88	41.20	1.0383	33.22
Metal Can						
12 oz	42.93	1.08	12.98	43.68	1.1008	13.20
16 oz	44.16	1.11	17.08	44.79	1.1333	18.13

* Includes $9.00 per barrel Federal excise tax and $3.70 average State tax.

† Includes $9.00 per barrel Federal excise tax and $4.45 average State tax.

Source: Census of Manufactures and Brewers Almanac.

is beyond the scope of this study to investigate and we have continued to use the best price data available as an estimate of the real cost of beer in refillable bottles.

M.5 Capital Stock Requirements

• Model plant approach inadequate.

As was pointed out in the draft report and reiterated by several reviewers (13, 38, 44, 47), the model plant type of approach has a limited ability to accurately project the existence of redundancies or shortages in capital unless the age distribution and the economic life of the existing capital stock are known. It is possible, depending on the extent of changes in market shares, that, even with the 3-year delay beteeen the passage and the introduction of the legislation, such legislation could obsolete some systems. Since non-refillable-bottle-filling lines can be converted to refillable lines by the substitution of a bottle washer for a rinser, the major impact on beverage producers would be on can-filling lines.

However, the scope of this study and the lack of data on the age distribution of filling lines dictated the approach used in this study. The approach employed focuses on the capital intensities of the alternative system and how changes in market shares would affect the beverage system capital requirements.

An attempt has been made, however, by the USBA (47) to estimate the capital impact of an all-refillable system on the brewing industry. Their procedure was to conduct a survey of breweries, asking each brewery to estimate the cost of converting to an all-refillable system. These costs have been analyzed by Robert Weinberg of R. S. Weinberg and Associates, and are presented with the USBA submission (47). Unfortunately, with the data presented, there is no way to weigh the cost to reflect different production capacities of the breweries that responded. However, from the data supplied, a mean estimate of $16.83 per barrel of beer converted was developed. This value does not include the requirements for the float and, when expressed on an ounce basis as it has been done in this report, comes to $4,241 per 10^6 ounces. That value compares to the value of $5,422 used for a refillable system in this study. Therefore, use of the USBA mean value would tend to produce a lower estimate of the capital impact of mandatory deposit legislation than the values presented in

this report. However, the variance in the USBA estimate is large. The standard deviation is $14.45, and the range is 0 to $50.15 per barrel, with the median value of $13.94.

• Cost of space too high.

The cost of space for storage of empty containers of $22 per square foot was criticized as being too high (2) on the basis that containers could be stored in secure cages outside the store. This argument appears reasonable, and, therefore, in this final report a value of $11 per square foot has been used for storage of empties by retailers.

• Inclusion of float incorrect.

Another major area of concern relating to the capital stock requirements is the inclusion of the bottle shell and carrier float costs as part of the capital stock requirements (13, 23, 25, 26, 49). As used in this study, "capital" is the investment plant and equipment. It is distinguished from operating costs in that it yields a service over a period of time. It is clear that the refillable bottle meets this general requirement. Whether one includes the initial cost of refillable bottles as part of capital or not is simply an accounting convention. However, refillable bottle purchases are apparently not included as part of the investment component of the National Income Accounts by the Department of Commerce. Therefore, in this final report, while estimates of the float are still provided, they are not included in the total value of capital stock requirements. However, they are discussed in the capital impacts section of the report.

• Materials should be treated as part of the float.

A second proposal with respect to float is the suggestion that recycled materials should be included as part of the float (17). First, the suggestion appears difficult to implement because these materials are constantly moving through the production system, and along the way their dollar value changes. For example, an empty new aluminum can is worth about 7 cents. An empty, used aluminum can is worth at the consumer level on the order of 0.75 cents. Second, the rationale for including materials as part of the float is unclear. Therefore, recycled materials are not treated as part of the float in this study.

• Other issues.

A large number of the issues raised related to the subject of the capital impacts and were beyond the scope of this study to include. Among these issues were:

1. Sources of financing capital expenditures (24, 44),
2. Capital requirements of energy-conserving technologies (2, 23, 26, 49),
3. Energy content of capital (17, 40),
4. Capital requirements of recycled cans (2).

However, one of the most consistent suggestions was to include estimates of the capital required to produce containers. This has been done for this final report.

M.6 Public Attitudes

• Referendum results are ignored.

Several reviewers (30, 38, 41) noted that in situations where voters actually had a chance to vote on the mandatory deposit legislation, it was defeated. These communities include: Juneau, Alaska (1971); Bridgeton, Maine (1973); Washington State (1970); Coon Rapids, Minnesota (1974); Crystal, Minnesota (1974); Dade County, Florida (1974); Ypsilanti, Michigan (1975); and Eau Claire, Wisconsin (1975).

On the other hand, such legislation has been passed in: Oregon (went into effect in 1972); Vermont (went into effect in 1973, revised in 1975); South Dakota (goes into effect July 1, 1976); in Montgomery County, Maryland; Cayuga County, New York; Fairfax County, Virginia; Loudon County, Virginia; and in the cities of Bowie, Maryland; Oberlin, Ohio (in effect since 1972); and Berkeley, California.

The conflicting evidence on public attitudes toward mandatory deposits is noted in this final report.

M.7 Closed Loop System

• Uneconomic system.

The system has been criticized by NSDA (44) as being uneconomic. Although no attempt has been made as part of this study to evaluate the economics of such a system, if returned containers have a value in secondary markets approximately equal to their handling costs, such a system would appear possible.

The system presented was based on a Coors Container Corporation proposal but was significantly simplified. Coors (34) feels the simplification is too great, primarily because they believe that beverage producers must maintain "title" to the returned can, much like the private-mold soft drink bottles. This final report, however, has dropped reference to the close loop system.

M.8 Electrical Energy Requirements

- Methodology is questioned.

Three reviewers (2, 16, 43) questioned the methodology used and the use of electricity data supplied by the Aluminum Association. Sections D.3 and D.6.4.3 of appendix D offer discussions of these points. However, in this study the actual industry electricity-use patterns were sought as the most representative information available. The aluminum industry happens to be the one which varies significantly in its electrical-use pattern (by fuel type) from other industries included in this study.

In evaluating the energy content of electrical energy it is important to determine first the use to which the data will be put. If the issue relates to the average energy content of a ton of aluminum, then it appears reasonable to use the actual fuel sources. On the other hand, if one is examining the implications of a change in aluminum production due to mandatory deposits, then the question is: Which is the marginal fuel? For the data presented in chapter 2 of this report, the average actual Btu content of hydroelectric power has been used (3,413 Btu per kWh). However, for the marginal analysis presented in chapter 3, the value of 10,429 Btu per kWh has been used, under the assumption that hydropower provides the fuel source for the base load and would not be affected by mandatory deposits. Thermally produced electricity is assumed to represent the marginal fuel source.

M.9 Impact on Consumer Expenditures

- Has been ignored.

In the draft final report, no estimates of consumer expenditures on beer and soft drinks were developed. Several reviewers cited this omission (23, 24, 49), which has been corrected for this report by developing expenditure projections based on a 12-ounce drink.

M.10 Impact on Beverage Consumption

• Impact is ignored.

Some reviewers thought the impacts on consumption were ignored (43, 44). However, they were, and are included. The impact of mandatory deposits on beer and soft drink consumption has been projected using the elasticities of demand presented in appendix A and a weighted price index constructed for each scenario. The weighted price index is developed on the assumption that consumers which shift to refillable bottles and return the bottles experience no change in their perceived price, whereas those who forfeit the deposit perceive a price increase. Because the aggregate elasticity of demand for both beverages is estimated to be quite low, no significant changes in total consumption are projected with mandatory deposits.

• Consumption model is inadequate.

Other reviewers considered the consumption model too simplistic, citing the need for inclusion of other factors (38, 44, 47). What would be desirable would be to estimate the complete set of own and cross price elasticities. However, such a task is beyond the scope of this study.

It is interesting to note that for Oregon no statistically significant impacts of deposits on consumption could be found.

M.11 Effect of Container Size

• Is ignored.

For the energy analyses a single container size has been utilized. However, some reviewers noted that the larger-sized bottles have lower per-unit energy requirements (43). The per-unit requirements of larger bottles have also been developed for this final report and are presented in Chapter 2 and Appendix D, although a single size is used for the impact analysis. In general, it appears that the use of a single size does not significantly bias the results of this study.

M.12 Plastic Bottles

• Market has not been projected.

Although plastic bottles have only a small share of the current soft drink market and none of the beer market, the industry projects a 10-percent share by

1985. The largest opportunities appear in the large nonrefillable bottle market, especially of soft drinks. The opportunities for beer are more limited since most beers are pasturized in the container in which they are sold. Coors beer is a significant exception as it is not pasturized.

Several reviewers cited the need for inclusion of plastic bottles in the analysis (21, 23, 35, 36, 37, 38, 43, 44, 46, 49). Accordingly, in Appendix J the impacts of plastic bottles on the without-government-intervention energy requirements are shown. The plastic bottle has an energy requirement slightly less than that of a nonrefillable bottle or can, and therefore, the projections are slightly reduced by inclusion of the plastic bottle.

M.13 Vermont Experience

- Is ignored.

The Oregon experience with mandatory deposits is cited several times in this report. Besides Oregon, Vermont is the only State to have imposed mandatory deposits. One reviewer (38) suggested inclusion of the Vermont experience. However, there do not appear to be any well-documented studies of the Vermont experience, as there are for Oregon and, therefore, no reference is made to the Vermont experience.

M.14 Energy Conservation

- Rates too high.

Many reviewers considered the rates of conservation unrealistically high (2, 23, 49). The conservation assumptions were derived from independently produced studies carried out for and reviewed by FEA. These studies are referenced in appendix D. However, in chapter 2, the impacts of a no conservation assumption are presented.

M.15 Steel Cans

- Projected weight too high.

Two reviewers (30, 41) noted that the weight of the two-piece can projected for 1985 was high. This weight error in the draft final report was discovered by the researchers prior to receiving these comments and has been corrected (see section D.7).

- Use of two-piece steel can inaccurate.

Several reviewers (2, 23, 44, 49) took issue with the use of a two-piece all-steel can for the 1985 case, stating that the industry could not change

over completely from the three-piece can by 1985. Recognizing this as a valid point, the revised study uses a mix of 50 percent three-piece all-steel cans and 50 percent two-piece all-steel cans for the 1985 case.

• Energy for recycled steel too high.

One comment (30) stated that the energy calculated for recycled steel is too high. However, the figure supplied by this reviewer apparently does not include waste processing to retrieve the steel scrap from mixed municipal waste (see table D.7-5 for this calculation). In particular, if cans are upgraded to be recycled into "tinplate" quality steel, then an energy-intensive scrap-upgrading process (e.g., detinning) must be utilized.

M.16 Glass Bottles

• Need to include packaging innovations.

Three comments on refillable bottles (2, 21, 43) suggested that introducion of durable secondary packaging, or other packaging innovations reducing the need for conventional paper and plastic packaging, could be quite important. These factors are now discussed in section D.8.8. It was also suggested in one comment (4) that on-premise packaging may be used only once in some cases before being discarded. The researchers concur with this, but the indications are that such a use pattern occurs in only a very small number of situations.

• Return of nonrefillable container package questioned.

Another comment (16) suggested that, under a deposit law, nonrefillable containers would be returned in their original package so that both containers and packages could be recycled. While it is possible that some paper packaging may be returned in that fashion, it is the opinion of the researchers that the amount would be small for nonrefillable containers, and quite difficult to estimate accurately. In any event, the effect on energy profiles would be small.

M.17 Transportation

• Projected distribution patterns questioned.

Comments on transportation related to two basic issues. One of the most frequently mentioned (12, 16, 17, 21, 26) was the assumption in the study that beverage distribution patterns for 1975 and 1985 were assumed to be essentially the same. Some reviewers suggested that in 1985 the trend to centralization of facilities would increase, while others felt that a return to refillable bottles and rising transportation costs would bring about decentralization. After

further consultation with industry representatives, the researchers felt that the best estimate of 1985 distribution patterns is to assume the same patterns as for 1975.

• Other assumptions questioned.

The other major category of comment (2, 4, 12, 24, 38) concerned the basic assumptions about transportation. The reader is referred to the numerous sections of appendix D where transportation is discussed for revisions which have been made, and for discussion of specific transportation assumptions and data sources.

M.18 Use of Industry Data

• Is questioned.

A basic requirement for this study was to seek the most realistic and representative energy values that can be obtained for selected container systems. Basically, this means the use of one, or some combination, of three types of sources: (1) calculated or design values; (2) statistical data in public documents, such as various census reports; or (3) data supplied by the industries for the specific products under study. The first source is frequently unrealistic and does not reflect actual operating practices. The second source is almost always general in nature and does not allow accurate calculation of specific processes. The third source carries with it the risk of bias. However, the third source is presently the only source capable of supplying accurate data at the level of detail sought and was the source selected by the researchers as being the primary one for the energy values used in this study.

Considerable effort was expended by the research team to receive back-up documentation from industrial sources and to cross-check all data received with other sources. In addition, data from each industry, which appeared in the review draft, were reviewed by their competitors in other industries. The research team is confident that the data received from industry is valid and accurate and represents the industry's best efforts at data development for "business as practical" operating conditions.

• Glass bottle data.

Data for bottle systems were received from the industry's major trade association, businesses, soft drink bottlers, and material manufacturers. Some comments were received (16, 23, 24, 38, 43) challenging various data. However,

after reviewing the data received from the industrial sources, the researchers concluded that, except where revised industry data were received, the original data should not be modified.

One major corporation submitted energy values for soft drink systems based on their own experience (38). However, the values submitted did not seem to be derived on a basis consistent with the data used in this study, so the values were not included. (It was not possible to examine the basis of the data as they were derived from company confidential material).

One comment (34) expressed surprise at a large discrepancy between some values in this report and values from an EPA report (EPA/530/SW-91c). A section has been added (section D.10) to discuss some of the differences between this study and the EPA report. However, the reader should generally use great care in comparing studies to insure that the basic methodology used, as well as the specific containers studied, are comparable. In the case of the specific point made in comment (34), the 5-trip container mentioned was a "special case" calculation where all secondary packaging achieved only one trip.

• Aluminum data.

One reviewer (24) questioned the validity, accuracy, and objectivity of using aluminum recovery data from the Aluminum Association, and the implication was that the metal recovery reported is not only aluminum beverage cans. In fact, this is the only source of data, since it is via industry-sponsored collection centers that aluminum can recovery takes place. The text of appendix H was modified to reflect the fact that small amounts of noncan aluminum are also collected. Industry spokesmen contacted by the authors estimate that up to 5 to 7 percent on a weight basis is from aluminum products other than cans. Care was used to show exactly what the data source was and the basis on which it was expressed. There was no way to validate these data, so they were accepted as accurate, just as were hundreds of other data sources which were reported by industrial sources.

M.19 Energy - Fuel Sources

• Should use component fuel disaggregation.

Several comments (4, 12, 21, 43, 47) were made asserting that the use of component fuels rather than total Btu is the best measure of energy consumption

and questioning the projection of the fuel-use patterns to 1985. The energy data in appendix D are provided in terms of the component fuels for 1974-75, and much of the analysis is carried out in this fashion. However, it becomes impractical to carry out the entire analysis in the summary in this way, so total Btu were selected as a "best" compromise. In addition, the difficulties in projecting fuel-use patterns to 1985 (see section D.3) raise the possibility that total Btu may be the most valid measure for this study.

M.20 Comparison With Other Studies

• Is needed.

As an input to this study, data developed for other studies were used, especially the report: Resource and Environmental Profile Analysis of Nine Beverage Container Alternatives by Robert G. Hunt et al. Some reviewers cited the need for a comparison between the results presented in this and other studies. Section D.10 has been added to appendix D to discuss the differences between the energy values presented here and those presented in the above-referenced report.

M.21 Impacts on Resource Systems

• Method of estimation is questioned.

One basis sometimes advanced for opposing mandatory deposits is that such legislation would tend to reduce the glass, steel, and aluminum content of the solid waste stream, thereby reducing the viability of resource recovery systems. A number of reviewers commented on the approch taken in the draft report to estimate those impacts (2, 17, 40, 44, 45, 49). For this report, the methodology has been substantially revised and is presented in Appendix I.

M.22 Labor Requirements

• Are inaccurate.

An error in the beverage production labor requirements was found by one reviewer (47) and has been corrected.

• Treatment of indirect employment.

Several reviewers questioned the treatment of indirect employment (2, 21, 22, 23, 24, 25, 26). Specifically, the argument was frequently advanced that the estimated indirect employment was not complete since the employment impact of changes in consumer expenditures as consumers shift to nonbeverages was ignored. In this final study, the indirect unemployment estimates are still presented. However, the focus has been shifted to the major direct and indirect employment.

M.23 Estimates of Refillable Bottle Trippage

• Projections are criticized.

NSDA (45) felt that the RTI projected trippage of 5.7 for soft drink refillable bottles in 1985 is biased upward because these projections improperly assume continued deposit increases, whereas deposits cannot economically go above new bottle prices and will probably stabilize before the 1982 period. However, in developing the projections, deposits were assumed constant and only personal income changed.

Regarding trippage with mandatory deposits, both USBA and NSDA (44, 47) believe that trippage will be substantially lower then the projected trippage of refillable bottles under normal conditions. NSDA (45) argues that further declines in trippage as a result of mandatory deposits are very likely, and trippage would be depressed even further to the three-trip range. They substantiate their argument by indicating that convenience-oriented buyers who switch to refillable bottles have higher than average incomes and a lower propensity to return empty bottles than other refillable buyers. Their reasoning may be correct, but they failed to consider another important probable phenomenon for all refillable-bottle systems: that, as correctly suggested by Maryland, if the market share of the refillable bottles becomes larger, the return rate should tend to rise, as the tendency to return containers is dependent on the ability to find a convenient place for returning them. For this final report, however, trippage has been parameterized so that the reader can examine the impact of low trip rates.

USBA (47) has also argued that the off-premise return rate for beer bottles is probably much lower than the current average rate based on an assumed high return rate and market share for on-premise sales. Given the average return rate (0.93) and average trippage (14.55) for the total refillable bottled beer market and an assumed average return rate (0.98) and average trippage (49) for the on-premise market, USBA calculated a 1973 average trippage for the off-premise market using the following equation:

$$0.85(0.98) + 0.15\ (\chi) = 0.93.$$

where 0.85 and 0.15 are the assumed distributions of beer refillable bottle sales attributable to the on- and off-premise markets respectively. The solution of the above equation indicates an off-premise market return rate of 0.655 and a corresponding 1973 average trippage of 2.9.

The value of X is obviously very sensitive to the assumed on-premise return rate. For example, use of the soft drink return rate of 0.898 for off-premise beer sales would imply an on-premise return rate of 0.94. Since there are no independent estimates of return rates for the on- and off-premise beer markets it is questionable how much reliability should be attributed to the 0.98 value.

Second, when one compares USBA's suggested off-premise beer market trippage, 2.9, with the 1973 soft drink refillable bottle trippage, 9.8, the market for which is mostly off-premise, it is difficult to explain why beer off-premise market trippage should be less than one-third the soft drink off-premise trippage rate. Also, most off-premise beer sales in refillable bottles are in case units which one would think would have a high return rate.

Finally, our equation B-31 (page B-27) was estimated using the data series for the period 1956 through 1973. NSDA (45) seems to have obtained a lower R^2 than RTI's because NSDA's data series used the period 1947-1973.

M.24 Aluminum Can Recovery and Recycling

- Price is questioned.

The value of $300 per ton (15¢/lb) for aluminum recovered from resource recovery systems was questioned by two reviewers (9, 14).

The value used was that paid currently by aluminum companies that purchase can scrap from collection centers or operate them. The price is FOB purchase point. In the case of resource recovery systems, the purchase commitments for both the Ames, Iowa, and Milwaukee, Wisconsin, systems are $300 per ton or higher (although depressed market conditions could vary them downward). There is little question that the three major aluminum producers, having expanded recovery programs and facilities to recycle can metal, intend to stay in the business. The prices paid are supportable from an economic viewpoint where the purchase is direct and recycling is to high grade applications.

GCMI (43) questioned the energy conservation possible when aluminum is recycled. The data and approach are covered extensively in another section of the report (appendix D). Cans may be made from recycled can material almost as readily as from virgin materials, according to aluminum industry experts.

M.25 Steel Can Recovery and Recycling

- Impact of technical problems is ignored.

One reviewer (12) asked what the impact would be on ferrous metal recovery rates forecast as a consequence of recent failures of resource recovery plants used for front-end recovery.

It appears that the pace of implementation of resource recovery will slow while technological problems are worked out. However, the critical unit processes required to recover steel are not a deterrent to recovery--shredding, magnetic spearation, and densification of the ferrous metal. In many cases ferrous metals will likely be recovered by independent front-end systems. (26 were in operation at the end of 1975, according to the American Iron and Steel Institute).

The forecast recovery rate (discussed in appendix H) is 12.5 percent in 1985 compared to 5.3 percent in 1980. This forecast is based upon a resumption of resource recovery implementation in the early 1980's.

• Recovery rate is questioned.

Three reviewers questioned whether the recovery forecasts for aluminum for 1985 could be realized since they are quite high by recycling standards and the techniques used (2, 12, 21). One reviewer (34) felt the forcasts of recovery were low, citing their own experience, which is well above the recovery rate shown for 1985.

The recovery and recycling rates for aluminum given in appendix H were actually raised by the researchers after documentation for the year 1975 became available (see section H.2.4). The forecasts were for the baseline case of no mandatory deposit legislation. The Aluminum Association gave estimates of 50-percent "minimum" to 70-percent "possible" recovery by 1985; Coors states a 60-percent rate to be minimal.

The vigor with which aluminum recovery is pursued adds to the expectations of recovery. Therefore, based upon a contribution of the historic trend and some loss of efficiency as the rate of recovery rises, the authors forecast a rate of recovery of 45 percent in 1985 (without deposit legislation). Many geographic areas have recovery rates exceeding this level now. Further, the aluminum industry is placing additional emphasis on recycling as a means to meet demand it cannot fill because new primary metal capacity will not likely be constructed. Unfortunately, there is no firm way to know if the forecast is realistic except to state that it is a best estimate based upon practitioners' more optimistic forecasts and nonpractitioners' more conservative forecasts.

Hannon (17) asked is the energy cost of a special trip to a recycle center is included. It is, and the basis is outlined in appendix D.

The 1985 forecast could be slightly high, but the evidence now is that ferrous-metal recovery will advance faster than resource recovery in general, because of the ability to recovery the metal independently of large recovery plants, as well as in conjunction with their operation.

M.26 Plastic Bottle Recycling

- Impact on recycling of other materials ignored.

One reviewer (49) pointed out that the use of the plastic container will impact on the recycling of glass and, perhaps, metal containers. It was suggested that these impacts be calculated and inserted in the figures on beverage container recovery.

Because the market share of plastics is expected to be in the order of only 5 to 10 percent by 1985 on a volume basis (soft drink principally) the impacts would be relatively low. Another reviewer (46) pointed out that the plastics industry's plan is to recycle bottles. In addition, the energy value could be recovered where resource recovery systems operate.

These factors are fully acknowledged and recognized in the plastic bottle equations of appendix D. However, at this time recovery rates are largely a guess, and, as pointed out above, the total market impact by 1985 will be low. While these factors were not discussed in the main body of the report, they are included in appendix D, and the authors concur that recycling and energy recovery of plastic bottles has a favorable impact on the total energy requirements of the system. Appendix J presents the impacts of alternative plastics market shares on the energy projections.

M.27 Other Issues

A variety of other issues were raised by reviewers which were beyond the scope of this study to evaluate. They included:

- The need for a cost-benefit analysis (29, 40);
- The need for a general equilibrium approach to (a) the entire issue (2, 17, 43), (b) energy analysis (38, 47), (c) consumer expenditures (49), and (d) employment (2, 21, 22, 23, 24, 25, 26);
- The impact on solid waste and litter 1 (24);
- The possibility of a refillable can (4);
- The need for regionalized impacts (43) (Note a regional model is presented in appendix G)

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