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The Industrial Energy-Efficiency Improvement Program

Department of Energy
Assistant Secretary for Conservation and Renewable Resources
Office of Industrial Programs

Annual Report to the Congress and the President 1979

December 1, 1980

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This Annual Report to the Congress and the President on the Industrial Energy Efficiency Improvement Program in 1979 is provided pursuant to Section 375, Energy Policy and Conservation Act (Public Law 94-163)(EPCA) as amended by the National Energy Conservation Policy Act (Public Law 95-619)(NECPA).

The report provides information on Industrial Energy Efficiency Improvement in 1979. The Federal role reflects historical program initiatives and as such does not reflect new administration budget and program redirection.

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Executive Summary

The Energy Policy and Conservation Act (EPCA) mandated the creation of the Industrial Energy Efficiency Improvement Program. An important component of this program is to monitor and report to the Congress and the President of the United States on the progress of industry toward attainment of voluntary 1980 energy efficiency improvement targets. This third Annual Report on the Industrial Energy Efficiency Improvement Program is respectfully tendered in fulfillment of this requirement.

In 1979 the Office of Industrial Programs, Conservation and Solar Energy, initiated actions to revise the energy efficiency reporting program to implement consistent plant-level reporting on the part of energy-intensive corporations. The mandatory reporting population was also expanded to include ten additional non-targeted industries and all corporations using over one trillion Btu's annually in any manufacturing industry, as defined by a 2-digit Standard Industrial Classification, in accordance with amendments to the EPCA program contained in the National Energy Conservation Policy Act (NECPA). This effort has greatly improved the consistency and accuracy of reported data, while simultaneously reducing the overall reporting burden of the participating corporations. The NECPA amendments also required the Department of Energy to establish voluntary 1987 recovered materials utilization targets in four industries and to monitor and report to the Congress and the President of the United States on the progress of industry to attain these targets. Analysis of information received on operations during 1979 has led to the following major findings:

- At the close of 1979, the weighted average energy efficiency improvement for all targeted industries participating in the program

was 15.4 percent, in comparison to 1972 energy use efficiencies. Although this average is not strictly comparable to 1978 reported efficiencies (due to changes in the reporting system), this represents a significant increase from the 14% average energy efficiency improvement reported for all targeted industries in 1978. Those industries for which voluntary 1980 targets were established include: chemicals and allied products; primary metals industries; petroleum and coal products; stone, clay, and glass products; paper and allied products; food and kindred products; fabricated metals products; transportation equipment; machinery (except electrical); and textile mill products.

- Five industries—chemicals and allied products; petroleum and coal products; food and kindred products; transportation equipment and machinery (except electrical) have surpassed their 1980 energy efficiency improvement targets. At current rates of energy efficiency improvement,the primary metals and the fabricated metals industries will probably achieve their targets by the close of 1980.

- The absolute level of energy consumption for the ten most energy-intensive reporting industries,as measured in Btu's,has fallen by 2.5% since 1972, during a period when the output in manufacturing industries has risen over 17%.

- Total energy savings for the reporting corporations in 1979 amounted to 2.2 quadrillion Btu per year—the equivalent of over 1 million barrels of oil per day, compared to what would have been required at 1972 energy per unit of output levels.

- The reporting corporations have reduced their consumption of natural gas by approximately 14% since 1972, and residual oil usage has declined by almost 5%, in absolute terms. These reductions have been the result of an evident trend toward fuel switching from oil and natural gas to electricity. There is no indication of any emerging trend toward direct substitution of coal for primary fuels. Coal consumption has also declined by over 5% since 1972, among the reporting industries.

- Corporations from the paper and allied products, rubber, primary metals products and textile mill products industries reported on progress toward recovered materials utilization targets for the first time in 1979. The progress of these industries toward 1987 recovered materials utilization targets is summarized in section II.4. While first year data submissions report progress toward these 1987 targets, the reporting program for recovered materials requires further development before it will provide representative information on recovered materials utilization in industry.

- The Department of Energy concludes that the energy efficiency improvement program has had a positive effect in raising awareness and participation in energy management and conservation by industrial corporations. There is a continuing need, however, for further refinement of the reporting system, particularly with respect to recovered materials reporting and the verification of reported data.

Based upon analysis of the reported data, the Department of Energy has formulated the following recommendations. There is a need to reassess the recovered materials reporting program to develop remedial measures which will support the establishment of a represen-

tative and cost-effective recovered materials reporting program. The scope of this reassessment should range from the revision of reporting procedures and reduction of reporting burden to, if necessary, the formulation of legislative initiatives which will facilitate the effective revision of the recovered materials reporting program. The Department of Energy also recommends that a continued emphasis should be placed on the development of narrative input to the reporting program, because it provides valuable insight on the nature and extent of conservation activities currently underway in industry. It is also recommended that the Department of Energy encourage and provide limited technical support to industry-set 1985 energy efficiency improvement targets. The Department of Energy does not recommend Federal involvement in setting targets; targets should be voluntarily set by industry, with the Department of Energy acting in a monitoring role. Finally, the Department of Energy recommends that a verification program designed to validate the accuracy of reported energy efficiency improvement data be initiated in FY 1981.

Based upon information received, it is clear that reporting industries are making progress in excess of historical levels in improving their energy efficiency. The subject of concern as the nation enters the 1980's is one of timing. Current levels of energy efficiency improvement in industry indicate industry is decreasing its consumption of energy per unit of output at a faster rate than was evident prior to 1972. Continuation of this improvement in energy efficiency is currently limited, however, by many factors.

One important factor is that capital-intensive energy conservation investments are often not competitive in an atmosphere of limited industrial capital. Significant energy efficiency improvements (20-30%) could be realized if best available technology were to be utilized. The rate at which these new conservation technologies will be deployed is largely dependent upon the ability of industry to make the transition to capital-invement-based conservation strategies. The emerging issue is one of how and to what extent industry can act to initiate this transition.

DOE's Industrial Energy Efficiency Improvement Program

I. 1

Industry Overview

At the close of this decade of change, U.S. industry has emerged as a leading practitioner of improved energy conservation and management. The 1970's have brought major changes in the perceptions of energy availability and price, and have established new energy management priorities for both government and industry. In responding to the new realities of energy supply and cost, industry seems to have realized that energy conservation represents a major alternative source of energy that can be accessed quickly and at relatively low cost.

At the end of 1979, the ten heaviest consumers of energy in industry, as defined by 2-digit Standard Industrial Classification (SIC), had reduced their per unit of output energy consumption by 15.4 percent in comparison to 1972 efficiencies. The corporations reporting under the Industrial Energy Efficiency Improvement Program from these ten industries reduced their demand for energy by more than 2.2 quadrillion Btu during 1979, compared to what would have been used at 1972 levels of per unit of output energy consumption. What this means is that the reporting industries would have consumed an additional million barrels of oil equivalent per day to achieve their 1979 product output if they were still operating at 1972 levels of energy efficiency. This represents almost 3 percent of U.S. energy consumption in 1979. In absolute terms, the reporting industries consumed 2.2 percent fewer Btu's in 1979 than in 1972—during a period in which manufacturing output has increased by over 17 percent.[1] This 2.2 percent reduction in actual consumption equates to an annual energy savings equivalent to 60 million barrels of crude oil.

This progress, while commendable, has served only to bring U.S. industry to the threshold of the greater energy challenge. The corporations reporting under the Industrial Energy Efficiency Improvement Program are among the largest in the U.S. and are not completely representative of industry as a whole. Industry-wide progress in energy conservation is assumed to be somewhat lower. More importantly, current rates of efficiency improvement will not accommodate industry's growth, eliminate vulnerability to supply interruption, or

[1]Source: U.S. Department of Commerce, *1980 Industrial Outlook.*

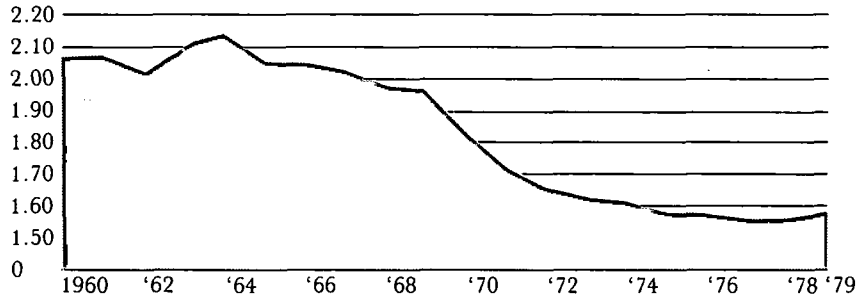
offset inflation in energy costs. The industrial sector uses 37 percent of the nation's energy, and still depends on oil and gas for 60 percent of its consumption.[2] Current industrial consumption stands at 28.8 quadrillion Btu per year.[3] By 1990, industrial output is expected to grow by as much as 50 percent.[4] An important challenge of the 1980's, for government and industry, will be to achieve this growth without unecessarily increasing demand for and dependence upon energy sources such as oil and gas.

The obstacles to this goal are formidable, encompassing economic, technical and institutional constraints. Energy conservation in industry seems to have reached a turning point. The Office of Industrial Programs estimates that best available energy conservation technologies and practices could increase energy efficiency in industry by 20 to 30 percent, and that energy savings of 30 to 50 percent could eventually be achieved through development of emerging and advanced technology.[5]

Adoption of these technologies by industry will require major capital investment, however, and many industrial corporations are constrained from making the transition from low cost conservation to strategies which require major capital investments. The U.S. industrial complex was conceived, designed and built during a period when energy was both plentiful and cheap. Energy costs still comprise only 2-8 percent of the operational costs of most energy-intensive industries.[6] Because energy is still not a major cost to most industrial corporations, energy conservation related investments often receive a relatively low priority in comparison to competing capital investment needs. Available capital will generally be invested in projects having the highest prospective returns or in projects which are non-discretionary such as pollution control. Although capital investment decision-making varies considerably, industrial capital investment generally follows certain priorities. The first priority is investment for the expansion or maintenance of market position. Second-level capital investment priorities are geared to required investments in pollution control, OSHA-related worker safety investments and related research and development. If discretionary capital is available after these needs are met, it is usually in limited amounts, and conservation investments must still compete with other discretionary investments which often offer higher rates of return and lower risk factors. In this atmosphere of limited discretionary capital availability, energy conservation investments are often assigned a low priority by industrial decision-makers.

Figure 1

Real industrial research and development outlays as percent of real gross national product



Source: National Science Foundation, Annual Report on Research & Development, *Business Week*

The constraints to energy conservation investment posed by intense competition for capital investment funds are aggravated by the fact that capital generation in many energy intensive industries is also limited. Analyses of the steel, aluminum, and cement industries, for example, indicate that these industries are generating relatively little capital (the average rate of return on sales for these industries is only 3.9 percent).[7] Access to equity and debt market capital is similarly constrained by the relatively low market value of assets and high long term debt obligations. With the exception of few industries (most notably petroleum and chemicals), these statistics generally indicative of conditions in most energy-intensive industries.

The capital limitations evident in many energy-intensive industries have contributed to a marked decline in industrial research and development spending. Since 1964, industrial investments in research and development have declined severely (Figure 1). Industrial research and development spending reached a peak of 2.1 percent of GNP ($21.1 billion constant 1972 dollars)in 1969. In terms of constant dollar investment, this level was not exceeded until 1979, when industrial research and development spending was $22.1 billion constant dollars—a figure which represents only 1.6 percent of GNP.

Since 1969, the rate of growth of the U.S. scientific and R.D&D workforce has fallen by almost 50 percent, from an annual rate of growth of 5.9 percent in 1969 to a current level of 2.8 percent (Figure 2). In 1969 the scientific RD&D workforce comprised 556,000 individuals. At the end of 1979, this workforce had grown to 610,000 individuals—slightly more than 9 percent in ten years.

These trends have eroded the technical base required to support development and adoption of new conservation technologies which are needed to realize energy efficiency improvements in excess of 30 percent. Economic and technical limitations reinforce the assignment of risk to energy-conservation technologies by industrial decision-makers. There is evidence that this contributes to a perception that the returns offered by conservation technologies do not offset the potentially negative impacts on production which could result from installing such relatively unfamiliar technologies.

From a Federal policy perspective, the capital and technical limitations within industry are critical considerations which are currently being addressed. The current DOE industrial energy conservation strategy stresses decreased reliance on oil and natural gas, reductions in vulnerable oil imports, the substitution of coal for scarce oil and gas, and reductions in both materials and energy waste.[8] The industrial sector is large, energy us relatively concentrated, and the pote

[2]Source: Energy Information Administration, *1979 Annual Report to Congress.*

[3]IBID.

[4]*Industrial Energy Conservation Strategic Plan,* Office of Industrial Programs, U.S. Department of Energy, July 1978.

[5]IBID.

[6]U.S. Department of Commerce, *1980 Industrial Outlook.*

[7]*Presentation of Discussion Issues Affecting Energy-Related Decision-Making in Industry,* Office of Industrial Programs, U.S. Department of Energy, January 1980.

[8]*Industrial Energy Conservation Strategic Plan,* Office of Industrial Programs, U.S. Department of Energy, July 1978.

for energy savings is immense. The National Academy of Sciences Committee on Nuclear and Alternative Strategy Systems, for example, estimates that an aggressive industrial energy conservation policy could save as much as 5.5 million barrels per day of oil equivalent by 2010—more energy than is represented by the oil the U.S. currently imports from OPEC. In the coming two decades, conservation is likely to prove to be the largest and most cost-effective alternative source of energy for industry. Fuel switching will also play an increasing role in industry as oil and gas supplies become more limited and prices rise to world levels. Achievement of national energy policy objectives will not be served, however, unless these changes are not only forthcoming, but also timely.

Herein lies a dichotomy. At present only a few industrial sectors—such as chemicals, petroleum and transportation equipment—are in a position to invest significant capital in energy conservation.

Industry is expected to continue its productive efforts toward low-cost and housekeeping conservation measures which are appropriate to current conditions. These actions will, however, produce smaller incremental efficiency gains than in previous years, because the potential for conservation from such actions is diminishing. These actions will, therefore, lessen, but not offset completely, the growth in industrial demand for energy. Since fuel switching to coal and other alternative fuels is generally subject to the same capital constraints (i.e., high first cost investment in process and environmental control technology) as energy conservation technologies in many cases, it seems logical to assume that much of industry's increased demand for energy will be supplied by oil and gas.

The Federal role in industrial conservation, therefore, is to counteract this scenario by supporting the development and accelerated investment in energy conservation technology. Conservation, like all sources of energy, can only produce substantial energy through significant investment. Industrial conservation technologies which could save 30 percent of per unit of output energy consumption already exist. Emerging technologies offer even greater potential. The rate at which these potentials are exploited will be dependent upon the ability of industry to effectively with current limitations to technology development and deployment.

I.2
The Industrial Energy Conservation Program

The industrial energy efficiency improvement program is part of a broad-based program to improve industrial energy efficiency which is administered by the Office of Industrial Programs, of the Deprtment of Energy's (DOE) Division of Conservation and Solar Energy. The objectives of the Federal industrial conservation program are to:

- accelerate market penetration of new and emerging industrial technologies and practices which will improve energy efficiency.
- encourage substitution of more plentiful domestic fuels, such as coal, for oil and natural gas.
- enhance recovery of energy and materials from industrial waste streams.

All activities of the program are designed with sensitivity to environmental protection standards and to the efficient utilization of Federal expenditures. The most visible component of DOE's industrial conservation operations is the energy efficiency reporting program. The industrial reporting program is, however, only one component of the industrial conservation effort.

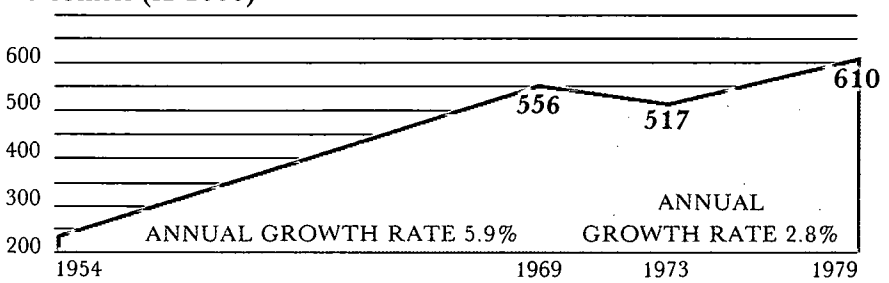
The primary emphasis of the industrial conservation program has been to develop, through research, development and demonstration, new industrial conservation technologies. Emerging industrial conservation programs are being developed to accelerate the deployment of these new technologies, as well as existing but underutilized technologies.

I.2.1
The Role of Research, Development and Demonstration

The emphasis on RD&D is grounded in a perception of the environment in which industry operates. The industrial sector currently uses approximately 37% of the nation's total energy.[1] Industrial consumption is projected to increase to 50% by 1990.[2] Although secure energy supplies are essential to industry operations, energy represents a low percentage of costs in most energy-intensive industries. Consequently, energy conservation investments generally receive a low priority for industrial investments. This has led to the establishment of formidable technical and economic constraints to obtaining the estimated 30-50 percent energy efficiency improvement that existing and emerging technologies could provide to industry. Principal among these constraints are:

- Lack of proven energy-efficient technologies to replace currently employed energy-intensive industrial processes.
- Technical and economic risks to production associated with emerging but as yet unproven technology options.

Figure 2
Growth of Scientific and RD&D Work Force 1954-1979



Source: National Science Foundation, Annual Report on Research and Development, *Business Week*

[1]Source: Energy Information Administration, *1979 Annual Report to Congress.*

[2]*Industrial Energy Conservation Strategic Plan,* Office of Industrial Programs, U.S. Department of Energy, July 1978.

• In some industries, concentration of RD&D funds within a few companies, reducing the availability of new technologies industry-wide.

The Federal industrial conservation program is acting to offset these constraints by cost-shared funding of energy conservation RD&D. These projects help to mitigate technical and institutional constraints to industrial energy conservation by sharing the burden of risk in the development of technology, providing research and development funding to industries where capital or other requirements are retarding development of energy conservation technology, and by commercially demonstrating new technologies to prove their practicability under actual operating conditions.

The Office of Industrial Programs has analyzed energy-intensive U.S. industries to determine the most productive role for Federal involvement in promoting industrial conservation. Emphasis is being placed on those industries and energy-intensive processes which offer the highest potential for conservation. By assisting industry in the research, development and demonstration of high-risk technologies, usually on a cost-shared basis, the Department of Energy can demonstrate the commercial viability of emerging technologies, and assist in providing the technology base for the long-term replacement of energy-intensive capital equipment currently employed in many industries.

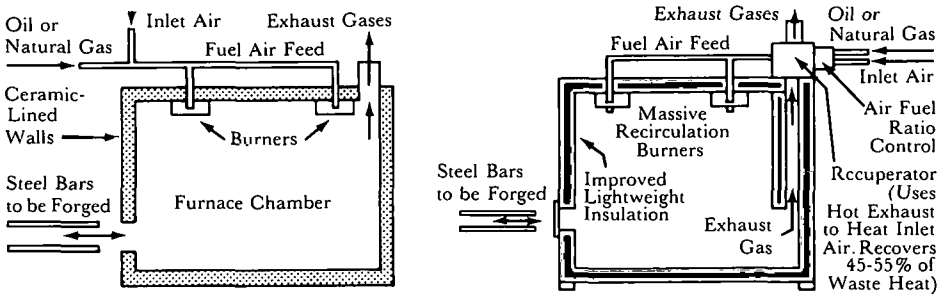
The RD&D programs of the Office of Industrial Programs have two major thrusts. One is to develop wide-application technologies such as waste heat recuperators and boiler air-fuel ratio controls which offer relatively small per-unit energy savings, but which have very broad generic potential for application in industry. These are generally retrofit technologies like the slot forge furnace recuperator/air fuel ratio control retrofit illustrated in Figure 3—relatively low-cost conservation applications which could achieve significant near-term market penetration once successfully demonstrated.

The other principal area of industrial conservation research is geared to the development of new technologies which could replace the energy-intensive capital equipment currently used in industries such as aluminum, steel and cement with more efficient process systems. In the aluminum industry, for example, there is presently no viable alternative to the industry-standard Hall-Heroult electrolytic reduction process. This process, which reduces alumina to aluminum through electrolysis in box-like cells, requires substantial energy. Large amounts of electricity are required to power these cells—an estimated 840 trillion Btu per year. In addition, the high temperatures and intense electrodynamic forces that characterize the electrolysis process consume the cell's anodes. These anodes must be manufactured from a mixture of coke and pitch and then baked—an energy-intensive process which consumes about 60 trillion Btu per year industry-wide.

The Office of Industrial Programs is sponsoring a program to develop an alternative process—direct carbothermic reduction—which, if successful, would provide a long range alternative for the replacement of Hall-Heroult cells in aluminum processing. The technology would allow aluminum to be produced in coal-fired shaft-type furnaces which would be 50% more energy efficient, and which would also offer the flexibility of using lower grade domestic ores in aluminum production.

These examples are representative of the research, development and demonstration programs which are conducted by the Office of Industrial Programs in cooperation with energy-intensive industries. There are currently over a hundred development and demonstration projects being supported by the Office.

Figure 3
Modifications to Slot Forge Furnaces to Reduce Energy Loss



Conventional slot forge furnace. High-performance slot forge furnace.

I.2.2
Technology Implementation Program

To ensure that new technologies, as well as existing practices, receive industry attention, technology implementation plans are being developed and pursued. The Office of Industrial Programs' activities in this area include the following:

- development of technical publications;
- interchange of energy conservation information within and between industries, through seminars and workshops;
- energy audit assistance programs.

These areas of activity constitute a balanced approach to accelerating market penetration of conservation technologies, in a mode which requires government and industry to work together. It should be noted that the strategy for developing conservation technologies is dynamic, being revised to reflect changes in the industrial sector which influence opportunities for conservation.

I.2.3
The Reporting Program

The Industrial Energy Efficiency Reporting Program, one of the earliest government efforts relating to industrial conservation, continues as the most visible element among the Office of Industrial Programs' responsibilities. The program began as a joint industry-government effort to stimulate energy conservation immediately following the 1973 oil embargo. In 1974, the Department of Commerce (DOC) developed a four point program aimed at voluntary adoption by the industrial sector. Under

this program industry was encouraged to:

- obtain the commitment of top management to energy conservation;
- undertake a thorough company energy audit;
- develop voluntary conservation goals and programs designed to meet them; and
- conduct energy awareness campaigns aimed at employees, suppliers, customers and community at large.

The voluntary reporting program was designed to measure the progress achieved. Industry trade associations played a major role in communicating the program objectives to their members. The number of voluntary participants grew significantly in the following years, with the trade associations assisting by compiling energy improvement data and establishing technology development and transfer programs.

Legislative Actions

In 1975, the enactment of the Energy Policy Conservation Act (EPCA) required the establishment of an Industrial Energy Conservation Program including mandatory reporting. This program developed 1980 energy efficiency improvement targets for the 10 most energy-intensive manufacturing industries and identified the 50 most energy-consumptive companies among those consuming at least one trillion Btu's of energy within these industries.[1] The mandatory reporting program was established to monitor industry's progress toward achieving the targets. The 10 most energy-consumptive manufacturing industries are listed under EPCA reporters in Table 1.

The program was extensively altered as a result of the National Energy Conservation Policy Act (NECPA) amendments to EPCA. The 1979 calendar year was the first reporting period for which NECPA mandated changes to the reporting program were implemented. The legislative changes increased the reporting population to include all corporations consuming more than one trillion Btu's per year in each of the 20 manufacturing SIC's; required that each reporting corporation base its report on plant data; required the DOE to provide plant reporting forms; and required the DOE to establish voluntary 1987 targets on the collection of information concerning the increased utilization of recovered materials from corporations in the textiles, rubber, primary metals and paper industries. The manufacturing industries added to the reporting program are listed under "NECPA additions" in Table 1.

In 1979, DOE identified over 1000 corporations which consumed more than one trillion Btu's during 1979, in manufacturing operations in a 2-digit SIC industry. DOE verified the identification process by utilizing Bureau of Census information. A listing of identified corporations, taken from the *Federal Register* of May 20, 1980, is provided in Appendix I.

In July 1979, DOE proposed reporting program regulations and forms. Several hearings on the proposed forms and regulations on energy consumption and efficiency reporting were conducted. Many corporations and trade associations participated in this process, providing comments and assistance in developing a set of reporting forms that would be easily adopted to the many corporate reporting modes that were already in place. The final regulations governing energy consumption efficiency reporting and the final reporting forms were published on February 14, 1980.[2]

This report is based on industry reports filed in accordance with the recently-revised program regulations. It should be noted that energy efficiency improvement information reported under this new system is not strictly comparable with that reported in previous years. The revised reporting system is based on plant-level reporting. In previous years, energy efficiency reporting was conducted at a corporate level. The reported data in previous years did not compensate for the closing of obsolescent plants since 1972. This may have had the effect of distorting reported energy efficiency favorably in previous years, because the effect of the closing of obsolete facilities had in overstating energy efficiency improvements since 1972 could not be estimated or compensated for. Under the current reporting system, obsolescent facilities which have been closed since the base year(1972, in the case of the 10 most energy consuming industries) are deleted from the base year in preparing energy efficiency reports. This modification has greatly improved the accuracy of energy efficiency improvement measurement.

It is also the first report providing actual gross energy consumption comparisons from current to base year. The Department of Energy estimates that 53%[3] of the total energy used by industry is being monitored by the program.

A series of workshops were held in March 1980, to present the new regulations and reporting forms to both old and new respondents. These workshops, attended by over 1,000 corporate representatives, were designed to provide a better understanding on the part of industry regarding DOE's role and objectives in industrial energy conservation. In addition, the meetings also served to increase industry awareness of government-

Table 1
Manufacturing Industries Reporting Under the Energy Efficiency Improvement Program

SIC	EPCA Reporters	NECPA Additions	Recovered Materials
20	Food and Kindred Products		
21		Tobacco Products	
22	Textile Mill Products		Textile Mill Products
23		Apparel and Other Textile Products	
24		Lumber and Wood Products	
25		Furniture and Fixtures	
26	Paper and Allied Products		Paper and Allied Products
27		Printing and Publishing	
28	Chemical and Allied Products		
29	Petroleum and Coal Products		
30		Rubber and Miscellaneous Plastics Products	Rubber and Miscellaneous Plastics Products
31		Leather and Leather Products	
32	Stone, Clay and Glass Products		
33	Primary Metal Products		Primary Metal Products
34	Fabricated Metal Products		
35	Machinery, except electrical		
36		Electrical, Electronic Equipment	
37	Transportation equipment		
38		Instruments and Related Products	
39		Miscellaneous Manufacturing Industries	

[1] For further details on the EPCA-mandated reporting program see the *Annual Report of the Industrial Energy Efficiency Program*, July 1977 through December 1978 (DOE/CS/0111).

[2] *Federal Register*, Industrial Energy Efficiency Reporting Program, Program Rule, February 14, 1980.

[3] The reporting population constitutes 53% of total industrial consumption in 1979 (with electricity distributed). On an end-use basis (without electricity distributed) the reporting population constitutes 81% of annual consumption.

Source: Energy Information Administration, *1979 Annual Report to Congress.*

industry cost-shared projects to develop new energy saving technologies, and current DOE efforts involving technology transfer.

II.1
Industrial Energy Efficiency Improvement Progress

II.1.1
Summary

By the close of 1979, America's heaviest industrial consumers of energy reduced their energy demand, per unit of output, over 15 percent in comparison to 1972 base year efficiencies. Manufacturing corporations reporting to the Department of Energy account for 53 percent of total industrial energy consumption on an end use basis.[1]

As Figure 4 illustrates, five industries - chemicals, petroleum, food, transportation equipment and machinery (except electrical) - have exceeded the 1980 energy efficiency improvement targets. At current rates of energy efficiency improvement, it is probable that other industries reporting against 1980 targets - with the exception of paper and allied products; stone, clay and glass; and textile mill products - will achieve improvements at or above their energy efficiency improvement targets by the close of 1980.

The paper and allied products, stone, clay and glass and textile mill products industries will probably be unable to achieve their 1980 targeted improvements, but are expected to have minor shortfalls in the .5 to 1.5% range. The progress of these industries to date, however, still represents significant savings, since their energy efficiency has been improved from 10 to 17% in comparison to 1972 per-unit-of-production efficiencies.

In 1979 the chemicals, machinery (except electrical) and transportation equipment industries have exceeded their 1980 targets by 8 percent, 9.8 percent and 7.6 percent, respectively. In terms of relative contributions to actual energy savings, the chemicals, petroleum, and primary metals industries sectors were the leading contributors. Conservation measures in the chemicals industry have reduced the demand for energy by 860 trillion Btu in 1979, compared to the energy use which would have been required at 1972 efficiencies. On this basis, the petroleum industry reduced its 1979 demand for energy by 440 trillion Btu and the primary metals sector reduced its energy by 307 trillion Btu.

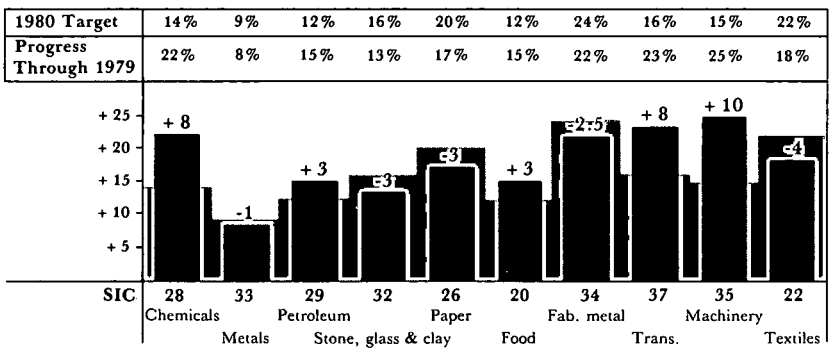
The second ten manufacturing industries were required to report efficiency improvement for the first time in 1979, against a 1978 base year. Reported progress in these industries closely parallels the reported progress of the ten most energy-intensive industries since 1976. The energy efficiency improvement from 1978 to 1979 averaged 2.4 percent. The annual energy efficiency improvement in the ten most energy-intensive industries has averaged 2.2 percent since 1972.

In perspective, the 15.4 perc energy efficiency improvement attained by reporting corporations in 1979 constitutes an immense energy savings benefit to the nation. The reporting corporations in the ten most energy consumptive industries substantially increased output between 1972 and 1979 without increasing energy use. An indication of average output growth in these industries is provided in Table 2. In fact, reporting corporations from these industries have reduced actual energy consumption by almost 350 trillion Btu since 1972. This is enough energy to supply the current annual needs of reporting corporations in three of the ten most energy consumptive industries - fabricated metals, machinery (except electrical) and textile mill products. Figure 5 depicts graphically actual 1979 energy use for the reporting corporations with what 1979 reporting corporation consumption would have been at 1972 energy use efficiencies.

At 1972 efficiencies, energy use in the reporting corporations would have risen to approximately 17.8 quadrillion Btu per year - over 2 quadrillion more Btu than were actually consumed. This reduction in per-unit-of-production demand for energy in the reporting corporations is equivalent to reducing consumption by 1 million barrels of crude oil per day. In terms of contribution to productivity of the reporting corporations, the energy savings due to efficiency improvement equates to over $9 billion dollars per year in energy cost reductions for the reporting corporations. This figure is calculated by costing crude oil at $17.72 per barrel (the composite average refiner acquisition cost of crude oil in 1979[2]).

The energy efficiency improvements by these industries have been attained primarily through application of no or low cost conservation measures. These conservation actions have ranged from the initiation of energy management awareness programs to relatively low cost improvements, such as the use of insulation in process equipment and the installation of improved fuel use controls on boilers and other energy-intensive process equipment. Only in the relati

Figure 4
Energy Efficiency Improvement Progress for Ten Major Energy Consuming Industries (1972 Base Year)



[1]Note: With electricity distributed, i.e. includes energy consumption by electric utilities which is allocated to end-use sectors in proportion to electricity sales by privately owned Class A and B electric utilities.
On an end-use basis (without electricity distributed), the reporting population constitutes 81 percent of total annual industrial consumption.
Source: Energy Information Administration, *1979 Annual Report to Congress.*

[2]Source: Energy Information Administration, *1979 Annual Report to Congress.*

well capitalized industries, most notably chemicals and petroleum, is there evidence, in reports provided to DOE, of ıital-investment-based conservation. e fact that these industries exhibit rates of energy efficiency improvement which are among the highest reported in the energy-intensive industries is notable.

In looking to the future, the prospects for continued energy efficiency improvements in the energy-intensive industries are viewed as less promising. It is anticipated that the rate of improvement in energy efficiency in the energy-intensive industries will decline unless a general transition is made to capital-investment-based conservation strategies (i.e., more substantial industrial investments in energy-efficient process equipment). Best available energy conservation technology could improve energy efficiency in the energy-intensive industries by 20 to 30% over current levels. Emerging technologies offer even greater potentials - up to 50% energy efficiency improvement.

Adoption of these technologies is currently constrained by several major factors. A principal obstacle to implementation is the fact that many energy-intensive industries have alternative uses for capital which limit conservation investment and have very long capital equipment replacement cycles (28 years in the case of the steel industry).[3] The limited amount of capital generated in these industries tends to be absorbed by investments in market position, new product development, and mandatory investments in such areas as pollution control. As a result, there is often insufficient discretionary capital for investment in projects having energy conservation as their principal purpose, or in research, development and demonstration projects.

The capital limitation problem is aggravated by the relatively high risk associated with many conservation technologies. As Figure 6 illustrates, energy is a low percentage of total costs to most industries. In all energy-intensive industries of the 2-digit level, energy accounts for less than 8% of the total value of shipments, and the average for most energy-intensive industries is closer to 3%. This contributes to a perception on the part of many industrial decision makers that the costs and risks to production inherent in the adoption of new technologies outweigh the potential benefits of improved energy efficiency.

A corollary constraint to the deployment of more energy efficient technology is the lack of a technical base sufficient to support accelerated adoption. Many of the emerging energy-efficient technologies available to industry are unproven in an operational mode due to the lack of funds to support demonstration and further development. These problems are associated with the steady decline in RD&D spending that has occurred in industry during the last twenty years. As Table 3 shows constant dollar spending for RD&D among the reporting corporations has risen very little since 1972 - far less than the increase in production output. RD&D spending in two of the reporting industries actually declined since 1972. This de-emphasis on innovation in the energy-intensive industries has been accompanied by reductions in engineering staff as a cost-cutting measure, which further constrains industry's ability to develop and adopt conservation technologies.

In view of these factors, it appears that capital-intensive conservation technologies will not quickly achieve significant market penetration. What this portends in terms of future increases in energy efficiency improvement cannot be precisely estimated, but the rate of efficiency improvement can be expected to slow as opportunities for low and no-cost improvements diminish, unless the types of constraints indicated above can be mitigated.

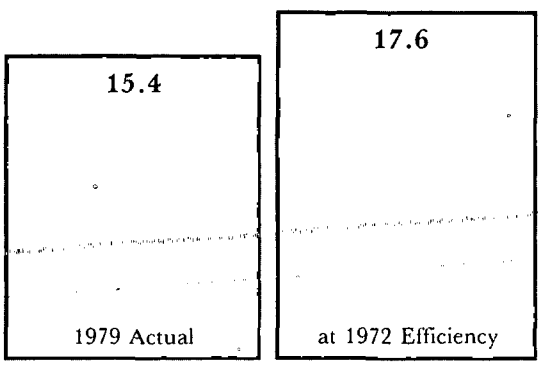
The five industries which have exceeded their energy efficiency improvement targets - chemicals, petroleum, transportation equipment, machinery (except electrical) and food and kindred products - are all relatively well capitalized and exhibit high rates of investment in RD&D. These five industries, for example, accounted for over 85% of the total RD&D expenditures for the ten industries listed in Table 3 - or almost $8 billion (constant 1972 dollars) in 1978. A direct cause-effect relationship cannot be drawn at this time between RD&D spending and energy efficiency improvement. However, there may well be a connection

Table 2
Growth in Output, Ten Most Energy Consuming Industries—[1]

SIC Code	Industry	% Year Average (1968-1978)	% Growth Since 1972-[2]
20	Food & Kindred Products	2.8	23.7
22	Textile Mill Products	2.4	19.8
26	Paper & Allied Products	3.1	26.6
28	Chemicals	3.8	34.3
29	Petroleum	4.0	36.6
32	Stone, Clay & Glass	2.5	20.6
33	Primary Metals	-1.2	-9.0
34	Fabricated Metals	1.1	-8.2
35	Machinery, except electrical	3.8	34.3
37	Transportation equipment	-3.3	-28.8

[1]Source: U.S. Department of Commerce, 1980 Industrial Outlook
[2]Based on average yearly growth in output 1968-1978.

Figure 5
Reporting Corporation Consumption at 1972 and 1979 Efficiencies (Quadrillion Btu)



[3]IBID.

which is deserving of analysis.

There may well be a high correlation among capital availability, RD&D and energy efficiency improvement progress among reporting industries. A corollary assumption would be that the rate of increase in energy efficiency improvement in the less-well-capitalized industries will decline in the coming decade unless capital limitations to conservation investment can be removed. Less marked declines in the rate of energy efficiency improvement could also be expected for the better capitalized industries, since the high risk and non-competitive rates of return associated with some energy conservation technologies would act to limit investment.

Specific discussion of the progress of individual reporting sectors is presented in the following section, which addresses energy efficiency improvement on an industry-by-industry basis.

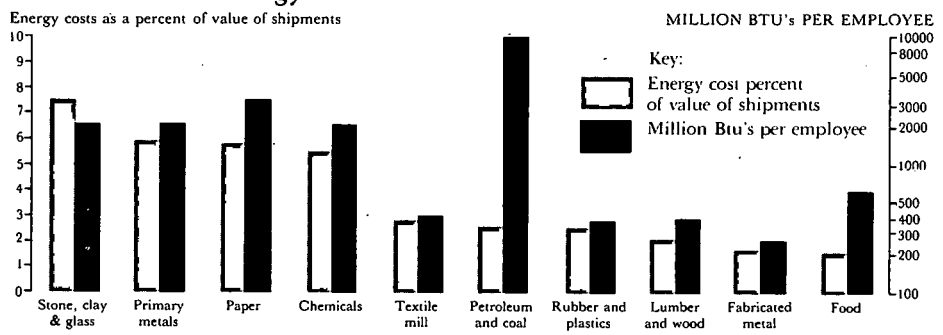
II.2

Industry-Specific Energy Efficiency Improvement Progress

The energy efficiency improvement reporting program currently includes 20 industries in the manufacturing sector as defined by the Standard Industrial Classification (SIC) system. All corporations using over a trillion Btu's per year in any 2-digit manufacturing SIC are required to report energy efficiency improvement in accordance with the provisions of the Energy Policy and Conservation Act (EPCA), as amended by the National Energy Conservation Policy Act (NECPA). The ten most energy-

Figure 6

Energy Costs as a Percent of Shipments in the 10 Most Energy Intensive Industries



Source: U.S. Department of Commerce, *1980 Industrial Outlook.*

Table 3

Research, Development & Demonstration in Ten Energy—Intensive Industries[1] (Constant 1972 Dollars)

SIC	INDUSTRY	RD&D Expenditures (Millions of $) 1972	1978[2]	Average Year % Change Since 1972
20	Food & Kindred Products	259	259.3	0.0
22	Textile Mill Products	61	52.1	-2.4
26	Paper & Allied Products	189	226.6	+19.8
28	Chemicals	1,932	2,180.0	+2.0
29	Petroleum	468	649.0	+6.3
32	Stone Clay & Glass	183	244.4	+5.6
33	Primary Metals	277	330.9	+3.1
34	Fabricated Metals	253	240.6	4.9
35	Machinery, Except Electrical	2,158	2,708.5	+4.2
37	Transportation Equipment	1,768	2,292.1	+4.9

[1]National Science Foundation, Annual Report on Research and Development.
[2]Deflated to 1972 Constant Dollars, based on GNP deflator.

intensive industries have been involved in the reporting program since the signing of EPCA, which also mandated that 1980 energy efficiency improvement targets be established for those ten industries. The industrial energy efficiency improvement overview presented in Section II.1 is based primarily on information provided by these industries, because they have the largest established base of historical data, and because their reports tend to be more inclusive and detailed.

In previous DOE annual reports, DOE employed tracking curves of results reported semiannually by industry. The annual reporting requirement has eliminated the seasonality impacts that were reflected on these curves. As a result of this factor, as well as changes in the reporting format mentioned in the previous Section, these curves have been eliminated. Table 4 displays reported improvements for both 1978 and 1979. Caution should be exercised in making interprctations based on direct comparison, because of factors such as changes in reporting regulations, the new plant reporting requirement and the increased reporting population.

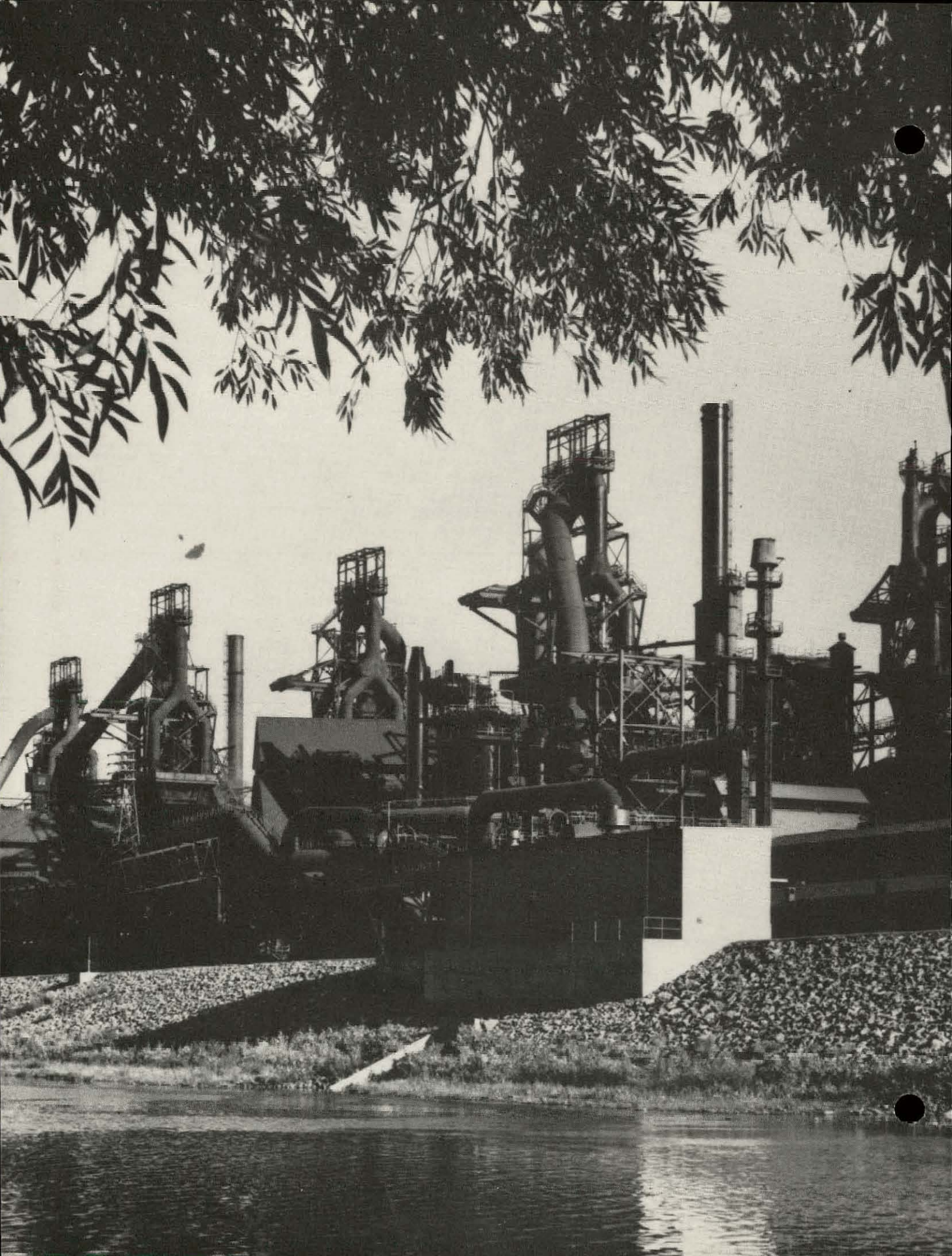
The second ten industries now required to report energy efficiency improvement have a more limited amount of historical information available on energy consumption dating back to 1972. As a result, many newly identified corporations are measuring current efficiencies as compared to the efficiency in a base year of 1978. When data is available for 1972 comparisons and was provided to DOE, it is included in the individual industry summaries.

Additional corporations and trade associations, on a voluntary basis, provide DOE with more detailed and informative data related on energy and energy consumption. This information, which includes data from many firms that are not mandated to report, is summarized in Section II.3.

Table 4

Reported Energy Efficiency Improvement (Percent). Relative to 1972 Base Year Efficiencies

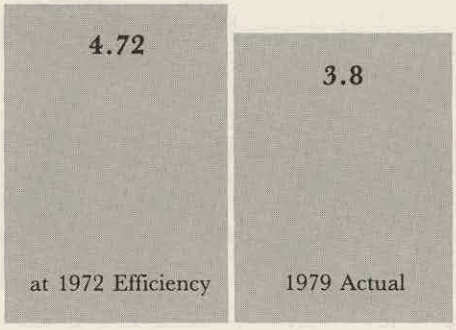
Reporting Industries	Industry SIC Code	First Half 1978	Second Half 1978	1979	1980 Target
Chemicals and Allied Products	28	15.1	17.2	22.1	14
Primary Metals Industry	33	6.7	8.9	7.8	9
Petroleum and Coal Products	29	12.6	16.4	14.7	12
Stone, Clay and Glass Products	32	11.6	12.9	12.9	16
Paper and Allied Products	26	11.7	13.6	16.9	20
Food and Kindred Products	20	12.1	16.6	15.3	12
Fabricated Metal Products	34	12.1	21.9	21.5	24
Transportation Equipment	37	17.4	21.2	23.4	16
Machinery, Except Electrical	35	20.6	28.3	24.7	15
Textile Mill Products	22	14.7	19.4	17.7	22



SIC 28

Chemicals and Allied Products

Figure 7
Comparison of Current Reported Chemicals and Allied Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 28 Consumption (in quadrillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 14%

Energy Efficiency Improvement: 22.1%

Energy Savings: 860 Trillion Btu's per year

The chemicals industry is one of the largest consumers of energy in United States industry. In 1979, corporations reporting from the chemicals industry consumed more than 3.8 quadrillion Btu of oil, natural gas, electricity and other fuels. This figure does not include feedstocks. The industry is highly dependent on natural gas and oil both as a raw material and a fuel, and in recent years has become increasingly more reliant on electricity as a source of process energy.

The organic chemicals industry is the largest consumer of energy in the sector (40% of total energy use in 1976). Inorganic chemicals (25% of total energy use), plastics and synthetics, and agricultural chemicals are other important consumers of energy within the sector. Together these industries comprise over 90% of total SIC 28 energy use.

The chemicals industry has taken one of the most active roles in industrial energy conservation activities. The industry's early recognition of the value of energy conservation has paralleled the economic importance brought on by the rise in energy prices. In part because regulation has restrained the growth in price of domestic fossil fuels, the chemicals industry currently enjoys a price advantage in world markets. This advantage will be reduced as deregulation of domestic energy prices continues. The chemicals industry must improve its energy efficiency and feedstock flexibility if it is to maintain its competitive advantage. This is particularly true in petrochemicals producers (the dominant sector of the industry), which rely on oil and natural gas as their principal sources of raw materials.

The industry has committed itself to dealing with these realities, emerging as a leader in industrial energy conservation. In 1979, the chemicals industry achieved a 22.1 percent improvement in its energy efficiency, in comparison to 1972 operations, exceeding its 1980 targeted improvement of 14 percent by more than 8 percent. This represents an energy sav-

ings that exceeds 860 trillion Btu, compared to what would have been required at 1972 efficiencies. The 22.1 percent improvement equates to nearly 461,000 barrels of crude oil equivalent per day. The magnitude of this energy savings benefits becomes apparent when viewed in terms of its potential to reducing dependence on imported oil - total imports of crude oil averaged 6.3 million barrels per day in 1979. [1] It should also be noted that, if the chemicals industry's consumption were adjusted to reflect that portion of energy use which is devoted to environmental protection, the energy efficiency improvement for the industry since 1972 would be over 24 percent. This is a significant improvement over 1978. In 1978, reporting corporations (limited to the top 50 identified trillion Btu's consumers in SIC 28 and voluntary reporters) achieved a 15.1% improvement in the first half of 1978 and a 17.2% improvement in the second half of 1978.

The success of the chemicals industry in improving its energy efficiency can be attributed to a solid commitment to energy management programs, which involves investment in retrofitting plants for cost efficiency improvement and is buttressed by relatively rapid plant turnover and a high level of RD&D expenditures. Since energy costs as a percent of sales are relatively high in the chemicals industry (as high as 17%, in the case of inorganic chemicals), investments in new capacity and retrofits have significantly increased energy efficiency. Unlike some energy-intensive industries, the chemicals industry is relatively well capitalized. Its discretionary capital investment in RD&D is the second highest in the industrial sector - an average of $200 million annually for leading firms. Capital investment programs have introduced energy saving processes and technologies such as the wet grinding of phosphate rock and the use of cross-pipe reactors in fertilizer production, as as a variety of measures such as the u improved boilers and waste energy recovery systems, including cogeneration technologies. The industry has also been active in promoting energy conservation through low cost energy management and conservation awareness programs, which have contributed significantly to improved energy efficiency. The effectiveness of the chemicals industry's conservation efforts is reflected in its modest rate of growth in absolute levels of energy consumption. Since 1972, total energy consumption by reporting corporations has risen from 3.74 quadrillion Btu per year to a current rate of 3.87 quadrillion Btu, a rise of 3.37% in eight years (See Table 5). In comparison, the output of production increased almost 28%.[2]

The success of the industry in decreasing its dependence on nautral gas has been positive. Industry consumption of natural gas - the industry's primary fuel - has been reduced by 12.2%. Oil usage, in contrast, has risen. Residual fuel oil usage is up 20.1% since 1972, and middle distillate usage increased by over 5.5%.

Coal use by reporting corporations has declined from approximately 336 trillion Btu in 1972 to a 1979 level of approximately 315 trillion Btu, according to data received from reporting corporations. This trend is expected to be reversed consistent with environmental and operational constraints, but a significant shift toward greater reliance on coal is not expected in the near term. The most significant fuel switching trend evident in data submitted by reporting corporations is that of a substantial decline in natural

Table 5
1979 SIC 28 Chemicals and Allied Products
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	1076622.0	31.8
Natural Gas	1567951.0	-12.2
Propane	3825.3	-10.5
LPG	3474.3	6.7
Bituminous Coal	308905.2	-6.1
Anthracite Coal	6888.4	-6.7
Coke	4799.7	-37.1
Gasoline	1390.2	26.5
Distillate Fuel Oil	44673.8	5.6
Residual Fuel Oil	240846.3	20.1
Petroleum Coke	2675.2	1422.6
Purchased Steam	119518.9	-12.6
Other	497749.4	19.6
Totals	**3879319.7**	**3.4**

*Utilizing 1972 as reference year

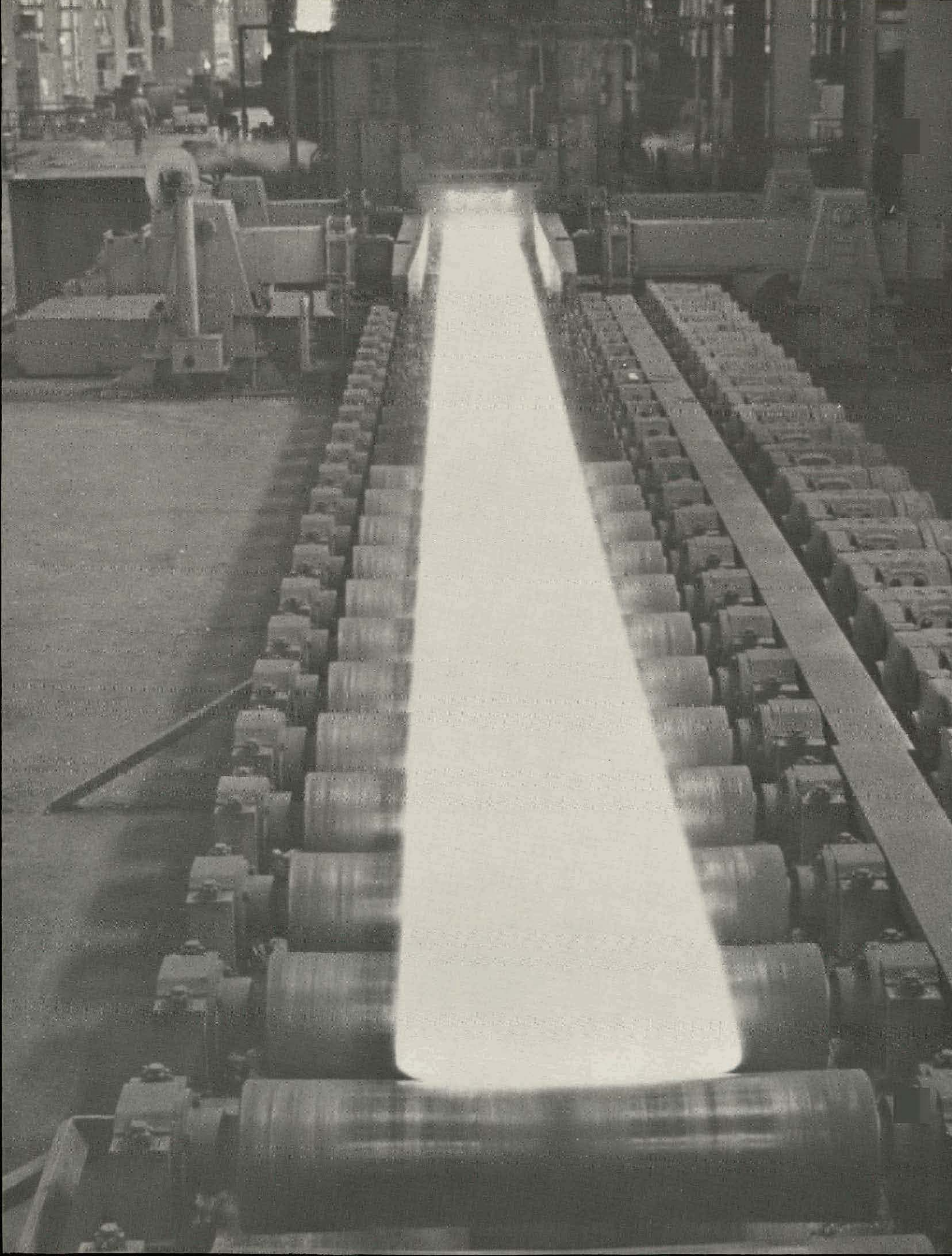
[1]Energy Information Administration, *1979 Annual Report to Congress.*

[2]U.S. Department of Commerce, 1980 Industrial Outlook.

gas usage accompanied by a major shift toward substitution of electricity for fossil fuels. Electricity usage in reporting corrations has increased by 31.8%, rising a total consumption of 1.07 quadrillion Btu per year (in SIC 28, the conversion factor used for electricity is 10,500 Btu/Kwh).

The outlook for future improvements in energy efficiency in the chemicals industry is encouraging. The Chemical Manufacturers Association, the major industry trade association, has informed DOE that its members have committed themselves to achieving an energy efficiency improvement of 30%, relative to 1972 levels of efficiency, by 1985. This voluntary commitment on the part of the reporting corporations will be supported by ongoing capital investment programs geared to specific objectives and time frames. Between now and 1985, industry efforts are expected to be directed to the more efficient utilization of crude oil as a raw material. This effort will be supported by research into the development of new process designs. By 1985-1990, the industry is expected to accelerate its development of processes which rely on coal-based chemistry, to facilitate substitution of coal for natural gas and oil. Beyond 1990, the industry's efforts are expected to center on other alternative sources of fossil fuels such as oil shales and tar sands, and the possible use of biomass as a raw materials feedstock. Although a 30% improvement will be beneficial to the industry and the national objectives, additional improvements will be necessary to meet the industry's energy demands towards the end of this decade.

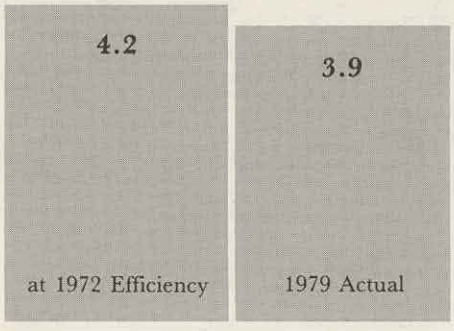
The Office of Industrial Programs is supporting development of energy efficient chemicals industry technologies by sponsoring basic and applied research in a variety of areas. These programs have been instrumental in the development of cross-pipe reactor technology, which has had a significant impact in reducing the amount of energy required to produce fertilizer chemicals. The Department of Energy has also been active in sponsoring the development of waste heat recovery technologies for generic application in energy-intensive chemical production operations. Other research has addressed the development of alternative fertilizer formulations which will facilitate the use of less energy-intensive processes in the production of ammonia and other organic chemicals.



SIC 33

Primary Metals

Figure 8
Comparison of Current Reported Primary Metals Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 33 Consumption (in quadrillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 9%

Energy Efficiency Improvement: 7.8%

Energy Savings: 307 Trillion Btu's per year

The primary metals industry is also one of the largest consumers of energy in the industrial sector. The industry consumes over 4 quadrillion Btu per year – or over 13 percent of total industrial consumption. The largest group within SIC 33 is the steel industry, which accounts for approximately 70 percent of total energy use, or nearly 3 quadrillion Btu. The aluminum industry is the second largest consumer within SIC 33, accounting for over 876 trillion Btu of energy per year, or approximately 20 percent of the industry's total. The nonaluminum, nonferrous metals industries account for nearly 10 percent of total energy consumption.

The industry's primary fuels are coal and coke, which accounted for 43 percent of the industry's total consumption during 1979. The primary metals industry is also heavily dependent on oil and natural gas, which comprised approximately 29 percent of total consumption. The third most widely used fuel in primary metals is electricity, with a 23 percent share of total consumption.

Energy conservation is probably more difficult and complex for the primary metals industry than it is for any other energy-consumptive industry. This is confirmed by the 9 percent energy efficiency improvement target established by the Federal Energy Administration for the 1972 through 1980 time frame. While this target is the lowest for all industries required to report in the industrial energy efficiency improvement program, it would constitute a major energy savings. A 9 percent increase in energy efficiency by 1980 would yield energy savings of 477 trillion Btu per year – the equivalent of 207,000 barrels of oil per day, compared to usage at 1972 efficiency levels. Consequently, while the energy efficiency improvement target for the industry is low in comparison to those for other industries, the benefit to be derived from its attainment would be far greater than that which would accrue from the higher percentage improvements in the

less energy intensive industries which participate in the industrial energy efficiency improvement program.

At the close of 1979, the primary metals industry had achieved substantial progress toward its 1980 energy efficiency improvement target of 9 percent, indicating probable realization of that goal. The industry had improved its energy efficiency by 7.8 percent in comparison to the 1972 base year. This compares to semiannually reported energy efficiency improvements of 6.7% for the first half of 1978, and 8.9% for the second half of 1978. The reporting corporations within the primary metals group have improved their combined energy efficiency at a rate of slightly more than 1.5 percent per year since the industrial energy efficiency improvement program was initiated. If this rate of improvement holds through 1980, the industry will slightly exceed its 1980 energy efficiency goal.

markedly, falling over 29 percent. Residual oil usage has grown, at a rate of about 1.6 percent per year. Bituminous coal usage has also declined significantly, but this decline is probably more indicative of the economic situation in the industry (output has declined more than 9% since 1972) than of conservation activity, and is largely responsible for the almost 6 percent decline in the absolute amount of energy consumption by this industry.

In looking to the future, it seems clear that major increases in SIC 33 energy efficiency will be difficult. The steel industry, which accounts for over 70 percent of SIC 33 energy consumption, is highly capital-intensive, and its profit levels are quite sensitive to production volume changes. In the current economic atmosphere of heavy pressure from imported steel, and a general surplus of domestic and international steel production capacity, the industry is generating a low return on its sales. This poor financial performance has reduced the availability of capital for the replacement of old, inefficient production equipment. This circumstance is reflected by the industry's low asset turnover rate, which further constrains the infusion of more energy efficient technologies and processes. As a result, the steel industry is presently at a crossroads - a situation which is receiving widespread attention at the highest levels of government. Its production costs are noncompetitive in the world market, and its ability to improve both its productivity and energy efficiency are limited by a lack of sufficient capital for modernization. Consequently, the industry's conservation activity has generally been focused on low to moderate cost improvements.

While adoption of these technolog has has a significant effect on overall co.. sumption, the industry continues to be, on the average, 15 to 30 percent more energy-intensive (i.e., in energy use per ton of output) than its foreign competitors.

The outlook for further energy efficiency improvement in the aluminum sector is more promising. The aluminum industry is relatively well capitalized, and is one of few industries in which conservation is a major component of RD&D spending. The aluminum industry is heavily dependent on the Hall-Heroult electrolytic reduction process, however, and energy efficiency improvements in excess of 20 percent for the industry will evidently be dependent upon the development of new processes for the reduction of aluminum. This will be a major technical and capital replacement challenge, as there are presently no developed alternatives to the industry-standard Hall-Heroult process.

The primary metals industry represents one of the highest priority development and demonstration efforts in the Office of Industrial Programs. The Office is currently sponsoring a broad variety of cost-shared developmental projects in the steel and aluminum industries, to develop both generic heat recovery retrofit technologies for currently used equipment as well as completely new technology concepts for the eventual replacement of current processes such as electrolytic aluminum reduction, which are inherently energy inefficient.

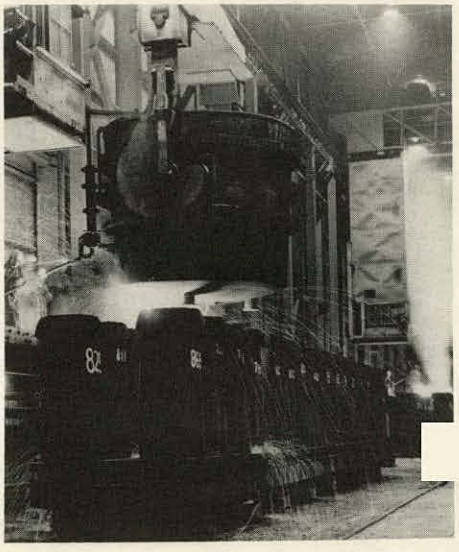
Table 6
1979 SIC 33 Primary Metals Industry
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	912803.8	2.2
Natural Gas	910269.3	-9.0
Propane	5210.6	-27.4
LPG	213.6	164.1
Bituminous Coal	1490468.0	-15.4
Anthracite Coal	7383.6	-27.3
Coke	210627.8	54.0
Gasoline	21446.0	663.4
Distillate Fuel Oil	33409.7	16.7
Residual Fuel Oil	222930.4	12.6
Petroleum Coke	63831.0	-4.8
Purchased Steam	26486.1	343.0
Other	31716.4	-55.6
Totals	**3936796.3**	**-5.9**

*Utilizing 1972 as reference year

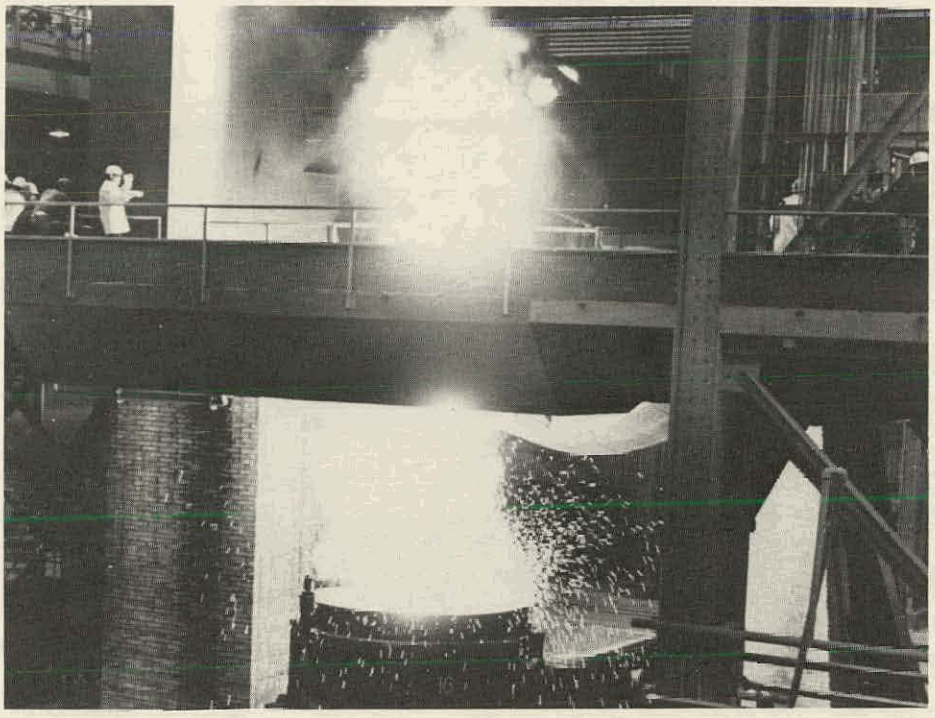
It should be noted that the achieved level of energy improvement represents a major contribution to energy conservation. The 7.8 percent increase in energy efficiency reported by SIC 33 corporations represents 307 trillion Btu in energy savings to the nation each year, relative to usage at 1972 efficiency levels. This is equivalent to 154,000 barrels of crude oil per day.

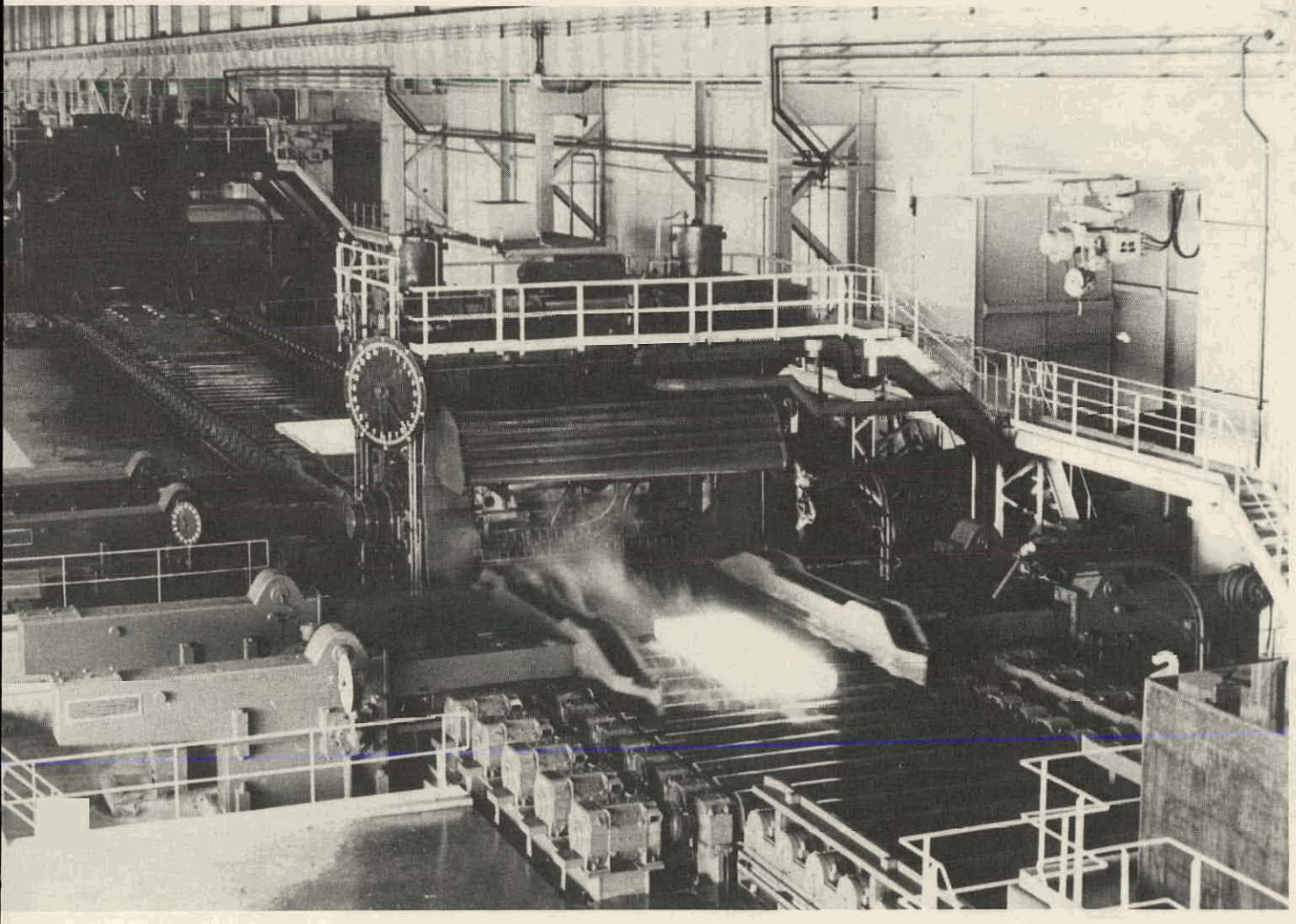
The industry's fuel switching performance has been positive in view of the capital constraints evident in the industry. In 1972 natural gas comprised over 30 percent of SIC 33 usage. This share has been reduced by almost 9 percent. Propane usage has declined



In the steel industry, RD&D has ranged from the development of retrofit technologies for slot forge furnaces and ndry cupolas to the development of ipletely new processes for the continuous casting of steel strip. Activities in the aluminum industry include development of new cathodes for aluminum reduction cells, which could greatly reduce energy use in the smelting of aluminum.

A longer-range Department of Energy project related to aluminum production is development of an entirely new process for the direct carbothermic reduction of aluminum. This advanced technology will, if successful, be considerably more energy efficient than currently employed electrolytic reduction processes, and would enable the U.S. aluminum industry to utilize relatively low grade domestic aluminum ores in place of imported high grade ores.

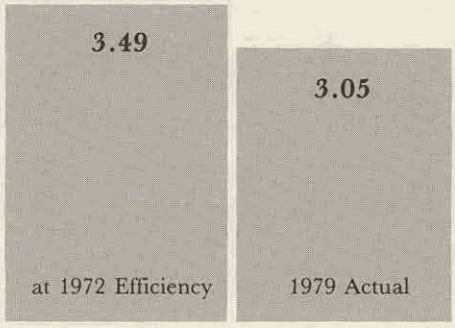




SIC 29

Petroleum and Coal Products

Figure 9
Comparison of Current Reported Petroleum and Coal Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 29 Consumption (in quadrillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 12%

Energy Efficiency Improvement: 14.7%

Energy Savings: 440 Trillion Btu's per year

The petroleum refining industry is the nation's third largest industrial consumer of energy, on the basis of 2-digit SIC total consumption. Annual consumption for the industry comprises 4 percent of national consumption, or over 12 percent of annual consumption in the industrial sector.

The petroleum refining corporations reporting in the program have improved their net energy efficiency by 14.7 percent, exceeding the 1980 energy efficiency improvement target of 12 percent. As of 1979, the industry had achieved energy efficiency improvements which produced an energy savings equivalent to more than 440 trillion Btu per year (220,000 barrels of crude oil per day), compared to the energy which would have been consumed at 1972 efficiencies. This progress compares to progress of 12.6 and 16.4 reported for the first and second halves of 1978.

It should be noted that the American Petroleum Institute (API) has provided detailed information which further disaggregates petroleum refining energy use by classes of operation. According to this data, if energy efficiency improvement progress is adjusted to account for energy use allocated to environmental protection, the energy efficiency improvement of refiners reporting through the API would be 19.4%, in comparison to the energy which would have been required to support current levels of production at 1972 energy use efficiencies.

Corporations reporting under the auspices of the industrial energy efficiency improvement program state that energy conservation measures implemented since 1972 have reduced the energy cost of refining a barrel of oil from the 1972 average of 645 million Btu to a 1979 average rate of 550 million Btu per barrel. This accomplishment is amplified by the fact that, although net energy consumption for reporting corporations within the industry declined from 3.09 quadrillion Btu per year in 1972 to 3.05

quadrillion Btu per year in 1979, refinery throughput rose by almost 2 million barrels per day. The success of the industry in improving its energy efficiency can, in part, be attributed to the fact that the industry has the capital resources to allow significant investment in energy conservation technologies. This factor, however, has only influenced energy efficiency improvement because petroleum industry managers have been attentive to the opportunities for conservation.

Investment funds have been primarily devoted to modifications of the refining operations of the industry. Seventy-two percent of corporations reported significant energy savings resulting from refining process heater modifications, and approximately two-thirds of the reporting corporations cited significant levels of investment in improved heat exchange equipment and the insulation of process equipment. Other major types of investment in energy efficient equipment - listed by 41 to 48% of the reporting corporations - are improved waste heat recovery, steam system improvements, and boiler efficiency improvements. The reports received from the industry reflect a significant effort to improve process equipment in the most energy-intensive process operations in refining.

On a value-added basis, the petroleum industry is the most intensive major industrial consumer of energy, at the 2-digit SIC level. Consequently, a relatively greater incentive for investment in energy conservation exists. Further, decontrol of domestic oil prices will improve the viability of conservation investments which are presently marginal and help maintain the industry's current rate of deployment of energy efficient technologies.

The industry also reports significant progress in reducing its usage of and dependence on premium fuels. Natural gas usage in the industry has declined by a substantial 27.4 percent - a significant reduction in the industry's most heavily used purchased fuel. Declines in middle distillate and residual fuel oil have been less pronounced, but are still substantial at 12 and 9 percent, respectively. Propane usage has declined more moderately, with reporting corporations indicating a 5 percent reduction. The only heavily used fuel in the industry which exhibits a growing share of total industry usage is electricity, which increased by 21 percent between 1972 and 1979. Gasoline usage has increased by 21 percent between 1972 and 1979. Gasoline usage has increased to a marked extent, but still comprises a very minor share of total usage. Coal consumption in the petroleum industry has increased by 5 percent, but still does not show any indication of significant market penetration.

The outlook for further increases in the energy efficiency in the petroleum industry is promising, relative to that in other industries. Current estimates indicate that the industry could achieve an additional 10 to 15 percent improvement in energy efficiency through deployment of best available technology. Investment in these technologies will be constrained to some extent, however, by competing capital investment needs including delayed improvements to refineries such as improved down-stream processing capabilities and substantial investment in environmental protection technology.

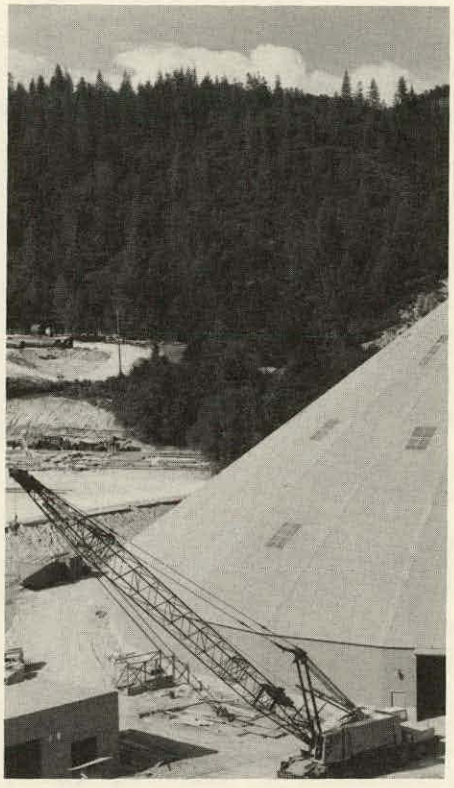


Table 7

1979 SIC 29 Petroleum and Coal Products
Fuel Use by Type for Reporting Corporations *

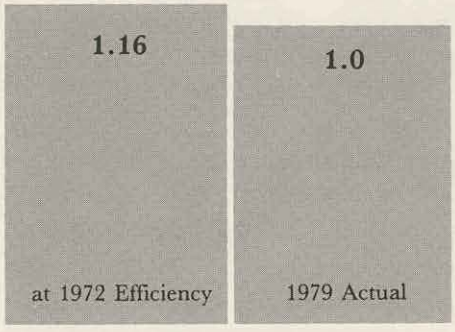
Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	245224.4	21.0
Natural Gas	774087.3	-27.0
Propane	9611.6	-5.1
LPG	34641.0	21.2
Bituminous Coal	4987.0	5.3
Anthracite Coal	0.0	-100.0
Coke	0.0	0.0
Gasoline	4025.7	2505.6
Distillate Fuel Oil	23921.2	-12.0
Residual Fuel Oil	239325.4	-9.3
Petroleum Coke	432015.7	-2.0
Purchased Steam	31985.7	-13.7
Other	3056924.0	17.5
Totals	**3056921.0**	**-2.8**

*Utilizing 1972 as reference year

SIC 32

Stone, Clay and Glass

Figure 10
Comparison of Current Reported Stone, Clay and Glass Energy Consumption at 1972 and 1979 Efficiencies



Operations in SIC 32 – stone, clay and glass – rank fourth in overall energy consumption, among industries at the 2-digit SIC level. Corporations reporting achieved an aggregated efficiency improvement of 12.9% in 1979, in comparison to 1972 base year efficiencies. This is several percentage points below the 1980 target of 16% for the SIC 32 industries. In 1979, total energy consumption for the reporting corporations declined three percent compared to 1972. Natural gas represented 44.3% of total reported industry consumption. Coal use accounted for 34.7% of consumption. Usage of residual and distillate fuel oils was 9.2% of total energy used in 1979, down from 10.7% in 1972.

Comparisons to 1972 energy consumption, by fuel type, show large declines in residual oil (45%) and natural gas (28%) use, with accompanying increases in coal (66%), electricity (18%) and distillate fuel oil (74%) consumption. An analysis of two sectors within the industry – cement and glass – demonstrates the diversified energy outlook for SIC 32.

Cement production requires a highly energy-intensive manufacturing process, with energy costs approaching one-quarter of the value of shipments. The cement industry is the largest energy consuming industry component in SIC 32 accounting for over one-third of the total consumption in stone, clay and glass industries. The Portland Cement Association, representing corporations responsible for more than 99% of U.S. total cement production capacity, reported a 10% energy efficiency improvement in 1979 compared to 1972, which equates to a savings of 50 trillion Btu's annually. This is primarily a result of movement from wet process production capacity to dry process cement production. A dry process plant is on average about 20% more energy efficient than a wet process plant. In 1979, wet process plants still represented about 50% of production capacity. Future energy efficiency improvement will be

directly related to the amount of new and replacement capacity installed. The industry projects that, by 1985, about one-third of its 1976 capacity will be replaced using more efficient dry-process kilns.

With 80% of its production energy consumed in firing the pyroprocessing kilns, the cement industry has focused heavily on improvements to recover kiln gases. While energy conservation is achieving efficiency improvements in the production process, however, it is particularly noteworthy that the cement industry has moved very strongly to coal burning since 1972. In 1979 about 71% of all fossil fuel energy consumed came from coal and coke compared to only 39% in 1972. Natural gas use in 1979 declined to 22% while oil provided about 6% of usage.

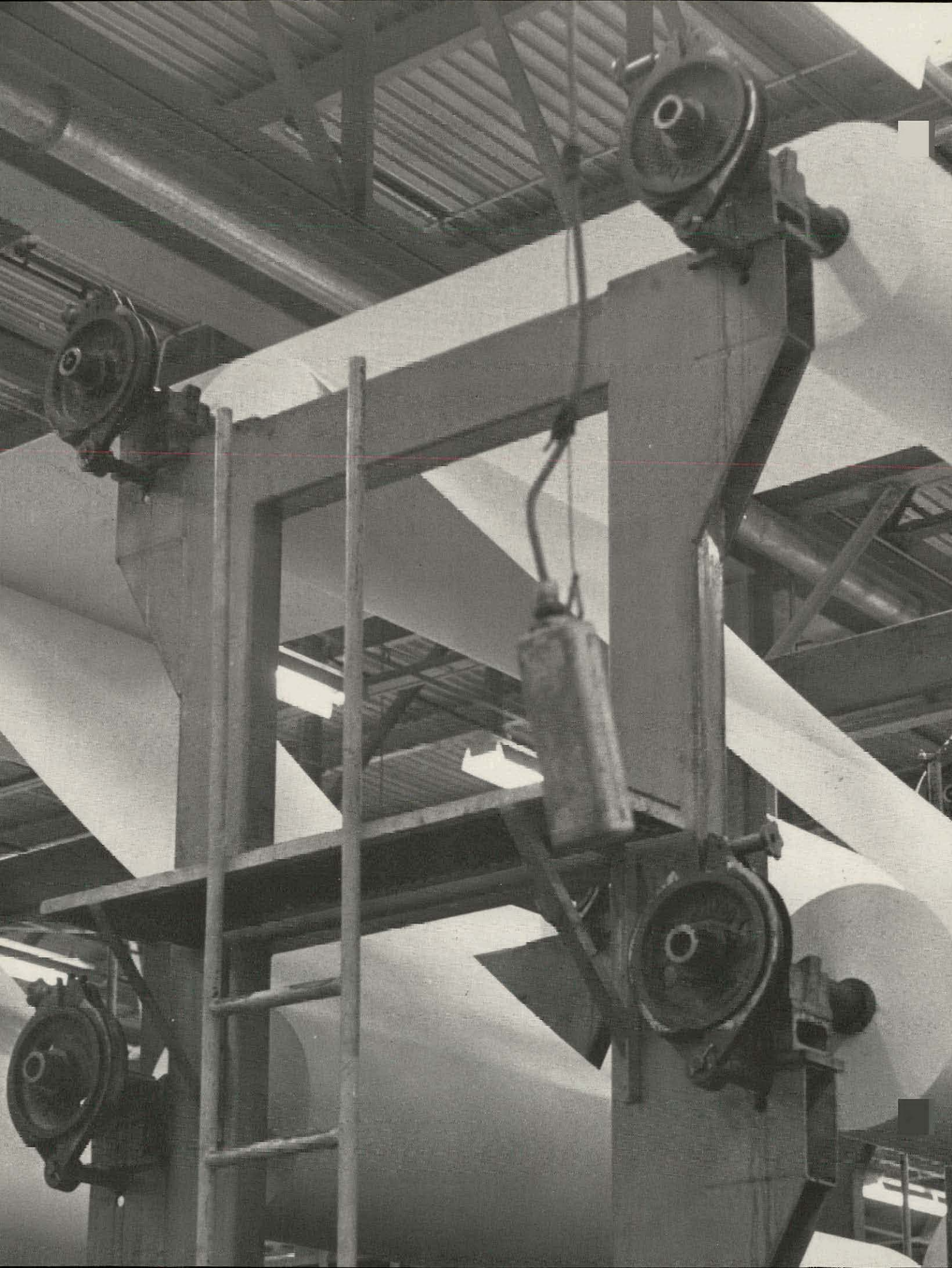
The glass industry accounts for about 24% of SIC 32 consumption, with energy costs ranging form 6 to 8 percent of sales. The Glass Packaging Institute, representing a large portion of the bottle industry, reported a 14.8% efficiency improvement for its members. Six glass manufacturing corporations reporting through a third party achieved a 29.2% efficiency improvement compared to 1972. The glass industry is heavily dependent on natural gas to fire its furnaces, with the most energy-intensive manufacturing process being the melting of glass.

Improvements have been reported as a result of heat recovery from furnaces, improved furnace design and improved furnace operating controls. In addition, energy management procedures similar to those used in other manufacturing industries, such as adding insulation improvement and HVAC controls, have also provided significant savings. Fuel switching to coal in the near term is doubtful, unless proven technology evolves for the processing of coal to synthetic gaseous or liquid fuels. Among the other SIC components sectors reporting to DOE are corporations reporting through the Refractories Institute and Tile Council of America. Refractories corporations reported an energy efficiency improvement of 10% in comparison to 1972 levels of efficiency. The ceramic tile manufacturers reported an average increase in efficiency of 15.5% in comparison to 1972 levels of efficiency. The Department of Energy has actively supported research on and development of more energy-efficient technology for the cement industry. Examples of sponsored research are improved insulation technology for concrete block curing ovens, and investigations on the possible use of refuse-derived fuel in kilns. The development of specifications for blended cement, which would allow substitution of fly ash or slag for raw materials, have also been addressed by the Office of Industrial Programs. Other research has focused on technology for the precalcining of raw materials, which would involve recovery heat from the cement kiln to preheat raw materials.

Table 8
1979 SIC 32 Stone, Clay and Glass Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	88862.9	18.0
Natural Gas	449005.4	-28.1
Propane	3354.2	-29.9
LPG	173.8	40.6
Bituminous Coal	352326.5	65.5
Anthracite Coal	594.5	60.5
Coke	2206.6	.3
Gasoline	1135.2	-9.8
Distillate Fuel Oil	46913.5	74.1
Residual Fuel Oil	46769.6	-45.1
Petroleum Coke	19088.1	621.5
Purchased Steam	1127.3	-22.5
Other	3107.9	-61.4
Totals	**1014665.2**	**-3.0**

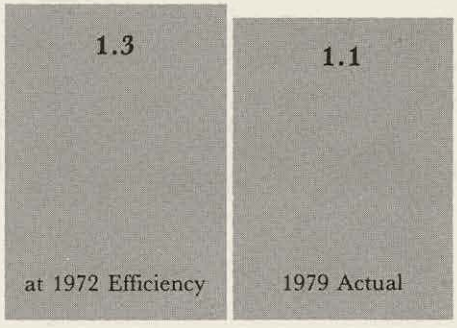
*Utilizing 1972 as reference year



SIC 26

Paper and Allied Products

Figure 11
Comparison of Current Reported Paper and Allied Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 26 Consumption (in quadrillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 20.0%

Energy Efficiency Improvement: 16.9%

Energy Savings: 186 Trillion Btu's per year

The Paper and Allied Products Industry, ranking fifth in industrial energy consumption, has a 1980 energy efficiency improvement target of 20 percent for purchased energy. Attainment of this target by the entire industry would provide an estimated savings of 316 trillion Btu's per year, or 137,000 barrels of oil equivalent per day, compared to production at 1972 energy efficiency levels. For the 1979 reporting period, the reporting population in SIC 26 achieved a 16.9 percent improvement in efficiency relative to 1972. This compares to a reported energy efficiency improvement of 11.7% for the first half of 1978 and 13.6% for the second half of 1978.

The paper industry consumes over 2 quadrillion Btu's of energy annually. Over 50% of this is generated from waste material created during production activities. Total purchased energy for the reporting population during 1979 was 1.1 quads, a decrease of 3.5 percent compared to 1972. The industry continues to be heavily dependent on oil. Residual oil consumption accounted for over one-third of the purchased fuel in 1979, declining 6.4% in absolute amounts used compared to 1972.

Natural gas, accounting for one-third of total consumption in 1979, decreased 10.2% compared to 1972. Only coal and electricity, among major energy sources, increased in consumption since 1972 (3 percent and 42 percent, respectively).

The American Paper Institute, the major industry trade association, provided DOE with a detailed report from 108 corporations (88 of which consumed a trillion or more Btu's), consisting of 403 pulp, paper and paper-board mills. This report, covering over 90 percent of the industry's production in 1979, provided the following information.

Improvement in fossil fuel and purchased energy use per unit of activity for primary mills was 16.9 percent; for converting mills it was 20 percent. With converting mills accounting for 5 percent of

the energy consumed, the overall improvement reported by API was 17 percent. In 1972 the entire industry's capacity utilization was 94.2 percent, compared to 93.3 percent for 1979. The API also indicated that the industry used 110 billion Btu's per day for environmental control in 1979. When capacity utilization and environmental controls are considered, the adjusted energy efficiency improvement for 1979 is 19.8 percent.

It is estimated that the industry spent about $254 million constant 1972 dollars in 1979 on research and development. These efforts have been oriented toward product development and improvement, as well as pollution control. In the last decade, pollution control has been a major capital item, accounting for $1 billion of capital expenditures, according to the API report.

The industry has great potential for increasing its use of wastes, both as a fuel and a substitute for virgin materials. The use of wood wastes has dramatically demonstrated the potential for use of renewable resources in the industry. Major efforts have been reported in fuel switching to save fossil fuels. These include conversion to and installation of waste, wood and coal burning boilers. Process changes such as increasing drying efficiency, reducing operating pressures and reclaiming fibers are some of the other actions reported to DOE as contributing to energy savings.

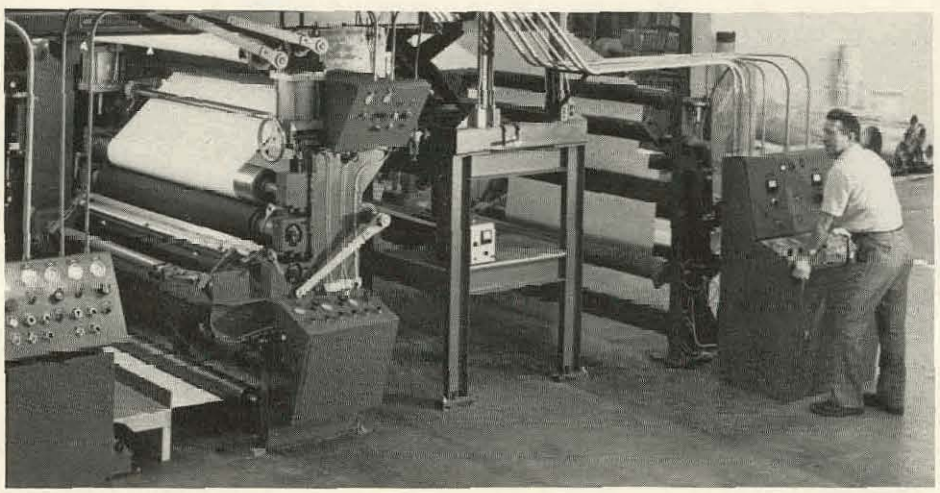
As in other industries, the role of energy management is critical to successful conservation activities. Actions taken as a result of energy management programs include utilization of waste heat for heating buildings and process water, cogeneration, reducing excess air in drying ovens and adding steam and condensate flow instrumentation. Computer controls for paper drying and pulp making have achieved additional savings. The industry is continuing the replacement of burners with more efficient ones. Boiler maintenance is generally recognized and emphasized as a low cost means for saving substantial energy in the paper industry.

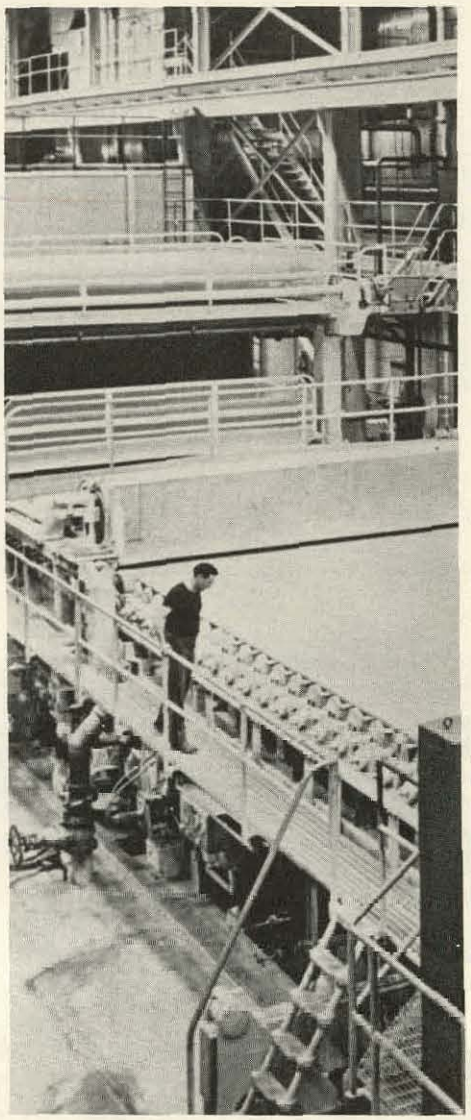
DOE's research and development projects in the paper industry include a project entitled "Basic Extractive Sludge Treatment," which has been demonstrated to require 50 percent less energy for sludge disposal than the standard industry hog-fuel incineration techniques. Other technologies that may soon be ready for commercialization include the use of advanced air/fuel ratio control systems and heat recovery from paper dryers using heat wheels.

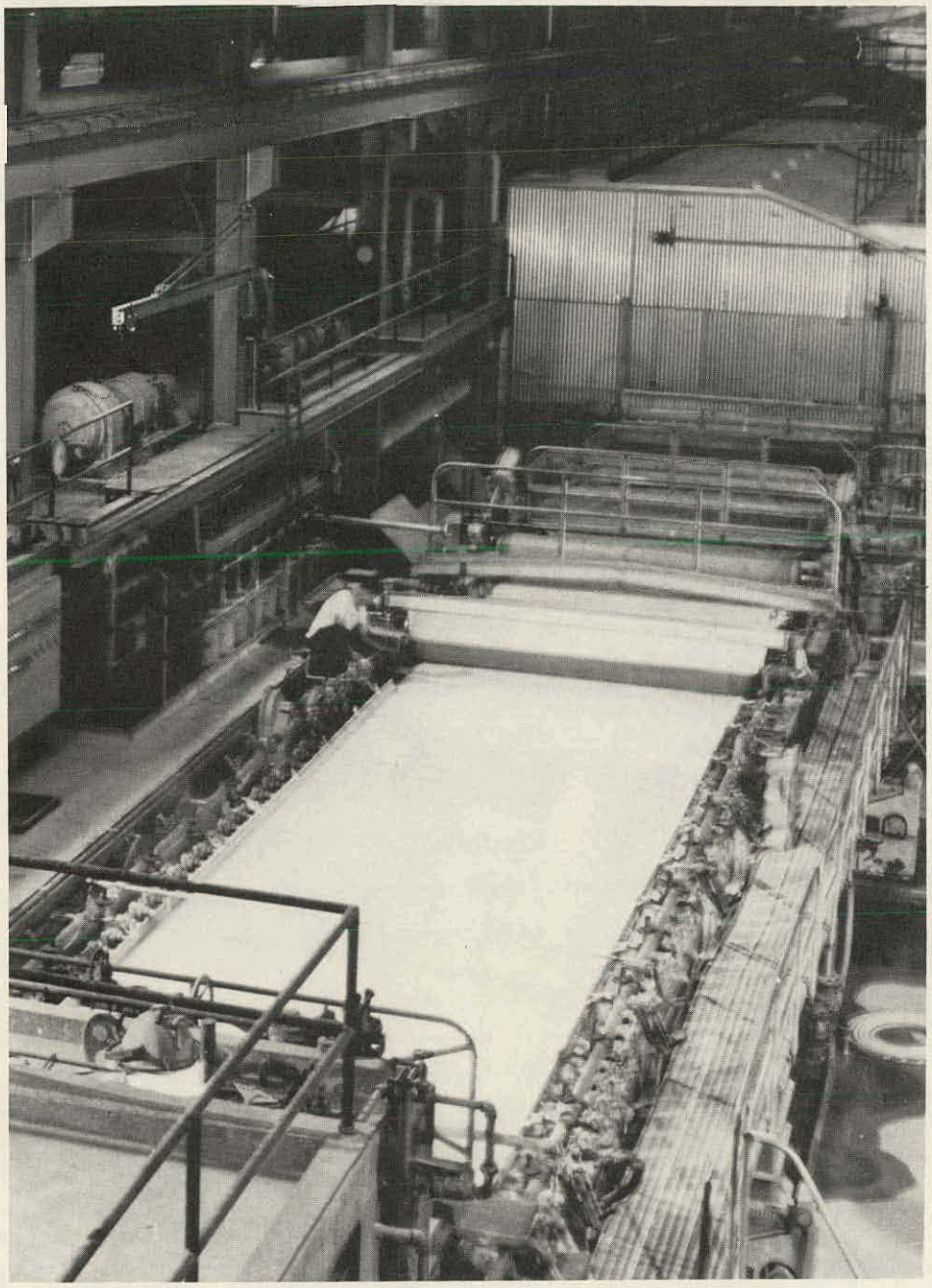
Table 9
1979 SIC 26 Paper and Allied Products
Fuel Use by Type for Reporting Corporations*

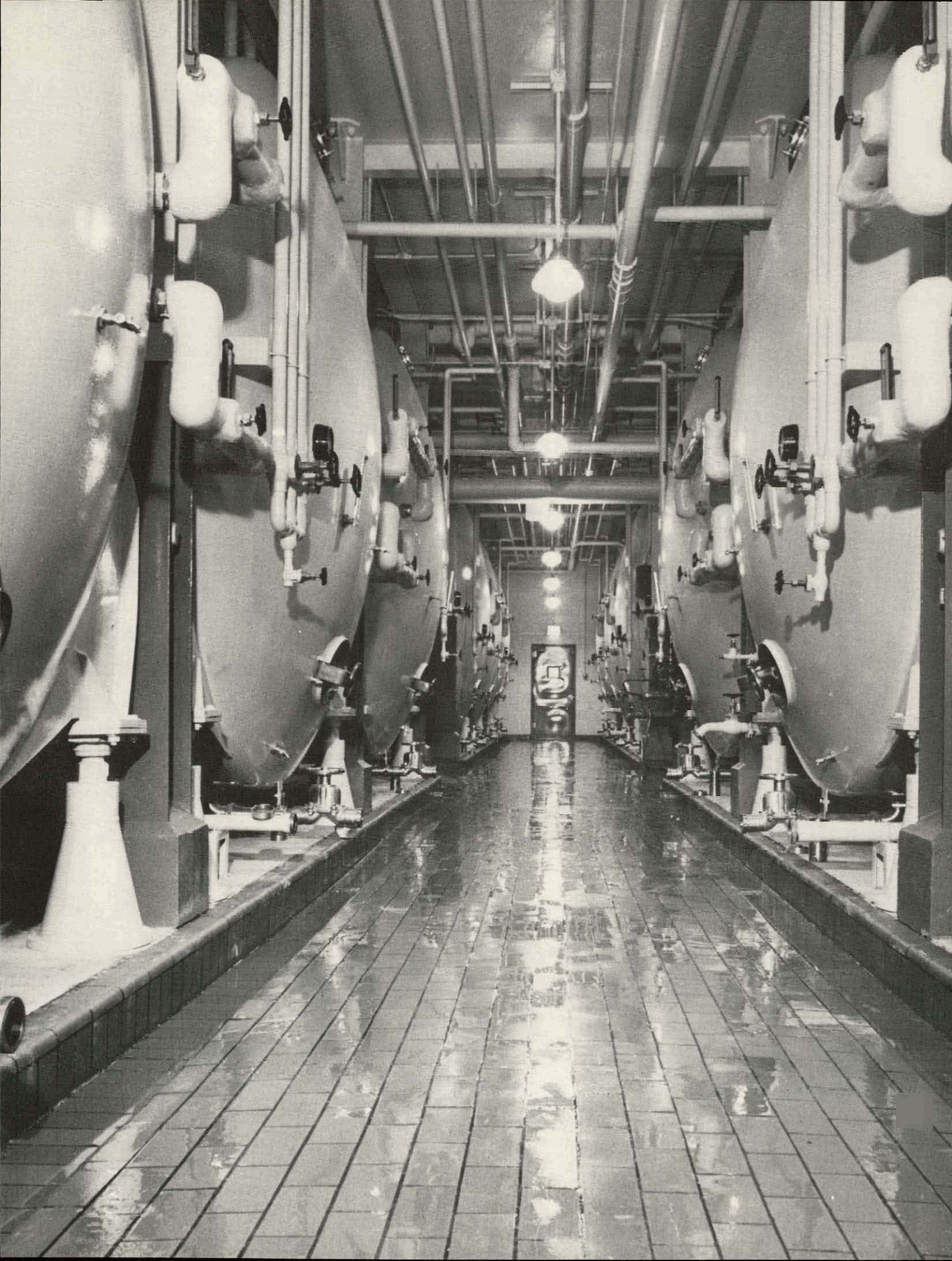
Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	124323.3	42.3
Natural Gas	368312.1	-10.2
Propane	35.0	-65.6
LPG	1521.0	-37.7
Bituminous Coal	200960.9	2.9
Anthracite Coal	0.0	0.0
Coke	0.0	0.0
Gasoline	14.0	-2.2
Distillate Fuel Oil	10802.4	-54.5
Residual Fuel Oil	373378.9	-6.4
Petroleum Coke	0.0	0.0
Purchased Steam	16976.3	-24.8
Other	9183.9	67.1
Totals	**1105507.8**	**-3.5**

*Utilizing 1972 as reference year





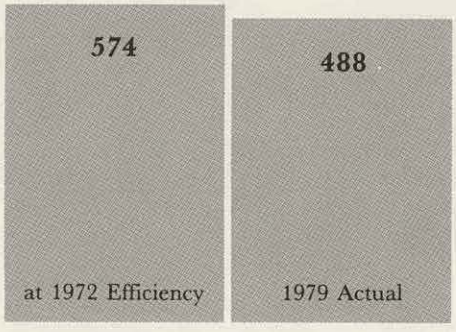




SIC 20

Food and Kindred Products

Figure 12
Comparison of Current Reported Food and Kindred Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 20 Consumption (in trillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 12.0%

Energy Efficiency Improvement: 15.3%

Energy Savings: 86 Trillion Btu's per year

The Food and Kindred Products Industry, ranking sixth among 2-digit SIC's in energy consumption, has a 1980 target of 12 percent energy efficiency improvement relative to 1972. The industry annually consumes almost a quadrillion Btu's of energy. Reported energy efficiency improvement was 15.3 percent compared to 1972 efficiencies; this improvement is 25% greater than the target, and continues a trend indicated in previous reports. The semiannual reports of 1978 showed a 12.1 and 16.6 improvement over 1972. Progress at this level for SIC 20 manufacturing activities yeilded a savings of 86 trillion Btu's, compared to the energy which would have been required at 1972 efficiencies.

The reporting population for SIC 20 is large, with about 127 corporations identified as consuming at least one trillion Btu's annually. The program also includes a substantial number of voluntary reporters participating in the 13 trade association sponsored programs. The sponsored programs provide detailed progress achieved by various sectors within SIC 20. The Grocery Manufacturers of America, Inc., representing a wide range of SIC 20 activities, reported a 16.8 percent improvement in efficiency by its participating members. The National Food Processors Association, which includes most of the canning industry, reported an improvement of 21.5 percent, while the efficiency improvement reported by the U.S. Brewers Association was 16.9 percent. Other improvements reported include 9.5 percent by the U.S. Beet Sugar Association, 8.2 percent by the U.S. Cane Sugar Refiners Association, 10.3 percent by the Corn Refiners Association, 21.0 percent by the American Meat Institute, 16.9 percent by the American Frozen Food Institute, 11.8 percent by the National Frozen Food Association, 6.3 percent by the Biscuit and Cracker Manufacturers Association, and 9.2 percent by the American Bakers Association.

In addition, The American Feed

Manufacturers Association reported a 15.5% efficiency improvement and the National Meat Association a 15.4% improvement.

Natural gas continues to be the preferred industry fuel, although curtailments during 1970's led to some fuel switching to fuel oil. Information on total energy consumption during 1979 indicates an overall decrease for SIC 20 of 11.4 percent compared to 1972 usage. Natural gas accounted for 35.4 percent of the Btu energy consumption in 1979, with bituminous coal increasing to 14 percent, electricity at 32.9 percent and residual oil at 14.8 percent of total consumption. The increase in coal consumption reflects primarily a trend towards coal conversion in the beet sugar industry.

Compared to 1972 base year energy consumption for the same plants, the reported fuel mix represents a 20 percent decrease for natural gas, a 2.8 percent increase for bituminous coal, a 1.8 percent increase for electricity and a 21 percent decrease for residual oil.

Based on the 1977 Census of Manufacturers, energy cost was 2.7 percent of the value of shipments for SIC 20. As a result of this relatively low total cost contribution, most capital improvements having energy conservation as their primary purpose have a relatively low return on investment. There is no evidence of significantly increased penetration of capital-intensive energy conservation technologies at the present time.

Major savings in the industry have occurred through in-house energy management programs concentrating on housekeeping activities. Such actions as waste heat reduction, changing production shifts and weekend shutdowns have all provided energy savings at relative low cost. The potential for housekeeping savings is still substantial because of the large number of corporations with smaller plants.

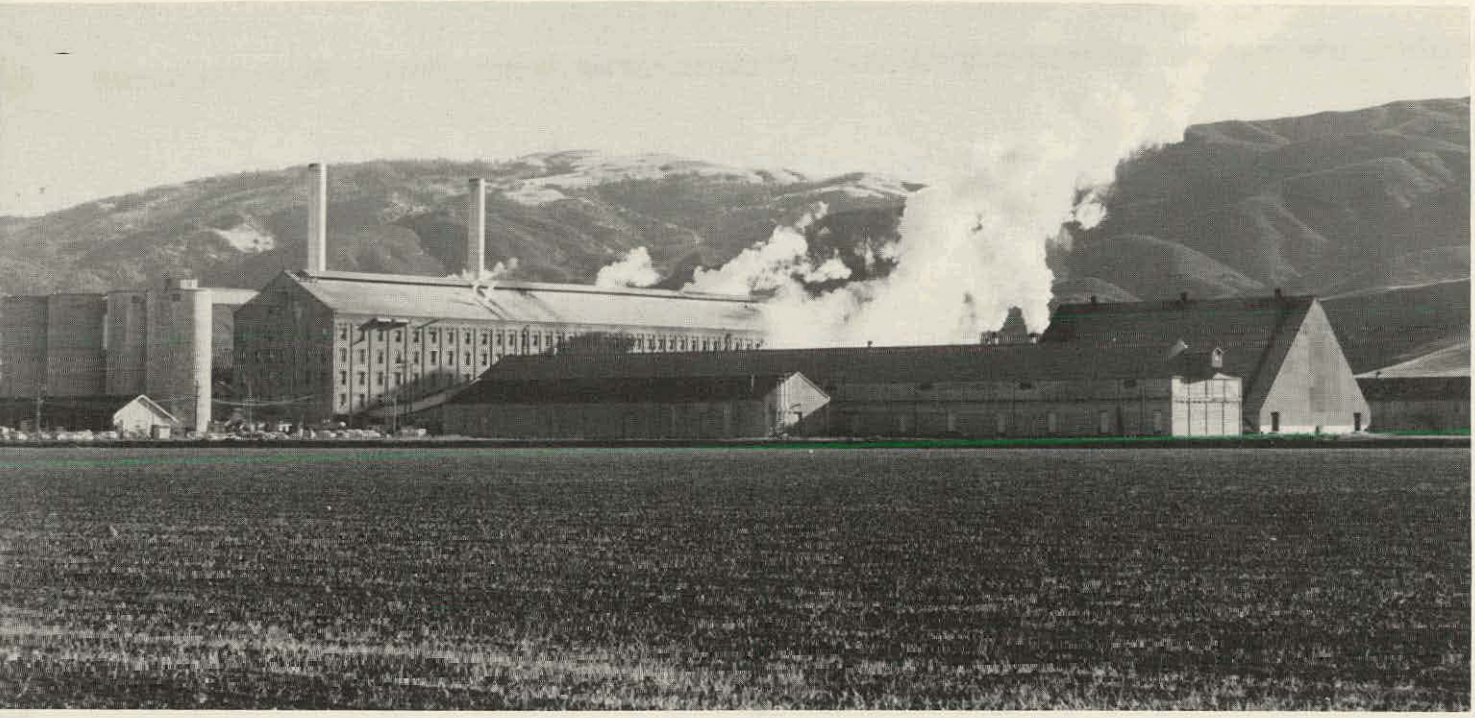
The industry has also taken additional action in promoting energy conservation awareness beyond the plant gate. Such programs as the Grocery Manufacturers Association's *Be Energy Alert Today* program are promoting additional employee awareness of energy conservation practices in the transportation and residential sectors.

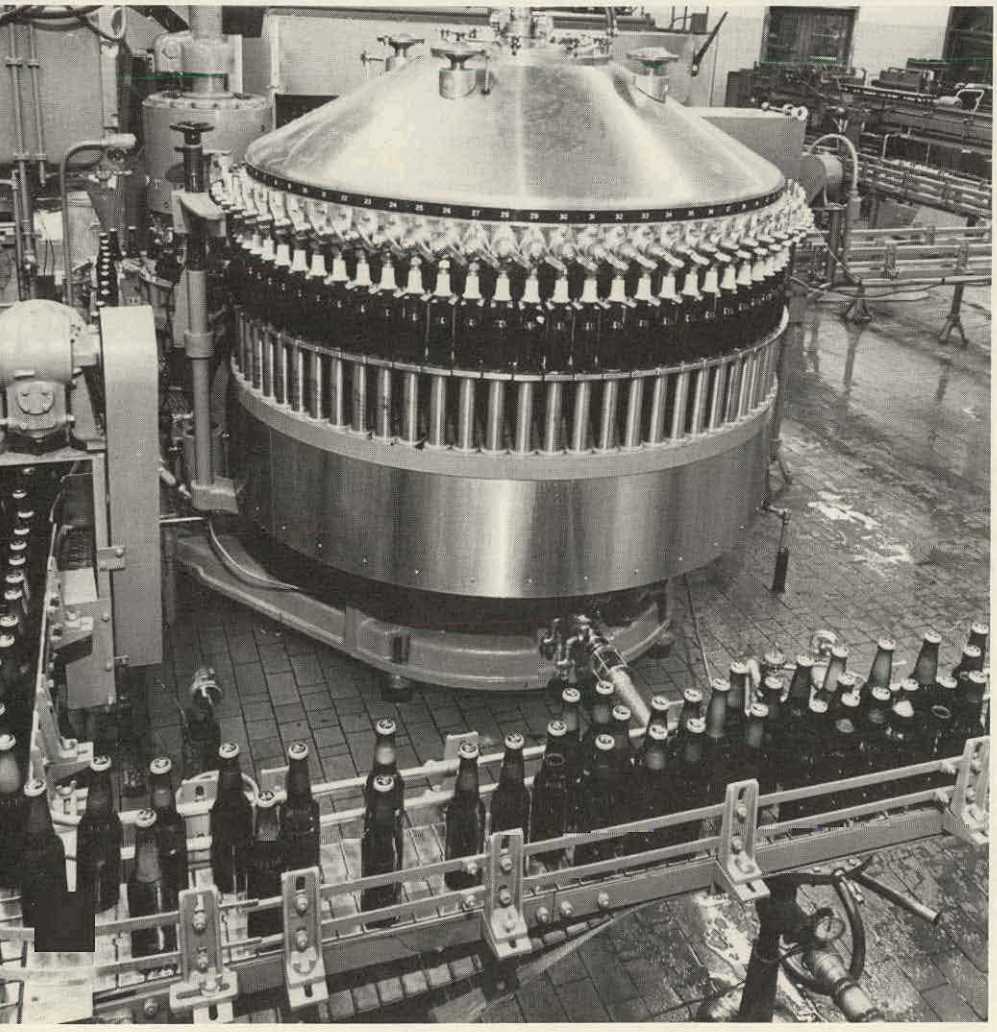
DOE has developmental projects underway in several agriculture and food processing areas. For example, DOE is examining alternate approaches to the evaporative processes of the beet sugar industry, the single most energy consuming component of the industry. Application of reverse osmosis, ultrafiltration and electrodialysis may reduce the overall process energy consumption by 20 to 25 percent. Alternative wet corn milling, the second most energy intensive component, is being examined with a project involving dry milling of degermed corn. Other areas include the potential for energy savings in the meat industry through hot boning, in the poultry processing industry through reduction of waste heat, and possible energy saving alternatives to freezing and canning through gas exchange packaging.

Table 10
1979 SIC 20 Food and Kindred Products
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	67982.9	44.3
Natural Gas	256366.2	-4.8
Propane	2949.8	20.9
LPG	290.9	22.9
Bituminous Coal	74792.6	25.5
Anthracite Coal	0.0	-100.0
Coke	2724.3	-.5
Gasoline	488.5	-32.9
Distillate Fuel Oil	21199.0	13.9
Residual Fuel Oil	56853.7	-5.1
Petroleum Coke	129.7	-20.9
Purchased Steam	3566.8	-25.8
Other	325.7	-59.1
Totals	**487669.9**	**4.9**

*Utilizing 1972 as reference year

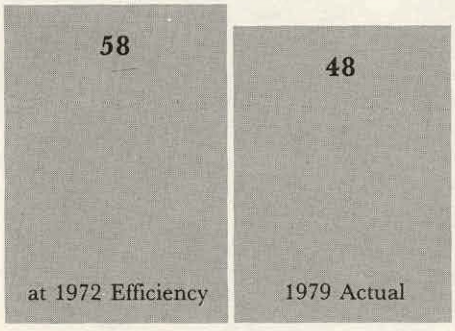




SIC 34

Fabricated Metals

Figure 13
Comparison of Current Reported Fabricated Metals Products Energy Consumption at 1972 and 1979 Efficiencies



The Fabricated Metal Products Industry ranks seventh among the major energy consuming sectors, as defined at the 2-digit SIC level with 44 corporations identified as consuming one trillion or more Btu's. The aggregated energy efficiency improvement was 21.5% in 1979, relative to the 1972 base year. In 1978 semiannual progress showed a 12.1% improvement for the first half and 21.9% for the second half. This is 2.5% below the 1980 target of 24%.

The primary energy consuming area within the industry includes forging and stamping operations (27% of total industrial energy reported), fabricated structural products (18%), springwire and pipe (13.5%), plating, polishing and coating (10%), and cans and shipping containers (9%).

The progress achieved by the SIC 34 corporations is mainly attributable to energy conservation "housekeeping" and low-cost measures. Many industry reports, both from trade associations and those submitted directly, reflect the following common energy-saving activities. Thirty-five percent of the reporters upgraded manufacturing equipment or added process controls. Strict adherence to heating and cooling standards, and improved control of heating, ventilating and air conditioning systems were cited by about 40 percent of the respondents, as was insulation of both buidings and process equipment. Twenty-five percent of the reporting firms replaced lighting systems to obtain the energy-savings benefits of sodium vapor lighting.

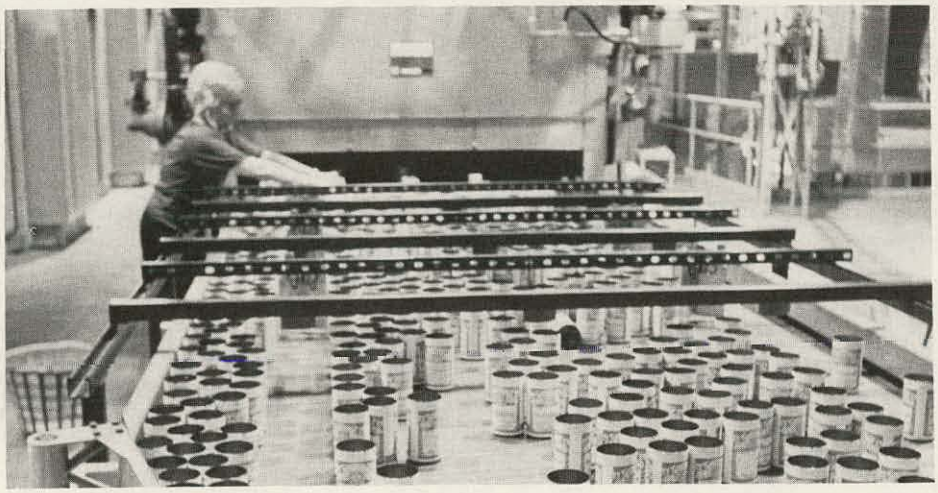
Several sponsoring trade associations provided information to the DOE on energy performance by their reporting members. The Can Manufacturers Institute reported a 23.2% energy efficiency improvement for its participating members, while the American Boiler Manufacturers Association reported 10% improvement. Members of tl forging industry report through the Forging Industry Association; because of the

Table 11

1979 SIC 34 Fabricated Metals Products Industry Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	10750.4	1.9
Natural Gas	29222.3	-19.9
Propane	515.1	-64.8
LPG	50.3	-12.3
Bituminous Coal	246.2	-66.9
Anthracite Coal	.5	-99.1
Coke	645.2	-24.0
Gasoline	893.0	-35.2
Distillate Fuel Oil	1031.1	-1.7
Residual Fuel Oil	3964.3	-38.3
Petroleum Coke	0.0	0.0
Purchased Steam	381.9	0.0
Other	18.3	4.9
Totals	**47718.4**	**-19.2**

*Utilizing 1972 as reference year



complexity of the processes used and the extreme variety of materials and shapes processed, however, the forging industry has been unable to accurately determine efficiency improvement. DOE will continue to work with that industry's corporations to develop an acceptable reporting mechanism.

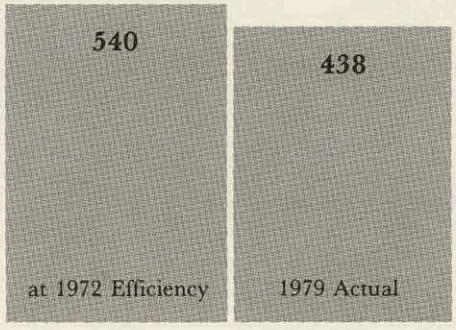
With energy costs accounting for about 10% of the total operating cost of a large SIC 34 corporation, the industry would seem to have significant incentive to achieve greater energy conservation savings in the future.

Total consumption, of energy by the reporting corporations was 19.2% less in 1979 than in 1972. Natural gas consumption declined 20% compared to 1972, accounting for 61% of total industry consumption in 1979. Electricity consumption increased about 2%, representing 22.5% of consumption. A 38% decline occurred in the use of residual fuel oil, which accounted for 8.3% of the reporting population's fuel use in 1979.

SIC 37

Transportation Equipment

Figure 14
Comparison of Current Reported Transportation Equipment Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 37 Consumption (in trillion Btu's per Year)

Energy Efficiency Improvement: 23.4%
1980 Energy Efficiency Improvement Target:16.0%
Energy Savings:
102 Trillion Btu's per year

The transportation equipment industry continues to outpace the 1980 target of 16%, achieving an energy efficiency improvement of 23.4% in 1979, relative to the 1972 base year. This achievement yielded energy savings of 102 trillion Btu, compared with the energy which would have been consumed at 1972 efficiencies. This exceeds both the 17.4% and 21.2% improvement reported semiannually in 1978. Ranking eighth in overall manufacturing consumption, this industry is composed of several components. The motor vehicle and equipment component dominates consumption, accounting for 68% of total SIC 37 energy use in 1979. Aircraft manufacturing followed with 16%, while ship construction, railroad equipment and missle and space manufacturers each represented 5% of the total. Total energy consumption in 1979 by all components declined 14.9% compared to that consumed in 1972. Natural gas, the primary industry fuel, accounted for 36.6% of total use in 1979. Actual use of natural gas declined by 17.7% in 1979, however, compared to 1972. Electricity consumption increased about 5% compared to 1972, and represented 17% of total use. Declines in coal consumption of 27% and residual oil of 9.5%, relative to 1972 use, were also reported. In 1979, coal and residual oil accounted for 13 and 8 percent of total energy consumption, respectively. Thirty-five corporations were identified by DOE as consuming one trillion or more Btu's in SIC 37. The Motor Vehicle Manufacturers Association, a trade association sponsor, reported a 1979 improvement achievement of 20.6% over 1972 efficiency. Improvement of 30.3% was registered by corporations reporting through the Aerospace Industry Association.

The savings to date are impressive and should continue beyond 1980. It is expected that major trends in downsizing, and lowering the weight of passenger cars, will positively effect future energy efficiencies associated with

Table 12

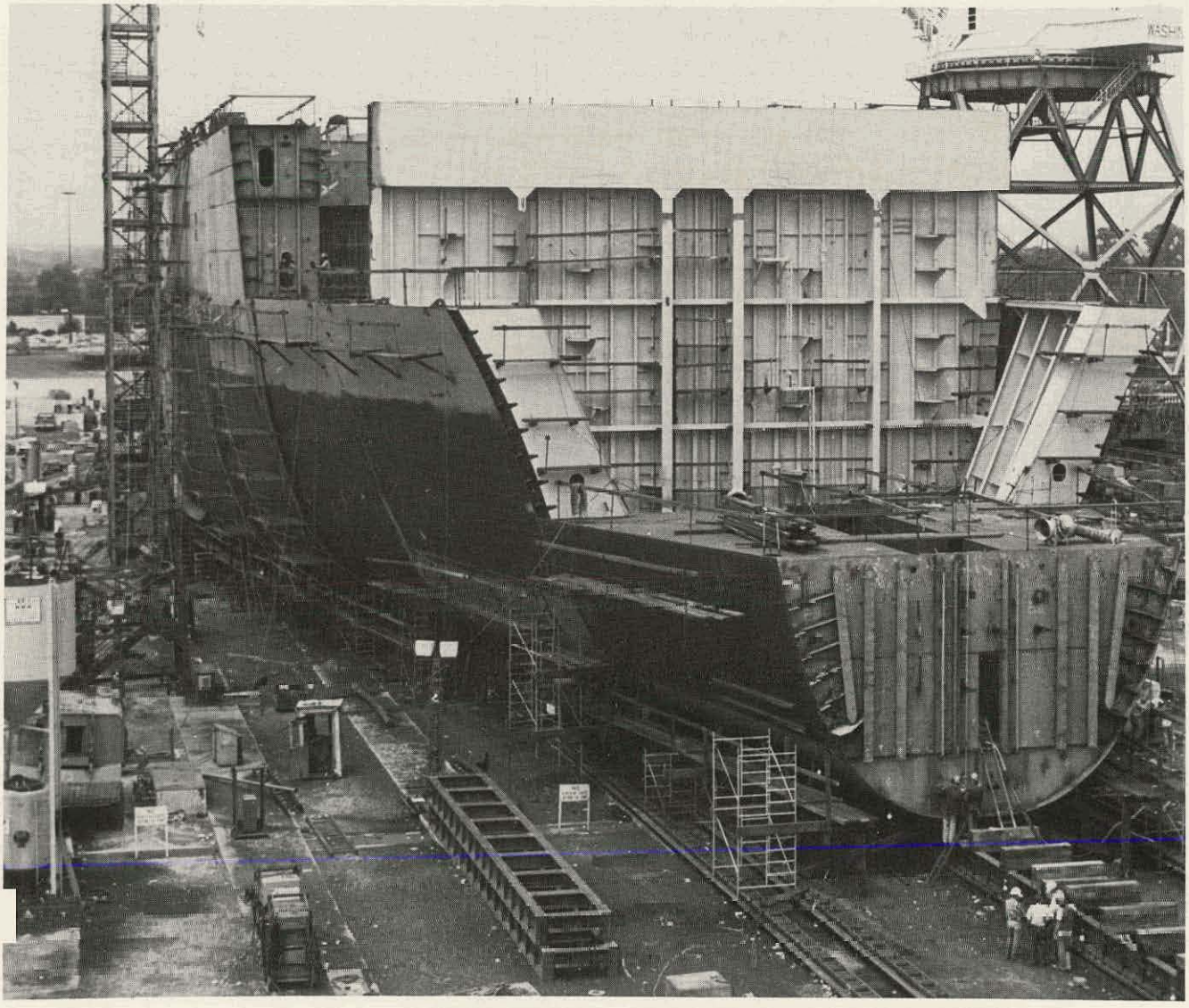
1979 SIC 37 Transportation Equipment
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	119213.6	4.8
Natural Gas	160269.7	-17.7
Propane	2059.6	-42.9
LPG	352.7	471.6
Bituminous Coal	58341.9	-26.9
Anthracite Coal	0.0	-100.0
Coke	22036.9	-19.2
Gasoline	6105.0	-26.7
Distillate Fuel Oil	9058.6	-33.4
Residual Fuel Oil	36676.2	-9.5
Petroleum Coke	0.0	0.0
Purchased Steam	7966.3	-43.1
Other	16233.4	-10.1
Totals	**438313.9**	**-14.8**

*Utilizing 1972 as reference year

auto production. It is estimated that the automobile of 1985 will contain 1100 pounds less steel than a 1975 car, with lighter weight material such as aluminum and plastics being substituted for steel.

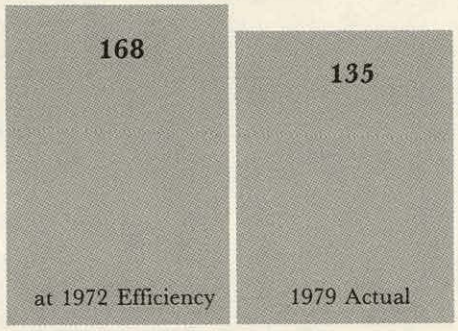
Sources of energy savings reported by the transportation equipment industrial sector include conversion to more energy-efficient lighting systems. Installation of energy management computer controls has been completed by 40 percent of the reporting corporations. Process changes to consolidate manufacturing operations for maximum efficiency, the upgrading of facilities, caulking and increasing insulation, and maintenance of Federal building temperature standards are ongoing programs reported by corporations in this industry, as are control of heating, ventilating and air conditioning equipment, and employee awareness programs.



SIC 35

Machinery, Except Electrical

Figure 15
Comparison of Current Reported Machinery (Except Electrical) Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 35 Consumption (in trillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 15.0%

Energy Efficiency Improvement: 24.7%

Energy Savings: 33 Trillion Btu's per year

Corporations reporting under SIC 35 classification of machinery, (except electrical) continued to exceed their 15 percent target by achieving a 24.7% improvement in energy efficiency during 1979, relative to the energy per unit of output in 1972. Total energy consumption by the reporting companies declined about 9% compared to 1972. This compares to reported energy efficiency improvements of 21 and 28% for the first and second halves of 1978.

Consumption of electricity by SIC 35 corporations increased by 15.6%. This increase was accompanied by significant decreases in use of natural gas (12.9%), residual fuel oil (34.7%), distillate fuel oil (18.9%), and bituminous coal (14%). Gasoline consumption, a minor industry fuel, showed a 40% decline.

As a percentage of total fuel use, natural gas, at 47.8%, was the major SIC 35 fuel required in 1979, with electricity consumption, having about a 30% share, next. The remaining major fuels were bituminous coal at 10.1% of total use, and residual fuel oil at 9.4%.

Participants in three major energy reporting groups collectively accounted for over 55 percent of the energy consumption reported. These are the Construction Industry Manufacturers Association, the Computer and Business Equipment Manufacturers Association, and the Air Conditioning and Refrigeration Institute. For calendar year 1979, reporting members of the Construction Industry Manufacturers Association achieved a 21.3 percent improvement in energy efficiency, compared with the 1972 base year; the Computer and Business Equipment Manufacturers Association reported a 27 percent improvement; and the Air Conditioning and Refrigeration Institute registered an 8.4 percent improvement.

Progress to date has been a result of industry efforts to apply energy conservation measures such as space conditionir controls, efficient lighting systems, i sulation and process equipment modifications.

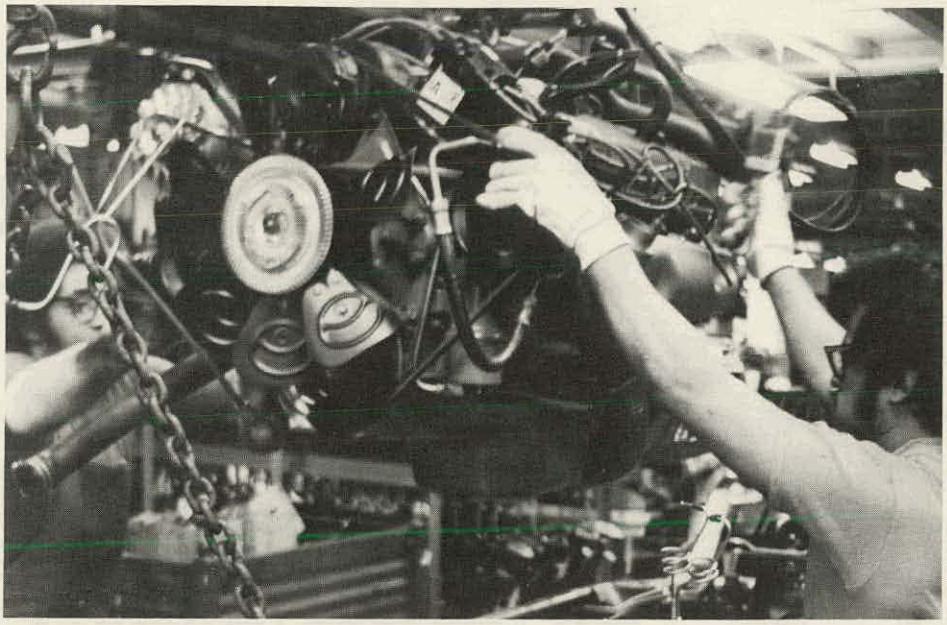
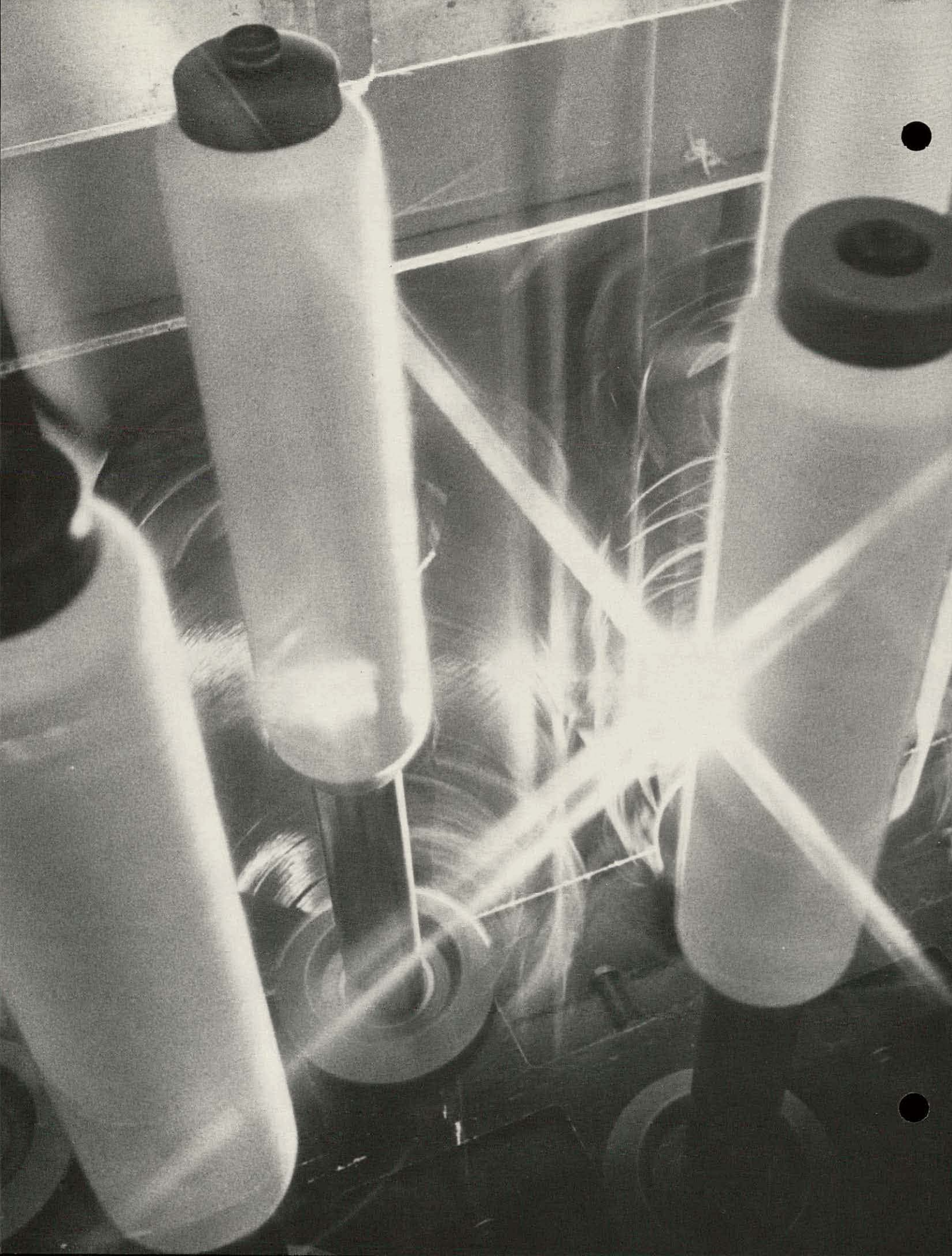


Table 13
1979 SIC 35 Machinery (Except Electrical)
Fuel Use by Type for Reporting Corporations*

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	40217.0	15.6
Natural Gas	57646.8	-12.9
Propane	1564.9	-6.8
LPG	44.9	-29.1
Bituminous Coal	13659.5	-13.9
Anthracite Coal	31.4	0.0
Coke	2192.0	-19.9
Gasoline	564.0	-40.2
Distillate Fuel Oil	4567.5	-18.9
Residual Fuel Oil	12649.5	-34.7
Petroleum Coke	59.2	59.5
Purchased Steam	908.2	538.2
Other	588.2	98.5
Totals	**134693.1**	**8.9**

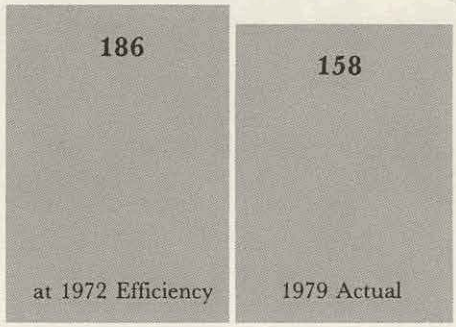
*Utilizing 1972 as reference year



SIC 22

Textile Mill Products

Figure 16
Comparison of Current Reported Textile Mill Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 22 Consumption (in trillion Btu's per Year)

1980 Energy Efficiency Improvement Target: 22%

Energy Efficiency Improvement: 17.7%

Energy Savings: 28 Trillion Btu's per year

The Textile Mill Products Industry is the least energy consumptive industry for which energy efficiency improvement targets were established. The industry consumes about .4 quadrillion Btu per year and is targeted to achieve a 22 percent efficiency improvement by 1980. The aggregated results for 1979 show an achievement of 17.7 percent. This compares to the semiannual progress of 14.7 for the first half and 19.4 for the second half improvement reported in 1978. This efficiency increase for the reporting corporations, which account for 30 percent of the total energy use in the industry, represents an energy savings of 28 trillion Btu per year for the reporting corporations, or approximately 12,625 barrels of crude oil equivalent per day, compared to energy which would have been required at 1972 efficiencies.

Included in the data are reports of 51 corporations identified as consuming at least one trillion Btu's. The American Textile Manufacturers Institute (ATMI) and the Carpet and Rug Institute (CRI) are the two principle SIC 22 associations participating as sponsors. ATMI's reporting members achieved a 15.7 percent improvement in energy efficiency, while corporation reporting through the CRI program reported a 40.4 percent improvement.

Energy consumption within the industry is roughly divided between wet and dry processing. Energy requirements for the wet processes of dyeing and finishing, accounting for 60 percent of consumption, are provided by steam boilers using natural gas, oil and coal. The dry processes, weaving and spinning, consume about 40 percent of total energy use, deriving most of its power from electricity.

Fuel use in 1979, and percent change as compared to 1972, are provided in Table 14. Total energy consumption for the reporting population declined 11.4 percent compared to 1972. Decreases of 20 percent in natural gas, 35 percent in distillate fuel oil and 21 per-

cent in residual fuel oil consumption were reported as compared to requirements for those fuels in 1972. Increases in consumption were recorded for two fuel types. Consumption of electricity increased by 1.8 percent, and coal use increased by 2.2 percent during the period between 1972 and 1979. As a proportion of total energy consumed in 1979, natural gas represented 35.4 percent, electricity 32.5 percent, residual fuel oil 14 percent and coal 14 percent.

Fuel switching to coal has been limited to the largest boilers, which usually deliver at least 150,000 pounds of steam per hour. These fuel switching actions have primarily been reconversions of units which had burned coal previously. Further fuel switching to coal-burning boilers has been constrained by capital shortages, as well as costs associated with installing electrostatic precipitators to meet emission standards, increasing coal storage capacity, and purchasing materials handling and disposal systems.

Energy conservation has resulted from efforts to improve boiler efficiency, improved maintenance, the installation of economizers and oxygen analysers, and the utilization of smaller and more efficient boilers during periods of light loads.

Major conservation-related savings have been derived from improved corporate energy management programs. These have resulted in many relatively low capital expenditures such as increasing plant insulation, changes in process steps, waste heat reclamation and efficient use of refrigeration systems.

Looking beyond the target year, the textile industry's energy efficiency improvement efforts will be affected by the economic profile of the industry. Based on the 1977 Census of Manufacturers, energy cost as a percent of value of shipments amounted to 2.8 percent. On a cost basis, energy is obviously not a significant portion of resource input. Low profitability and slow growth have been characteristic of the industry recently. Capitalization of future energy conservation projects will also have to compete with capital expenditures that may be required under pollution control regulations, as well as capital required for maintaining product output and quality.

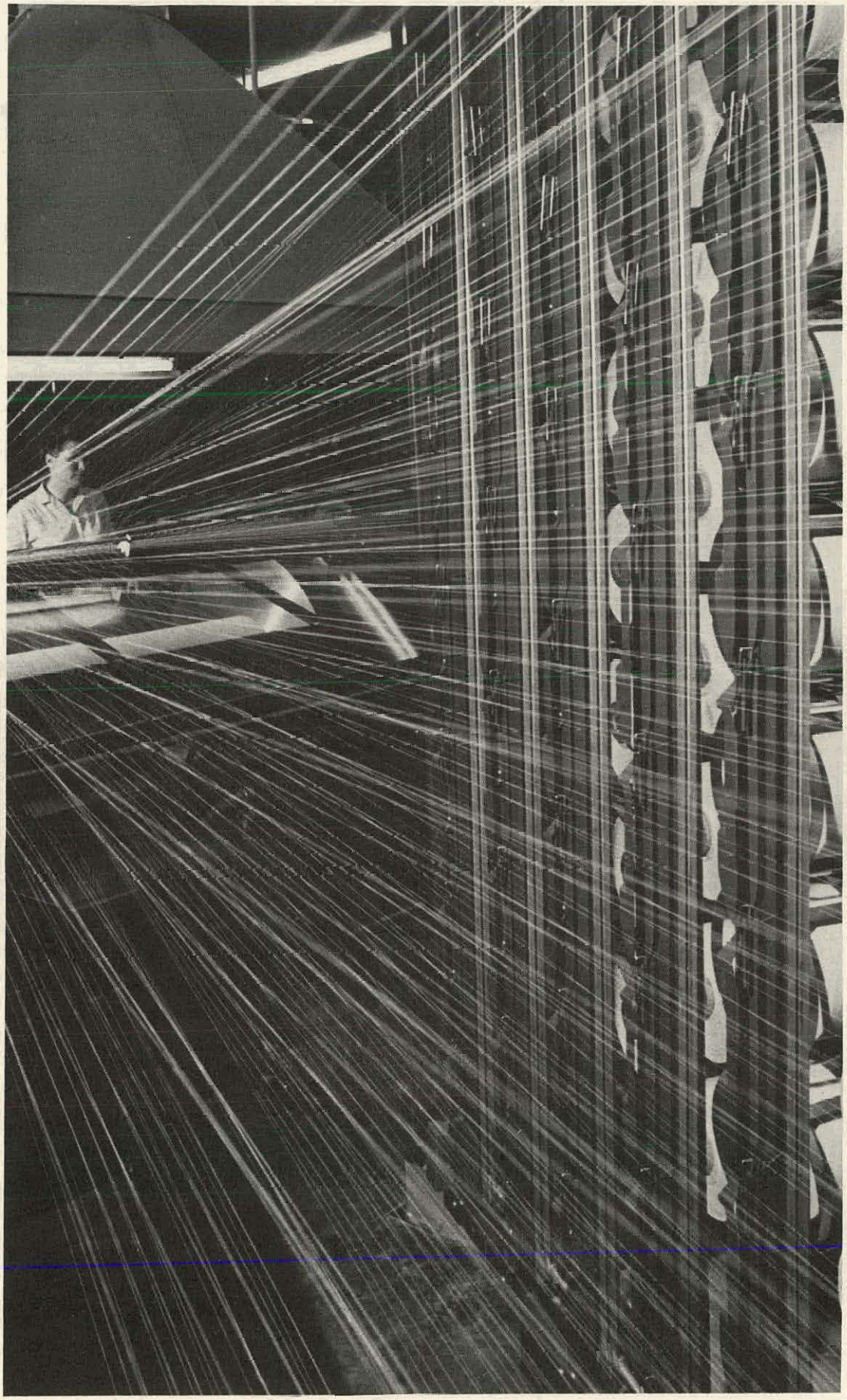
Table 14
1979 SIC 22 Textile Mill Products
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1978
Electricity	51268.3	1.8
Natural Gas	55966.8	-19.9
Propane	1516.4	-2.5
LPG	14.5	85.9
Bituminous Coal	22132.7	2.2
Anthracite Coal	360.9	-22.0
Coke	0.0	0.0
Gasoline	244.0	94.1
Distillate Fuel Oil	2923.3	-35.1
Residual Fuel Oil	23358.0	-21.1
Petroleum Coke	33.4	0.0
Purchased Steam	0.0	0.0
Other	83.9	-1.3
Totals	**157902.2**	**-11.4**

*Utilizing 1978 as reference year

The Department of Energy (DOE) has been actively working with the textiles industry on several projects. An example is research being conducted on the exhaust flow rate in textile drying, which has the potential of reducing energy use 25 to 50 percent in these operations.

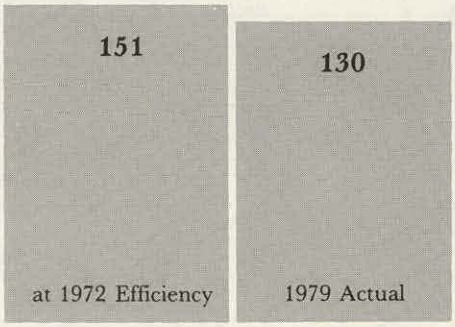
DOE has also developed equipment and procedural modifications in textile dyeing operations, some of which are already saving significant amounts of energy.



SIC 30

Rubber and Miscellaneous Plastics

Figure 17
Comparison of Current Reported Rubber and Miscellaneous Plastics Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 30 Consumption (in trillion Btu's per Year)

Energy Efficiency Improvement: 16.3%

Energy Savings:
21 Trillion Btu's per year

Corporations reporting in the Rubber and Miscellaneous Plastic Products Industry consumed 130 trillion Btu in 1979. Although this is the first year in which reporting became mandatory for identified corporations in SIC 30, many corporations in the industry have participated on a voluntary basis in the reporting programs since its inception. The Rubber Manufacturers Association (RMA) has sponsored an industry program that includes most of the major tire companies, as well as many of the footwear and industrial product manufacturers. As a result of the industry's early participation in the program, most corporations (including all those reporting through RMA) use 1972 as a base year. The 1979 energy efficiency improvement for these corporations was 16.3 percent compared to a base year at 1972. Total energy consumption for these corporations declined 2.8 percent in 1979 relative to 1972 consumption for corporations. Using 1978 as the reference year, consumption was 19838.7 billion Btu's, a 3.3 percent increase over 1978. The energy efficiency improvement for this group was 1.5 percent.

On an aggregated basis, for all reporting corporations in SIC 30, electricity continues to be the major fuel source. In 1979 electricity consumption accounted for 50.7% of the total reported SIC 30 usage. For corporations reporting against a 1972 base year, this represents a 9.2 percent increase since 1972. Natural gas consumption accounted for 29.7% of the industry usage, declining 12.4% for 1972 reporting corporations. Residual oil also showed a slight decline, representing 13% of the total in 1979. Coal, which accounted for about 5 percent of usage in 1979, declined 35% compared to 1972.

Energy saving measures reported by the industry include a number of process improvements which required the addition or replacement of equipment a controls. Energy management prograr... continue to emphasize boiler efficiency improvements, required maintenance

Table 15
1979 SIC 30 Rubber and Miscellaneous Plastic Products
Fuel Use by Type for Reporting Corporations *

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1978
Electricity	63863.3	9.2
Natural Gas	39803.7	-12.4
Propane	224.2	-38.6
LPG	36.9	-59.2
Bituminous Coal	6967.0	-35.1
Anthracite Coal	0.0	-100.0
Coke	0.0	0.0
Gasoline	22.7	-7.3
Distillate Fuel Oil	2818.8	25.4
Residual Fuel Oil	16132.9	-.6
Petroleum Coke	0.0	0.0
Purchased Steam	247.5	-2.3
Other	26.9	3262.5
Totals	**130113.7**	**-2.8**

*Utilizing 1978 as reference year

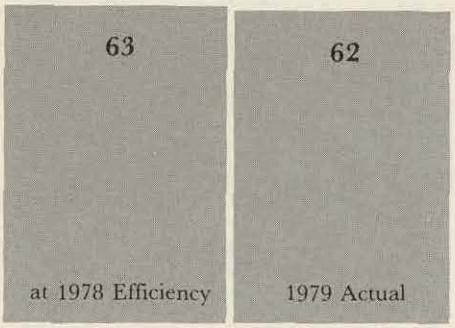
and inspection of steam traps. The installation of waste heat recovery equipment and more efficient lighting systems were also frequently cited as contributing to the reported savings.

SIC 36

Electrical and Electronic Equipment

Figure 18

***Comparison of Current Reported Electric, Electronic Equipment* Energy Consumption at 1978 and 1979 Efficiencies**



Total Annual SIC 36 Consumption (in trillion Btu's per year)

Energy Efficiency Improvement: 2.35%

Energy Savings:
1 Trillion Btu's per year

Energy reporting for SIC 36 for corporations using over a trillion Btu's per year became mandatory in 1979. Although a standardized base year of 1978 was established, DOE received many reports on corporate progress which also included information relative to a 1972 base year. This reflects the fact that many of the major corporations established reporting programs as part of their energy management strategies following the 1973 oil embargo. The results of these programs have been impressive and have been included in previous annual reports. Efficiency improvements ranging from 30-55%, compared to 1972 efficiency, have been reported by corporations in this industry.

Corporations included in the DOE reporting program consumed 61835.0 billion Btu's in 1979. Natural gas was the predominant fuel, accounting for 45.8% of the total fuel used in 1979. Electricity consumption followed with 37%. Residual fuel and distillate fuel combined amounted to 10.2% of total consumption.

Overall efficiency improvement for corporations reporting against a 1972 base was 49.1%, with total energy consumption down 14.7% since 1972. For corporations reporting against 1978, a 2.35% improvement was recorded with a 7.8% decline in consumption. DOE received comments which related hundreds of individual conservation actions which have contributed to the reported gains. These actions included the installation of demand controllers, set-back timers and boiler economizers.

Table 16

1979 SIC 36 Electrical, Electronic Equipment
Fuel Use by Type for Reporting Corporations *

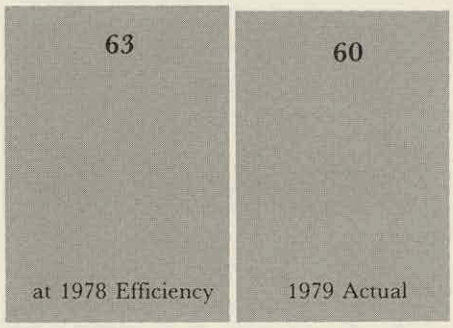
Fuel Type	Consumption (Billion Btu)	Percent Change Since 1978
Electricity	24109.1	-23.3
Natural Gas	28711.9	17.1
Propane	724.0	-26.2
LPG	39.5	9.7
Bituminous Coal	993.8	-5.7
Anthracite Coal	321.3	21.7
Coke	19.8	9.4
Gasoline	92.3	39.7
Distillate Fuel Oil	2014.5	-26.3
Residual Fuel Oil	3414.2	-26.2
Petroleum Coke	1.7	-10.5
Purchased Steam	143.9	-5.4
Other	1248.9	6.2
Totals	**61834.0**	**-7.8**

*Utilizing 1978 as reference year

SIC 24

Lumber and Wood

Figure 19
Comparison of Current Reported Lumber and Wood Products Energy Consumption at 1978 and 1979 Efficiencies



Total Annual SIC 24 Consumption (in trillion Btu's per year)

Energy Efficiency Improvement: 4.6%

Energy Savings:
3 Trillion Btu's per year

Corporations reporting in the Lumber and Wood Products Industry reported a 4.6 percent improvement in energy efficiency for purchased fuels, compared to its 1978 base year. Eighteen corporations identified as consuming at least one trillion Btu's have contributed data to this report. Combined, they account for approximately 33 percent of all lumber production in the United States, and about 60 percent of all U.S. plywood and particle board production.

This reported one-year improvement is significant, in that most of the corporations had accomplished earlier savings as a result of measures undertaken following the 1973-1974 oil embargo. Total energy consumption for the reporting companies in 1979 was 59905.7 billion Btu's. According to the 1977 Census of Manufacturers, the industry's energy cost as a percent of value of shipments amounted to 1.9 percent.

An analysis of the industry's energy profile demonstrates a strong industry-wide effort to utilize wood waste as fuels wherever possible.

The National Forest Products Association, the primary industry sponsor participating in the reporting program, stated that, of the total energy consumed by the 14 corporations reporting through it in 1979, over 70 percent was produced by utilizing barkwood residue and other waste. The same corporations reported that natural gas accounted for 10.5 percent, electricity 10 percent and residual oil 5.1 percent of total energy consumed in 1979.

The percentage of major purchased fuel follows for reporting companies: natural gas, 37.5 percent; electricity, 33.4 percent; and residual oil, 14.8 percent.

Members of the National Forest Products Association also reported that in-plant electricity generation increased 28.9 percent in 1979, over that generated in 1978, with a surplus of 29.32 million Kwh sold in 1979. This trend is expected to continue as cogeneration opportunities

become increasingly attractive and cost-effective.

Most of the reported savings in purchased fuels have been achieved by increasing the use of wood waste. Several plants reported installation of woodfired boilers as part of this effort. Besides bark, the waste residues utilized include planer shavings, sawdust, product rejects, hogged wood fuel, spent pulping liquor (from SIC 26 plants) and off gas produced as a byproduct of charcoal production. Several companies sell hogged fuel as a primary product. Hogged fuel is usually transferred to a paper and pulp mill where it is burned to produce process steam, which may in turn be piped back to the SIC 24 plant.

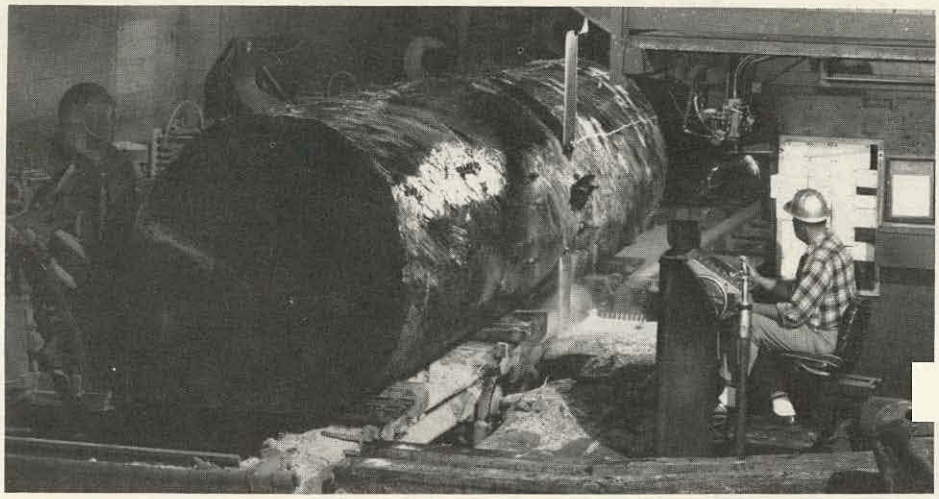
Other common energy management activities include projects for increasing condensate recovery, reducing leakage from steam and dryer air systems, and installing additional insulation. Improved capacity utilization, installation of electrical energy demand controllers and increased conservation consciousness by plant operators were also cited as having a positive input on conservation progress reported.

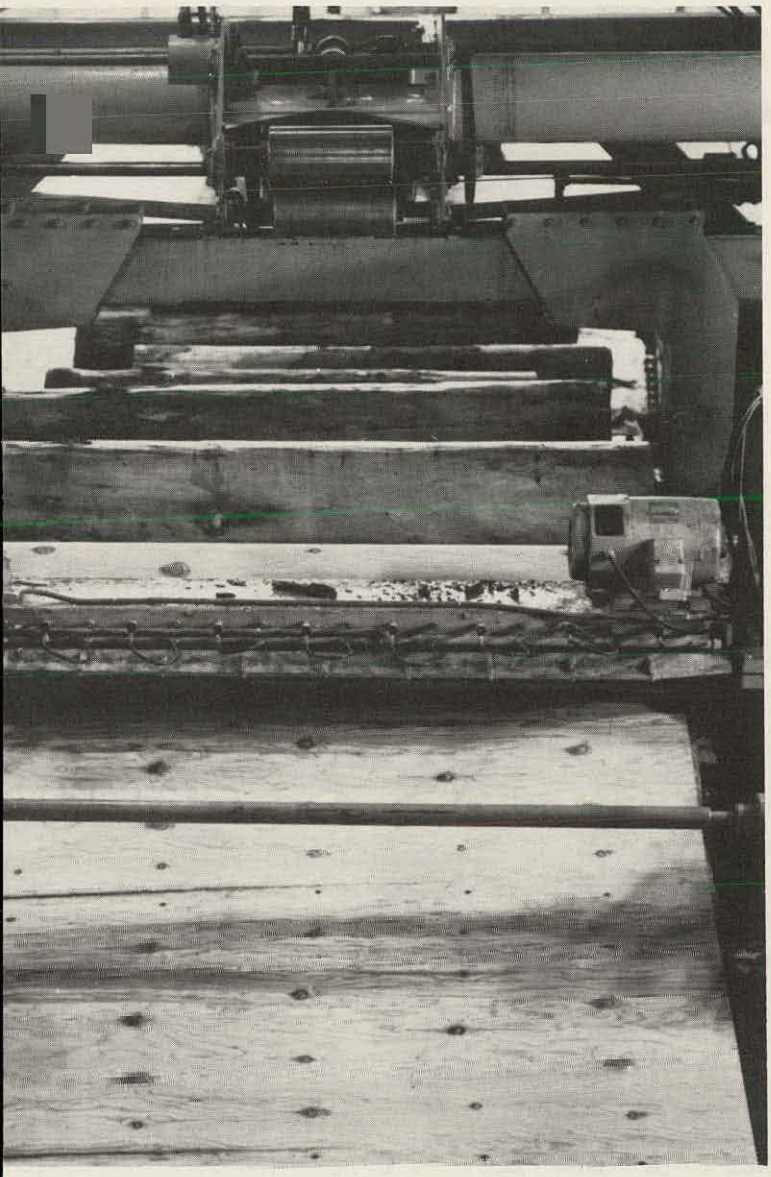
Negative impacts which accounted for increased consumption at some plants included severe winter weather during 1979 in parts of the northwest and installation of additional pollution control equipment.

Table 17
1979 SIC 24 Lumber and Wood Products
Fuel Use by Type for Reporting Corporations*

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1978
Electricity	19833.4	-.5
Natural Gas	22540.9	-3.7
Propane	99.6	-62.5
LPG	869.7	-22.2
Bituminous Coal	973.5	-23.0
Anthracite Coal	0.0	0.0
Coke	0.0	0.0
Gasoline	504.4	-1.3
Distillate Fuel Oil	3054.9	-20.2
Residual Fuel Oil	8586.0	-16.3
Petroleum Coke	0.0	0.0
Purchased Steam	2576.6	10.6
Other	866.7	4.0
Totals	**59905.7**	**-5.3**

*Utilizing 1978 as reference year

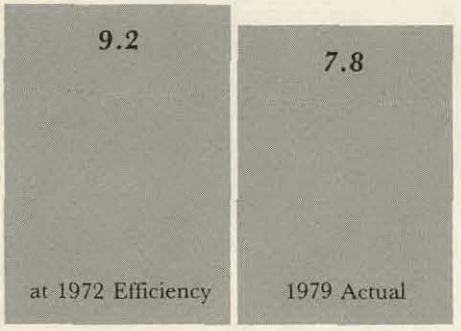




SIC 21

Tobacco Products

Figure 20
Comparison of Current Reported Tobacco Products Energy Consumption at 1972 and 1979 Efficiencies



Total Annual SIC 21 Consumption (in trillion Btu's per year)

Energy Efficiency Improvement: 18.5%

Energy Savings:
1.4 Trillion Btu's per year

The Tobacco Products Industry has only five major corporations identified as consuming over one trillion Btu's per year. Several of the major SIC 21 corporations, having participated in the reporting program in other SIC's in previous years, have utilized 1972 as a base year. Compared to 1972, these companies reported an 18.5 percent improvement in energy efficiency during 1979.

The reporting sample provides the following information. Those companies using 1972 as a reference year reported a total consumption of 7812.31 billion Btu's in 1979. This represents a decline of 12.2 percent in total consumption compared to 1972. Residual oil consumption declined about 26 percent during this period.

For those companies reporting against a 1978 base year, the total 1979 energy consumption of 8266.95 billion Btu's is an 8.3 percent increase from 1978 use. During this one year period coal consumption increased 156 percent, a significant fuel switching accomplishment for these corporations. Natural gas declined 33 percent while residual oil consumption declined 37.4 percent.

Energy management programs have accounted for the overall efficiency improvements of the industry. These programs include such actions as less energy-intensive lighting systems and insulation of piping. In the area of energy audits, one corporation reported its utilization of infrared scanner equipment to determine energy losses. Boiler efficiency improvements, such as the installation of automatic oxygen analyzers and boiler trim control systems, added to the reported savings. The installation of waste burning boilers was also cited as contributing to conservation progress. In the area of process changes, low pressure steam is being substituted for high pressure steam where allowable. In addition, motors and compressors are be installed with controllers that promote energy savings.

Table 18
1979 SIC 21 Tobacco Products
Fuel Use by Type for Reporting Corporations*

Fuel Type	Consumption (Billion Btu)	Percent Change Since 1972
Electricity	1162.5	5.8
Natural Gas	219.5	-53.4
Propane	.3	0.0
LPG	8.8	11.4
Bituminous Coal	5094.2	-10.0
Anthracite Coal	0.0	0.0
Coke	0.0	0.0
Gasoline	73.5	-11.9
Distillate Fuel Oil	297.2	1.3
Residual Fuel Oil	956.4	-25.8
Petroleum Coke	0.0	0.0
Purchased Steam	0.0	0.0
Other	0.0	0.0
Totals	**7812.4**	**-12.2**

*Utilizing 1972 as reference year

The absence of sufficient reported data has precluded the inclusion of industry-specific summaries in six of the twenty participating industries: apparel and other textile products; furniture and fixtures; printing and publishing; leather and leather products; instruments and related products; and miscellaneous manufacturing industries. There were no corporations consuming over 1 trillion Btu's per year identified in the furniture and fixtures; and leather and leather products industries; and only one identified corporation in apparel and other textile products. Only four companies identified in the instruments and related products industry submitted data in compliance with the program rule and four corporations in the printing and publishing industry. In all six industries, because the consumption sample was insignificant, the data was considered to be non-representative of industry energy efficiency improvement progress. Consequently, no summaries were prepared for these industries in this report. In FY 1981 the Department of Energy will examine options for developing meaningful data on these industries for inclusion in subsequent reports.

DOE's Industrial Energy Efficiency Improvement Program (continued)

II.3

Additional Data from Voluntary Submissions

The Office of Industrial Programs encourages organizations, such as industrial trade associations, to develop voluntary programs which promote energy conservation among their members. Establishment of energy efficiency goals and reporting systems are considered to be important aspects of these programs. The sponsors of voluntary energy conservation programs, some of which are not in the manufacturing sector, regularly report to the Office of Industrial Programs on energy conservation progress of their members. This section presents data recently received from the American Gas Association, the American Hotel and Motel Association, General Telephone and Electronics Corporation and American Telephone and Telegraph Company.

American Gas Association

The American Gas Association uses as its criterion for energy efficiency the volume of natural gas delivered for sale, divided by the fuel used in the compressor stations to move bulk gas through the pipelines. From the data provided, which are shown in the following table, an improvement of 26.2 percent has been achieved in 1979 over the base year 1972.

This improvement is due to a combination of improved energy management and application of new technologies, such as the use of epoxy resin on the inside of gas transmission lines to reduce friction and provide better pumping efficiency; replacing the older, less efficient, reciprocal compressors with centrifugal compressors powered by gas turbines; installing higher strength steel in pipelines to permit the use of higher pressure and a greater volume flow for a given amount of energy consumption; and the use of plastic pipe in low pressure systems to reduce friction and eliminate corrosion.

Another source of increased efficiency in distribution systems is the placement of liquified natural gas peaking facilities near points of use rather than bringing gas from a distant storage field.

American Hotel & Motel Association

Since 1972 the American Hotel and Motel Association has provided the Federal Government with information on energy conservation progress. The data reported in the following table was

developed by its affiliates of the Energy Technical Center (ETC) of the Hospitality, Lodging and Travel Research Foundation, Inc. Analyses are provided based on the number of guest rooms, the geographical location, and by both size and location.

For 1979, the ETC compared 1979 energy consumption to 1978 consumption for 284 representative properties. Energy consumption declined 6.1 percent over the one year reporting period for this group. The results are shown below.

In considering the table below, a 6.1% decrease in energy use by 284 hotels and motels, (1979 versus 1978), it should be noted that the American Hotel and Motel Association estimates that the average guest occupancy for 1979 was 67.8 percent, compared to 65.5 percent in 1978—an increase of 3.5 percent.

The Department of Energy is working with the AHMA in the development of a metering project for the industry. This should provide significant data for future energy conservation projects and initiatives. The ETC responds to requests for information on energy management, maintains an energy management library and writes and distributes articles for publication in industrial journals. Engineering seminars have promoted improved air conditioner sizing, energy housekeeping activities, boiler efficiencies in hotel laundry and heating systems, installation of water flow restrictors, insulation retrofits and renewable resource applications.

General Telephone and Electronics Corporation

GTE has achieved an 18.8 percent reduction in energy from 1973 to 1979 as measured by their standard of Btu per customer line. Energy conservation was carried out in all companies. The table presented on the next page summarizes progress in reducing Btu per customer line energy consumption since 1973.

The increase in 1979 in Btu's per customer line was due to rapid growth in GTE's largest companies. In times of

American Gas Association

	1972	1978	1979*
Total disposition**	19,259.0	16,274.9	17,038.0
Fuel Use***	814.0	512.1	531.2
Ratio: Fuel Use X100 / Total Disposition	42.3	31.5	31.2
Percentage Improvement	Base Year	25.5	26.2

* 1979 data are preliminary.
** Gas delivered for ultimate sale (trillion of Btu's).
***Compressor station fuel.

American Hotel and Motel Association

	1977	1978	1978	versus	1979
No. of Properties	210	327	284		284
No. of Guest Rooms	59,648	84,554	68,911		69,368
Total Sq. Ft. (Million)	42.6	52.6	40.4		40.8
Total Energy Use (Trillion of Btu's)	7.7	8.4	6.2		5.9
Btu/Sq. Ft./Year	181,685	158,736	153,308		143,977
Indicated Decrease in Energy Use:					
1978 versus 1977	—	12.6%	—		—
1979 versus 1978	—	—	—		6.1%
1979 versus 1977	—	—	—		20.8%

high growth, buildings must be built, vehicles must be added to the fleet, construction carried out and switches put in place before customer lines can be installed. According to GTE, growth in customer lines can soon be anticipated which will have the effect of reducing the Btu per customer line.

Since telephone operations do not include manufacturing, energy savings were achieved by reductions in lighting, heating, ventilating and air conditioning of buildings and economies in transportation and vehicle operations. These reductions were obtained by reducing temperatures in off hours, reducing the number of lights in operation, replacing ordinary lamps with high-efficiency types and installing automatic time clocks to control off-hour energy consumption of the HVAC systems.

American Telephone and Telegraph Company

As noted in the table below, AT&T has achieved considerable energy savings since 1973. Based on their primary measure of energy efficiency (total energy per customer line), 1979 energy efficiency was 27 percent less than in 1973.

AT&T has developed energy efficiency measurement factors appropriate to various energy uses in their business. Gasoline per telephone, which is applied to service vehicle use, has been reduced by 17 percent. Building energy per square foot of floor space has been reduced by 28 percent. This has been achieved by reduction in building temperatures, relamping and reduction in number of lights, changes in ventilation systems, and use of programmed energy management systems.

General Telephone and Electronics Corporation (Telephone Operations)

Energy Usage in GTE Telephone Operations

Year	Total Usage 10^{12}— Btu	Btu per Customer Line 10^{3}— Btu/line**
1973	7.2	1080
1974	7.1	982
1975	7.0	930
1976	7.5	969
1977	7.5	938
1978	7.4	866
1979	7.9	877

**Company target for 1982 = 723 x 10^{3}— Btu/line

American Telephone and Telegraph Company (Telephone Operations)

Category	Percent Change, Energy Use Per Customer Line 1979 vs 1978	1979 vs 1973
Total Energy per Customer Line	-3.0	-27.0
Gasoline per Customer Line	-0.1	-17.0
Electricity per Customer Line	-2.0	-17.0
Building Fuels per Square Foot of Floor Space	-12.0	-50.0
Building Energy per Square Foot of Floor Space	-4.0	-28.0

II.4

Summary on Progress in the Utilization of Recovered Materials

Background

The Department of Energy published in the Febuary 14, 1980 *Federal Register* (45 FR 10194) final 1987 voluntary targets for the utilization of recovered materials. Targets were then established for the textile mill products, paper and allied products, rubber and miscellaneous plastics products, and primary metals industries. In the same notice, DOE published the requirements for reporting towards the targets. The reporting form for the recovered materials utilization programs was included as part of the energy efficiency improvement forms published in the *Federal Register* February 27, 1980, (45 FR 12920). In an effort to further examine utilization of recovered materials, DOE completed a study in July 1980 on "The Availability of Recovered Materials and Potential Federal Actions to Promote Their Increased Use in U.S. Industry."

Recovered Materials Utilization Monitoring Findings

Analysis of first year submissions from reporting corporations indicates that the recovered materials utilization reporting program will require further development if it is to become a useful monitoring system. There are serious deficiencies in the format configuration and industry interpretation of the reporting system that have prevented meaningful assessment of recovered materials utilization in industry. The identification criteria for corporations required to report under the program mandated by the NECPA, for example, are proble-

SIC 22

Textile Mill Products

	1987 Target %	1979 % R.M. Use
2231 (Broad, Woven Fabric Mills, Wool)	13	10.4
2283 (Yarn Mills, Wool)	13	*
2291 (Felt Goods, Except Woven Felt Hats)	80	*
2293 (Padding and Upholstery Filling)	93	4.5
2297 (Non-woven Fabrics)	15	7.9
2298 (Cordage and Twine)	22	*

*Insufficient data

SIC 26

1978 API Waste Paper Data

Percent Waste Paper Used for Production of Paper and Paperboard (Thousands of Short Tons)

Grade	1978 Short Tons Produced	1978 Short Tons Waste Paper Consumed	1978 Percent Waste Paper Used to Tons Produced	1987 Targets
Newsprint	3,768	533	14.1	18.0
Printing & Writing	14,545	906	6.2	6.0
Kraft Paper	5,325	269	5.1	10.0
Tissue	4,215	1,469	34.9	30.0
Kraft Paperboard (Bleached and Unbleached)	18,352	618	3.4	10.0
Semi-chemical	4,439	1,147	25.8	26.0
Recycled Paperboard	7,485	8,237	110.0	108.0
Insulating & Hard Pressed Board	NR	NR	NR	17.0
Construction Paper	3,515	1,793	51.0	55.0

matic. The fact that only corporations using more than one trillion Btu per year are required to report excludes many smaller corporations which are those most heavily dependent on recovered materials and most worthy of monitoring. This concern was initially raised by DOE in publication of the proposed regulations in July 1979.

The first report under the program also highlighted certain deficiencies which tend to lessen the significance of the first year data. Reporting corporations displayed a large variation in interpreting the definitions provided by DOE. The use of the term "manufacturing process" on the recovered materials utilization form was broadly interpreted to include all types of processes rather than those identified by the targets. DOE intends to limit this definition in future reports to specific targeted areas, (i.e., tissue making for SIC 26). In addition, units of production for input and output varied within certain industries, providing data that could not be meaningfully aggregated (i.e., tons vs. dozens).

DOE also found that some corporations not utilizing any recovered materials had erroneously believed that they need not file a report. All deficient reporters have been notified, and DOE expects full compliance with the statutory requirements.

Based on first year data, the following summaries provide progress made by reporting corporations towards achieving the 1987 targets:

SIC 22—Textiles

The table for SIC 22 provides data on progress towards the targets for recovered materials utilization. While the data reported indicates satisfactory progress toward recovered materials utilization targets, it is based on the limited amount of data available from large textile firms, and is not considered to be representative of total industry performance by the Department of Energy.

SIC 26—Paper

The aggregated results for the utilization of recovered materials for the paper industry show that about

SIC 26

1979 Waste Paper Data
Summary of Data from Paper Companies
Using Over 1 Trillion Btu's
(Thousands of Short Tons)

1979 Production of Paper and Paperboard (Short Tons)	1979 Virgin Fiber Consumed (Short Tons)	1979 Waste Paper Consumptions (Short Tons)	1979 Prompt Scrap (Short Tons)	1979 Obsolete Scrap (Short Tons)	1979 % Waste Paper Used to Production
68,681	39,806	10,967	4,866	6,101	16%

SIC 30

Rubber & Miscellaneous Plastics Products
Recovered Materials Utilization Progress

Materials Class	1987 Target (% Recovered Materials)	1979 Recovered Materials Utilization %
3011 Tire and Tire Repair Material	5	2.6
3031 Rubber Industrial Products	2	1.2
3021 Rubber Footwear	15	0.0

10,000,000 short tons of waste paper were utilized in the production of 69,000,000 short tons of paper and paper board. In 1981, DOE will require reporting by manufacturing processes identified under the target grades of paper and paperboard.

The American Paper Institute (API) provided DOE with annual data on capacity that provides a detailed breakout by grades. API provided the displayed information for 1979.

SIC 30—Rubber

The progress of the reporting corporations in the rubber industry towards 1987 recovered materials utilization targets is summarized below. Most of the data upon which this table is based was reported by the Rubber Manufacturers Association, which represents 75-80% of the corporations within SIC 30. First year recovered materials data suggests satisfactory progress toward 1987 targeted levels of materials recovery. The recovered materials reporting system is, however, in a formative stage of development, and a high level of confidence cannot be assigned to the reported data.

SIC 33

Primary Metals
Recovered Materials Utilization Progress

Materials Class	1987 Target (% Recovered Materials)	1979 Recovered (% Materials Utilization)
Ferrous	41	32
Aluminum	35	14
Copper	45	32
Lead	60	*
Zinc	36	*

*Insufficient data

SIC 33—Primary Metals

The reported 1979 progress of the primary metals industry in recovered materials utilization is summarized. Only data received from the steel and aluminum industries, and copper were statistically valid for analysis. Most of the data submitted to the Department of Energy in the ferrous, aluminum and copper industries was submitted by sponsored reports from major trade associations. As first year data, the figures depicted in the table below may be viewed as rough baseline measures of levels of materials recovery in the largest corporations within the primary metals sector. However, due to the formative stage of development of recovered materials reporting, a high level of confidence cannot be assigned to these figures at this time.

[1]Source: U.S. Department of Commerce, *1980 Industrial Outlook.*

II.5
Fuel Mix Analysis

Manufacturing corporations reporting under the auspices of the energy efficiency improvement program have made significant progress toward the national energy policy objective of decreased reliance on fossil fuels such as oil and natural gas. Energy use in the reporting corporations has declined by 2.2% since 1972, a notable accomplishment considering the fact that output for manufacturing industries has risen by over 17%.[1] Especially notable, however, is the fact that reliance on natural gas and oil has declined at a faster rate than total energy use (Table 19). Natural gas consumption, in absolute quantities used, has declined by almost 14% since 1972, while residual fuel oil usage, dropped by almost 5 percent for the reporting corporations. Distillate fuel oil usage, a relatively minor part of petroleum usage, has declined almost 2 percent. In concert, these reductions in oil and gas consumption amount to 912 trillion Btu per year. This is equivalent to 13.6 percent of total reporting corporation consumption of oil and gas in 1972, or in excess of 450,000 barrels of crude oil equivalent per day. These reductions in primary fuel use have substantially altered the disposition of industrial energy supply. As Figure 21 illustrates, natural gas and oil constituted almost 50 percent of total consumption in the most energy intensive industries in 1972. In 1979, these fuels comprised

[2]Source: U.S. Department of Commerce *1980 Industrial Outlook.*

43.5% of total consumption by these industries. This progress represents a significant response to the need for decreased reliance on primary fuels.

This positive trend has not, however, been accompanied by a significant trend toward the direct substitution of coal for these primary fuels. Coal use in the reporting industries has actually declined, in part because of substantial output declines (9 percent since 1971)[2] in the primary metals sector, which accounts for the bulk of coal consumption among the reporting industries. Minor increases in coal usage have occurred in several reporting industries. The most significant general trend in fuel switching among the reporting industries is one of substitution of electricity for natural gas. Electricity consumption in the reporting industries has risen by almost 16 percent since 1972, and electricity is now the second most heavily consumed fuel. This trend is interpreted as a concern about security of supply, which has been fostered by the curtailments of natural gas to some reporting corporations since 1972. The trend toward the substitution of electricity for natural gas is positive since it constitutes, indirectly, an opportunity for switching to coal-generated electricity. Coal is the primary fuel for U.S. electrical utilities, and the substitution of electricity for natural gas therefore furthers both increased reliance on coal and security of industrial energy supply.

Direct substitution of coal for oil and natural gas in industry continues to be constrained by a number of factors. Conversion to coal-fired process equipment is technically difficult for most of the energy-intensive industries. The initial capital costs are high and fuel switching to coal is therefore constrained by factors which act to limit investment in more energy-efficient capital equipment. Uncertainties over potential losses to production which could result from coal conversion, and of the cost of environmental protection technology required for coal-fired equipment, act to further constrain the economic viability of coal conversion. It seems unlikely, therefore, that any significant trend toward fuel switching to coal in the energy intensive industries will emerge in the near term.

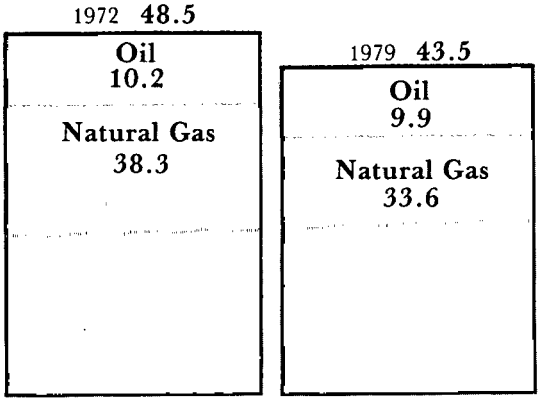
Table 19

Comparison of 1972 and 1979 Energy Consumption by Type, All Manufacturing Corporations Reporting

Fuel Type	1979 Consumption (Billion Btu)	1972 Consumption (Billion Btu)	Percent Change
Electricity	3,000,188.34	2,589,537.51	15.86
Natural Gas	5,229,158.07	6,069,551.11	-13.85
Propane	35,179.67	43,587.33	-19.29
LPG	43,287.72	38,118.07	13.56
Bituminous Coal	2,687,453.44	2,835,280.03	-5.21
Anthracite Coal	21,375.08	25,172.27	-15.08
Coke	276,185.00	213,817.19	29.17
Gasoline	38,085.33	18,572.04	105.07
Distillate Fuel Oil	223,868.47	228,013.83	-1.82
Residual Fuel Oil	1,352,227.00	1,419,169.00	-4.72
Petroleum Coke	518,000.62	514,067.25	.77
Purchased Steam	216,992.87	229,189.25	-5.32
Other	1,819,922.22	1,593,810.60	14.19
Total Energy Cons.	**15,461,923.83**	**15,817,885.48**	**-2.25**

Figure 21

Oil & Natural Gas As A Percentage Of Total Reported Consumption



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III.
Conclusions and Recommendations

Based on the review and analysis of 1979 energy efficiency and recovered materials data provided through the industrial reporting program, the Department of Energy has reached the following conclusions and recommendations with respect to the Industrial Energy Efficiency Improvement Program.

Conclusions

Value of the Energy Reporting Concept

The quality of data submitted and the degree of involvement of industry in the energy efficiency reporting program suggest that the reporting process and evolution have had a positive influence in raising the level of industrial awareness of, and participation in, energy management programs. While energy savings estimates cannot be derived for the reporting mandate, reporting programs have had a positive effect in raising corporate awareness of the benefits of formalized energy management programs, and the ability to both measure and control energy use in corporate operations has continually improved. An important step toward conservation in an industrial operation is the establishment of the ability to accurately measure energy consumption, and therefore quantify the potential for savings in specific industrial operations. A reporting program provides the basic framework for energy use measurement, and the establishment of targets for energy efficiency improvements provides a "yardstick" against which energy efficiency progress can be compared. A reporting program—whether mandated or otherwise—provides a structural framework in industrial corporations which promotes conservation, and a benchmark for assessment of achievements.

Effectiveness of Revisions to the Reporting Process

In late 1978, the Office of Industrial Programs initiated a comprehensive program aimed at revising the industrial energy efficiency improvement reporting system. The aim was to improve the consistency and accuracy of data collected in accordance with the Energy Policy and Conservation Act (EPCA), as amended by the National Energy Conservation Policy Act (NECPA). The focus of this effort was to revise the reporting criteria and to implement consistent plant-level reporting by identified corporations. To this end, a new regulation was developed and published for comment in the *Federal Register* (June 8, 1979, 44 FR 33344). Comments were received, and revisions to the proposed regulation were adopted

in response to the comments. The final regulation was issued on February 14, 1980 (45 FR 10194).

The quality of the data received on 1979 efficiency improvements was markedly superior to data collected for previous years, and has facilitated interpretation and analysis of quantitative energy efficiency improvement information for the reporting industries. The revised data format provides disaggregations of fuel use by source, and has contributed to the ability of the Office of Industrial Programs to assess the past performance and emerging trends in the reporting industries with respect to fuel switching and decreased reliance on premium fossil fuels, particularly oil and natural gas.

The recently-revised reporting format has also attached greater significance to the narrative section, which reporting corporations are to use in describing specific actions implemented to improve energy efficiency. This information has improved the ability of the Department of Energy to assess the degree to which, for example, capital investments are being implemented by industry in support of conservation. The narrative section of the reporting system will require additional development and use to support conclusions regarding Federal programs, but the changes to date have improved the informational value of energy efficiency reporting.

Also of importance is the fact that the revised reporting process has also reduced the data aggregation burden associated with program compliance. In previous years, reporting was semiannual, with corporations and sponsors required to aggregate and submit energy efficiency reports twice each year. The revised reporting program requires corporations and sponsors to submit energy efficiency data only once each year. Consequently, while the revised system requires more detailed plant-level data in compliance with NECPA, the aggregation burden for mandatory reporters has been reduced considerably.

Recovered Materials Utilization Monitoring

Analysis of first year submissions from reporting corporations indicates that the recovered materials utilization reporting program will require significant further development to become a useful monitoring system. Deficiencies have been identified in the current format and definitions used in the reporting system which preclude meaningful assessment of recovered materials utilization in industry. Industrial concerns which use substantial amounts of recovered materials are often corporations using fewer than one trillion Btu's per year. The fact that only corporations using more than one trillion Btu per year are required to report acts to constrain collection of meaningful data, because it excludes many of the corporations which use recovered materials extensively.

The Need for Verification of Reported Data

The Department of Energy believes there is a need to at least minimally verify the accuracy of data reported under the Industrial Energy Efficiency Improvement Program. The base of information that has been developed under the program provides a detailed and valuable basis for the assessment of conservation progress in industry, and for the future development of substantive Federal industrial energy conservation programs. Verification of the information developed under this program will validate the quality and accuracy of reported data, enhance its credibility as a component of industrial conservation strategy development, and the usefulness of the program as a vehicle for communication between government and industry on energy management.

Recommendations

Verification

The Office of Industrial Programs recommends that a verification program, which would serve to validate the accuracy of data reported by corporations under the Industrial Energy Efficiency Improvement Program, should be initiated. The verification process would be limited in scope, but structured to provide an effective data verification survey procedure. The Office of Industrial Programs of the Department of Energy has developed standards and procedures for the conduct of a verification program.[1] Implementation of this verification program would require appropriation of resources, which will be proposed by OIP for consideration by DOE management.

[1] "Standards and Procedures for the Validation Program for the Industrial Energy Conservation Reporting Program," Office of Industrial Programs, U.S. Department of Energy, January 11, 1980.

Recovered Materials Utilization Reporting

The Office of Industrial Programs recommends that the recovered materials utilization reporting program be reassessed to examine the cost-effectiveness of the program. In FY 1981, the Office of Industrial Programs, U.S. Department of Energy, will undertake an evaluation of the available alternatives for the revision of the reporting system. This assessment will address the establishment of a revised materials reporting system, including consideration of how reporting burden can be reduced, and cost-effectiveness improved. Based on this analysis, the Office of Industrial Programs will develop conclusions, including proposed legislative changes (if necessary), that will guide implementation of an improved recovered materials utilization reporting program.

Energy Efficiency Improvement Narrative Reporting

The Department of Energy believes that the narrative section of the industrial energy efficiency reporting form could, if properly utilized, provide extremely valuable insights into the current practices of conservation in industry. It is the narrative section which actually explains the conservation actions underway in industry. It is further believed that the narrative inputs to the energy efficiency reporting offer the opportunity of establishing a working dialogue with industry which would promote greater understanding of the constraints to further improvements in energy efficiency improvement in industry. Consequently, continued emphasis will be placed on increasing use of the narrative section of the energy efficiency reporting forms. This expanded narrative input will aid in the development of more effective industrial energy management programs, as well as more informed Federal analysis of, and comment on, various legislative proposals which are being introduced.

Industry-Set Targets

The Department of Energy believes that energy efficiency improvement targets have had a positive effect in raising industry awareness of and participation in energy management and conservation efforts. It is therefore recommended that the Department of Energy encourage and provide technical support to industries and corporations which desire to set their own voluntary energy efficiency improvement targets. The Department of Energy believes that these voluntary targets should be set by the participating industries, and that the Department's involvement in the target-setting process should be limited to an appropriate role of technical assistance and monitoring. This Federal role will serve to ensure that the target-setting process is consistent with the objectives of the Industrial Energy Efficiency Improvement Program, without imposing undue burdens on the reporting corporations.

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Appendix I

DEPARTMENT OF ENERGY

Industrial Energy Conservation Program; Identification of Corporations for Purposes of Industrial Energy Reporting and Recovered Materials Reporting

AGENCY: Department of Energy.

ACTION: Notice of Corporate Identification.

SUMMARY: The Department of Energy (DOE) is identifying corporations which consumed at least one trillion British thermal units of energy in calendar year 1979 in any of 20 major energy-consuming manufacturing industries as required by DOE's regulations implementing the Industrial Energy Conservation Program established by the Energy Policy and Conservation Act, as amended by the National Energy Conservation Policy Act. Based on this identification, corporations are required to participate in the reporting aspects of the Industrial Energy Conservation Program. The identified corporations are listed alphabetically by industry in the appendix to this Notice.

EFFECTIVE DATE: May 20, 1980.

FOR FURTHER INFORMATION CONTACT:

Tyler E. Williams, Jr., Office of Industrial Programs, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, D.C. 20585, (202) 252-2371.

Pamela M. Pelcovits, Office of General Counsel, U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, D.C. 20585, (202) 252-9516.

SUPPLEMENTARY INFORMATION: The Department of Energy (DOE) recently issued as a final rule Part 445 of Chapter II of Title 10 of the Code of Federal Regulations (45 FR 10194, February 14, 1980), which sets out the requirements of DOE's Industrial Energy Conservation Program, required by Part E of Title III of the Energy Policy and Conservation Act (Pub. L. 94-163), as amended by the National Energy Conservation Policy Act (Pub. L. 95-619).

Subpart B of Part 445 requires that a corporation that consumed at least one trillion British thermal units of energy in a calendar year in any of the 20 major energy-consuming industries file a statement to that effect with DOE and provides instructions for submitting the report. Pursuant to § 445.14(b), the deadline for filing a report on 1979 energy consumption was changed to March 31, 1980 by a **Federal Register** notice, (45 FR 10232, February 14, 1980). Based on the reports received by DOE and other information available to DOE, DOE is publishing a list of indentified corporations in the appendix to this notice, as required by § 445.15(b).

Identified corporations are required to meet the applicable reporting requirements set forth in subpart C of Part 445. The procedures for seeking a modification of identification are set forth at § 445.16.

Issued in Washington, D.C., May 12, 1980.

Worth Bateman,

Acting Under Secretary.

List of Identified Corporations

SIC 20—Food and Kindred Products

A E Staley Manufacturing Co
Adolph Coors Company
American Brands Inc
American Crystal Sugar Co
American Home Products Corp.
American Maize-Products Co
Amfac Inc
Ampco Foods Inc
Amstar Corporation
Anderson Clayton & Co
Anheuser-Busch Inc
Archer Daniels Midland Company
Beatrice Foods Co
Borden Inc
Bunge Corporation
California & Hawaiian Sugar Co
California Canners and Growers Co
Campbell Soup Company
Campbell Taggart Inc
Cargill Incorporated
Carnation Company
Castle & Cooke Inc
Central Soya Co Inc
Coca Cola Company
Conagra Inc
Consolidated Foods Corporation
Continental Grain Company
CPC International Inc
Cudahy Foods Co
Curtice-Burns Inc
Dawson Mills Inc
Del Monte Corporation
Dubuque Packing Company
E W Kneip Inc
Eli Lilly and Company
Farmland Industries Inc
Federal Company
Flowers Industries Inc
Foremost-McKesson Inc
Froedtert Malt Corp.
G Heileman Brewing Company Inc
General Foods Corporation
General Mills Inc
Geo A Hormel & Co
Gerber Products Company
Gold Kist Inc
Grain Processing Corporation
Grain Terminal Assoc.
Great A & P Tea Co Inc
Greyhound Corporation
Gulf & Western Industries Inc
H J Heinz Company
Hanson Industries Inc
Henkel Corporation
Hershey Foods Corporation
Heublein Inc
Holly Sugar Corporation
Hunt Intl Resources Corp.
Hygrade Food Products Corp.
IC Industries Inc
Imperial Sugar Company
International Tel & Tel Corp.
Interstate Brands Corporation
Iowa Beef Processors Inc
J R Simplot Company
Jewel Companies Inc
Jos Schlitz Brewing Company
Joseph E Seagram & Sons Inc
Keebler Company
Kellogg Company
Kraft Inc
Kroger Company
Ladish Malting Co
Land O' Lakes, Inc
Lauhoff Grain Company
Lever Brothers Company
Liggett Group Inc
Lykes Bros Inc
Mars Incorporated
MBPXL Corporation
Michigan Sugar Company
Midwest Solvents Company Inc
Minn-Dak Farmers Cooperative
Monitor Sugar Company
Moorman Manufacturing Co
Nabisco Inc
National Starch & Chemical Corp
Natl Distillers & Chemical Corp
Nestle Enterprises Inc
Norton Simon Inc
Olympia Brewing Company
Oscar Mayer & Co
Pabst Brewing Company
Pepsico Inc
Perdue Inc
Philip Morris Incorporated
Pillsbury Company
Proctor & Gamble Co
Quaker Oats Company
R J Reynolds Industries Inc
R T French Company
Ralston Purina Co
Rapid American Corporation
Rath Packing Company
RCA Corporation
Refined Syrups & Sugars Inc
Revere Sugar Corporation
Riceland Foods Inc
Safeway Stores Incorporated
Savannah Foods & Industries Inc
SCM Corporation
Southern Minnesota Sugar Cooperative
Standard Brands Incorporated
Stokely-Van Camp Inc
Stroh Brewery Co
Sunkist Growers Inc
Swift & Company
Thomas J Lipton Inc
Tillie Lewis Foods Inc
Tri/Valley Growers Inc
Twin City Foods Inc
U and I Incorporated
United Brands Company
United Suppliers Inc
Univar Corporation
Universal Foods Corporation
Wilson Foods Corporation

SIC 21—Tobacco Products

American Brands Inc
Brown & Williamson Tobacco Corp
Gulf & Western Industries Inc
Philip Morris Incorporated
R J Reynolds Industries Inc

SIC 22—Textile Mill Products

American Thread Company

Armstrong Cork Company
Avondale Mills Inc
Bibb Company
Burlington Industries Inc
Cannon Mills Company
Clinton Mills Inc
Coats & Clark Inc
Colgate-Palmolive Company
Collins & Aikman Corporation
Cone Mills Corporation
Consolidated Foods Corporation
Cranston Print Works Company
Crompton Company Inc
Crown America Inc
Daisy Hosiery Mills Inc
Dan River Inc
Dixie Yarns Inc
Fieldcrest Mills Inc
General Tire & Rubber Co
Goodyear Tire & Rubber Co
Graniteville Company
Greenwood Mills Inc
Gulf & Western Industries Inc
High Voltage Engineering Corp
J P Stevens & Co Inc
Johnson & Johnson
Kiddie Tot Hosiery Mills Inc
M Lowenstein & Sons Inc
Milliken & Company
Mohasco Corporation
Northwest Industries Inc
RCA Corporation
Reeves Brothers Inc
Riegel Textile Corporation
Shaw Industries Inc
Spartan Mills Inc
Sperry and Hutchinson Co
Springs Mills Inc
Standard Oil Company (Indiana)
Standard Oil Company of California
Standard-Ccosa-Thatcher Co
Texfi Industries Inc
Thomaston Mills Inc
Ti-Caro Inc
Union Underwear Company Inc
United Merchants & Mfgrs Inc
West Point-Pepperell Inc
WWG Industries Inc

SIC 23—Apparel and Other Textile Products

Kellwood Company

SIC 24—Lumber and Wood Products

Bendix Corporation
Boise Cascade Corporation
Champion International Corp
Crown Zellerbach Corp
Evans Products Company
Georgia-Pacific Corporation
Jim Walter Corporation
Kimberly-Clark Corp
Koppers Company Inc
Louisiana-Pacific Corporation
Macmillan Bloedel Inc
Masonite Corporation
Potlatch Corporation
Southwest Forest Ind Inc
Time Inc
Union Camp Corp
Weyerhaeuser Company
Willamette Industries Inc

SIC 25—Furniture and Fixtures

None.

SIC 26—Paper and Allied Products

Abitibi Corporation
Abitibi Southern Corporation
Alaska Lumber & Pulp Co Inc
Alton Box Board Company
American Can Company
Appleton Papers Inc
Arcata Corporation
Armstrong Cork Company
Austell Box Board Corporation
Bell Fibre Products Corp
Bird & Son Inc
Blandin Paper Company
Boise Cascade Corporation
Bowater Incorporated
Champion International Corp
Chesapeake Corporation
Clevepak Corporation
Collins & Aikman Corporation
Consolidated Papers Inc
Consolidated Packaging Corp
Continental Group Inc
Crown Zellerbach Corporation
Deerfield Specialty Papers Inc
Dennison Manufacturing Company
Dexter Corporation
Diamond International Corp
Eddy Paper Company Limited
Erving Paper Mills Inc
Federal Paper Board Co Inc
Finch Pruyn & Co Inc
Flintkote Company
Fort Howard Paper Company
Fraser Paper, Limited
GAF Corporation
Garden State Paper Co Inc
General Refractories Company
Georgia-Pacific Corporation
Gilman Paper Company
Great Northern Nekoosa Corp
Green Bay Packaging Inc
Gulf & Western Industries Inc
Gulf States Paper Corp
Hammermill Paper Company
Hollingsworth & Vose Co
Howard Paper Mills Inc
International Paper Company
International Tel & Tel Corp
Interstate Paper Corporation
James River Corporation of VA
Jim Walter Corporation
Johns-Manville Sales Corp
Johnson & Johnson
Kimberly-Clark Corporation
Litton Industries Inc
Longview Fiber Company
Louisiana-Pacific Corporation
MacMillan Bloedel Inc
Parcal Paper Mills Inc
Masonite Corporation
Mead Corporation
Menasha Corporation
Merrimac Paper Co Inc
Minnesota Mining & MFG Co
Mobil Oil Corporation
Mosinee Paper Corp
National Gypsum Company
Newark Boxboard Co
Newton Falls Paper Mill Inc
Clin Corporation
Owens-Corning Fiberglas Corp
Owens-Illinois Inc
P H Glatfelter Co
Pacific Paperboard Products Inc
Penntech Papers Inc
Pentair Industries Inc
Philip Morris Incorporated
Pineville Kraft Corporation
Port Huron Paper Company
Potlatch Corporation
Procter & Gamble Co
Rhinelander Paper Co
SCM Corporation
Scott Paper Company
Simpson Paper Company
Sonoco Products Company
Sorg Paper Co
Southeast Paper Manufacturing Company
Southwest Forest Ind Inc
St Joe Paper Company
St Regis Paper Company
Stone Container Corporation
Tenneco Inc
Time Inc
Times Mirror Company
Union Camp Corporation
United States Gypsum Company
Virginia Fibre Corporation
Wausau Paper Mills Company
Western Paper & Mfg Co
Westvaco Corporation
Weyerhaeuser Company
Willamette Industries Inc

SIC 27—Printing and Publishing

Arcata Corporation
Gulf & Western Industries Inc
R R Donnelley & Sons Company
W. F. Hall Printing Co

SIC 28—Chemicals and Allied Products

Abbott Laboratories
Air Products & Chemicals Inc
Airco Inc
Akzona Incorporated
Alcon Laboratories Inc
Allegheny Ludlum Industries Inc
Allied Chemical Corporation
Aluminum Company of America
American Can Company
American Cyanamid Company
American Hoechst Corporation
American Home Products Corp
American Petrofina Inc
American Synthetic Rubber Corp
Arizona Chemical Company
Asarco Incorporated
Ashland Oil Inc
Atlantic Richfield Company
Avtex Fibers Inc
B F Goodrich Company
Badische Corporation
Basf Wyandotte Corporation
Beker Industries Corp
Big Three Industries Inc
Borden Inc
Borg-Warner Corporation
Bristol-Myers Company
Buffalo Color Corp
C F Industries Inc
Cabot Corporation
Cargill Incorporated
Carus Chemical Company Inc
Celanese Corporation
Ciba-Geigy Corporation
Cities Service Company
Coastal Corporation
Colgate-Palmolive Company
Cominco American Incorporated
Commonwealth Oil Refining Co
Conoco Inc
Copolymer Rubber & Chem Corp
CPC International Inc
Diamond Crystal Salt Company

Diamond Shamrock Corporation
Dow Chemical Company
Dow Corning Corporation
E I Du Pont De Nemours & Co
Eagle Picher Industries Inc
Eastman Kodak Company
Economics Laboratory Inc
El Paso Products Company
Eli Lilly and Company
Estech General Chemicals Corp
Ethyl Corporation
Exxon Corporation
Farmland Industries Inc
Felmont Oil Corporation
Ferro Corporation
Firestone Tire & Rubber Co
First Mississippi Corporation
FMC Corporation
Freeport Minerals Company
GAF Corporation
Gardinier Big River Inc
General Electric Company
General Tire & Rubber Co
Georgia-Pacific Corporation
Getty Chemical Company
Goodyear Tire & Rubber Co
Greyhound Corporation
Gulf & Western Industries Inc
Gulf Oil Corporation
Gulf Resources & Chemical Corp
Halcon International Inc
Hardy Salt Company
Hawkeye Chemical Company
Henkel Corporation
Hercules Incorporated
Hoffmann-La Roche Inc
Hygrade Food Products Corp
ICI Americas Inc
Internatl Minerals & Chem Corp
J M Huber Corporation
J R Simplot Company
Johnson & Johnson
Kaiser Aluminum & Chemical Corp
Kerr-McGee Corporation
Knoll Pharmaceutical Co
Koppers Company Inc
Kraft Inc
Lever Brothers Company
Linden Chemicals & Plastics Inc
Lubrizol Corporation
Mallinckrodt Inc
Martin Marietta Corporation
Melamine Chemicals Inc
Merck & Co Inc
Merichem Company
Miles Laboratory Inc
Minnesota Mining & Mfg Co
Mississippi Chemical Corp
Mobay Chemical Corporation
Mobil Oil Corporation
Monsanto Company
Morton-Norwich Products Inc
Neren Corporation
Nalco Chemical Company
Natl Distillers & Chemical Corp
NIPRC Inc
NL Industries Inc
North American Rayon Corp
Northern Natural Gas Company
Northern Petrochemical Co
Northwest Industries Inc
Occidental Petroleum Corp
Olin Corporation
Pennwalt Corporation
Pfizer Inc
Phillips Petroleum Company
PPG Industries Inc
PQ Corporation
Proctor & Gamble Co
Publicker Industries Inc
Quaker Oats Company
Reichhold Chemicals Inc
Reilly Tar & Chemical Corp
Reynolds Metal Company
Richardson-Merrell Inc
Rohm & Haas Company
SCM Corporation
Shell Oil Company
Sherex Chemical Co Inc
Sherwin-Williams Company
Signal Companies Inc
Soltex Polymer Corporation
Squibb Corporation
St Joe Minerals Corporation
Standard Oil Company (Indiana)
Standard Oil Company (Ohio)
Standard Oil Company of Calif
Stauffer Chemical Company
Sterling Drug Inc
Superior Oil Company
Sunolin Chemical Company
Tenneco Inc
Terra Chemicals Internatl Inc
Texaco Inc
Tesasgulf Inc
Thiokol Corporation
Tyler Corporation
Union Camp Corporation
Union Carbide Corporation
Union Oil Co of California
Uniroyal Inc
United States Borax & Chem Corp
United States Steel Corp
United Technologies Corp
Upjohn Company
USA Petroleum Corp
Valley Nitrogen Producers Inc
Velsicol Chemical Corporation
Vertac Inc
Virginia Chemicals Inc
Vulcan Materials Company
W R Grace & Co
Warner-Lambert Company
Westvaco Corporation
Willamette Industries Inc
Williams Companies
WITCO Chemical Corporation
Wycon Chemical Co

SIC 29—Petroleum and Coal Products

Agway Inc
Amerada Hess Corporation
American Petrofina Inc
Asamera Oil (US) Inc
Ashland Oil Inc
Atlantic Richfield Company
Beacon Oil Company
Belridge Oil Company
Bird & Son Inc
Certainteed Corporation
Champlin Petroleum Co
Charter International Oil Co
Cities Service Company
Clark Oil & Refining Corp
Coastal Corporation
Commonwealth Oil Refining Co
Conoco Inc
CRA Inc
Crown Central Petroleum Corp
Crystal Oil Company
Diamond Shamrock Corporation
Dorchester Gas Corporation
Earth Resources Company
Energy Cooperative Inc
Exxon Corporation
Farmers Union Central Exch. Inc
Farmland Industries Inc
Fletcher Oil & Refining Co
GAF Corporation
Getty Refining & Marketing Co
Great Lakes Carbon Corporation
Guam Oil & Refining Co Inc
Gulf Oil Corporation
Holly Corp
Howell Hydrocarbons Inc
Hunt Oil Company
Husky Oil Company
Indiana Farm Bureau Coop. Assn.
Jim Walter Corporation
Johns-Manville Sales Corp
Kern County Refinery Inc
Kerr-McGee Corporation
Koch Industries Inc
Koppers Company Inc
Little America Refining Co
Louisiana Land & Exploration Co
Marathon Oil Company
Mobil Oil Corporation
Murphy Oil Corporation
National Coop. Refinery Assn.
Nueces Petrochemical Co
OKC Corp
Oklahoma Refining Company
Owens-Corning Fiberglas Corp
Pacific Resources Inc
Pennzoil Company
Petrolite Corp
Phillips Petroleum Company
Placid Refining Company
Powerine Oil Company
Pride Refining Inc
Quaker State Oil Refining Corp
Reserve Oil & Gas Company
Rock Island Refining Corp
Shell Oil Company
Sinclair Oil Corp
Southern Union Company
Southland Oil Company
Standard Oil Company (Indiana)
Standard Oil Company (Ohio)
Standard Oil Company of Calif.
Standard Products Co
Sun Company Inc
Superior Oil Company
Tenneco Inc
Tesoro Petroleum Corp
Texaco Inc
Texas Eastern Transmission Corp
Time Oil Company
Tosco Corporation
Total Petroleum Inc
Union Oil Co of California
Uniroyal Inc
United Refining Company
USA Petroleum Corp
Vickers Petroleum Corporation
Winston Refining Company
Witco Chemical Corporation

SIC 30—Rubber and Miscellaneous Plastics Products

Amerace Corporation
American Cyanamid Company
Armstrong Rubber Company
B F Goodrich Company
Baxter Travenol Labs Inc
Eudd Company
Continental Group Inc

Cooper Tire & Rubber Company
art Industries Inc
ayco Corporation
Dunlop Tire & Rubber Corp
Eagle Picher Industries Inc
Ethyl Corporation
Firestone Tire & Rubber Co
Gates Rubber Company
General Electric Company
General Motors Corporation
General Tire & Rubber Co
Goodyear Tire & Rubber Co
High Voltage Engineering Corp
Michelin Tire Corporation
Minnesota Mining & Mfg Co
Novamont Corporation
Owens-Illinois Inc
Reichhold Chemicals Inc
Union Carbide Corporation
Uniroyal Inc
W R Grace & Co
Westinghouse Electric Corp

SIC 31—Leather and Leather Products

None.

SIC 32—Stone, Clay and Glass Products

Adolph Coors Company
AFG Industries Inc
Alamo Cement Co
Allied Chemical Corp
Allied Products Company
Alpha Portland Cement Company
Amcord Inc
American Standard Inc
Amsted Industries Incorporated
Anchor Hocking Corporation
Arkansas Cement Co
Arkansas Louisiana Gas Company
ARMCC Inc
Armstrong Cork Company
Ash Grove Cement Company
Austin White Lime Company
Babcock & Wilcox Company
Ball Corporation
Basic Incorporated
Belden Brick Company
Bethlehem Steel Corporation
Bickerstaff Clay Prod Co Inc
Boren Clay Products Company
Brockway Glass Company Inc
California Portland Cement Co
Can-Am Corporation
Capitol Aggregates Inc
Centex Corporation
Certainteed Corporation
Citadel Cement Corporation
CLM Corporation
Combustion Engineering Inc
Coplay Cement Manufacturing Co
Corning Glass Works
Crane Co
Cyprus Hawaiian Cement Co
Dart Industries Inc
Delta Macon Brick & Tile Co
Dickey Company
Domtar Industries Inc
Dorsey Corporation
Dravo Corporation
Dresser Industries Inc
Dundee Cement Company
gle Picher Industries In
W C Levy Company
Engelhard Minerals & Chemicals Corp
Federal Paper Board Co Inc
Ferro Corporation
Filtrol Corporation
Flintkote Company
Florida Mining & Materials Corp
Ford Motor Company
GAF Corporation
Gallo Glass Company
Gen Telephone & Electronic Corp
General Dynamics Corp
General Electric Company
General Portland Inc
General Refractories Company
General Shale Products Corp
Georgia-Pacific Corporation
Giant Portland & Masonry Cem Co
Gifford-Hill & Company Inc
Glen-Gery Corporation
Glenshaw Glass Company Inc
Guardian Industries Corp
Gulf & Western Industries Inc
Harsco Corporation
Ideal Basic Industries Inc
Illinois Cement Company
Independent Cement Corp
Indian Head Inc
Interface Corporation
J E Baker Company
Jim Walter Corporation
Johns-Manville Sales Corp
Justin Industries Inc
Kaiser Aluminum & Chemical Corp
Kaiser Cement & Gypsum Corp
Kennecott Copper Corporation
Kerr Glass Manufacturing Corp
Keystone Portland Cement Co
Kohler Co
Kraft Inc
Lancaster Colony Corp
Latchford Glass Company
Lehigh Portland Cement Company
Libbey-Owens-Ford Company
Liberty Glass Company
Lone Star Industries Inc
Louisville Cement Company
Martin Marietta Corporation
McDonough Co
Midland Glass Company Inc
Minnesota Mining & MFG Co
Mississippi Lime Company
Missouri Portland Cement Co
Monarch Cement Company
Monolith Portland Cement Co
National Bottle MFG Company
National Can Corporation
National Cement Company
National Gypsum Company
Nevada Cement Company
Newmont Mining Corporation
Northwstrn St Portland Cemt Co
Norton Company
Norton Simon Inc
Oko Corp
Oregon Portland Cement Company
Owens-Corning Fiberglas Corp
Owens-Illinois Inc
Pacific Coast Building Prods Co
Pacific Holding Corporation
Penn-Dixie Industries Inc
Pfizer Inc
Pomona Corporation
Portland Cement Co of Utah
Ppg Industries Inc
Puerto Rican Cement Co Inc
Rangaire Corporation
Raybestos Manhattan Inc
Reicphold Chemicals Inc
Republic Steel Corp
Rinker Portland Cement Corp
River Cement Company
Rockwool Industries Inc
Round Rock Lime Company
San Antonio Portland Cement Co
Solite Corporation
South Dakota Cement Company
Southdown Inc
St Clair Lime Company
Texas Industries Inc
United States Gypsum Company
United States Steel Corp
Vulcan Materials Company
Warner Company
Weyerhaeuser Company
Wheaton Industries
Whitehall Cement Mfg Co
Woodville Lime & Chemical Co

SIC 33—Primary Metal Industries

Airco Inc
Alcan Aluminum Corporation
Allegheny Ludlum Industries Inc
Allied Chemical Corporation
Alumax Inc
Aluminum Company of America
Amax Inc
American Can Company
American Cast Iron Pipe Co
American Tele & Tele Co
Amsted Industries Incorporated
Armco Inc
Asarco Incorporated
Athlone Industries Inc
Atlantic Richfield Company
Atlantic Steel Company
Babcock & Wilcox Company
Bethlehem Steel Corporation
Budd Company
Cargill Incorporated
Carpenter Technology Corp
Caterpillar Tractor Co
Ceco Corp
Century Brass Products Inc
Chromium Mining & Smelting Corp
Clow Corporation
Colt Industries Inc
Connors Steel Company
Consolidated Aluminum Corp
Copperweld Corporation
Crane Company
Cyclops Corporation
Dana Corporation
Dayton Malleable Inc
Dow Chemical Company
Eastmet Corp
Engelhard Minerals & Chemicals
Envirodyne Industries Inc
Ethyl Corporation
Evans Products Company
Florida Steel Corporation
Ford Motor Company
General Cable Corporation
General Electric Company
General Motors Corporation
Great Lakes Carbon Corporation
Grede Foundries Inc
Gulf & Western Industries Inc
Ellf Resources & Chemical Corp
Hanna Mining Co—Silicon Div
Hanna Nickel Smelting Company
Hayes-Albion Corp
Huntington Alloys Inc
IC Industries Inc
Inland Steel Company
Inspiration Consol Copper Co

Interlake Inc
Internatl Minerals & Chem Corp
Jim Walter Corporation
Jones & Laughlin Steel Corp
Kaiser Aluminum & Chemical Corp
Kaiser Steel Corporation
Kennecott Copper Corporation
Keystone Consolidated Ind Inc
Koppers Company Inc
Korf Industries Inc
Laclede Steel Company
Lone Star Steel Co
Louisiana Land & Exploration Co
Lukens Steel Company
Martin Industries, Inc
Martin Marietta Corporation
McLouth Steel Corporation
Mead Corporation
Midland-Ross Corporation
Natl Distillers & Chemical Corp
National Steel Corporation
National-Standard Company
Neenah Foundry Company
Newmont Mining Corporation
NL Industries Inc
Noranda Aluminum Inc
Northwest Industries Inc
Northwest Steel Rolling Mills Inc
Northwestern Steel & Wire Co
Ohio Ferro-Alloys Corporation
Olin Corporation
Outboard Marine Corporation
Pechiney Ugine Kuhlmann Corp
Penn-Dixie Steel Corp
Phelps Dodge Corporation
Phoenix Steel Corporation
Quanex Corporation
Republic Steel Corp
Revere Copper and Brass Inc
Reynolds Metals Company
Roane Electric Furnace Co Inc
Satralloy Inc
Sharon Steel Corporation
Shenango Incorporated
SKW Alloys Inc
Southwire Co
St Joe Minerals Corporation
Standard Oil Company (Indiana)
Structural Metals Inc
Sundstrand Corporation
Teledyne Inc
Tenneco Inc
Textron Inc
Timken Company
Tyler Corporation
Union Carbide Corporation
United States Steel Corp
United Technologies Corp
Vulcan Materials Company
Wabash Alloys Inc
Wheeling Pittsburgh Steel Corp
White Consolidated Ind Inc

SIC 34—Fabricated Metal Products

Adolph Coors Company
Allegheny Ludlum Industries Inc
Aluminum Company of America
American Can Company
American Standard Inc
AMPCO-Pittsburgh Corp
Amsted Industries Incorporated
Babcock & Wilcox Company
Bethlehem Steel Corporation
Budd Company
Cameron Iron Works Inc
Cameron Tool & Supply Co
Canton Drop Forging & Mfg Co
Century Brass Products Inc
Chrysler Corporation
Combustion Engineering Inc
Continental Group Inc
Crown Cork & Seal Company Inc
Ford Motor Company
Frost Co
General Motors Corporation
Gulf & Western Industries Inc
Gulf Coast Machine & Supply Co
Harsco Corporation
Inland Steel Company
International Tel & Tel Corp
Jos Schlitz Brewing Company
Kaiser Aluminum & Chemical Corp
Kohler Co
Ladish Co
Litton Industrial Products Inc
Martin Marietta Corporation
Moorman Manufacturing Co
National Can Corporation
National Steel Corporation
Olin Corporation
Park-Ohio Industries Inc
Remington Arms Company Inc
Reynolds Metals Company
Rockwell International Corp
Signal Companies Inc
SKF Industries Inc
Stanley Works Inc
Sundstrand Corporation
Textron Inc
TRW Inc
United States Steel Corp
Wallace Murray Corporation
Wyman-Gordon Company

SIC 35—Machinery, Except Electrical

Allis-Chalmers Corporation
Arkansas Louisiana Gas Co
Borg-Warner Corporation
Briggs & Stratton Corporation
Bucyrus-Erie Company
Caterpillar Tractor Co
Chrysler Corporation
Clark Equipment Company
Colt Industries Inc
Control Data Corporation
Cooper Industries Inc
Cummins Engine Company Inc
Dana Corporation
Deere & Company
Dresser Industries Inc
Eaton Corp
Federal-Mogul Corporation
FMC Corporation
Ford Motor Company
General Electric Company
General Motors Corporation
Harnischfeger Corporation
Hughes Tool Company
IC Industries Inc
Ingersoll-Rand Company
International Harvester Co
Intl Business Machines Corp
Litton Industries Inc
Mesta Machine Company
NCR Corporation
Outboard Marine Corporation
Rexnord, Inc
Rockwell International Corp
SKF Industries Inc
Sperry Rand Corporation
Sundstrand Corporation
Teledyne Inc
Tenneco Inc
Timken Company
Trane Co
TRW Inc
United Technologies Corp
Xerox Corporation
Westinghouse Electric Corp
White Consolidated Ind Inc

SIC 36–Electric, Electronic Equipment

A O Smith Corporation
Airco Inc
Allied Chemical Corp
American Tele & Tele Co
Arkansas Louisiana Gas Co
Bendix Corporation
Dayton-Walther Corporation
Digital Equipment Corp
Emerson Electric Co
Ford Motor Company
Gen Telephone & Electronic Corp
General Cable Corporation
General Electric Company
General Motors Corporation
Great Lakes Carbon Corporation
Harvey Hubbell Inc
High Voltage Engineering Corp
Hughes Aircraft Company
Johnson Controls Inc
Maytag Company
McGraw-Edison Company
Minnesota Mining & Mfg Co
Raytheon Company
RCA Corporation
Reliance Electric Company
Rockwell International Corp
Square D Company
Stackpole Carbon Company
Sunbeam Corporation
Tappan Company
Union Carbide Corporation
Westinghouse Electric Corp
Whilpool Corporation
White Consolidated Ind Inc

SIC 37—Transportation Equipment

A O Smith Corporation
American Motors Corporation
Avco Corporation
Bendix Corporation
Bethlehem Steel Corporation
Boeing Company
Borg-Warner Corporation
Budd Company
Chrysler Corporation
Congoleum Corporation
Dayton-Walther Corporation
Eaton Corp
Ford Motor Company
Fruehauf Corporation
Gatx Corp
General Dynamics Corp
General Electric Company
General Motors Corporation
Goodyear Tire & Rubber Co
Grumman Corporation
Hercules Incorporated
Hughes Aircraft Company
International Harvester Co
Litton Industries Inc
Lockheed Corporation
Martin Marietta Corporation
McDonnell Douglas Corp
Northrop Corporation
Pullman Incorporated
Rockwell International Corp

Signal Companies Inc
Sundstrand Corporation
nneco Inc
xtron Inc
Thiokol Corporation
TRW Inc
United Technologies Corp
Vought Corporation

SIC 38—Instruments and Related Products

Eastman Kodak Company
Gaf Corporation
Johnson & Johnson
Johnson Controls Inc
Minnesota Mining & Mfg Co
Polaroid Corporation
Sundstrand Corporation
Warner-Lambert Company
Armstrong Cork Company
Congoleum Corporation

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