SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB)

COMMERCIALIZATION REPORT

PART B -- Analysis of Market Development

Volume II: Technical Report

final report to

FEDERAL ENERGY ADMINISTRATION

TASK FORCE ON SOLAR ENERGY COMMERCIALIZATION

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SOLAR HEATING AND COOLING OF BUILDINGS (SHACOB) COMMERCIALIZATION REPORT

PART B – ANALYSIS OF MARKET DEVELOPMENT

VOLUME II – TECHNICAL REPORT

FINAL REPORT

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PREFACE

The Energy Conservation and Production Act (PL 94-385) authorizes the Federal Energy Administration (FEA) to "provide overall coordination of federal solar energy commercialization activities" and "to carry out a program to develop the policies, plans, implementation strategies, and program definitions for promoting the accelerated utilization and widespread commercialization of solar energy." The Congressional conference report listed several specific actions desired by the Congress including (among others):

- Develop a national plan for the accelerated commercialization of solar energy to include workable options for achieving on the order of 1 million barrels per day of oil equivalency in energy savings by 1985 from a combined total of *all* solar technologies;*
- Develop commercialization plans for *each* major solar technology;
- Conduct studies and analyses addressing mitigation of economic, legal, environmental, and institutional constraints.

In essence, the "National Plan . . . for *all* solar technologies" will be comprised of the combination of "commercialization plans for *each* major solar technology." Analyses of costs, benefits, and strategy options for each of the technologies can be placed in context, coordinated and optimized into an overall commercialization plan for solar energy.

The SHACOB Commercialization Report (PARTS A and B) is the first step toward development of a SHACOB Commercialization *Plan.* PART A, prepared by Midwest Research Institute under FEA Contract No. CR-05-70065-00, addresses *qualitatively* the potential barriers to and incentives for the accelerated commercialization of SHACOB in the residential and commercial sectors. It represents a summary and synthesis of a large amount of recently completed research on all aspects of the market development of solar heating and cooling. PART B, prepared by Arthur D. Little, Inc., contains *quantitative* analyses of the market penetration and the costs and benefits to the government associated with some of the incentives examined in PART A.

The SHACOB Commercialization Report relates closely to the President's proposed National Energy Plan (NEP) in that it analyzes a large number of incentives in terms of their impact on barriers to commercialization, their impact on income and interest groups, and possible administrative mechanisms. The impacts of incentives contained in the NEP are analyzed and compared to the present research, development and demonstration programs, an expanded NEP, and new initiatives.

* Major solar technologies include: solar heating (including hot water) and cooling of buildings — SHACOB, agricultural and industrial process heat, wind energy conversion systems, photovoltaics, fuels from biomass, solar thermal, and ocean thermal energy conversion.

PART B is divided into three volumes. Volume I contains the executive summary, while the technical report makes up Volume II. Volume III contains appendices which support the technical discussions in Volume II.

PART B was prepared by Arthur D. Little, Inc., under FEA Contract No. CR-05-70066-00. The principal authors are Martin Glesk (Project Leader), Charles Giersch, Richard Goodale, Deborah Harrity, Brian Huckins and Scott Nainis. Members of the Federal Energy Administration's Task Force on Solar Energy Commercialization include Norman W. Lutkefedder (Director), Samuel J. Taylor (Deputy Director), Howard L. Walton, Charles Allen, Richard D. Stoll, Howard Magnas, LaVerne P. Johnson, Robert Grubenmann, I-Ling Chow, Stanly Stephenson, Edward Downey, Mike Kutsch, Elaine Smith, Robert Jordan, Jeffrey Milstein, Margaret Sibley, Sally Mott, Ned Dearborn, James H. Berry, Mary Liebert, and Jack Koser.

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CHAPTER 1
METHODOLOGY

The SHACOB Commercialization Model is designed to gauge the impacts of selected Federal incentive programs to encourage the development of solar energy equipment for hot water heating, space heating and space cooling in residential and commercial buildings. The model has been implemented as a FORTRAN program and is presently running on the FEA computer system, and is used via the SUPER WYLBUR data management system at FEA.

The SHACOB Model represents an integrated approach for developing reasonable estimates of the magnitude of the market acceptance and impact of solar heating and cooling technology as presently conceived to be available over the 1977-1990 time horizon. The approach is integrated because it simultaneously considers all relevant residential and commercial market sectors, can distinguish among regional areas, and simulates the dynamics inherent in the process of solar energy technology introduction.

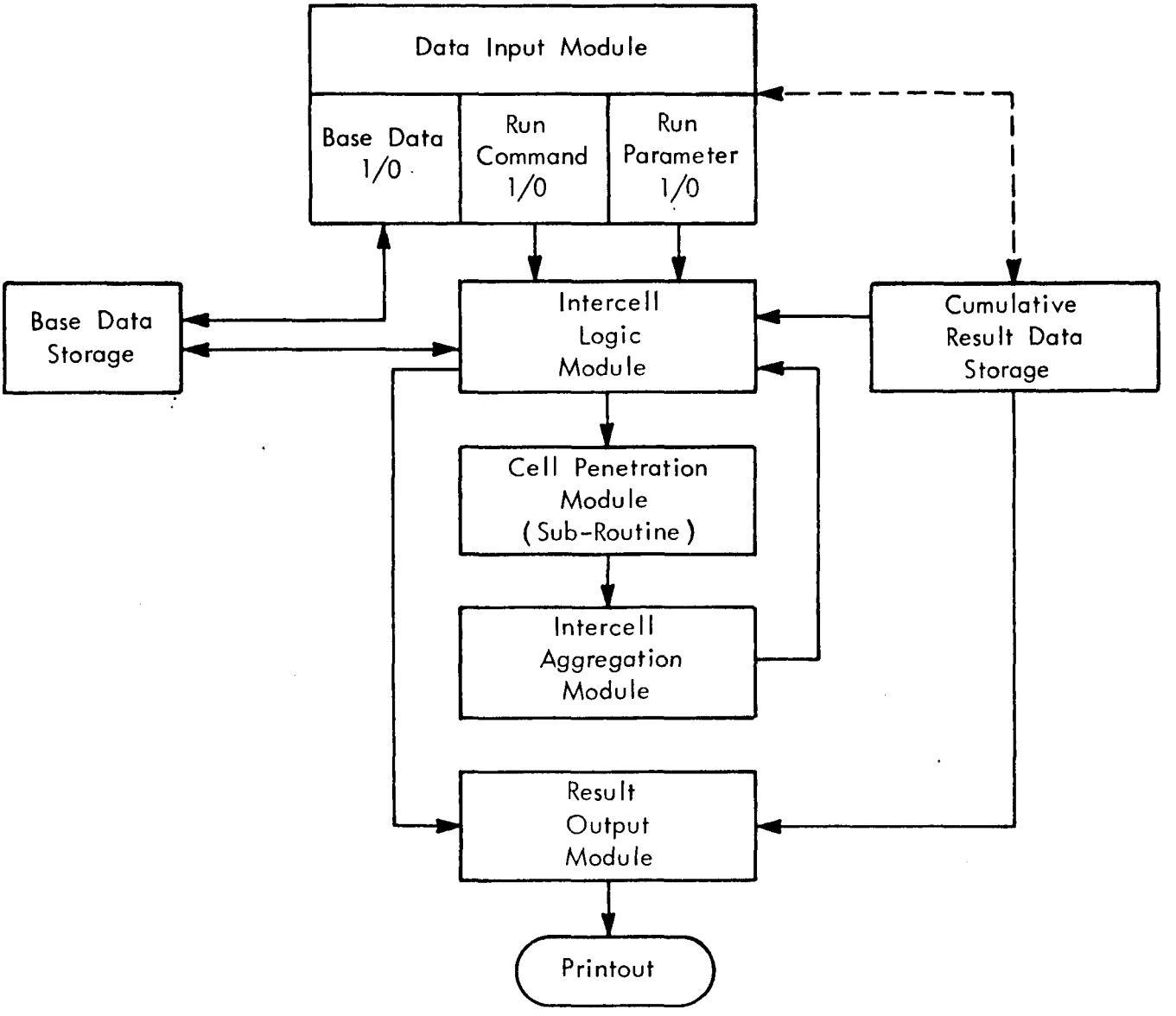
The model is designed to run with 10 different categories of market/building types; for the 10 FEA regions; and for the 14-year period of 1977 to 1990. For each of the 10 market/building types the analyses are conducted for both the new buildings and the existing buildings (retrofit).

Figure I-1 is a block diagram of the overall structure of the model computer program. The program is designed as a series of interacting modules, comprising several subroutines each serving a specific function. At the heart of the model is the cell penetration module, within which the market penetrations for solar energy devices are calculated for each particular year, market and building type and region. A large portion of the logic associated with the important market variables resides in the penetration module.

For execution, the model requires a large amount of data, much of it projections of building markets and fuel prices over the 1977 to 1990 time frame. Generally, these types of data will not change from run to run and are entered onto a large data file maintained under the SUPER WYLBUR file system. Other data required to execute the program include command and parameter inputs. Command inputs direct the model to be executed for various regions, years and markets; command inputs are used to direct the format in which results will be printed. Command inputs also indicate which Federal incentives will be considered when and for which market/building types.

Parameter inputs include the levels of the incentive programs (tax credit percentage, investment limits, etc.) and other parameters relating to the weighting or importance of certain effects in the model. In the model these parameters are either reset for each computer run or are defaulted to values already within the data base.

The penetration cell considers the degree of market penetration, i.e., the fraction of the cases where solar devices could have been chosen and were. The actual penetration is considered separately for each of the basic fuels, energy load applications, and HVA/C equipment against which solar heating and cooling devices are to compete (at least for satisfying some fraction of the anticipated load).



Source: A. D. Little, Inc.

FIGURE I-1 SHACOB COMMERCIALIZATION MODEL SUBSTRUCTURE

The economics of solar systems (hot water only; heating and hot water; and cooling, heating and hot water) are thus separately estimated when applied in conventional gas, oil and electric heating, hot water and cooling systems and heat pump systems. The operating costs savings depend upon not only the building type but also the fuel, energy load, and HVA/C equipment against which solar energy is competing.

The separate penetration cells (region by market/building type by year) are linked together by the Intercell Modules. Within the computer program these modules preprocess the data used within the Cell Penetration Model such as the solar device costs and the individual market response functions or penetration curves. The results of the Cell Penetration Module are aggregated by the Intercell Modules in order to accumulate total solar device experience, which is used to influence both production costs and market behavior.

During execution of the model the important results, such as the energy saved, the square feet of collector installed, the cost to government, etc., are aggregated for summary printout at the end of execution.

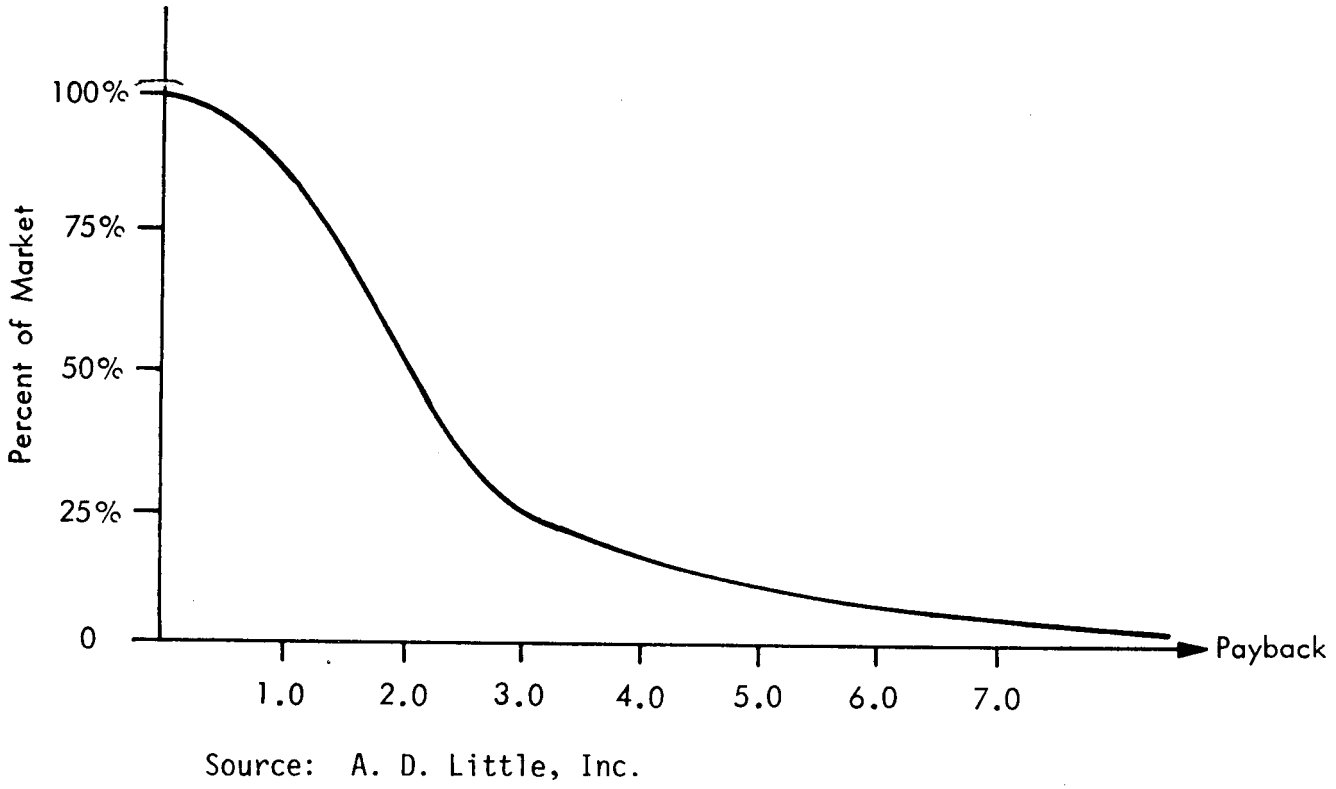
The philosophy of the model is to simulate the expected behavior of potential solar energy purchases in an integrated framework which projects the probable economic situation under which the decision will be made. The model is in this sense a balance between normative and descriptive, i.e., it describes what the purchaser ought to do under the circumstances he would be faced with. The fact that a probabilistic or statistical mapping is made between device performance (i.e., economic payback and utility function or market attitude) indicates that a range of attitudes is being described.

An important feature of the model is its degree of comprehensiveness. All markets are considered simultaneously. Total experience in the solar heating and cooling marketplace is needed to run the model. From this point of view it becomes important to run the entire model at once. The results of one year materially affect the next; initial assumptions are required by the model in order for it to be run.

PENETRATION CURVES

The central component upon which the solar device impacts are estimated is the penetration curve. The penetration curve is a market-oriented response function which indicates the percentage of building/market type decisions in which a solar device will be chosen for installation. The major independent variable is the financial parameter of undiscounted device payback period. Payback is simply the ratio of device installed first-cost to net annual cost savings associated with the device. Figure I-2 represents a typical penetration function expressed in relation to payback. The penetration curve of Figure I-2 illustrates that with a 2.0-year payback period, in 50% of the situations where a solar device could be chosen it would be.

The relatively simple economic performance measure of payback was chosen over other more sophisticated economic measures such as life-cycle cost because payback is the function most often used by decision-makers in the building markets to determine the acceptability of any particular investment. Life-cycle cost provides a more thorough consideration of the factors which should ultimately influence the economic performance of solar systems, but this "better" determinant is not commonly used in making the purchase decision.



Source: A. D. Little, Inc.

FIGURE I-2 PENETRATION CURVE

The development of a market penetration curve is ultimately an empirical task. Available data are not adequate to construct a market penetration curve for most building sectors, mainly because the exposure to solar energy technology has been small. Curves can only be developed from historical information and so will never directly apply to estimating market response in the future. For this reason, market penetration curves are theoretically postulated, and are calibrated against near-term and benchmark market developments.

Complete calibration of market penetration curves could only be performed by having enough historical information on solar system sales to project a very wide range of penetration levels (e.g., 0.01% to 75% "penetration"). The general approach would be to develop an "attractiveness function" which correctly weights all the objective and subjective (somehow quantified) characteristics of the technology. Historic experience would be used to determine the relative penetrations of alternative devices (i.e., percent of market). These relative percentage penetrations would then be compared against the relative attractiveness levels of the alternative devices. It is possible to fully calibrate a penetration curve for solar devices in this manner, but this type of research activity is time-consuming and difficult at present because nearly all historical decision situations with respect to heating and cooling technology differ from solar technology. As such they are difficult to relate to solar technology. Our effort has been to use both our experience and intuition to develop a curve which we calibrate at the "low end" from most recent solar energy market information.

The basis for postulation of the penetration curves is involved with the spectrum of rates-of-return on investment deemed necessary by the particular class of decision-makers in that market. The rate-of-return expected generally will be higher in situations where the technology is not well-proven within that building/market type and the decision-makers have little or no experience with solar energy devices. Many individuals will shy away from solar energy and require large rates-of-return on their investment to pursuade them to decide in favor of solar energy. Figure I-3 indicates two separate market penetration curves which bound the range of market acceptance as it varies with market experience. Experience is expressed as a function of the level and cumulative volume of solar heating and cooling device sales. The curve on the left is the initial, or low-experience-level, curve; whereas, the curve on the right is the final, or high-experience-level, curve. The initial curve represents the penetration curve in effect when solar energy experience is low. As experience increases, the effective curve tends to move toward the final curve.

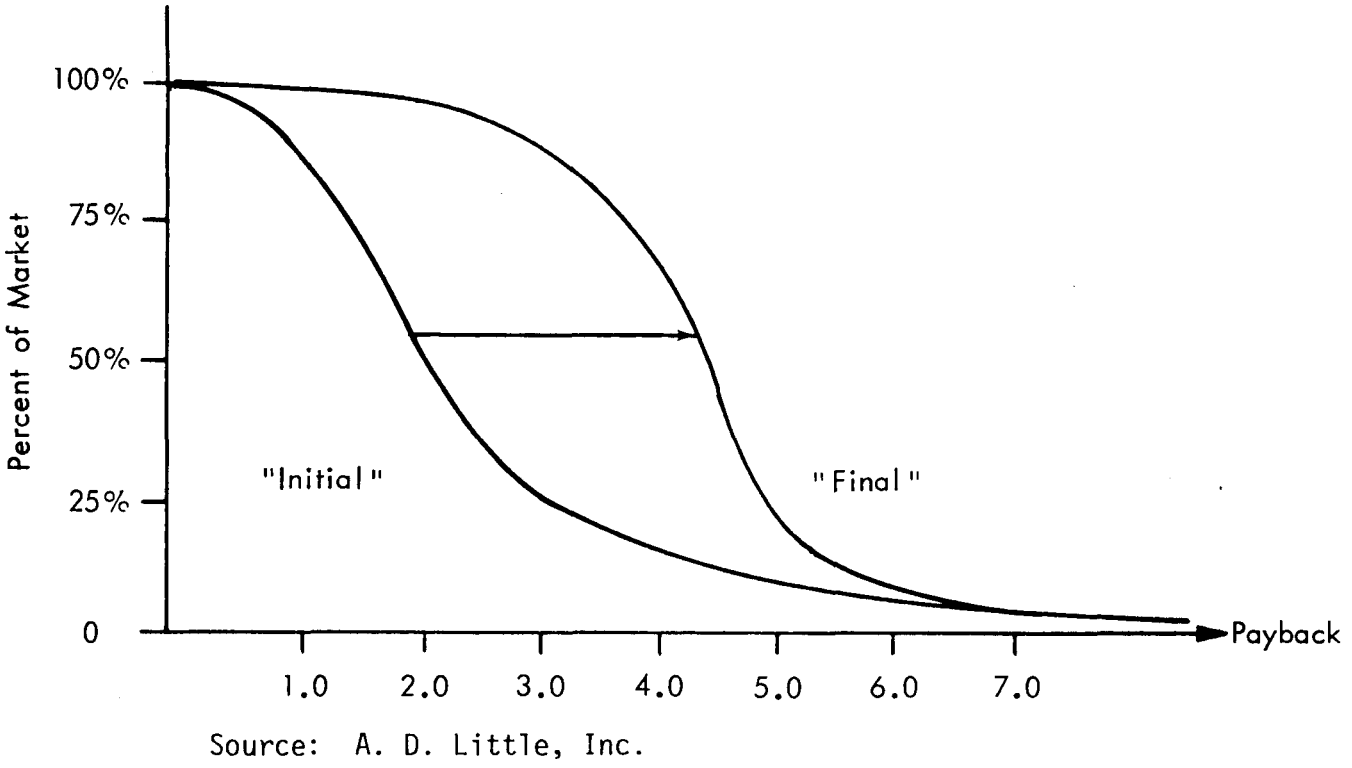


FIGURE I-3 PENETRATION CURVE, "FINAL" AND "INITIAL" CONFIGURATIONS

From the point of view of economics, the final curve is the economically rational curve; the initial curve reflects an uneconomic point of view. The shape of these curves will vary among market sectors and as a function of time.

The transformation between the two penetration curves serves to describe a market which grows more rapidly as the market magnitude increases. This growth represents the first inflection of the "S-Shaped" or logistics curve nature of innovative technology growth. The second, or flattening of the solar heating and cooling growth, scenario is very likely to be considerably beyond the 1990 time horizon.

Penetration is not only affected by the financial performance of the solar devices. In addition to their financial attributes, solar devices have characteristics which are non-financial in nature and rate their ability to fulfill ancillary secondary functions. These non-financial characteristics include the device esthetics, space requirements, reliability (from a non-financial point of view), non-polluting nature, noise and convenience.

According to this class or category (connected to the choice of solar energy devices within the market sectors) the various decision-makers would give different weighting or importance to the range of solar device characteristics — both financial and non-financial. For any market sector the importance of the decision-makers within the decision must also be considered. The classes of decision-makers which may be important to the decision include the developer, owner, architect/engineer, bank officer, municipal official, et cetera. By mapping the decision-makers' characteristic weights against the decision-maker weight in the decision, the importance of each characteristic of the device is rated as a percentage of the total.

In the penetration logic it is postulated that non-financial characteristics can affect the penetration of solar devices. The mechanism for effecting this influence is to establish a trade-off between the financial variable of payback (PB) and the composite weighted rating of the non-financial characteristics referred to as the non-financial utility (UTIL). The concept of "utility" has been developed and investigated by economists and social scientists to represent quantitatively the value decision-makers place upon those characteristics of choice-options which are typically non-monetary or difficult to quantify. The rating of each non-financial characteristic can vary between + 1.0 and -1.0; a level of 0.0 implies a level equivalent to conventional systems. A + 1.0 indicates the highest level that characteristic could attain; whereas, a -1.0 indicates the worst possible level. Because 1/PB = FOM (figure-of-merit) ranges from a level of 1.0 (or more if PB < 1.0) down to 0.0 (as PB goes to $+\infty$), the UTIL value is used to adjust or trade off 1/PB and UTIL. A scale factor of 0.1 is used to reduce the effect of the UTIL rating by a factor of 10:1. A factor of 2:1 exists in implied range of UTIL being between [-1,+ 1]. The 5:1 factor on the effect of UTIL is introduced to allow the penetration only a 20% range change in PB assuming a W_{PB} of 0.5. If W_{PB} is the relative weighting of PB (and $[1-W_{PB}]$ is the relative weight of UTIL) then the payback adjusted for UTIL non-zero is:

$$\text{Adjust Payback} = \text{APB} = \frac{W_{PB}}{\frac{W_{PB}}{PB} + (1 - W_{PB}) * \text{UTIL} * 0.1}$$

Note: when UTIL = 0.0,APB=PB.

The penetration curve is used with the adjusted payback (APB) in place of the unadjusted payback (PB).

Present penetration of the solar energy market is greater than would be predicted by the present solar energy conventional fuel economics and the near-term penetration curves. The model logic assumes that these higher-than-predicted penetration levels are due to the non-financial attractiveness of solar energy for space heating and hot water heating. The utilities are adjusted for each market — both new and retrofit and for each solar device in order to match the best estimates of the solar heating and cooling market for 1977.

The weighting term between financial (payback) and non-financial (UTIL) device characteristics is set by the level of W_{PB}. W_{PB} can change over time to indicate a shift in the relative importance of the two types of device performance characteristics.[1]

As experience with solar energy devices increases, the influence of the "final," more-experience curve is felt. The utilities (or non-financial characteristics) are related to both the "initial" and "final" penetration curves. The utilities associated with the "final" curve can be set different from the "initial" curve utilities in order to reflect a belief that consumer perception will change as greater experience is reached. The heating and space cooling solar devices, for example, can be represented by a utility which is considerably larger in association with the "final" penetration curve than for the "initial" penetration curve.

The penetration curves of Figure I-3 represent the percent of consumers that would opt for a solar energy device in lieu of 100% reliance on their conventional fuel/firing system. When the choice among multiple solar devices is made, then there must be a method to allocate the penetration among the devices.

The method used to allocate the penetration of each solar device — hot water only; hot water and space heating; and hot water, space heating, and space cooling — is based upon the "market share theorem."[2] In order to describe the approach consider the penetration curve of Figure I-4.

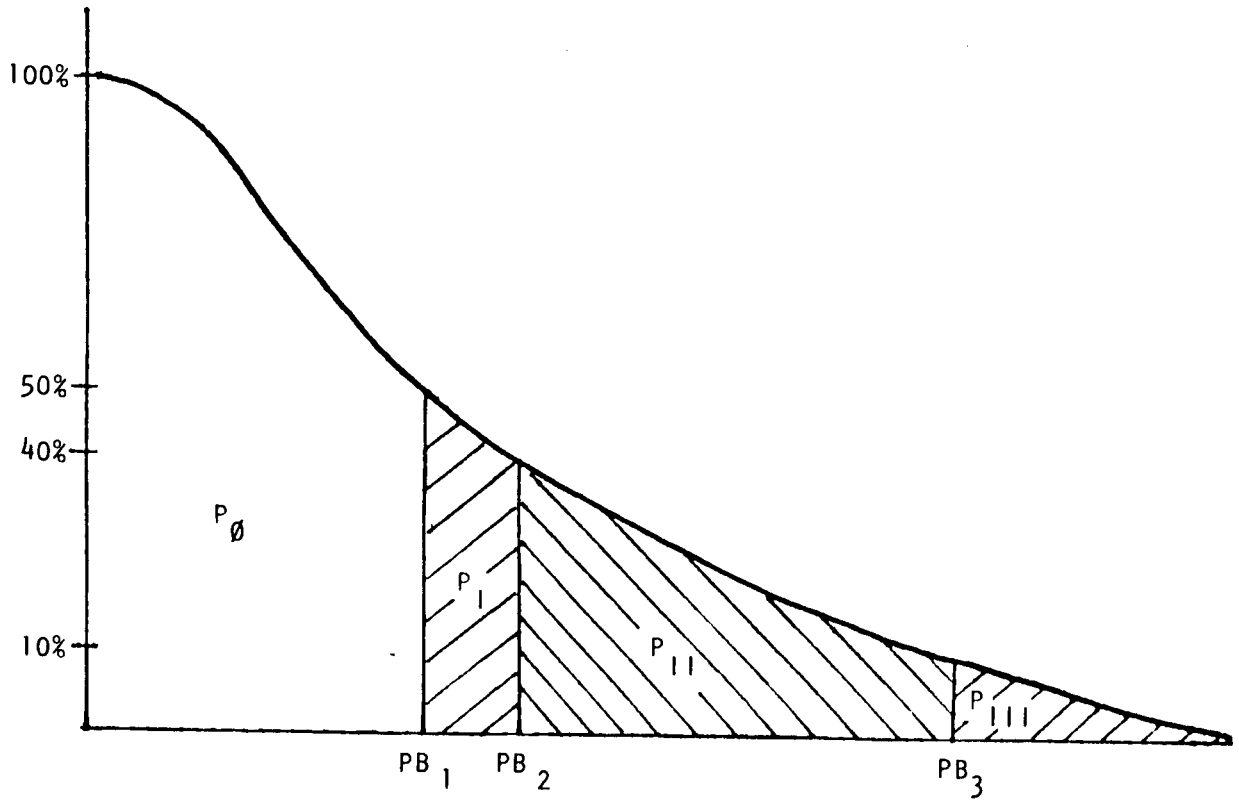


FIGURE I-4 PENETRATION CURVE

1. The model is presently run using a set of W_{PB}'s which gradually shift to the financial weighting side as time progresses.

2. See David Bell, et al., "A Market Share Theorem," *Journal of Marketing Research* Vol. XII (May, 1975), 136-141.

Figure I-4 provided an illustration of penetration levels versus PB. The total area under the shaded "tail" of the penetration curve in Figure I-4 represents 50% of the possible market. Notice that this 50% area is composed of three segments: P_I, P_{II}, and P_{III}. According to the interpretation given to the penetration curve, the meanings of each of these areas are as follows:

- P_I — These decision-makers will only choose device 1; they are not interested in devices 2 and 3.
- P_{II} — These decision-makers will choose either device 1 or device 2, and are not interested in device 3.
- P_{III} — These decision-makers will choose either device 1, 2, or 3.

The area P ϕ represents all decision-makers who will choose none of the three solar devices. In the case of areas P_{II} and P_{III}, the decision-makers will choose one of two or one of three devices. The allocation of these choices can be made using the "market share theorem," as follows:

If the three choices have "attractiveness" a_1, a_2, a_3, then the fraction f_i that choose i= 1, 2, 3 is:

$$f_i = \frac{a_i}{a_1 + a_2 + a_3} \text{, where } i = 1, 2, \text{ or } 3$$

An appropriate proxy for attractiveness in the case of the solar device market is the figure-of-merit (FOM), which is equal to 1/PB. Using the market shares approach for allocating choices, the illustrative penetrations P_I, P_{II} and P_{III} can be determined as in Table I-1.

Table I-1 indicates that the resulting penetrations of devices 1, 2 and 3 are 31.85%, 16.39% and 1.76%, respectively.

EXPERIENCE EFFECTS

It is generally recognized that as both producers and consumers become more familiar with the installation and use of new equipment (i.e., solar heating and cooling devices), the acceptance of the equipment increases. This will occur for two reasons: (1) the cost of manufacturing and installation in constant dollars will decrease as more units are built and the industry grows; and (2) the purchaser of the equipment will become more familiar with its operation and reliability and will perceive the use of the equipment as less risky and more convenient. Thus, experience affects the way in which both the supply and demand market respond to incentives and device economics. Generally, experience is considered to be the total national square feet of solar device installation on either an annual production or a cumulative-production basis. It is also possible to have experience measured as a combination of both annual and cumulative production experience. It is possible to consider another component of experience which is specialized to specific market building type and regional area. Total experience would be a combination of market/regional experience and national square foot experience.

A convenient way to describe experience is in the form of a ratio; i.e., the ratio between present or initial (for a future starting year) and the level of experience for each future year in the model run. National experience, EXP_N is calculated as shown in Equation 1.

TABLE I-1

RESULTS OF MARKET SHARE ALLOCATION LOGIC

Penetration Region	θ	Allocated To: Device 1	Device 2	Device 3
P_φ = 50%	50%	0%	0%	0%
P_I = 10%	0%	10%	0%	0%
P_{II} = 30%	0%	$30\%\left(\frac{\frac{1}{PB_1}}{\frac{1}{PB_1}+\frac{1}{PB_2}}\right)$ = 17.14%	$30\%\left(\frac{\frac{1}{PB_2}}{\frac{1}{PB_1}+\frac{1}{PB_2}}\right)$ = 12.86%	0%
P_{III} = 10%	0%	$10\%\left(\frac{\frac{1}{PB_1}}{\frac{1}{PB_1}+\frac{1}{PB_2}+\frac{1}{PB_3}}\right)$ = 4.71%	$10\%\left(\frac{\frac{1}{PB_2}}{\frac{1}{PB_1}+\frac{1}{PB_2}+\frac{1}{PB_3}}\right)$ = 3.53%	$10\%\left(\frac{\frac{1}{PB_3}}{\frac{1}{PB_1}+\frac{1}{PB_2}+\frac{1}{PB_3}}\right)$ = 1.76%
Total Curve	**50%**	**31.85%**	**16.39%**	**1.76**

$$EXP_N = \text{NATIONAL EXPERIENCE} = \alpha\frac{A}{A_o} + (1-\alpha)\frac{C}{C_o} \qquad (1)$$

where:

- A = level of annual solar device sq. ft. installed — nationally;
- A_o = level of initial annual solar device sq. ft. installed — nationally (e.g., 1976);
- C = level of cumulative solar device sq. ft. installed — nationally;
- C_o = level of initial annual solar device sq. ft. installed — nationally (e.g., 1976); and
- α = annual/cumulative experience weighting factor.[3]

In a similar manner the specialized region and market experience, $EXP_{M/R}$, can be described as the ratio of present to initial market penetration, as shown in Equation 2.

3. In the present runs it is assumed that the national experience is effectively represented by annual production; i.e., $\alpha = 1.0$.

$$\text{Market/Region Specific Experience} = EXP_{M/R} = \frac{PENE}{PENE_0} \quad (2)$$

where:

PENE = last year's market penetration; and

$PENE_0$ = initial year's market penetration (e.g., 1976 starting in 1977).

The experiences — both national and specific — are used to calculate solar device costs per square foot and the degree to which the "initial" or "final" market penetration curves are to be used.

Total experience can be developed by combining national experience, EXP_N, and market/regional experience, $EXP_{M/R}$. Equation 3 indicates the expression for total experience.[4]

$$EXP_{TOTAL} = \gamma\, EXP_N + (1 - \gamma)\, EXP_{M/R} \quad (3)$$

where:

γ = weighting factor

In order to select between the "initial" and the "final" penetration curve a weighting function, driven by total experience, EXP_{TOTAL}, is required. Figure I-5 represents the functional form of weighting which starts at 1.0 when $EXP_{TOTAL} = 1.0$ (initial experience level) and drops to 0.0 as experience becomes large. The equation for the penetration curve weighting factor $\mu\,(EXP_{TOTAL})$ is:

$$\mu\,(EXP_{TOTAL}) = e^{-K_M(EXP_{TOTAL} - 1.0)} \quad (4)$$

where:

$\mu\,(EXP_{TOTAL})$ = penetration curve weighting factor;

K_M = market response experience constant; and

EXP_{TOTAL} = total solar energy experience level.

K_M determines how rapidly the market will approach the final penetration curve behavior as experience increases.

The penetration curve for any level of experience EXP_{TOTAL} is represented by Equation 5.

$$PENE(EXP_{TOTAL}; APB) = \mu(EXP_{TOTAL}) * PENE_{INITIAL}(APB) + (1-\mu) * PENE_{FINAL}(APB) \quad (5)$$

4. For the present model runs the weighting factor γ has been set to 1.0 to reflect weighting on national experience only.

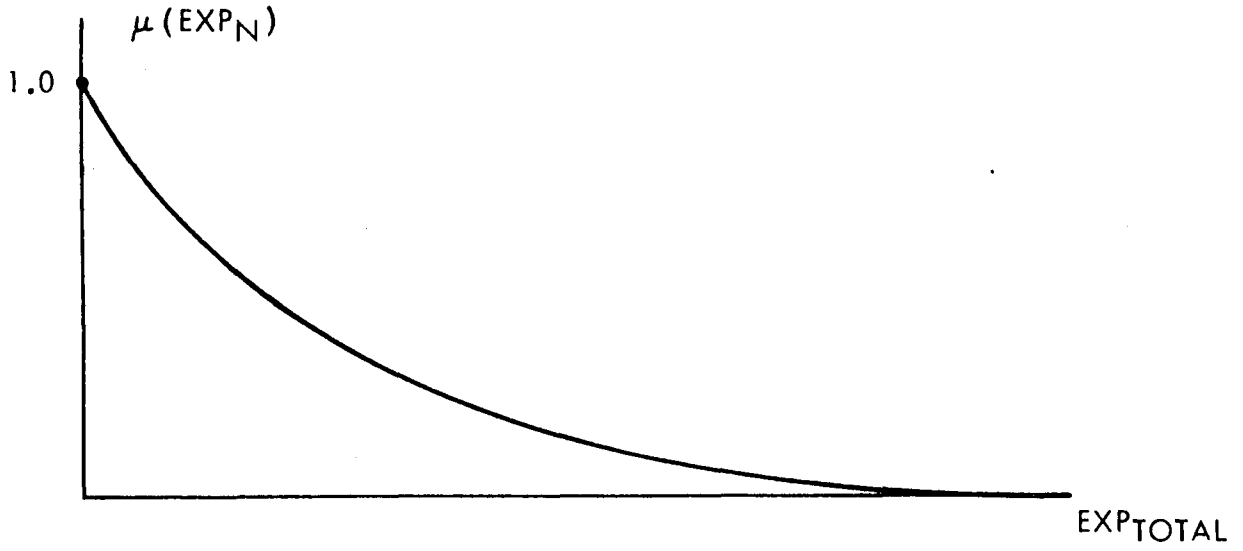


FIGURE I-5 RELATIONSHIP BETWEEN TOTAL SOLAR ENERGY EXPERIENCE AND MARKET PENETRATION

The actual penetration can be seen (in Equation 5) to relate both to the level of experience and the adjusted payback (APB). Adjusted payback is, however, also affected by experience through the effects of experience upon solar device total installed costs. The per-square foot installed solar device costs are represented by the function:

$$C_{SF} = \text{COST/SQ FT} = C_A + C_B\,(SF) - C_N \tag{6}$$

where:

C_{SF} = unit cost in dollars per square foot;
C_A = production cost component;
C_B = installation cost component;
S_F = size of unit in square feet; and
C_N = installation cost exponent.

The values of C_A and C_B are postulated to drop to a minimum lower bound constant dollar cost level as a function of national and market/region experience. Figures I-6 and I-7 graphically display the relationships. The relationship between experience and cost coefficients are depicted in Equations 7 and 8.

$$C_A = C_{A_{MIN}} + \left(C_{A_\phi} - C_{A_{MIN}}\right) e^{-K_A(EXP_N - 1.0)} \tag{7}$$

$$C_B = C_{B_{MIN}} + \left(C_{B_\phi} - C_{B_{MIN}}\right) e^{-K_B(EXP_{INSTALL} - 1.0)} \tag{8}$$

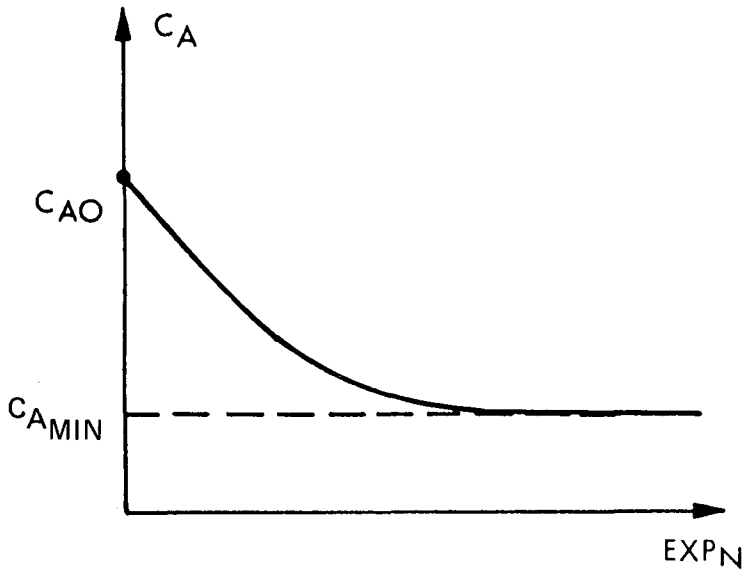


FIGURE I-6 RELATIONSHIP BETWEEN PRODUCTION COST COMPONENT AND NATIONAL EXPERIENCE

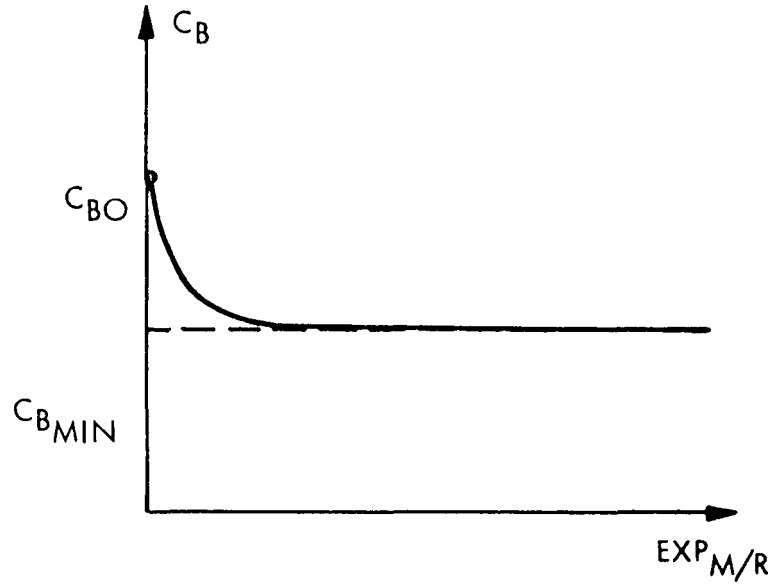


FIGURE I-7 RELATIONSHIP BETWEEN INSTALLATION COST COMPONENT AND MARKET/REGION EXPERIENCE

Equation 7 indicates that the constant term C_A is driven by national experience EXP_N, because it relates mostly to production costs. Equation 8 indicates that the variable term coefficient C_B is driven by $EXP_{INSTALL}$ because it relates to installation experience. $EXP_{INSTALL}$ is presently configured as:[5]

where:

$$EXP_{INSTALL} = \beta\, EXP_N + (1-\beta)\, EXP_{M/R} \tag{9}$$

β = weighting factor.

The form of $EXP_{INSTALL}$ considers the important determinants of installation experience. The cost per square foot of installed collector C_{SF} drops to a minimum value as experience increases. The general phenomenon illustrated represents the familiar "learning curve" effect. The response of decreasing costs with increased experience is typical of most learning curve approaches and many learning curve models assume no minimum value for declining costs. The "experience function" of the model differs from a learning curve approach in that it postulates a minimum value for C_{SF}.

5. Existing runs made with β = 1.0.

CHAPTER II
DATA BASE ELEMENTS

There are two major and interactive components of computer modeling: methodology and input assumptions. Methodology must be logical and flexible, and can be precisely developed to generate a specified output. Input assumptions, on the other hand, may reflect a high degree of uncertainty over a wide range of variables. The SHACOB Model is based on assumptions as to the present and future economic and technical aspects of solar commercialization, and its results must be interpreted with an understanding of the uncertainty associated with those variables. This chapter discusses the origin of the major economic and technical data base elements used in the model, and highlights projected trends of these elements over the time frame of this study.

The major economic inputs to the model are residential and non-residential building inventory, projected construction activity, conventional fuel prices and fuel availability. In the technical segment, data base elements include building classifications, building loads, solar collector costs and collector efficiencies. The model has been calibrated to reflect 1977 values for these variables, and provides the reference case on which projections for future activity are based. With a reference case established, it is possible to test the sensitivity of important variables against a constant base. (See Chapter V for results of sensitivity analysis.)

While this discussion will concentrate on data at the national level, the SHACOB Model data base includes a complete breakdown of all data items to each FEA region. (Figure II-1 outlines the geographical makeup of these 10 FEA regions of the United States.)

ECONOMIC DATA BASE ELEMENTS

Residential Inventory and Projections

The following are the basic definitions of residential units used throughout this study:

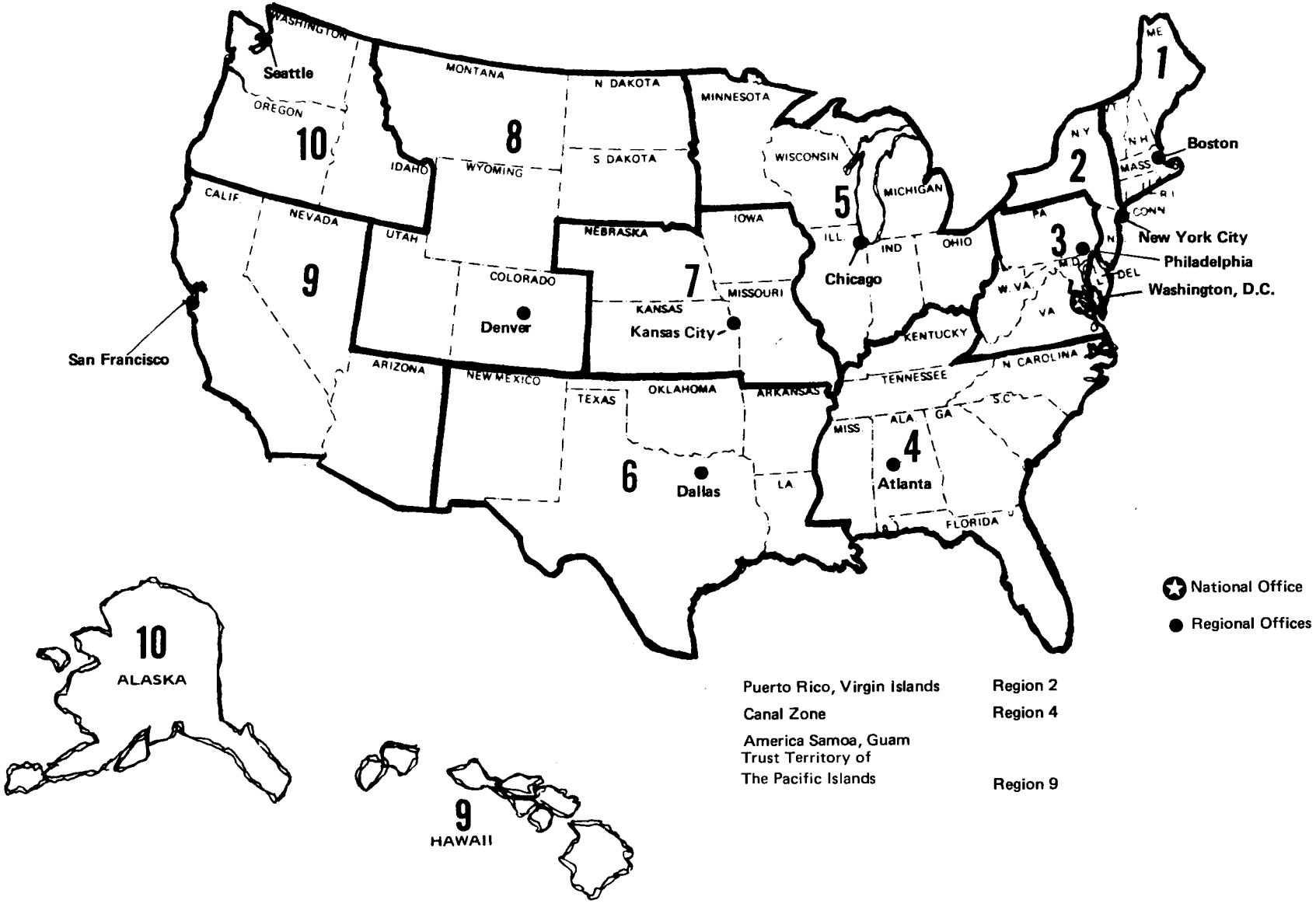
Single family: one-unit detached structures;
Low density: one-unit attached, two- to four-unit structures;
Multi-family: low rise and high rise multi-unit (five or more) structures occupied by renter or owner;
Mobile Homes: owner-occupied units.

These four categories were used to group residential inventory by similar physical characteristics (i.e., building energy demands). In order to measure market acceptance more precisely, however, the multi-family category was further split into condominiums and apartment houses to properly reflect the two different decision makers involved with the one physical building type. Apartment houses, for example, are afforded commercial fuel rates, and are not eligible for residential tax credits.

The inventory of residential buildings as of December 31, 1976, was estimated from the *1970 Census of Housing* and from the *Annual Housing Survey: 1973,* published by the U.S. Census Bureau and the Department of Housing and Urban Development, respectively.

FIGURE II-1

FEDERAL ENERGY ADMINISTRATION – REGIONS



Puerto Rico, Virgin Islands	Region 2
Canal Zone	Region 4
America Samoa, Guam Trust Territory of The Pacific Islands	Region 9

The 1976 residential inventory was broken into the 10 FEA regions using Bureau of Census data as well as internal Arthur D. Little estimates. In each year of the study period, the model was designed to assume 10% of the existing residential inventory as available for the potential solar retrofit market.

Residential housing forecasts were based in part on the report to CEQ/FEA, *Residential and Commercial Energy Use Patterns, 1970-1990,* updated by inputs from Arthur D. Little's on-going inhouse input-output economic model. In order to derive forecasts for the 10 FEA regions, current projections were applied to gross migration trends, fertility rates, and other socio-economic factors. Table II-1 illustrates the national residential housing stock projections for 1977, 1980, 1985, and 1990. Table II-2 depicts the trends in new residential activity; single-family construction will lose some ground as the more land efficient low-density and multi-family housing stocks rise faster proportionally.

Nonresidential Inventory and Projections

In the context of this study, the non-residential market consists of commercial construction excluding industrial and agricultural activities. As with the residential sector, we have delineated building classes (i.e., those types of buildings from an energy requirement standpoint resembling each other). A further division of these building classes into market types was made to acknowledge the different decision-making process that is applicable to an owner-occupied unit as opposed to an owner/lessor unit. Table II-3 details the non-residential building/market categories and outlines the major subdivisions of each.

As has been pointed out in many studies, there are no published data on the inventory of commercial and institutional structures. Using previous studies by Arthur D. Little (specifically the CEQ/FEA report and other related private Arthur D. Little case work), figures for national 1976 non-residential building inventory were developed. To break this national building stock down into the 10 FEA regions, a variety of allocation bases were used, including personal income, population, hospital bed counts, general revenues by state, and GSA inventory reports of governmental buildings. As direct input, note that all non-residential construction activity is expressed in millions of square feet, rather than units as in the residential sector, an accepted practice due to the great variety of non-residential building types, sizes and end uses. As with the residential inventory market, annual commercial removals were estimated on a national and regional level, and 10% of this net yearly inventory was used to represent the potential solar retrofit market in any one year.

Non-residential commercial and institutional construction were projected on the basis of trend analysis techniques, supplemented by judgments regarding the impact of present and possible future events. Commercial buildings were projected on the basis of real personal income forecasts while institutional buildings were projected on the basis of historical time trends (adjusted for such abnormalities as the post-war baby boom and the subsequent educational construction surge). Table II-4 shows the new commercial and institutional building activity projected from 1977 through 1990; Table II-5 summarizes the trends in new commercial and institutional construction during this period.

Fuel Prices

The uncertainty regarding the future movement of fuel prices is based on variability in supply, demand and regulation.

TABLE II-1

RESIDENTIAL BUILDING STOCK

1977 - 1990

(000's Units)

	1976 Inventory	1977-1980 Additions	1977-1980 Removals	Activity 1980 Stock	1981-1985 Additions	1981-1985 Removals	Activity 1985 Stock	1986-1990 Additions	1986-1990 Removals	Activity 1990 Stock
Single Family	49,175	4,319	720	52,774	5,475	900	57,349	5,790	900	62,239
Low Density	10,984	742	160	11,566	1,142	200	12,508	1,435	200	13,743
Multi-Family	12,538	1,369	180	13,727	2,088	225	15,590	2,275	225	17,640
Mobile Home	3,847	1,175	180	4,842	1,795	225	6,412	1,940	225	8,127
Total	76,544	7,605	1,240	82,909	10,500	1,550	91,859	11,440	1,550	101,749

Source: Bureau of Census, Department of Housing and Urban Development, and Arthur D. Little, Inc. estimates

TABLE II-2

TREND IN RESIDENTIAL NEW CONSTRUCTION MIX
1977-1990

	Percentage Distribution of New Construction By Housing Type			
	1977	1980	1985	1990
Single Family	60%	53%	52%	50%
Low Density	10	10	11	13
Multi-Family	17	20	20	20
Mobile Home	13	17	17	17

Sources: Arthur D. Little, Inc., estimates.

TABLE II-3

NON RESIDENTIAL MARKET BREAKDOWN
(Input in Millions of Square Feet)

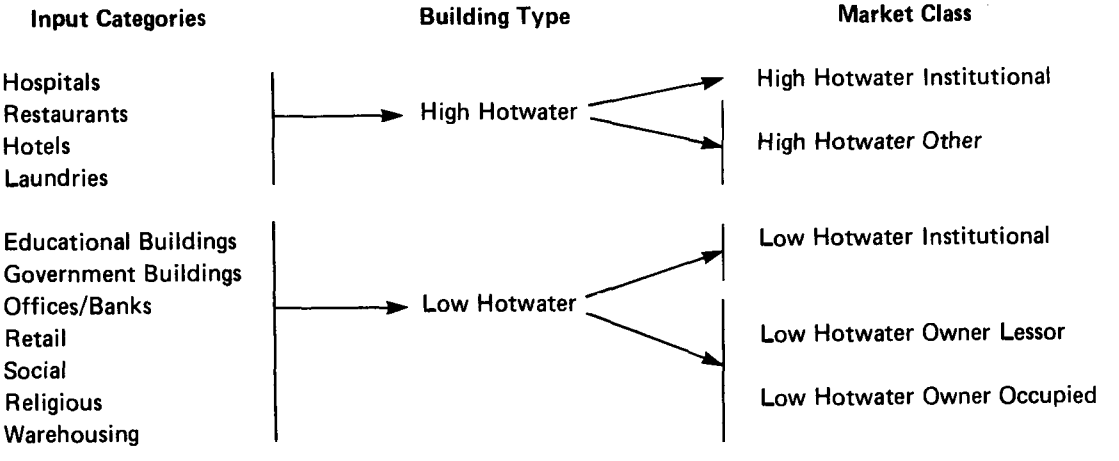


TABLE II-4

COMMERCIAL NEW CONSTRUCTION FORECASTS 1977-1990

(Millions of Square Feet)

	1977	1980	1985	1990
Warehouse	205	206	239	270
Retail	138	139	161	182
Schools	120	108	103	103
Hospital	82	94	108	120
Office and Bank	69	69	80	93
Social	64	69	73	76
Government	49	54	57	59
Religious	35	37	39	40
Restaurant	32	32	37	42
Hotel	26	24	26	27
Laundry	7	7	8	10
Total	**827**	**839**	**931**	**1,022**

Source: Arthur D. Little, Inc., estimates.

TABLE II-5

TRENDS IN COMMERCIAL/INSTITUTIONAL CONSTRUCTION MIX 1977-1990

	Percentage Distribution of New Construction By Building Type			
	1977	1980	1985	1990
Warehouse	25%	25%	26%	26%
Retail	17	17	17	18
School	15	13	11	10
Hospital	10	11	12	12
Social	8	8	8	7
Office and Bank	8	8	9	9
Government	6	6	6	6
All Other	11	12	11	12

Source: Arthur D. Little, Inc., estimates.

The Reference Case of this study incorporates energy prices (expressed in 1977 dollars per million Btu) for residential and commercial electricity, natural gas, and oil in each of the ten FEA regions. These prices were provided by FEA from the Project Independence Evaluation System (PIES) Reference Case results as reported in the *Federal Register* of April 15, 1977, Appendix A: "Energy Price Projections." Table II-6 portrays average national energy prices for the three major fuels from 1977 through 1990. These figures were developed by weighting the FEA regional data with Bureau of the Census (unpublished) preliminary state population estimates for 1976.

According to these projections, residential electricity shows a real annual growth rate of 0.7% per year during the period included in this study, while commercial electric rates rise 0.9% annually. Natural gas prices rise more substantially averaging an annual 4.5% for residential and 5.9% for commercial; oil prices increase on the order of 1.5% per year.

The data provided by FEA may not adequately reflect the potential impact of the National Energy Plan, particularly with respect to electricity prices. More recent official FEA projections, such as those published in the *Federal Register* of June 29, 1977 (after inputs for this study were finalized) are somewhat higher but still quite conservative. For this reason, we feel the fuel-price fuel-share sensitivity analysis presented in Chapter V of this report is of particular importance in assessing the results of this study.

Fuel Shares

As is true of fuel prices, the market share of the three major fuels is subject to future uncertainty, particularly in light of availability and government regulations.

Fuel shares for the Reference Case were also provided by FEA but are *not* official projections: there were none available at the time inputs to this study were finalized. Estimates for the existing inventory of residential structures were taken directly from heating fuel data reported by the Bureau of the Census for electricity, natural gas, and oil. For the purposes of this study, Liquefied Petroleum Gas (LPG) was included under natural gas while coal, wood, and other were included under oil. The data were broken down into FEA regions on a proportional basis utilizing the preliminary 1976 census estimates of state populations. Estimated near-term fuel shares for new residential construction were derived by adding the estimated number of new customers shown in the American Gas Association's *Gas House-Heating Survey* for 1976 and the Edison Electric Institute's *1976 Space Heating Survey.* The difference between this sum and the census estimate of total new residential units was assumed to be oil heated (including coal, wood, and other). Estimated fuel shares for 1980, 1985, and 1990 were then developed by scaling the near term 1976-77 estimates to correspond with overall national averages computed with the Oak Ridge National Laboratory Residential Energy Use Model. Table II-7 illustrates the estimated residential fuel shares by region for pre-1977 inventory, 1977, and 1990 new construction.

FEA's estimates of commercial inventory fuel shares were based on *Energy Consumption in Commercial Industries,* a report prepared for the Agency by Jack Faucett Associates and organized for 1974 census division data. The breakdown into FEA regions was based on the preliminary 1976 state population estimates from the Bureau of the Census. Estimated fuel shares were derived for new construction in 1980, 1985, and 1990, by scaling the existing inventory data to

TABLE II-6

REGIONAL RESIDENTIAL/COMMERCIAL FUEL PRICES

1977 - 1990

(1977 $/MM Btu)

Residential

FEA Region	1977			1980			1985			1990		
	Electric	Gas	Oil	Electric	Gas	Oil	Electric	Gas	Oil	Electric	Gas	Oil
1	14.49	3.37	3.48	14.43	3.39	3.54	14.25	4.14	3.69	14.82	5.02	3.93
2	16.03	2.90	3.32	15.80	3.13	3.59	14.86	3.63	3.77	14.93	4.28	4.01
3	12.12	2.35	3.34	11.94	2.69	3.76	12.37	3.24	3.94	12.79	3.79	4.18
4	9.57	1.88	3.38	10.40	2.24	3.83	10.51	2.86	4.02	10.69	3.52	4.28
5	10.81	1.89	3.06	11.05	2.21	3.30	11.48	2.74	3.58	11.92	3.72	3.86
6	10.70	1.61	3.21	13.70	1.80	3.53	12.89	2.04	3.71	13.59	2.76	3.97
7	10.38	1.53	3.04	11.27	1.69	3.20	11.18	1.72	3.49	10.94	2.83	3.76
8	9.11	1.45	3.21	9.25	1.70	3.40	8.97	1.77	3.68	9.58	2.72	3.94
9	12.07	1.98	3.37	13.92	2.42	3.48	13.11	3.59	3.70	13.26	3.73	3.94
10	5.45	2.72	3.33	6.64	3.35	3.48	6.51	3.36	3.70	7.01	3.48	3.94
Nat.Average	10.89	2.02	3.28	11.72	2.32	3.53	11.65	2.80	3.74	11.93	3.56	3.99

Commercial

1	14.17	2.78	3.15	14.19	2.76	3.31	14.16	3.51	3.47	14.88	4.39	3.70
2	16.44	2.37	3.05	16.48	2.56	3.35	16.53	3.07	3.53	17.39	3.72	3.77
3	11.33	1.99	3.06	11.24	2.25	3.39	11.83	2.80	3.57	12.40	3.35	3.81
4	9.94	1.48	3.06	10.68	1.76	3.40	10.63	2.38	3.58	10.66	3.04	3.84
5	10.62	1.61	2.89	10.92	1.90	3.12	11.46	2.43	3.41	12.00	3.41	3.68
6	9.71	1.12	2.96	12.87	1.30	3.28	12.32	1.99	3.47	13.29	3.32	3.73
7	9.62	1.16	2.86	10.42	1.30	3.04	10.93	2.30	3.32	11.30	3.56	3.60
8	7.80	1.24	3.04	8.13	1.48	3.18	8.17	2.40	3.47	9.10	3.59	3.73
9	10.52	1.60	3.10	12.62	1.93	3.22	12.23	3.10	3.44	12.78	3.24	3.67
10	5.63	2.16	3.06	6.74	2.80	3.22	6.49	2.81	3.44	6.87	4.44	3.67
Nat.Average	10.82	1.61	3.02	11.79	1.87	3.27	11.78	2.60	3.48	12.21	3.41	3.73

Source: Federal Energy Administration

TABLE II-7

RESIDENTIAL FUEL SHARES
(Percent)

		Pre-1977 Inventory			1977 New Construction			1990 New Construction		
		Gas	Oil	Electric	Gas	Oil	Electric	Gas	Oil	Electric
FEA Region	1	24	52	24	14	41	45	0	45	55
	2	43	36	21	4	41	55	0	35	65
	3	41	32	27	3	15	82	0	10	90
	4	42	28	30	22	4	74	20	0	80
	5	72	15	13	32	9	59	25	5	70
	6	90	0	10	64	4	32	70	10	20
	7	62	4	34	44	9	47	40	10	50
	8	77	15	8	32	3	65	20	5	75
	9	74	7	19	80	2	18	80	5	15
	10	27	30	43	23	2	75	15	0	85
National Average		**58**	**21**	**12**	**32**	**10**	**58**	**28**	**12**	**60**

Source: Federal Energy Administration estimates.

correspond with overall national averages computed with the Oak Ridge National Laboratory Commercial Energy Use Model. This FEA breakdown of fuel shares by building type and region was then translated into the building classification scheme on a proportional basis utilizing Bureau of the Census data for Standard Industrial Classification (SIC) codes.

The assumption that buildings with gas space heating also use gas for water heating is incorporated into internal fuel share computations of the model. The same assumption is made for buildings using oil or electricity as the alternative energy source. All air-conditioning in all regions is presumed to be electrical through 1990 and heat pumps are introduced as a competitive fuel-firing option between 1977 and 1980, depending on region.

The data provided by FEA somewhat understate the impact of the reallocations and fuel price adjustments implied in the National Energy Plan. The number of natural gas hookups for new construction in the Northeastern United States declines dramatically, but this reduction is offset by upward adjustments in areas with plentiful natural gas supply (especially the Southwest). On balance, gas fuel shares for new construction on the national level decrease from 32% in 1977 to 28% in 1990. Other unofficial estimates from other agencies show as low as 10% and as high as 50% in 1990. For this reason, as previously noted, the fuel-price fuel-share sensitivity analysis presented in Chapter V of this report is particularly important in assessing the results of the study.

TECHNICAL/DEVICE SPECIFIC DATA BASE ELEMENTS

The three solar systems being investigated in this analysis include water heating, water heating and space-heating, and water heating/space heating and cooling systems. Each of the three systems represents a generic class of solar energy system available in the marketplace now

and within the timeframe considered for this study (through 1990). The following is a discussion of these devices with particular reference to collector sizing, cost, and solar load (percent of heating/hot water/cooling demand displaced by installation of solar equipment).

Water Heating Systems

This is the simplest of the three systems, the least costly, and the one with the most favorable economic performance at today's level of technology. The system for a standard 1500 square foot single family detached house consists of a small (45 to 50 square feet) collector with necessary piping, pump, and thermostorage tank. Within the model, the solar water heating system is designed to provide 50% of hot water requirements. This figure reflects system sizing on the basis of solar heat costs — an approach which yields results that are different from those obtained when life cycle costs are used to establish system size. The life-cycle approach is geared to optimization of payback, which leads to oversizing of collectors. System efficiencies will therefore be lower, and the larger system, with its associated higher load, may not be economically acceptable. Previous analysis has indicated that minimum solar heat costs, throughout the United States, occur at solar load percentages in the 40-70% range, and a 50% solar load combines acceptable economic performance with reasonable collector sizing. It may be economical to use larger solar load percentages when energy costs exceed the minimum solar heat cost.

Previous work has also indicated that the annual efficiency of solar water heating tends to be a single-valued function of the solar load, essentially independent of building type or location. Although annual hot water efficiency may vary from one region to another, the difference is not large. Because of this lack of regional variety in collector efficiencies, a 50% solar load would result in an annual efficiency of about 35% in present-day collectors. We expect (and have built into the model) improvements in solar water heating efficiency to 40% by 1990.

Space Heating and Hot Water Systems

The basic configuration used for these systems is similar to the water heating system, but with the addition of pipes and valves connecting thermostorage to the conventional heating system. These systems all tend to have lower efficiencies than hot-water-only systems because of the seasonal variation in the heating load. Because of the great variety in building types, regions, and fuels used in the model, annual efficiencies were calculated by region. These annual efficiencies were plotted from a correlation between the efficiency ratio (space heat and hot water annual efficiency divided by annual efficiency of a hot-water-only system) and the ratio of space heat load to total load. Space heat and hot water efficiencies are expected to improve through 1990 by approximately the same annual percentage as hot-water-only systems. As in previous solar device studies, these systems provide 40% of the combined water heating and space heating load requirements in all regions.

Water Heating, Space Heating and Cooling Systems

Although this solar device is not economically feasible at present, some market penetration is anticipated as more efficient units appear in the late 1980's. For performance purposes, there does not appear to be any substantial variation in performance by either location or building type (with some minor exceptions in the non-residential building category of low hot water usage). For

the combined system of this type, a 50% solar load is assumed (up from the 40% for space heating and hot water) because the air-conditioning load will help balance the seasonal space heating requirements and permit better performance at higher solar fractions. Given a 50% solar load, this would imply an annual efficiency of approximately 38% for advanced collectors. The advanced collectors are profiled in this analysis because higher temperatures (180° to 200°F) are required for absorption air-conditioning. Because of their late introduction to the market, no significant improvements in performance of the advanced collectors are anticipated in the period covered by this study.

Solar Device Costs

The solar cost estimates used in this model are based largely upon previous Arthur D. Little work. In all cases, collector cost per square foot represents total cost (including installation) divided by square feet of collector. It is assumed that installation costs will vary by region, while device costs will be constant. An experience modification coefficient, built into the costing formula, reduces the cost per square foot of collector as the solar market expands — the result of manufacturing economies of scale.

The cost of solar energy systems will increase as system size and collector area increase. Costs associated with controls, piping and storage will not change as rapidly, relative to increases in system size, as do costs for the actual collectors. For example; a 500-gallon storage tank appropriate for use in a space heating system costs only three to four times more than a 60-gallon tank for a hot water system. Therefore as collector area requirements for these systems increase, overall systems costs based on square footage of collector decrease. Single family water heating systems expected to be available in 1977 are projected to cost roughly $40 per square foot for a 50 square foot collector; a comparable commercial system (typically 200 square feet) will cost about $34 per square foot.

All cost exponents were developed for incorporating solar systems and designs into new construction. As the SHACOB Model provides for the analysis of retrofit applications as well, retrofit costs are calculated by adjusting new construction costs upward by 15% (for hot water only) and 25% (space heating and cooling). These adjustments reflect the fact that retrofitting an existing building to include solar systems is more costly than incorporating solar in the process of new construction and that the distribution and installation process for the retrofit market typically has higher costs and markups than when similar systems are sold to the new construction market. While penalties for retrofit applications will vary widely, depending upon building type, house location, etc., the premiums chosen are representative of nationwide experience.

COLLECTOR SIZING

The appropriate collector area sizing done within the SHACOB Model is based upon regional radiation values, percent load assumed by the solar device, device efficiency, and total building load. Collector sizes will vary as the market develops, depending upon improved collector efficiencies or decreased building load requirements. Table II-8 provides examples of collector sizing in single-family applications for the three solar systems in 1977 and 1985 (nationally averaged for new construction).

TABLE II-8

AVERAGE SOLAR COLLECTOR AREA–SINGLE FAMILY NEW CONSTRUCTION
(Square Feet)

(Per Housing Unit)

Type Home	1977			1985		
	Hot Water	Heat and Hot Water	Cooling, Heat and Hot Water	Hot Water	Heat and Hot Water	Cooling, Heat and Hot Water
Gas	49.8	229.3	286.8	40.0	171.7	249.5
Oil	49.8	229.3	286.8	40.0	171.7	249.5
Electric	49.8	192.9	261.3	40.0	150.3	234.6

Source: Arthur D. Little, Inc., estimates.

BUILDING LOADS

Residential and commercial/institutional buildings were grouped on the basis of similarity in building type and energy demand. This classification process becomes quite difficult in the commercial sector because of the wide variety of sizes and end-use characteristics within that category. Traditional building stock designations were combined into six categories of building load requirements, including the four classes of residential construction (single family, low density, multi-family, and mobile home) and two classes of non-residential construction (high hot water and low hot water). While the method of dividing non-residential building types into only two load categories may appear simplistic, the major distinction in energy usage per thousand square feet of floor area consists of high hot water and low hot water applications.

Building loads represent the theoretical consumption of each fuel by each building type expressed in millions of Btu's per unit (or per 1000 square feet in the case of commercial/institutional) per year. Derivation of these unit demands was based on work done for CEQ/FEA in the *Residential and Commercial Use Patterns, 1970 and 1990* report. Unit demands were adjusted to reflect the different climatic conditions in the 10 FEA regions and to reflect the differently defined building types. Factors for heating were based upon weighted average heating degree days in the 10 FEA regions; cooling factors were based upon weighted average cooling degree days. In all cases, these building loads represent theoretical energy requirements "at the walls." To arrive at the gross number of Btu's required to provide these energy units, the theoretical Btu's are divided by the industry accepted conversion rates for fuel firing efficiency. These are: gas, 0.7; oil, 0.6; electric heating, 1.0; electric cooling, 2.1; and heat pump heating, 1.4-1.6.

Table II-9 details the building load requirements for new single-family construction on a national basis in 1977 and 1990. The decrease in building load levels has been put into the model to reflect greater energy conservation measures and better construction techniques. Building loads were established for each device, for each region, for each building type, and for each year covered in the scope of this study.

TABLE II-9

NEW CONSTRUCTION BUILDING LOADS–SINGLE FAMILY
1977 – 1990
(MM Btu/Unit)

1977

	Space Heating			
FEA Region	Gas & Oil	Electricity	Water Heating	Air Conditioning
1	112	89	19	7
2	87	70	↓	8
3	81	65		10
4	33	31		59
5	99	79		13
6	33	30		57
7	85	68		13
8	108	86		12
9	32	30		69
10	93	74	↓	8

1990

	Space Heating			
FEA Region	Gas & Oil	Electricity	Water Heating	Air Conditioning
1	81	68	15	7
2	63	54	↓	8
3	58	50		10
4	28	27		59
5	71	61		13
6	28	26		57
7	61	52		13
8	78	66		12
9	27	26		69
10	67	57	↓	8

Source: Arthur D. Little, Inc., estimates.

CHAPTER III
THE SOLAR INDUSTRY

INTRODUCTION

The solar energy industry, which was active in this country as early as the 1930's, is on the verge of rapid growth and change. The emerging conservation ethic and general attention to a changing energy environment have done much to encourage the evaluation of alternative energy sources, and economic feasibility is now bringing solar energy to the point of being competitive with conventional fuels. This chapter briefly reviews the status of the solar industry.

Sales of solar equipment used for heating and cooling totaled less than $1 million in 1973. The current estimate for 1977 is that solar sales will exceed $140 million. The present allocations of this total by system type and end use are given in Table III-1.

TABLE III-1

SALES OF SOLAR EQUIPMENT BY TYPE AND MARKET SEGMENT

Sales volume – 1977	$145 million
Systems Type:	
hot water	61%
heating/hot water	38
heating/hot water/cooling	1
	100%
Market Segment:	
residential	82%
commercial	18
	100%

In assessing the impact of solar on energy markets, two basic issues must be addressed. First, one must look separately at possible applications of solar energy in existing buildings versus new construction. It is clear that a new building can be designed to conserve energy. It is more difficult to redesign an existing building. Yet, by virtue of the number of units involved, penetration of solar energy in the retrofit market could be far more significant in terms of energy saved and solar devices sold than comparable penetration levels in new construction.

Second, use of solar energy will be determined largely on the basis of economics. Residential hot water systems presently offer the most attractive application for solar energy. Load stability throughout the year allows efficient system sizing, and the cost of a solar water heating system is low enough to be readily affordable. Incremental investment in solar heating/hot water, and ultimately solar heating/hot water/cooling, will be considered only as the investment is justified by incremental energy savings. Economic and noneconomic Federal incentives have the potential for increasing the use of solar much sooner than might otherwise be the case, but the development

of the solar industry will also depend on external macro-economic trends and the specific economies of the industry.

External factors will center on trends in mortgage rates, interest rates for home improvement loans, housing starts in the construction industry, and other national trends in economic activity. Energy prices are not tied so directly to economic cycles, but will clearly have a major impact on solar investment.

Industry-specific economics will be strongly influenced by government policy, and the granting of incentives for investment in solar devices. The effects of alternate incentive packages are discussed in detail in Chapter V and have been the focus of much of the present work.

All this is not to say that solar industry participants can do nothing to influence their own future. For while economics will rule, the industry itself will influence economic trends through experience and cost reductions. It is also important that the consumer understand and appreciate the use of economics as they apply to his own decision regarding solar. Consumer education, particularly on concepts such as life-cycle costing, can be shared by industry and government.

There is a need to develop an industry infrastructure that is sensitive to the importance of reliability and durability in solar systems. Faulty installation and/or poor design can lead to consumer backlash — as can overly broad expectations about the capabilities of solar equipment — and in both cases there is the potential for undermining many of the positive aspects of the conservation concept. Ultimately, the solar industry itself will determine the success of market development of solar energy systems. This effort will take place via self-policing activities of industry participants and in response to government standards for consumer protection, patterns of trade, etc.

INDUSTRY INFRASTRUCTURE

The solar energy industry is in the early stages of its development. It can best be described as a collection of relatively small and inexperienced firms, most of which lack the financial resources and management capability to survive or become significant in the industry in the long run. The approximate size of the industry can be gauged by examining the results of an FEA survey of solar collector manufacturing activity, released in April 1977. This survey indicates that roughly 185 companies were engaged in the manufacture of solar collectors in late 1976. The Solar Energy Industry Association, which is concerned with developing broad public credibility and promoting the use of solar systems, had a membership of 231 product and service companies in early 1977. Figures such as these can not be interpreted as definitive; participants can be expected to enter and leave the industry in significant numbers over the next several years, and the exact nature of and participation in the industry cannot be predicted accurately. However, a starting point for industry specification has been established.

Many of the solar firms now in existence are local or regional concerns. Many of these firms will have a role in the expansion of the industry, but it is likely that their primary functions increasingly will center on distribution and installation rather than on the manufacture of solar equipment. As consolidation and rationalization occur, however, the major HVA/C and materials companies will begin to capitalize on their established strengths in manufacturing and distribution, and the number of large companies participating in the industry will increase.

The participants in the infrastructure of the solar industry include designers and architects, materials suppliers, equipment manufacturers and distributors, builders and contractors, financial institutions, and finally, the ultimate consumer. The government (Federal, state and local) participates to the extent that incentives and demonstration programs are used and in the development and administration of regulations, codes and standards. As the industry develops, large numbers of participants at all levels will be dealing with solar on a regular basis, but in the interim, coordination of efforts toward solar development may pose problems. Very few people are yet capable of assessing the cost/benefit implications of solar use.

The purpose of financial incentive legislation is to create rapid acceleration in the development of the industry. With this condensed rationalization will come significant problems. It is clear from experience over the last year that the industry has not reached the stage of maturity where reliable and cost effective products are being accepted by knowledgeable consumers. Further modifications are required in the design of systems to improve both their performance and their reliability. Systems costs are relatively high because there are limited economies of scale from manufacturing, distribution and installation and because many industry participants are inexperienced. The typical consumer has a limited understanding of solar energy or unrealistically high expectations about the potential of solar systems.

MARKET RESEARCH

A review of current literature indicates that a wide variety of quantitative and qualitative studies of solar energy have been undertaken in the recent past. On the most general level, a number of national surveys have been conducted in 1977 which focus on consumer response to energy conservation. Such surveys have been done by Louis Harris, Opinion Research Corp., and others and provide a useful indication of public awareness of solar as an energy conservation option. On the supply side, the Bureau of Building Marketing Research has polled professional builders to determine response to energy conservation, including experience with solar energy systems.

The most technical solar studies focus on specification of system design and performance. A number of computer programs have been formulated, for example, to assist industry participants in resolving solar design problems. The three best known of these programs are FCHART, TRNSYS and SOL COST. FCHART and TRNSYS were both developed by the University of Wisconsin, and have been used by other researchers in assessing system economics, energy balances, paybacks, etc. FCHART is designed for use by architects, engineers, etc., while TRNSYS is intended to be used as a research and development tool.

SOL COST, developed for ERDA by Martin-Marietta Aerospace Corp., is also designed for use by architects and engineers. Its primary function is to size solar systems, but the program will also calculate heat loads, compute optimal tilt angle, and generate life-cycle cost analyses.

Research focusing on solar commercialization and market penetration falls between the extremes of the overly general and the highly technical. Attempts to develop market penetration forecasts are hampered by minimal and diffuse sales volume experience and low levels of penetration in the present market and it is not unusual to find significant variability among those penetration forecasts that have been attempted. By reviewing current studies, however, it is

possible to develop a feel for the sophistication and cumulative value of research efforts. Five studies have received particular attention from decision and policy makers. They are viewed as significant contributions to solar development, and are reviewed briefly below:

- *Solar Water Heating — Economic Feasibility, Capture Potential, and Incentives,* Research Supported by the National Science Foundation, conducted by Dr. Jerome E. Scott, University of Delaware, February 1977.

Scott's analysis of solar water heating systems is focused on residential applications and covers three system types compared across five geographic locations. Direct water, anti-freeze and air systems were chosen for investigation, and geographic regions (Phoenix, Miami, Wilmington, Denver and Boston) were chosen as representative of insolation and temperature ranges in major market areas. The first part of Scott's study works toward the establishment of optimum system size, performance, reliability and cost for each system by region. New and retrofit markets are considered, and system economics are examined in terms of payback period and cumulative savings.

In the second phase of this study, Scott has used his basic economic analysis and a range of alternative incentives to make estimates of market acceptance for solar. He is particularly concerned with the costs and benefits of incentives and has attempted to address the question of the reaction of decision makers to incentive programs. From a list of possible incentives, several were chosen for inclusion in the consumer research, which constitutes the third part of the study.

Scott's consumer acceptance research estimates and compares the market penetration to the year 2000 for solar water heaters under two scenarios: laissez-faire, or a business-as-usual scenario; and government stimulation via a $350 tax credit (25% of an initial cost of $1400). To obtain consumer utility factors to accompany his economic analysis, personal interviews with 300 male heads of households (all owners of single family homes) were conducted. (In each case, care was taken to educate the potential consumer with regard to solar hot water systems so that a realistic estimate of behavior could be obtained.) The results of these interviews were aggregated to produce market performance functions, and ultimately market penetration forecasts, taking into account the impact of proposed initiatives.

- *Attitudes and Beliefs of Consumers and Supporting Institutions About Solar Heating in the Home,* Prepared for the Federal Energy Administration by Decisions and Designs, Inc., July 1977 (Draft).

As its title indicates, this study is limited to an evaluation of solar heating (including space and water heating) in residential applications. It is a behavioral analysis of homeowner willingness to utilize solar, given various incentive scenarios, and its main focus is on the results of telephone surveys with 400 homeowners in four areas of the country. (These geographic areas — each of which is considered to be an economically feasible location for solar by 1985 — included: New York City; Nobles County, Minnesota; Santa Clara County, California; and Washington, D.C.) The study also touches on institutional roles in support of solar energy, in particular the roles of builder/developers, lending institutions and utility companies.

The stated purpose of this work is to assist in the choice of initiatives to encourage utilization of solar energy. As such, the survey instrument was designed to illicit consumer

reaction to solar costs relative to other modes of heating. Analytical sections of the report indicate that there was some confusion on the part of respondents when they were asked to choose among economic alternatives; nevertheless, results were used, in conjunction with figures from other research efforts, to project penetration figures for solar heating systems to 1985. The uncertain availability of reliable solar heating equipment was identified as the most serious source of error in market penetration projections.

Other perceived barriers to solar penetration included: 1) uncertain future costs of solar devices and fuels; and 2) the disposition of homeowners to opt for solar heating. In support of the behavioral approach taken, it is pointed out in the study that purely economic forecasts fail to take account of consumer attitudes, which will have an important impact on actual penetration levels.

- *HUD Residential Solar Heating and Cooling Demonstration Program: Summary of Findings on Marketing and Institutional Opportunities and Constraints,* Real Estate Research Corp., June/July 1977.

As solar energy systems become a viable force in the marketplace, the opportunity for first-hand evaluation of marketing efforts and market acceptance emerges. The U.S. Department of Housing and Urban Development, as part of its Residential Solar Heating and Cooling Demonstration Program, has contracted a team of consultants to gather information on and analyze program impacts. The role of Real Estate Research Corp. (RERC) is "to survey and assess the marketing of residential solar energy units, and the strength of their market and institutional acceptance."

RERC's work will be carried out over a five-year period, and members of the research team hope to determine whether a true market for solar energy systems exists, to whom such systems are most effectively marketed, what factors are most significant to a purchase decision, and what determines satisfaction with a system. The building and financial communities, utility companies, insurance companies and local governments will be actively monitored as a means of assessing institutional constraints to solar acceptance.

The work thus far completed by RERC is only a small part of its total commitment to HUD. Over the course of the study, significant changes in government initiatives and supply, demand and cost characteristics of fossil fuels can be expected. If the "energy crisis" worsens, new trends in construction, financing and design of buildings may be established. Evaluative research of the type being undertaken by RERC will be valuable as a data base against which to measure the accuracy of market penetration models, and will aid in the refinement of judgments as to the speed and direction of solar development.

- *Solar Energy Applications — A Comparative Analysis to the Year 2020.* Prepared by the METREK Division of MITRE Corp. for ERDA, July, 1977.

This study is a comparison and evaluation of several potential applications of solar energy, including solar heating and cooling of buildings, solar process heat for industry and agriculture, wind energy conversion systems and biomass conversion. Projected utilization of solar in each of these categories is described in terms of cost and market penetration, alternative fuel displacement and energy production. Likely developments in the use of solar energy are analyzed by comparing two scenarios. One is a base case called "Recent Trends Scenario." The other is based on the provisions of President Carter's National Energy Plan.

The analysis of solar applications in the building sector was limited to those cases where solar would displace electricity. The assumption is that displacement of gas and oil will be negligible, at least through the year 2000. Solar penetration in buildings was developed for each of 16 regions of the country. Nine building types and three conventional systems for the supply of hot water, heating and cooling were considered for both new and retrofit markets.

Solar penetration figures were generated with the aid of computer simulation called SPURR — a "System for Projecting the Utilization of Renewable Resources." The model considers such factors in energy demand as differing criteria of decision makers by market sector, time lags in the market development for new technologies, fuel price and escalation rates, system costing factors, building inventory projections, etc. Optimum system size was determined on the basis of minimum life-cycle cost.

- *Federal Incentives for Solar Houses: An Assessment of Program Options.* Prepared by RUPI, Inc. Final Report to the United States Department of Housing & Urban Development. July, 1977.

The RUPI report focuses on market acceptance for residential solar energy systems on the basis of various proposed financial incentives. Basic data was collected through a field consumer survey and through telephone interviews with homebuilders, private lenders, solar collector manufacturers and government officials.

1500 households in 8 metropolitan areas were included in the field survey. The results of these interviews served as the basis for a market penetration model designed to estimate the number of solar heated housing units resulting from any particular Federal incentive program.

Several kinds of incentives are examined by RUPI, including: front-end incentives (rebates and tax benefits); low-interest loans; and measures to improve the availability of financing. Attention is then given to the design of an effective incentive program — one which provides the most advantageous mix between administrative control, government cost and market impact. Projections for market impact by incentive type are given through 1985.

CHAPTER IV
FEDERALLY SPONSORED SOLAR INCENTIVES

Federally sponsored economic and non-economic incentives have been proposed to increase the installation and use of solar energy heating and cooling systems in residential and non-residential buildings. The purpose of the incentives is twofold: to improve the economics of solar energy heating and cooling systems as compared to conventional heating and cooling systems and, just as importantly, to reduce the normal lead time required in the construction business for introduction of a major new system.

One of the foremost barriers to widespread utilization of solar heating and cooling systems is the cost of solar systems as compared to conventional heating and cooling systems. Solar systems require high initial capital investment with relatively low annual operating costs. Conventional heating and cooling systems, on the other hand, require lower initial capital costs but have high annual operating costs for fuel. On the basis of most generally accepted measures of economic evaluation (i.e., first costs, payback period, life cycle costing) solar systems have not yet been proven to be economically competitive with conventional systems. Solar hot water systems appear to be competitive with conventional systems in some locations, but the integrated hot water and space heating and/or cooling systems do not. At present, this economic differential is the most serious barrier to the use of solar systems. Solar heating and cooling systems will become competitive with conventional systems only in the long term as the costs of conventional fuels rise, as solar energy technology improves, and as solar equipment costs are reduced. To achieve short-term consumer acceptance of solar systems, and to accelerate the improvements in solar equipment costs and performance the Federal Government can offer incentives to residential and commercial sectors to improve the comparative economics of solar systems.

In addition to diluting the impact of the first-cost barrier, properly channeled government incentives can stimulate private industry's participation in the solar market through greater consumer demand. This stimulation of the market for solar energy systems leads to growing solar system sales, which further stimulate the industry, leading to additional cost reductions and a greater penetration. The construction industry, both residential and commercial, has traditionally been very cost conscious and wary of new methods and equipment. The industry is a fragmented, ever-shifting partnership of participants who rely on time-tested equipment in order to limit their liability. This, together with reasonably low levels of sophistication among construction workers themselves, leads to the traditional rule of thumb that a new construction product takes from 20 to 30 years before it is broadly accepted and used by architects, contractors, and owners. But if the nation depends only on free market forces in the construction industry, the solar industry will not be ready to provide nor the consuming public ready to accept solar energy in sufficient time to circumvent energy crises. The Federal Government is in a position to shorten the 20-30 year lead time dramatically through the use of economic and non-economic incentives. (The Federal Government is presently responsible for subsidies in all other energy areas.)

Spectrum of Economic and Non-economic Federal Incentives

Part A of the SHACOB Commercialization Report (prepared for the Federal Energy Administration by Midwest Research Institute under FEA Contract No. CR-05-70065-00) provides a reasonably detailed breakdown of the various types of both economic and non-economic incentives, the potential markets at which each incentive might be aimed, and the relative ease of government administration of such incentives. Our quantitative modeling effort has been aimed

at evaluation of the impact of four distinct incentive packages, i.e., the National Energy Plan (NEP) proposed by President Carter in April, 1977; an expanded version of the NEP; the further expanded "New Initiatives" package; and a "business as usual" reference case. Table IV-1 identifies the four major incentive package analyses which were undertaken in this study together with those economic and non-economic incentives included in each. The Expanded NEP program investigated under this study does not include the provision for exempting solar equipment from property taxes by state and local governments. The cost of Federally sponsored research, development and demonstration (Federal RD&D) is assumed to be the same in all scenarios and is reflected in the total government cost; R&D expenditures prior to 1977 have not been included.

TABLE IV-1

FEDERAL INCENTIVES

	Reference Case	NEP	Expanded NEP	New Incentives
Federal Economic Incentives				
Grants			√	√
Tax Credits		√	√	√
Tax Deductions				
Investment Tax Credit	√	√	√	√
Accelerated Depreciation				√
Low Interest Loans				√
Loan Guarantees			√	√
Government Buildings Program		√	√	√
Federal Non-economic Incentives				
Consumer Education Programs		√	√	√
Financial Education				√
Building Code/Certification Programs		√	√	√
Utility Programs			√	√
Government Insurance Program				√
Federal RD&D	√	√	√	√

Economic Incentives

Economic incentives (Table IV-1) range from direct grants to government building programs. With the exception of the latter category of incentives, each Federal economic incentive was analyzed in terms of its impact on first cost of solar devices. Grants, for example, were assumed to reduce first cost on a dollar-per-dollar basis, thereby improving the adjusted payback and increasing penetration. Tax credits were handled similarly but were discounted. For purposes of this study, an average 6½% discount rate has been used. This represents the discount rate on one-half year's capital (presuming that the average capital investment was made in mid-year of

any one year). Short-term loans and accelerated depreciation were analyzed, again for their relative impact on first cost, based upon their discounted cash flow implications.

Treatment of Federal government building program incentives was substantially different from treatment of direct economic incentives. The total square footage of Federal buildings in this category was entered directly into the experience function of the model, thereby affecting the annual production level of solar devices and thus substantially impacting device cost.

Non-economic Incentives

Federal economic incentives allow for straightforward analysis by improving payback through lowered first-cost factors. When one begins to weigh the impact of such non-economic incentives as consumer education programs, financial institution educational programs, and government insurance programs, specific quantitative analysis is no longer applicable. For each level of non-economic incentive considered in our study, we have attempted to set a non-economic (utility) weighting for the impact of each incentive. While this methodology is theoretical and open to considerable ranges of judgmental input, the values that we have set in this model have been conservative rather than liberal. A more rigorous quantitative analysis of the potential impacts of the non-economic incentives upon total solar penetration is possible, but such a task would be vastly complex, and is beyond the scope of this project.

Reference Case

The reference case studied under this methodology includes only one direct government incentive which we have assumed to be available, i.e., an investment tax credit of 10% relating to the commercial markets. This 10% investment tax credit results from solar energy devices being considered an energy conservation item. The credit is reduced to 7% after 1980.

National Energy Plan

The National Energy Plan scenario includes three types of government incentive: an expansion of the investment tax credit by 10% for the years 1978-1982; a residential tax credit of 40% on the first $1,000 of solar investment, with 25% credit on expenditures over $1,000 to a total of $7,400 (for a total available credit of $2,000); and a $100 million government buildings program, evenly divided over the years 1979, 1980 and 1981. The NEP incentives come into the model in 1978. In 1980, the residential tax credit is reduced to the 30%/20% level. It is further reduced in 1982 to 25%/15%. All incentive items terminate at the end of 1984.

The utility (or non-economic) factors were adjusted to consider the proposed NEP consumer education program and even more importantly, the effort towards building code acceptance and product certification programs. As mentioned above, any non-economic adjustment in the model is subjective, but based upon previous studies of reactions among the decision makers in the residential and commercial building markets. While these adjustments seem reasonable, there is no question that further analysis of such consumer reaction must be undertaken.

Expanded NEP and New Initiatives

Only one economic incentive is added under the assumption of the Expanded NEP scenario: the government buildings program is expanded to $200 million over the years 1979, 1980 and 1981. Loan guarantees and various non-economic incentives are also instituted in this scenario. Under

New Initiatives, low interest loan programs for consumers, accelerated depreciation allowance and a government buildings program expanded to $500 million are added. The New Initiatives program also includes government insurance programs for solar devices, and expanded educational programs.

The specific incentives included in analyzing the input of Expanded NEP and New Initiatives are itemized in Table IV-1. In each of these incentive packages (and in the NEP), a degree of synergism results from the combination of financial and non-financial incentives directed towards key market sectors. The synergism built into the model consists of the experience factor operating on the device-cost factor. Essentially, this means that a series of well-planned simultaneously implemented incentives directed at various construction decision makers will produce a greater total impact than a series of singly instituted incentives directed at the same decision makers. As is true for the NEP, the initiatives under these two scenarios are instituted in 1978, and terminate at the end of 1984.

CHAPTER V
MODELING RESULTS

The SHACOB Commercialization Model analyzed some 130 market situations based upon four major scenarios — the Reference Case, the National Energy Plan (NEP), Expanded NEP, and New Initiatives. In addition to these four scenarios, the effects of several other incentive scenarios were examined, the most important being the NEP program containing the House version of the residential tax credit (as per HR8444 of August 4, 1977) — Compromise NEP (COMP/NEP) — and several phased incentive scenario programs. This chapter discusses the results of the SHACOB Model analysis in the following areas: a comparison of the four major incentive scenarios, the sensitivity of the SHACOB Model to key data assumptions, the impact of single incentives (versus incentive packages), a comparative view of the NEP projections versus the COMP/NEP approach, and finally, a brief investigation of possible phased incentive programs designed to avoid the disruptive effects resulting from the sudden termination of major incentives.

Before discussing the results of the SHACOB Model, a description of the model output format is necessary. There are three types of reports available presently, and variations of these reports can be easily implemented; commercialization results are reported by year, by type of market (single family, high hot water institutional, etc.), and by FEA region. It should also be noted that the SHACOB Model generates these reports for both new and retrofit solar applications as well as a combination of the two markets. Both annual and cumulative commercialization results are automatic on each report option. Each of these three reports generates the following categories of data for each solar device (hot water, space heating and hot water, and space conditioning and hot water):

- *Residential solar units* — for the five residential classes of buildings, and results of which are reported in thousands of building units.
- *Commercial solar units* — for the five commercial classes of buildings, the results are reported in thousands of units (each commercial building type assigned a typical size in square feet).
- *Penetration — residential* — the percentage that each device has penetrated the total residential market.
- *Penetration — commercial* — representing percent penetration of commercial markets.
- *Collectors sold* — solar equipment sales in terms of millions of square feet of collectors sold for *both* residential and non-residential applications.
- *Total solar industry sales* — in millions of dollars, this data represents total solar equipment sales.
- *Private dollars invested* — in millions of dollars, the cost of devices actually paid from private funds (first cost minus government incentive contribution).
- *Government cost of incentives* — this describes government costs in two ways, on a cash flow basis and on a present value basis. The cash flow represents the actual expenditure (or loss in tax revenue) in the particular year. The present value

approach considers the cost of long term commitments created by low interest loans by discounting the future cash flow requirements of loans committed in a particular year at a discount rate of 10%. These costs do not include administrative expenditures but rather device costs only. The government's costs are further broken down into type of incentive, again on a present value and cash flow basis.

- *Btu's saved* — the total Btu's saved by type of energy is shown in trillions of Btu's. Electricity savings are measured at the building and do not reflect power plant and distribution losses.

The Reference Case data output format is shown in Tables V-1 through V-5.[1]

COMPARATIVE ANALYSIS OF INCENTIVE SCENARIOS

This section discusses the comparative commercialization results obtained from the SHACOB Model on the four basic incentive scenarios of the Reference Case, NEP, Expanded NEP, and New Initiatives. Table IV-1 provided an initial listing of the individual incentives contained in each of these four scenarios. Each scenario will be discussed further in this section. It is important to note that, for comparative purposes, each of the incentive scenarios was instituted in 1978 with most of the economic incentives phasing out by the end of Fiscal Year 1984. While it is unlikely that a New Initiatives package could be adopted by 1978, it is important to judge the relative impacts of each scenario with the same inception and cessation dates. Later in this chapter, more realistic phased incentive programs will be analyzed.

A summary of the comparative commercialization results of the four incentive scenarios appears in Table V-6. Figure V-1 charts the growth of annual solar sales from 1977 through 1990 resulting from the four scenarios.

Reference Case

The Reference Case represents a "business as usual" base case with little government incentive activity other than the present ongoing RD&D effort. The only direct incentive for solar equipment contained in the Reference Case is an investment tax credit amounting to 10% on qualified commercial expenditures from 1978 through 1980, dropping to 7% for the period 1981 through 1990. This investment tax credit for commercial solar devices represents the basic premise in HR8444 that solar devices qualify as energy conservation expenditures and thus are eligible for tax credits.

The SHACOB Model results for the Reference Case are outlined in Table V-6 while the full model computer results are contained in Tables V-1 — V-5. To highlight the movement of the Reference Case from 1977 through 1990, Figure V-1 charts the growth of total solar device sales on an annual basis, both for the Reference Case as well as the other three incentive packages. Reference Case annual solar sales rise from 47,000 units in 1977 to 147,000 units by 1990, an average annual increase of only 9% per year. As shown in Figure V-1, the Reference Case sales rise moderately through 1980, begin to decline slightly from 1980 through 1985, and then reflect a gradual sales increase through 1990. This general trend of the Reference Case represents a typical growth pattern for a new construction product competing in a dispersed market situation. The

1. These tables are included at the end of Chapter V.

TABLE V-6

SOLAR INCENTIVE COMPARISONS
SUMMARY TABLE

	Annual			Cumulative		
	1977	1985	1990	1977	1985	1990
1. Residential Units Sold (000)[1]						
- Reference Case	46	87	144	46	749	1,330
- NEP	46	577	774	46	3,465	6,951
- Expanded NEP	46	641	850	46	4,211	8,042
- New Initiatives	46	933	1,224	46	7,633	13,168
2. Non-residential Units Sold (000)[2]						
- Reference Case	1	2	3	1	14	26
- NEP	1	9	12	1	44	98
- Expanded NEP	1	9	13	1	52	111
- New Initiatives	1	15	20	1	99	189
3. Total Collector Area (MM Sq.Ft.)						
- Reference Case	4	7	10	4	62	103
- NEP	4	55	65	4	315	623
- Expanded NEP	4	61	72	4	389	731
- New Initiatives	4	91	108	4	743	1,253
4. Total Solar Equipment Sales (MM $)						
- Reference Case	153	236	352	153	2,197	3,684
- NEP	153	1,225	1,507	153	7,939	14,975
- Expanded NEP	153	1,355	1,648	153	9,422	17,120
- New Initiatives	153	1,987	2,421	153	16,897	28,212
5. Government Cost of Incentives (MM $)[3]						
- Reference Case	87	11	12	87	451	509
- NEP	87	17	18	87	1,831	1,919
- Expanded NEP	87	17	19	87	2,202	2,294
- New Initiatives	87	300	364	87	6,219	7,921
6. Total Energy Saved (10^{12} BTU)[4]				Cumulative Annual Savings		
- Reference Case	1	2	2	1	13	23
- NEP	1	12	15	1	67	138
- Expanded NEP	1	13	17	1	83	161
- New Initiatives	1	20	25	1	159	275
7. Btu's (000) Saved/$ Government Cost						
- Reference Case	N/A	N/A	N/A	11.5	28.8	45.2
- NEP	↓	↓	↓	11.5	36.6	71.9
- Expanded NEP	↓	↓	↓	11.5	37.7	70.2
- New Initiatives	↓	↓	↓	11.5	25.6	34.7

(1) Average Residential collector size (all devices) for the NEP case in 1985 is 80 square feet.

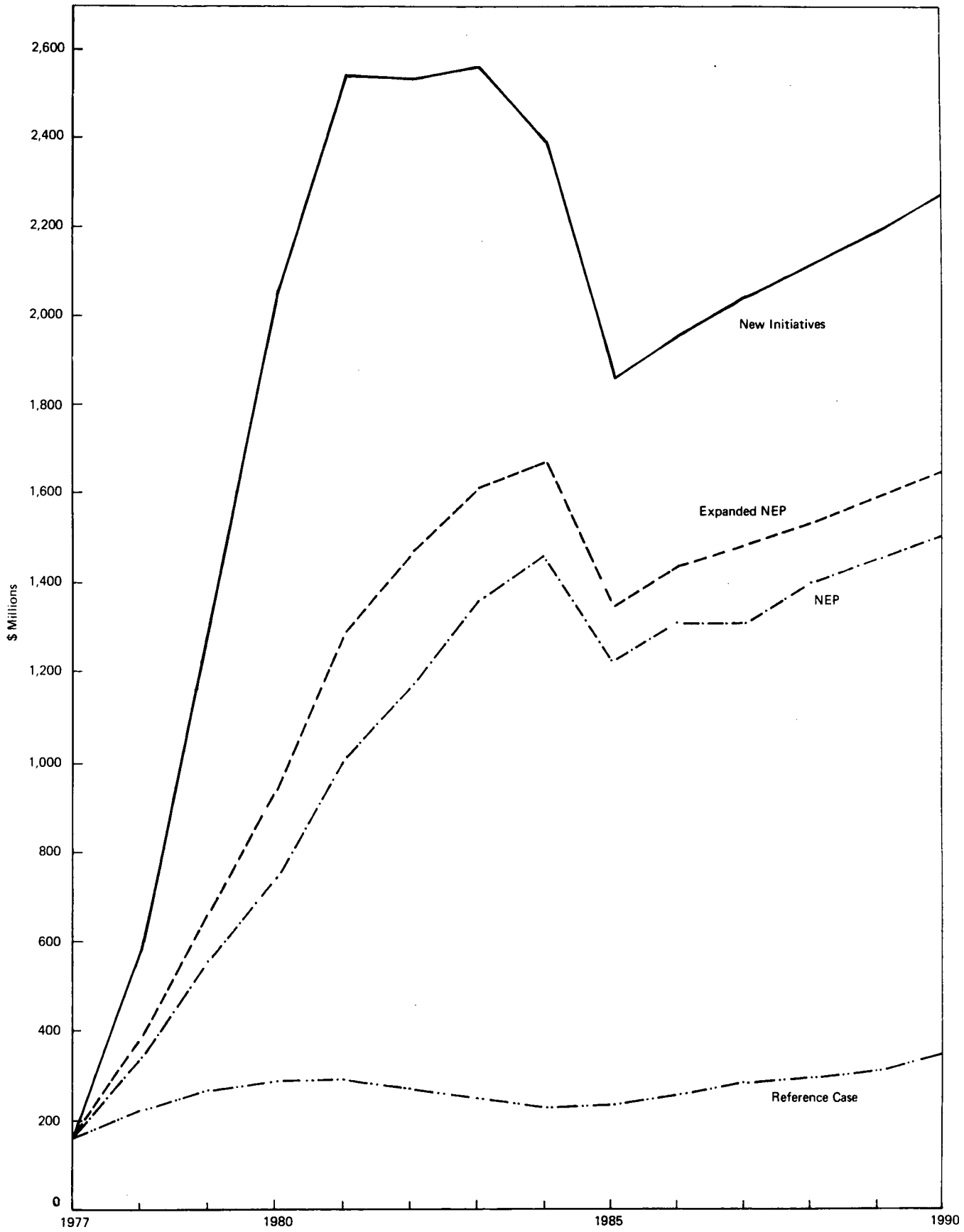
(2) Average Non-residential collector size (all devices) for the NEP in 1985 is 965 square feet.

(3) Governmental RD & D expenses for solar prior to 1977 were not included for comparative purposes. RD & D expenditures for 1979 are estimates and have been divided evenly among the three solar devices.

(4) Energy savings are measured at the point of entry to the building. In the case of electricity, these savings do not reflect power plant or distribution losses. Under the assumptions of the NEP, and taking energy savings in 1985 as an example, an energy saving of 67×10^{12} Btu at the wall is equivalent to 122.4×10^{12} Btu of primary energy.

For conversion to oil equivalent, 2.1 quads = 1 million barrels of oil per day. Thus an energy saving of 122.4×10^{12} Btu annually is the equivalent of 58,300 barrels of oil per day.

FIGURE V–1
TOTAL ANNUAL SOLAR SYSTEM SALES: 1977–1990
($ MM)



rather active growth through 1980 for solar devices is largely due to its novelty and the public concern with energy shortages. However, as solar equipment costs remain high and solar technologies do not dramatically improve, the solar market stalls and begins a mild decline which lasts through 1985. The increasingly mature solar device market then begins a modest increase through 1990.

The Reference Case results clearly indicate that, without the impetus provided by financial and non-economic programs proposed in the NEP or the other Federally sponsored initiative scenarios, the solar industry will remain relatively static through 1990. This non-dynamic aspect of the market results from the lack of economic benefits accruing from solar devices (high initial costs, low fuel savings), and the normal installation and performance quality problems that will affect the industry during its start-up period. During the mid-1980's, however, industry maturity, technical advances, cost reductions and ever increasing fuel prices will begin to exert a more positive influence on solar device penetration. This, coupled with a more mature distribution and installation infrastructure, will result in the modest growth projected in the Reference Case from 1985 through 1990.

National Energy Plan

The NEP scenario contains three basic government financial incentives: a residential tax credit, an investment tax credit, and a government buildings program. The residential tax credit contained in the NEP consists of 40% tax credit on the first $1,000 solar investment with 25% credit on additional expenditures over $1,000 up to a total of $7,400 (a total available credit of $2,000). This tax credit decreases to 30%/20% in 1980, and to 25%/15% from 1982 to 1984. For purposes of the SHACOB Model analysis, this residential tax credit was put into effect in Fiscal Year 1978. The investment tax credit consists of the 10%/7% that was itemized in the Reference Case; an additional 10% investment tax credit is added from 1978 through 1982. These investment tax credit provisions accruing to commercial customers are outlined in HR8444 as passed by the House of Representatives in August. The government buildings program consists of $100 million expenditures in solar equipment for government buildings spent in 1979, 1980, and 1981.

As shown in the summary on Table V-6, the NEP scenario rises from a 47,000 unit sales year in 1977 up to an annual 786,000 units sold in 1990 (an average annual increase of 24%). On a cumulative basis, the NEP scenario reaches over almost 7 million residential and 9,800 non-residential solar units through 1990, representing total solar equipment sold of 623 million square feet of collector area and cumulative annual savings of 138 trillion Btu's per year. The solar industry grows rapidly from annual sales of $153 million in 1977 to over $1.5 billion in 1990, a tenfold increase. Complete results for the NEP scenario are included in Tables V-7 through V-11.[2]

Figure V-1 shows the growth of the solar market under the NEP scenario. The NEP case exhibits dramatic sales growth from 1978, the first effective year of the solar incentives, with a leveling off between 1984 and 1985 as the NEP incentives phase out, then a gradual pick-up of momentum in solar sales through 1990.

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2. These tables are included at the end of Chapter V.

Later in this chapter, the NEP scenario will be compared to the COMP/NEP case, and it will also be used to test the sensitivity of the SHACOB Commercialization Model to key variables in the model's data assumptions. Table V-12, however, shows the wide range of situations under which the NEP was run through the SHACOB Model. The Table represents 36 different situations and combinations of data assumptions, and shows the range of NEP cumulative solar systems sales ranging from the low of 47 million square feet by 1990 (with solar equipment costs high and a low penetration curve) up to 3.9 billion square feet under the most optimistic set of circumstances (high fuel costs, low solar equipment costs, no new gas hook-ups, and high penetration curves). This very favorable case generates 37 million residential solar units; accumulative through 1985, residential units total 18.9 million units versus the NEP base case total of 3.4 million units. This type of analysis was also performed for the Reference Case and the Expanded NEP.

The NEP was also analyzed on the SHACOB Model using a third variation of fuel price assumptions. The base fuel price data for the SHACOB Model was, as referenced earlier, supplied by the Federal Energy Administration; a second set of assumptions, with fuel prices at 25% over the FEA projections for each year was included in the sensitivity analysis of the model (which follows later in this chapter). To make the NEP case more comparable to other modeling efforts (most notably the MITRE results), a fuel scenario was devised which represents cost increases on gas, oil, and electricity of 4%, 4%, and 2%, respectively, on an annual basis using FEA 1977 fuel prices as a base. The results of the three separate fuel variations follow in Table V-13. Given the extreme with the high fuel price scenario of a 25% increase over FEA/PIES prices, the NEP generates 13.5 million cumulative residential units by 1990, almost double the NEP results with the PIES fuel prices. Even the more moderate fuel price scenario (increasing gas and oil 4% annually and electricity 2% annually over the same base year), results in 11.3 million residential solar units through 1990, or some 62% over the NEP scenario. Clearly, the growth in the use of solar equipment is extremely sensitive to fuel prices, a factor about which there will continue to be considerable uncertainty.

Expanded NEP

The Expanded NEP scenario represents additional incentives over NEP, designed to further stimulate the commercialization of solar equipment. The only economic incentive added is a government buildings program expanded to $200 million, again spent evenly during 1979, 1980, and 1981. Loan guarantees, and a package of non-economic incentives which include consumer education programs and building code/certification programs are all instituted under the Expanded NEP scenario. Since the Expanded NEP does not contain any new direct financial market incentives, the results obtained from the SHACOB Model analysis do not reflect major increases over the NEP.

As shown in Table V-6, the Expanded NEP generates some 863,000 solar units annually by 1990, some 10% over the NEP activity level for that year. On a cumulative basis, the Expanded NEP generates over 8 million cumulative solar units by 1990 with total collectors area, again on a cumulative basis, of 731 million square feet. A detailed breakdown of both the annual and the cumulative Expanded NEP results are shown in the SHACOB Model computer printouts represented in Tables V-14 through V-18.[3]

3. These tables are included at the end of Chapter V.

TABLE V-12

NEP – RANGE OF ANALYSES
COLLECTOR AREA (MM SQ. FT.)
CUMULATIVE – 1990

1.	3,908	No Gas, Fuel Up, Hi Penet *
2.	3,655	Cost Dn, Fuel Up, Hi Penet
3.	3,217	No Gas, Fuel Up, Hi Penet
4.	3,030	No Gas, Cost Dn, Hi Penet
5.	2,997	Fuel Up, Hi Penet
6.	2,821	Cost Dn, Hi Penet
7.	2,702	No Gas, Fuel Up, Cost Up, Hi Penet
8.	2,507	Cost Up, Fuel Up, Hi Penet
9.	2,487	No Gas, Hi Penet
10.	2,300	Hi Penet
11.	2,073	No Gas, Cost Up, Hi Penet
12.	2,058	No Gas, Fuel Up, Cost Dn
13.	1,900	Cost Up, Hi Penet
14.	1,829	Cost Dn, Fuel Up
15.	1,519	No Gas, Fuel Up
16.	1,394	No Gas, Cost Dn
17.	1,379	No Gas, Fuel Up, Cost Dn, Lo Penet
18.	1,302	Fuel Up
19.	1,183	Cost Dn
20.	1,174	Cost Dn, Fuel Up, Lo Penet
21.	1,058	No Gas, Fuel Up, Cost Up
22.	934	No Gas, Lo Penet
23.	873	No New Gas Hook-Ups
24.	837	Cost Up, Fuel Up
25.	812	No Gas, Cost Dn, Hi Penet
26.	723	Fuel Up, Lo Penet
27.	623	N.E.P. (Including 6.9 million residential units)
28.	592	Cost Dn, Low Penet
29.	476	No Gas, Fuel Up, Cost Up, Lo Penet
30.	196	No Gas, Lo Penet
31.	195	Cost Up, Fuel Up, Lo Penet
32.	193	Cost Up, No Gas
33.	107	Lo Penet
34.	99	Cost Up
35.	66	No Gas, Cost Up, Lo Penet
36.	47	Cost Up, Lo Penet

KEY

Hi Penet = High Penetration Curve
Lo Penet = Low Penetration Curve
Cost Up = Solar Equipment Cost Up by 15%
Cost Dn = Solar Equipment Cost Down by 15%
Fuel Up = Fuel Cost up by 25%

* (Including 37 million residential units)

TABLE V-13

NEP - EFFECT OF FUEL PRICE VARIATIONS

CUMULATIVE THROUGH 1990

	FEA/PIES Prices	25% Over FEA/ PIES Prices	Annual Increase Gas - 4%, Oil - 4%, Electricity - 2%
Residential Units (000)	6,951	13,494	11,278
Non-Residential Units (000)	98	175	150
Collector Area (MM SQ.FT.)	623	1,302	1,088

(1)
Using FEA/PIES 1977 prices as base

Figure V-1 graphs the growth of the solar market under the Expanded NEP scenario. Beginning from the same 1977 base as the NEP case, the Expanded NEP rises more rapidly through 1984 and then displays the similar dip in annual sales resulting from the cessation of financial incentives in 1984. Like the NEP, the Expanded NEP then begins a gradual climb through 1985 through 1990. The chart also shows that the incremental growth as a result of Expanded NEP policies over that of NEP is not as dramatic a rise as the NEP's stimulation over the Reference Case. As will be discussed later in this chapter, the sensitivity of the market to financial incentives is the key ingredient to actively stimulating the commercialization of solar devices. Because the Expanded NEP contains only minor increases in economic incentives over the NEP, its incremental effect on the market is predictably modest.

New Initiatives

The New Initiatives scenario represents the most ambitious of the three incentive cases investigated under the SHACOB Commercialization Model. It retains all of the financial and non-financial incentives included under the previous NEP and Expanded NEP cases. In addition, it contains a low interest loan program for consumers (computed at an interest rate of 7% for a 20 year, 80% loan), accelerated depreciation (a five year depreciation period versus the standard 10 year standard depreciation period for solar equipment), and a heavily increased government buildings program ($500 million to be spent equally in 1979, 1980, and 1981). In addition to the financial stimuli, New Initiatives also includes expanded educational programs, and a government insurance program for solar devices. The New Initiatives program was instituted in 1978 for comparative modeling purposes against the other three scenarios, although the program could not realistically be passed by Fiscal Year 1978. A more realistic phased incentive program combination will be analyzed later in this chapter.

The results upon the solar heating and cooling commercialization generated by the New Initiatives scenario are shown in summary form in Table V-6 and in complete form in both annual and cumulative computer print-outs in Tables V-19 through V-23[4] at the back of this chapter. As may be anticipated, the New Initiatives scenario generates some tenfold greater commercialization activity for solar systems than the Reference Case. By 1990, annual solar unit sales are 1.2 million per year as opposed to the 144 thousand for the Reference Case. Cumulative residential and commercial unit sales reach 13.2 million units by 1990, and total solar sales are 1.3 billion square feet of collector area. Cumulative annual savings accruing from the New Initiatives scenario reach 275 trillion Btu's by 1990.

Figure V-1 illustrates solar activity resulting from the New Initiatives scenario. The market growth curve shows a dramatic growth pattern from 1977 through 1980 due to the massive New Initiatives financial incentives; after 1980, the solar system annual sales level off and then dip in 1985 reflecting the end of the residential and investment tax credits. The solar market then begins to recover and grows at a modest rate through 1990.

Other Incentive Scenario Comparisons

Figures V-2 and V-3 use annual sales of solar devices to chart comparisons between the four major incentive scenarios discussed above. Figure V-2 plots the relationship of new and retrofit (installations on existing buildings) solar installations under each of the four scenarios. In the Reference Case, the retrofit segment of solar sales climbs irregularly from 62% in 1977 to 68% by

4. These tables are included at the end of Chapter V.

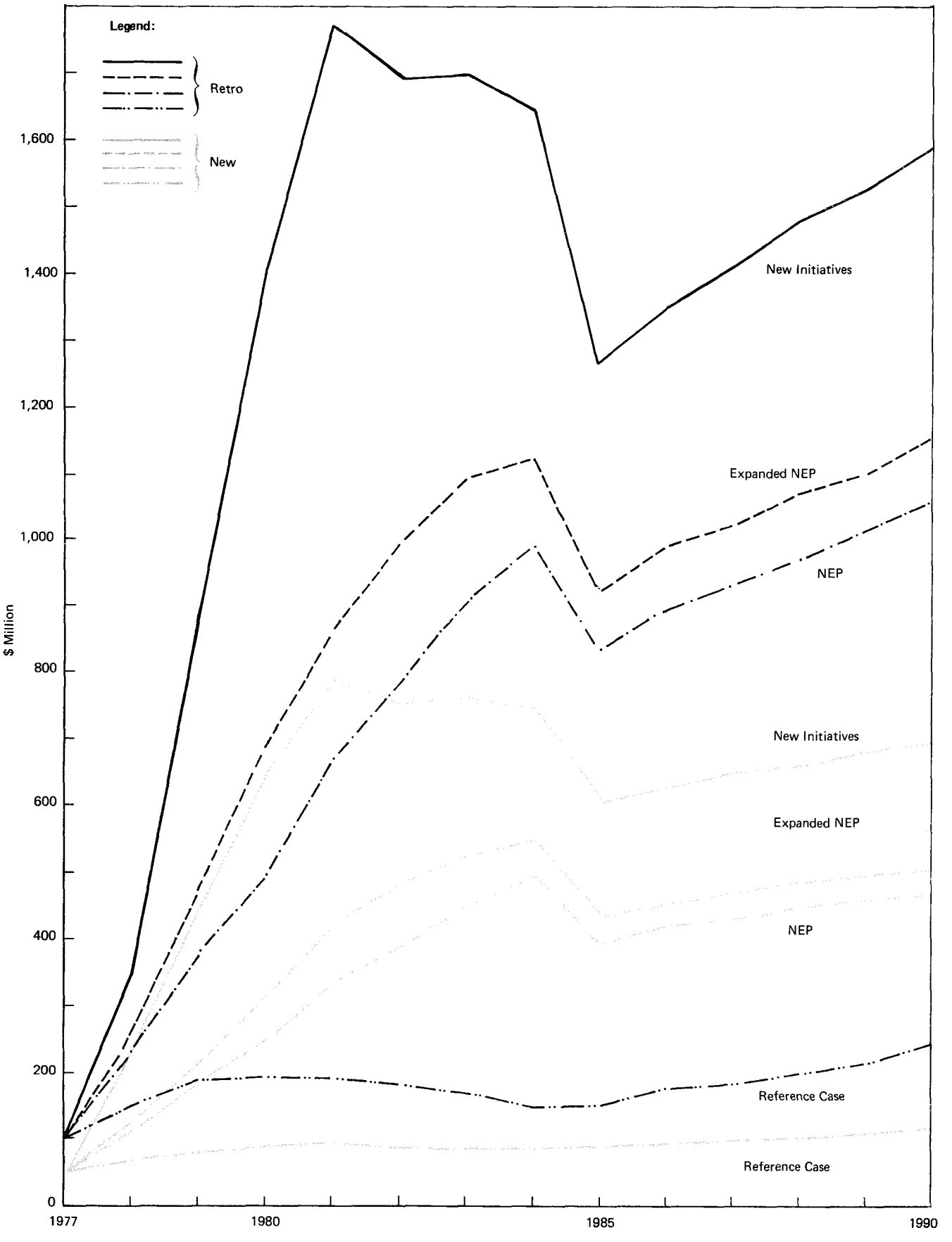

FIGURE V–2
ANNUAL SOLAR SYSTEM SALES BY MARKET: 1977–1990
($ MM)
NEW VS. RETROFIT

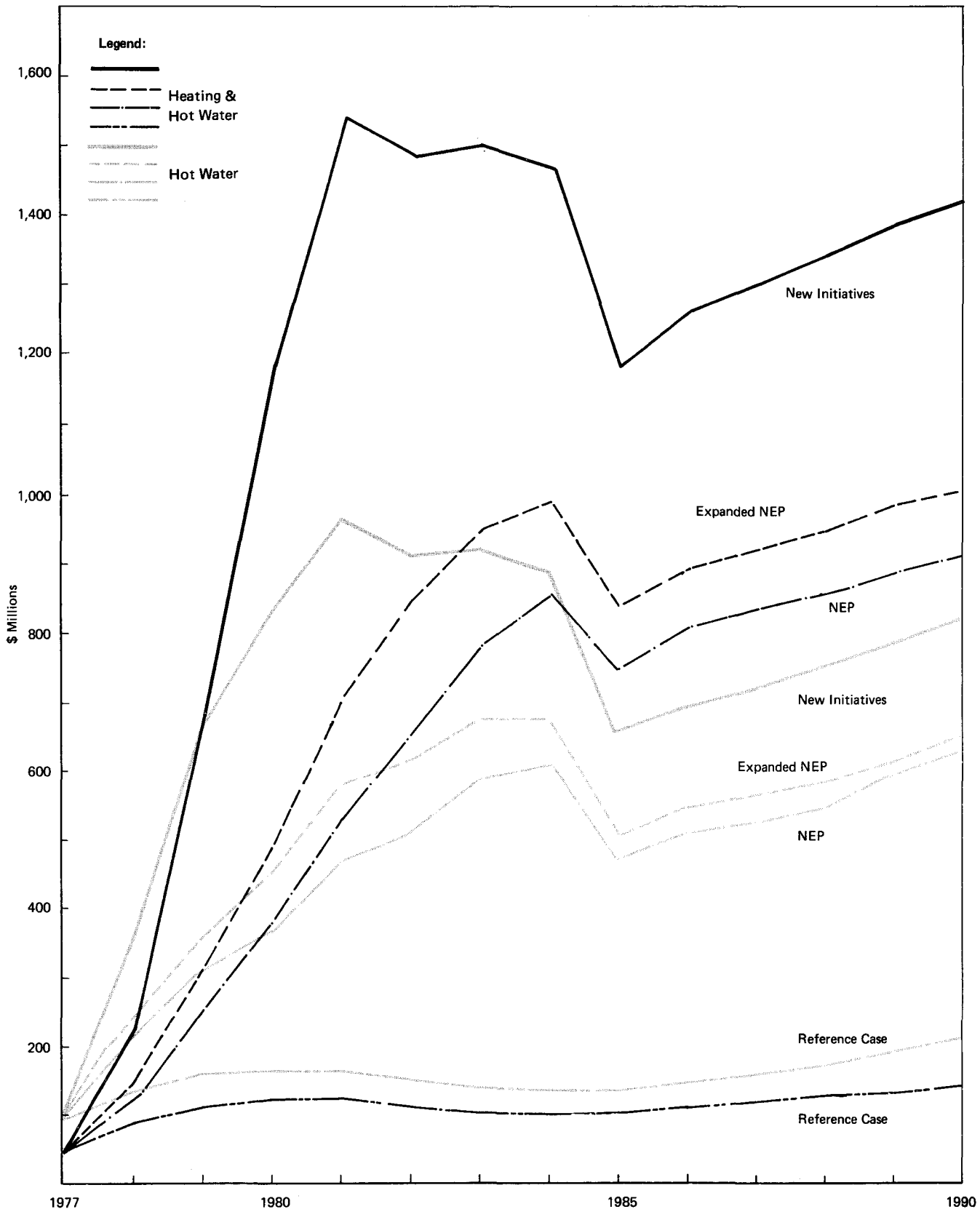

FIGURE V–3
ANNUAL SOLAR SYSTEM SALES BY DEVICE: 1977–1990
($ MM)
HOT WATER VS. HEATING & HOT WATER

1990. A pronounced dip in retrofit investment does occur in the 1980 through 1985 period due to the higher retrofit costs of installation during a period of time in which the total solar market growth is slowing. Both the NEP and the two larger incentive packages display a more active retrofit activity pattern, particularly during the years of the incentive programs. The NEP scenario, for example, shows retrofit and new installations initially peaking in 1984, with retrofit applications dipping more substantially in 1985 (after the incentives have been lifted), then increasing substantially from 1985 through 1990. The Expanded NEP and New Initiatives cases show similar relationships between retrofit and new installations, the only difference being the magnitude of the increase and the trend of the large incentive packages to peak earlier in the period.

Figure V-3 traces the relationships of the two major solar devices, hot water systems and heating and hot water systems for each of the four basic scenarios. In the Reference Case, hot water system investments maintain their dollar volume lead over heating and hot water systems throughout the duration of the 13 year period. With the addition of incentives, the relationship between hot water, and heating and hot water investments changes. In the case of the NEP scenario, heating and hot water expenditures surpass hot water investment by 1980. The Expanded NEP program follows the same trend but the crossover between heating and hot water versus hot water systems occurs early in the time frame (1979), while the New Initiatives package develops this switch between devices by 1978. In all cases, the incentive scenarios show a dip in annual investment around 1985 reflecting the cessation of most Federally sponsored financial incentives. In both the device-specific comparison and the new versus retrofit comparison, the heating and hot water devices and the retrofit applications exhibit the stronger growth rates but also react more strongly to the elimination of financial incentives. In both situations, these more sensitive segments are also the more expensive on a first cost basis. Therefore, all efforts to reduce the first cost would benefit in particular the retrofit and the heating and hot water markets.

The structure of the solar market by building type changes very little between the four basic scenarios investigated. Single-family homes represent 65% of the investment made in solar in 1977 and declines slightly to between 63% and 64% by 1990 under all four cases. Low-density residential units (which represent the second largest dollar investment by market type in solar devices) move from 9% in 1977 up to 10% in 1990. Non-residential markets account for 19% of the solar sales in 1977, dropping to 15% by 1990 under the NEP scenario. Low hot water/institutional (principally educational facilities) is the largest of the non-residential group, with the other four markets relatively equal in importance. Table V-24 summarizes the breakdown in cumulative solar sales among the various market segments.

Table V-6 also specifies the cost to the govermnent on an annual and cumulative basis for the incentives included under the four scenarios. The SHACOB Commercialization Model has assumed that all governmental financial and non-economic incentives become effective in 1978 and that the government costs also include RD&D (at the same level for all scenarios) and the cost of the government building programs. Administrative costs of handling the various financial and non-economic incentives have not been included.

The Reference Case generates an annual government cost of $12 million by 1990 with cumulative totals of $509 million. These government costs include the standard 10/7% investment tax credit directed to the commercial markets discussed earlier, as well as the RD&D expendi-

TABLE V-24

BUILDING MARKET SHARES

CUMULATIVE SOLAR EQUIPMENT SALES ($)

	1977	1990			
	All Cases	Reference	NEP	Exp. NEP	New Initiative
Single Family	65%	64%	63%	63%	63%
Low Density	9	10	10	10	11
Condominiums	1	1	1	1	1
Apartments	4	6	7	7	7
Mobile Homes	2	3	4	4	4
Total Residential	81	84	85	85	86
High Hot Water/Institutional	5	4	3	3	3
High Hot Water/Other	3	3	2	2	2
Low Hot Water/Institutional	7	4	5	5	5
Low Hot Water/Owner Lessor	3	3	3	3	3
Low Hot Water/Owner Occupied	1	2	2	2	1
Total Commercial/Institutional	19	16	15	15	14
Grand Total	100%	100%	100%	100%	100%

Source: Arthur D. Little, Inc., estimates

tures mentioned above. The modest Reference Case government costs generate only 23 trillion Btu's of cumulative annual savings by 1990 resulting in a total of 45,000 Btu savings per dollar of governmental cost. The more ambitious NEP scenario generates a cumulative cost of $1.9 billion through 1990 resulting in Btu savings of 138 trillion — or approximately 72,000 Btu's per dollar of governmental cost. The comparably higher cost scenarios represented by the Expanded NEP and the New Initiatives scenarios would result in 70,000 and 35,000 Btu's saved per dollar of governmental outlay respectively.

There are two major reasons for the greater Btu savings per dollar cost resulting from the more ambitious incentive scenarios: first, incentives attract the greater usage of space heating and hot water versus hot water only; secondly, incentives induce greater participation from the retrofit market. In both cases, the higher first cost barriers are reduced and payback improved — the higher the level of incentives, the more motivation toward larger systems and, as a result, greater energy savings.

Table V-25 details the cumulative annual savings by type of energy (gas, oil and electricity) through 1990 under the four basic scenarios. The savings in electricity are as measured at the building and do *not* include power plant losses and distribution losses. The solar devices do have the highest penetration with the higher priced electricity, followed by gas and oil. This pattern holds true in three of the four basic scenarios. However, with the New Initiatives case, the largest savings are in gas and oil. In this scenario, the sharp improvement in the economic performance begins to develop significant penetration in the large numbers of buildings which use gas and oil for hot water and heating purposes.

Sensitivity Analysis

Table V-26 contains the results of a sensitivity analysis conducted on the SHACOB Commercialization Model in which six important variables were independently changed. For comparison purposes, the NEP scenario was selected and the results of the NEP generated installations and solar industry sales are shown in the first line of the referenced table. A scenario in which the NEP fuel costs were increased by 25% above those from FEA/PIES generated substantial increases in solar commercialization. On a cumulative basis through 1990, the high fuel cost scenario generated some 90% more solar activity than the NEP. If, however, collector costs were reduced by 15% below the NEP scenario levels, the effect on solar commercialization is also impressive; installations run some 78% higher for residential units than the NEP and even approach the levels reached by the high fuel cost case. On the other hand, by increasing collector costs 15% above the SHACOB Model assumption levels, the opposite effect occurs; only slightly over 1.2 million units are in place through 1990, some 80% below NEP projected levels.

The obvious sensitivity of the SHACOB Commercialization Model to the shape and type of penetration curve used is also shown in Table V-26. By using a set of very inflexible, low-acceptance penetration curves, the NEP program develops only 1.3 million units on a cumulative basis through 1990, or only about the same level as the high collector costs case discussed above. Conversely, when very favorable sets of high acceptance penetration curves are used, the NEP results dramatically improve to over 24 million units through 1990. As is true for many of the other assumptions used in the SHACOB Commercialization Model, the precise shape and value of the curves being used may be open to question. The basic sets of curves which have been selected for use in the NEP scenario seem best to fit both the current level of solar commercialization and projections of future activity.

TABLE V-25

CUMULATIVE FUEL SAVINGS BY INCENTIVE PLAN (%) 1977-1990

	Gas	Oil	Electricity
Reference Case	32	26	42
NEP	34	28	38
Expanded NEP	34	29	37
New Incentives	39	33	28

Source: Arthur D. Little, Inc., estimates.

TABLE V-26

MODEL SENSITIVITY ANALYSIS

NEP - CUMULATIVE THROUGH 1990

	Installations (000 Units)		Solar Industry
	Residential	Non-Residential	Investment ($ MM)
NEP	6,951	98	$14,975
NEP - Fuel Cost Up 25%	13,494	175	29,263
NEP - Collector Cost Down 15%	12,397	162	22,772
NEP - Collector Cost Up 15%	1,213	21	3,954
NEP - Low Penetration Curve	1,319	23	3,602
NEP - High Penetration Curve	23,710	300	51,863
NEP - No New Gas Hook-Ups After 1977	9,520	136	20,010
	% Deviation - Over/(Under) NEP		
NEP - Fuel Cost Up 25%	94%	79%	95%
NEP - Collector Cost Down 15%	78%	65%	52%
NEP - Collector Cost Up 15%	(83)	(79)	(74)
NEP - Low Penetration Curve	(89)	(77)	(74)
NEP - High Penetration Curve	241	206	246
NEP - No New Gas Hook-Ups After 1977	37	39	34

Source: Arthur D. Little, Inc., estimates

The final sensitivity analysis assumes no new residential gas hook-ups after 1977 due to unavailability of supply. Because of the uncertainties of natural gas supplies to both residential and non-residential markets, the model isolated the importance of the supply of gas on solar commercialization. It was assumed that the new residences unable to receive natural gas would then be proportionally divided between oil and electricity. By assuming the radical case of no new gas hook-ups after 1977, the NEP scenario shows a 37% increase in solar unit sales (cumulative through 1990). Given less dramatic impacts on gas availability in real life, the solar commercialization levels should not be drastically affected over or under the NEP results.

SINGLE INCENTIVES IMPACTS

As part of the SHACOB Commercialization Analysis, the impact of the single incentives on the growth of solar device sales was determined using the Reference Case as a base. The following incentives were considered individually:

- Residential tax credit, both NEP and COMP/NEP versions
- Investment tax credit
- Government buildings program — $100 million
- Low interest loan @ 7% interest rate
- Accelerated Depreciation — 5 years

The results of the single incentive impact analysis are contained in Table V-27 which shows cumulative solar statistics through 1990 for unit installations, total dollar sales, government cost of incentives, energy savings and Btu's saved per dollar of governmental cost.

The major impact of residential tax credits upon the commercialization of solar devices becomes quite evident when one views its effect on the Reference Case. The NEP tax credit generates some 6.8 million cumulative residential installations by 1990, or only some 3% below the levels obtained by the total NEP incentive scenario. The House version of the residential tax credit (COMP/NEP) generates almost 7 million residential units through 1990. (The effects of this compromise incentive will be discussed later in this chapter.) Because solar devices would be dispersed by necessity and since the majority of sales would be to the residential market, it is logical that the residential tax credit contributes most to the development of the solar industry. When compared to the Reference Case a commercial investment tax credit generates only slightly higher installations on a cumulative basis through 1990. Actually, the greatest increase due to the investment tax credit comes in the residential spheres, due to the impact on collector costs resulting from the additional commercial activity. The $100 million government buildings program and accelerated depreciation generate from 10 to 30% more activity than the Reference Case. It's interesting to note that the low interest loan at 7% (80% financed over 20 years) doubles the Reference Case solar sales and proves to be a more powerful incentive than those geared towards the commercial sphere. In terms of cost effectiveness, the residential tax credits (79,000 Btu's per dollar of governmental costs for NEP) are also the most cost effective single incentives.

NEP versus COMP/NEP

The energy package legislation is presently pending in Congress and it is difficult to presume what format the final legislation will take. Because of the importance of the residential tax credit, the SHACOB Commercialization Model was used to analyze a fifth basic scenario.

TABLE V-27

SINGLE INCENTIVE IMPACT - REFERENCE CASE - CUMULATIVE THROUGH 1990

	Installations (000 Units) Residential	Installations (000 Units) Non-Residential	Solar Industry Sales ($ MM)	Gov't. Cost of Incentives ($ MM) (1)	Btu's Saved (2) (Trillion Btu)	MBtu's Saved/per $ Gov't. Cost
Reference Case	1,330	26	$ 3,684	$ 509	23	45.2
Reference Case with						
NEP Res. Tax Credit	6,790	89	14,565	1,689	133	78.7
Compromise Res. Tax Credit	6,956	89	14,882	1,876	137	73.0
Investment Tax Credit	1,482	29	4,056	526	26	49.4
$100 MM Gov. Bldg. Prog.	1,828	34	4,864	616	32	51.9
Low Interest Loan (7%)	2,690	43	6,784	1,691	49	29.0
Accelerated Deprec.	1,469	31	4,001	514	26	50.6

(1) On a present value basis

(2) Energy Savings are measured at the point of entry to the building. In the case of electricity, these savings do not reflect power plant or distribution losses.

Essentially, the House version of the NEP consists of the identical incentives contained in the NEP with the exception of the revised residential tax credit; this takes the form of a 30% tax credit on the first $1500 of solar expenditure with a 20% tax credit on expenditures above that amount up to a limit of $10,000. The maximum credit would thus be $2,150. Unlike the NEP tax credit, the House version does not decline but rather remains at the 30/20% level through 1984.

Table V-28 shows the comparison of the NEP versus the COMP/NEP for cumulative solar results in the years 1980, 1985, and 1990. By 1980, the NEP has generated some 16% more solar units than the COMP/NEP, and the other categories of results mirror this early unit lead. By 1985, however, the COMP/NEP shows cumulative residential solar units of almost 2% higher than the NEP and this lead increases through 1990 when the cumulative results of COMP/NEP reach over 7 million units or some 4% over the NEP. The reason for this early lead by the NEP is the phased residential tax percents starting at 40% versus 30% for the COMP/NEP. As the NEP tax credits are stepped down to 30% in 1980 and 25% in 1982, the higher tax credit (and higher dollar limits) for the COMP/NEP begin to develop the greater market. The effect on commercial solar units generated by the two residential tax credits obviously are minimal.

The comparison of the NEP results versus the COMP/NEP indicate that, in terms of dollar efficiencies, the NEP program develops slightly more Btu savings per dollar of government cost than COMP/NEP. In 1985 for example, NEP develops 58,000 Btu's saved per dollar of government cost versus 52,600 for the House version. One of the major reasons for the higher cost of the COMP/NEP is that it generates more heating and hot water system sales than the NEP. By 1985, for example, the COMP/NEP has generated only 19,400 more hot water units but some 35,400 more heating and hot water units. The higher dollar limits and the higher tax credit percentages in the later years tend to encourage purchase of more costly heating systems. These heating systems also tend to provide lower energy savings per dollar of investment because the efficiency of solar heating/hot water systems is lower than the efficiency of solar hot water systems. Table V-29 compares the sensitivity of two NEP cases.

The original House version of the residential tax credit called for the incentive to be phased out by 1982 rather than 1984. Had this version been adopted by the House it would have resulted in cumulative residential solar units of some 5.7 million through 1990 versus the NEP's 6.9 million (and COMP/NEP's 7.2 million). This 20% lower level of commercialization below the other two scenarios obviously results from the credit period terminating in 1982.

PHASING OF INCENTIVES

The previous scenario incentive cases have been run for comparative purposes. All of the incentive programs are assumed to begin in 1978, with the major financial incentives phasing out in 1984. As shown in Figure V-1, this action results in certain peaks and valleys of solar activity which would not prove beneficial to the industry. When incentives are being used to stimulate an industry, there is a natural concern about the disruptive effects that may occur when the incentives are phased out.

With this concern in mind, the SHACOB Commercialization Model was used to analyze a series of other phased incentive cases designed to smooth the transition of incentives in and out of the solar market. One major scenario was developed which combines the features of the NEP, Expanded NEP, and the New Initiatives discussed previously in this chapter. This scenario was

TABLE V-28

NEP VERSUS HOUSE COMPROMISE NEP (COMP/NEP)

CUMULATIVE RESULTS THROUGH:

	1980		1985		1990	
	NEP	COMP/NEP	NEP	COMP/NEP	NEP	COMP/NEP
Residential Solar Units (000 Units)	624	539	3,465	3,517	6,951	7,236
Commercial Solar Units (000 Units)	9	8	44	42	98	99
Collectors Sold (MM Sq.Ft.)	55	47	315	319	623	653
Total Solar Sales (MM $)	1,781	1,576	7,939	8,031	14,975	15,531
Government Cost of Incentives (MM $) (1)	805	732	1,831	2,054	1,919	2,146
Total Btu's Saved (Trillion Btu's) (2)	12	10	67	68	138	144
Btu's (M) Saved/ $ Government Cost	14.9	13.7	36.6	33.1	71.9	67.1

(1) Government Cost on Present Value Basis rather than Cash Flow

(2) Energy savings are measured at the point of entry to the building. In the case of electricity, these savings do not reflect power plant or distribution losses.

TABLE V-29

NEP VERSUS COMP/NEP

SENSITIVITY COMPARISON

COLLECTORS SOLD (MM SQ.FT.)

(CUMULATIVE THROUGH 1990)

	NEP	COMP/NEP	% COMP/NEP OVER (UNDER) NEP
Base Data	623	653	4.8%
Fuel Costs Up 25%	1,302	1,336	2.6
Collector Costs Up 15%	99	94	(5.1)
Collector Costs Down 15%	1,183	1,215	2.7
High Penetration Curve	2,300	2,328	1.2
Low Penetration Curve	107	94	(12.1)
No New Gas Hook-Ups after 1977	873	898	2.9

then analyzed both with the NEP version of the residential tax credit and with the compromise residential tax credit. This phased scenario consists of the following elements:

- The residential tax credits are phased out through 1986 rather than terminated in 1984. In the NEP version, this consists of a tax credit of 20% for the first thousand and 10% for expenditures over $1,000 and up to $6,400 for the years 1985 and 1986. The House compromise version of the residential tax credits has been extended through 1985 and 1986 with a 20% tax credit for the first $1,500 and 10% for the next $8,500.
- The investment tax credit remains the same.
- Accelerated depreciation and low interest loans are introduced in 1980 (versus 1978 in the previous analysis).
- The government buildings program is phased to have the first year (1979) at NEP level of expenditures ($33 million) the second year at Expanded NEP levels of expenditures ($67 million) the third and fourth years at New Initiatives levels of commitment ($167 million each) and a fifth and sixth year backed down to NEP levels ($33 million). The total cost for the six year program (versus a three year program used for the previous scenarios) is at the $500 million New Initiatives level.

The results of these two phased approaches are shown in Figure V-4 and compared against the original New Initiatives scenario. The two phased scenarios provide a much more gentle, although still dramatic, growth in the solar markets through 1985 and, because of the phased nature of their residential tax credits, the resulting slump from the elimination of that incentive is not as dramatic in 1987 as with the New Initiatives dip in 1985. While these scenarios may not represent the most appropriate phasing of incentives, they demonstrate the effect of the timing of the incentives on solar commercialization.

FIGURE V–4
ANNUAL SOLAR SYSTEM SALES
($MM)

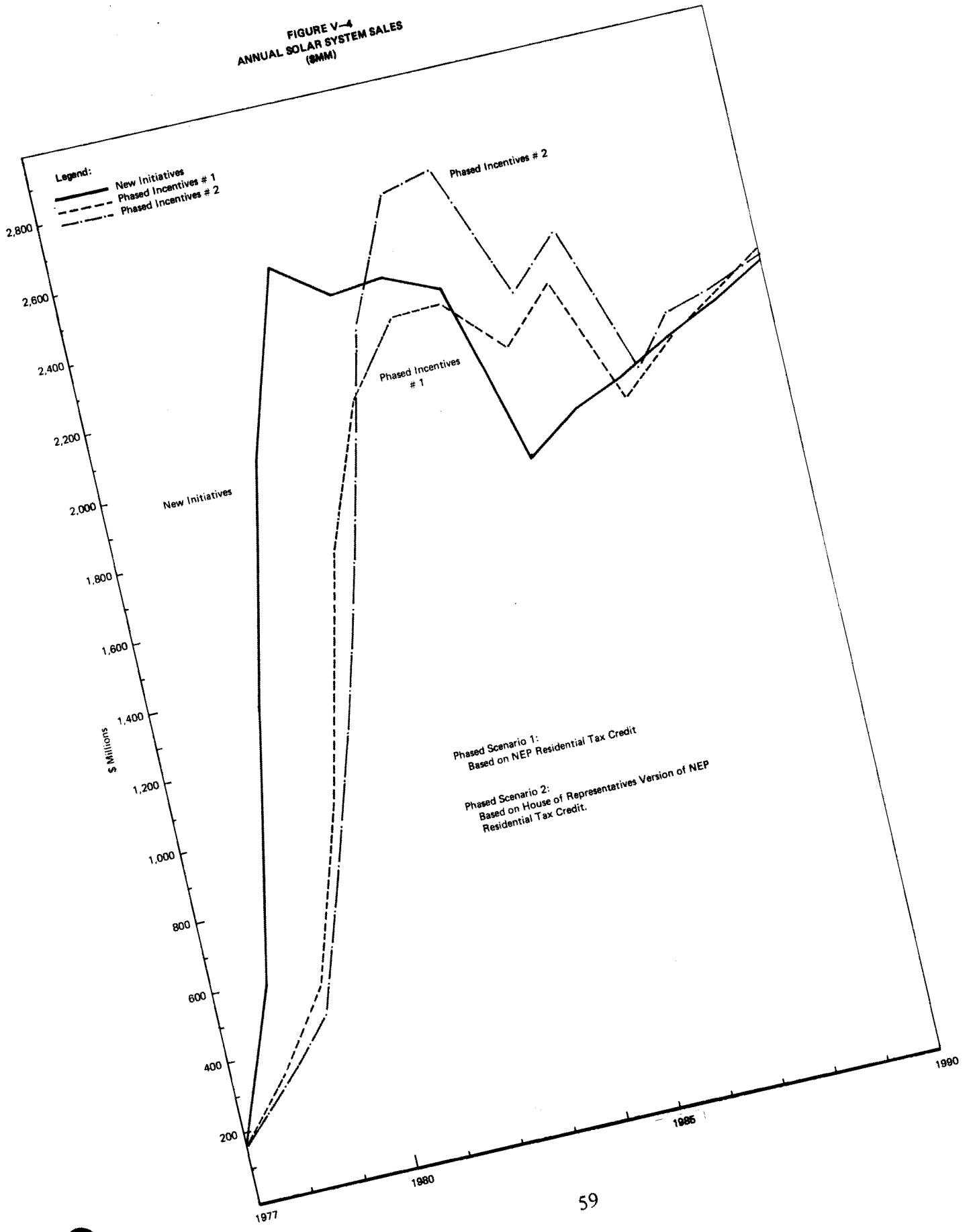

TABLE V-1

SOLAR IMPACT MODEL
REFERENCE CASE 28 SEPT 77
ANNUAL DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	56.0	69.4	76.7	79.4	76.1	71.9	67.8	68.9	76.0	81.1	90.3	100.8	116.3
SOLAR UNITS	(HHW)	7.5	11.5	14.8	18.3	19.3	18.9	18.2	17.6	18.1	20.2	21.5	23.0	24.4	27.8
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	45.6	67.6	84.2	95.0	98.8	95.0	90.1	85.4	87.0	96.2	102.6	113.3	125.3	144.1
COMMERCIAL	(HW)	0.7	1.2	1.4	1.4	1.4	1.4	1.4	1.3	1.4	1.5	1.7	1.9	2.1	2.5
SOLAR UNITS	(HHW)	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	1.4	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.8	2.0	2.2	2.5	2.9
PENETRATION	(HW)	0.42	0.64	0.81	0.87	0.90	0.86	0.81	0.76	0.77	0.85	0.91	1.01	1.13	1.30
RESIDENTIAL	(HHW)	0.08	0.13	0.17	0.21	0.22	0.21	0.20	0.20	0.20	0.23	0.24	0.26	0.27	0.31
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	0.77	0.99	1.08	1.12	1.07	1.02	0.96	0.98	1.08	1.15	1.27	1.40	1.61
PENETRATION	(HW)	0.62	1.05	1.25	1.32	1.32	1.29	1.26	1.23	1.26	1.40	1.53	1.71	1.94	2.24
COMMERCIAL	(HHW)	0.14	0.22	0.26	0.28	0.28	0.27	0.26	0.25	0.26	0.29	0.31	0.34	0.36	0.41
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.27	1.51	1.60	1.60	1.57	1.52	1.47	1.52	1.69	1.84	2.05	2.30	2.65
COLLECTOR	(HW)	2.2	3.2	3.8	4.0	4.1	3.8	3.5	3.3	3.3	3.5	3.7	4.1	4.5	5.1
SOLD	(HHW)	1.8	2.8	3.5	4.0	4.1	3.9	3.6	3.4	3.4	3.7	3.9	4.0	4.2	4.7
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	4.0	6.0	7.4	8.1	8.2	7.7	7.2	6.7	6.7	7.3	7.6	8.1	8.7	9.7
PVT DOLLARS	(HW)	96.3	134.3	154.9	160.4	160.5	151.4	141.2	131.6	132.0	143.9	152.1	167.6	184.8	208.5
INVESTED	(HHW)	56.6	86.9	107.4	119.8	121.6	115.1	107.8	101.2	102.3	112.0	116.7	122.3	127.8	141.6
(MIL $ S)	(HC)	0.0	0.3	0.5	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5
	(ALL)	152.9	221.5	262.7	280.8	282.7	267.1	249.5	233.2	234.7	256.3	269.2	290.3	313.0	350.6
TOT INDUSTRY	(HW)	96.3	135.0	155.6	161.2	161.0	151.9	141.7	132.1	132.5	144.4	152.6	168.2	185.5	209.3
SALES	(HHW)	56.6	88.0	108.6	121.1	122.5	115.9	108.5	101.9	103.0	112.8	117.5	123.2	128.7	142.6
(MIL $ S)	(HC)	0.0	0.3	0.5	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5
	(ALL)	152.9	223.2	264.7	282.9	284.1	268.4	250.7	234.4	235.9	257.6	270.6	291.8	314.6	352.4
BTU S SAVED	(HW)	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.6
GAS	(HHW)	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.4	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.7	0.7	0.9
BTU S SAVED	(HW)	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
OIL	(HHW)	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.3	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6
BTU S SAVED	(HW)	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5
ELECTRIC	(HHW)	0.2	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.4	0.5	0.6	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9
BTU S SAVED	(HW)	0.5	0.8	1.0	1.0	1.0	1.0	0.9	0.8	0.9	0.9	1.0	1.1	1.2	1.4
TOTAL	(HHW)	0.3	0.5	0.6	0.7	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.8	0.8	0.9
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	1.3	1.6	1.7	1.8	1.7	1.6	1.5	1.5	1.7	1.8	1.9	2.1	2.4

TABLE V-2

SOLAR IMPACT MODEL
REFERENCE CASE 28 SEPT 77
CUMULATIVE DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	94.1	163.5	240.2	319.6	395.7	467.6	535.5	604.4	680.4	761.5	851.8	952.7	1068.9
SOLAR UNITS	(HHW)	7.5	19.1	33.9	52.2	71.5	90.4	108.6	126.2	144.3	164.5	185.9	208.9	233.3	261.2
(000 UNITS)	(HC)	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
	(ALL)	45.6	113.2	197.4	292.5	391.2	486.3	576.4	661.8	748.9	845.1	947.7	1061.0	1186.3	1330.4
COMMERCIAL	(HW)	0.7	1.8	3.2	4.6	6.1	7.5	8.9	10.2	11.6	13.1	14.8	16.7	18.8	21.3
SOLAR UNITS	(HHW)	0.2	0.4	0.7	1.0	1.3	1.6	1.9	2.1	2.4	2.7	3.1	3.4	3.8	4.3
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	2.2	3.9	5.6	7.4	9.1	10.7	12.3	14.0	15.9	17.9	20.1	22.6	25.5
PENETRATION	(HW)	0.42	0.53	0.62	0.68	0.73	0.75	0.76	0.76	0.76	0.77	0.78	0.80	0.83	0.86
RESIDENTIAL	(HHW)	0.08	0.11	0.13	0.15	0.16	0.17	0.18	0.18	0.18	0.19	0.19	0.20	0.20	0.21
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	0.64	0.75	0.83	0.89	0.92	0.93	0.94	0.94	0.96	0.97	1.00	1.03	1.07
PENETRATION	(HW)	0.62	0.84	0.97	1.06	1.11	1.14	1.16	1.17	1.18	1.20	1.23	1.27	1.32	1.39
COMMERCIAL	(HHW)	0.14	0.18	0.21	0.22	0.24	0.24	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.28
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.01	1.18	1.28	1.35	1.38	1.40	1.41	1.42	1.45	1.48	1.53	1.59	1.67
COLLECTOR	(HW)	2.2	5.4	9.2	13.3	17.3	21.1	24.7	28.0	31.2	34.6	38.5	42.6	47.1	52.1
SOLD	(HHW)	1.8	4.6	8.1	12.1	16.3	20.2	23.8	27.2	30.6	34.4	38.2	42.3	46.5	51.1
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	4.0	10.0	17.4	25.4	33.6	41.3	48.5	55.2	61.9	69.2	76.8	84.9	93.6	103.3
PVT DOLLARS	(HW)	96.3	230.6	385.4	545.9	706.3	857.7	998.9	1130.5	1262.6	1406.4	1558.5	1726.1	1910.9	2119.4
INVESTED	(HHW)	56.6	143.5	250.9	370.7	492.4	607.5	715.2	816.4	918.7	1030.8	1147.4	1269.7	1397.5	1539.1
(MIL $ 8)	(HC)	0.0	0.3	0.7	1.3	1.9	2.5	3.0	3.4	3.8	4.3	4.7	5.1	5.6	6.1
	(ALL)	152.9	374.4	637.1	917.9	1200.6	1467.7	1717.2	1950.4	2185.1	2441.4	2710.6	3000.9	3314.0	3664.6
TOT INDUSTRY	(HW)	96.3	231.3	386.9	548.1	709.1	861.0	1002.7	1134.7	1267.2	1411.6	1564.2	1732.4	1917.9	2127.2
SALES	(HHW)	56.6	144.6	253.2	374.3	496.8	612.7	721.2	823.1	926.1	1038.9	1156.4	1279.5	1408.2	1550.8
(MIL $ S)	(HC)	0.0	0.3	0.7	1.3	1.9	2.5	3.0	3.4	3.8	4.3	4.7	5.2	5.6	6.1
	(ALL)	152.9	376.1	640.8	923.7	1207.8	1476.2	1726.9	1961.3	2197.1	2454.8	2725.4	3017.1	3331.8	3684.2
BTU S SAVED	(HW)	0.2	0.5	0.8	1.2	1.5	1.8	2.2	2.5	2.8	3.1	3.5	3.9	4.4	5.0
GAS	(HHW)	0.0	0.1	0.3	0.5	0.6	0.8	1.0	1.1	1.3	1.5	1.7	1.9	2.2	2.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.6	1.1	1.6	2.2	2.7	3.1	3.6	4.1	4.6	5.2	5.8	6.6	7.5
BTU S SAVED	(HW)	0.2	0.4	0.6	0.9	1.2	1.4	1.7	1.9	2.1	2.3	2.6	2.9	3.2	3.5
OIL	(HHW)	0.0	0.2	0.3	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.5	1.0	1.4	1.9	2.3	2.8	3.1	3.5	4.0	4.4	4.9	5.4	6.0
BTU S SAVED	(HW)	0.2	0.5	0.8	1.2	1.6	2.0	2.4	2.7	3.0	3.4	3.8	4.2	4.6	5.1
ELECTRIC	(HHW)	0.2	0.5	0.8	1.1	1.5	1.8	2.1	2.5	2.8	3.1	3.5	3.8	4.2	4.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.4	0.9	1.6	2.3	3.1	3.8	4.5	5.2	5.8	6.5	7.2	8.0	8.8	9.7
BTU S SAVED	(HW)	0.5	1.3	2.3	3.3	4.3	5.3	6.2	7.0	7.9	8.8	9.8	10.9	12.2	13.6
TOTAL	(HHW)	0.3	0.8	1.4	2.1	2.8	3.6	4.2	4.9	5.5	6.2	7.0	7.7	8.6	9.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	2.1	3.7	5.4	7.2	8.8	10.4	11.9	13.4	15.0	16.8	18.7	20.8	23.1

TABLE V-3

SOLAR IMPACT MODEL
REFERENCE CASE 28 SEPT 77
ANNUAL DATA – N/R

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	HH/INST	HH/OTHR	LH/INST	LH/LESR	LH/OUCU
RESIDENTIAL	(HH)	79.1	15.1	2.1	11.2	8.9	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHH)	18.0	4.0	0.7	3.2	2.0	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	97.1	19.1	2.8	14.4	10.9	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.5	1.0	0.4
SOLAR UNITS	(HHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.6	1.2	0.5
PENETRATION	(HH)	1.46	1.19	1.20	0.81	1.29	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHH)	0.33	0.32	0.40	0.23	0.28	0.0	0.0	0.0	0.0	0.0
(PCT)	(HC)	0.00	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
	(ALL)	1.79	1.50	1.61	1.04	1.57	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HH)	0.0	0.0	0.0	0.0	0.0	3.50	2.78	2.23	2.09	2.08
COMMERCIAL	(HHH)	0.0	0.0	0.0	0.0	0.0	0.68	0.50	0.39	0.39	0.38
(PCT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.0	0.0	0.0	0.0	0.0	4.17	3.27	2.62	2.47	2.45
COLLECTOR	(HH)	3.4	0.4	0.0	0.3	0.1	0.3	0.2	0.1	0.1	0.0
SOLD	(HHH)	2.7	0.5	0.0	0.2	0.2	0.2	0.1	0.4	0.3	0.1
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	6.1	0.9	0.1	0.5	0.3	0.5	0.3	0.5	0.4	0.2
PVT DOLLARS	(HH)	140.7	21.1	2.4	14.4	6.3	8.5	6.2	4.1	3.4	1.4
INVESTED	(HHH)	82.1	14.7	1.3	7.9	5.5	5.2	3.3	10.8	7.7	3.1
(MIL $ $)	(HC)	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	223.2	35.8	3.7	22.3	11.7	13.7	9.5	15.0	11.1	4.6
TOT INDUSTRY	(HH)	140.7	21.1	2.4	14.4	6.3	8.5	6.6	4.1	3.7	1.5
SALES	(HHH)	82.1	14.7	1.3	7.9	5.5	5.2	3.5	10.8	8.2	3.4
(MIL $ $)	(HC)	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	223.2	35.8	3.7	22.3	11.7	13.7	10.1	15.0	11.9	4.9
BTU $ SAVED	(HH)	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GAS	(HHH)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU $ SAVED	(HH)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OIL	(HHH)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU $ SAVED	(HH)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELECTRIC	(HHH)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.6	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
BTU $ SAVED	(HH)	1.0	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
TOTAL	(HHH)	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	1.5	0.2	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0

TABLE V-4

SOLAR IMPACT MODEL
REFERENCE CASE 28 SEPT 77
CUMULATIVE DATA – N/R

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	HH/INST	HH/OTHR	LH/INST	LH/LESR	LH/OOCU
RESIDENTIAL	(HH)	743.6	134.6	18.7	96.3	75.8	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHW)	173.3	34.4	6.6	29.1	17.7	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(MC)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	917.2	169.0	25.3	125.5	93.5	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.8	3.5	4.6	8.7	3.6
SOLAR UNITS	(HHW)	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.9	1.8	0.7
(000 UNITS)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	1.0	4.2	5.5	10.5	4.4
PENETRATION	(HH)	0.97	0.79	0.85	0.51	0.81	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHW)	0.23	0.20	0.30	0.15	0.19	0.0	0.0	0.0	0.0	0.0
(PCT)	(MC)	0.00	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
	(ALL)	1.20	1.00	1.15	0.66	1.00	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HH)	0.0	0.0	0.0	0.0	0.0	2.18	1.71	1.39	1.29	1.28
COMMERCIAL	(HHW)	0.0	0.0	0.0	0.0	0.0	0.46	0.34	0.27	0.26	0.26
(PCT)	(MC)	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.0	0.0	0.0	0.0	0.0	2.64	2.05	1.67	1.55	1.54
COLLECTOR	(HH)	35.6	4.4	0.5	2.7	1.4	3.0	2.0	1.2	0.9	0.4
SOLD	(HHW)	30.4	4.7	0.4	2.3	1.6	1.9	1.2	4.3	3.1	1.3
(MIL SQ FT)	(MC)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	66.1	9.1	0.9	5.0	3.1	4.9	3.2	5.4	4.0	1.6
PVT DOLLARS	(HH)	1462.1	209.3	23.5	135.0	60.8	84.0	60.4	39.6	31.5	13.2
INVESTED	(HHW)	900.5	144.9	14.9	81.4	58.0	54.1	34.5	128.9	86.9	35.2
(MIL $ $)	(MC)	4.8	0.3	0.0	0.0	0.0	0.3	0.2	0.1	0.2	0.1
	(ALL)	2367.5	354.5	38.3	216.4	118.8	138.4	95.1	168.6	118.6	48.4
TOT INDUSTRY	(HH)	1462.1	209.3	23.5	135.0	60.8	84.0	64.9	39.6	33.8	14.2
SALES	(HHW)	900.5	144.9	14.9	81.4	58.0	54.1	37.0	128.9	93.4	37.8
(MIL $ $)	(MC)	4.8	0.3	0.0	0.0	0.0	0.3	0.2	0.1	0.3	0.1
	(ALL)	2367.5	354.5	38.3	216.4	118.8	138.4	102.2	168.6	127.4	52.1
BTU $ SAVED	(HH)	3.6	0.5	0.0	0.3	0.1	0.2	0.1	0.1	0.1	0.0
GAS	(HHW)	1.3	0.2	0.0	0.1	0.0	0.1	0.1	0.3	0.2	0.1
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	4.9	0.7	0.0	0.4	0.1	0.3	0.2	0.4	0.3	0.1
BTU $ SAVED	(HH)	2.5	0.3	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.0
OIL	(HHW)	1.3	0.2	0.0	0.2	0.0	0.1	0.1	0.3	0.2	0.1
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	3.8	0.5	0.0	0.3	0.1	0.3	0.2	0.3	0.2	0.1
BTU $ SAVED	(HH)	3.3	0.4	0.1	0.3	0.2	0.4	0.3	0.1	0.1	0.0
ELECTRIC	(HHW)	3.0	0.4	0.0	0.2	0.2	0.1	0.1	0.2	0.2	0.1
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	6.3	0.8	0.1	0.4	0.4	0.5	0.4	0.3	0.3	0.1
BTU $ SAVED	(HH)	9.4	1.2	0.1	0.7	0.3	0.7	0.5	0.3	0.2	0.1
TOTAL	(HHW)	5.7	0.9	0.1	0.5	0.3	0.4	0.2	0.8	0.5	0.2
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	15.1	2.1	0.2	1.2	0.6	1.1	0.7	1.1	0.8	0.3

TABLE V-5

SOLAR IMPACT MODEL
REFERENCE CASE 28 SEPT 77
GOVERNMENT COST OF INCENTIVES, REGION 11 (MIL $)

INCENTIVE		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
TAX CREDIT RESIDENT	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TAX CREDIT COMMERCIAL	(MW)	0.0	0.7	0.8	0.8	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.8
	(MMW)	0.0	1.1	1.3	1.4	0.9	0.9	0.8	0.7	0.7	0.8	0.9	0.9	1.0	1.1
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	1.8	2.1	2.2	1.5	1.4	1.3	1.2	1.3	1.4	1.5	1.6	1.7	1.9
DIR SUBSIDY	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN PRESENT VAL	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN CASH FLOW	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC PRESENT VAL	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC CASH FLOW	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GOVERNMENT BUILDINGS	(MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MMW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R D & D	(MW)	29.0	32.0	34.0	20.0	12.0	8.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	(MMW)	29.0	32.0	33.0	20.0	12.0	8.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	96.0	100.0	60.0	35.0	23.0	15.0	12.0	10.0	10.0	10.0	10.0	10.0	10.0
PRESENT VAL	(MW)	29.0	32.7	34.8	20.8	12.6	8.5	5.5	4.5	4.5	4.5	4.6	4.7	4.7	4.8
TOTAL	(MMW)	29.0	33.1	34.3	21.4	12.9	8.9	5.8	4.7	3.7	3.8	3.9	3.9	4.0	4.1
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	97.8	102.1	62.2	36.5	24.4	16.3	13.2	11.3	11.4	11.5	11.6	11.7	11.9
CASH FLOW TOTAL	(MW)	29.0	32.7	34.8	20.8	12.6	8.5	5.5	4.5	4.5	4.5	4.6	4.7	4.7	4.8
	(MMW)	29.0	33.1	34.3	21.4	12.9	8.9	5.8	4.7	3.7	3.8	3.9	3.9	4.0	4.1
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	97.8	102.1	62.2	36.5	24.4	16.3	13.2	11.3	11.4	11.5	11.6	11.7	11.9

TABLE V-7

SOLAR IMPACT MODEL
NATIONAL ENERGY PLAN 28 SEPT 77
ANNUAL DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	91.8	151.5	207.3	298.3	362.5	441.1	483.9	376.1	409.6	430.6	454.0	474.5	508.1
SOLAR UNITS	(HHW)	7.5	18.8	40.2	68.7	110.5	148.7	192.4	226.1	200.2	218.9	229.8	241.5	253.0	265.3
(000 UNITS)	(HC)	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
	(ALL)	45.6	110.6	191.7	276.2	409.0	511.2	633.8	710.3	576.5	628.7	660.6	695.7	727.5	773.7
COMMERCIAL	(HW)	0.7	1.4	2.0	3.0	4.0	5.0	5.3	5.8	6.4	7.0	7.4	8.0	8.6	9.2
SOLAR UNITS	(HHW)	0.2	0.3	0.5	0.8	1.1	1.5	1.7	2.0	2.2	2.5	2.6	2.8	2.9	3.1
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	1.7	2.5	3.8	5.1	6.5	7.1	7.8	8.6	9.4	10.0	10.7	11.5	12.3
PENETRATION	(HW)	0.42	1.05	1.77	2.35	3.37	4.09	4.97	5.45	4.23	4.60	4.84	5.09	5.32	5.69
RESIDENTIAL	(HHW)	0.08	0.22	0.47	0.78	1.25	1.68	2.17	2.55	2.25	2.46	2.58	2.71	2.84	2.97
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	1.26	2.24	3.13	4.62	5.77	7.15	8.00	6.48	7.06	7.42	7.80	8.16	8.66
PENETRATION	(HW)	0.62	1.25	1.83	2.77	3.64	4.59	4.91	5.35	5.81	6.37	6.78	7.29	7.80	8.41
COMMERCIAL	(HHW)	0.14	0.24	0.45	0.72	1.01	1.40	1.60	1.83	2.05	2.24	2.37	2.51	2.65	2.79
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.49	2.28	3.49	4.66	5.99	6.51	7.19	7.86	8.61	9.15	9.80	10.45	11.20
COLLECTOR	(HW)	2.2	5.0	7.9	10.5	14.7	17.5	20.7	22.2	17.4	18.6	19.2	19.8	20.4	21.4
SOLD	(HHW)	1.8	4.2	8.8	14.4	22.3	29.4	36.6	41.7	37.1	39.7	40.6	41.7	42.6	43.6
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	4.0	9.2	16.8	25.0	37.1	47.0	57.4	64.0	54.6	58.3	59.9	61.6	63.1	65.1
PVT DOLLARS	(HW)	96.3	153.0	215.3	279.3	355.9	409.6	464.8	484.5	465.5	501.0	520.5	542.0	559.7	593.6
INVESTED	(HHW)	56.6	103.4	197.7	304.3	429.8	546.8	659.2	730.8	749.7	804.4	827.6	853.1	876.6	901.3
(MIL $ $)	(HC)	0.0	0.4	1.5	2.5	3.1	3.7	4.0	4.2	3.5	3.7	3.8	3.9	4.0	4.0
	(ALL)	152.9	256.7	414.4	586.1	788.8	960.0	1128.1	1419.5	1218.8	1309.1	1352.0	1399.0	1440.3	1498.9
TOT INDUSTRY	(HW)	96.3	210.5	299.7	358.5	459.6	505.1	573.3	599.6	467.2	502.7	522.4	543.9	561.7	595.7
SALES	(HHW)	56.6	131.1	252.6	370.8	525.0	639.3	765.2	849.7	754.3	809.3	832.8	858.5	882.1	906.9
(MIL $ $)	(HC)	0.0	0.4	1.7	2.8	3.5	4.0	4.4	4.6	3.5	3.7	3.8	3.9	4.0	4.1
	(ALL)	152.9	342.1	554.0	732.1	988.2	1148.3	1342.9	1453.8	1225.0	1315.8	1358.9	1406.3	1447.8	1506.7
BTU $ SAVED	(HW)	0.2	0.4	0.6	0.9	1.2	1.5	1.8	2.0	1.8	2.0	2.1	2.2	2.3	2.6
GAS	(HHW)	0.0	0.1	0.4	0.6	1.1	1.5	2.0	2.4	2.2	2.6	2.8	3.0	3.2	3.4
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.5	1.0	1.5	2.3	3.0	3.8	4.5	4.0	4.5	4.8	5.2	5.5	6.0
BTU $ SAVED	(HW)	0.2	0.3	0.5	0.7	1.0	1.2	1.5	1.7	1.2	1.4	1.5	1.6	1.6	1.7
OIL	(HHW)	0.0	0.2	0.4	0.7	1.2	1.6	2.1	2.4	2.2	2.4	2.4	2.5	2.5	2.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.5	0.9	1.4	2.2	2.9	3.6	4.1	3.5	3.7	3.9	4.0	4.1	4.3
BTU $ SAVED	(HW)	0.2	0.5	0.8	1.0	1.5	1.7	2.0	2.2	1.6	1.7	1.7	1.8	1.8	1.8
ELECTRIC	(HHW)	0.2	0.4	0.8	1.2	1.9	2.4	2.9	3.3	2.8	3.0	3.0	3.1	3.1	3.2
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.4	0.9	1.6	2.3	3.3	4.1	4.9	5.5	4.5	4.7	4.7	4.8	4.9	5.0
BTU $ SAVED	(HW)	0.5	1.2	1.9	2.6	3.7	4.5	5.4	5.8	4.6	5.0	5.3	5.5	5.7	6.1
TOTAL	(HHW)	0.3	0.7	1.6	2.6	4.1	5.5	7.0	8.1	7.3	7.9	8.2	8.5	8.8	9.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	1.9	3.5	5.2	7.8	10.0	12.4	13.9	11.9	12.9	13.5	14.0	14.6	15.3

TABLE V-8

SOLAR IMPACT MODEL
NATIONAL ENERGY PLAN 28 SEPT 77
CUMULATIVE DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	129.9	281.4	488.7	787.0	1149.3	1590.4	2074.2	2450.4	2860.0	3290.6	3744.5	4218.8	4726.9
SOLAR UNITS	(HHW)	7.5	26.4	66.5	135.2	245.7	394.4	586.8	812.9	1013.1	1232.0	1461.7	1703.2	1956.2	2221.6
(000 UNITS)	(HC)	0.0	0.0	0.1	0.3	0.5	0.7	1.0	1.3	1.5	1.7	2.0	2.2	2.4	2.7
	(ALL)	45.6	156.3	348.0	624.2	1033.2	1544.4	2178.1	2888.4	3464.9	4093.7	4754.2	5450.0	6177.5	6951.2
COMMERCIAL	(HW)	0.7	2.1	4.1	7.1	11.1	16.1	21.4	27.2	33.6	40.6	48.0	56.0	64.5	73.8
SOLAR UNITS	(HHW)	0.2	0.4	0.9	1.7	2.8	4.3	6.1	8.1	10.3	12.8	15.4	18.1	21.0	24.1
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	2.5	5.0	8.8	13.9	20.4	27.5	35.3	43.9	53.3	63.4	74.1	85.6	97.9
PENETRATION	(HW)	0.42	0.73	1.07	1.39	1.79	2.17	2.58	2.94	3.08	3.23	3.38	3.52	3.66	3.81
RESIDENTIAL	(HHW)	0.08	0.15	0.25	0.38	0.56	0.75	0.95	1.15	1.27	1.39	1.50	1.60	1.70	1.79
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	0.88	1.32	1.77	2.35	2.92	3.53	4.09	4.36	4.63	4.88	5.13	5.36	5.60
PENETRATION	(HW)	0.62	0.94	1.23	1.61	2.02	2.44	2.79	3.11	3.41	3.71	3.99	4.26	4.54	4.81
COMMERCIAL	(HHW)	0.14	0.19	0.28	0.39	0.51	0.66	0.79	0.92	1.05	1.17	1.28	1.38	1.48	1.57
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.13	1.51	2.00	2.53	3.10	3.59	4.04	4.46	4.88	5.26	5.64	6.01	6.39
COLLECTOR	(HW)	2.2	7.2	15.1	25.6	40.4	57.9	78.6	100.8	118.2	136.8	155.9	175.8	196.1	217.6
SOLD	(HHW)	1.8	5.9	14.8	29.2	51.5	80.9	117.5	159.2	196.4	236.1	276.7	318.4	361.0	404.7
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
	(ALL)	4.0	13.1	29.9	54.9	92.0	139.0	196.4	260.4	315.0	373.3	433.2	494.8	557.8	623.0
PVT DOLLARS	(HW)	96.3	249.3	464.5	743.8	1099.7	1509.3	1974.1	2458.6	2924.1	3425.1	3945.6	4487.6	5047.3	5640.8
INVESTED	(HHW)	56.6	160.0	357.7	662.0	1091.8	1638.6	2297.9	3028.7	3778.4	4582.7	5410.4	6263.5	7140.1	8041.4
(MIL $ $)	(HC)	0.0	0.4	1.8	4.3	7.4	11.1	15.1	19.3	22.9	26.6	30.4	34.2	38.2	42.2
	(ALL)	152.9	409.6	824.0	1410.1	2198.9	3159.0	4287.1	5506.6	6725.3	8034.4	9386.3	10785.4	12225.6	13724.5
TOT INDUSTRY	(HW)	96.3	306.8	606.5	965.1	1424.7	1929.8	2503.1	3102.6	3569.8	4072.5	4594.8	5138.8	5700.5	6296.2
SALES	(HHW)	56.6	187.7	440.4	811.2	1336.2	1975.4	2740.7	3590.3	4344.6	5153.9	5986.7	6845.2	7727.3	8634.2
(MIL $ $)	(HC)	0.0	0.4	2.1	4.9	8.4	12.4	16.7	21.3	24.8	28.6	32.4	36.3	40.3	44.3
	(ALL)	152.9	495.0	1049.0	1781.1	2769.2	3917.6	5260.5	6714.3	7939.3	9255.0	10614.0	12020.2	13468.0	14974.7
BTU S SAVED	(HW)	0.2	0.6	1.2	2.1	3.3	4.8	6.6	8.6	10.4	12.3	14.4	16.6	18.9	21.6
GAS	(HHW)	0.0	0.1	0.5	1.2	2.2	3.7	5.7	8.1	10.3	12.9	15.6	18.6	21.8	25.2
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.7	1.7	3.2	5.5	8.5	12.3	16.6	20.7	25.2	30.0	35.2	40.7	46.7
BTU S SAVED	(HW)	0.2	0.5	1.0	1.7	2.7	4.0	5.5	7.1	8.4	9.8	11.2	12.8	14.4	16.1
OIL	(HHW)	0.0	0.2	0.6	1.4	2.6	4.2	6.3	8.7	10.9	13.2	15.6	18.1	20.6	23.2
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.7	1.6	3.1	5.3	8.2	11.7	15.8	19.3	23.0	26.9	30.9	35.0	39.3
BTU S SAVED	(HW)	0.2	0.7	1.5	2.5	4.0	5.7	7.7	9.9	11.5	13.2	14.9	16.6	18.4	20.3
ELECTRIC	(HHW)	0.2	0.6	1.4	2.6	4.5	6.9	9.8	13.1	16.0	18.9	22.0	25.0	28.2	31.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	0.4	1.3	2.9	5.1	8.5	12.6	17.6	23.1	27.5	32.2	36.9	41.8	46.7	51.7
BTU S SAVED	(HW)	0.5	1.8	3.7	6.3	10.0	14.5	19.8	25.6	30.2	35.5	40.5	46.1	51.8	57.9
TOTAL	(HHW)	0.3	1.0	2.5	5.2	9.3	14.8	21.8	29.8	37.1	45.0	53.2	61.7	70.5	79.7
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	0.8	2.7	6.2	11.5	19.3	29.3	41.6	55.5	67.4	80.4	93.8	107.9	122.5	137.7

TABLE V-9

SOLAR IMPACT MODEL
NATIONAL ENERGY PLAN 28 SEPT 77
ANNUAL DATA – N/R

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	HH/INST	HH/OTHR	LH/INST	LH/LESR	LH/OOCU
RESIDENTIAL	(HH)	546.7	63.0	8.8	55.0	36.5	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHH)	169.0	40.2	6.3	33.8	16.2	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(HC)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	515.9	103.2	15.1	86.8	52.7	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.3	1.4	2.0	5.9	1.6
SOLAR UNITS	(HHH)	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.6	1.5	0.5
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.4	1.9	2.6	5.2	2.2
PENETRATION	(HH)	6.40	4.97	5.15	3.83	5.27	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHH)	3.12	3.17	3.66	2.44	2.33	0.0	0.0	0.0	0.0	0.0
(PCT)	(HC)	0.00	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
	(ALL)	9.53	8.14	8.81	6.28	7.61	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HH)	0.0	0.0	0.0	0.0	0.0	10.71	9.85	8.53	7.98	7.97
COMMERCIAL	(HHH)	0.0	0.0	0.0	0.0	0.0	4.11	3.36	2.65	2.68	2.62
(PCT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.00	0.00	0.00
	(ALL)	0.0	0.0	0.0	0.0	0.0	14.82	13.22	11.18	10.66	10.59
COLLECTOR	(HH)	14.8	1.8	0.2	1.3	0.6	0.9	0.7	0.5	0.4	0.2
SOLD	(HHH)	27.0	4.9	0.4	2.5	1.3	1.2	0.8	2.7	2.1	0.9
(MIL SQ FT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	41.8	6.7	0.6	3.8	1.9	2.1	1.6	3.2	2.5	1.0
PVT DOLLARS	(HH)	403.8	57.7	6.6	44.1	19.5	19.6	16.4	11.9	9.8	4.1
INVESTED	(HHH)	533.7	101.4	8.4	58.4	34.4	24.2	17.5	60.4	44.6	18.3
(MIL $ $)	(HC)	2.9	0.3	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1
	(ALL)	940.5	159.3	15.0	102.6	53.9	44.1	34.1	72.4	54.6	22.5
TOT INDUSTRY	(HH)	403.8	57.7	6.6	44.1	19.5	19.6	17.6	11.9	10.5	4.4
SALES	(HHH)	533.7	101.4	8.4	58.4	34.4	24.2	18.7	60.4	47.7	19.6
(MIL $ $)	(HC)	2.9	0.3	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.1
	(ALL)	940.5	159.3	15.0	102.6	53.9	44.1	36.5	72.4	58.4	24.1
BTU S SAVED	(HH)	1.9	0.2	0.0	0.2	0.0	0.1	0.1	0.1	0.0	0.0
GAS	(HHH)	2.0	0.4	0.0	0.2	0.1	0.1	0.1	0.3	0.2	0.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	3.9	0.6	0.0	0.4	0.1	0.2	0.1	0.3	0.2	0.1
BTU S SAVED	(HH)	1.2	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
OIL	(HHH)	1.5	0.3	0.0	0.2	0.0	0.1	0.1	0.2	0.1	0.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	2.8	0.4	0.0	0.3	0.1	0.2	0.1	0.2	0.2	0.1
BTU S SAVED	(HH)	1.2	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
ELECTRIC	(HHH)	2.1	0.4	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	3.3	0.5	0.1	0.3	0.2	0.2	0.1	0.1	0.1	0.1
BTU S SAVED	(HH)	4.3	0.5	0.1	0.4	0.2	0.3	0.2	0.1	0.1	0.0
TOTAL	(HHH)	5.7	1.0	0.1	0.6	0.2	0.3	0.2	0.5	0.4	0.2
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	10.0	1.5	0.1	0.9	0.4	0.5	0.4	0.7	0.5	0.2

TABLE V-11

SOLAR IMPACT MODEL
NATIONAL ENERGY PLAN 28 SEPT 77
GOVERNMENT COST OF INCENTIVES, REGION 11 (MIL $)

INCENTIVE		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
TAX CREDIT RESIDENT	(HH)	0.0	57.1	83.8	77.4	102.4	93.5	108.8	115.4	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	25.3	51.2	60.6	88.9	84.2	102.8	115.4	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	82.4	135.1	138.3	191.6	177.9	211.9	231.2	0.0	0.0	0.0	0.0	0.0	0.0
TAX CREDIT COMMERCIAL	(HH)	0.0	4.2	6.2	7.0	8.2	8.3	8.7	7.2	1.7	1.8	1.9	2.0	2.2	2.3
	(MHH)	0.0	4.3	7.4	10.2	12.5	14.2	10.1	11.2	4.9	5.3	5.5	5.7	5.8	6.0
	(MC)	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	8.5	13.6	17.2	20.7	22.6	18.8	18.4	6.6	7.2	7.4	7.7	8.0	8.3
DIR SUBSIDY	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN PRESENT VAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN CASH FLOW	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC PRESENT VAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC CASH FLOW	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GOVERNMENT BUILDINGS	(HH)	0.0	0.0	12.0	11.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	11.0	11.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	11.0	11.0	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	34.0	33.0	33.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R D & D	(HH)	29.0	32.0	34.0	20.0	12.0	8.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	(MHH)	29.0	32.0	33.0	20.0	12.0	8.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	96.0	100.0	60.0	35.0	23.0	15.0	12.0	10.0	10.0	10.0	10.0	10.0	10.0
PRESENT VAL	(HH)	29.0	93.3	135.9	115.4	133.5	109.7	120.5	126.6	5.7	5.8	5.9	6.0	6.2	6.3
TOTAL	(MHH)	29.0	61.5	102.5	101.8	124.4	106.4	117.9	130.6	7.9	8.5	8.5	8.7	8.8	9.0
	(MC)	29.0	32.1	44.2	31.3	22.4	7.4	5.4	4.4	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	186.9	282.7	248.5	280.3	223.5	243.7	261.5	16.6	17.2	17.4	17.7	18.0	18.3
CASH FLOW TOTAL	(HH)	29.0	93.3	135.9	115.4	133.5	109.7	120.5	126.6	5.7	5.8	5.9	6.0	6.2	6.3
	(MHH)	29.0	61.5	102.5	101.8	124.4	106.4	117.9	130.6	7.9	8.5	8.5	8.7	8.8	9.0
	(MC)	29.0	32.1	44.2	31.3	22.4	7.4	5.4	4.4	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	186.9	282.7	248.5	280.3	223.5	243.7	261.5	16.6	17.2	17.4	17.7	18.0	18.3

TABLE V-14

SOLAR IMPACT MODEL
EXPANDED NATIONAL ENERGY PLAN 28 SEPT 77
ANNUAL DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(MW)	38.1	97.0	180.1	270.3	399.9	467.1	528.0	545.6	414.8	447.3	468.1	490.6	519.8	554.0
SOLAR UNITS	(MWW)	7.5	19.9	48.8	94.3	157.9	204.4	244.3	264.8	225.9	244.9	256.4	269.4	281.9	296.0
(000 UNITS)	(MC)	0.0	0.0	0.2	0.3	0.4	0.4	0.5	0.5	0.3	0.4	0.4	0.4	0.4	0.4
	(ALL)	45.6	117.0	229.1	364.9	558.2	671.9	772.7	810.9	641.0	692.6	724.9	760.4	802.0	850.3
COMMERCIAL	(MW)	0.7	1.5	2.4	3.8	5.1	6.2	6.4	6.6	6.9	7.5	7.9	8.6	9.2	9.9
SOLAR UNITS	(MWW)	0.2	0.3	0.6	1.0	1.5	2.1	2.2	2.4	2.5	2.7	2.9	3.1	3.2	3.4
(000 UNITS)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	1.7	3.0	4.8	6.6	8.3	8.6	9.0	9.4	10.2	10.8	11.6	12.4	13.3
PENETRATION	(MW)	0.42	1.11	2.11	3.06	4.52	5.27	5.95	6.14	4.66	5.02	5.26	5.50	5.83	6.20
RESIDENTIAL	(MWW)	0.08	0.23	0.57	1.07	1.79	2.31	2.75	2.98	2.54	2.75	2.88	3.02	3.16	3.31
(PCT)	(MC)	0.0	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	1.34	2.68	4.13	6.31	7.59	8.71	9.13	7.21	7.78	8.14	8.53	8.99	9.52
PENETRATION	(MW)	0.62	1.31	2.16	3.48	4.69	5.71	5.83	6.03	6.30	6.84	7.25	7.82	8.36	9.00
COMMERCIAL	(MWW)	0.14	0.26	0.54	0.94	1.41	1.91	2.04	2.17	2.30	2.51	2.65	2.80	2.95	3.10
(PCT)	(MC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.57	2.71	4.42	6.11	7.62	7.88	8.20	8.60	9.36	9.91	10.62	11.32	12.10
COLLECTOR	(MW)	2.2	5.3	9.4	13.7	19.6	22.5	24.7	25.0	19.1	20.3	20.8	21.4	22.3	23.4
SOLD	(MWW)	1.8	4.4	10.8	19.8	31.9	40.5	46.7	49.1	42.0	44.5	45.4	46.6	47.6	48.7
(MIL SQ FT)	(MC)	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	4.0	9.7	20.2	33.6	51.7	63.1	71.5	74.2	61.2	64.9	66.4	68.1	70.0	72.2
PVT DOLLARS	(MW)	96.3	161.6	248.6	343.0	438.3	491.4	530.6	532.3	505.9	539.2	557.6	577.5	605.5	638.7
INVESTED	(MWW)	56.6	110.2	236.9	396.2	572.3	710.6	808.7	841.9	836.2	891.0	914.4	942.4	967.2	996.4
(MIL $ $)	(MC)	0.0	0.4	2.2	4.0	5.3	5.9	6.4	6.4	5.4	5.7	5.8	6.0	6.1	6.2
	(ALL)	152.9	272.2	487.8	743.2	1015.9	1207.9	1345.6	1380.6	1347.6	1435.9	1477.8	1525.9	1578.8	1639.2
TOT INDUSTRY	(MW)	96.3	222.4	347.0	441.9	569.1	608.8	656.4	659.7	507.6	541.1	559.6	579.6	607.7	641.0
SALES	(MWW)	56.6	139.7	303.1	484.1	699.8	831.3	938.8	978.7	841.4	896.5	920.1	948.3	973.3	1000.6
(MIL $ $)	(MC)	0.0	0.4	2.6	4.5	6.0	6.5	6.9	7.0	5.4	5.8	5.9	6.0	6.1	6.2
	(ALL)	152.9	362.5	652.7	930.4	1274.9	1446.6	1602.1	1645.4	1354.5	1443.4	1485.5	1533.9	1587.1	1647.8
BTU $ SAVED	(MW)	0.2	0.4	0.7	1.1	1.6	1.9	2.2	2.3	2.0	2.1	2.3	2.4	2.6	2.9
GAS	(MWW)	0.0	0.1	0.5	0.9	1.6	2.2	2.7	2.9	2.6	2.9	3.1	3.4	3.6	3.9
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.6	1.2	2.0	3.2	4.1	4.9	5.1	4.5	5.1	5.4	5.8	6.2	6.8
BTU $ SAVED	(MW)	0.2	0.4	0.6	0.9	1.4	1.7	1.9	1.9	1.4	1.5	1.6	1.7	1.8	1.8
OIL	(MWW)	0.0	0.2	0.5	1.0	1.7	2.3	2.7	2.8	2.5	2.6	2.7	2.8	2.8	2.9
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.5	1.2	2.0	3.1	3.9	4.6	4.8	3.9	4.2	4.3	4.5	4.6	4.7
BTU $ SAVED	(MW)	0.2	0.5	0.9	1.4	1.9	2.2	2.3	2.4	1.7	1.8	1.8	1.9	1.9	1.9
ELECTRIC	(MWW)	0.2	0.4	0.9	1.6	2.6	3.2	3.6	3.8	3.2	3.3	3.3	3.4	3.4	3.5
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.4	0.9	1.8	3.0	4.5	5.4	6.0	6.2	4.9	5.1	5.2	5.3	5.4	5.4
BTU $ SAVED	(MW)	0.5	1.3	2.3	3.4	4.9	5.8	6.4	6.6	5.1	5.5	5.7	6.0	6.3	6.7
TOTAL	(MWW)	0.3	0.8	1.9	3.6	5.9	7.6	9.0	9.5	8.3	8.9	9.2	9.5	9.9	10.2
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	2.0	4.2	7.0	10.9	13.4	15.4	16.1	13.4	14.4	14.9	15.5	16.2	17.0

TABLE V-15

SOLAR IMPACT MODEL
EXPANDED NATIONAL ENERGY PLAN 28 SEPT 77
CUMULATIVE DATA – N/R

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	135.1	315.2	585.6	985.5	1452.6	1980.6	2526.2	2941.0	3388.3	3856.4	4347.0	4866.7	5420.7
SOLAR UNITS	(HHW)	7.5	27.5	76.3	170.6	328.5	533.0	777.3	1042.1	1267.9	1512.9	1769.3	2038.7	2320.6	2616.5
(000 UNITS)	(HC)	0.0	0.0	0.2	0.5	0.8	1.2	1.7	2.2	2.5	2.9	3.2	3.6	4.0	4.4
	(ALL)	45.6	162.6	391.7	756.6	1314.8	1986.8	2759.5	3570.4	4211.4	4904.0	5628.9	6389.3	7191.3	8041.6
COMMERCIAL	(HW)	0.7	2.1	4.5	8.3	13.4	19.6	26.0	32.5	39.4	46.9	54.9	63.4	72.6	82.5
SOLAR UNITS	(HHW)	0.2	0.4	1.0	2.1	3.6	5.7	7.9	10.3	12.8	15.5	18.4	21.5	24.7	28.1
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	(ALL)	0.8	2.6	5.5	10.4	17.0	25.3	33.9	42.8	52.2	62.5	73.3	85.0	97.4	110.7
PENETRATION	(HW)	0.42	0.76	1.20	1.66	2.24	2.75	3.21	3.58	3.70	3.83	3.96	4.09	4.23	4.37
RESIDENTIAL	(HHW)	0.08	0.15	0.29	0.48	0.75	1.01	1.26	1.48	1.59	1.71	1.82	1.92	2.01	2.11
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.50	0.91	1.49	2.15	2.99	3.76	4.47	5.05	5.30	5.55	5.78	6.01	6.24	6.48
PENETRATION	(HW)	0.62	0.97	1.36	1.89	2.44	2.98	3.39	3.72	4.00	4.29	4.56	4.83	5.10	5.38
COMMERCIAL	(HHW)	0.14	0.20	0.31	0.47	0.66	0.86	1.03	1.17	1.30	1.42	1.53	1.64	1.74	1.84
(PCT)	(HC)	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(ALL)	0.76	1.17	1.68	2.36	3.10	3.85	4.42	4.89	5.30	5.71	6.09	6.47	6.84	7.22
COLLECTOR	(HW)	2.2	7.5	16.8	30.5	50.1	72.6	97.3	122.3	141.4	161.7	182.5	203.9	226.2	249.6
SOLD	(HHW)	1.8	6.2	17.0	36.9	68.8	109.3	156.0	205.1	247.1	291.5	337.0	383.6	431.2	480.0
(MIL SQ FT)	(HC)	0.0	0.0	0.1	0.1	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
	(ALL)	4.0	13.7	33.9	67.5	119.2	182.3	253.8	328.0	389.1	454.0	520.4	588.5	658.5	730.7
PVT DOLLARS	(HW)	96.3	257.9	506.6	849.6	1287.8	1779.2	2309.8	2842.1	3348.0	3887.2	4444.8	5022.4	5627.9	6266.6
INVESTED	(HHW)	56.6	166.9	403.8	800.0	1372.3	2082.9	2891.5	3733.5	4569.7	5460.7	6375.0	7317.5	8284.7	9279.0
(MIL $ $)	(HC)	0.0	0.4	2.6	6.6	11.9	17.9	24.2	30.7	36.1	41.8	47.6	53.6	59.6	65.8
	(ALL)	152.9	425.2	913.0	1656.2	2672.1	3879.9	5225.6	6606.2	7953.8	9389.7	10867.5	12393.4	13972.2	15611.4
TOT INDUSTRY	(HW)	96.3	318.7	665.7	1107.6	1676.7	2285.5	2941.9	3601.6	4109.3	4650.3	5209.9	5789.4	6397.1	7038.1
SALES	(HHW)	56.6	196.3	499.4	983.5	1683.3	2514.6	3453.4	4432.1	5273.5	6170.0	7090.1	8038.4	9011.7	10018.3
(MIL $ $)	(HC)	0.0	0.4	3.0	7.5	13.5	20.0	26.9	33.9	39.4	45.1	51.0	57.0	63.1	69.3
	(ALL)	152.9	515.4	1168.2	2098.6	3373.5	4820.1	6422.2	8067.6	9422.1	10865.5	12350.9	13884.8	15471.9	17119.7
BTU $ SAVED	(HW)	0.2	0.6	1.3	2.5	4.1	6.0	8.2	10.4	12.4	14.6	16.8	19.2	21.8	24.7
GAS	(HHW)	0.0	0.2	0.7	1.6	3.2	5.4	8.0	10.9	13.5	16.4	19.5	22.9	26.6	30.4
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.8	2.0	4.0	7.3	11.4	16.2	21.3	25.9	31.0	36.4	42.1	48.4	55.2
BTU $ SAVED	(HW)	0.2	0.5	1.1	2.0	3.4	5.1	7.0	8.9	10.3	11.9	13.5	15.2	17.0	18.8
OIL	(HHW)	0.0	0.2	0.8	1.8	3.5	5.8	8.5	11.3	13.8	16.5	19.2	21.9	24.8	27.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.7	1.9	3.8	7.0	10.9	15.5	20.2	24.1	28.3	32.7	37.1	41.7	46.5
BTU $ SAVED	(HW)	0.2	0.7	1.6	3.0	4.9	7.1	9.5	11.8	13.6	15.4	17.2	19.1	21.0	23.0
ELECTRIC	(HHW)	0.2	0.6	1.6	3.2	5.8	9.0	12.6	16.4	19.6	22.9	26.2	29.6	33.0	36.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
	(ALL)	0.4	1.4	3.2	6.2	10.8	16.1	22.1	28.3	33.2	38.4	43.6	48.8	54.2	59.6
BTU $ SAVED	(HW)	0.5	1.8	4.1	7.5	12.4	18.2	24.6	31.2	36.3	41.8	47.5	53.5	59.8	66.5
TOTAL	(HHW)	0.3	1.0	3.0	6.6	12.5	20.1	29.1	38.6	46.9	55.7	64.9	74.5	84.3	94.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
	(ALL)	0.8	2.8	7.1	14.1	25.0	38.4	53.8	69.9	83.3	97.7	112.6	128.1	144.3	161.2

TABLE V-16

SOLAR IMPACT MODEL
EXPANDED NATIONAL ENERGY PLAN 28 SEPT 77
ANNUAL DATA – N/R

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	MM/INST	MM/OTHR	LM/INST	LM/LESR	LM/OOCU
RESIDENTIAL	(MW)	381.0	68.2	9.4	56.6	38.7	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(MHW)	188.1	44.9	7.0	37.9	18.1	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(MC)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	569.4	113.1	16.4	94.5	56.8	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(MW)	0.0	0.0	0.0	0.0	0.0	0.3	1.5	2.1	4.2	1.7
SOLAR UNITS	(MHW)	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.7	1.5	0.6
(000 UNITS)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.4	2.1	2.8	5.7	2.3
PENETRATION	(MW)	7.04	5.38	5.50	4.10	5.59	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(MHW)	3.47	3.54	4.07	2.74	2.61	0.0	0.0	0.0	0.0	0.0
(PCT)	(MC)	0.01	0.00	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0
	(ALL)	10.51	8.92	9.57	6.84	8.20	0.0	0.0	0.0	0.0	0.0
PENETRATION	(MW)	0.0	0.0	0.0	0.0	0.0	11.26	10.41	9.15	8.56	8.55
COMMERCIAL	(MHW)	0.0	0.0	0.0	0.0	0.0	4.55	3.74	2.94	2.98	2.92
(PCT)	(MC)	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.00	0.00	0.00
	(ALL)	0.0	0.0	0.0	0.0	0.0	15.81	14.16	12.09	11.55	11.47
COLLECTOR	(MW)	16.3	2.0	0.2	1.4	0.6	1.0	0.8	0.5	0.4	0.2
SOLD	(MHW)	30.1	5.5	0.4	2.8	1.4	1.3	0.9	3.0	2.3	1.0
(MIL SQ FT)	(MC)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	46.4	7.5	0.6	4.2	2.1	2.3	1.7	3.5	2.8	1.1
PVT DOLLARS	(MW)	438.0	61.5	6.9	46.5	20.5	20.5	17.2	12.6	10.5	4.4
INVESTED	(MHW)	587.5	111.9	9.3	64.9	38.2	26.6	19.3	66.8	49.5	20.4
(MIL $ $)	(MC)	4.4	0.5	0.0	0.0	0.1	0.3	0.2	0.2	0.3	0.1
	(ALL)	1029.9	174.0	16.2	111.4	58.8	47.4	36.8	79.6	60.2	24.9
TOT INDUSTRY	(MW)	438.0	61.5	6.9	46.5	20.5	20.5	18.4	12.6	11.2	4.7
SALES	(MHW)	587.5	111.9	9.3	64.9	38.2	26.6	20.7	66.8	52.9	21.8
(MIL $ $)	(MC)	4.4	0.5	0.0	0.0	0.1	0.3	0.3	0.2	0.3	0.1
	(ALL)	1029.9	174.0	16.2	111.4	58.8	47.4	39.4	79.6	64.5	26.6
BTU $ SAVED	(MW)	2.1	0.2	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0
GAS	(MHW)	2.3	0.4	0.0	0.2	0.1	0.1	0.1	0.3	0.2	0.1
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	4.4	0.7	0.0	0.4	0.1	0.2	0.2	0.4	0.3	0.1
BTU $ SAVED	(MW)	1.3	0.2	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
OIL	(MHW)	1.7	0.3	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.1
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	3.1	0.5	0.0	0.3	0.1	0.2	0.1	0.2	0.2	0.1
BTU $ SAVED	(MW)	1.3	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
ELECTRIC	(MHW)	2.3	0.4	0.0	0.2	0.2	0.1	0.1	0.1	0.1	0.0
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	3.6	0.6	0.1	0.3	0.2	0.2	0.1	0.1	0.1	0.1
BTU $ SAVED	(MW)	4.7	0.6	0.1	0.4	0.2	0.3	0.2	0.1	0.1	0.0
TOTAL	(MHW)	6.4	1.1	0.1	0.6	0.3	0.3	0.2	0.6	0.5	0.2
(TRL BTU)	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	11.1	1.7	0.1	1.0	0.4	0.6	0.4	0.7	0.6	0.2

TABLE V-17

SOLAR IMPACT MODEL
EXPANDED NATIONAL ENERGY PLAN 28 SEPT 77
CUMULATIVE DATA – N/R

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	HH/INST	HH/OTHR	LH/INST	LH/LESR	LH/OUCU
RESIDENTIAL	(HW)	3775.4	675.8	95.5	484.0	390.1	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHW)	1716.7	371.5	66.2	301.1	161.0	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(HC)	3.7	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
	(ALL)	5495.9	1047.7	161.7	785.1	551.3	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HW)	0.0	0.0	0.0	0.0	0.0	2.7	13.3	17.0	34.9	14.6
SOLAR UNITS	(HHW)	0.0	0.0	0.0	0.0	0.0	1.0	4.5	5.7	12.0	4.9
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	3.7	17.9	22.7	46.9	19.5
PENETRATION	(HW)	4.93	3.99	4.32	2.54	4.16	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHW)	2.24	2.19	3.00	1.58	1.72	0.0	0.0	0.0	0.0	0.0
(PCT)	(HC)	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
	(ALL)	7.18	6.19	7.32	4.12	5.88	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HW)	0.0	0.0	0.0	0.0	0.0	7.02	6.55	5.19	5.14	5.13
COMMERCIAL	(HHW)	0.0	0.0	0.0	0.0	0.0	2.64	2.22	1.73	1.77	1.73
(PCT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.00	0.00	0.00
	(ALL)	0.0	0.0	0.0	0.0	0.0	9.67	8.78	6.92	6.91	6.86
COLLECTOR	(HW)	178.4	21.8	2.4	13.2	7.3	9.4	7.6	4.3	3.7	1.5
SOLD	(HHW)	307.1	51.4	4.4	24.2	14.7	11.2	8.2	28.1	21.9	8.9
(MIL SQ FT)	(HC)	0.9	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0
	(ALL)	486.4	73.3	6.8	37.4	22.0	20.6	15.8	32.4	25.6	10.5
PVT DOLLARS	(HW)	4333.4	606.4	68.9	439.9	206.7	201.8	168.7	110.3	92.0	38.6
INVESTED	(HHW)	5593.6	976.5	89.7	566.3	358.9	236.1	172.6	641.5	457.0	187.1
(MIL $ $)	(HC)	48.5	5.3	0.1	0.0	1.6	2.6	2.2	1.5	2.9	1.2
	(ALL)	9975.4	1588.1	158.7	1006.2	567.1	440.5	343.5	753.3	552.0	226.8
TOT INDUSTRY	(HW)	4940.2	696.2	79.5	439.9	239.5	201.8	186.8	110.3	101.5	42.5
SALES	(HHW)	6111.8	1064.3	100.0	566.3	394.5	236.1	189.6	641.5	502.6	205.7
(MIL $ $)	(HC)	50.8	5.6	0.1	0.0	1.7	2.6	2.4	1.5	3.3	1.3
	(ALL)	11102.8	1766.0	179.6	1006.2	635.7	440.5	378.8	753.3	607.4	249.6
BTU $ SAVED	(HW)	18.2	2.4	0.2	1.4	0.5	0.7	0.5	0.4	0.3	0.1
GAS	(HHW)	18.4	3.2	0.2	1.6	0.5	0.9	0.6	2.5	1.7	0.7
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	36.7	5.6	0.4	3.0	1.0	1.6	1.1	3.0	2.0	0.8
BTU $ SAVED	(HW)	14.0	1.7	0.1	0.8	0.3	0.7	0.5	0.4	0.3	0.1
OIL	(HHW)	17.0	3.0	0.2	1.9	0.5	0.8	0.6	1.7	1.3	0.5
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	31.0	4.6	0.3	2.7	0.8	1.5	1.1	2.1	1.6	0.7
BTU $ SAVED	(HW)	15.7	1.8	0.3	1.3	1.0	1.0	0.9	0.4	0.4	0.2
ELECTRIC	(HHW)	25.3	4.0	0.4	1.6	1.6	0.7	0.6	1.0	1.0	0.4
(TRL BTU)	(HC)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	41.1	5.8	0.7	2.9	2.6	1.7	1.5	1.3	1.4	0.6
BTU $ SAVED	(HW)	47.9	5.9	0.6	3.5	1.8	2.4	2.0	1.2	1.0	0.4
TOTAL	(HHW)	60.8	10.2	0.8	5.1	2.6	2.4	1.7	5.2	4.0	1.6
(TRL BTU)	(HC)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	108.8	16.1	1.4	8.6	4.4	4.9	3.7	6.4	5.0	2.0

TABLE V-18

SOLAR IMPACT MODEL
EXPANDED NATIONAL ENERGY PLAN 28 SEPT 77
GOVERNMENT COST OF INCENTIVES, REGION 11 (MIL $)

INCENTIVE		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
TAX CREDIT RESIDENT	(HH)	0.0	60.3	97.6	96.9	129.3	115.1	126.1	127.7	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	26.8	61.7	80.5	119.0	109.8	126.0	132.6	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.3	0.4	0.6	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	87.2	159.7	177.8	248.9	225.4	252.7	260.9	0.0	0.0	0.0	0.0	0.0	0.0
TAX CREDIT COMMERCIAL	(HH)	0.0	4.5	7.1	8.4	10.1	10.0	7.8	8.0	1.8	2.0	2.0	2.2	2.3	2.4
	(MHH)	0.0	4.5	8.8	13.1	16.7	16.8	12.6	13.1	5.5	5.9	6.1	6.3	6.5	6.7
	(MC)	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	9.0	16.0	21.6	27.0	28.9	20.5	21.1	7.4	7.9	8.2	8.5	8.8	9.1
DIR SUBSIDY	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN PRESENT VAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN CASH FLOW	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC PRESENT VAL	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCEL DEPREC CASH FLOW	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GOVERNMENT BUILDINGS	(HH)	0.0	0.0	23.0	23.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	22.0	22.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	67.0	67.0	66.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R D & D	(HH)	29.0	32.0	34.0	20.0	12.0	8.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	(MHH)	29.0	32.0	33.0	20.0	12.0	8.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	96.0	100.0	60.0	35.0	23.0	15.0	12.0	10.0	10.0	10.0	10.0	10.0	10.0
PRESENT VAL	(HH)	29.0	96.7	161.7	148.3	173.4	133.1	139.0	139.7	5.8	6.0	6.0	6.2	6.3	6.4
TOTAL	(MHH)	29.0	63.3	125.5	135.5	169.8	136.6	143.6	149.7	8.5	8.9	9.1	9.3	9.5	9.7
	(MC)	29.0	32.1	55.4	42.5	33.7	7.6	5.6	4.6	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	192.1	342.6	326.4	376.9	277.3	288.1	294.0	17.4	17.9	18.2	18.5	18.8	19.1
CASH FLOW TOTAL	(HH)	29.0	96.7	161.7	148.3	173.4	133.1	139.0	139.7	5.8	6.0	6.0	6.2	6.3	6.4
	(MHH)	29.0	63.3	125.5	135.5	169.8	136.6	143.6	149.7	8.5	8.9	9.1	9.3	9.5	9.7
	(MC)	29.0	32.1	55.4	42.5	33.7	7.6	5.6	4.6	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	192.1	342.6	326.4	376.9	277.3	288.1	294.0	17.4	17.9	18.2	18.5	18.8	19.1

TABLE V-19

SOLAR IMPACT MODEL
NEW INITIATIVES 30 SEPT 77
ANNUAL DATA – NEW/RETROFIT

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	161.7	395.5	626.9	782.7	750.2	771.1	757.5	551.9	581.8	614.7	651.9	688.2	725.4
SOLAR UNITS	(HHW)	7.5	34.9	126.1	280.9	390.0	386.5	401.4	403.5	327.9	354.3	373.1	394.6	414.4	434.7
(000 UNITS)	(HC)	0.0	0.0	0.9	1.8	2.7	2.6	2.6	2.5	1.7	1.8	1.8	1.8	1.9	1.9
	(ALL)	45.6	196.6	522.5	909.6	1175.4	1139.3	1175.1	1163.4	881.5	937.9	989.6	1048.4	1104.5	1162.0
COMMERCIAL	(HW)	0.7	1.9	4.3	7.2	8.4	8.8	8.3	8.2	8.5	9.1	9.6	10.3	11.1	11.7
SOLAR UNITS	(HHW)	0.2	0.3	1.2	2.5	3.3	3.5	3.3	3.2	3.3	3.6	3.8	4.0	4.2	4.5
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.8	2.2	5.5	9.7	11.8	12.3	11.6	11.5	11.8	12.7	13.4	14.4	15.3	16.2
PENETRATION	(HW)	0.42	1.85	4.62	7.09	8.85	8.47	8.70	8.53	6.21	6.53	6.90	7.31	7.72	8.12
RESIDENTIAL	(HHW)	0.08	0.40	1.48	3.18	4.41	4.36	4.53	4.54	3.69	3.98	4.19	4.43	4.65	4.87
(PCT)	(HC)	0.0	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
	(ALL)	0.50	2.24	6.11	10.29	13.29	12.86	13.25	13.10	9.91	10.53	11.11	11.76	12.38	13.01
PENETRATION	(HW)	0.62	1.67	3.94	6.60	7.75	8.08	7.59	7.52	7.74	8.30	8.75	9.42	10.07	10.70
COMMERCIAL	(HHW)	0.14	0.30	1.07	2.30	3.03	3.22	3.00	2.95	3.05	3.31	3.48	3.68	3.86	4.06
(PCT)	(HC)	0.0	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	(ALL)	0.76	1.97	5.02	8.92	10.80	11.32	10.61	10.49	10.80	11.63	12.26	13.12	13.96	14.78
COLLECTOR	(HW)	2.2	8.4	19.9	30.8	37.6	35.5	35.6	34.3	25.2	26.0	27.0	28.2	29.2	30.2
SOLD	(HHW)	1.8	7.3	27.0	58.5	79.4	76.9	77.2	75.2	60.1	63.7	65.5	67.7	69.3	70.9
(MIL SQ FT)	(HC)	0.0	0.0	0.2	0.5	0.7	0.7	0.7	0.6	0.4	0.5	0.5	0.5	0.5	0.5
	(ALL)	4.0	15.7	47.2	89.9	117.8	113.1	113.5	110.1	85.7	90.2	93.0	96.4	99.1	101.6
PVT DOLLARS	(HW)	96.3	216.4	394.1	546.1	631.2	634.7	643.0	622.2	589.7	613.5	641.4	673.2	702.5	731.3
INVESTED	(HHW)	56.6	153.5	449.5	854.0	1106.3	1130.1	1145.6	1117.2	1064.4	1133.9	1172.4	1216.4	1251.3	1285.0
(MIL $ S)	(HC)	0.0	0.5	9.3	19.6	28.3	28.3	26.8	25.3	19.7	21.0	21.4	22.1	22.7	23.7
	(ALL)	152.9	370.4	852.8	1419.7	1765.9	1793.0	1815.5	1764.7	1673.8	1768.3	1835.1	1911.7	1976.5	2040.1
TOT INDUSTRY	(HW)	96.3	353.3	658.4	827.9	962.0	908.3	917.7	888.6	657.7	684.1	715.2	750.7	783.5	815.7
SALES	(HHW)	56.6	226.5	670.6	1195.9	1547.2	1497.2	1505.9	1471.2	1183.0	1260.1	1302.9	1352.0	1390.9	1428.4
(MIL $ S)	(HC)	0.0	0.7	12.4	25.3	36.6	35.4	33.3	31.5	22.1	23.5	24.0	24.7	25.4	26.5
	(ALL)	152.9	580.5	1341.5	2049.2	2545.8	2440.9	2456.9	2391.4	1862.7	1967.6	2042.1	2127.4	2199.7	2270.6
BTU $ SAVED	(HW)	0.2	0.5	1.5	2.7	3.6	3.4	3.6	3.4	2.5	2.7	3.0	3.4	3.7	4.0
GAS	(HHW)	0.0	0.2	1.2	3.0	4.4	4.4	4.6	4.5	3.8	4.3	4.6	5.0	5.3	5.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.7	2.7	5.7	8.0	7.7	8.1	7.9	6.3	6.9	7.6	8.3	9.0	9.7
BTU $ SAVED	(HW)	0.2	0.4	1.3	2.2	2.7	2.7	2.7	2.6	2.0	2.1	2.1	2.2	2.2	2.3
OIL	(HHW)	0.0	0.3	1.4	3.5	5.1	5.0	5.0	4.9	3.6	3.9	4.0	4.2	4.4	4.6
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.7	2.6	5.7	7.8	7.7	7.7	7.5	5.6	6.0	6.2	6.4	6.6	6.8
BTU $ SAVED	(HW)	0.2	1.0	2.1	2.9	3.3	3.2	3.1	3.1	2.3	2.3	2.3	2.4	2.4	2.4
ELECTRIC	(HHW)	0.2	0.8	2.3	4.4	5.7	5.5	5.5	5.4	4.5	4.6	4.7	4.8	4.8	4.9
(TRL BTU)	(HC)	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	0.4	1.8	4.4	7.4	9.1	8.8	8.7	8.6	6.8	7.0	7.1	7.2	7.3	7.3
BTU $ SAVED	(HW)	0.5	1.9	4.8	7.7	9.6	9.2	9.4	9.1	6.8	7.1	7.5	7.9	8.3	8.7
TOTAL	(HHW)	0.3	1.2	4.9	10.9	15.2	14.8	15.1	14.8	11.8	12.8	13.3	14.0	14.5	15.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	(ALL)	0.8	3.2	9.7	18.8	24.9	24.2	24.6	24.0	18.7	19.9	20.9	22.0	22.9	23.8

TABLE V-20

SOLAR IMPACT MODEL
NEW INITIATIVES 30 SEPT 77
CUMULATIVE DATA – NEW/RETROFIT

		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
RESIDENTIAL	(HW)	38.1	199.7	595.2	1222.1	2004.8	2754.9	3526.1	4283.5	4835.5	5417.3	6032.0	6683.9	7372.1	8097.5
SOLAR UNITS	(HHW)	7.5	42.4	168.6	449.5	839.5	1225.9	1627.3	2030.8	2358.7	2713.0	3086.1	3480.7	3895.1	4329.8
(000 UNITS)	(HC)	0.0	0.0	0.9	2.7	5.4	8.0	10.6	13.1	14.7	16.5	18.3	20.1	22.0	23.9
	(ALL)	45.6	242.2	764.7	1674.3	2849.7	3988.9	5164.0	6327.4	7208.9	8146.8	9136.4	10184.7	11289.2	12451.2
COMMERCIAL	(HW)	0.7	2.5	6.9	14.0	22.5	31.3	39.6	47.8	56.2	65.3	74.9	85.2	96.2	108.0
SOLAR UNITS	(HHW)	0.2	0.5	1.7	4.2	7.5	11.0	14.2	17.5	20.8	24.4	28.2	32.3	36.5	41.0
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	(ALL)	0.8	3.0	8.5	18.2	30.0	42.3	53.9	65.3	77.1	89.9	103.3	117.6	133.0	149.2
PENETRATION	(HW)	0.42	1.12	2.26	3.47	4.55	5.21	5.71	6.06	6.08	6.13	6.20	6.29	6.40	6.53
RESIDENTIAL	(HHW)	0.08	0.24	0.64	1.28	1.91	2.32	2.64	2.88	2.97	3.07	3.17	3.28	3.38	3.49
(PCT)	(HC)	0.0	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	(ALL)	0.50	1.36	2.90	4.76	6.47	7.54	8.36	8.96	9.07	9.21	9.39	9.59	9.80	10.03
PENETRATION	(HW)	0.62	1.15	2.08	3.20	4.10	4.76	5.16	5.46	5.71	5.97	6.22	6.49	6.77	7.05
COMMERCIAL	(HHW)	0.14	0.22	0.50	0.95	1.36	1.67	1.86	1.99	2.11	2.23	2.35	2.46	2.57	2.67
(PCT)	(HC)	0.0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	(ALL)	0.76	1.37	2.58	4.15	5.47	6.44	7.03	7.46	7.83	8.21	8.58	8.96	9.34	9.73
COLLECTOR	(HW)	2.2	10.6	30.5	61.4	99.0	134.5	170.1	204.4	229.6	255.6	282.7	310.9	340.1	370.3
SOLD	(HHW)	1.8	9.1	36.1	94.7	174.1	251.0	328.2	403.4	463.4	527.1	592.6	660.3	729.6	800.5
(MIL SQ FT)	(HC)	0.0	0.0	0.3	0.8	1.5	2.2	2.9	3.5	4.0	4.5	4.9	5.4	5.9	6.5
	(ALL)	4.0	19.7	66.9	156.8	274.6	387.7	501.2	611.3	697.0	787.2	880.2	976.6	1075.7	1177.3
PVT DOLLARS	(HW)	96.3	312.6	706.7	1252.8	1884.0	2518.6	3161.6	3783.8	4373.5	4987.0	5628.4	6301.5	7004.0	7735.4
INVESTED	(HHW)	56.6	210.1	659.5	1513.5	2619.9	3750.0	4895.6	6012.8	7077.2	8211.0	9383.4	10599.8	11851.1	13136.1
(MIL $ $)	(HC)	0.0	0.5	9.9	29.4	57.8	86.0	112.8	138.2	157.9	178.9	200.3	222.4	245.0	268.8
	(ALL)	152.9	523.3	1376.1	2795.8	4561.6	6354.7	8170.0	9934.7	11608.5	13376.9	15212.0	17123.7	19100.2	21140.3
TOT INDUSTRY	(HW)	96.3	449.6	1108.0	1935.9	2897.9	3806.2	4723.9	5612.5	6270.2	6954.2	7669.4	8420.1	9203.6	10019.2
SALES	(HHW)	56.6	283.1	953.7	2149.7	3696.9	5194.0	6699.9	8171.1	9354.1	10614.2	11917.1	13269.1	14660.0	16088.4
(MIL $ $)	(HC)	0.0	0.7	13.1	38.4	75.1	110.4	143.8	175.3	197.4	220.8	244.8	269.6	294.9	321.5
	(ALL)	152.9	733.4	2074.8	4124.0	6669.8	9110.7	11567.5	13958.9	15821.6	17789.3	19831.3	21958.8	24158.5	26429.1
BTU $ SAVED	(HW)	0.2	0.7	2.2	4.9	8.5	11.9	15.5	18.9	21.4	24.1	27.1	30.5	34.2	38.2
GAS	(HHW)	0.0	0.2	1.4	4.4	8.7	13.1	17.6	22.1	25.9	30.2	34.8	39.8	45.1	50.7
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.2	0.9	3.6	9.3	17.3	25.0	33.1	41.1	47.4	54.3	61.9	70.3	79.3	88.9
BTU $ SAVED	(HW)	0.2	0.6	1.9	4.0	6.7	9.4	12.0	14.6	16.6	18.7	20.9	23.1	25.3	27.5
OIL	(HHW)	0.0	0.3	1.7	5.2	10.3	15.3	20.3	25.2	28.8	32.6	36.7	40.9	45.3	49.9
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
	(ALL)	0.2	0.9	3.5	9.3	17.1	24.8	32.4	39.9	45.5	51.5	57.7	64.1	70.8	77.6
BTU $ SAVED	(HW)	0.2	1.2	3.3	6.1	9.5	12.6	15.8	18.8	21.1	23.4	25.7	28.1	30.4	32.8
ELECTRIC	(HHW)	0.2	1.0	3.3	7.7	13.4	18.9	24.4	29.8	34.3	39.0	43.7	48.4	53.2	58.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9
	(ALL)	0.4	2.2	6.6	13.9	23.0	31.8	40.6	49.2	56.0	63.0	70.1	77.2	84.5	91.8
BTU $ SAVED	(HW)	0.5	2.5	7.3	15.1	24.7	33.9	43.3	52.4	59.1	66.2	73.7	81.6	89.9	98.6
TOTAL	(HHW)	0.3	1.5	6.4	17.3	32.4	47.3	62.4	77.2	89.0	101.8	115.1	129.1	143.6	158.7
(TRL BTU)	(HC)	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.1
	(ALL)	0.8	4.0	13.7	32.5	57.4	81.6	106.1	130.2	148.9	168.8	189.7	211.7	234.6	258.4

TABLE V-21

SOLAR IMPACT MODEL
NEW INITIATIVES 30 SEPT 77
ANNUAL DATA – NEW/RETROFIT

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	HH/INST	HH/OTHR	LH/INST	LH/LESR	LH/OOCU
RESIDENTIAL	(HW)	501.4	92.4	12.2	68.5	50.8	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHW)	278.1	66.7	10.5	53.4	26.0	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(HC)	1.6	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	(ALL)	781.0	159.4	22.7	122.0	76.9	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HW)	0.0	0.0	0.0	0.0	0.0	0.3	1.8	2.4	5.1	2.1
SOLAR UNITS	(HHW)	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.8	1.9	0.8
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.5	2.5	3.2	7.1	2.9
PENETRATION	(HW)	9.26	7.28	7.12	4.96	7.34	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHW)	5.13	5.26	6.10	3.87	3.75	0.0	0.0	0.0	0.0	0.0
(PCT)	(HC)	0.03	0.02	0.01	0.00	0.01	0.0	0.0	0.0	0.0	0.0
	(ALL)	14.42	12.56	13.23	8.83	11.10	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HW)	0.0	0.0	0.0	0.0	0.0	12.36	12.21	10.28	10.45	10.45
COMMERCIAL	(HHW)	0.0	0.0	0.0	0.0	0.0	5.53	5.04	3.63	3.96	3.88
(PCT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.04	0.04	0.01	0.02	0.02
	(ALL)	0.0	0.0	0.0	0.0	0.0	17.92	17.29	13.92	14.43	14.35
COLLECTOR	(HW)	21.4	2.7	0.3	1.7	0.8	1.1	0.9	0.6	0.5	0.2
SOLD	(HHW)	45.1	8.3	0.6	3.9	2.1	1.6	1.2	3.7	3.1	1.3
(MIL SQ FT)	(HC)	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	66.9	11.0	0.9	5.6	2.9	2.7	2.2	4.3	3.7	1.5
PVT DOLLARS	(HW)	503.7	72.8	7.8	51.8	23.6	22.2	18.7	14.0	11.8	5.0
INVESTED	(HHW)	769.5	146.9	12.2	83.6	46.5	32.2	24.2	81.9	60.9	25.1
(MIL $ $)	(HC)	16.3	2.1	0.1	0.2	0.8	0.9	0.8	0.7	1.4	0.6
	(ALL)	1289.5	221.7	20.1	135.5	72.8	55.2	43.7	96.6	74.2	30.7
TOT INDUSTRY	(HW)	566.4	81.9	8.8	55.2	26.5	22.2	21.4	14.0	13.6	5.7
SALES	(HHW)	865.4	165.2	13.7	89.1	54.5	32.2	27.7	81.9	69.9	28.8
(MIL $ $)	(HC)	18.4	2.3	0.1	0.2	0.9	0.9	0.9	0.7	1.6	0.7
	(ALL)	1450.2	249.3	22.6	144.5	81.9	55.2	50.0	96.6	85.1	35.2
BTU $ SAVED	(HW)	3.0	0.4	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.0
GAS	(HHW)	3.4	0.6	0.0	0.3	0.1	0.2	0.1	0.4	0.3	0.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	6.5	1.0	0.1	0.5	0.2	0.3	0.2	0.5	0.3	0.1
BTU $ SAVED	(HW)	1.6	0.2	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0
OIL	(HHW)	2.9	0.5	0.0	0.3	0.1	0.1	0.1	0.2	0.2	0.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	4.6	0.7	0.0	0.4	0.1	0.2	0.2	0.3	0.2	0.1
BTU $ SAVED	(HW)	1.6	0.2	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0
ELECTRIC	(HHW)	3.3	0.6	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	4.9	0.8	0.1	0.4	0.3	0.2	0.2	0.2	0.2	0.1
BTU $ SAVED	(HW)	6.2	0.8	0.1	0.5	0.2	0.3	0.3	0.2	0.1	0.1
TOTAL	(HHW)	9.7	1.7	0.1	0.9	0.4	0.4	0.3	0.7	0.6	0.2
(TRL BTU)	(HC)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	16.0	2.5	0.2	1.3	0.6	0.7	0.5	0.9	0.8	0.3

TABLE V-22

SOLAR IMPACT MODEL
NEW INITIATIVES 30 SEPT 77
CUMULATIVE DATA – NEW/RETROFIT

(1990)

		S/FAM	L/DEN	CONDO	APTS	MOBIL	MH/INST	MH/UTHR	LH/INST	LH/LESR	LH/OOCU
RESIDENTIAL	(HW)	5666.0	1016.7	144.8	652.2	617.9	0.0	0.0	0.0	0.0	0.0
SOLAR UNITS	(HHW)	2867.8	617.7	112.9	464.6	266.9	0.0	0.0	0.0	0.0	0.0
(000 UNITS)	(HC)	19.3	2.8	0.3	0.3	1.3	0.0	0.0	0.0	0.0	0.0
	(ALL)	8553.1	1637.1	257.9	1117.1	886.0	0.0	0.0	0.0	0.0	0.0
COMMERCIAL	(HW)	0.0	0.0	0.0	0.0	0.0	3.2	17.4	21.0	46.8	19.6
SOLAR UNITS	(HHW)	0.0	0.0	0.0	0.0	0.0	1.4	6.7	7.7	17.9	7.3
(000 UNITS)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	4.6	24.1	28.7	64.8	26.9
PENETRATION	(HW)	7.41	6.01	6.55	3.42	6.59	0.0	0.0	0.0	0.0	0.0
RESIDENTIAL	(HHW)	3.75	3.65	5.11	2.44	2.85	0.0	0.0	0.0	0.0	0.0
(PCT)	(HC)	0.03	0.02	0.01	0.00	0.01	0.0	0.0	0.0	0.0	0.0
	(ALL)	11.18	9.67	11.67	5.86	9.44	0.0	0.0	0.0	0.0	0.0
PENETRATION	(HW)	0.0	0.0	0.0	0.0	0.0	8.36	8.55	6.41	6.90	6.90
COMMERCIAL	(HHW)	0.0	0.0	0.0	0.0	0.0	3.53	3.28	2.36	2.64	2.57
(PCT)	(HC)	0.0	0.0	0.0	0.0	0.0	0.02	0.03	0.00	0.02	0.01
	(ALL)	0.0	0.0	0.0	0.0	0.0	11.91	11.84	8.77	9.55	9.48
COLLECTOR	(HW)	270.3	33.1	3.7	17.9	11.8	11.2	10.0	5.3	5.0	2.1
SOLD	(HHW)	528.8	88.0	7.7	37.9	24.8	15.2	12.2	39.1	33.3	13.7
(MIL SQ FT)	(HC)	4.8	0.5	0.0	0.0	0.2	0.2	0.2	0.1	0.3	0.1
	(ALL)	803.9	121.6	11.4	55.7	36.7	26.6	22.4	44.5	38.6	15.9
PVT DOLLARS	(HW)	5363.2	749.6	85.8	536.3	272.7	235.4	199.6	133.5	112.2	47.1
INVESTED	(HHW)	8010.5	1390.9	128.4	800.0	508.3	311.8	232.5	870.0	626.5	257.3
(MIL $ S)	(HC)	194.6	22.7	1.4	2.0	9.5	6.9	7.4	5.5	13.3	5.4
	(ALL)	13568.3	2163.2	215.6	1338.3	790.6	554.1	439.5	1008.9	752.0	309.8
TOT INDUSTRY	(HW)	7147.9	1009.6	116.6	571.5	376.8	235.4	238.5	133.5	133.6	56.1
SALES	(HHW)	10151.5	1758.8	167.3	852.6	648.6	311.8	276.2	870.0	745.5	306.2
(MIL $ S)	(HC)	234.3	27.7	1.9	2.2	11.8	6.9	8.8	5.5	15.9	6.5
	(ALL)	17533.6	2796.1	285.7	1426.4	1037.2	554.1	523.5	1008.9	895.1	368.8
BTU $ SAVED	(HW)	29.2	3.5	0.2	1.9	0.7	0.9	0.7	0.5	0.4	0.2
GAS	(HHW)	32.0	5.6	0.3	2.5	0.9	1.2	0.9	3.6	2.5	1.0
(TRL BTU)	(HC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	61.2	9.1	0.6	4.4	1.7	2.1	1.7	4.1	3.0	1.2
BTU $ SAVED	(HW)	20.5	2.6	0.2	1.0	0.5	0.9	0.7	0.5	0.4	0.2
OIL	(HHW)	32.8	5.5	0.4	3.0	0.8	1.2	0.9	2.4	2.0	0.8
(TRL BTU)	(HC)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	53.5	8.1	0.6	4.0	1.4	2.0	1.6	2.9	2.5	1.0
BTU $ SAVED	(HW)	22.7	2.8	0.5	1.8	1.6	1.2	1.1	0.5	0.5	0.2
ELECTRIC	(HHW)	40.8	6.4	0.7	2.5	2.6	0.9	0.8	1.5	1.5	0.6
(TRL BTU)	(HC)	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	64.2	9.3	1.2	4.2	4.2	2.1	2.0	1.8	2.0	0.8
BTU $ SAVED	(HW)	72.5	8.9	0.9	4.7	2.8	2.9	2.6	1.4	1.3	0.6
TOTAL	(HHW)	105.6	17.5	1.5	8.0	4.3	3.3	2.6	7.5	6.0	2.5
(TRL BTU)	(HC)	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	(ALL)	179.0	26.5	2.4	12.7	7.2	6.3	5.2	8.7	7.4	3.1

TABLE V-23

SOLAR IMPACT MODEL
NEW INITIATIVES 30 SEPT 77
GOVERNMENT COST OF INCENTIVES, REGION 11 (MIL $)

INCENTIVE		1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
TAX CREDIT RESIDENT	(HH)	0.0	98.0	192.8	192.5	228.4	176.7	180.3	175.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	48.2	147.9	209.0	272.1	203.4	207.6	204.6	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.1	1.6	2.6	4.0	2.9	2.9	2.8	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	146.3	342.3	404.1	504.4	383.0	390.8	382.5	0.0	0.0	0.0	0.0	0.0	0.0
TAX CREDIT COMMERCIAL	(HH)	0.0	8.4	15.6	16.7	18.0	15.4	11.6	11.3	2.3	2.4	2.5	2.6	2.7	2.8
	(MHH)	0.0	5.7	17.5	30.7	36.2	32.8	19.8	19.2	7.4	7.9	8.1	8.4	8.6	8.8
	(MC)	0.0	0.0	0.3	0.7	0.9	0.8	0.5	0.5	0.1	0.2	0.2	0.2	0.2	0.2
	(ALL)	0.0	14.1	33.4	48.1	55.1	49.0	31.8	30.8	9.8	10.4	10.8	11.2	11.6	11.9
DIR SUBSIDY	(HH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOW LOAN PRESENT VAL	(HH)	0.0	42.0	77.3	95.3	111.0	103.7	105.3	101.9	71.7	74.3	77.8	81.8	85.5	89.1
	(MHH)	0.0	24.7	72.1	127.0	164.6	156.8	159.4	156.4	118.4	125.9	130.3	135.4	139.4	143.2
	(MC)	0.0	0.1	1.4	2.8	4.1	4.0	3.9	3.7	2.5	2.6	2.6	2.7	2.7	2.8
	(ALL)	0.0	66.8	150.8	225.0	279.7	264.4	268.7	262.1	192.6	202.8	210.8	219.9	227.7	235.1
LOW LOAN CASH FLOW	(HH)	0.0	5.2	14.6	26.3	39.8	52.3	64.9	76.9	85.1	93.2	101.6	110.0	118.5	127.0
	(MHH)	0.0	3.0	11.9	27.4	47.5	66.6	85.8	104.4	118.1	132.4	146.8	161.4	175.9	190.2
	(MC)	0.0	0.0	0.2	0.5	1.0	1.5	2.0	2.4	2.7	3.0	3.3	3.6	3.9	4.1
	(ALL)	0.0	8.2	26.7	54.2	88.4	120.4	152.7	183.8	205.9	228.6	251.7	275.0	298.3	321.3
ACCEL DEPREC PRESENT VAL	(HH)	0.0	1.5	3.2	4.8	5.4	5.6	5.5	5.2	5.2	5.5	5.7	5.9	6.1	6.4
	(MHH)	0.0	1.4	4.9	9.6	12.3	12.9	12.1	11.6	11.8	12.7	13.1	13.5	13.9	14.3
	(MC)	0.0	0.0	0.1	0.2	0.3	0.3	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2
	(ALL)	0.0	2.9	8.2	14.6	18.1	18.7	17.8	17.0	17.2	18.3	18.9	19.6	20.2	20.9
ACCEL DEPREC CASH FLOW	(HH)	0.0	2.1	5.5	8.9	11.1	12.2	11.7	10.1	7.9	5.8	3.6	2.2	1.7	2.0
	(MHH)	0.0	2.1	7.9	16.9	24.1	27.3	27.0	24.6	20.5	16.0	10.8	6.7	4.4	4.4
	(MC)	0.0	0.0	0.1	0.3	0.5	0.6	0.4	0.3	0.2	0.1	0.0	-0.0	-0.0	0.0
	(ALL)	0.0	4.2	13.5	26.2	35.6	40.1	39.1	35.1	28.7	21.9	14.4	8.8	6.1	6.5
GOVERNMENT BUILDINGS	(HH)	0.0	0.0	56.0	56.0	55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MHH)	0.0	0.0	56.0	56.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(MC)	0.0	0.0	55.0	55.0	55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(ALL)	0.0	0.0	167.0	167.0	166.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R D & D	(HH)	29.0	32.0	34.0	20.0	12.0	8.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	(MHH)	29.0	32.0	33.0	20.0	12.0	8.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(MC)	29.0	32.0	33.0	20.0	11.0	7.0	5.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
	(ALL)	87.0	96.0	100.0	60.0	35.0	23.0	15.0	12.0	10.0	10.0	10.0	10.0	10.0	10.0
PRESENT VAL	(HH)	29.0	181.8	378.9	385.2	429.9	309.3	307.6	297.5	83.2	86.2	90.0	94.4	98.4	102.3
TOTAL	(MHH)	29.0	112.1	331.4	452.3	553.2	413.8	403.9	395.9	140.6	149.4	154.5	160.3	164.9	169.4
	(MC)	29.0	32.2	91.4	81.4	75.2	15.0	12.3	10.9	5.8	5.9	6.0	6.1	6.1	6.3
	(ALL)	87.0	326.1	801.7	918.9	1058.3	738.1	723.8	704.3	229.6	241.6	250.5	260.7	269.4	277.9
CASH FLOW TOTAL	(HH)	29.0	145.7	318.5	320.3	364.5	264.6	273.5	277.5	99.3	105.4	111.6	118.8	126.9	135.8
	(MHH)	29.0	91.1	274.3	360.1	447.8	338.1	345.1	356.8	149.0	159.2	168.7	179.5	191.9	206.4
	(MC)	29.0	32.1	90.3	79.2	72.4	12.8	10.7	9.9	6.1	6.5	6.5	6.7	7.0	7.4
	(ALL)	87.0	268.8	683.0	759.6	884.5	615.5	629.3	644.2	254.5	271.0	286.8	305.0	325.9	349.7