REPORT BY THE

Comptroller General

OF THE UNITED STATES

A Framework For Developing A National Energy Conservation Program

In this report GAO identifies energy conservation opportunities, discusses how alternative policies or programs can be evaluated, and identifies possible criteria to determine merits of various energy conservation actions.

GAO's purpose is to suggest a method that could be used to develop a comprehensive national energy conservation program.

The report responds to a request from the Chairman, Subcommittee on Energy, Joint Economic Committee.

EMD-79-76
JULY 31, 1979

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

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TNT 00704

The Honorable Edward M. Kennedy
Chairman, Subcommittee on Energy
Joint Economic Committee
Congress of the United States

Dear Mr. Chairman:

In your March 20, 1979, letter you requested that we undertake an analysis of the opportunities for energy conservation and provide our observations on how criteria to select individual energy conservation opportunities could be developed.

This report (1) provides our overall views in the energy conservation area, (2) identifies major energy conservation opportunities, (3) discusses an approach for considering alternative policy or program options to achieve some of those opportunities, and (4) identifies possible criteria which could be used to evaluate the relative merits of alternative actions to achieve greater energy conservation.

Chapter 1 provides a background and perspective on energy conservation and includes some of the major conclusions we have reached on the Federal Government's efforts to achieve energy conservation. Chapter 2 discusses one possible set of criteria which could be used to evaluate the relative merits of alternative programs to achieve energy conservation. Chapter 3 provides examples of the range of specific strategies which could be considered to achieve some of the energy conservation opportunities in the major energy-consuming sectors. Chapter 4 presents our conclusions.

The purpose of this report is to suggest to the Congress and the administration one approach which could be used to develop a comprehensive national energy conservation program. We recognize that the specific framework presented is only one alternative for addressing the issues inherent in moving forward with a viable, effective energy conservation program. We hope that the report will serve to focus the energy conservation debate on the choices which need to be made concerning alternative energy conservation policies and programs.

Fed retaining energy conservation

CWD 01121
AHC 00912

As requested by your office we obtained comments on a draft of this report from the Department of Energy, including the Energy Productivity Task Force. In addition, as requested by your office, we plan to restrict further distribution of this report for 30 days from the date of this report unless the report contents are released by your office before that time.

Sincerely yours,

Comptroller General
of the United States

REPORT BY THE
COMPTROLLER GENERAL
OF THE UNITED STATES

A FRAMEWORK FOR DEVELOPIN A NATIONAL ENERGY CONSERV TION PROGRAM

D I G E S T

In this report GAO undertakes an analysis of energy conservation opportunities and evaluates how the administration might develop an overall national energy conservation program.

The framework discussed for developing such a program is one among several possibilities.

There is no reason to believe that the world will not go on experiencing periods of tight energy supply and rising energy prices. The present gasoline supply and price situation is a constant reminder.

For the Government to lead the Nation effectively toward a more efficient use of energy, the administration should establish an overall national energy conservation goal which includes an acceptable level of crude oil imports and, at the same time, the eventual use of renewable energy resources.

GAO's past energy conservation work identified the following overriding problems which reduce the effectiveness of present energy conservation policies and programs.

--The lack of an overall energy conservation goal.

--The lack of an aggressive Federal in-house energy conservation program.

--The failure of the Congress and the administration to agree on emergency energy conservation and gasoline-rationing plans.

The decisionmaking framework discussed in this report is intended as one approach for considering the wide range of alternatives available to the Government for achieving more energy conservation in the Nation. The framework provides for evaluating energy conservation strategies ranging from voluntary initiatives to mandatory actions. It also provides for selecting specific policies and programs based on an evaluation of expected energy savings and costs and on environmental, economic, and social impacts.

GAO believes the development of an energy conservation ethic deserves special attention and that it is probably the most important challenge facing the Federal Government in the energy conservation area. The Federal Government needs to

--clearly and convincingly describe the Nation's energy problem to the public, and

--promote energy conservation as providing positive cost benefits in an environment of rising energy prices.

The Department of Energy basically agrees that the administration needs to develop a comprehensive energy conservation plan. The Department stated that emphasis is needed on examining how various industrial, commercial, and governmental institutions might vary their operations to minimize traffic flow and maximize mass transit use.

Contents

ABBREVIATIONS

MB/DO	Thousand barrels per day of oil
MB/DOE	Thousand barrels per day of oil equivalent
mpg	Miles-per-gallon
RPA	Resource Planning Associates, Inc.

CHAPTER 1

INTRODUCTION

In a March 20, 1979, letter, the Chairman, Subcommittee on Energy, Joint Economic Committee, requested that we undertake an analysis of the opportunities for energy conservation and provide our observations on how criteria to select individual energy conservation opportunities could be developed. This report (1) provides our overall views in the energy conservation area, (2) identifies major energy conservation opportunities, (3) discusses an approach for considering alternative policy or program options to achieve some of those opportunities, and (4) identifies possible criteria which could be used to evaluate the relative merits of alternative actions to achieve greater energy conservation.

BACKGROUND

The Federal Government needs to get its energy conservation act together. There is no reason to believe that the world is not going to continue experiencing periods of tight supply and upward pressure on prices. The existing gasoline supply and price situation is a constant reminder of this.

The Congress and the administration need to develop and implement an effective energy conservation program which will substantially reduce the Nation's dependence on foreign energy sources and allow for an orderly transition to essentially renewable energy sources. Substantial opportunities for conserving energy exist in all major energy-consuming sectors. However, the Nation's progress in achieving energy conservation, given the extent of available energy conservation opportunities, has been limited.

In June 1978, we reported 1/ on the results of the Nation's efforts to conserve energy following the 1973 oil embargo and the effectiveness of Federal energy conservation programs being carried out during the 1973-76 time period. We reported that supply disruptions, a recession, and increased energy prices contributed to decreased rates of energy consumption growth during that time. We also concluded that,

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1/"The Federal Government Should Establish and Meet Energy Conservation Goals" (EMD-78-38, June 30, 1978).

while some consumers implemented energy conservation actions, by 1976, many of the energy conservation actions undertaken were not being sustained.

Concerning the impact of Federal energy conservation programs, we concluded that some of the programs were initially successful in some energy consuming sectors, primarily transportation and residential. The success of those programs, which were mostly educational and consisted of public appeals to conserve, can be attributed, for the most part, to the prevailing circumstances of that time--supply disruptions (either actual or threatened) and rapidly increasing energy prices (both in actual and real terms). However, as the "crisis" situation subsided, consumers apparently reverted to previous energy consumption practices.

Data on domestic energy consumption trends for 1977 and 1978 show that the Nation's rate of total energy consumption growth is significantly below historical levels. For example, energy consumption increased about 2 percent for each of those years, compared to historical growth of 3.5 to 4 percent per year. The primary reason for the slower growth was that industrial energy consumption remained essentially unchanged for these 2 years even though industrial output continued to increase. On the other hand, energy consumption in the transportation and building sectors continued to increase at annual rates of over 2.5 percent and 3.2 percent, respectively. These increases are important because these sectors accounted for over 70 percent of the total U.S. petroleum consumption in 1978 and, as such, are primarily responsible for the Nation's continued high level of crude oil imports. Thus, the need for increased levels of energy conservation is still apparent.

Overall, our past energy conservation work has identified overriding problems which, in our opinion, have reduced the effectiveness of existing Federal energy conservation policies and programs. These problems are:

--The lack of consistent, specific planning which clearly identifies what contribution energy conservation is to make in the overall national energy plan.

--The lack of an aggressive, coordinated effort to conserve energy in Federal operations and facilities.

--The failure of the Congress and the administration to agree on emergency energy conservation and gasoline-rationing plans.

In our view, these problems exist because the administration has essentially viewed energy conservation in the context of short-term crisis management of real or threatened energy supply shortfalls (for example, the 1973 oil embargo, unusually cold winters, the national coal strike, and the recent Iranian situation). Even now, with gasoline shortages occurring and various State and regional gasoline purchase restriction plans either activated or seriously considered, much of the Nation still sees the energy problem as an "oil company ripoff" rather than a long-term physical supply problem.

In the final analysis, a concentrated effort by the Congress, the administration, and the general public will be needed to move forward with an aggressive, effective national energy conservation program. The actions which need to take place to effectively move forward include the following:

--The administration must develop an energy conservation plan which clearly establishes overall energy conservation goals, proposes specific actions which would be taken to achieve those goals, and provides for standby initiatives which could be implemented if it appeared that established goals would not be met. The specific actions proposed in the plan should be identified in terms of the contribution each is to make in achieving the overall energy conservation goal. The plan should also contain milestones and a program to continuously monitor and evaluate each action.

--The Congress must fully support the need to achieve substantial levels of energy conservation and make the hard choices between alternative policy and program actions which, if effectively implemented, will result in the necessary level of energy conservation.

--The general public must be convinced of the need to conserve energy and must be provided the information necessary to make efficient choices in their consumption of energy.

PERSPECTIVE

Energy conservation means using energy more efficiently and reducing waste. Energy conservation has been viewed as both a partial solution to the Nation's long-run problem of domestic energy supply/demand imbalances and as an alternative to deal with short-term supply disruptions. While to some extent both views are appropriate, we believe that energy conservation must be a key component of the Nation's long-run energy program. An effective energy conservation program in this context will also serve to minimize the adverse impacts of future supply disruptions similar to the recent Iranian situation.

Energy conservation's role in the Nation's long-run energy program has been extensively examined by a number of Government and private concerns. While these groups have generally used different bases and assumptions to estimate the magnitude of energy conservation opportunities and the types of policies or programs which would be needed to achieve substantial energy savings, two key points seem to be generally accepted--it is significantly less costly to save energy than it is to purchase new energy supplies, and the price of energy is probably the most influential factor in achieving energy conservation.

The Energy Policy Project of the Ford Foundation reported in 1974, 1/ that investment required to conserve energy between 1975 and 2000 would be $300 billion less than the investment which would be needed to develop the energy facilities if the energy were not conserved. The recent report by the Council on Environmental Quality 2/ also concluded, based on the work of many others, that measures to conserve energy generally require less investment than programs to install new energy supply systems. For example, power requirements for window air conditioners can be reduced at a cost of about $90 per kilowatt, while new peak generation and distribution capacity costs over $400 per kilowatt. In addition, in a report on financing commercialization of

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1/"A Time to Choose," Energy Policy Project of the Ford Foundation, 1974.

2/"The Good News About Energy," Council on Environmental Quality, 1979.

energy technologies, 1/ we concluded that energy conservation should have top priority for Government financial assistance because it has the greatest potential payoff and is the most attractive on an incremental cost basis.

The energy-pricing issue has been a key element in the continuing debate over national energy policy. In our opinion, there has been little disagreement that upward movement in energy prices will provide significant incentives for gains in the efficiency of energy use and for finding and developing new energy sources. The primary issues at the center of the debate are the timing and level of increased prices in view of the effect such increases could have on specific groups of consumers, for example, low-income families.

In several instances, we have recognized the need for higher energy prices, both to promote energy conservation and to establish the viability of alternative fuels. In our report on commercializing energy technologies, we concluded that energy prices are important in achieving effective energy conservation because price increases would serve to implement some conservation technologies without direct Government financial assistance. More recently, in our June 30, 1978, report on energy conservation, we concluded that gasoline prices and residential fuel prices should increase, by Government action if necessary, if it appeared that the energy savings to be gained from the use of more efficient vehicles and homes was being offset by increased personal consumption of energy. In addition, in previous reports 2/, we have supported the concept of pricing energy at its replacement cost because it is important that consumers pay such costs for all energy consumed.

While we believe the level of energy prices is a key component in the Nation's efforts to move forward with an aggressive, effective energy conservation program, difficult choices will need to be made concerning other specific energy

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1/"An Evaluation of Proposed Federal Assistance for Financing Commercialization of Emerging Energy Technologies" (EMD-76-10, Aug. 24, 1976).

2/"An Evaluation of the National Energy Plan" (EMD-77-48, July 25, 1977) and "Region at the Crossroads--The Pacific Northwest Searches for New Sources of Electric Energy" (EMD-78-76, Aug. 10, 1978).

conservation policies and programs. These choices will need to be based on a careful analysis of criteria, such as environmental and economic impacts, which clearly describe the trade-offs of alternative programs or policies.

From the perspective of the Federal Government, policies and programs to effect changes in existing energy consumption patterns can be developed using any or a combination of three basic approaches--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. 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). The indirect market 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.

Federal energy conservation programs currently authorized and ongoing use all of the above approaches. However, in many cases, the effectiveness of these efforts in achieving energy conservation is unknown because of inadequate monitoring of the program's impact or the difficulty in measuring the program's impact. This latter difficulty is particularly relevant to voluntary programs.

As additional actions are undertaken, the administration needs to develop an overall national energy conservation plan which identifies an appropriate longer term goal and describes how each of the existing Federal conservation initiatives are expected to contribute to meeting the established goal. Such a plan will provide the basis for evaluating the extent of additional energy conservation needed to meet the goal as well as the trade-offs involved in choosing among specific policy and program alternatives. We continue to believe this type of plan is needed, as soon as possible.

The following chapters provide a framework for addressing the energy conservation area. We describe a possible methodology for making decisions on specific energy conservation policies and programs to be pursued by the Nation. Included are

--a presentation of one possible set of criteria which could be used to evaluate the relative merits of alternative policies or programs,

--an identification of selected major energy conservation opportunities, and

--a discussion of the types of policy and program alternatives which could be considered to realize some or all of the energy conservation opportunities.

The policy and program alternatives provided as examples do not include such actions as free mass transit or 100-percent tax credits for energy conservation investments. However, such innovative alternatives also need to be carefully considered when developing an overall energy conservation plan.

SCOPE

The information contained in this report is based on our work in energy conservation over the past 2 or 3 years as well as a number of private and governmental studies which have been published in recent years.

We emphasize that the energy savings estimates included in this report were either obtained from previously published studies or are based on such studies. We have made no attempt to determine their accuracy but have included them because we believe the estimates reasonably represent the relative magnitude of various energy conservation opportunities which have been examined in recent years.

CHAPTER 2

POSSIBLE CRITERIA FOR SELECTING SPECIFIC POLICIES AND PROGRAMS

Selecting a specific set of strategies to achieve greater energy conservation is a complex and involved task. Both the Congress and the administration are faced with the final decisions concerning the specific strategies which are to be pursued. In making those choices, we believe a number of "selection factors" should be evaluated to better understand the trade-offs involved in choosing one set of strategies over another. Those factors include the following:

--Energy savings likely to be achieved, by fuel type, from effective implementation of the strategy.

--Time frame in which energy savings can be achieved.

--Dollar cost of implementing, both from the Government and consumer perspectives, as well as the strategy's administrative feasibility.

--Environmental implications, particularly health and safety.

--Economic impact, for example, inflation and unemployment.

--Burden on selected consumer groups or regions.

Careful evaluation of the above factors should highlight many of the trade-offs which may be necessary to achieve additional energy conservation and should result in the selection of an effective package of energy conservation strategies to meet any necessary level of energy savings required. In addition, consideration would also have to be given to any overriding national security issues. However, as we have emphasized in previous reports, the Federal Government needs to agree on and establish an overall national energy conservation goal before any package of strategies can be adequately considered.

EXPECTED ENERGY SAVINGS AND COST TO IMPLEMENT

Before any specific energy conservation strategy can be considered for implementation, an expected level of energy savings should be determined along with the cost of implementing the strategy to both the Government and the consumer. An evaluation of expected energy savings is necessary to identify what a specific program can contribute to an overall energy conservation goal and to provide a basis for continuously monitoring the program to ensure that the expected energy savings are being realized.

Energy savings should also be evaluated in terms of the types of energy being affected. In the near term, the Nation's level of crude oil imports poses a serious problem. Thus, energy conservation strategies designed to increase the efficiency of petroleum consumption should receive greater emphasis than strategies directed at saving other fuel types. However, this is not to say that energy conservation strategies which can effectively increase the efficiency of the Nation's use of other fuels are not important and necessary. As we discussed in our report evaluating the President's National Energy Plan, it is highly questionable whether the Nation can increase its production capabilities of other conventional fuels--for example, electricity generated from coal and nuclear fuel--at rates which would limit future demands for crude oil. In summary, any overall national energy conservation program undertaken must guide consumers toward more efficient use of all conventional energy sources while emphasizing the urgent need to improve the efficiency of petroleum consumption.

Identifying the cost of implementing a specific energy conservation strategy is necessary for evaluating its cost effectiveness in terms of individual consumers as well as the administrative actions required for implementation. From the individual consumer's perspective, the energy conservation action which the strategy is to encourage should at least be cost effective over the action's lifespan; i.e., the cost of the energy to be saved should exceed the cost of implementing and maintaining the conservation action.

We have shown in past work that the "cost effectiveness to the consumer" factor has limited the number and types of energy conservation actions undertaken, primarily in the commercial and industrial sectors. However, the cost effectiveness issue has not been whether energy conservation actions

are cost effective over the action's lifespan, but whether these actions have been cost effective when compared to alternative investment opportunities. This distinction becomes critical when evaluating the effectiveness of various energy conservation strategies directed at the commercial and industrial sectors. This distinction also centers on the difference between cost effective improvements in the efficiency of energy use from the Nation's and the individual consumer's perspective.

Any energy conservation strategy undertaken by the Federal Government will involve certain administrative costs. Such costs should be considered to assure that any strategy undertaken does not result in an excessive level of administrative cost in view of the amount of energy expected to be saved.

TIME FRAME OF EXPECTED ENERGY SAVINGS

Evaluating the timing of energy savings expected from a given set of strategies is important because it provides a basis for (1) viewing each strategy in terms of its contribution to an overall energy conservation goal, (2) selecting a package of strategies which results in an orderly progression toward the overall goal, and (3) monitoring each strategy's impact so that the need for additional actions to meet the goal can be identified in a timely manner.

Although numerous opportunities for improved energy efficiency exist, the time frame in which they could be achieved varies significantly. For example, while energy savings from lowering thermostats can be realized immediately, energy savings from improved efficiency of the Nation's housing stock will take years to accomplish. Thus, energy conservation strategies should be evaluated in the context of the time frame in which the expected savings will be achieved.

We have stated in the past that energy conservation should be an integral part of the Nation's long run energy program. We also believe an overall energy conservation program should reflect continuous movement toward greater energy efficiency. Estimating the time frame of expected energy savings from specific energy conservation strategies provides a basis for pursuing a set of strategies which, when implemented as a package, can help guide the Nation in a more orderly approach to achieving energy conservation goals.

ENVIRONMENTAL IMPLICATIONS

An evaluation of the environmental impacts of an energy conservation strategy must be performed to identify any possible health, safety, and other risks associated with its implementation. Overall, reducing energy use through greater efficiency should result in positive benefits to the environment because adverse environmental impacts will be reduced along the entire chain of energy extraction, delivery, and consumption. Nevertheless, certain energy conservation strategies can pose health and safety risks. For example, in conjunction with appeals from the Federal Government following the 1973 oil embargo for consumers to increase the thermal performance of their residences through increased levels of insulation, demand for insulation increased. To meet that demand, new firms entered the market and produced and sold cellulose insulation. However, some of the cellulose material produced and sold was later determined to pose a fire hazard. Although the Federal Government has taken steps to alleviate this problem, the situation demonstrates the need to adequately assess alternative energy conservation strategies in terms of their potential health and safety impacts.

Some energy conservation strategies could directly affect requirements for maintaining clean air. For example, requirements for catalytic devices on automobiles or air pollution control devices for industry to maintain air quality standards could be relaxed to increase the efficiency of energy consumption. In addition, the administration is in the process of temporarily relaxing requirements to reduce the amount of lead in leaded gasoline in order to save energy in the crude oil refining process. Thus, a careful analysis of the environmental implications of such actions should be performed to clearly identify the trade-offs which are inherent in selected energy conservation strategies.

ECONOMIC IMPACTS

The relationship between energy conservation and overall economic growth has been, and continues to be, a central issue in the debate over to what extent the Nation can conserve energy. While, historically, the Nation's economic growth and energy consumption have been related in essentially a one-to-one relationship, recent studies and trends indicate that continued economic growth does not require similar growth

in energy consumption. 1/ However, since these factors are still closely related, an evaluation of the expected economic impact of a given energy conservation strategy should be undertaken to identify what specific impacts may result from implementing the strategy.

Examples of possible adverse impacts which may result from selected energy conservation strategies are unemployment and increased rates of inflation. We would expect that energy conservation strategies which include financial disincentives, such as energy use taxes and taxes on inefficient products, depending on their magnitude, would more likely adversely affect inflation and employment than either financial incentives or voluntary strategies, particularly in the short run.

On the other hand, certain energy conservation strategies may result in positive benefits to the economy. According to the recent Council on Environmental Quality report on energy conservation, greater energy conservation can thwart inflation because energy conservation measures can cost as little as 10 to 50 percent that of new supply, can improve the Nation's balance of payments, and can have a beneficial effect on total employment because energy conservation should lead to greater growth in labor-intensive sectors. In addition, in a report on the future of electricity in the Pacific Northwest, 2/ we assessed the regional economic and employment impacts of selected alternative energy futures. We concluded that a policy of increased energy conservation and use of renewable resource technologies would, in the long term, contribute more to the region's overall economy and employment picture than a policy of expanding thermal generating capacity.

Because the level of energy consumption and the economy are closely related, we believe it is necessary to assess individual energy conservation strategies in terms of their expected economic impact to better understand the possible trade-offs involved in pursuing specific strategies.

1/See footnote 2 on p. 4.

2/"Region at the Crossroads--The Pacific Northwest Searches for New Sources of Electric Energy" (EMD-78-76, Aug. 10, 1978).

BURDENS ON SELECTED CONSUMERS OR REGIONS

Alternative energy conservation strategies should be evaluated in terms of possible burdens which may be placed on selected consumer groups and/or geographic regions. A frequently discussed example is the added burden that energy taxes or increased energy prices in general may place on low-income groups. Another example is the added burden increased oil prices would have on the New England area because of this region's heavy reliance on oil for its heating as well as its transportation needs. These examples point out the need to evaluate the possible adverse impacts certain energy conservation strategies may have on selected consumer groups or geographic areas. Once identified, efforts should be made to minimize such impacts to assure, to the extent possible, that specific groups are not unduly affected.

Overall, we do not believe that increasing the efficiency of energy consumption necessitates that substantial burdens be placed on any specific groups or regions. However, should the administration fail to develop an overall national energy conservation plan with specific goals and move forward with an effective program to achieve those goals, as we have recommended in the past, the Nation will continue to experience supply shortage situations which will be even more severe. In our opinion, these circumstances are most likely to require Federal actions which may result in excessive burdens on selected consumer groups or regions.

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The following presents a method for assessing various energy conservation strategies using the selection factors discussed above. Two specific energy conservation strategies are evaluated, for illustration purposes, to demonstrate how the framework might be used. The specific categories included under each selection factor (for example, the various ranges of energy savings shown under "Expected energy savings by fuel type") are intended to be generally representative of the types of categories which would have to be developed in order to assign rating values for each selection factor. Developing such categories will require judgmental decisions.

One Example of an Approach for Evaluating the Relative Merits and Selecting Alternative Energy Conservation Strategies

ENERGY CONSERVATION OPPORTUNITY: Operational changes and retrofit of existing commercial buildings

DESCRIPTION OF THE STRATEGY: Strategy A - Accelerated depreciation on qualifying retrofit equipment

Strategy B - A 15 percent tax credit on the purchase and installation of qualifying retrofit equipment

SELECTION FACTORS	Assigned ratings (note a)	Strategy A ratings	Strategy B ratings
Expected energy savings by fuel type			
Over 400 MB/DOE (note b) or 200 MB/DO (note c)	100		
Between 100 and 400 MB/DOE or 50 and 200 MB/DO	90	90	90
Between 50 and 100 MB/DOE or between 25 and 50 MB/DO	80		

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a/Assigned rating values represent the "score" to be given to the specific strategy evaluated in each of the selection factor areas. The assigned ratings shown do not necessarily represent the relative importance of each factor when compared to the others. Determining appropriate assigned rating values will require, to a great extent, subjective judgment. We have included values merely to illustrate how this approach could be used to evaluate alternative energy conservation strategies.

b/MB/DOE - Thousand barrels per day of oil equivalent.

c/MB/DO - Thousand barrels per day of oil.

Selection Factors	Assigned ratings	Strategy A ratings	Strategy B ratings
Associated cost/benefit to consumer for undertaking the conservation measure: (note a)		3	3
Under 1-year payback	5		
1 to 3-year payback	3		
3 to 5-year payback	1		
Over 5-year payback	0		
Administrative cost:		0	-5
Substantial administrative burden	-15		
Moderate administrative burden	- 5		
Minimal cost	0		
Environmental impacts:		0	0
Serious environmental impact	-30		
Some adverse impact	-10		
Beneficial impact	10		
No measurable impact	0		
Economic impacts:			
Inflation:		0	-10
Contributes significantly (3%)	-30		
Slightly inflationary (1%)	-10		
Deflationary effect	10		
No measurable effects	0		
Unemployment:		10	10
Increases 2%	-30		
Increases 1%	-10		
Creates jobs	10		
No effect	0		
Time frame of savings		5	5
Within 1 year	10		
Between 1 to 5 years	5		
Over 5 years	0		

a/One might evaluate a strategy based on both current and projected fuel prices.

Selection factors	Assigned ratings	Strategy A ratings	Strategy B ratings
Burdens on selected groups:		0	0
Severe hardship and inability to alleviate	-30		
Some hardship but not excessively burdened	-10		
No adverse effect on specific groups	0		
Final strategy rating (note a)		108	93

a/The higher the final strategy rating score, the greater the overall effectiveness of the strategy in conserving energy.

CHAPTER 3

STRATEGY ALTERNATIVES TO ACHIEVE ENERGY CONSERVATION

A number of studies conducted by Government and private concerns in recent years provide convincing evidence that substantial opportunities for energy conservation exist in all four of the major energy-consuming sectors--residential, transportation, commercial, and industrial. Whether or not the opportunities for energy conservation are ultimately realized will depend, to a great extent, on the types of policies and programs initiated by the Federal Government.

We have listed energy conservation opportunities identified in various studies and reports in appendix I of this report. We have also included in appendix I estimates of energy savings potential associated with many of the conservation opportunities. The estimates are based on or were obtained directly from the various studies and reports. It must be emphasized that quantifying potential energy savings is an estimation process which relies on critical assumptions made by the estimator. We have not attempted to evaluate the validity of the energy savings estimates but only include them to illustrate the relative magnitude of individual opportunities.

If one added the individual energy savings estimates included in appendix I, the total would be from 12.7 to 13.6 million barrels of oil equivalent per day. However, such a calculation would not provide an accurate estimate of the total energy conservation potential in the Nation because

--many of the opportunities contained in appendix I have not been quantified,

--the estimates came from a wide variety of sources and are not necessarily compatible,

--some of the energy savings estimates obtained from older studies may have already been achieved,

--for the industrial sector, the potential energy savings associated with energy conservation opportunities on an industry-wide basis are

extremely difficult to quantify because of the many different ways energy is used in American industry, and

--implementing some measures may preclude or reduce the achievement of energy savings from another measure.

With regard to the last point, appendix I contains some individually listed opportunities, and their corresponding energy savings potentials, which may not be entirely achievable if other related opportunities are pursued at the same time. The residential and transportation sector opportunities provide examples.

In the residential sector, retrofitting gas furnaces with electric ignition devices would preclude achievement of the energy savings associated with shutting off pilots in gas furnaces during non-heating seasons. This is true because the installation of electric ignition devices in gas furnaces would eliminate the need for a continuously burning pilot. Although totaling the energy savings potential of these two opportunities results in 150,000 barrels per day of oil equivalent, the inability to achieve the 30,000 barrels per day of oil equivalent savings associated with shutting off pilots would reduce the total savings to 120,000 barrels per day of oil equivalent.

In another case, pursuing two opportunities may not entirely eliminate the impact of one of the opportunities, but rather reduce its expected result. For example, improving the thermal performance of existing residences would likely reduce, to some degree, the estimated energy savings associated with some operational type energy conservation actions (such as thermostat adjustments). This is true because increasing the thermal performance of a residence would decrease the amount of time the heating and cooling system operated. For this example, we could not determine what that impact would be.

As another example, in the transportation sector, accelerating the average automobile fleet fuel economy in 1985 by 1 mpg, if pursued in combination with reducing miles traveled per vehicle in the same year by 10 percent, would result in somewhat less energy savings than that indicated by the total of these two opportunities. Using the estimates contained in appendix I, the total of these two opportunities is 710,000 barrels of oil per day. Pursuing these actions in combination

would result in a total expected savings of about 690,000 barrels of oil per day; a "reduction" in savings of 20,000 barrels per day of oil or about 3 percent of the total savings. The "reduction" occurs because energy savings from more efficient automobiles are reduced when they are driven less miles.

In any event, however, we believe it is significant to note that even if the energy conservation potential were only half as great as the total indicates, it would represent nearly three-fourths of the Nation's current level of crude oil imports, in oil equivalent terms.

The previous chapter discussed a possible set of criteria which could be used to select a package of specific energy conservation strategies the Nation should pursue in its energy conservation program. This chapter provides examples of the range of specific strategies which could be considered to achieve selected energy conservation opportunities in each of the major energy-consuming sectors. The strategies are discussed in terms of voluntary, indirect market intervention and direct market intervention approaches. We also discuss, in general terms, how application of the previously discussed selection factors highlight some of the trade-offs in specific strategies. Our purpose is to illustrate the range of policy and program options which should be considered in developing a national energy conservation program.

FURNACE AND WATER HEATER THERMOSTAT SET-BACKS IN RESIDENCES

More energy is used for space heating than for any other purpose in the residential sector. In fact, about 55 percent of all energy consumed in the residential sector is for spaceheating purposes. Simply lowering the average indoor temperature 5 to 6 degrees for a 24-hour period can reduce space-heating energy requirements by 15 percent. Lowering the temperature an additional 8 degrees for 8 hours at night can reduce space-heating energy requirements another 7 percent. Thermostat set-backs can be done manually, at no cost, or with automatic set-back devices (clock thermostats), at a moderate cost ($40-$100).

After space-heating energy requirements, water heating accounts for the largest portion of residential energy use--about 15 percent. Adjusting the water heater thermostat to lower the water temperature 20 or 30 degrees can reduce the amount of energy used for water heating by up to 27 percent.

By taking the above two actions, residential consumers could reduce their energy use by 16 percent. A number of strategies can be implemented to achieve this conservation opportunity. These range from simply asking people to lower thermostat settings, to establishing and enforcing mandatory maximum settings. Figure 1 summarizes some of these strategies and, in some cases, their expected impact.

Voluntary strategies

The President can appeal to consumers to conserve energy by turning down thermostats; appeals by other public officials and by public service advertisements would then follow.

FIGURE 1

Conservation Opportunity: Furnace and Water Heater Thermostat Setback

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings	Direct market intervention strategies	Possible savings
Encourage consumers to take action through public appeal program.	Up to 200 MB/ DOE.	Tax excessive energy use.	Unknown.	Legislate maximum temperature settings for furnaces (68 F) and water heaters (120 F).	up to 1,400 MB/DOE.
Conduct an intensive public education program stressing the economic benefits of taking the actions.		Adopt utility structures which discourage excessive energy use (i.e., increasing block rates).	Unknown.		
Require automatic thermostat controls for furnaces in all residences prior to utility hook-up to make it easier for consumers to undertake the action. (note a)					

a/Since this strategy would not require a specific consumer behavior, but would only encourage it, we have classified this action as a voluntary rather than a mandatory action.

This type of action has the advantages of being easy to implement and relatively inexpensive, and can result in immediate energy savings. On the other hand, response is usually short-term. It appears that this approach is most effective when consumer perception of real shortage situations is high, such as during the oil embargo in 1973-74 and the natural gas shortage in 1976-77. Consumers appeared to respond well to public appeals to conserve energy during what they perceived as a "crisis." However, they apparently resumed normal consumption habits once the "crisis" atmosphere abated.

A second strategy could be to inform consumers, on an individual basis, of the amount of real cost savings they might achieve by turning down thermostats. Local utility companies could be required to provide this information to each consumer and reinforce any actions taken by consumers by providing frequent feedback on savings achieved. The advantage of this approach is that it stresses the fact that conserving energy saves money. Continued increasing of energy prices and frequent feedback on the cost savings effect of conservation actions could provide sufficient incentive for consumers to continue taking these actions. A disadvantage of this type of strategy is that it would involve considerable effort and expense on the part of utilities.

A third strategy could be to encourage the revision of State and local building codes to require that all new residential construction and existing residences being sold have automatic thermostat controls installed prior to utility hook-up. Manual adjustment may demand a greater degree of time and attention on a day-to-day basis then some consumers are willing to put forth. Also, some consumers may object to waking up to or returning to a cool house. The use of an automatic thermostat control device improves the convenience of lowering temperatures after the consumer has retired for the night or left the house, and of raising temperatures again shortly before the consumer rises or returns home. This approach would ensure the fact that, eventually, most residential units would have such devices. However, it does not guarantee that all consumers would use them.

Indirect market intervention strategies

Energy-use taxes, progressive utility rate structures, or other energy-pricing strategies which discourage excessive energy consumption could provide consumers with the incentive to undertake operational conservation measures such

as lowering furnace and water heater thermostat settings. Aside from these financial disincentives, there appears to be few strategies to encourage consumers to undertake these or any other operational conservation measures under the indirect market intervention approach. One such strategy is to provide a tax credit for the purchase of automatic clock thermostat controls.

A 15-percent Federal tax credit was enacted as part of the Energy Tax Act of 1978 for the purchase and installation of automatic energy-saving setback thermostats. The impacts of that action are not yet known.

Direct market intervention strategies

Assuming the requisite constitutional power, the Federal Government could legislate maximum allowable furnace and water heater thermostat settings for residential units--an extreme approach. Assuming general compliance with the law, energy savings would be very significant. However, we do not believe that such a law could be adequately enforced, at least not without major funding increases for State or Federal enforcement efforts.

RETROFIT GAS AND OIL FURNACES WITH AUTOMATIC VENT DAMPERS

An automatic vent damper is a device which, when installed in a gas or oil furnace, closes the exhaust flue when the furnace is not on and prevents the loss of conditioned air to the outside through the flue. Thus, energy is saved by reducing the amount of time the furnace needs to operate.

Approximately 46 million heating systems could be retrofitted with vent damper devices. As many as 185,000 barrels per day of oil equivalent could be saved through this action. Some strategies which could be used to realize some of this opportunity are discussed below and summarized in figure 2.

Voluntary strategies

The Federal Government could conduct a comprehensive promotional campaign to encourage consumers to install vent dampers in residences now equipped with oil- and gas-fired furnaces. The campaign could use major media publicity and should stress the economic benefits to be gained from installing these devices. Other types of information should also be provided including possible energy savings, inspection and

FIGURE 2

Conservation Opportunity: Retrofit Gas and Oil Furnaces with Automatic Vent Dampers

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings	Direct market intervention strategies	Possible savings
Conduct a comprehensive advertising campaign for the installation of vent dampers.	28 MB/ DOE.	Reduce the cost of vent dampers to the consumer by having gas utilities and heating oil distributors purchase the devices directly from the manufacturer and arrange for installing them.	Unknown.	Require the retrofit installation of the devices on oil and gas furnaces prior to resale of homes.	Up to 185 MB/ DOE.

testing for proper function, and safety precautions to installers of such devices. If 15 percent of those reached by such a campaign took the desired actions, energy savings equivalent to about 28,000 barrels of oil per day could be expected.

The Federal Government could also encourage State and local governments to revise building codes to provide for the installation of vent dampers in appropriate residences. This strategy would focus more on improving the energy efficiency of new residences but would also allow for the installation of vent dampers in existing residences where building codes currently prohibit their installation. Thus, some additional energy savings might be realized.

Indirect market intervention strategies

Depending on the type of vent damper and the difficulty of installation, the total cost to the consumer of installing a vent damper could reach $200. This cost could possibly be reduced if the Federal Government required gas utilities

and heating oil distributors to arrange for bulk purchases and installation of vent dampers for their customers who wanted them. Lowering the cost of the device and its installation would shorten the consumer's payback period and make vent dampers more economically attractive for consumers with older furnaces.

Another strategy for reducing the cost of vent dampers would be through a tax credit. The recently enacted Energy Tax Act of 1978 includes a 15-percent tax credit for the purchase and installation of vent dampers.

Direct market intervention strategies

Legislation could be passed which would require the retrofit of oil and gas furnaces with vent dampers in many residences at the time of resale. Federally insured financial institutions could be required to make approval of mortgage loans for the purchase of existing homes with oil or gas furnaces contingent upon the seller certifying that the furnace has been retrofitted, where justified, with a vent damper device. While such an action would not ensure that all existing oil and gas heated residences would be retrofitted with vent dampers, it could stimulate some consumers to install vent dampers for their own benefit.

ACCELERATE THE IMPROVEMENT OF THE AUTOMOBILE FLEET'S AVERAGE FUEL ECONOMY

The average fuel economy of the automobile fleet is projected to increase to 19.4 miles per gallon (mpg) in 1985 due to the effects of the mandated new car fuel economy standards set by the Energy Policy and Conservation Act (Public Law 94-163). This is an increase of 43 percent from the fleet average of 13.6 mpg in 1975.

A larger increase in the average fleet fuel economy could be attained if actions are taken to accelerate the introduction of more efficient new cars into the fleet. An increase in the average fleet fuel economy of 1 mpg by 1985 would reduce oil consumption by 240,000 barrels per day. Figure 3 summarizes strategies which could be adopted to achieve the potential savings. These strategies are discussed below.

FIGURE 3

Conservation Opportunity: Improve the Fuel Efficiency of the Vehicle Fleet

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings	Direct market intervention strategies	Possible savings
Encourage consumers to purchase the most efficient vehicle available which suits their needs.	Assuming 15 percent of consumers purchasing new cars took the action 13 MB/DO of oil could be saved.	Encourage the States to impose higher registration fees on less fuel-efficient vehicles.	Unknown.	Ban the sale of vehicles which fail to meet a specified minimum mpg rating.	240 MB/DO.
		Offer rebates on fuel-efficient vehicles.	Unknown.		
Direct mailing of EPA Gas Mileage Guide to every household.		Reduce import tax on fuel-efficient foreign cars.	Unknown.		
		Remove the Federal excise tax on radial tires.	Unknown.		

Voluntary strategies

The Federal Government could take actions to encourage consumers to purchase the most efficient model available which suits their particular needs. One such action might be the direct mailing of the EPA Gas Mileage Guide to all registered drivers. If 15 percent of consumers purchasing a new car each year between 1980 and 1985 responded to this action by selecting a model which averaged 5-percent better gas mileage than a model they would have otherwise selected, savings of about 13,000 barrels of oil a day could be achieved by 1985.

Indirect market intervention strategies

Various financial incentives or disincentives could be used to stimulate the purchase of more fuel-efficient cars and accelerate the scrappage of fuel-inefficient cars.

Consumers could be encouraged to replace existing inefficient automobiles with new, more efficient models by the imposition of higher annual registration fees on inefficient automobiles. The less efficient an automobile, the more the owner would have to pay to register it within his State of residence. Also, consumers could be offered cash rebates as an incentive to purchase more efficient automobiles. The more efficient the automobile purchased, the greater the rebate.

The Federal Government could remove or reduce the import duty on foreign automobiles which meet or exceed a specified fuel economy standard. This action would increase the competiveness of such automobiles with comparable, less efficient domestic models. The Federal Government could also remove the Federal excise tax on radial-ply tires in order to encourage consumers to replace conventional bias-ply tires on existing automobiles with radial tires. Replacing bias-ply tires with radial tires can increase an automobile's fuel economy by 3 to 5 percent.

Direct market intervention strategies

The Federal Government could ban the sale of cars which cannot achieve a minimum fuel economy standard. Assuming that manufacturers do not alter their production mix, this action would increase the new car fleet's average fuel economy beyond the currently mandated standard. The Federal Government could set the minimum standard at any level necessary to achieve the desired increase in fleet average fuel economy.

IMPROVE THE FUEL ECONOMY OF NEW AUTOMOBILES BEYOND 1985

The Energy Policy and Conservation Act mandates fuel economy standards for new automobiles for model years 1978 through 1985. These standards require a sales-weighted new car fleet average of 18 mpg in 1978, increasing to 27.5 mpg in 1985.

Increasing these standards further between 1985 and 2000 is possible and would save a significant amount of energy. Increasing the fuel economy standards to 40 mpg in 2000 could reduce automobile gasoline consumption by 25 percent. This would amount to a savings of 1.2 million barrels of oil per day from what demand would be if fuel economy standards remain constant at 27.5 mpg from 1985 through the end of the century. A discussion of alternative strategies to achieve this opportunity follows and is summarized in figure 4.

FIGURE 4

Conservation Opportunity: Improve the Fuel Efficiency of Automobiles Beyond 1985

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings	Direct market intervention strategies	Possible savings
Establish voluntary fuel economy goals beyond 1985 and encourage manufacturers to comply.	Unknown.	Subsidize the development of more efficient engine and vehicle design technology directly with grants or indirectly with tax incentives.	Unknown.	Establish post-1985 fuel economy standards for autos.	1,200 MB/DO.

Voluntary strategies

The Federal Government can establish fuel economy goals for automobiles beyond 1985 and encourage manufacturers to meet those goals. But we do not expect this action alone to bring about much, if any, improvement in fuel economy beyond 1985. Consumer preference for more efficient cars, outside of mandated standards, primarily determines the extent to which automobile manufacturers will improve the fuel economy of their models. Government efforts to increase consumer preference for models which achieve a fuel economy in excess of the 1985 standards could increase the manufacturers' willingness to meet voluntary goals.

Indirect market intervention strategies

Indirect market intervention strategies which could increase consumer preference for more fuel efficient automobiles have been discussed earlier in the section on accelerating the introduction of the more fuel efficient automobiles into the national fleet. Such strategies could be continued beyond 1985.

The Federal Government could also subsidize the development of advanced automobile energy conservation technology. This action could include Federal research, development, and demonstration; direct grants; or tax incentives.

Direct market intervention strategies

As we have already stated, the Federal Government has mandated automobile fuel economy standards through 1985. However, the Government could mandate more stringent standards beyond that date. Such standards would have to take into account existing technology at the time of development and would assure a continuous upgrading of the efficiency of the Nation's automobile fleet.

REDUCE THE AVERAGE NUMBER OF MILES TRAVELED ANNUALLY BY EACH AUTOMOBILE

In 1976, each automobile in operation in the U.S. traveled an average of 10,941 miles. This figure has been projected to rise to 12,119 by 1985--an increase of about 11 percent. If the average number of miles traveled by each automobile is reduced to the 1976 level (a reduction of about 3.5 percent from the estimated 1979 level) and held at that level, oil consumption in 1985 would be reduced by about 470,000 barrels a day.

One key aspect in the area of reducing vehicle miles traveled is the price of gasoline. The current gasoline supply shortage situation, with its accompanying increases in gasoline prices, is likely to have its greatest impact in reducing the amount of driving. While it is difficult to predict what impact the increased gasoline prices will have when the supply situation improves, we would expect miles traveled per vehicle annually to fall below previously projected levels.

Beyond the impact of increased gasoline prices on vehicle miles traveled, the Federal Government can undertake a number of strategies which could reduce the average number of miles traveled by each automobile. Some of these strategies are discussed below and summarized in figure 5.

FIGURE 5

Conservation Opportunity: Reduce Vehicle Miles Traveled by Increasing the Use of Mass Transit and Car/Van Pools for Commutes.

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings	Direct market intervention strategies	Possible savings
Encourage commuters to form car and van pools.	72 MB/DO could be expected from various voluntary appeals to consumers.	Reduce mass transit fares by subsidizing operating costs.	Unknown.	Legislate a mandatory car or van pooling program for all employers with a specified number of employees.	Unknown.
Encourage consumers to use mass transit when available.		Increase the cost of parking.	Unknown.		
Encourage employers to establish car and van pool programs for their employees.		Subsidize the capital and operating costs of employer operated car and van pool programs.	Unknown.	Restrict parking to multiple occupancy vehicles.	Unknown.
Encourage the expansion of urban bus systems by providing capital subsidies.					
Encourage limited access highways for multiple occupancy vehicles.					
Provide priority parking for car/van pools.					

Voluntary strategies

The Federal Government can encourage ridesharing, in the form of carpools and vanpools, and the use of mass transit where available. Advertising campaigns can be used to encourage commuters to form carpools and participate in existing vanpool programs. The advertising should stress the economic benefits obtained by the commuters through reduced fuel, vehicle maintenance, and parking expenditures.

The Federal Government can also promote the development of employer-based carpool and vanpool programs, promote preferential parking and limited access highways for high-occupancy vehicles, and encourage the expansion of urban bus systems to provide a wider service area and reduce waiting times. These actions would encourage consumers to shift to higher occupancy forms of transportation by providing convenient alternatives to their private automobiles.

Indirect market intervention strategies

Financial incentives or disincentives can be used to encourage consumers to use their personal automobiles less. Reducing the cost of using public transit, subsidizing employer-based carpool or vanpool programs, or increasing the cost of using the private automobile can improve the attractiveness of high-occupancy forms of transportation.

The Federal Government can help hold down public transit fares by further subsidizing the operating costs of public transportation systems. The Federal Government can also subsidize the capital and operating costs of employer-operated carpool or vanpool programs. Direct funding or tax incentives could be used to implement these strategies.

The Federal Government can encourage local governments to impose higher parking rates for low-occupancy vehicles or to implement a toll system based on the occupancy of the vehicles. These measures would make it more cost effective for commuters to share rides or use public transportation systems.

Direct market intervention strategies

All employers with a specified number of employees in a central location could be required to establish a carpool and/or vanpool program. Legislation establishing such a requirement could also provide funding for financial and technical assistance for establishing the programs. Another strategy would be to encourage local governments to ban drivers from parking private (non-carpool) vehicles in central city areas.

OPERATIONAL MEASURES AND RETROFIT OF EXISTING COMMERCIAL BUILDINGS

Commercial buildings present significant opportunities for saving energy through the implementation of various operational measures and retrofit actions. Energy savings estimated for these opportunities amount to the equivalent of over 2.5 million barrels of oil per day. The types of operational measures which could be undertaken are similar to those in the residential sector and include thermostat adjustments for both heating and cooling, reduced lighting, and reduced temperatures for hot water. Possible retrofit measures to conserve energy include increasing the levels of insulation, caulking, and weatherstripping; performing scheduled maintenance on equipment; and installing double glazed windows.

In a study for the former Federal Energy Administration, 1/ Hittman Associates, Inc., evaluated a number of energy conservation strategies which could be pursued by the Federal Government to achieve some of the energy conservation opportunities available in the commercial building sector. Some of these strategies are discussed below and are summarized in Figure 6.

1/Now part of the Department of Energy.

FIGURE 6

Conservation Opportunity: Operational Measures and Retrofit of Existing Commercial Buildings

Voluntary strategies	Possible savings	Indirect market intervention strategies	Possible savings
Public information.	96.5 MB/DOE.	Tax credit (15 percent).	107 MB/DOE.
Require disclosure of building energy consumption at time of sale.	108.5 MB/DOE.	Accelerated depreciation for retrofit measures.	103 MB/DOE.
		Excise tax on excess consumption.	109 MB/DOE.
		Revised utility rate structures.	155 MB/DOE.

Voluntary strategies

One voluntary strategy would be for the Federal Government to mount a substantial public information campaign to educate building owners regarding the energy issues of which they should be aware. It would involve (1) distribution of literature as well as the composition of articles and advertisements for trade publications, and (2) the preparation of displays and presentations for building owners trade conferences and conventions. Such a strategy could be expected to save the energy equivalent of about 100,000 barrels of oil per day by 1985. The strategy would involve minimal cost to both the consumer and the Government.

Another strategy which the Federal Government could undertake would involve requiring all banks which participate in Federal insurance programs to certify, for any commercial building sale financed through their bank, that the building

owner had provided the prospective buyer with the previous 5-year energy consumption information. The estimated energy savings associated with this strategy are the equivalent of about 110,000 barrels of oil per day by 1985. This strategy would involve little cost to the consumer or the Government, but would likely be resisted by commercial building owners and the banks.

Indirect market intervention strategies

The Federal Government could grant building owners and occupants a 15-percent tax credit on qualifying expenses in the purchase and installation of retrofit equipment for energy conservation. This strategy could be expected to save the energy equivalent of about 107,000 barrels of oil per day by 1985. In essence, the tax credit would provide an incentive which lowers the first cost of retrofit measures. First cost investment has traditionally been a major factor affecting decisions to purchase equipment. It would also provide a stimulant for investing in capital equipment.

The Federal Government could also permit accelerated depreciation on the costs of qualifying retrofit equipment. Under this strategy, retrofit equipment would be allowed to depreciate fully over a 3-year period rather than the normal 8-year period. The program would be implemented and administered by the Internal Revenue Service. Energy savings associated with this strategy amount to the equivalent of about 103,000 barrels of oil per day by 1985.

The Federal Government could implement an energy consumption excise tax by defining an appropriate standard for energy consumption in buildings and then leveling the excise tax on consumption above the standard. The tax would be a fixed percentage of the cost of energy consumed above the standard. In subsequent years, the standard could be made more stringent, requiring increasing efficiency in buildings. The strategy would be implemented at the State level because it would be necessary to have variations in the standard along climatic lines.

Energy savings associated with this strategy amount to the equivalent of about 110,000 barrels of oil per day by 1985. While this strategy would provide a substantial disincentive to energy consumption, it would be difficult to administer because energy use rates vary with building type, age, and heating and cooling systems, among other things.

The Federal Government could instruct the Federal Energy Regulatory Commission to remove the decreasing unit cost feature of interstate utility rates and exert influence to motivate State power commissions to do the same. Such a strategy could be expected to save the energy equivalent of about 155,000 barrels of oil per day by 1985. However, this strategy would probably receive extreme resistance from the utility industry, and would place heavy penalties on large-volume energy consumers who in some cases may be the least wasteful energy users.

IMPROVED USE OF COGENERATION

Cogeneration is the simultaneous or sometimes sequential production of both electricity and useful thermal energy (usually in the form of process steam). Because a cogeneration plant produces both thermal and electric energy, it saves from 10 to 30 percent of the fuel that would otherwise be used if two separate plants were involved.

The total amount of energy that could be saved by cogeneration in America is unknown; however, using six of the largest industrial users of electricity and process steam gives a good insight into how effective cogeneration can be. Past estimates of the energy savings from increased industrial cogeneration development in these industries range from the energy equivalent of several hundred-thousand to over 1.6 million barrels of oil per day.

In a study of six industries, Resource Planning Associates (RPA) evaluated a number of voluntary and indirect market intervention energy conservation strategies which could be implemented to increase energy savings through cogeneration beyond what is expected to be achieved without Government action.

We are currently completing a major study of the energy savings potential of cogeneration. That study assesses the role that cogeneration can play in the Nation's energy conservation efforts and evaluates how much energy savings can be expected. We are planning to issue a report later this year.

The following discussion and figure 7 summarize some of the RPA study. In addition, the Government could mandate measures that would encourage cogeneration development.

FIGURE 7

Industrial Conservation Opportunity: Cogeneration

Voluntary strategies	Possible savings	Indirect market Intervention strategies	Possible savings	Direct market Intervention strategies	Possible savings
Encourage industry to begin or increase cogeneration. This can be facilitated by	250 to 420 MB/ DOE. (Most of the savings would be in oil.)	30-percent investment tax credit.	47 MB/ DOE.	Require that all technically feasible cogeneration be undertaken.	1,000 to 1,600 MB/ DOE.
--exemption from electric utility regulation, and	4 MB/DOE.	Loan guarantees.	10.5 MB/ DOE.		
--relaxation of some emission/pollution standards.	12 MB/DOE.	12-year depreciation.	19 MB/ DOE.		

Voluntary strategies

RPA estimated that without direct Government action, energy savings from cogeneration could reach between the equivalent of 250,000 and 420,000 barrels of oil per day by 1985. This level of energy savings would result from that cogeneration potential which is currently considered economically attractive. Government encouragement of private industry may result in energy savings at the higher end of the range.

Government actions which may facilitate more voluntary cogeneration action by industry include exempting cogeneration plants at industrial sites from electric utility regulation and relaxing sulfur dioxide emission standards.

Government action to exempt industrial cogeneration plants from electric utility regulation could result, according to RPA, in energy savings equivalent to only about 4,000 barrels of oil per day. However, the estimated cumulative net cost over the period is only $8 million. This action would be

responsive to management's expressed concern that an industrial plant might become subject to the authority of a public utility commission if there were a parallel interconnection with the utility grid. It would require that Federal and State utility commissions relinquish all jurisdiction over industrial cogeneration plants, except perhaps during a declared state of emergency, but would in no way restrict Federal or State authority over the sale of power from industrial cogeneration plants.

RPA estimated that the relaxation of sulfur dioxide emission standards could save the energy equivalent of about 12,000 barrels of oil per day. There are, of course, environmental costs which must be considered. By 1985, an incremental amount of 700 tons of sulfur per year would be released to the atmosphere. There are additional considerations of shifts from low-sulfur western coal to higher sulfur content eastern coal, also.

Indirect market intervention strategies

RPA evaluated a number of indirect market intervention strategies to achieve additional energy savings from cogeneration. Among these were a 30-percent investment tax credit, a 12-year depreciation option, and Government loan guarantees.

The establishment of a 30-percent investment tax credit, according to RPA, could be expected to result in energy savings equivalent to about 47,000 barrels of oil per day by 1985. The tax credit would increase cogeneration development by improving the financial returns of industry and increasing the percentage of technically suitable steam development in those instances where cogeneration is already financially attractive. To cogenerate additional electricity, industry would burn more coal, oil, and waste fuel, and would recover more waste-heat. Since this additional industrial generation displaces an equivalent amount from the electric utilities' systems, the savings of coal, oil, natural gas, or nuclear fuel are affected at the utilities.

RPA estimated that the establishment of a 12-year depreciation option for industrial cogeneration equipment could be expected to save the energy equivalent of about 19,000 barrels of oil per day by 1985. According to RPA, the 12-year depreciation option is shorter than that allowed under Federal tax codes (22-1/2 years on equipment). Similar to the tax credit strategy, this option will increase cogeneration development

by improving financial returns and increasing the percentage of technically suitable steam developed in those instances where cogeneration is financially attractive.

According to RPA, the establishment of a loan guarantee program could be expected to result in energy savings equivalent to about 10,500 barrels of oil per day in 1985. The program would be expected to increase cogeneration development primarily in small companies by reducing the risk on such investments. The amount of technically suitable steam developed is expected to be small since only the steel and petroleum refining industries anticipate severe capital restraints.

Direct market intervention strategies

The Federal Government could mandate measures that would encourage that all technically feasible cogeneration opportunities be undertaken. Assuming complete compliance with such a mandate, the energy equivalent of between 1 million and 1.6 million barrels of oil per day could be expected to be saved by 1985. However, such an action would impose severe hardships on industry in addition to being very costly to enforce.

CHAPTER 4

CONCLUSIONS

The Federal Government needs to take a more active leadership role in moving the Nation toward using energy more efficiently. Carrying out this role will first require that the administration establish an overall national energy conservation goal which reflects a more acceptable future level of crude oil imports and, at the same time, recognize the need to move toward the use of renewable energy sources. As we have reported in the past, the administration has not provided this type of leadership.

Once a national energy conservation goal has been established, difficult choices will need to be made concerning the specific types of policies and programs which will be needed to achieve the overall energy conservation goal. The policy and program choices must be made in the context of currently known opportunities for improving the efficiency of the Nation's use of energy.

In this report, we have discussed a framework which could be used to facilitate making the decisions on specific energy conservation policies and programs because, in our view, the administration has not demonstrated its willingness or ability to put forth a comprehensive, effective overall energy conservation program. Should the administration fail to develop such a comprehensive plan and fail to effectively implement the actions called for in the plan, we see further instances of increasingly more severe supply disruptions in the future and a diminishing ability of the Nation to effectively deal with them.

The decision-making framework we have presented provides, in our opinion, one logical systematic approach for considering the wide range of alternatives available to the Federal Government for achieving greater levels of energy conservation in the Nation. The framework provides for the evaluation of energy conservation strategies within the spectrum ranging from voluntary initiatives to mandatory actions. The framework also provides for selecting specific policies or programs for implementation based upon an evaluation of each strategy's expected energy savings and costs; and environmental, economic, and social impacts.

We recognize that the framework we have presented has limitations. The methodology relies on a significant amount of subjective judgment and may not adequately address certain, more innovative approaches to achieving energy conservation. Thus, it is important that the administration consider alternative methodologies for devising a comprehensive energy conservation plan and then expeditiously move forward with an effective national energy conservation program.

Based upon the results of our work in the energy conservation area, we believe one issue deserves special attention in the continuing effort to achieve greater levels of energy conservation: the development of individual consumer habits and attitudes which result in more efficient personal consumption of energy.

Many studies have identified substantial opportunities for conserving energy in the residential and transportation sectors. Much of the energy consumed in these sectors is directly affected by individual consumer's personal habits and behavior. It appears that a conscientious concerted effort by the public to change their energy consumption habits and behavior has not yet taken place. Convincing the public to make such changes--development of an energy conservation ethic--is probably the most important challenge facing the Federal Government in the energy conservation area. The Federal Government needs to clearly and convincingly describe the Nation's energy problem to the public and must promote energy conservation as providing positive cost benefits in an environment of rising energy prices. Accomplishing this objective will, in our view, provide the foundation necessary to achieve other energy conservation opportunities.

AGENCY COMMENTS

In commenting on a draft of this report the Department of Energy said it was in basic agreement that the administration needs to develop a comprehensive energy conservation plan and it is now developing key elements of a plan. The Department stated that emphasis is needed on examining how various industrial, commercial, and governmental institutions might vary their operations to minimize traffic flow problems and maximize mass transit use.

The Department further stated that while the report recommends that the administration develop conservation strategies, and contingency plans, a clear distinction needs to be made between these two activities. In addition, the

Department pointed out that, when evaluating various energy conservation strategies, long-term strategies should not be penalized in favor of taking actions which yield benefits in the short-term.

We agree that analyses should be made of alternative actions to achieve a more efficient and effective transportation systems as well as other alternative strategies to achieve greater energy conservation. We also agree with the thrust of the Department's comment that long-term energy conservation strategies should generally not be penalized in favor of short-term strategies. It is important, however, that analyses of alternative strategies be performed in the context of energy conservation goals. As we state on page 8 of the report, the Federal Government needs to agree on and establish an overall national energy conservation goal before a package of strategies can be adequately considered. Once such a goal has been established, an evaluation of alternative strategies to effectively achieve that goal can proceed in the context of the time frame implicit in the goal.

This report does not discuss contingency planning activities, but rather focuses on how the administration might proceed with the development of a comprehensive energy conservation plan. We certainly agree with the Department that a distinction should be made between developing energy conservation strategies and contingency planning. We point out that the report contains no recommendations in either of these areas.

CONSERVATION OPPORTUNITIES

RESIDENTIAL

Improve the operational efficiency of the home (lifestyle changes)	Estimated Savings MB/DOE, (note a)
Furnace thermostat set-back (manual or with clock thermostat).	750 to 1,000
Air conditioner thermostat set-up.	125
Water heater thermostat set-back.	235 to 350
Reduce hot water consumption by 1/3.	200
Shut off pilots in gas furnaces during non-heating season.	30
Reduce heating and air conditioning load by	
--closing off unused rooms;	
--keeping doors, fireplace dampers (when no fire going), and windows closed when units are in operation; and	
--keeping drapes and curtains closed in unoccupied rooms.	
Reduce use of lights and appliances by	
--switching off unneeded lights and	
--turning off appliances when not in use.	

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a/Savings estimates are based on, or were obtained directly from, various studies and reports. We have not evaluated the validity of the estimates but believe they represent a reasonable estimate of the relative magnitude of the various energy conservation opportunities. Energy savings estimates were not available for some opportunities.

APPENDIX I

	Estimated Savings (MB/DOE)
Improve the thermal performance of existing homes	500
Install ceiling, wall, and floor insulation.	
Caulk and weatherstrip.	
Add storm doors and windows.	
Improve the thermal performance of new buildings	1850
Use energy efficient design and construction practices to minimize heat loss and gain.	
Improve the energy efficiency of existing equipment	
Furnace tune-up.	485
Gas furnace electric ignition retrofit.	120
Air conditioner tune-up.	60
Insulate water heaters.	
Install automatic vent dampers.	185
Improve efficiency of oil furnaces by	200 to 400
--reducing nozzle size and modifying air handling parts and	
--replacing inefficient burners with high efficiency burners.	

APPENDIX I

	Estimated Savings (MB/DOE)
Improve the efficiency of new equipment	350 to 500
Refrigerators/refrigerator freezers.	
Freezers.	
Furnaces.	
Central air conditioners.	
Humidifiers/dehumidifiers.	
Televisions.	
Room air conditioners.	
Clothes washers.	
Clothes dryers.	
Dishwashers.	
Water heaters.	
Room heaters.	
Cooking ranges.	
TRANSPORTATION	
Autos/light trucks	
Increase new automobile fuel economy beyond 1985 (40 mpg in 2000).	1,200
Accelerate the improvement of average fleet fuel economy (increase 1985 fleet average by 1 mpg).	240

APPENDIX I

	Estimated Savings (MB/DOE)
Improve the efficiency of existing autos by	
--better maintenance (tune-ups) (improve 1/2 fleet by 5%),	135
--use of radial tires (one half the auto fleet using radials),	80 to 135
--correct inflation of tires, and	
--use of low friction oil.	
Improve efficiency by use of more efficient driving techniques by	
--driving at more efficient speeds (comply with 55 mph speed limit) and	140
--avoiding "jackrabbit" starts and stops.	80 to 100
Reduce miles traveled per vehicle by about 10 percent by	470
--increasing use of mass transit,	
--increasing car/vanpooling,	
--eliminating unnecessary trips, and	
--combining trips.	
Improve highway design (applies to all highway modes) by	
--improving traffic flow (reduce stops and starts),	
--reducing grades,	
--building smoother surfaces, and	

	Estimated Savings (MB/DOE)
--shortening travel time (more direct routes).	
Commercial trucks	(note a) 80 to 200
Improve efficiency of the trucks themselves by	
--reducing aerodynamic drag,	
--using radial tires,	
--modifying power train and reducing demand for horsepower,	
--maintaining vehicles properly, and	
--building more efficient engines.	
Improve efficiency of operation through more efficient driving techniques by	
--driving at efficient speeds,	
--maintaining constant speeds,	
--avoiding sudden starts and stops, and	
--Shifting to higher gears at minimum speeds.	

a/This savings range applies only to heavy trucks (those with a Gross Vehicle Weight in excess of 26,000 lbs). These trucks consume about 70 percent of the fuel used by the commercial truck fleet.

APPENDIX I

	Estimated Savings (MB/DOE)
Reduce vehicle miles traveled by	
--increasing load factors,	
--using more direct routes,	
--reducing empty (deadhead) miles, and	
--consolidating trips.	
Air	
Improve air traffic control by	10
--flying at altitudes best suited for fuel efficiency,	
--utilizing fuel efficient climb and descent profiles,	
--minimizing circuitous routings, and	
--decreasing airborne delays in airport terminal areas.	
Reduce number of flights by	
--increasing load factors and	112
--increasing use of simulators for pilot training.	4
Improve the efficiency of aircraft.	245
Rail	14 to 27
Improve operating efficiency by	
--maintaining diesel engines,	
--reducing fuel spillage,	

APPENDIX I

	Estimated Savings (MB/DOE)
--adjusting service of low density lines,	
--using Train Performance Calculator to develop for each line segment the most effective balance of horsepower, tonnage, and speed for overall fuel conservation, and	
--improving road bed.	
Waterways	
Improve efficiency by	
--reducing speeds,	1
--improving port turnaround time, and	4
--improving the efficiency of operating practices.	17
COMMERCIAL	
Undertake operational type (housekeeping) measures	
Thermostat setting changes.	590
Night thermostat set-back.	340
Reduce lighting levels.	150
Reduce hot water temperature by 20 F (120 F minimum).	30
Use automatic shut-off faucets in lavatories.	30

APPENDIX I

	Estimated Savings (MB/DOE)
Scheduled maintenance.	290
Use restricted-flow shower heads.	50
Improve thermal performance of existing buildings	
Caulk and weatherstrip.	300
Improve ceiling insulation.	270
Improve wall insulation.	260
Install storm or high efficiency glass.	250
Use trees for shading and wind-breaker effect.	
Establish minimum ventilating air requirements.	80
Improve efficiency of equipment	
Equipment maintenance and feedback control.	
Improve operation schedule (including automated controls).	
Recover chiller waste heat.	
Repair system leaks.	
Increase air conditioner efficiency.	180
Increase refrigeration efficiency.	110

	Estimated Savings (MB/DOE)
Improve thermal performance of new buildings	
Use energy efficient design and construction practices.	
INDUSTRIAL	
Improved housekeeping measures	750
Adjust temperatures for space heating and cooling.	
Turn off unnecessary lights.	
Shut down machines when not in use.	
Repair steam leaks.	
Clean heat transfer barriers.	
Maintain steam traps and boilers at peak efficiency.	
Fuel instead of electric heat in direct heat application	28
Steam/electric cogeneration for 50 percent of process steam	500
Heat recuperators or regenerators in 50 percent of direct heat applications	145
Electricity from bottoming cycles in 50 percent heat applications	100
Recycling of aluminum in urban refuse	14
Recycling of iron and steel in urban refuse	14
Fuel from organic wastes in urban refuse	130

APPENDIX I

	Estimated Savings (MB/DOE)
Reduced throughput at oil refineries	170
Substitution of more efficient electric motors	
Replacement of obsolete plants and equipment	
Development of new, more efficient industrial processes	

APPENDIX II

Department of Energy
Washington, D.C. 20545

July 11, 1979

Mr. J. Dexter Peach, Director
Energy and Minerals Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

We appreciate the opportunity to review and comment on the GAO draft report entitled "A Framework For Developing A National Energy Conservation Program." Our views with respect to the text of the report are discussed below.

The Department of Energy (DOE) is in basic agreement that the Administration needs to develop a comprehensive energy conservation plan. DOE is now developing key elements of a plan via National Energy Plan II (NEP II), Conservation Strategy Papers, and Energy Productivity Task Force.

The report has consolidated many ideas that have already been put forward by various sources. Most of these bases are technological (increase auto engine efficiency) or institutional (parking taxes). The technology base will require several years to impact the vehicle fleet in a major way. The institutional bases presented do not, in general, provide the public with alternatives.

Emphasis is needed on overall systems analysis of fuel use by National, regional, and local transportation systems as a function of the operational flexibility of the industrial and commercial systems which they serve. In other words, an examination of how various industrial, commercial, and government institutions might vary their operations to minimize traffic flow problems and maximize mass transit use is needed. Examples of this might be recommendations for a four day work week in certain industries or commercial operations, or staggered commuting hours in certain urban areas. Advantages of this approach are the potential for near term implementation with associated near term fuel savings. Inherent in such a systems approach is the

possibility of enabling a variety of organizational flexibilities to see a means of changing their operation while minimizing adverse economic impacts due to fuel shortages.

The report recommends that the Administration develop conservation strategies and contingency plans but a clear distinction is not made between these two different activities. Contingency plans need to be developed for dealing with sudden supply disruptions. Conservation actions, on the other hand, should be designed so that they specify using energy more efficiently and reducing waste. A distinction should be made between these two activities.

Although we recognize the need to analyze conservation strategies with time frames in mind, long term strategies should not be penalized in favor of taking actions which will yield benefits in the short term. For example, building energy performance standards will, in the long term, yield significant energy savings and should not receive lower rankings when compared with other strategies such as voluntary thermostat set back programs.

We appreciate your consideration of these comments in the preparation of the final report and will be pleased to provide any additional information you may desire.

Sincerely,

Donald C. Gestiehr
Director
Office of GAO Liaison

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