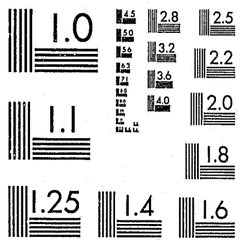

BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

The Federal Government Should Establish And Meet Energy Conservation Goals

Past Federal conservation programs have not effectively curbed the Nation's demand for energy. The administration has proposed a national energy plan highlighting energy conservation, but more is needed to meet the plan's goals and objectives. Additional Federal actions should be taken in the transportation, industrial, residential, and commercial sectors. There will be a need for the Department of Energy to

--continuously assess each Federal step in terms of what its contribution will be in meeting the short-, mid-, and long-term objectives of the plan and

--develop alternatives and use them in case ongoing initiatives do not sufficiently meet the established goals.

EMD-78-38
JUNE 30, 1978

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-178205

To the President of the Senate and the
Speaker of the House of Representatives

This report presents our evaluation of (1) energy conservation activity in the Nation, (2) Federal energy conservation programs directed at the private sector, (3) opportunities to achieve greater energy conservation, and (4) additional actions which should be taken by the Congress and the Department of Energy. It is intended to assist the Congress in its efforts to establish a national energy plan.

This examination was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67), and because of the important contribution energy conservation must make in solving the Nation's energy problems.

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Energy; the Secretary of Transportation; and the chairmen of energy-related congressional committees.

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

THE FEDERAL GOVERNMENT SHOULD ESTABLISH AND MEET ENERGY CONSERVATION GOALS

D I G E S T

Between 1972 and 1976 the rate of energy consumption decreased substantially because of supply disruptions, a recession, and increased prices. Many energy conservation actions taken by consumers during that period have not been sustained; current statistics show that the Nation's energy consumption is increasing.

The administration has proposed a national energy plan which highlights conservation. GAO previously reported that the plan's conservation provisions would not significantly reduce energy demand.

Energy conservation can contribute more to meeting the plan's goals. Its success will depend, to a large extent, on consumers' development of attitudes and habits which foster the efficient use of energy. In addition, for the specific actions undertaken by the Federal Government, the Department of Energy should

--continuously assess each Federal initiative for what its contribution will be in meeting the short-, mid-, and long-term plan objectives and

--develop sufficient standby initiatives and implement them in case ongoing programs and actions do not result in sufficient progress in meeting the established goals.
(See p. 73)

OVERALL RECOMMENDATIONS

GAO recommends that the Congress

--equalize the Federal share of costs for mass transit projects undertaken with Highway Trust Fund moneys and Urban Mass Transportation Administration funds (where appropriate) and

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--specifically include heat pumps as approved energy conservation measures eligible for the residential tax credit. (See. p. 89.)

The Secretary of Energy should, by January 1, 1979, submit to the Congress an energy conservation plan which includes

--energy conservation goals by consumption sector, to help achieve stated national energy plan objectives;

--executive branch actions which constitute an energy conservation program needed to achieve the goals;

--milestones and a plan to continuously monitor and evaluate each portion of the energy conservation program's contribution toward meeting its goals; and

--proposals to try other methods in case the energy conservation program is not meeting the established milestones.

TRANSPORTATION

The Federal Government should take further action to reduce transportation energy consumption by encouraging

--the reduction of annual miles traveled per automobile and increasing ridesharing and the use of mass transit,

--the purchase of more efficient automobiles, and

--an increase in the efficient use of fuel in the Nation's fleet of trucks. (See pp. 76 to 78.)

Maintaining the real fuel cost per mile at least at present levels would help assure that the potential energy savings from increased auto efficiency will be realized. (See pp. 15, 16 and 76.)

INDUSTRIAL

The level of energy consumption in the Nation is substantially affected by the industrial sector. The National Energy Plan includes three initiatives which could make industrial energy conservation investments more financially attractive--a 10-percent investment tax credit for investments in energy conservation measures, an oil and gas users tax, and a crude oil equalization tax. A combination of the first two measures may result in additional efforts by industry to conserve energy by making energy savings investments more financially attractive. (See pp. 44.)

The existing Federal voluntary industrial energy conservation program is inadequate because of the lack of appropriate data to monitor industry's energy conservation progress and because the energy efficiency improvement targets as established by the Department of Energy do not sufficiently challenge industry to conserve energy. (See pp. 34 and 35.)

RESIDENTIAL

Conservation was partly responsible for the low growth rate in residential energy consumption between 1972 and 1976. Federal programs seem to have been somewhat successful in stimulating conservation activity (particularly in 1974) but more conservation activity will be necessary if substantial opportunities are to be realized. (See pp. 56 and 58 to 61.)

Existing Federal programs coupled with proposed National Energy Plan initiatives can result in greater realization of the energy conservation opportunities in the residential sector. Two additional actions could be taken to strengthen the conservation effort: (1) encouraging the installation of heat pumps and (2) intensifying efforts to encourage consumers to follow more efficient personal consumption patterns. (See pp. 61 and 89.)

COMMERCIAL

There is need in the commercial sector to make energy conservation investments more financially attractive, to eliminate master metering of commercial and apartment buildings, and to perform energy audits. The National Energy Plan included two proposals which directly focus on these needs: (1) a 10-percent tax credit for business investments in energy conservation measures and (2) the elimination of master metering in new structures. GAO supports these proposals. (See p. 71.)

RECOMMENDATIONS

The Secretary of Energy, after consultation with the Secretary of Transportation, should submit in his report to the Congress recommendations regarding additional financial actions that can be taken under existing or new legislation to encourage the use of mass transit. (See p. 79.)

The Secretary should also:

--Monitor automobile fuel costs per mile and include, in his submission to the Congress, proposals to increase gasoline prices when fuel costs per mile decrease in real terms. (See p. 78.)

--Monitor residential energy consumption and fuel prices and include, in his submission to the Congress, standby authority proposals to increase fuel prices when evidence indicates that residential energy consumption is increasing because of a decrease in real residential energy prices. (See p. 90.)

--Discontinue the existing industrial energy conservation improvement targets program and, after considering the views of industry, implement a revised program to extend beyond 1980 which includes (1) establishment of an energy conservation goal for each industry, (2) development of an adequate measure of each industry's progress in achieving established goals, (3) establishment of specific milestones to assess each industry's progress toward the goals, and (4) development of standby authorities to implement if milestones are not being met. (See p. 84.)

AGENCY COMMENTS

The Department of Energy stated it basically agreed with the recommendations, except for those on industrial energy conservation. Its major concern is with GAO's implication that the targets are too low because more improvement in energy efficiency is technically feasible. (See p. 75.)

GAO believes that voluntary energy efficiency improvement targets should be established at a level which sufficiently challenges private industry to invest in cost-effective energy conservation measures. (See p. 87.)

The Department of Energy said that a fuel substitution strategy should be carefully considered as part of any broad-based energy conservation program and that substantial energy savings can be realized with regulated carriers. (See p. 74.)

GAO also agrees that the Nation will need to move toward the use of more domestically abundant fossil fuels to lower its dependence on imported oil during the transition to renewable energy sources. (See p. 75.)

The Department of Transportation said it was in general agreement with the objectives of the transportation energy conservation section of the report but that the recommendations needed to be more clearly delineated. (See p. 80.)

Transportation also stated there would be merit in recommending that any new initiatives be developed by itself, or jointly by itself and the Energy Department. GAO believes it is vital that the Energy Department be responsible for developing the overall Federal energy conservation plan. This will

require that the Energy Department work closely with other appropriate Federal departments and agencies but will place the Energy Department in a position to assess the contribution each proposed initiative is to make toward achieving the overall Federal energy conservation goals. (See pp. 80 and 81.)

The Department of Transportation questioned the need for some of GAO's recommendations because of ongoing or proposed Federal programs--in particular, the proposed Highway and Public Transportation Improvement Act of 1978.

GAO supports new initiatives to increase carpooling activity and the use of mass transit. GAO is concerned, however, with the lack of an overall Federal energy conservation plan which clearly points out the interrelationships among various initiatives to achieve energy conservation. The Energy Department should focus more attention on the most important areas to pursue in the next few years. (See p. 81.)

Transportation stated that it disagreed with GAO's recommendation that the Secretary of Energy monitor automobile fuel cost per mile and include in his submission to the Congress proposals to increase gasoline prices when fuel costs per mile decrease in real terms. (See p. 81.)

GAO believes the potential seriousness of the impact of increases in automobile travel, which might occur as a result of future lower real fuel costs per mile, warrants preventive action. Otherwise, some of the energy savings to be achieved from more efficient automobiles could be lost. GAO's purpose is to maintain real fuel costs per mile at current levels for the next few years. (See p. 82.)

Contents

ABBREVIATIONS

CSA	Community Services Administration
DOE	Department of Energy
FAA	Federal Aviation Administration
FEA	Federal Energy Administration
HUD	Department of Housing and Urban Development
ICC	Interstate Commerce Commission
NEP	National Energy Plan

CHAPTER 1

INTRODUCTION

Rapid changes have occurred in the energy situation over the past 4 or 5 years. The United States has witnessed a growth in the strength of the Organization of Petroleum Exporting Countries and has experienced an oil embargo by its members. International oil prices have increased substantially. During the winter of 1976-77 the Nation experienced critical shortages of natural gas, brought on by unusually cold weather. During these years the United States has come to realize the finite nature of conventional energy sources and has responded to the energy problem with new legislation, programs, and regulations.

Many of the actions taken by the Federal Government have been directed at conserving energy and using it more efficiently. Actions taken during the 94th Congress included two major pieces of energy conservation legislation--the Energy Policy and Conservation Act (Public Law 94-163) and the Energy Conservation and Production Act (Public Law 94-385). In this report these acts will be referred to as the 1975 Energy Act and the 1976 Energy Act, respectively. Also, Federal agencies, primarily the Federal Energy Administration (FEA), the Energy Research and Development Administration, the Department of Commerce, the Department of Housing and Urban Development (HUD), and the Department of Transportation, developed other programs designed to encourage energy conservation in all sectors of the economy.

Concurrent with the above Federal initiatives, the U.S. gross energy consumption between 1972 and 1976 increased by over 2 quadrillion Btu's and represented a percentage increase of about 2.9 percent. This increase was significantly below the previous 5-year period when energy consumption increased nearly 18 percent. However, annual changes in energy consumption which occurred during this period portray a significantly different picture. In 1973 gross energy consumption grew 3.9 percent over 1972 levels. Energy consumption in 1974 decreased about 2.3 percent from 1973 levels, and in 1975 decreased about 3.4 percent from 1974 levels. However, in 1976, energy consumption increased by about 4.8 percent over 1975 levels. Preliminary figures for 1977 show total energy consumption up about 4.0 percent over the comparable 1976 period.

More recently the Department of Energy (DOE) has been established and the administration has proposed a National Energy Plan (NEP).

The proposed NEP submitted to the Congress in April 1977 combined legislative, administrative, and budgetary proposals aimed at solving the Nation's energy problems, and included new energy conservation initiatives in all of the major energy consuming sectors--transportation, residential, commercial, and industrial. Most of the initiatives would provide financial incentives and disincentives to consumers in each of the sectors. Included were tax credits for investing in energy conservation measures for residential, industrial, and commercial consumers; gas guzzler taxes on inefficient automobiles and rebates for the purchase of efficient automobiles, and oil and gas user taxes. More direct initiatives were also included in the NEP; for example, energy efficiency standards on certain household appliances and utility rate reform.

SCOPE

Because of the important role energy conservation plays in solving the Nation's energy problems, we analyzed the status and problems of and opportunities for energy conservation. The primary purpose of this study was to identify how the Federal Government could more effectively promote energy conservation in the Nation's end use of energy. As such, this report

- --discusses the extent to which actions to save energy have been taken in major energy-consuming sectors of the economy (residential, commercial, industrial, and transportation);
- --identifies why conservation measures have or have not been implemented and what impact governmental programs have had;
- --discusses major opportunities for additional energy conservation savings; and
- --recommends additional actions which should be taken by the Federal Government to achieve greater energy savings through conservation.

Research and development activities in the area of energy conservation were not included in the scope of our review.

Our review was performed at 9 Federal agencies, 10 State governments, and 13 local governments. In addition, we visited private companies and associations in the commercial, industrial, and transportation sectors of the economy. (See app. I.) At each of these organizations, discussions were held with officials and pertinent information and documents were obtained. We selected 1972 as a base year for data collection purposes because it was the last full calendar year preceding the 1973 oil embargo, and provided data from a year uninfluenced by the economic and social impacts of the embargo. In addition, we analyzed numerous studies which discuss the U.S. energy situation and the possible impact of increased energy conservation.

The following chapters present our findings, conclusions, and recommendations concerning Federal efforts to achieve energy conservation. Chapter 2 discusses our framework for analyzing energy conservation actions and options. Chapters 3, 4, 5, and 6 discuss the status, problems, and energy conservation opportunities in the transportation, industrial, residential, and commercial sectors, respectively. Our conclusions and recommendations are presented in chapter 7.

CHAPTER 2

ENERGY CONSERVATION: A CONCEPTUAL FRAMEWORK

As pointed out in chapter 1, there is growing agreement on the need for increased energy conservation activity in the United States. However, there is disagreement as to the specific conservation actions which should be undertaken, the energy savings which could result from various actions, the consequences of taking those actions, and the role the Federal Government should play.

These disagreements are the result of several substantive issues which are closely intermingled with energy conservation. These issues include the role of economics, particularly energy pricing policy in influencing energy conservation; the relationship between energy conservation and economic growth; the need for and extent of changes in lifestyle which could result from an aggressive energy conservation program; the question of credibility as to the extent of the energy problem; and the possible need for politically undesirable Federal actions, such as taxes or mandatory requirements, to achieve an adequate level of energy conservation.

While we agree that further energy conservation is needed to reduce a growing level of crude oil imports, we recognize that selecting a specific set of initiatives to achieve greater energy conservation is a difficult and complex task. In this chapter we describe our conceptual framework for assessing further opportunities to save energy and for developing an appropriate Federal role to foster and promote increased energy savings. This framework was also used to determine how effective the Federal Government has been in achieving energy conservation during the past few years.

ENERGY CONSUMPTION AND OPPORTUNITIES FOR ENERGY CONSERVATION

Energy consumption is dependent on (1) the energy efficiency of existing products and equipment that use energy (existing stocks of products) and (2) the way consumers operate or use the existing stock of products (traditional use patterns). Altering energy consumption patterns, therefore, requires changing one or both of these factors.

Energy-consuming products can be modified in two basic ways. In the short term these products can be made more energy efficient through retrofit. Over the longer run, products can be replaced with more energy efficient products. In both cases it is important to recognize that before energy consumption can be reduced, energy efficient products or retrofit devices must be available in adequate numbers and consumers must prefer to purchase these products over less energy efficient ones. It should also be pointed out that these modifications do not generally change the purpose or output of the products themselves.

Altering traditional energy use patterns involves changing the way individuals, businesses, and others carry out daily activities, such as the use of home appliances. These types of changes often are difficult to accomplish because of the sheer number of consumers that need to be affected and because such changes often require, from the consumer perspective, carrying out daily activities in a less convenient manner.

The Federal Government has a role to play in promoting energy conservation. However, this role can be successfully carried out only if actions taken by the Federal Government effectively

--alter consumers' traditional energy use patterns,

--increase consumers' preference for energy efficient products and equipment, and

--increase the availability of more energy efficient products and equipment.

Federal initiatives undertaken should include a mechanism to monitor and evaluate their success in saving energy so that the need for alternative Federal actions can be identified in a timely manner.

POLICY OPTIONS TO ACHIEVE ENERGY SAVINGS

From the perspective of the Federal Government, programs to effect changes in existing energy consumption patterns can be developed using any or a combination of three basic approaches, which we will refer to as voluntary, indirect market intervention, and direct market intervention.

The voluntary approach involves creating an awareness among consumers of the benefits of energy conservation actions, such as dollar and energy savings. For example, specific programs can be developed to encourage residential consumers to insulate their homes, adjust their thermostats, or use their appliances more efficiently. In addition, private citizens can be encouraged to drive less, purchase more efficient automobiles, or participate in carpools when going to and from work. Many of these types of programs have been developed and implemented by the Federal Government. In each case, the program attempts to encourage individuals to implement conservation measures voluntarily on the basis of information provided through the program. The success of this approach is dependent on energy consumers implementing such actions as a result of the newly created awareness.

The indirect market intervention approach involves either (1) raising the effective price of energy and/or less energy efficient products (a financial disincentive) or (2) lowering the real cost of implementing conservation actions and/or lowering the cost of more energy efficient products (a financial incentive). For example, specific programs providing financial incentives to conserve energy, such as tax credits, grants, low interest loans, or loan guarantees for business and individuals to install energy conservation measures, can be enacted. Financial disincentives, such as gasoline taxes, energy user taxes, and gas guzzler taxes, can also be enacted. Many of these types of actions have been proposed or enacted. The purpose of these types of actions is to provide consumers with a more direct economic incentive to take energy-saving actions. This approach's success relies on the assumption that consumers will alter their behavior to maximize economic benefits.

The third approach is direct market intervention, which relies on governmental regulation or restriction of energy use or energy-using products. Examples of specific actions using the direct market intervention, or mandatory, approach include mandatory energy efficiency standards for automobiles, home appliances, and buildings; restrictions on gasoline consumption through rationing; and imposing energy budgets on residential energy consumption to limit the amounts consumed. Some of these actions have been proposed or enacted.

Certain limitations exist in the use of each approach to alter traditional use patterns, increase consumer preference for energy efficient products or increase the availability of energy efficient products. Tailoring specific

actions to the desired results requires a careful balancing of the many trade-offs involved in each action. Failure to recognize the sensitivity of these trade-offs and of consumer reaction to them can lead to inefficient and ineffective governmental programs.

To illustrate the Federal Government's activities within the above discussed framework, the following chart categorizes major Federal energy conservation programs which have been enacted in recent years, in terms of the desired result and approach used.

Enacted programs	Desired result: Alter consumer preference to Retrofit	Alter consumer preference to Replace	Alter product availability	Alter consumer use patterns	Approach used
Automotive fuel economy: Average fuel economy standards			x		Direct market intervention
Labeling		x			a/ Voluntary
Consumer products other than automobiles: Labeling		x			a/ Voluntary
Energy efficiency improvement targets			x		Voluntary
Industry energy improvement targets	x	x		x	Voluntary
Energy conservation standards for new buildings			x		Direct market intervention
Weatherization assistance for low-income persons	x				Indirect market intervention
Energy conservation and renewable-resource demonstration program for existing buildings	x				Indirect market intervention
Energy conservation and renewable resource obligation guarantees	x	x			Indirect market intervention

a/The labeling programs place requirements on manufacturers of products to provide information to consumers so that they can make energy efficient choices among competing products.

CHAPTER 3

TRANSPORTATION SECTOR:

STATUS, PROBLEMS, AND OPPORTUNITIES

The transportation sector consists of automobiles, buses, trucks, aircraft, railroads, and other modes of moving people and things. This sector, which is exceeded only by the industrial sector in energy consumption, has been the focus of numerous Federal programs to conserve energy. The transportation sector has received much Federal attention primarily because essentially all energy consumed by this sector is oil or its derived products. As such, energy consumed by this sector directly relates to the level of crude oil imports.

FEDERAL PROGRAMS

Since 1972, federally initiated programs have been directed toward improving the fuel efficiency and consumer use of the automobile and, to a lesser extent, making the Nation's intercity transportation systems more energy efficient. Voluntary and direct market intervention approaches have been used. The following describes the major Federal programs which have been developed to increase the level of energy conservation in the transportation sector.

Automobiles and related programs

The automobile dominates energy consumption in the transportation sector. Particular attention has been directd by the Federal Government at reducing highway vehicle fuel demand through programs to (1) improve the efficiency of vehicles, (2) increase consumer preference for energy efficient automobiles, (3) lower highway speed limits, (4) encourage greater use of carpools and vanpools, and (5) encourage greater availability and use of mass transportation as an alternative to the automobile.

One major Federal initiative has been the establishment of auto fuel efficiency standards. The 1975 Energy Act requires that automobile manufacturers, beginning with the 1978 model year, produce on a sales weighted average a fleet of automobiles meeting the average fuel economy standards shown on the next page.

Model year	Average fuel economy standard (miles per gallon)
1978	18.0
1979	19.0
1980	20.0
1981	a/22.0
1982	a/24.0
1983	a/26.0
1984	a/27.0
1985 and thereafter	27.5

a/Determined by the Secretary of Transportation and published in the Federal Register June 30, 1977.

The Secretary of Transportation was given certain latitudes in setting standards for 1981 to 1984 to adjust for feasibility limitations and clean air requirements.

The 1975 Energy Act also required that fuel economy standards for trucks weighing less than 6,000 pounds be established, and authorized the Secretary of Transportation to determine whether standards for trucks between 6,000 and 10,000 pounds were appropriate. The Department of Transportation has published a 1979 model year standard of 17.2 miles per gallon for trucks under 6,000 pounds and announced 1980 and 1981 standards for vehicles with gross vehicle weights up to 8,500 pounds of 16 miles per gallon and 18 miles per gallon, respectively.

The Environmental Protection Agency role in setting highway vehicle energy efficiency standards has been to establish vehicle gas mileage measurements and manufactured fleet gas mileage calculations.

To encourage the purchase of more efficient automobiles and light trucks, the 1975 Energy Act also required manufacturers to display on their vehicles a label indicating the fuel efficiency of each particular model. Further, automobile dealers were required to make available to prospective purchasers a booklet, prepared by EPA and printed and distributed by DOE, containing comparative data on the gas mileage of automobiles and light trucks manufactured each year. Labeling by manufacturers began in the latter half of the 1976 model year, and the mileage booklet is now being made available through two major printings a year.

The Federal Government has a number of initiatives underway to increase vehicle occupancy through carpooling and vanpooling. The objectives of such programs are to conserve fuel, decrease traffic congestion at peak hours, and improve air quality. The types of programs undertaken include supporting carpooling demonstration projects with Federal funds, providing technical assistance to State and local governments and major employers to promote both vanpooling and carpooling, offering employer workshops to promote vanpooling, directing national public campaigns to encourage individuals to carpool and vanpool, and eliminating institutional obstacles to vanpooling and carpooling.

The Federal Government has also established a national 55-mile-per-hour speed limit to, among other things, increase the efficiency with which automobiles are operated. Instituted as a temporary measure during the 1973 oil embargo, the speed limit was permanently established by the Congress in January 1975. Current law makes Federal highway construction aid to any State contingent on the establishment and enforcement of a maximum 55-mile-per-hour speed limit. All 50 States have now reduced maximum speed limits and are periodically certifying enforcement to the Secretary of Transportation.

In addition to programs directed at auto efficiency and ridership, energy can be conserved by increasing the use of existing mass transit. The Federal Aid Highway Act of 1973 encouraged the development, improvement, and use of mass transit by authorizing, for the first time, the use of Highway Trust Fund moneys for urban system mass transit projects. Also, under the State Energy Conservation Program authorized in the 1975 Energy Act, States are required, among other things, to plan a program encouraging the use of carpools, vanpools, and mass transit before receiving Federal assistance under the program.

Programs directed at long-distance movements

Some Federal programs address the need to conserve energy in intercity movements of passengers and freight. Such programs stress the Nation's need for a strong, well-balanced, and interlinking rail, air, water, and highway system. The major programs in this area resulted from the 1975 Energy Act which required the Civil Aeronautics Board, the Interstate Commerce Commission (ICC), the Federal Maritime Commission, the Federal Power Commission, and the Federal Aviation Administration (FAA) to propose programs which could save energy in the regulated industries.

In the area of air transportation, both FAA and the Civil Aeronautics Board have ongoing activities to conserve energy. FAA's conservation program stresses improvements in the operation of air traffic control and has identified changes to aircraft flight paths, speeds, and ground procedures to achieve short and intermediate term energy savings. CAB's conservation program stresses improvements in the regulation of aircraft routes as they affect flight frequency.

ICC actions to conserve energy in the trucking industry include relaxing some regulatory requirements and studying what additional regulations could be changed. ICC has, for example, relaxed rules which required trucks to travel through certain cities, called gateways, even though shorter routes were possible. Also, ICC relaxed rules limiting opportunities for trucks to use superhighways and to ship truck trailers on railcars.

TRANSPORTATION ENERGY CONSUMPTION AND CONSERVATION SINCE 1972

Transportation sector energy consumption grew 7.8 percent from 1972 to 1976 while total U.S. consumption grew 2.9 percent. This compares to the previous 5-year period when transportation energy consumption grew 20.8 percent and total U.S. consumption grew 18.0 percent. The transportation sector consumed, in 1976, a larger share of total U.S. energy than in 1972. Transportation sector energy consumption since 1972 as reported by the Bureau of Mines is shown below.

Year	Consumption (in quads) (note a)	Growth rate (percent)	Percent of total U.S. consumption
1972	17.9	5.7	24.9
1973	18.8	5.0	25.6
1974	18.3	(2.7)	25.1
1975	18.6	1.6	26.4
1976	19.4	4.3	26.1

a/A quad is equal to 1 quadrillion Btu's of energy.

Historically, transportation consumption has increased at an annual rate of about 2.7 percent. The annual rate of increase in transportation energy consumption from 1972 to 1976, however, was about 2 percent. Many observers believe that the level of economic activity, higher fuel prices,

fuel shortages, more efficient vehicles, and increased consumer awareness of conservation all have contributed to this decline in the growth rate.

While various transportation modes make up the transportation sector, traditionally the automobile has accounted for more than half of transportation energy use. Thus, we focused on historical data involving auto efficiency and patterns of use to assess recent energy consumption trends. However, we also examined statistics related to the use of trucks, which accounted for about a fourth of transportation energy use, and mass transit. Unless indicated otherwise, the data used were drawn from Department of Transportation publications or obtained from Department officials.

Automobiles

Total passenger car gasoline consumption increased about 9 percent from 1972 to 1976, while per car consumption was down about 3.6 percent. Annual figures for 1972-76 consumption follow.

	Gasoline consumption				
	1972	1973	1974	1975	1976 (note a)
Total automobile gasoline consumed (millions of gallons)	73,121	77,619	73,770	76,010	79,811
Average gasoline consumed per automobile (gallons)	755	763	704	712	728

a/GAO estimates based on Department of Transportation data.

Three important aspects in assessing automobile energy consumption are (1) the composition of the total U.S. automobile fleet, (2) the costs associated with driving an automobile, and (3) the demand for travel. In some ways these aspects are interrelated; i.e., the demand for travel is affected by the cost to drive. However, viewing them separately results in a clearer understanding of recent trends in automobile energy consumption.

Fleet composition

In 1972 there were about 86.3 million automobiles 1/ in operation (registrations less scrappage) with an average age of 5.7 years. 2/ This compares to 1976 figures of 100.1 million automobiles with an average age of 6.2 years. The following 1972 and 1976 sales figures are indicative of the change in buying patterns which gradually occurred over the intervening years.

	Percent of total new car sales by type of vehicle 2/	
	1972	1976
Subcompact/compact	20.5	26.4
Intermediate	21.2	27.4
Regular	31.8	17.9
High	8.2	5.9
Specialty	3.5	7.6
Imports	14.8	14.8
Total	100.0	100.0

Certain changes occurred in the fleet composition between 1972 and 1976 which had an impact on the energy consumed by automobiles. There were nearly 14 million more vehicles on the road in 1976. However, there were significant shifts in the types of vehicles entering the fleet--more subcompact, compact, and intermediate cars--in 1976. These types of vehicles tended to be more energy efficient and, as such, minimized the energy consumption impact of more vehicles in operation.

1/"Franchise New Car and Truck Dealer Facts," National Automobile Dealers Association, 1977 edition.

2/"Motor Vehicle Facts and Figures 1977," Motor Vehicle Manufacturers Association, 1977.

Another important trend in the fleet composition was in the age of vehicles in operation. The data showed that vehicles in operation had become older. This change resulted from a substantial drop in new car sales in 1974 and 1975, which was probably due to consumer uncertainties resulting from energy supply problems and the general recession in business during those years. The implications for energy consumption resulting from this situation are that older, generally less efficient vehicles are still being driven. However, these vehicles are likely to be replaced in the next few years with substantially more energy efficient vehicles as the automobile fuel efficiency standards are met.

Automobile fuel costs

A major economic factor affecting auto travel is the fuel cost per mile. Gasoline prices and auto fuel economy primarily determine fuel cost per mile. Since individuals generally hold the same automobile for a few years, it could be expected that gasoline prices would have a greater influence on the amount of driving done by individuals, in the short run. In the long run, however, individuals could adjust to higher fuel prices by buying a more fuel-efficient automobile. Thus, individuals could continue to drive the same amount as they had previously, at no greater fuel cost.

The following table presents data on gasoline prices, automobile fuel economy, and fuel cost per mile to drive for the years 1972-76.

	Driving cost factors				
	1972	1973	1974	1975	1976
Gasoline price per gallon	$.3613	$.3882	$.5241	$.5722	$.5947
Real gasoline price per gallon (in 1967 dollars)	.2883	.2917	.3548	.3550	.3488
Fleet fuel economy (miles per gallon)	13.49	13.10	13.43	13.53	a/13.60
Real fuel cost per mile (in 1967 dollars)	.0214	.0223	.0264	.0262	a/.0256

a/GAO estimates based on Department of Transportation data.

Actual gasoline prices per gallon have risen significantly since 1972. In 1974, for example, the price of gas, influenced by the oil embargo, increased 35 percent over 1973 prices. While the actual price of gas has been steadily increasing since 1972, the real price (the price in constant dollars) increased significantly in 1974 but has since been relatively stable. We also noted that, although the real gasoline price increase from 1972 to 1976 was 6 cents per gallon, the 1976 real price was only 2 cents above the 1968 real price and below the 1950 real price.

The trend in real fuel cost per mile closely followed that of real gasoline prices for the 1972-76 period. However, improvements in the fleet fuel economy during the period, specifically from 1973 to 1976, lessened somewhat the impact of increased gasoline prices on fuel cost per mile. The increase in real fuel cost per mile between 1972 and 1976 meant that a driver using his car at a 10,000-mile-a-year rate would have paid, in real dollars, $3.50 more per month for gasoline in 1976 than in the lowest cost per mile year, 1972.

The precise impact changes in automobile travel costs had on energy consumption between 1972 and 1976 is impossible to determine. However, we believe that the significant cost increases experienced in 1974 helped reduce energy consumed in that year. Since that time, the real cost of gasoline has stabilized and the real fuel cost per mile has decreased somewhat, while energy consumption has increased. Thus, it would appear that, to whatever extent higher fuel costs reduced automobile travel in 1974, consumers have adjusted to that impact.

Demand for travel

The recent history of the demand for travel is also an important factor in understanding past levels of energy consumption. The following table shows certain key data on travel demand.

	Travel Demand Indicators				
	1972	1973	1974	1975	1976
Passenger car miles traveled (billions)	986.4	1,016.9	990.7	1,028	a/1,085.4
Average annual miles traveled per car	10,184	9,992	9,448	9,634	a/9,897
Passenger car registrations (thousands)	96,860	101,763	104,856	106,713	109,675

a/GAO estimates based on Department of Transportation data.

Total travel and per vehicle travel significantly decreased during 1974 and 1973 levels. However, by 1976 total passenger car travel had achieved a new high--about 10 percent above the 1972 level--primarily as a result of a similar (13 percent) increase in the number of automobiles. By 1976, per vehicle travel had risen above the depressed 1974 level, but was still moderately below the 1972 level.

The sharply decreased demand for travel during the middle years, as shown in the above table, was influenced, we believe, by (1) lower fuel availability, (2) increased gasoline prices, (3) driver attitude changes resulting from the strong promotion of a conservation ethic, and (4) an economic downturn characterized by the only decrease in real disposable personal income in the most recent 25-year period. Although these factors probably influenced the disposition of consumers toward travel, the precise impact of each influence is impossible to identify.

The most important single source of demand for travel is to get to and from work. Ridesharing in this situation can have a significant impact on reducing vehicle miles traveled and consequently vehicle fuel consumption. A DOE contracted study asserted that the coordination of several strategies which cause a shift to carpooling could reduce urban auto fuel consumption 5 percent and nationwide could save about 230,000 barrels of oil a day. Thus, we attempted to assess changes in ridesharing patterns during this period.

A nationwide Department of Transportation study--made in 1972--measuring automobile occupancy estimated the national average occupancy rate in 1969 to be 1.4 persons for work trips. According to data from a 1975 sample of automobile occupancy sponsored by Transportation, the national average occupancy rate for work trips in 1975 was about 1.15. Comparison indicates that worktrip vehicle occupancy has declined from preembargo levels. Department officials also had compiled data from certain specific metropolitan areas which indicated that, while carpooling activity generally increased immediately following the oil embargo, the increase was temporary except where there was another strong incentive, such as the ability to avoid traffic congestion.

More recent data on carpooling is limited to specific areas where initiatives have been taken by Federal, State, and local governments and employers to increase carpooling activity. The results of these initiatives have been mixed and have indicated that certain areas are more susceptible to carpooling, such as where there is a dominant employer in an area to provide focus for the promotion and administration of ridesharing initiatives.

Changes in the demand for travel between 1972 and 1976 directly affected fuel consumed by automobiles. Although demand for travel decreased substantially in 1974, the data for 1975 and 1976 indicated that demand for travel was approaching the higher 1973 level.

Implications of recent trends

Our analysis of data for the 1972-76 period shows that:

--The total automobile fleet increased, but the automobiles entering the fleet were more energy efficient. In fact, the total fleet average fuel efficiency has increased since 1973, reversing a long term downward trend in fleet fuel efficiency.

--Gasoline prices increased significantly in both actual and real terms in 1974. However, by 1976, real gasoline prices were below the 1974 real prices even though actual gasoline prices continued to rise. Real fuel cost per mile peaked in 1974 and then decreased through 1976, primarily because of the increased fuel efficiency of the fleet.

--Demand for travel, measured in average annual miles traveled per automobile, decreased significantly in 1974 but increased through 1976. However, it was below the 1973 level.

Preliminary 1977 data 1/ on gasoline consumption, demand for travel, gasoline prices, and automobile sales are as follows:

--Total gasoline sales (including automobiles and trucks) through August 1977 were up about 2.6 percent over the same 1976 period. This rate of increase was below the rate experienced for automobile gasoline consumption between 1974 and 1975 and was significantly below the rate experienced between 1975 and 1976 (5 percent).

--Total vehicle miles traveled for all highway vehicles (including trucks) through August 1977 was up about 3.9 percent over the same 1976 period. This rate of increase was similar to the rate of increase in automobile miles traveled between 1974 and 1975 but was below the rate of increase for automobiles experienced between 1975 and 1976 (5.6 percent).

--Actual gasoline prices were up about 6 percent over 1976. This rate of increase was consistent with the rates of increase experienced during 1975 and 1976.

--New automobile sales through August 1977 totaled about 7.5 million. Assuming automobile scrappage rates would be similar to those in recent years, we estimated that the increase in the fleet for 1977 would be similar to the increase in the fleet experienced in 1976 and above the increase experienced in 1975.

On the basis of our analysis of the 1972-76 period and the preliminary 1977 data, we believe the lower rate of increase in automobile fuel consumption occurring in 1977 resulted from a combination of the lower rate of increase in vehicle miles traveled and further increases in the fuel efficiency of the fleet. While we recognize that the 1977 data were preliminary, we believe that these data raised certain key questions for future energy consumption by automobiles--Will reduced energy consumption impacts from

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1/Data obtained from DOE, Department of Transportation, and National Automobile Dealers Association.

improved fleet fuel efficiency be offset by future increases in miles traveled per vehicle? Will miles traveled per vehicle increase in the future because real fuel cost per mile decreases as fleet fuel efficiency improves? In our opinion, attention should be focused on miles traveled per vehicle and its relationship to real fuel cost per mile.

Trucks

A National Academy of Sciences report 1/ and other studies have pointed out that although extensive data exists on numbers and types of trucks in operation, specific data on fuel consumption for each weight class of truck is not available. Thus, our assessment of energy consumption patterns of different types of trucks between 1972 and 1976 was limited. However, we were able to assess, in general terms, energy consumption patterns for total trucks and for certain types of trucks.

The following table provides basic data on trucks for the period 1972-76.

Truck Data

	1972	1973	1974	1975	1976 (note a)
Fuel consumed (millions of gallons)	30,718	31,615	31,226	31,632	34,577
Truck miles of travel (billions)	259.7	267.1	267.5	274.5	303.1
Truck registrations (millions)	21.2	23.2	24.6	25.8	b/27.1
Average annual miles traveled per truck	12,229	11,538	10,861	10,648	11,172
Average fuel consumption per truck (gallons)	1,446	1,361	1,268	1,227	1,274
Miles per gallon	8.46	8.45	8.57	8.68	8.77

a/GAO estimates based on Department of Transportation data.
b/Estimate by the Motor Vehicle Manufacturers Association.

1/"Energy Consumption Measurement: Data Needs for Public Policy," National Academy of Sciences, 1977.

There has been an increase of 28 percent in the number of trucks since 1972. In 1972 there were about 21.2 million trucks of all types registered, while in 1976 there were about 27.1 million trucks. Light trucks (those under 10,000 pounds gross vehicle weight) dominated the number of trucks on the road. This class of truck accounted for about three-quarters of all trucks in use in 1976. Although light trucks dominated the truck fleet in total numbers, in terms of fuel consumption they were far less dominant, consuming about 42 percent of the fuel consumed by all trucks and about 13 percent of all fuel used by motor vehicles.

Although there are four times as many light trucks as there are heavy-duty trucks (those over 26,000 pounds gross vehicle weight) in operation, heavy-duty trucks consumed nearly as much fuel as light trucks. Heavy-duty trucks accounted for about 40 percent of the fuel consumed by all trucks and about 12 percent of all fuel consumed by motor vehicles, primarily because (1) heavy-duty trucks, on the average, consumed 50 percent more fuel per mile than light trucks and (2) heavy-duty trucks were generally driven substantially more miles per vehicle annually than light trucks.

From 1972 to 1976 total truck fuel consumption increased about 13 percent while truck combination (tractor-trailer) fuel consumption, which historically has accounted for a third of truck consumption, increased roughly twice as fast. Total annual truck miles traveled increased about 17 percent, but per truck annual miles decreased about 9 percent. As a result of the decrease in per truck annual travel and an improvement in miles per gallon for the average truck (from 8.45 mpg in 1972 to 8.77 mpg in 1976), gallons of fuel consumed annually per truck decreased nearly 12 percent over the period.

Conservation activities and problems

The companies we visited in the trucking industry had implemented certain conservation actions. The most common types of measures implemented included reducing horsepower to better match needs, installing wind deflectors on trucks, increasing the use of radial tires, and performing more frequent tuneups. A Department of Transportation informal survey of truck manufacturers showed a trend to greater use of certain fuel saving items (aerodynamic devices, radial tires, clutch fans, and special engines) on 1976 model year heavy-duty trucks. Sales of these items increased sharply, ranging from 200 to 500 percent over the 1975 model year. Thus, it would appear that the effects of taking these energy

conservation actions have been to increase the truck fleet average fuel efficiency in terms of miles per gallon.

Although the above energy conservation actions have been taken, trucking company officials pointed out that additional energy could be conserved by trucks if gateway requirements were relaxed and State weight and size restrictions were made consistent. The operating permits (certificates of public convenience) issued to motor carriers frequently prevent carriers from using the most direct routes because they can operate only through cities stipulated by the permits (gateways). In other words they are not always allowed to take the shortest route to their destinations and therefore use more fuel than is necessary.

In 1973 a group of truckers estimated that eliminating gateways might result in annual savings of more than 1 billion vehicle miles and 200 million gallons of fuel. Such savings represented about 2 percent of 1973 fuel consumed by truck combinations (tractor trailers). We pointed out earlier that ICC has relaxed certain rules on the requirements of trucks to use gateways. In January 1977 ICC published a study, based on a 1976 sample, which projected fiscal year 1976 savings from eliminating some gateways of about 21 million gallons of fuel. ICC stated that the resultant savings, while substantial, were far less than that asserted as possible by truckers and others, at least partly because ICC eliminated fewer gateways.

In addition to ICC route restrictions, each State places restrictions on the size and weight of trucks which can operate on its highways. Consequently, carriers frequently must travel around certain States that have low limits or divide their loads among more trucks when traveling through those States. Carrier officials pointed out that this situation causes greater fuel consumption. If a truck must travel around a particular State, the extra miles constitute energy inefficiency. If a truck's load is divided between two trucks to meet size or weight limits, this also increases fuel consumption and causes operating problems for the carriers.

Implications of recent trends

Our analysis of data on trucks for the 1972-76 period indicated that

--the growth in total truck fuel consumption was greater by 3 percent than that of automobiles;

--the number of trucks increased significantly, but the percentage increase in total truck fuel consumption (13 percent) was less than the increase in the number of trucks (28 percent) because of lower per truck annual travel and better truck fleet fuel economy;

--large trucks consumed significant amounts of fuel even though the number of such trucks was small relative to the total number of trucks; and

--the substantial increase in large truck fuel consumption was primarily responsible for the increase in total truck fuel consumption over the period.

Preliminary Department of Transportation data for 1977 (through August) on changes in the consumption of special fuel (primarily diesel fuel used by large trucks) and gasoline (used by automobiles and trucks) follows:

--Total gasoline use increased 2.6 percent over the same 1976 period.

--Total special fuel use increased 9 percent over the same 1976 period.

These data indicate that large trucks using special fuel are continuing to be an important upward influence on the rate of increase in total transportation fuel consumption. Further, assuming that all trucks using gasoline follow the general consumption pattern of those using diesel fuel, total truck consumption of fuel has continued to increase faster than automobile fuel consumption.

Various studies we examined generally agreed that there is a potential for saving a significant amount of the fuel consumed by trucks. Two of the studies 1/ gave specific estimates of fuel savings which could be achieved for trucks above a certain weight. These savings figures illustrated the magnitude of the opportunity. In one study, savings were estimated at 550,000 barrels of oil a day in 1990 for

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1/"Interagency Study of Post-1980 Goals For Commercial Motor Vehicles, Revised Executive Summary," November 1976. "Energy and Economic Impacts of Projected Freight Transportation Improvements," Peat, Marwick, Mitchell & Co.; May 1977.

trucks over 10,000 pounds gross vehicle weight. In the other study, savings were estimated at 176,000 barrels a day in 1985 for trucks over 19,000 pounds.

Although there was general agreement that much could be done to conserve truck fuel, opinion varied widely on what the Federal Government's role should be in taking advantage of that opportunity. One study assumed that savings could be achieved through the voluntary cooperation of industry, labor, and government and the action of the free marketplace. That study argued that the complexity of commercial vehicle use weighed against any type of legislative or regulatory program. But another study projected savings resulting from governmental influence at 50 percent above the level which industry would likely achieve in its own behalf. These additional savings would result from the Government providing incentives, technical assistance, and capital assistance.

Mass transit

Greater use of existing mass transit systems could reduce the amount of energy consumed in the transportation sector primarily by reducing the number of people who use their personal automobile to travel to and from work. While the trend of passenger rides on all modes of mass transit declined from the end of World War II, in 1973 this trend reversed. The following table reflects recent trends in mass transit passenger ridership.

Total Passenger Rides (note a)

(000,000 omitted)

	Rail	Bus	Other	Total
1972	1,942	4,495	130	6,567
1973	1,921	4,642	97	6,660
1974	1,876	4,976	83	6,935
1975	1,810	5,084	78	6,972
1976 (note b)	1,759	5,247	75	7,081

a/Includes intracity and city to suburb rides and excludes intercity rides.
b/Preliminary.

Source: "Transit Fact Book," (1976-77 edition) American Public Transit Association, 1977.

As shown in the table, increased bus rides each year more than offset the continuing decrease in rail use and resulted in an overall increase in total rides of about 8 percent from 1972 to 1976. The reasons for the shift in trend after 1972 are difficult to define because of the need to judge the impact of the various cost and convenience factors affecting mass transit patronage. The relative cost and convenience of mass transit varies by geographic region and is influenced by many factors, including local economic conditions, traffic regulations, fares, and individual habit patterns. Generally, however, we believe the increase in mass transit ridership over the period was influenced by (1) lower fuel availability for automobiles, (2) increased gasoline prices, (3) a slow economy, and (4) increased Federal operating and capital assistance to mass transit systems, which encouraged greater service and lower fares.

A September 1977 study 1/ by the Congressional Budget Office pointed out that energy savings from changes in urban transportation systems depended on behavioral responses, such as increases in the number of trips made, shifts from other modes of travel, and changes in vehicle occupancy. Bus, subway, trolley, carpool, and vanpool are all more energy efficient than low-occupancy auto travel. But when improvements in one of these more efficient modes shift passengers from another efficient mode, the effect on energy consumption can be small, nonexistent, or even wasteful.

IMPACTS OF FEDERAL PROGRAMS

In the area of automobiles, Federal programs which have focused on improving vehicle efficiency, increasing consumer preference for energy efficient vehicles and mass transit use, and lowering highway speeds have apparently had some success, but the programs' full potential for energy savings has not been realized. The effect of programs directed at using automobile carrying capacity better appears to be limited to certain specific geographic areas. Based on available data, ridesharing has declined from preembargo levels.

1/"Urban Transportation and Energy: The Potential Savings of Different Modes," Congressional Budget Office, September 1977.

The automobile fuel economy standards program, in our opinion, could result in the greatest level of energy savings in the automobile area. In recent years, cars entering the fleet have been generally more efficient than those entering in past years, but slow new car sales in the 1974-75 period restrained improvement in the fleet fuel efficiency. The trend to more efficient new cars should continue into the 1980s, as automobile manufacturers meet Federal fleet fuel economy requirements.

Although the increased cost of fuel was an incentive which encouraged consumers to buy more efficient vehicles, Federal efforts to promote the use of more efficient vehicles probably also had an impact. In our report on convincing the public to buy more fuel efficient cars, 1/ we found that fuel economy figures and mileage guides prepared by the Federal Government have helped some energy conscious consumers to select fuel efficient cars. Moreover, we stated that, if even more consumers were made aware of the mileage guides and how they can be used, automobile fuel consumption savings would be increased. An FEA study showed that only 53 percent of buyers remembered seeing labels on the new cars they purchased and only 7 percent were aware of the gas mileage guide. Improved consumer awareness of such information could play an important role in helping to reduce fuel consumption in future years.

Programs providing financial assistance to mass transit systems, in our opinion, prompted some consumers to rely less on the automobile because such assistance served to encourage mass transit systems to lower fares and provide greater service. We reported previously, 2/ however, that the Highway Trust Fund, a major source of mass transit system funds, was not being fully used by local governments. In 1976, local governments used only 3 percent of the highway trust funds available for mass transit projects. Reasons why local governments did not use more Highway Trust Fund moneys for mass transit included unfavorable Federal cost-sharing ratios for these funds and an apparent lack of mass transit needs in some communities.

1/"Convincing the Public to Buy the More Fuel-Efficient Cars: An Urgent National Need," CED-77-107, August 10, 1977.
2/"Why Urban Systems Funds Were Seldom Used for Mass Transit," CED-77-49, March 18, 1977

In a February 1977 report 1/ we estimated that average speeds had decreased about 5 miles per hour since the Congress passed the national 55-mile-per-hour speed limit law. We also said, however, that even though speeds had been reduced, the full savings potential had not been achieved because many drivers were still exceeding the speed limit. We pointed to limited State enforcement resources and other State enforcement needs as problems precluding the achievement of the full energy savings potential.

Estimates of actual fuel savings resulting from the lower speed limit have varied widely, but estimates of savings have consistently been below the 3-percent target, which studies have indicated is theoretically possible. A Federal Highway Administration study released in October 1976 estimated that reduced speeds saved somewhere between 0.8 and 2.9 percent of total 1975 highway fuel consumption.

The impact of Federal programs to promote ridesharing has apparently not been enough to stop a trend to lower occupancy levels in the important worktrip area. In some geographic areas, governmental or private initiatives to promote ridesharing have been successful. Generally, however, the data available indicated that, while carpooling increased following the oil embargo, the increase was temporary, except where specific incentives remained, such as special highway lanes where access is legally limited to buses and carpools.

In addition to programs directed at the automobile, we have previously reported on Federal conservation programs directed at the trucking and airline industries. In our report on energy conservation in the trucking industry 2/ we found that ICC measures to reduce energy use by the industry have been limited because of unresolved policy questions involving conflicts between energy conservation objectives and ICC's traditional regulatory objectives of protecting existing regulated truckers and making certain that service is adequate.

1/"Speed Limit 55: Is it Achievable?," CED-77-27, February 14, 1977.
2/"Energy Conservation Competes With Regulatory Objectives For Truckers," CED-77-79, July 8, 1977.

In our report on airline conservation activities 1/ we found that FAA's suggestions to conserve airline fuel were, in several instances, infrequently used, impractical to implement, or ineffective. We also pointed to the need for higher airline load factors. We said that about 23.8 million barrels of fuel could be saved each year if flights were reduced so as to achieve a 20-percent increase in the 1976 industrywide load factor.

THE NATIONAL ENERGY PLAN

The proposed NEP to conserve energy in the transportation sector included, among other things, the following major actions:

--A gas guzzler tax and rebate for fuel efficient cars. 2/

--Expansion of the auto fuel efficiency standards programs.

--Increased enforcement of the 55-mile-per-hour speed limit.

--A standby gasoline tax. 2/

--Fuel efficiency standards for light trucks.

In our evaluation of the NEP 3/ we generally supported these initiatives as positive steps to increase the level of transportation energy conservation. We continue to do so.

Concerning the gas guzzler tax and rebate proposal, we pointed out in our earlier report the possibility that consumers desiring to purchase bigger, less fuel efficient cars may turn to the used car market or, alternatively, keep their less efficient cars longer. This situation could substantially slow down the process of upgrading the average miles per gallon of the Nation's automobiles. In view of this

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1/"Effective Fuel Conservation Programs Could Save Millions of Gallons of Aviation Fuel," CED-77-98, August 15, 1977.
2/As of April 1, 1978, the proposals on rebates for fuel efficient cars and the standby gasoline tax had been rejected by congressional conferees.
3/"An Evaluation of the National Energy Plan," EMD-77-48, July 25, 1977.

possibility, we suggested that the program be closely monitored. If established program goals and milestones were not being met, we stated that a tax and rebate program could be extended to the used car market. We continue to support that position.

In our earlier report we also noted that the NEP lacked new initiatives directed at encouraging ridesharing and the use of mass transit in the private sector. We continue to believe that the Federal Government should do more in this area. As we stated in that report, the State Energy Conservation Program could be the vehicle to provide additional financial support to encourage ridesharing. Such support could be used to aid major employers or local governments in establishing ridesharing matching systems. In addition, the Federal Government could provide assistance and support to the local governments of major urban areas to establish preferential carpool parking, preferential traffic control, and other positive actions to encourage increased ridesharing.

CHAPTER 4

INDUSTRIAL SECTOR:

STATUS, PROBLEMS, AND OPPORTUNITIES

The industrial sector, which includes private and governmental activities consuming energy in manufacturing, mining, construction, and agriculture, is the largest energy-consuming sector. The Federal Government has developed two major programs to encourage industry to voluntarily conserve energy. These programs are (1) a voluntary industrial energy conservation program, directed at all industrial companies, and (2) a voluntary energy efficiency improvement targets program, directed at the 10 most energy consumptive industries. The efficiency improvement targets program was authorized in the last 1975 Energy Act.

FEDERAL PROGRAMS

The voluntary industrial energy conservation program was initiated in late 1974 to persuade industries, through their trade associations, to adopt energy management programs and report achievements to the Federal Government. As a result of the program, at least 40 industry trade associations or other industrial representatives have reported energy efficiency data to the Federal Government.

Under the 1975 Energy Act program, DOE was to establish voluntary energy efficiency improvement targets for each of the 10 most energy consumptive industries. The targets, according to the act, were to be established at the level which represents the maximum feasible improvement over 1972 energy efficiency which each industry could achieve by 1980. Companies which used at least 1 trillion Btu's of energy a year and were among the 50 largest energy consumers in each industry were required to report annually to the Federal Government on the progress being made to improve their energy efficiency. This reporting could be either directly to DOE or through industry trade associations.

Final industrial energy efficiency targets for each of the 10 industries were announced in June 1977. The industries, ranked in order of energy consumption, and the final targets are shown below.

Industry	Target (note a)
	(percent)
Chemicals and allied products	14
Primary metal industries	9
Petroleum and coal products	12
Stone, clay, and glass products	16
Paper and allied products	20
Food and kindred products	12
Fabricated metal products	24
Transportation equipment	16
Machinery, except electrical	15
Textile mill products	22

a/The percent represents what DOE (then FEA) believed to be maximum feasible improvement over 1972 energy efficiency by 1980.

INDUSTRIAL ENERGY CONSUMPTION AND CONSERVATION SINCE 1972

Energy consumption in the industrial sector since 1972, as reported by the Bureau of Mines, is shown below. The consumption shown includes energy lost in converting primary fuels to electricity.

Year	Consumption (in quads)	Percent of total U.S. consumption
1972	28.4	39.6
1973	28.7	39.1
1974	29.1	39.9
1975	26.0	36.8
1976	27.2	36.7

As shown above, consumption remained relatively stable between 1972 and 1974. In 1975, consumption decreased about 10.7 percent from 1974 levels and then increased by 4.6 percent in 1976. Industrial officials we talked with told us that the 1975 decrease in consumption was attributable to both a general decline in the economy and industry conservation efforts.

We agree that the downturn in industrial activity in 1975 directly affected the amount of energy consumed in that year. With regard to conservation efforts, our analysis of industrial energy conservation activity since 1972 at selected companies indicated that while most, if not all, companies had undertaken activities to conserve energy, for the most part these actions involved operational changes, such as reduced lighting, equipment tuneups, repair of steam leaks, and other measures requiring little or no cost. The amounts of energy saved as a result of these actions could not be determined because either (1) energy consumption data collected by these companies were not in sufficient detail or form to make such an assessment or (2) the companies did not provide us with detailed energy consumption data because they said such data were considered proprietary.

Some companies we visited had made capital investments which increased the efficiency of energy use within their companies. Examples of these actions included installing heat recovery devices, changing manufacturing processes, and installing central control systems for efficient use of energy.

All companies did provide us with data indicating changes in energy consumption for some or all of the years 1973, 1974, and 1975 as compared to 1972. However, energy consumption in any one company can be affected by a number of factors, including the level of production, the types of products produced, the mix of fuels used, and energy conservation efforts. On the basis of data provided to us and the data which were reported to the Federal Government under the voluntary industrial energy conservation programs at the time of our review, the effects of any of these factors on changes in energy consumption could not be determined.

Company and trade association officials told us that the trends in industrial energy consumption between 1972 and 1976 resulted mostly from changes in levels of production. Although the level of industrial activity appeared to be the major reason for energy consumption trends, officials in all companies stated that energy conservation actions implemented by their companies also helped to reduce energy use during this period.

In the chemical industry, according to the Manufacturing Chemists Association (the industry trade association), there are three categories of energy conservation actions. These are housekeeping, or operational changes, which require little or no cost; energy efficiency improvements in existing

processes which require some capital investment and technical knowledge; and installation of new energy efficient processes which require substantial capital investment and a high degree of technical ability.

Officials of chemical companies we visited told us that efforts to reduce energy consumption through operational changes had been accomplished. In addition, these officials stated that some actions to improve the energy efficiency of existing processes had also been taken. Examples included the installation of energy demand control equipment, heat exchanges, and waste heat recovery systems.

In the steel industry, companies we visited had implemented various measures to use energy more efficiently. These measures included a mixture of operational changes, such as reduced lighting, and improvements in the energy efficiency of existing processes. In addition, two of the companies had established energy management programs to encourage employees to emphasize energy conservation in their areas of responsibility and assist in the identification of opportunities to achieve further energy conservation. In a third company, while all plants were directed in 1974 to form energy conservation committees, at the time of our review few had done so.

Beginning in 1973 all three automobile manufacturers we visited initiated corporatewide energy conservation programs for managing, monitoring, measuring, and reporting progress in achieving energy conservation in plants and offices. In addition, each of the companies had implemented various conservation measures in their plants. Operational measures, such as reduced lighting, heating, and ventilation in offices, and improved maintenance of equipment, had been implemented in all companies. Conservation measures requiring capital investment also had been undertaken. Examples included installation of waste heat recovery devices, elimination of the need for equipment because of engineering changes, and installation of central computer control systems to control energy use in processing operations.

While all cement companies we visited did not have formal energy conservation programs, information we obtained indicated that operational changes, such as reduced lighting and fine tuning of equipment, had been accomplished. In addition, all companies had changed from natural gas as primary fuel; one company had switched to residual oil and the others had switched to coal. However, the impact this change had on any company's total energy consumption appeared to be minor.

In addition to the four industries we visited, we recently reported on the effectiveness of Federal agencies in promoting energy conservation at Government contractors' plants. 1/ In that effort we found that all contractors contacted had implemented some energy conservation measures. The types of actions taken generally included reduced lighting, changed thermostat settings, and reduced ventilation when buildings were largely unoccupied. We also found that relatively few energy conservation projects requiring capital expenditures had been implemented.

IMPACT OF FEDERAL PROGRAMS

The Federal voluntary industrial energy conservation programs had not had a significant impact on the conservation activities of the major companies and industries which we visited. The primary reason was that the large energy consumptive industries generally had the knowledge and technical expertise concerning ways to conserve energy. This has been the type of information made available to industry through these programs. However, industry officials were in favor of these voluntary programs and some felt that they assisted smaller businesses to identify ways to save energy.

Industry officials we talked with did raise questions concerning the reporting requirements of the voluntary industrial energy efficiency targets program authorized in the 1975 Energy Act. These officials were generally opposed to any direct reporting requirement (not reporting through a trade association) because, they argued, (1) it placed an undue burden on companies to collect and report specific energy consumption data, (2) the data might be used to make energy efficiency comparisons between companies, and (3) differences between company operations would result in inaccurate conclusions being drawn from the data.

At the time of our review, energy consumption information was being reported on a total consumption basis as well as on a consumption per unit of output basis. The reported data generally did not reflect the impact of changes in the levels of production, a critical factor in assessing the reasons for changes in energy consumption. A reporting format for this program became effective in June 1977 which gave reporting companies the option of

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1/"Federal Agencies Can Do More to Promote Energy Conservation by Government Contractors," EMD-77-62, September 30, 1977.

adjusting their energy consumption data to reflect changes in levels of production. However, initial response by companies indicated that many were not making this adjustment. Thus, energy consumption data which were being reported would be inadequate for monitoring energy use and conservation activities of industry, regardless of whether the data reported continued to be on an aggregate basis through industry trade associations or was reported directly to DOE from individual companies.

In addition to the lack of adequate data to monitor industry's progress in achieving greater energy conservation, we believe that the voluntary energy efficiency improvement targets which have been established do not sufficiently challenge private industry to undertake substantial energy conservation actions because the targets are likely to be achieved, to a large extent, through the accomplishment of operational changes requiring little or no cost. Of the "target supporting studies" for chemicals and allied products; primary metals; stone, clay, and glass; and transportation equipment (the industries which include companies we visited), two stated that housekeeping or operational changes were expected to provide a large fraction of conservation actions in 1980; one of these indicated that 80 percent of the target could be achieved by such measures. In addition, all of the target support documents we reviewed showed that the potential for technically feasible conservation actions was significantly greater than the established target.

For example, the target support document for the chemical and allied products industry, prepared by Battelle Columbus Laboratories, pointed out that economic considerations, such as fuel prices and availability of capital, rather than technological considerations, limit energy conservation in the short term. In addition, the target support document for primary metals indicated a technically feasible potential reduction in energy use by 1980 for this industry of almost 20 percent as compared to the final target of 9 percent. In the cement industry (a part of the stone, clay, and glass industrial classification), the target support document identified a technically feasible potential for energy conservation by 1980 of about 26 percent, whereas the target for the cement industry was established at about 16 percent. A similar situation was identified in the target support document for transportation equipment. A technically feasible potential for energy use reduction of 20 percent was identified, whereas the final target was established at 16 percent.

Why more conservation efforts have not taken place

Officials in all companies we visited were aware of additional ways to increase the efficiency of energy use in their companies' operations. In the steel industry, heat recovery devices, use of continuous casting, and installation of basic oxygen furnaces were mentioned as measures which would increase the energy efficiency of steel manufacturing. In the auto manufacturing industry, measures such as computerized central control and monitoring systems for facilities to optimize operations performance and startup and shutdown times, installing heat recovery devices, and new processing systems which require reduced temperatures for painting activities were identified as additional ways to conserve energy. Chemical industry officials identified heat recovery systems, laser applications in processes, and water cooling for large chemical storage tanks as additional measures which would conserve energy. In the cement industry/waste heat recovery, changing from a wet to dry process for producing cement, and replacing obsolete equipment were identified as ways to save energy.

While officials from all companies could identify additional ways to use energy more efficiently in their operations, they also identified problems and barriers which were precluding company decisions to achieve additional energy savings. The primary barriers, according to these officials, included low rates of return on energy conservation investments and requirements to meet environmental standards.

Low rates of return

Investments in energy-saving measures competed with all other projects in company decisions to invest capital. For the most part, those investments which offered the greatest financial return in the shortest time were selected. Company officials told us that current Federal regulations over the prices of oil and gas caused energy prices to be lower than they would be without regulation. Thus, investments with the primary purpose of saving energy often could not compete, on the basis of rate of return and payback, with other investments. Industry officials pointed out that even though energy prices have risen sharply in the last few years, the rate of return for many energy conservation investments is still not competitive with other investment opportunities.

A review of trends in industrial energy consumption, industrial output, and energy prices between 1950 and 1972 did not indicate any clear relationship between changes in energy prices and consumption. However, the data did indicate a general increase in energy efficiency as measured by industrial output per unit of energy consumed while energy prices, in real terms, remained relatively stable or increased slightly throughout most of the period. Because energy prices did not change as dramatically in the years between 1950 and 1972 as they did in the 1974-75 period, industrial response to the substantial changes in energy prices could not be determined.

Environmental standards requirements

Industry representatives believe current and planned environmental requirements--mainly for air and water quality--are constraints to conservation. Company officials pointed out that environmental standards were very strict and that capital investments were often necessary to comply with pollution control requirements. Therefore, according to company officials, capital was used to meet environmental standards rather than for investment opportunities, such as energy conservation measures. Moreover, these officials stated that equipment needed to meet environmental standards consumed additional energy.

Company representatives cited several examples where pollution control had a negative impact on energy consumption. In the chemical industry, for example, compliance with the Environmental Protection Agency and Occupational Safety and Health Administration standards required greater energy use. According to a Manufacturing Chemists Association 1975 report, participating companies would use approximately 1 percent more energy in 1975 to meet the air and water pollution control requirements.

In the steel industry, according to a Battelle study, control of air and water pollution had a significant effect on energy consumption and would require large amounts of capital. Battelle estimated that by 1980 energy consumed to operate air and water pollution control facilities would be about 4.5 percent of total energy used in the industry. This compared to estimates of the steel industry, which indicated that in 1976 energy consumed for pollution control amounted to between 2 and 2.5 percent of total energy.

EPA and OSHA officials agreed that some additional energy may be required to comply with environmental and safety standards. They advised us, however, that these impacts could have only minor effects in relation to a company's total operations and that industry had consistently complained about EPA and OSHA regulations as an undesirable Federal imposition. These officials doubted, therefore, that this was a serious barrier to energy conservation.

We recognize that meeting environmental standards can require certain amounts of energy. However, we do not believe that the increased energy needed to operate pollution control equipment necessitates that a choice be made between using energy more efficiently and protecting the environment. We base this opinion on the industries' own estimate of the relatively small amounts of energy that would be needed for pollution control in the next few years when compared to the energy efficiency improvement goals which have been established for major industrial energy users, which would likely be achieved to a large extent by implementing basic operational changes and which are, as we have shown, only a fraction of the total available savings which could be achieved in any case.

INDUSTRIAL CONSERVATION OPPORTUNITIES

Even though some energy was saved in the past few years from energy conservation efforts, substantial energy conservation opportunities still exist in the industrial sector. A number of studies, reports, and other published material in the last 3 or 4 years discussed various ways that energy could be conserved in American industry. In addition, industrial officials and trade associations we visited identified energy conservation measures which could be implemented to reduce energy consumption within their respective companies and industries. These sources of information are in general agreement that the areas where energy can be conserved include the recovery of waste heat from industrial activities, the installation of more energy efficient industrial processes, and continued efforts to make operational changes.

Estimates of how much energy could be saved industrywide in these three major areas vary. Studies which attempted to quantify these energy-saving potentials generally discussed energy-saving opportunities in specific industries or segments of industries to demonstrate the magnitude of energy savings available. The difficulty in identifying quantifiable potential energy savings industrywide results from the many different ways energy is used in American industry. Thus, the extent that energy-saving measures can and will be implemented is generally unknown.

Estimates of the potential energy savings attributable to the areas of waste heat recovery, industrial process changes, and operational changes as they relate to specific industries or groups of industries are discussed below.

Waste heat recovery

Good waste heat management systems can provide a means for industry to reuse much of its otherwise lost energy and thus reduce total consumption significantly. Waste heat recovery generally involves capturing heat from manufacturing processes using direct heat or process steam and recirculating it for some other use. For example, the chemical industry uses numerous direct fired boilers which produce steam. This steam could be productively used as an energy form in some other process, but because the cost and availability of energy has not previously been a problem in most instances, the steam is not currently being used. Further, cement companies require very high temperature heat in their kilns. Much of this heat escapes the plants into the atmosphere. For both forms of energy--process steam or direct heat--much of the heat is lost to the environment instead of being productively used for energy.

A joint FEA, National Bureau of Standards study 1/ conducted in 1975 assessed the potential for waste heat recovery in the paper; food; stone, clay, and glass; and primary metals industries. The report concluded that with waste heat recovery equipment installed in a typical plant in these industries, about 20 percent of its annual energy needs could be saved. In addition, DOE estimated that 40-percent savings were possible in both a canning process in the food industry and a treating process in the textile industry because of the capturing and reusing of waste heat. These examples point out what we believe to be significant opportunities to conserve energy in industry through waste heat recovery.

Another method for potential large-scale use of waste heat in industry is cogeneration, a process by which (1) waste heat generated in making electricity is recycled and used in an industrial application or (2) waste heat from an industrial or fuel combustion process is recycled to generate electricity. The two common examples of cogeneration facilities are (1) a utility company which

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1/"Waste Heat Management Guide Book," FEA and National Bureau of Standards, 1975.

sells its waste heat from power generation for industrial, commercial, or space-heating purposes and (2) an industry which uses the waste heat of its industrial processes to generate electricity onsite for its own consumption or for sale to a utility company.

Estimates of fuel savings from industrial cogeneration vary although the energy savings potentials are significant--especially in the paper, chemical, and petroleum refining industries. For example, a preliminary study of the cogeneration potential for six major U.S. industries 1/ prepared for DOE estimated a maximum feasible cogeneration development through 1985 of 1.6 quads to 3.1 quads of electrical energy. The pulp and paper industry is forecast to account for 48 percent of the total by 1985. According to the study, given some form of Government encouragement, energy savings of approximately 0.77 quads are possible by 1985.

Studies by the Ford Foundation, 2/ the Dow Chemical Company, 3/ and the Thermo-Electron Corporation 4/ placed the range of fuel savings to be realized from cogeneration at 0.4 to 6 quads by 1985. Dow has further estimated the potential financial savings from reductions in capital construction costs and expenditures for electrical generation, due to cogeneration, from $2 billion to $5 billion annually over the period 1976-85 (depending upon the assumptions made in particular scenarios).

Despite the attractiveness of the energy-saving benefits from cogeneration, company decisions to realize these savings have been precluded by barriers of a technical, financial, institutional/regulatory, or attitudinal nature. Among the problems which have been identified are:

Technical:

--Unsuitability of certain process steam supplies for cogeneration due to, among other things, small loads and low pressure.

1/"The Potential For Cogeneration Development In Six Major Industries By 1985," Resource Planning Associates, 1977.
2/"A Time To Choose," Ford Foundation, 1974.
3/"Energy Industrial Center Study," Dow Chemical Company, 1975.
4/"A Study of Inplant Electric Power Generation In the Chemical, Petroleum Refining And Paper And Pulp Industries," Thermo Electron Corporation.

--Regional limitations to cogeneration due to fuel availability for gas turbine or diesel-powered systems.

Financial:

--Failure of required high capital investment to meet return on investment criteria.

--Shortage of equity capital which might require debt financing of cogenerating plants.

--Electric rate structure inequalities.

Institutional/regulatory:

--Uncertainties associated with regulation by the Federal Power Commission or State utility commissions of industries operating cogeneration plants.

--Long and complicated approval procedures for inplant generating equipment by regulatory agencies.

--Questions of ownership, e.g., legal feasibility of joint ventures.

--Environmental issues surrounding electrical generation.

Attitudinal:

--Unwillingness of industry to enter a new field (preference to purchase rather than generate electricity).

--Anticipation of future low steam demand by industry management.

--Unwillingness of utilities to accept intermittent generation on line, lose the industrial markets that they have served and to accept industry involvement in electric power marketing.

Industrial process changes

Manufacturing process changes offer significant potential for reducing energy consumption in the industrial sector. However, in many cases, introducing

an industrial process change is a long-term effort, interrelated with a number of factors; for example, technological, financial, and marketing constraints, such as capital costs to replace major equipment or change facilities; future availability of suitable fuels; research and development time required to commercialize processes; environmental constraints; and return on investment all impede the short-term development of more energy-efficient processes.

In several of the industries we studied, opportunities to improve the efficiency of energy use through process changes could be identified. In the cement industry switching from wet process to the more energy-efficient dry process kilns could save as much as 1 million Btu's per ton of cement produced. 1/ Additional energy could be conserved through optimization of crushing equipment, use of preheater kilns, and installation of rollermills.

In the steel industry important energy savings can be realized through continuous casting of steel. Battelle 2/ has estimated that increased use of continuous casting of steel could save 60 trillion Btu's of energy a year between 1975 and 1980, or a total of 0.3 quads. As of 1975, only 6 percent of raw steel in the United States was continuously cast. The American Steel Institute forecasts that 22 to 25 percent of capacity will be continuously cast by 1985.

Examples of opportunities to save energy in other industries through process changes include improvements in the aluminum industry in conventional smelter technology as well as through new processes, such as an Alcoa aluminum chloride process, which could reduce the electrical input to aluminum production by 30 percent (or about 59 million Btu's per ton based on 1974 consumption). In the paper industry, the trend toward the increased use of the Kraft pulping process and increased use of sawmill residue and waste fiber as raw materials for making paper products could significantly decrease energy consumption per ton of product. For example, shifting from virgin to recycled newsprint made from waste newspaper could save 7 percent of the

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1/"Energy Conservation Potential in the Cement Industry," Federal Energy Administration, Conservation Paper Number 26.

2/"Potential For Energy Conservation in the Steel Industry," Battelle Columbus Laboratories, 1975.

primary energy consumption per ton (or about 2.45 million Btu's per ton based on 1971 consumption).

Operational changes

Operational changes, or housekeeping and belt-tightening measures, involve conservation actions which result in energy savings in the short term and require little or no cost, such as thermostat adjustments, lighting level reductions, minor tuneups of equipment, and leak repairing. We have not been able to quantify how much energy would be saved industrywide through operational changes, although examples in specific industries and companies have been identified which demonstrate that more energy can be saved.

As previously discussed, all 12 of the companies we visited had completed, or nearly completed, some basic operational changes. However, on the basis of target support documents and progress reports on the 1980 energy conservation goals for industry, it can be seen that there is still room for operational improvements in major energy-consuming industries. For example, the paper industry achieved an overall energy reduction level of 3.5 percent from 1972 to 1976 with an additional 3-percent potential for conservation from operational changes alone projected for 1976 to 1980. A 9-percent target for conservation in the primary metal industries was set, acknowledging that a large fraction of that reduction would probably occur through operational changes. As of December 1976 only a 3.8 percent improvement in efficiency had been achieved by this industry.

The Department of Commerce and others have also found that many moderate and smaller size companies had not attempted operational changes, primarily because energy costs were minor when compared to other operating costs and because companies were not aware of energy conservation techniques.

In our report on energy conservation at Government contractors' plants, 1/ we found that the potential for saving energy through additional operational changes was great. Our analysis of six contractors indicated a range of potential savings through operational changes alone from 4.7 percent to 14.8 percent of each company's 1975 total energy consumption.

1/"Federal Agencies Can Do More To Promote Energy Conservation By Government Contractors," EMD-77-62, September 30, 1977.

THE NATIONAL ENERGY PLAN

The administration's NEP included a number of proposed initiatives which should increase the level of industrial conservation by making conservation investments more financially attractive and by removing many of the existing barriers to increased cogeneration activity.

The NEP included three initiatives which could make industrial energy conservation investments more financially attractive. These initiatives include a 10-percent tax credit for investments in energy conservation measures, an oil and gas users tax which would be levied on the use of oil and gas by industry and utilities, and the crude oil equalization tax. In our report on the NEP, 1/ we concluded that a combination of the first two measures may result in additional efforts by industry to conserve energy by making energy savings investments more financially attractive. We continue to support the general thrust of these proposals.

The NEP also included a number of initiatives in addition to the 10-percent tax credit for stimulating additional cogeneration of electricity and process steam. These initiatives included

--permission for industries using cogeneration equipment to intertie with utilities' transmission facilities to buy and sell electricity,

--a requirement that FPC establish procedures to assure that rates for the sale and purchase of electricity between cogenerators and utility companies did not discriminate against the cogenerators, and

--an exemption for industrial cogenerators from Federal and State public utility regulations.

In our evaluation of the NEP, we supported these proposals and pointed out that, if enacted, the proposals should effectively remove many of the existing barriers and constraints to increased use of cogeneration. We continue to support these proposals.

1/"An Evaluation Of The National Energy Plan," EMD-77-48, July 25, 1977.

CHAPTER 5

RESIDENTIAL SECTOR: STATUS, PROBLEMS, AND OPPORTUNITIES

For purposes of this report the residential sector consists of all housing units, except those in structures containing five or more units. Due to similarities in the management of commercial buildings and apartment complexes (the lessor/lessee relationship and responsibility for property maintenance and improvements), we included larger apartment buildings in the commercial sector. This also allowed us to use Bureau of Census housing data, which are categorized by single family structures (attached and detached), mobile homes, multifamily structures with two to four units, and multifamily structures with five or more units.

FEDERAL PROGRAMS

In chapter 2 we stated that energy consumption was dependent on the efficiency of energy-using products and the way consumers operate or use the products. Reducing energy consumption requires altering one or both of these factors. Since 1972, the Federal Government has instituted programs which focused on these factors in the residential sector.

The emphasis of the Federal effort has been to improve the thermal efficiency of new and existing homes, encourage residents to alter their traditional energy consumption patterns, and encourage the production and purchase of more efficient major home appliances. The agencies primarily involved in the Federal effort were FEA, Energy Research and Development Administration, Department of Housing and Urban Development (HUD), and the Community Services Administration (CSA), an independent agency. The new Department of Energy, created on October 1, 1977, now has the primary responsibility for Federal conservation efforts.

Improving the thermal quality of residences

Major Federal programs designed to improve the thermal quality of housing units included energy performance standards for new and renovated buildings, low-income weatherization programs, a program providing energy audits for residential units, and a program testing various forms of financial incentives to encourage the installation of energy

conservation measures in residences.

The 1975 Energy Act authorized a State Energy Conservation Program to provide financial and technical assistance to States for developing and implementing State energy conservation programs. To receive financial assistance under the program, State conservation plans must include certain required program measures. One requirement is that mandatory thermal efficiency standards and insulation requirements be established for new and renovated buildings within the State. A funding level of $150 million over a 3-year period was authorized to carry out the State Energy Conservation Program. By September 30, 1977, 55 jurisdictions, including all 50 States, 4 territories, and the District of Columbia, had DOE approval for conservation plans and had been granted $22.5 million.

DOE is responsible, under the 1976 Energy Act, for developing and promulgating energy performance standards for new residential and commercial buildings by 1980. Under this program, no Federal financial assistance 1/ would be made available or approved with respect to the construction of any commercial or residential building unless (1) a building code, or other construction control mechanism, had been adopted and was being implemented in the area in which the building was to be constructed which met or exceeded the standards and (2) the building had been determined to be in compliance with such standards. HUD is to monitor the progress made by the States and their political subdivisions in adopting and enforcing the standards and report to the Congress periodically on the progress and the effectiveness of the standards. The Secretary of HUD is authorized to make grants to States and local government agencies to assist them in adopting and implementing performance standards, implementing State certification standards, or administering the approval process.

1/"Federal financial assistance" means (a) any form of loan, grant, guarantee, insurance payment, rebate, subsidy, or any other form of direct or indirect Federal assistance (other than general or special revenue sharing or formula grants made to States) approved by any Federal officer or agency or (b) any loan made or purchased by any bank, savings and loan association, or similar institution subject to regulation by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, the Comptroller of the Currency, the Federal Home Loan Bank Board, the Federal Savings and Loan Insurance Corporation, or the National Credit Union Administration.

Prior to the transfer of the responsibility for developing the standards from HUD to DOE, HUD had entered into a contract with the American Institute of Architects Research Corporation for work on the standards. The American Institute of Architects is documenting energy consumption in residential and nonresidential buildings constructed in the last 3 to 5 years and developing classification systems based on variables of use, climate, and construction. This work is continuing under DOE.

The Federal Government also authorized two low-income weatherization programs in the last 3 years. In 1975, the Congress created the Emergency Energy Conservation Services program and charged CSA with the responsibility for implementing the program. CSA regulations stated that at least 60 percent of program funds must be spent on weatherizing the homes of low-income persons. As of December 1977 about $240 million had been appropriated to carry out the CSA program.

The 1976 Energy Act created an additional low-income weatherization program which would be implemented by DOE. While both programs focused on low-income persons, the DOE program gave special emphasis to elderly and handicapped low-income persons. The DOE program had been authorized $200 million, over 3 years, of which $92.5 million had been appropriated as of December 1977.

The 1976 Energy Act authorized a Supplemental State Energy Conservation Program which is being carried out by DOE. Under this program, States can receive Federal financial assistance for developing and implementing a supplemental energy conservation program which contains certain required measures. One of the required measures is that States must develop procedures for encouraging and carrying out energy audits with respect to buildings and industrial plants within the State. With respect to residential energy audits, consumers can request that the State either (1) provide a workbook to the consumer to enable the consumer to perform his own energy audit or (2) analyze and report the results of certain key data about the residential dwelling which the consumer provides to the State. The purpose of these audits is to identify energy conservation measures which the consumer can implement to improve the thermal quality of his residence. By December 31, 1977, 55 jurisdictions, including the 50 States, 4 territories, and the District of Columbia, had supplemental plans approved.

The 1976 Energy Act also requires DOE to demonstrate, on a national level, the feasibility and effectiveness of various forms of financial assistance for encouraging the installation of approved conservation or renewable resource measures in existing dwelling units. DOE is to recommend to the Congress, by August 1978, a national program based on the results of this demonstration program.

Encouraging the production and purchase of more efficient major appliances

The 1975 Energy Act established a program which required the National Bureau of Standards, at the direction of FEA, to develop procedures to test the energy efficiency of the following categories of energy-consuming products

--refrigerators and refrigerator-freezers,

--freezers,

--dishwashers,

--clothes dryers and washers,

--water heaters,

--room and central air conditioners,

--home heating equipment,

--humidifiers and dehumidifiers,

--television sets, and

--kitchen ranges and ovens.

The test procedures are to be used by manufacturers to determine the annual operating costs of appliances and one other measure of energy consumption, such as Btu's consumed per hour of operation, which will assist consumers in making purchasing decisions. Under the law, manufacturers of such appliances are required to label their products with the energy efficiency information. Test procedures had been prescribed, by December 1977, for all of the products except home heating equipment, kitchen ranges and ovens, and furnaces. 1/ However, test procedures were proposed for these products.

1/On March 29, 1978, DOE indefinitely suspended final test procedures for water heaters.

The 1975 Energy Act also requires that voluntary energy efficiency improvement targets be established for each of the home appliance categories. The improvement targets should identify the maximum improvement in energy efficiency over 1972 efficiency which was determined to be technologically and economically feasible by 1980. DOE was to monitor manufacturers' progress toward achieving those targets.

Energy efficiency improvement targets were proposed as of December 1977 for the products and are listed below.

Product	Energy efficiency improvement target (percent)
Refrigerator (refrigerator-freezers)	47
Freezer	30
Room air-conditioner	30
Television	79
Room heater (gas)	14
Clothes washer	47
Clothes dryer	11
Dishwasher	25
Water heater (gas and electric)	23
Cooking range (gas and electric)	64
Furnaces	
(gas)	25
(oil)	14
Central air-conditioner	25
Humidifier	18
Dehumidifier	28

Encouraging residents to alter traditional energy use patterns

Much of the Federal effort immediately following the Organization of Petroleum Exporting Countries oil embargo and before passage of the 1975 and 1976 Energy Acts involved distribution of information to encourage residents to take basic operational-type energy conservation measures. Among other things, the Government encouraged residents to turn down thermostats during the cold months to reduce heating requirements and turn up thermostats during the hot months to reduce air-conditioning requirements. Residents were also encouraged to turn out unnecessary lights and avoid wasteful use of major appliances. These activities were primarily carried out by FEA. Educational-type programs such as these are currently required to be carried out by the States under the State Energy Conservation Program.

RESIDENTIAL ENERGY CONSUMPTION AND CONSERVATION SINCE 1972

Residential energy consumption increased 8.5 percent from 1972 to 1976. This rate of increase was considerably lower than the previous 5-year period when energy consumption increased about 21 percent. The following table shows the changes in residential energy consumption on an annual basis for the 5-year period 1972-76. The consumption shown includes energy lost in converting primary fuels to electricity.

Year	Consumption (quads)	Growth rate (percent)	Percent of U.S. consumption
1972	15.3	5.5	21.3
1973	15.5	1.3	21.1
1974	15.3	-1.3	21.0
1975	15.6	2.0	22.1
1976	16.6	6.4	22.4

The annual changes in energy consumption between 1972 and 1976 varied significantly from historical trends, especially in 1974, when energy consumption actually declined. For example, from 1960 to 1971 residential energy consumption increased at an average annual rate of 5 percent and in no year during that period did it increase by less than 3.1 percent.

A major variable which influences residential energy consumption is the number of housing units. An identification of changes in the number of housing units and the corresponding energy consumed per housing unit provides a basis for assessing energy consumption trends. The following table shows the number of residential units and energy consumed per unit for the years 1972-76.

Year	Number of units (millions)	Energy consumed per unit (million Btu's)
1972 (note a)	61.9	247
1973	64.2	241
1974	64.5	237
1975	65.8	237
1976 (note a)	67.1	347

a/GAO estimates based on Bureau of Census and DOE data.

As shown in the table, while the number of units increased each year, energy consumed per unit decreased between 1972 and 1974 but returned to the 1972 level in 1976.

Per unit energy consumption is influenced by two factors--weather conditions and the total operating efficiency of each housing unit. Operating efficiency is in turn influenced by the size and thermal performance of the unit, the number and efficiency of appliances in the unit, the personal consumption patterns of the residents, and the price of energy. The following sections discuss changes in these factors between 1972 and 1976 and their impact on energy consumption.

Weather conditions

Weather conditions directly affect the amount of energy necessary to heat or cool a house. Because about 53 percent of all energy used in the residential sector is for heating and another 7 percent is for air-conditioning, average

national temperatures have a significant impact on total energy demand. The following table shows national heating and cooling degree days 1/ for the 1972-76 period.

	Heating		Cooling	
	Degree days	Percent change from normal	Degree Days	Percent change from normal
Normal (1941-70)	4,761	-	1,156	-
1972	4,996	4.9	1,036	-10.4
1973	4,534	-4.8	1,150	-.1
1974	4,669	-1.9	1,007	-12.9
1975	4,705	-1.2	1,075	-7.0
1976	5,019	5.4	938	-18.9

Source: National Oceanic and Atmospheric Administration Environmental Data Service, National Climatic Center.

As shown, heating requirements due to weather were below normal for 1973 through 1975 but considerably above normal for 1972 and 1976. Heating requirements were nearly the same for 1972 and 1976 with 1976 requirements being only 0.5 percent greater. Cooling requirements due to weather were below normal in every year.

As the data shows, changes in energy use per unit were fairly consistent with changes in heating degree days except for 1974. In 1974, although heating degree days were above 1973 levels, energy consumption per unit was below 1973 levels. Thus, factors other than weather conditions were responsible for the drop in energy consumption in 1974.

Operating efficiency of residential units

As previously pointed out, operating efficiency is influenced by the size and thermal performance of units, the number and efficiency of appliances in the unit, the personal consumption patterns of residential consumers, and the price of energy.

1/A degree day is 1 degree of deviation, on a single day, of the daily mean temperature from a given standard temperature (65 degrees F). Mean temperatures above 65 degrees F constitute cooling degree days, and mean temperatures below 65 degrees F constitute heating degree days. For example, if the mean temperature on a given day was 70 degrees F the number of cooling degree days would be 5.

The average size of new single family residential housing units increased 9.3 percent from 1972 to 1976. Single family units constitute about 80 percent of the sector. The average square feet of floor space in new single family units by year is shown below.

Year	Average square feet for new single family housing units
1972	1,555
1973	1,660
1974	1,695
1975	1,645
1976	1,700

Source: "Bureau of the Census, Characteristics of New Housing, 1976." (Construction Reports C25-76-13)

An increase in interior space means an increase in heating, air-conditioning, and lighting energy requirements. Thus, a continued upward trend in the size of housing units is likely to increase average per unit energy consumption as the housing stock turns over.

The thermal performance of a residential unit also directly affects the amount of energy used for heating and cooling. Improving the thermal performance of units by adding insulation, installing storm windows and storm doors, and caulking and weatherstripping around openings can reduce the amount of heating and cooling energy that is needed to maintain a constant temperature.

The thermal performance of the residential housing inventory is apparently improving somewhat. According to surveys sponsored by FEA, about 62 percent of American homes were insulated to some extent in 1975 as compared to about 70 percent in 1976 and about 80 percent by early 1977, although it was not known how adequately such units were insulated. The number of households with storm windows or storm doors has also increased about 20 percent since 1975, and residential units weatherstripped or caulked increased about 5 percent over the same time period. According to the FEA-sponsored surveys, about 50 percent of households, as of early 1977, had storm windows or storm doors and weatherstripping or caulking.

The effect of improvements in the thermal quality of residential units which have apparently occurred in recent years has been to offset, to some extent, increased energy

consumption due to the increase in the size of units entering the housing stock.

The saturation level of major energy-consuming appliances in the residential sector increased during the 1972-76 period. Information available for 1973, 1974, and 1975 showed that the number of homes with such appliances as refrigerators, freezers, room air-conditioners, dishwashers, clothes washers, water heaters, clothes dryers, and color televisions had increased steadily.

Increases in the number of appliances in the home are having an upward influence on energy consumption. However, should manufacturers meet the energy efficiency improvement targets established for major appliances, the efficiency improvements in appliances will offset, in part, the increased energy consumption resulting from greater numbers of appliances in the home.

Changes in the personal consumption patterns of residential consumers were not easy to measure. Officials of utility companies we visited generally believed that residential consumers had taken some conservation actions during 1974 and 1975 which contributed to the reduction in energy use during that period. According to consumer surveys conducted by such polling organizations as Gallup and Opinion Research, the average consumer claimed that he adjusted temperature levels and lighting usage during the supply scares brought on by the 1973 embargo (oil) and the 1976-77 winter (natural gas), but discontinued the practices once the shortage situations abated.

Surveys conducted by or for FEA in February and March of 1977 showed that, generally, efforts were minimal in the area of reducing temperature levels to save fuel. At the same time, however, efforts such as adding insulation were relatively significant. But the surveys also indicated that consumers living in States experiencing energy emergencies or natural gas shortages tended to lower temperature settings more than those who were not directly affected.

On the basis of the previous discussions of factors affecting residential consumption, the decrease in per unit energy consumption which occurred in 1974 was most likely due to individual consumers altering their personal consumption patterns. However, the changes in personal consumption patterns were not permanent. The decrease in 1974 consumption was apparently a reaction to the supply disruption brought on by the 1973 oil embargo.

Energy prices can also influence energy consumption. Since 1972, the price paid by the residential consumer for the major sources of energy have increased significantly. The following table illustrates what has occurred.

	Energy prices (note a)					
	Heating Oil		Electricity		Natural Gas	
Year	Actual	Real	Actual	Real	Actual	Real
1973	7.8	1.5	3.9	-2.2	4.7	-1.4
1974	69.7	52.9	18.4	6.7	15.4	4.0
1975	8.1	-1.0	13.4	3.6	23.5	13.1
1976	7.2	1.4	7.8	2.0	19.3	13.5

a/GAO computations with DOE pricing information.

As the table shows, the price of heating oil experienced the greatest increase in both actual and real terms between 1972 and 1976. The bulk of that increase came in 1974, however, with little real price increase in the 2 subsequent years. The price of electricity and natural gas did not experience the dramatic 1-year increase as did heating oil. But both increased steadily with the larger increases occurring in the price of natural gas in 1975 and 1976. The effects of changes in fuel prices on energy consumption could not adequately be determined.

As previously stated, energy consumption per residential unit fell significantly in 1974 but has increased since that time. While the largest fuel price increase, that for heating oil, occurred in 1974, only about 25 percent of the housing stock used heating oil as a primary fuel. Thus, it is unlikely that the increase in heating oil prices accounted for all of the decrease in per unit energy consumption, although it was undoubtably an important contributing factor. Price increases following 1974 for electricity and natural gas may likely have encouraged residential consumers to take energy conservation actions but it was impossible to determine the extent of those actions. It is likely, however, that the continued real price increases stimulated increased consumer activity to retrofit their homes with weatherization materials.

Implications of recent trends

On the basis of preliminary data for the first 6 months of 1977, residential energy consumption increased about

6.5 percent over the corresponding 1976 period. In addition, the weather varied to a greater degree than the same 1976 period, as evidenced by an increase in heating degree days of nearly 10 percent and an increase in cooling degree days of over 20 percent. Further, actual residential fuel prices continued to increase since 1976; natural gas by 14 percent, electricity by 10 percent, and heating oil by 11 percent as of December 1977.

On the basis of an analysis of factors affecting residential energy consumption trends between 1972-76, the recent data suggested that weather conditions caused some of the increase in energy consumption in the first 6 months of 1977. In addition, new residential units entering the housing stock in the first half of 1977 also increased total sector consumption. However, we expect that recent consumer activity to weatherize houses will serve to minimize, to some extent, the effects of weather and the increase in housing units in the future.

THE IMPACT OF FEDERAL PROGRAMS

The Federal programs established by the 1975 and 1976 Energy Acts had not been developed to the extent that we could measure any impacts. We believe, however, that these programs can have significant impact on residential energy demand primarily in the mid and long term.

We believe that the programs in effect during the 1972-76 time period, although generally relying on voluntary actions by residential consumers, may have had some success in stimulating conservation activities, particularly in 1974. Consumer reaction to the oil embargo was obviously an important factor also. However, we believe many of the actions taken during that time (operational measures) have not been sustained. Certain problems or barriers exist which inhibit the undertaking of additional or more permanent conservation actions. Predominate among these are

--limited commitment to the concept of conservation,

--lack of awareness among individual consumers as to the types of conservation measures best suited to their residences and the associated costs and benefits of taking such actions,

--lack of capital necessary to take many conservation measures, and

--institutional barriers in the form of building codes and construction standards.

Many residential consumers appeared to be unsure of the real importance of the energy situation. Surveys conducted for FEA in 1975 and 1976 indicated that 30 percent of the public had no understanding of what the energy problem was about. In addition, one study 1/ concluded that Americans are reluctant to implement operational conservation measures because they believe such measures call for sacrifices in their standard of living.

Motivation to conserve, based on economic factors, is restricted by a lack of information on what types of conservation measures are best suited for an individual residence in terms of energy and dollar savings. Despite the efforts by governmental agencies and utility companies to educate consumers in energy conservation, many homeowners are apparently unaware of many energy-conserving measures applicable to their residences. For example, in one survey FEA concluded that a large number of homeowners believed they had adequate insulation when in fact they did not. Also, up to 50 percent of homeowners did not know what steps would conserve the most energy in their homes.

For consumers who are motivated to conserve energy and are aware of conservation measures which could be applied to their residences, inadequate capital and building codes have limited energy conservation actions. Many residential conservation measures require capital investments which may put a serious burden on personal budgets.

FEA surveys indicated that most consumers prefer retrofit conservation measures to adjustments in temperature levels. However, some residential consumers, particularly those in lower income brackets, lack the money necessary for retrofit measures. Conservative lending policies prevent banks from encouraging energy conservation investments to lower income citizens.

1/"Group Discussions Regarding Consumer Energy Conservation," Federal Energy Administration, March 1976.

Not only are retrofit conservation measures affected by this barrier but the purchase of more energy efficient new homes may be discouraged by conservative mortgaging policies. The majority of banks and other lending institutions qualify home buyers on the basis of the cost of the home and the buyer's income and ability to make the down payment. New homes which incorporate significant energy conserving measures in the initial construction (resulting in a higher initial cost) have substantially lower energy costs in their operation. However, while mortgage policies include the higher initial costs of such homes when considering a mortgage they generally do not consider the lower operating costs.

According to the Congressional Research Service, some building codes have been criticized as being deficient in conserving energy. Codes often specify minimum standards for types and quantities of material to use which may be too low for adequate energy conservation.

RESIDENTIAL ENERGY CONSERVATION OPPORTUNITIES

Studies made by both private and governmental organizations have established that substantial improvement in the efficiency of energy use in the residential sector is possible. The studies indicate a range of potential improvement of from 20 to 50 percent in energy use efficiency through improvements in thermal qualities of new and existing structures, in the efficiency of major appliances and equipment, and the efficiency of residential operating practices.

Improving thermal qualities of structures

A recent analysis of Federal residential energy conservation programs pointed out that two existing sets of new building standards can have a substantial effect on the heating and cooling loads of new residences. 1/ According to studies by Arthur D. Little, Inc., cited in the analysis, thermal standards for new buildings developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers can reduce heating requirements in single family dwellings by 11 percent and cooling requirements by 9 percent. The analysis also pointed out that HUD's Minimum Property Standards (effective in June 1976)

1/"Residential Energy Use to the Year 2000: Conservation and Economics," Eric Hirst and Janet Carney, September 1977.

can reduce heating and cooling loads in single family dwellings by an even greater amount, 20 and 16 percent, respectively. The analysis also stated that the average reduction in the heating and cooling load of a single family unit resulting from retrofitting is the same as in new single family units constructed in accordance with the HUD minimum property standards.

Improving appliance and equipment efficiency

The efficiency of major energy-consuming appliances can be improved substantially. FEA estimated in July of 1977 1/ that full compliance with the existing voluntary efficiency improvement targets program for 10 consumer appliances could save over 107,000 barrels a day of oil equivalent in 1980, compared to 1972 operating performance. Annual savings would increase to about 680,000 barrels a day oil equivalent by 1985 as the more efficient products replaced the existing stock.

More immediate reductions in energy requirements can result from certain retrofit measures which can be applied to existing appliances, primarily furnances and water heaters. For example, improving the insulation qualities of the water heater jacket, adding insulation to the distribution pipe, and reducing the pilot rate on a gas water heater can improve its efficiency over 20 percent. In addition, retrofit measures, such as the replacement of pilot lights on gas heating equipment with electric ignition devices, can improve the operating efficiency of furnaces.

The improvement of heating and cooling system efficiency can reduce the energy requirements of a home significantly. One study 2/ indicated agreement within the heating, ventilating, and air-conditioning industry that many times oil and gas heating and air-conditioning equipment is oversized at the time of original installation. Improvements in the thermal qualities of new homes will make the use of smaller, more efficient equipment possible.

1/"Economic Impact of Proposed Energy Efficiency Targets for Ten Consumer Products," Federal Energy Administration, July 1977.

2/"Potential For Energy Conservation In the United States: 1974-1978, Residential/Commercial," National Petroleum Council, September 1974.

The use of heat pumps can also improve heating/cooling efficiency. Heat pumps are essentially heat transfer devices which extract solar heat from the outside air and use it for space-heating purposes. By reversing the heating operations, heat pumps can also cool by absorbing heat from the indoor air and pumping it outside.

Heat pumps have become increasingly popular in recent years. In 1975, for example, 46 percent of the new homes in the United States were electrically heated--50 percent of which had heat pumps. Heat pumps have increased their share of total home heating and cooling sales from 6.5 percent in 1974 to an estimated 15 percent in 1976. According to an Energy Research and Development Administration study on heat pump technology, 1/ projections call for a total potential market for residential electric heat pumps of about 1.7 million units a year through the year 2000.

The increased interest in heat pumps as a heating system alternative developed from increases in energy prices and from the higher efficiency levels of the heat pumps versus electric resistance heating systems. Estimated energy savings of from 33 to 50 percent can be realized through the use of a heat pump compared to conventional electric systems. According to the above mentioned study, gas heat pumps now under development have a higher efficiency than electric heat pumps, combustion furnaces, or resistance heating systems; however, these heat pumps are not yet commercially available.

Altering personal consumption patterns

Adjustments to the temperature levels for heating, air-conditioning, and water heating can result in substantial conservation of energy. Reducing thermostat settings for heating to 68 degrees F for 16 hours during the day and 60 degrees F for 8 hours at night, according to the ERDA heat pump study, can result in reductions in heating loads estimated to be as much as 20 percent. The estimate was based on reducing the temperature levels from a constant 74 degrees F. It was also estimated that setting up thermostats on central air-conditioning units to 78 degrees F from 72 degrees F on a constant 24-hour basis can reduce energy requirements for cooling by 15 percent.

1/"Heat Pump Technology: A Survey of Technical Developments, Market Prospects and Research Needs," Energy Research and Development Administration, December 1977.

According to a Rand Corporation study, 1/ setting back water heater temperature levels to 110 degrees F from a medium setting of 140 degrees F can also result in significant reductions--15 percent for gas or oil units and 9 percent for electric units.

THE NATIONAL ENERGY PLAN

The administration's National Energy Plan included several initiatives which focused on the areas of residential conservation opportunities. These initiatives include:

--Advancing the effective date of the current mandatory energy performance standards for new residential buildings from 1981 to 1980.

--Allowing a tax credit for the implementation of certain energy conservation measures.

--Creating a utility energy conservation service program.

--Replacing the current voluntary appliance energy efficiency improvement targets with mandatory minimum standards.

--Reforming utility rate structures. 2/

In our evaluation of the NEP 3/ we stated that we generally agreed with the above proposals to increase energy conservation in the residential sector. We continue to do so. We believe that the NEP, as it strengthens existing Federal programs and proposes new initiatives, can cause greater realization of residential energy conservation opportunities.

1/"Residential Water Heating: Fuel Conservation, Economics, and Public Policy," Rand Corporation, May 1974.

2/As of April 1, 1978, the proposal for utility rate reform had been modified by congressional conferees.

3/"An Evaluation of the National Energy Plan," EMD-77-48, July 25, 1977.

CHAPTER 6

COMMERCIAL SECTOR: STATUS, PROBLEMS, AND OPPORTUNITIES

The commercial sector, in terms of energy consumption, is categorized as communications; utilities (as an end user); wholesale trade; retail trade; finance, insurance, real estate, and services; hospitals and nursing homes; schools; and public administration. In addition, we included residential buildings of five or more housing units in our analysis because such apartments are generally operated as a commercial business.

FEDERAL PROGRAMS

The Federal Government has implemented programs designed to encourage energy conservation in commercial buildings. The primary emphasis of these efforts has been to increase the thermal efficiency of new and existing buildings. Most of the Federal programs have been voluntary.

FEA's Lighting and Thermal Operations for Commercial Buildings Program's objective was to reduce energy used for lighting, heating, and cooling in commercial buildings. To accomplish this objective, FEA met with commercial building owners and managers and explained the energy and dollar savings that could be realized by adopting energy efficient guidelines.

The Federal Government has also implemented programs directed at specific classes of commercial energy users and designers of commercial buildings. For example, FEA attempted to encourage energy conscious design for new buildings through contacts with the American Institute of Architects and through regional workshops for architects. FEA also conducted regional seminars directed at ways to save energy in public schools, colleges, universities, and health care facilities.

Recently enacted legislation could have a significant effect on future energy use in the commercial sector. The State Energy Conservation Program, included in the 1975 Energy Act, requires States to include in their conservation plan lighting efficiency standards for new and existing public buildings and thermal efficiency standards for new and renovated buildings as a condition to receiving any

financial assistance under the program. In addition, title III of the 1976 Energy Act requires the Secretary of HUD to develop, promulgate, and implement energy efficiency performance standards for new commercial and residential buildings. (This program is discussed in ch. 5.)

The 1976 Energy Act also authorized a supplemental State Energy Conservation Plan program. Under this program, States are required to, among other things, establish procedures for encouraging and carrying out energy audits with respect to at least one type of commercial building or industrial plant within at least one political subdivision of the State before receiving financial assistance under the program.

COMMERCIAL ENERGY CONSUMPTION AND CONSERVATION SINCE 1972

The commercial sector's demand for energy remained relatively stable between 1972 and 1975. However, 1976 figures showed the demand again on the rise. The following shows the commercial sector's energy consumption, including conversion losses from electrical generation between 1972 and 1976.

Year	Quads	Percent of total U.S. consumption
1972	10.2	14.2
1973	10.4	14.2
1974	10.2	14.0
1975	10.4	14.7
1976	11.0	14.8

Between 1972 and 1976 the commercial sector's energy consumption increased about 8 percent. This compares to the previous 5-year period when the sector's total consumption increased about 20 percent.

Data to assess overall energy consumption trends in the commercial sector is severely limited. A March 1977, FEA study 1/ on energy consumption in the commercial sector

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1/"Energy Consumption in Commercial Industries by Census Division,--1974," Federal Energy Administration, March 1977.

pointed out that primary data are not collected on a routine basis for most segments of the commercial services sector. The report pointed out that data also are not collected on energy consumption by building type. Thus, we relied primarily on data obtained at locations we visited and discussions with building owners and operators for our analysis of the commercial sector.

A review of consumption data at 14 locations where consumption data were available for the 1972-75 period showed that, except for one case, energy consumption on a Btu per square foot basis in 1975 was below 1972 levels. The extent that 1975 consumption was below 1972 consumption ranged from 57 percent to 9.8 percent. In over half of the locations, the reduction in energy consumed reflected a continuous downward trend between 1972 and 1975. In the other cases, 1975 levels of consumption, although below the 1972 levels, were greater than 1974 levels.

While we could not identify the specific reasons for decreased energy consumption levels, in general we found there was a commitment to conserve energy if conservation involved simple operational changes and if personal comfort or lessor revenues were not affected. In limited cases, however, some building officials initiated sophisticated actions, such as installing computers that control heating, ventilation, and air-conditioning and energy economizers that recycle otherwise wasted energy.

The primary reasons given for implementing conservation measures were increasing energy costs or, in some limited cases, an increased awareness of energy shortages caused by the 1973 oil embargo. Officials from several buildings stated they were civic/conservation minded, but that cost savings from reduced energy bills were far more important to them. These officials indicated that if the cost was either excessively high or if the return on investment period seemed excessive, e.g., usually described as more than 1 to 3 years, conservation measures would not be attempted.

We noted that energy audits and analyses of energy consumption had generally not been performed. Building officials often tracked their monthly energy consumption to determine how well they were managing operations, but often did not analyze the data to determine the cause and effect of fluctuations. However, most building managers assumed changes in energy consumption had resulted from their overall energy-reducing efforts, newer and more energy efficient equipment, and changes in the weather. Others did not attempt to explain specific fluctuations in energy consumption.

IMPACTS OF FEDERAL PROGRAMS

As mentioned previously, the Federal programs underway at the time of our review were voluntary in nature with the purpose of informing various building owners and operators of ways to reduce their energy consumption. Many of the building officials we visited had either been contacted by a Federal representative or had received information from the Federal Government.

Building managers contacted by Federal representatives generally believed that such contacts had resulted in limited benefits. These benefits included (1) getting building managers together to discuss the need for conservation, (2) obtaining some conservation brochures, and (3) receiving awards for conserving energy. Building managers indicated, however, that Federal officials could not offer technical assistance because they did not have appropriate training in technical matters.

While earlier Federal programs did not appear to have had much of an impact in locations we visited, certain Federal conservation programs which were enacted recently offer greater opportunities to save energy in the commercial sector. Energy performance standards for new buildings and the requirement for energy audits under the supplemental State Energy Conservation Program should result in more efficient energy use. Building performance standards should assure that new buildings constructed after 1980 incorporate energy efficiency in their design. The energy audits program should provide a means for some building owners and operators to identify additional opportunities for saving energy.

Problems and barriers

While some energy savings have occurred in recent years, there are specific problems and constraints inhibiting further reductions in energy use in the commerical sector, especially in the retrofit market. Among the constraints are financial limitations, competitive advantages, and tenants' existing leases.

Financial limitations

Building owners are often unwilling to invest in structural retrofitting and energy-saving equipment, such as installing insulation and using computers to control energy consumption, because they believe these actions are costly compared to other investment opportunities. Traditional financial practices, based on lowest initial

cost, have discouraged investment in technology which would have lower lifetime costs, but higher first costs, than the less energy-efficient technology.

Building managers were aware of energy-saving devices that could be installed in their buildings to reduce energy consumption. These devices included

--installing windows which restrict heat transfer,

--computerizing heating and cooling systems, and

--improving the efficiency of air-conditioning systems.

However, facts supporting energy savings and payback periods associated with conservation investments, according to managers, have not been adequately documented. Such information is necessary for knowledgeable conservation investments to take place. Building managers believed many energy-conserving measures would not be cost effective; therefore, they would not invest in them. The building managers would generally not make capital investments unless they could be recovered within 3 years.

Competition may hinder energy conservation

Competitive advantages may result if energy conservation methods are not universally applied. We were informed that building managers were more concerned about tenant requirements for heating, cooling, and lighting than conserving energy. The manager needed to minimize the number of tenant complaints and tenants moving to other buildings. Conservation is a secondary priority relative to these concerns.

Competition between buildings for tenants and the resulting fear of losing tenants and profits caused building managers and owners to resist conservation measures which made tenants uncomfortable or gave rise to tenant complaints. Some building managers indicated that they must maintain certain lighting and temperature levels to impress potential lessees and keep present tenants happy and comfortable even though these levels may be energy inefficient. Similarly, building managers preferred not to schedule janitorial crews during normal business hours, a technique used successfully in Federal office buildings to reduce energy consumption. They believed tenants would not tolereate any interruptions or distractions it may cause. Many building managers claimed that if building space

existed nearby, where conservation measures were less stringent, tenants who became dissatisfied with the buildings' energy conservation efforts might move to the buildings where less energy use was not a priority.

The new building performance standards program, when implemented, should help to minimize this problem in newly constructed buildings. Concerning existing buildings, we believe that measures to increase energy efficiency will have to be made more financially attractive so that most building owners and managers implement such measures and thus offset the competitive advantage problem.

Tenant leasing can include conservation disincentives

Many apartment and office buildings are master metered--a practice whereby energy for a building is serviced through one master meter and energy costs are paid by the lessor and recovered through rent and lease payments. In this way, tenants are not faced with visible incentives to conserve energy because they never see actual utility costs.

Utility costs were included but not specifically identified in many lease payments for the non-owner-occupied buildings we visited. Even though a tenant might cut back utility usage, his lease costs would not necessarily be reduced. Also, we found leases which contained clauses specifying the unit's lighting, heating, and cooling levels and period for which these levels were to be maintained. Tenants, therefore, leased space with the understanding that utilities were provided, and building managers feared that supplying less than the specified service would violate contractual agreements and probably result in a lawsuit.

According to a study prepared for FEA 1/ in 1975, residents of multifamily housing units in master-metered buildings consumed about one-third more energy than those who paid separately and directly for utility costs. For other types of commercial buildings, however, there was less evidence that eliminating master metering would result in this level of energy savings. Average consumption between individually metered and master metered groups for nonhousing commercial buildings varied by only 5 to 10 percent because individual organization policies based on

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1/"Energy Conservation Implications of Master-Metering." Midwest Research Institute, October 1975.

factors other than payment of utility costs, such as employee satisfaction and comfort, would dictate the lighting levels, thermostat settings, occupancy, hours of operation, and maintenance schedules that contributed to an establishment's energy consumption.

COMMERCIAL CONSERVATION OPPORTUNITIES

Information on the potential savings from energy conservation measures in the commercial sector was generally unavailable. This was due to the wide variation in size, age, and number of units constituting the commercial sector. In many cases, energy savings were dependent on an individual building's design since the greatest share of the energy used in the commercial sector was for space heating and cooling. The age, structure, function, type of energy system, and geographic location of a commercial building all influence its potential rate of energy use. Recognizing the limitations in estimating potential energy savings, the following provides our views on energy savings opportunities through operational changes, retrofit, and new building design.

Operational changes

In our opinion the greatest sources of commercial energy savings in the near term (1985) are operational and equipment changes. As in the other sectors, operational changes consist of measures such as thermostat adjustments, lighting reduction, equipment maintenance, changes in building use schedules, reduced ventilation, and other low-cost efforts. The National Petroleum Council estimated 1/ that an average 20-percent reduction in energy use can be achieved through such measures from 1979 to 1985. In addition, the Ford Foundation estimated in a 1974 study 2/ savings of 1.4 quads from operational and equipment changes in the commercial sector by 1985. Longer term energy savings would come through major retrofitting operations and new architectural designs to reduce heat losses and gains.

1/"Potential for Energy Conservation in the United States: 1979-1985," National Petroleum Council, 1975.

2/"A Time To Choose," Energy Policy Project of the Ford Foundation, 1974.

One often-cited example of an operational change is reduced illumination in commercial buildings. Reducing lighting levels through the use of natural light, turning off lights when not in use, concentrating task lighting, and shifting to daytime maintenance have been recommended by research of the National Petroleum Council, the Rand Corporation, and the California Energy Resources Conservation and Development Commission. While the specific nationwide potential for this action could not be quantified, the California Energy Resources Commission found that reducing illumination in existing buildings could save up to 134,000 barrels a day oil equivalent, or 20 percent of all the electricity currently used in California's commercial sector. 1/

Retrofit measures

Retrofit operations are generally building modifications, such as the installation of insulation, boiler replacements, and other renovations which require greater investment and time. Retail establishments and offices have been identified by DOE as the most likely candidates for conservation through retrofit. The National Petroleum Council sees such measures as the insulation of ceilings and sidewalls and installation of storm sashes or high efficiency glass as having a large (1.6 quads) energy-saving potential, but with minimal changes achievable by 1979 (0.3 quads). 2/

The elimination of master metering in commercial buildings can also save energy, particularly in apartment buildings. About one-third of all multifamily housing units are master metered as compared to nearly all of the office space in the United States. Converting these facilities from master to individual metering can often be costly and impractical. Midwest Research Institute has estimated 3/ that conversion costs range from $100 to $1,200 per unit to change wiring and structural work and to redecorate. Such costs, favorable

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1/"California Energy Trends and Choices," California Energy Resources Conservation and Development Commission, 1977.
2/"Potential for Energy Conservation in the United States: 1974-1978," Residential/Commercial, National Petroleum Council, 1974.
3/"Energy Conservation Implications of Master-Metering Volume I," Midwest Research Institute, October 1975.

commercial utility rates, and special requirements for office space flexibility for new tenants make individual metering of offices unpopular with building owners and managers. As a result, the multidwelling units portion of the commercial sector probably offers a greater achievable potential for energy conservation through the elimination of master metering.

Energy savings from the conversion of existing master-metered apartment buildings to individual meters have been estimated by the Midwest Research Institute to equal 35,000 barrels of oil a day. DOE is investigating methods to encourage residents of master-metered buildings to conserve energy when retrofitting such buildings is not economically feasible. To encourage conversions of existing buildings to individually metered units, the Midwest Research Institute has identified several policy options for the Federal Government:

--Require all federally owned housing to be retrofitted with individual meters.

--Allow a tax credit toward the cost of installing individual meters.

--Accelerate the depreciation allowance for capital investment in conversion to individual metering.

--Require utilities to bill master-metered customers at rates which would reflect what the utility costs of individuals would be if they were individually metered.

--Reduce fuel allocations to States whose utilities permit master-metering service.

The exact impacts of these policies have not been quantified, but according to the Midwest Research Institute an estimated 25 to 50 percent of the opportunities to convert to individual meters are seen as achievable through combinations of various incentives and penalties.

New building design

The final category of conservation measures in the commercial sector is new building design changes. Potential savings from new construction are the most difficult to project since any total impact would assume all new buildings

were designed and built for the specific purpose of energy conservation. However, to the extent that past construction has not been determined on the basis of life cycle costs, savings from new designs and building standards which account for energy costs can be expected.

THE NATIONAL ENERGY PLAN

The administration's proposed National Energy Plan included several initiatives which focused on the energy conservation opportunities which we have identified in the commercial sector. Those initiatives included

--a 10-percent tax credit for business investments in energy conservation measures,

--the elimination of master metering in new structures, 1/

--advancing the effective date of the current mandatory energy performance standards for new commercial buildings from 1981 to 1980,

--reforming utility rate structures, 1/ and

--a matching grants program to encourage the installation of energy conservation and certain renewable resource measures in schools and hospitals.

The results of our review point out the need in the commercial sector to make energy conservation investments more financially attractive. In addition, our review indicates energy savings opportunities through the elimination of master metering and by performing energy audits. The tax credit proposal and the proposal to eliminate master metering in new structures directly focused on two of these areas. In our evaluation of the NEP, we favored the enactment of these proposals. We continue to do so.

1/As of April 1, 1978, the proposal to eliminate master metering in new structures had been rejected and the proposal for utility rate reform had been modified by congressional conferees.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

OVERALL

Energy conservation must play a more prominent role in the Nation's energy program. Energy conservation programs undertaken in the past have not effectively curbed the Nation's demand for energy. While the 1972 to 1976 period reflected a substantial decrease in the rate of energy consumed when compared to the previous 5-year period, 1976 and preliminary 1977 data show that the Nation's energy consumption is substantially increasing.

Lower energy consumption levels in the last few years were due to the 1973 oil embargo, the ensuing recession, increased energy prices, and some energy conservation. Recent data show actual energy prices are continuing to rise; however, in real terms, energy prices have stabilized or have decreased.

Federal conservation programs were initially successful in some sectors (transportation and residential) but many of the energy conservation actions taken by consumers as a result of these programs have not been sustained. Many programs enacted in the 1975 and 1976 Energy Acts focus on mid-and-longer-term energy conservation and thus have not yet resulted in measurable energy savings. We believe these programs will result in energy savings in the future.

The proposed NEP contains these overriding energy objectives:

--In the short term, to reduce dependence on foreign oil and vulnerability to supply interruptions.

--In the mid term, to keep U.S. imports sufficiently low to weather the period when world oil production approaches its capacity limitation.

--In the long term, to have renewable and essentially inexhaustible energy sources for sustained economic growth.

Energy conservation was highlighted as the cornerstone of the NEP; however, the NEP did not contain enough actions in the conservation area to really have much impact in the short term. In fact, as we previously reported, the energy conservation provisions in the NEP would not significantly reduce energy demand between now and 1985. Based on the administration's own estimates they would only reduce energy demand by 4 percent, or 1.9 million barrels of oil a day by 1985.

Energy conservation can contribute more to meeting the goals and objectives of the NEP. The success of increased energy conservation will depend, to a large extent, on the development of attitudes and habits which foster an efficient use of energy. In addition, regardless of the specific actions undertaken by the Federal Government, there will be a need to

--continuously assess each Federal initiative in terms of: what its contribution will be in meeting the short-, mid-, and long-term objectives of the NEP and

--develop sufficient standby initiatives and implement them in the event that ongoing programs and actions do not result in sufficient progress in meeting the established goals.

RECOMMENDATIONS

The major recommendation below calls for the submission to the Congress of a detailed energy conservation plan, set up in a way that progress toward conservation goals can be clearly measured and adjustments made as needed. More detailed recommendations which follow under the "transportation," "industrial," "residential," and "commercial" sectors are intended both to be helpful to the Department of Energy in the preparation of an overall energy conservation plan and to specify actions which we believe should be taken immediately. Items focused on in our detailed recommendations appear to us to be the most significant areas to pursue in the next few years to achieve energy conservation.

We recommend that the Secretary of Energy, by January 1, 1979, submit to the Congress an energy conservation plan which includes:

--Energy conservation goals by consumption sector, to help achieve the stated objectives of the NEP. The goals should be stated in common quantified terms which relate conservation actions to expected energy supply, demand, and import levels.

--Executive branch actions, which constitute an energy conservation program needed to achieve the goals and proposals for additional legislative authority needed, as well as the status of ongoing Federal energy conservation programs.

--Milestones and a plan to continuously monitor and evaluate each portion of the energy conservation program's contribution toward meeting the energy conservation goals.

--Proposals for standby authorities and initiatives (i.e., standards, taxes, rationing, financial incentives, penalties, and deregualtion authority) for implementation if the energy conservation program is not meeting the established milestones.

We also recommend that the Secretary of Energy report annually to the Congress on the status and results of the programs included in the energy conservation plan, including any additional proposals for congressional or executive branch actions needed to achieve the goals of the plan.

AGENCY COMMENTS

Commenting on a draft of this report, DOE pointed out that a serious problem in the years ahead pertains to shortfalls in petroleum-based fuels. Thus, a fuel substitution strategy should be carefully considered as part of any broad-based energy conservation program because both fuel substitution and energy conservation will be needed to achieve the 1985 import goals contained in the NEP.

As stated in chapter 1, this report focuses on how the Federal Government can more effectively promote energy conservation in the Nation's end use of energy. We agree, in concept, with DOE's concern over future shortfalls in petroleum-based fuels. We also agree that the Nation will need to move toward the use of more domestically abundant fossil fuels to lower the Nation's dependence on imported oil during the transition to renewable energy sources.

However, as we pointed out in an earlier report, 1/ the administration was overly optimistic in its projections of the share of the Nation's 1985 energy supplies which would be made up from coal, nuclear, and natural gas sources. Thus, a significant amount of energy conservation of these fuels will also be necessary to achieve the 1985 import goals contained in the NEP.

DOE also stated that substantial energy savings can be realized in the area of regulated carriers. DOE pointed out that neither the carriers nor their regulatory agencies have worked vigorously enough to realize this energy savings potential. DOE stated that the provisions of the 1975 Energy Policy and Conservation Act which dealt with energy conservation programs for regulated carriers had not been effective because the legislation did not require the regulatory agencies to periodically account for or consult with DOE on their conservation actions.

While we have not specifically assessed whether all regulatory agencies have done all they can to realize energy savings potentials within their respective regulated industries, as pointed out on page 27 we found that actions by FAA and ICC to achieve energy conservation in the airline and trucking industries have been limited. We agree that DOE should work more closely with the regulatory agencies in their energy conservation efforts.

DOE also said that an important opportunity for energy conservation evolves through consumer education programs. DOE stated it had developed a program to educate fleet operators and motorists on appropriate energy conservation techniques in purchasing and operating automobiles. In our opinion, there will be a continuing need for consumer education programs in the area of energy conservation, primarily to develop a national energy conservation ethic. However, as this report discusses, much more will need to be done beyond education if the Nation's demand for energy is to be significantly reduced in the years to come.

With the exception of our conclusions and recommendation on industrial energy conservation, DOE stated it was in basic agreement with the other recommendations included in the report. DOE comments on the industrial sector are discussed on pages 87 to 89.

1/Letter report to the President of the Senate and Speaker of the House of Representatives, EMD-78-5, October 14, 1977.

TRANSPORTATION

Transportation energy consumption continues to warrant Federal attention. Transportation is consuming a large and growing share of the Nation's energy and directly affects the level of crude oil imports, since nearly all transportation energy use comes from petroleum. There are additional actions the Federal Government should take to further reduce energy consumption in the transportation sector. Such additional actions should be directed toward

--reducing annual miles traveled per automobile and increasing ridesharing and the use of mass transit,

--accelerating the rate of the automobile fleet turnover, and

--increasing the efficient use of fuel in the Nation's fleet of trucks, particularly large trucks.

Recent stable real gasoline prices and increased auto efficiency have resulted in a decrease in the real fuel costs per mile of driving. If real gasoline prices do not continue to rise, consumers will experience a decreasing fuel cost per mile in the years to come. This could stimulate higher per automobile annual travel rates and thus offset to some extent the energy savings to be achieved from more-efficient automobiles. Maintaining the real fuel cost per mile at least at present levels would help to assure that the potential energy savings from increased automobile efficiency will be realized.

Another key element in stabilizing or reducing the miles traveled annually per automobile is to increase automobile occupancy rates (ridesharing) and the use of mass transit in commuting to and from work. Recent data indicate that the nationwide automobile occupany rate probably declined from pre-embargo levels. Mass transit ridership has increased slightly since 1972, reversing a long-term downward trend. In our report on the NEP we pointed out that it lacked new initiatives to encourage ridesharing in the private sector and the use of mass transit. We continue to believe that the Federal Government should do more in this area.

To maintain a strong national transportation system while pursing policies to reduce automobile travel, the Federal Government should foster mass transit as an acceptable alternative to auto use. Mass transit must provide convenient service and be available at a reasonable cost to the rider. This will require an increased level of Federal financial assistance for mass transit systems. As we

previously reported, the Highway Trust Fund, a major potential source of mass transit system funds, was not being used by local governments for mass transit projects because, among other things, local governments could minimize their share of the cost of mass transit projects by obtaining funds from other Federal sources. As a first step in increasing the use of mass transit to contribute to energy conservation, the Federal Government will need to assure that the Highway Trust Fund monies and other Federal funds used for mass transit projects provide the same Federal cost sharing benefits to local governments.

The existing automobile fuel economy standards program will ensure that new cars manufactured over the next few years will be more energy efficient, on average, than automobiles produced in the past. Whether projected savings from the automobile fuel efficiency standards program will be achieved depends on how many and how soon new cars are purchased. Although more consumers are purchasing smaller, more-efficient automobiles, many consumers deferred purchasing new cars in the 1974-75 period. Thus, the average age of the automobile fleet increased.

Additional opportunities to save energy in the transportation sector could be achieved through increasing the rate of automobile fleet turnover. This would accelerate the realization of the energy savings which would result from the use of newer, more-efficient automobiles. In 1976, for example, if the Nation's fleet was just one mile per gallon more efficient, about 360,000 barrels of oil per day would have been saved.

We have supported, with certain modifications, the President's proposed gas-guzzler taxes and rebates on new car purchases, which should encourage more consumers to purchase more-efficient automobiles and thus speed improvement in the fuel economy of the automobile fleet. We pointed out, however, the possibility that some consumers might prefer to hold their less-efficient cars longer, or turn to bigger but less-efficient used cars. This situation could substantially slow down the process of upgrading the average miles per gallon of the Nation's automobiles. In view of this possibility, we suggested that the program be closely monitored. If established program goals and milestones were not being met, we stated that a tax and rebate program could be extended to the used car market. We continue to support that position.

Opportunities for fuel conservation by trucks received little Federal attention between 1972 and 1976, with the exception of some Federal action to support industry conservation initiatives. Fuel consumed by trucks (2.25 million barrels of oil per day), particularly large trucks, is increasing at a faster rate than fuel consumed by automobiles and accounts for about 30 percent of the fuel consumed by highway vehicles.

The Federal Government has concerned itself with, and taken action on, energy efficiency standards for light trucks (those under 10,000 pounds gross vehicle weight). These trucks consume about 42 percent of the fuel consumed by all trucks. Although there is general agreement that there is much that can be done to conserve fuel consumed by trucks over 10,000 pounds gross vehicle weight, opinion varies widely on what the Federal Government's role should be.

Based on our analysis of transportation consumption trends, the direction of current transportation conservation programs, and proposals in the NEP to increase transportation conservation, we believe the Federal Government should focus more attention on conserving fuel consumed in trucks over 10,000 pounds gross vehicle weight. In our opinion the next step should be to determine what specific initiatives the Federal Government should undertake to encourage a greater level of energy conservation in this area. In the recommendations section below, we outline some possible areas where initiatives should be explored.

RECOMMENDATIONS

We recommend that the Secretary of Energy:

--Monitor automobile fuel costs per mile and include in his submission to the Congress proposals to increase gasoline prices when fuel costs per mile decrease in real terms. The proposed crude oil equalization tax, 1/ part of the NEP, is intended to increase domestic crude oil prices between now and 1980. The impact of the tax beyond 1980 is unclear. The equalization tax, if enacted, would likely increase real gasoline prices between now and 1980 and could be

1/As of April 1, 1978, congressional passage of the crude oil equalization tax was uncertain.

a mechanism to maintain real fuel costs per mile at current levels for the next few years. However, this period of time should be used to create appropriate additional standby authorities which could be implemented quickly, either to supplement the crude oil equalization tax or to assure that the real cost per mile does not drop in the event the crude oil equalization tax is not enacted by the Congress.

--Include in his submission (after consulation with DOT and ICC) proposals to encourage a more efficient use of energy by trucks over 10,000 pounds gross vehicle weight. In developing the proposals the following initiatives should be considered: demonstrating the use of, and providing financial incentives for, implementation of energy conserving devices for trucks; increasing weight and size limits on Federal highways; modifying other Federal regulations over trucking (such as remaining gateway requirements) to promote more efficient use of energy; and providing incentives to promote joint rail/truck intermodal operations where energy savings can be achieved.

--Include, in his submission, proposals to provide greater assistance and support to local governments of major urban areas to establish preferential carpool parking, preferential traffic control, and other actions to encourage increased ridesharing. The State energy conservation program could be the mechanism for implementing these new actions.

We recommend that the Secretary of Energy, in consultation with the Secretary of Transportation, submit in his report to the Congress recommendations regarding financial actions that can be taken under existing or proposed legislation and, if necessary, new legislation to encourage the use of mass transit in support of identified conservation goals. The report should indicate those Federal actions which should be given highest priority, recommend the level of Federal funding, and the conditions under which the funds should be applied. In addition, the report should quantify the amount of energy savings to be expected, over different time frames, from undertaking the recommended actions and show the energy conservation potential of such actions when combined with the increased ridesharing proposals submitted under the preceding recommendations. In this way the Congress may see the combined costs and benefits of proposed Federal actions to hold constant or reduce the annual miles traveled per automobile.

We recommend that the Congress equalize the Federal share of costs for mass transit projects undertaken with Highway Trust Fund moneys and Urban Mass Transportation Administration funds in States where the Federal cost share for mass transit projects under the highway program is lower than the Federal cost share for mass transit projects under the mass transit program.

AGENCY COMMENTS

DOT stated that it was in general agreement with the objectives of the transportation energy conservation section of the report. While DOT did not indicate any disagreement with the overall nature and level of Federal involvement called for by our recommendations in the transportation area, DOT stated that the recommendations needed to be more clearly delineated. DOT's concerns generally focused on

--who should be responsible for carrying out the recommended actions,

--whether certain recommendations were needed in view of ongoing or proposed Federal programs, and

--the need for further development and analysis of our recommendation relating to increasing the fuel cost per mile of driving.

DOT stated there would be merit in recommending that any new initiatives be developed by DOT, or jointly by DOT and DOE. While we recognize that many of the specific programs which may result from our recommendations could ultimately be carried out by DOT, we believe it is vital that DOE be responsible for developing the overall Federal energy conservation plan. This will require that DOE work closely with other appropriate Federal departments and agencies but will also place DOE in a position to assess the contribution each proposed initiative is to make toward achieving the overall Federal energy conservation goals.

DOT questioned the need for certain of our recommendations in view of ongoing or proposed Federal programs, in particular the proposed Highway and Public Transportation Improvement Act of 1978. DOT stated that the proposed legislation includes (1) increased assistance to local governments to foster carpools, (2) elements contained in our recommendation for a report on actions that can be taken to encourage the use of mass transit, and (3) extensive measures to permit increased Federal support to mass transit.

We support new incentives to increase carpooling activity and the use of mass transit. However, we are concerned with the lack of an overall Federal energy conservation plan which clearly points out the interrelationship between various initiatives to achieve greater energy conservation and which identifies the extent that each initiative will contribute to the overall energy conservation goals. Our recommendations are intended to address this problem by focusing DOE's attention on areas which appear to us to be the most significant areas to pursue in the next few years to achieve energy conservation. The jointly prepared report that we have recommended to be submitted to the Congress would address how various carpool, vanpool, and mass transit initiatives would contribute to meeting established energy conservation goals.

DOT said it disagreed with our recommendation that the Secretary of Energy should monitor automobile fuel costs per mile and include in his submission to the Congress proposals to increase gasoline prices when fuel costs per mile decrease in real terms. DOT said consumer responses to changes in fuel costs and other costs need to be better understood before specific measures can be proposed. Therefore, it said, our recommendation would require further development and analysis.

We agree with DOT that the particulars of what the consumer response would be to price changes are little understood. However, the basic proposition is well established that price, since it affects everyone, is a highly important aspect of energy conservation. The administration has recognized this in its proposals in the NEP of a standby gasoline tax and a crude oil equalization tax. We realize that the administration's proposals, if enacted, could possibly accomplish the purpose of our recommendation through 1980. Whether or not they are enacted, however, we believe our recommendation should be acted upon. The fuel costs per mile are an easily understood and sufficiently sensitive trigger mechanism for signaling needed action. Further study to refine or broaden the trigger mechanism may be appropriate, but we see no reason to conduct lengthy studies before acting on initial steps. The potential seriousness of the impact of any increase in automobile travel, which might occur as a result of future lower real fuel costs per mile, warrants preventive action. Otherwise, some of the energy savings to be achieved from more efficient automobiles could be lost. Our purpose is to maintain real fuel costs per mile at current levels for the next few years.

CONTINUED

1 OF 2

DOT agreed in principle with our recommendation that a proposal be submitted to the Congress to encourage a more efficient use of energy by trucks over 10,000 pounds gross vehicle weight. DOT suggested, however, certain changes to the recommendation's wording so that the recommendation would (1) be made to DOT rather than DOE, (2) have the Secretary of Transportation propose an expanded voluntary truck and bus fuel economy improvement program (for trucks over 10,000 pounds), and (3) clearly not require DOT to make proposals on increasing weight and size limits, but instead would specify that the ramifications of these limits be studied. DOT also suggested that instead of recommending providing incentive to promote joint rail/truck intermodel operations, GAO should recommend "removal of barriers" to such operations.

We previously discussed the need for DOE to be principally responsible for carrying out our recommendations. We believe DOT's Voluntary Truck and Bus Fuel Economy Improvement Program is vital to the total truck fuel conservation effort. Our recommendation, however, calls for a level and kind of Federal involvement not now present in that program. The additional Federal involvement our recommendation entails may result in initiatives by a number of Federal organizations in addition to DOT, such as the Internal Revenue Service or the Interstate Commerce Commission. Thus, we believe the responsibility for developing such initiatives should rest principally with DOE.

DOT viewed our recommendation concerning heavy trucks (over 10,000 pounds) as requiring certain items to be included in any package of proposals developed. It is not our intention that the items included in our recommendation necessarily be included in any package of proposals ultimately developed, but the items should be carefully considered as options in the development of proposals.

Concerning our recommendation for DOT and DOE to jointly submit a report to the Congress identifying additional financial actions that can be taken to encourage the use of mass transit, DOT stated it had research underway specifically focused on this area. Because of these efforts DOT felt a separately funded study appeared unnecessary. We are encouraged by DOT's initiative to examine options to increase the use of mass transit. We believe the results of this research could be an integral part of the report we have recommended be prepared and may well preclude the need for any additional extensive study in this area. We

also wish to point out that the report we have recommended be submitted to the Congress is to include, in addition to a discussion of proposals to encourage the use of mass transit, a description of how such proposals together with proposals developed to encourage carpooling and vanpooling will contribute to meeting established overall energy conservation goals.

INDUSTRIAL

It is evident that the level of energy consumption in the Nation is substantially affected by the energy consumed in the industrial sector. Thus, significant energy conservation in this sector can go a long way toward slowing the Nation's energy consumption growth rate and at the same time reduce the Nation's dependence on imported oil. Although some energy conservation has apparently taken place in the last few years, we believe that more could have been done. The lack of aggressive energy conservation initiatives by industry has primarily resulted from

--the absence of a desirable economic atmosphere which places energy conservation investments in a competitive position with other industrial investments and

--the ineffectiveness of Federal industrial energy conservation programs.

These two problems can and should be solved by the Federal Government.

Low energy prices were the primary reason identified by industry officials for the lack of additional efforts to conserve energy. These officials believed that energy prices remained low because of Government price regulation of oil and gas. Thus, investments with the primary purpose of saving energy were not financially competitive with other investment alternatives.

The NEP includes three initiatives which could make industrial energy conservation investments more financially attractive--a 10-percent investment tax credit for investments in energy conservation measures, an oil and gas users tax, and the crude oil equalization tax. In our report on the NEP we concluded that a combination of the first two measures may result in additional efforts by industry to conserve energy by making energy savings investments more financially attractive. We continue to support the concept of all of these proposals.

The existing voluntary industrial energy conservation program is inadequate because of the lack of appropriate data to monitor industry's energy conservation progress and because the energy efficiency improvement targets, as established, do not sufficiently challenge industry to conserve energy. We believe this program should be modified to more effectively challenge industry to achieve greater energy conservation.

RECOMMENDATIONS

We recommend that the Secretary of Energy discontinue the existing industrial energy conservation improvement targets program and, after considering the views of industry, implement a revised program to extend beyond 1980 which includes

--development of a set of energy conservation goals that reflect levels of energy conservation achievement for each industry within a specified time frame,

--establishment of an energy conservation goal for each industry,

--development of an adequate measure of each industry's progress in achieving established goals,

--establishment of specific milestones to assess each industry's progress toward the goals, and

--development of standby authorities to implement if milestones are not being met.

The program should be developed by first requesting that each industry submit a specific plan with milestones on how the industry would achieve specified goals reflecting various levels of energy conservation achievement by a certain time. As part of its response industry should identify (1) appropriate measures, such as levels of energy conservation investment and energy consumed per unit of output adjusted for changes in levels of production, to assess its progress in meeting its respective goals, (2) what specific actions, if any, should be taken by the Federal Government to enable the industry to accomplish the stated goals, and (3) how each Federal action would assist the industry in meeting its goals and an estimate of energy savings to result from such actions.

After receiving and reviewing the industry submissions, the Secretary should, after undertaking a benefit/cost

analysis of each goal, establish an energy conservation goal for each industry and milestones which would require that progress toward the goal be accomplished through a substantial level of operational changes, industrial process changes, and installations of waste heat recovery devices, if applicable.

In implementing the program, the Secretary of Energy should request any legislative authority needed to provide appropriate incentives, such as those identified by industry in its submission, for industry to meet the established energy conservation goals. Once the program is implemented, the Secretary should monitor industry's progress in meeting the milestones, using measures agreed upon with industry and include, in his annual report to the Congress, the results of this effort.

DOE's energy conservation plan should include a request for standby authority from the Congress to implement selected requirements to place on industry if agreed upon milestones are not being met. In its annual report to the Congress, DOE should discuss its rationale for additional requirements needed to assure that industry achieves its goals.

We believe it is critical, if such a program is to be successful, that a system of standby measures be used as necessary to insure that industry meets previously developed energy savings goals. The standby measures should include mandatory equipment standards to be used where technically feasible. This would be similar in approach to certain existing environmental requirements which have had some positive effect in encouraging industry to meet required environmental targets.

AGENCY COMMENTS

Commenting on this report, DOE stated its concern about the industrial energy efficiency improvements targets program. DOE stated that

--while the report stressed the program's voluntary nature, reporting on program progress is mandatory;

--the existing targets and reporting form had been established after industry had an opportunity to comment;

--the report suggests the targets are too low because a greater amount of improvement in energy efficiency

is technically feasible; however, the legislation provided that DOE incorporate both the technological feasibility and economic practicability of utilizing more energy efficient operating procedures and technologies in establishing the targets; and

--the recommended program would require new legislation.

DOE pointed out that raising the price of energy is one of the more effective means of encouraging energy conservation and should be considered in the report. DOE also said that the report should recognize that people behave differently when they perceive a shortage than when they do not, which was a major factor in the success of energy conservation efforts in 1973 and 1974. Furthermore, DOE said when comparing 1975 energy consumption with 1972 it should be noted that in 1975 the U.S. economy was still in a recession.

We recognize that reporting under the industrial energy efficiency improvement target program is mandatory. (See pp. 34 and 35.) Our problem with the reporting aspects of the program concerns the data being reported. In our opinion the data is inadequate for assessing industry's progress under the program because it generally does not reflect the impact of changes in levels of production, a critical factor in assessing the reasons for changes in energy consumption.

Our recommendation calls for more involvement by industry in program development than did the existing program. The type of involvement we envision includes an industry description of how it would achieve specified energy conservation goals, identification of appropriate measures to assess its progress in meeting established goals, and discussion of what specific actions the Federal Government could take, including their energy savings effect, to enable industry to accomplish specified goals.

We are aware that the legislation authorizing the industrial energy efficiency improvement target program states that the targets are to be established after considering, among other things, both the technological feasibility and economic practicability of utilizing alternative operating procedures and more energy efficiency technologies. Our concern with the level at which the industry targets have been established arises from the indication, from our work, that a large share of the energy efficiency improvements to be made by certain industries in achieving their targets will come from operational type energy conservation measures requiring little or no cost. A significant share of the total energy conservation effort will need to come from

industry if the Nation is to slow its energy consumption growth rate. Thus, we believe that voluntary energy efficiency improvement targets should sufficiently challenge private industry to invest in cost-effective energy conservation measures, including process changes and waste heat recovery, even though such investments probably would not be as profitable as some other investment alternatives.

In our opinion, the existing legislation is sufficiently broad in scope to encompass a program of the type we have recommended. The Energy Policy and Conservation Act provides for the establishment of energy efficiency improvement targets for at least the 10 most energy consumptive industries after the public has had an opportunity to comment on proposed targets. The act also provides that any target established may be modified if the Secretary of Energy determines that such target cannot reasonably be attained or could reasonably be made more stringent. According to the act, the targets are to reflect the maximum feasible improvement to be achieved in each industry by 1980. The act states that no penalties may be imposed for failure to meet any established target.

Aspects of our recommended program which go beyond the existing authority in the Energy Policy and Conservation Act include extending the program beyond 1980 and developing standby authorities to be implemented if program milestones are not being met. However, we believe the DOE's broad general authority, given in the Federal Energy Administration Act of 1974, to develop and oversee the implementation of equitable voluntary and mandatory energy conservation programs and promote efficiencies in the use of energy resources, which was transferred to DOE in the Department of Energy Organization Act, provides DOE the authority to carry out such aspects of our recommended program. We recognize that new legislative authority may be necessary for implementing specific standby authorities--depending on their nature.

We agree with DOE that energy prices are important for encouraging industrial energy conservation. As we point out (beginning on p. 36) energy price increases should result in a greater level of investment in energy conservation opportunities. We have also supported, in general, the administration's proposed oil and gas users tax, which would raise the price of these fuels.

Concerning DOE's remaining points, the report does recognize that people behave differently when they perceive a shortage. This point is addressed in our discussion of

residential energy consumption. (See p. 55.) The report also points out that the downturn in business activity during 1975 was in part responsible for the decreased industrial energy consumption during that year. (See p. 32.)

RESIDENTIAL

Conservation activity was partly responsible for the low growth rate in residential energy consumption between 1972 and 1976 and Federal programs seem to have been successful, at least to some extent, in stimulating conservation activity --particularly in 1974. However, more conservation activity will be necessary if the substantial opportunities for energy conservation in the residential sector which still exist are to be realized.

Opportunities exist for increased energy conservation by

--implementing energy conservation measures in existing housing units and appliances,

--building new homes and manufacturing new appliances which are more energy efficient, and

--causing residents to follow efficient personal energy consumption patterns.

We believe that existing Federal programs, as strengthened by the NEP, coupled with the new initiatives proposed in the NEP can result in greater realization of the energy conservation opportunities in the residential sector. These include

--low-income weatherization assistance,

--mandatory energy performance standards for new buildings and major energy-consuming appliances,

--a residential energy conservation tax credit, and

--utility energy conservation services.

There are two specific additional actions which the Government could take to strengthen its residential energy conservation effort: (1) encourage the installation of heat pumps and (2) intensify efforts to encourage consumers to follow more efficient personal consumption patterns.

The increasing proportion of the housing inventory which is using electric heating emphasizes the need to encourage the use of electric heat pumps in homes, both new and existing, where they are more energy efficient than electric resistance heating. Also, the large share of the existing housing inventory which uses utility gas for heating points out conservation opportunities available through the use of gas heat pumps when they become commercially available.

In this regard the proposed residential tax credit currently under consideration by the Congress does not specifically include heat pumps as an approved energy conservation measure eligible for the tax credit. We believe specific inclusion of the heat pump as an approved energy conservation measure would encourage more consumers to install them in their residences.

As pointed out earlier, more efficient operating practices (personal consumption patterns) by residential consumers present an important opportunity for conserving energy. One way to encourage efficient operating practices is through the continuation of Government promotional programs. In our opinion such programs influenced consumers to conserve energy in the 1974-75 period at least to some extent. However, many of the actions taken during that time (operational measures) have not been sustained.

Another way to encourage consumers to make operational changes could be through the maintenance of real energy prices, at least at current levels. A decline in a residential consumer's real energy costs, brought about by a decline in the real price of energy and/or significant improvements in the thermal efficiency of the home and energy efficiency of appliances, could lead to inefficient operating practices by the consumer. We believe that DOE should monitor energy consumption on a per-housing-unit basis and real residential energy prices and take appropriate actions to increase residential fuel prices when evidence indicates that residential energy consumption is increasing because of a decrease in real residential energy prices.

RECOMMENDATIONS

We recommend that the Congress, in its consideration of the NEP, specifically include heat pumps as an approved energy conservation measure eligible for the residential tax credit as was done in the Senate-approved version of the tax credit.

We recommend that the Secretary of Energy monitor energy consumption on a per-housing-unit basis and residential energy prices, and include in his submission to the Congress standby authority proposals to increase fuel prices when evidence indicates that residential energy consumption is increasing because of a decrease in real residential energy prices.

COMMERCIAL

The commercial sector's energy consumption growth rate between 1972 and 1976 was substantially below the increase experienced in the previous 5-year period. Specific reasons for the slower energy consumption growth could not be identified because of the lack of adequate data. However, conservation actions were taken, primarily because of increased energy prices and subsequent efforts by building officials to reduce energy consumption. While Federal energy conservation programs may have encouraged some building officials nationwide to conserve, these programs appeared to have had little impact on those building officials we contacted.

There are additional opportunities to conserve energy in existing commercial buildings, but the realization of energy savings will require more Federal action. The NEP included two proposals which, if enacted, should result in more energy conservation in the commercial sector: (1) a 10-percent tax credit for business investments in energy conservation measures and (2) the elimination of master metering in new structures. The results of our review pointed out the need in the commercial sector to make energy conservation investments more financially attractive and also indicate some energy savings opportunities through the elimination of master metering in commercial and apartment buildings. The tax credit proposal and the proposal to eliminate master metering in new structures directly focus on these areas. In our evaluation of the NEP we favored the enactment of these proposals and continue to do so.

In addition, we believe that the energy audits program for commercial buildings under the State energy conservation program should be closely monitored by DOE to determine whether building owners or operators make full use of this program. Under this program, each State is required to make available energy audits for at least one type of commercial building or industrial plant in one geographic area within each State. Energy audits are a necessary step in determining what types of energy conservation measures are most

appropriate for specific buildings. We found that, generally, energy audits of buildings had not been performed. If building owners and operators included in the program take advantage of the energy audits, we believe the program should be expanded to cover other types of commercial buildings. If not, we believe that DOE should initiate other actions, such as financial incentives, to encourage individuals to undertake energy audits.

RECOMMENDATIONS

We recommend that the Secretary of Energy closely monitor the energy audits program under the State Energy Conservation Program and include in his submission proposals to expand the coverage of the energy audits portion of the State energy conservation program, should the program prove successful; and proposals to accomplish the objectives of the energy audits through other means, such as tax incentives, grants, or mandatory measures, should the program prove unsuccessful.

LIST OF GOVERNMENTAL AGENCIES, PRIVATE COMPANIES, AND OTHER BUSINESSES CONTACTED DURING OUR REVIEW

GOVERNMENT

Federal

Washington, D.C.

Civil Aeronautics Board
Department of Energy
Department of Transportation
Federal Aviation Administration
Federal Maritime Commission
Interstate Commerce Commission

State

Arizona

City Manager's Office, City of Phoenix
Office of the Governor, Arizona Office of Economic Planning and Development

California

Department of General Services, County of San Diego
Office of the City Manager, City of San Diego
Office of the Mayor, Los Angeles
Office of the Supervisor and County Energy Office, Los Angeles
State of California Energy Resources Conservation and Development Commission
State of California Public Utilities Commission

Georgia

State of Georgia, Office of Energy Resources

Illinois

City of Chicago Department of Environmental Control, Chicago
Illinois Commerce Commission, Springfield
Illinois Department of Business and Economic Development, Division of Energy, Springfield

Louisiana

City of New Orleans, Mayor's Office of Consumer Affairs

Michigan

City of Detroit, Office of the Mayor
Michigan Public Service Commission
Southeast Michigan Council of Governments
State of Michigan Department of Commerce

Minnesota

Office of City Coordinator, Minneapolis
Minnesota Energy Agency, St. Paul

New Jersey

New Jersey Department of Transportation, Trenton
New Jersey Environmental Protection Agency, Trenton
New Jersey Public Utilities Commission, Newark
New Jersey State Energy Office, Newark
Office of the Deputy Mayor, Newark

New York

New York City Environmental Protection Agency
New York City Intergovernmental Service
New York City Planning Office
New York State Department of Transportation, Albany
New York State Emergency Fuel Office, Albany
New York State Office of General Services, Albany
New York State Police, Albany
New York State Public Service Commission, Albany

Ohio

Ohio Energy and Research Development Agency
City of Cleveland, Office of Energy Conservation

Oregon

Project Director, City of Portland

Wisconsin

Civil Defense and Disaster Administration, Milwaukee
Wisconsin Office of Emergency Energy Assistance, Madison

APPENDIX I

BUILDINGS

Phoenix, Arizona

Luhrs Building
Valley Bank Center

Los Angeles, California

Atlantic Richfield Plaza
Crocker Bank Plaza
Occidental Center
Security Pacific Plaza
United California Bank Building

San Diego, California

Bank of America Building
Bank of California Building
Home Federal Tower Building
San Diego Federal Savings and Loan
Union Bank Building

Chicago, Illinois

Insurance Exchange
Midcontinental Plaza
Prudential Plaza
Sears Tower
Standard Oil Building

Detroit, Michigan

Blue Cross and Blue Shield Service Center
City National Bank Building
Francis Palms Building
Guardian Building

Minneapolis, Minnesota

First National Bank
IDS Center
Medical Arts Building
Northwestern National Bank
Osborn Building

APPENDIX I

New York, New York

Chase Manhattan Plaza
Gateway II
General Motors Building
Metropolitan Life Insurance
Pan American Building
Public Service Gas and Electric
Prudential Life Insurance Company
Time & Life Building

Cleveland, Ohio

East Ohio Building
Erieview Plaza Building
Euclid Building
Sears Building
Williamson Building

Milwaukee, Wisconsin

First Federal Savings and Loan
Marine National Exchange Bank
Northwestern Mutual Insurance Company

SHOPPING CENTERS

Phoenix, Arizona

Park Central Shopping Center

Chicago, Illinois

Merchandise Mart

Milwaukee, Wisconsin

Mayfair Mall

INDUSTRIAL

Automotive

Chrysler Corporation
General Motors Corporation
Motor Vehicle Manufacturers Association
The Ford Motor Company

Cement

Amcord/Riverside Cement Company
California Portland Cement Company
Portland Cement Association
Southwestern Portland Cement Company

Chemical

Allied Chemical Corporation
Dow Chemical Company
E.I. duPont de Nemoure & Company, Incorporated
Manufacturing Chemists Association
Pfizer, Incorporated
Union Carbide Corporation

Steel

American Iron and Steel Institute
Inland Steel Company
Institute of Scrap Iron and Steel, Incorporated
Interlake, Incorporated
United States Steel Corporation

TRANSPORTATION

Air California
American Trucking Association
AMTRAK
Chicago and Northwestern Transportation Company
Dart Transportation Service
H and H Cartage Company
Ocean, Air, and Rail Transportation Company
Roadway Express Company
Seaboard World Airlines, Inc.
The Greyhound Corporation
Transcon Lines
Western Airlines
Western Gillette, Inc.

UTILITIES

Arizona Public Service
Brooklyn Union Gas
Burbank Public Service
Commonwealth Edison
Consolidated Edison Company
Consumers Power Company
Detroit Edison Company

Los Angeles Department of Water and Power
Michigan Consolidated Gas Company
Northern Illinois Gas Company
Peoples Gas, Light and Coke Company
San Diego Gas and Electric Company
Southern California Edison Company
Southern California Gas

MISCELLANEOUS

Electric League of Arizona
Engineering Supervision Company
Environmental Defense Fund
Environmental Policy Institute
Goettl Bros. Metal Products, Inc.
Honeywell
National Climatic Center
National Conference of State Legislatures
National Resource Defense Council
The Rand Corporation

APPENDIX II

Department of Energy
Washington, D.C. 20545

MAR 20 1978

Mr. Monte Canfield, Jr., Director
Energy and Minerals Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Canfield:

We appreciate the opportunity to review and comment on the GAO draft report entitled "Energy Conservation: Status, Problems, Opportunities, and Programmatic Considerations." Our views with respect to the text of the report and the recommendations made by GAO are discussed below.

Although the report is a reasonably comprehensive summary of existing and proposed Federal conservation programs, the report tends to treat all forms of energy the same. The most serious problem for the next few decades pertains to shortfalls in petroleum-based fuels. Looked at from this point of view, a fuel substitution strategy should be carefully considered as part of any broad-based conservation program. In this context, a switchover to electric cars for urban travel might be an easier and more politically acceptable way to gain certain objectives -- reducing petroleum imports, cleaner air, etc. -- even though there would be no overall savings in energy when one takes into consideration the consumption of coal or nuclear fuel to generate the electricity. Other fuel-switching examples are: oil to solar hot water heating in the Northeast; oil to geothermal electric plants in the Southwest. Thus, it is not an either/or situation; both fuel substitution and conservation will be needed to achieve the 1985 limitation on imported oil. The usefulness of the report would also be substantially enhanced if some systematic attempts were made to prioritize conservation options considering total energy savings, scarce fuel savings, and regional supply implications.

A more specific concern we have regarding the report is its treatment of the EPCA industrial energy conservation program. We make the following observations:

(1) The report continually stresses the program's voluntary nature. In fact, while achievement of the targets is voluntary, reporting on progress is mandatory. Similarly, while the report on page 48 recommends that direct reporting be mandatory, this is already required by DOE pursuant to statutory provisions.

(2) The report suggests that the targets are too low because a greater amount of improvement is technically feasible. Pursuant to section 374(b)(2) of the EPCA, the establishment of the energy

APPENDIX II

efficiency improvement targets as the "maximum feasible improvement" must incorporate both "the technological feasibility and economic practicability of utilizing alternative operating procedures and more energy efficient technologies." (emphasis added). Consequently, DOE was not authorized to establish the energy efficiency improvement targets based only on technically feasible conservation actions.

(3) The report recommends that DOE discontinue the existing targets program and implement a revised program. The EPCA requires DOE to carry out the program in a particular way and the suggested revision would need to be authorized by new legislation.

(4) The report recommends that a revised program involve substantial industry participation. It should be noted that the industrial energy improvement targets, the direct reporting form and the criteria for adequate voluntary reporting programs were each established after significant opportunity was provided for comment from the public, including industry, and comments received were carefully considered.

(5) The report suggests that DOE impose penalties on companies for failure to achieve progress in meeting energy efficiency improvement targets. There is no authority under the current law for the imposition of such penalties.

(6) Since raising the price of energy is one of the more effective means of encouraging conservation, this option should be explicitly considered somewhere in the report.

(7) The report should recognize that people behave differently when they perceive a shortage than when they do not. This was a major factor in the success of conservation efforts in 1973-1974 and their reduced effectiveness today.

(8) 1975 energy consumption is often compared with that of 1972. It should be noted that in 1975 the U.S. economy was still in a recession and total U.S. energy consumption is closely correlated with the state of health of our economy.

Although we differ on some of the specifics, we are in basic agreement with the remaining recommendations included in the report.

The DOE is involved in other major areas which were not mentioned in the draft report. For example, we believe that substantial savings can be realized in the areas of regulated carriers. A large potential exists for additional energy conservation by regulated carriers. Neither the carriers, nor their regulatory agencies have worked vigorously enough to realize the

APPENDIX II

Mr. Monte Canfield, Jr.

potential. Section 382 of the Energy Policy and Conservation Act of 1975, which dealt with energy conservation programs for regulated carriers was aimed at these groups. We believe that the provision has not been effective. This is because the legislation did not require the regulatory agencies to periodically account or consult with a body with a continuing interest in energy conservation (such as DOE) on their conservation actions.

We would also like to point out that a significant opportunity for energy conservation evolves through consumer education programs. Over the past few years, DOE has developed a program, which after identifying and demonstrating appropriate conservation techniques for car and equipment purchase, operation, maintenance, planning and personal transportation decisions, educates fleet operators and motorists on their implementation. We have also included driver education in the DOE field test of driver-aid devices and are currently running a Fuel Economy Challenge prototype series to determine, demonstrate and showcase fuel efficiency operating techniques.

The DOE fully supports these efforts and many others which provide significant advantages in the energy conservation area.

Additional comments of lesser significance were furnished to members of your staff for consideration in preparing the final report.

Sincerely,

Fred L. Hiser, Director
Division of GAO Liaison

GAO note: Page reference refers to our draft report and may not correspond to this final report.

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DEPARTMENT OF TRANSPORTATION • UNITED STATES OF AMERICA •

ASSISTANT SECRETARY FOR ADMINISTRATION

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

March 22, 1978

Mr. Henry Eschwege
Director
Community and Economic
Development Division
General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

We have enclosed two copies of the Department of Transportation reply to the General Accounting Office (GAO) draft report "Energy Conservation: Status, Problems, Opportunities and Programmatic Considerations."

The GAO found that transportation is consuming a large and growing share of the nation's energy and that directly affects the level of crude imports, since nearly all transportation energy is in the form of oil. GAO believes that the Federal Government should take additional actions to further reduce energy consumption in the transportation sector.

The Department is in general agreement with the objectives in the transportation energy conservation section of the GAO report. However, many of the recommendations need to be more clearly delineated. Most of the recommendations relate to areas in which Federal programs are underway, or proposed in pending legislation. Since the recommendations are not spelled out in detail, it is not possible to determine, in many cases, whether they differ in any essential way from current conservation programs. Our position on the specific recommendations are discussed in the enclosed statement.

Please let us know if we can assist you further.

Sincerely,

for Edward W. Scott, Jr.

Enclosure

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DEPARTMENT OF TRANSPORTATION REPLY

TO

GAO DRAFT REPORT OF 7 FEBRUARY 1978

ON

ENERGY CONSERVATION: STATUS, PROBLEMS,

OPPORTUNITIES AND PROGRAMMATIC CONSIDERATIONS

SUMMARY OF GAO FINDINGS AND RECOMMENDATIONS

The primary purpose of the GAO report is to identify ways in which the Federal Government can promote energy conservation more effectively. Accordingly, the report:

-- discusses the extent to which actions to save energy are being taken in major energy consuming sectors of the economy (residential, commercial, industrial and transportation),

-- identifies why conservation measures have or have not been implemented and what the impact of government programs has been,

-- discusses major opportunities for additional energy conservation savings, and

-- recommends additional actions which should be taken by the Federal Government to achieve greater energy savings through conservation.

Research and development activities in the area of energy conservation were not included in the scope of the GAO review.

GAO found that the transportation sector has been consuming an increasing share of the Nation's energy and that it directly affects the level of crude oil imports. The report concluded that additional Federal Government actions are warranted, and that they should be directed toward the following objectives.

A. Reducing the annual miles traveled per automobile, through:

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(1) Maintaining the real prices of fuel to discourage increased travel as auto fuel efficiency increases.

(2) Increasing automobile occupancy rates for work trips (ridesharing).

(3) Promotion of shifts by commuters from automobiles to mass transit.

B. Accelerating the turnover rate of the automobile fleet.

C. Increasing the efficient use of fuel in trucks, particularly trucks of more than 10,000 pounds gross vehicle weight rating.

GAO made the following specific recommendations, based on their findings as summarized above.

A. Programs to be proposed by the Secretary of Energy:

(1) Monitoring of automobile fuel cost-per-mile and proposing to the Congress measures to increase gasoline prices, when such costs per mile decline in real terms.

(2) Development of programs to encourage more efficient use of energy by trucks of more than 10,000 lb. gross vehicle weight rating, including such measures as the following:

- Financial incentives for use of energy-saving devices.

- Modification of Federal trucking regulations to improve energy efficiency (such as increasing truck size and weight limits).

- Provision of incentives to foster rail/truck intermodal operations.

(3) Proposals to the Congress to increase support to urban local governments to establish preferential parking and traffic control to encourage greater ridesharing.

B. Preparation of a report to the Congress jointly by the Secretary of Energy and the Secretary of Transportation by January 1, 1979, proposing measures to encourage the use of mass transit. This report should identify additional financial actions that can be taken under

existing or new legislation and should specify the following for each proposed action:

(1) Order of priority.

(2) Level of Federal funding.

(3) Conditions for application of funds.

(4) Estimated energy savings for the mass transit measures alone and when combined with the recommended ride-sharing actions.

(5) Estimated costs and benefits of the combined measures designed to hold constant or reduce the annual miles traveled per automobile.

C. Action by the Congress to equalize the Federal share of mass transit costs under highway and mass transit programs in all states where the action would increase the Federal funding share for mass transit projects.

SUMMARY OF DEPARTMENT OF TRANSPORTATION POSITION

DOT is in general agreement with the objectives in the transportation energy conservation section of this draft GAO report. However, many of the recommendations need to be more clearly delineated. Most of the recommendations relate to areas in which Federal programs are underway, or proposed in pending legislation. Since the GAO recommendations are not spelled out in detail, it is not possible to determine, in many cases, whether they differ in any essential way from current conservation programs. DOT positions on GAO's specific findings and recommendations are summarized in the following paragraphs.

Recommendations A(1)--A(3)

GAO recommends that this group of proposals be made by the Secretary of Energy. However, they deal largely with conservation programs underway within DOT, joint programs with other agencies, or programs which affect performance of DOT functions. There would be merit in recommending that any new initiative proposals be developed by DOT, or jointly by DOT and DOE.

A.(1). The proposal to discourage driving through controls that would maintain or increase the fuel cost-per-mile requires further development and analysis. Uncertainties concerning consumer reaction to fuel price changes, as well as to changes in other costs of automobile ownership and operation, need to be better understood before specific measures can be proposed.

A.(2). In view of the existing Government-Industry Voluntary Truck and Bus Fuel Economy Improvement Program, DOT recommends that this proposal be restated as follows:

"The Secretary of Transportation submit (after consultation with DOE, EPA and the ICC) proposals to expand the Voluntary Truck and Bus Fuel Economy Improvement Program (for trucks over 10,000 lbs. gross vehicle weight rating), including consideration of the following initiatives: demonstrating the use of and providing financial incentives for implementation of energy conserving devices for trucks; studying the full ramifications of increased weight and size limits on Federal highways; modifying other Federal regulations over trucking to promote more efficient use of energy; and removal of barriers to joint rail/truck intermodal operations where energy savings can be achieved."

A.(3). DOT agrees with this recommendation of Federal financial assistance to local governments to foster carpools. However, DOT already has drafted legislation increasing such assistance in the "Highway and Public Transportation Improvement Act of 1978," Title IV.

Recommendation B:

DOT agrees with the objectives of this recommended study. The Department has included many of the elements of the study in Title V of the proposed "Highway and Public Transportation Improvement Act of 1978." Research is already underway within DOT to identify additional actions needed to realize energy savings through mass transit. Because of the DOT efforts already underway, a separately funded joint DOE-DOT study appears unnecessary.

Recommendation C:

DOT agrees with the objectives of this recommendation to achieve equalization of the Federal share of mass transit costs and highway and mass transit programs. Extensive measures to permit increased Federal support of mass transit were included by DOT in the proposed "Highway and Public Transportation Improvement Act of 1978."

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DOT POSITION

Recommendations A(1)--A(3)

A.(1). The proposed measure to control automotive fuel so as to maintain or increase the fuel cost-per-mile is similar in objective to the crude oil equalization tax proposed in President Carter's National Energy Plan (NEP), and to the NEP's proposed standby gasoline tax. Neither of these provisions has been enacted by Congress.

GAO's recommendation is based on a finding that increases in fuel efficiency will result in an offsetting increase in vehicle miles traveled unless the demand is dampened by increases in the real cost-per-mile of fuel. The GAO finding, however, was based on limited data for the period 1972-76. The dynamics of travel demand were not fully reflected in the data. For example, no consideration was given to the total cost of owning and operating an automobile or to the influence of income changes on travel demand. Additionally, the secondary impacts and distribution among automobile users of higher fuel costs were not assessed.

DOT recommends that analyses of the influence of the real fuel cost-per-mile of travel be conducted before such a proposal is advanced. Optional mechanisms for control and uses of the revenues generated should be included in the analyses.

A.(2). GAO's recommendation does not recognize the existence of the Joint Government-Industry Voluntary Truck and Bus Fuel Economy Improvement Program which is the Federal effort addressing conservation in this sector of transportation. Since 1975, the Department of Transportation, the Department of Energy, and the Environmental Protection Agency have sponsored this voluntary program which now has over 175 members, including motor carriers, all major bus, truck and engine manufacturers, industry suppliers, trade associations, unions, and the trade press. This program encourages conservation through the exchange of information and endeavors to develop industry consensus standards for the accurate measurement and prediction of fuel use in vehicles.

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Although accurate measurements of fleet-wide success in the Voluntary Truck and Bus Fuel Economy Program are difficult, there are a number of indications that it is working well. A DOT survey of truck manufacturers showed that sales of fuel-saving devices on 1976 model trucks led to a 155,000,000 gallon fuel saving per year on 1976 models alone. A survey taken by Diesel Equipment Superintendent Magazine reported similar favorable results--an improvement of 11 percent in mpg over two years. The survey covered fleets operating 64,000 pieces of equipment approximately .75 billion miles per year. The Federal Highway Administration reports an improvement in combination vehicle fuel economy between 1972 and 1975 of 5 percent for the entire vehicle fleet.

The text relating to this recommendation is deficient. For example, in the table entitled, "Truck Data," the grouping of small personal-use trucks with heavy commercial trucks averages the data to a point of hiding important factors. DOT data on fuel economy improvements in large trucks is lost, as is the significance of commercial truck mileage. The following data for heavy trucks (from the Interagency Study of Post-1980 Goals for Commercial Vehicles) and the data for light trucks (from the National Highway Transportation Savety Administration) illustrate the differences which are masked by use of averages for all trucks. Trucks of more than 10,000 lb. gross vehicle weight rating averaged 5.7 miles per gallon of fuel in 1975. DOT estimates fuel consumption for the personal truck/van portion of the "truck" fleet at 12.2 miles per gallon in 1975.

GAO has not fully stated the situation with regard to increasing truck size and weight limits. It is the Federal Government that established maximum allowable truck size and weight limits on the Interstate Highway System. Although these weight limits were set in 1956 at the beginning of the Interstate highway program, Congress recently (in the Federal-Aid Highway Amendments of 1974) authorized the States through that enabling legislation to increase the allowable axle loads and gross weights to a prescribed maximum. Many of the States have since taken advantage of that legislation and have increased their weight limits; yet a number have not. Those that have not are arrayed from north to south along the Mississippi River and effectively block the movement of east-west commodity flow in commercial vehicles traveling between States that have taken action to adopt the higher, allowable weight limits. Although charges have been leveled at these States that their inaction results in a lower fuel efficiency for the Nation's commercial motor vehicle fleet, their actions have typically resulted from concern with the tradeoff between the potential increase in fuel efficiency and the increased costs of maintaining and rebuilding highways whose service life would be shortened by imposition of the heavier loads. The latter costs, of course, would be borne by the States, whereas the benefits of increased fuel economy would accrue to the motor carrier industry. It is not clear how much of these savings would be passed on to users in the form of lower transportation rates.

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The complexity of this issue is such that DOT cannot support Federal regulatory changes to increase truck size and weight limits unequivocally Instead, DOT proposes continued study of the full ramifications of increased truck size and weight limits.

A.(3). The Federal government has been engaged in ridesharing promotional programs since 1973. DOT, EPA, and DOE (FEA) have all been involved in such programs. The Department of Energy Organization Act transferred vanpooling and carpooling promotion functions from FEA to the Secretary of Transportation. GAO's recommendation specifies "greater assistance and support of local governments of major urban areas to establish preferential carpool parking, preferential traffic controls and other actions to increase ridesharing." DOT and others have carried out a number of demonstration programs in carpooling and vanpooling and DOT has studies underway to assess strengths and weaknesses of various kinds of incentives and other program characteristics for the purpose of proposing a strong nationwide pooling program. The Department has proposed new legislation to strengthen future efforts. Title IV of the proposed "Highway and Public Transportation Improvement Act of 1978" calls for authority for the Secretary of Transportation to approve financial assistance from existing transportation funds for carpool and vanpool encouragement, including such specific projects as "designation of existing highway lanes as preferential carpool highway lanes, providing related traffic control devices and designating existing facilities for use as preferential parking for carpools."

Recommendation B:

DOT is already heavily involved in assessments of management, technological and financial alternatives in mass transit promotion. Title V of the proposed Act cited above includes among its provisions the following: "(1) to provide. . . a formula grant program which will provide a continuous and predictable flow of funds to help ensure that services are maintained . . .," and "(2) to allocate available Federal and local resources through a more efficient use of the existing transportation resources and an analysis of alternative transportation investments...."

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Recommendation C:

DOT's proposed legislation (cited above) will provide financing on a four-year authorization basis and includes proposals to: adopt uniform Federal matching shares for highway and public transportation.