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**Emergency Petroleum
Conservation: A Review
and Analysis of Selected Measures**

F. D. Boercker
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E. Hull
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EMERGENCY PETROLEUM CONSERVATION:
A REVIEW AND ANALYSIS OF SELECTED MEASURES

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ABSTRACT

This is a report of work performed by Oak Ridge National Laboratory for the Economic Regulatory Administration. ORNL was asked to (1) collect, screen, and recommend a limited number of emergency measures that might conserve petroleum in residential and commercial buildings and in commercial transportation and (2) provide a detailed analysis of the energy savings and the economic and environmental impacts associated with restricting the hours of operation of commercial buildings. A total of 41 emergency measures were identified that might conserve petroleum, and these were reduced to a list of five that seemed most promising. Analysis of the measure to restrict hours of operation for commercial buildings shows that it might save 4 to 6% of annual commercial building energy use. The type of fuel conserved would vary widely from region to region, and appreciable negative economic impacts would result from implementing the measure. Results of the studies will be used by ERA in its efforts to devise petroleum conservation contingency plans as required by the Energy Policy and Contingency Act of 1975.

1. SUMMARY

The Energy Policy and Contingency Act of 1975 required the president to submit petroleum conservation contingency plans to Congress for its approval. The Regulations and Emergency Planning Division of the Economic Regulatory Administration (ERA) was responsible for developing the plans, while Oak Ridge National Laboratory and others were asked to supply technical assistance in the formulation and evaluation of the plans. ORNL was responsible for two studies: (1) to collect, screen, and recommend a limited number of measures that might conserve petroleum in residential and commercial buildings and in commercial transportation and (2) to provide a detailed analysis of one of the recommended measures. This emergency measure would restrict hours of operation of commercial buildings to 60 hr/week.

1.1 List of Emergency Conservation Measures

ORNL staff surveyed selected literature, contacted a number of public and private agencies, and assembled from these sources a list of 41 emergency conservation measures that might save appreciable amounts of energy, including petroleum. These 41 emergency measures were further screened down to five that seemed to bear the most promise:

1. Residential building owners could reduce thermostat settings in winter and raise them in summer, use less hot water, reduce infiltration, and have furnace burners tuned. With reasonable compliance rates, such measures might save about 1 quad (or 400,000 to 500,000 bbl/day) of energy, including about 200,000 bbl/day of petroleum.*

* Note regarding units: ORNL policy is to use metric units, but the sponsoring agency for this study has requested that this report use conventional units. Conversion factors are:

1 British thermal unit (Btu) = 1055 joules (J)

1 quadrillion Btu = 1 quad = 10^{15} Btu = 1.055×10^{18} J = 1.72×10^8 bbl of crude oil equivalent

1 barrel of crude oil equivalent energy = 5.8×10^6 Btu = 6.12×10^9 J

1 quad/year = 472,000 bbl/day = 1.055×10^{18} J/year

2. Building temperature restrictions could be mandated for commercial buildings. Depending on the severity of the restrictions and on the rigor of enforcement, savings might range from 2/3 to almost 2 quads (300,000 to 1,000,000 bbl/day) of energy, including about 100,000 to 300,000 bbl/day of petroleum.
3. Commercial buildings could be restricted in their hours of operation. Depending again on the severity of the restriction, on whether additional temperature restrictions accompany the hours of curtailment, and on rigor of enforcement, savings might range from 1/3 to 1/2 quad (160,000 to 240,000 bbl/day), including about 70,000 bbl/day of petroleum.
4. The 55-mph speed limit could be enforced on intercity trucking. Petroleum savings might amount to about 1/5 quad (90,000 bbl/day).
5. Reduced use of government trucks by 10 to 20% would result in a very small energy saving, but it would be useful as a symbolic measure.

At the time this study was being conducted, none of the above measures was in effect. However, recent federal actions have started implementation of the first two. The Residential Conservation Service (a part of the National Energy Act) is not an emergency measure, but its goal is to reduce residential energy consumption. The Emergency Building Temperature Restriction Plan (item 2 above) was put into effect during the summer of 1979. In addition, a number of federal agencies are reducing vehicle usage.

1.2 Restricted Hours of Operation for Commercial Buildings

After reviewing the list of possible emergency measures to reduce petroleum consumption, ERA asked ORNL staff to do an in-depth analysis of the measure to restrict hours of operation of commercial buildings. The measure, as defined, would limit hours of opening for commercial buildings to 60 hr/week, but it would provide some flexibility in choice of hours. It would also mandate temperature restrictions, beyond those specified in the Emergency Building Temperature Restriction Plan (EBTRP), to be in effect during hours of closure. The relationship between these two plans would be as follows:

	<u>Winter</u>	<u>Summer</u>
Building temp. restr. plan	65°F 24 hr/day	80°F 24 hr/day
Restricted hours of operation plan	65°F when open = 60 hr/week 55°F when closed = 108 hr/week	80°F when open = 60 hr/week No air conditioning when closed = 108 hr/week

1.3 Potential Energy Savings

The Restricted Hours of Operation for Commercial Buildings Plan might save 1/3 to 1/2 quad of energy (160,000 to 240,000 bbl/day) if it were rigorously enforced. These savings represent 4 to 6% of annual energy use by the commercial sector. Additional restrictions of commercial buildings to 40 hr/week of operation would add little to the energy conserved.

Energy savings, by type of fuel saved, vary markedly from one region of the country to another. Detailed studies of federal regions I, IV, and VI show that about 85% of the total energy saving in commercial buildings in region I would consist of petroleum; 87% of the savings in region VI would be natural gas; and the savings in region IV would be more evenly divided among petroleum, gas, and coal with the largest share to coal. Figure 1.1 identifies the federal regions.

1.4 Economic Impacts

- The imposition of regulation restricting hours of operation in the commercial sector can be expected to significantly affect several establishments in the retail trade and services divisions and to have a lesser or negligible effect on those in other divisions. Seven categories of business establishments were determined to be impacted under a 60-hr/week restriction, with the number increasing to 12 under the more stringent 40-hr/week restriction. If restricted to a 60-hr week, the seven categories of commercial establishments would experience reductions in

Fig. 1.1. The ten standard federal regions. Source: *United States Government Manual 1978/79*, rev., Office of the Federal Register, National Archives and Records Serv., General Services Administration, Washington, D.C., 1978.

operating hours ranging from 17 to 43%; a 40-hr week would reduce operating hours of 12 categories of establishments from 17 to 62%.

- The level of economic activity (measured over the 1980-81 baseline period) is adversely affected by the regulation even under conservative assumptions regarding effects of reduced operating hours on wages and sales in the commercial sector. The negative impacts worsen as the regulation becomes more restrictive.
- Direct wage loss in the commercial sector estimated in proportion to reduced operating hours of establishments was \$4.5 billion per year for a 60-hr week and \$13.0 billion per year for a 40-hr week. In addition, there are secondary losses as lost purchasing power of displaced workers reduces effective demand throughout the economy.
- In addition to the loss in wages, loss in sales of commercial establishments may be a possible outcome of the regulation. Under conservative assumptions, the sales losses were estimated to range between \$14 billion per year with the 60-hr week and \$41 billion per year with the 40-hr week. The inclusion of these sales losses in the economic analyses results in negative impacts significantly in excess of those determined with wage losses alone.
- Direct employment effects of regulated hours are not easily determined because of uncertainties in the number of part-time and full-time employees that firms would choose to lay off as a result of regulation. However, an unemployment equivalent of the loss in income (direct and indirect) can be derived. Depending on whether sales are unaffected or affected by regulation, this unemployment equivalent at the national level ranges from 300,000 to 740,000 for a 60-hr week and from 730,000 to 2,100,000 for a 40-hr week.
- The loss in personal income and the loss in sales (should that occur) will both result in reduced tax revenues to federal, state, and local governments. In addition to the decline in revenues, government transfer payments to the unemployed would increase. These effects, although not explicitly determined, are reflected in the overall response of the economy to the regulation.

- Selected economic impacts were analyzed for DOE regions I, IV, and VI, considering regional employment, wages, and sales in commercial establishments. All three regions are adversely impacted by the regulation in proportion to the extent of their commercial sector activities relative to national levels.
- On an absolute basis, region IV would suffer the greatest loss in income and employment for all cases considered and region I the least. On a relative basis (i.e., in relation to each region's baseline economic activity) the impacts on income and employment are similar to those determined nationally.

1.5 Environmental Impacts

- Regulation-induced impacts on the environment were determined on the assumption that direct and indirect savings in petroleum and natural gas resulting from restricted commercial sector operating hours would be used in the manufacturing sector. Savings in the utility use of coal were not assumed to be used elsewhere.
- Changes in emission levels (from a predetermined baseline) were estimated at the national and regional levels, considering only shifts in the patterns of use of petroleum and natural gas. These changes were found to be exceedingly small, probably well within the margins of error associated with data from the Strategic Environmental Assessment System model used in this study. Additionally, since savings in the use of coal by utilities were not assumed to be used elsewhere, it is reasonable to expect an overall reduction in emissions of all of the criteria pollutants considered (i.e., NO_x, SO_x, particulates, CO, and HC).
- The human factors aspect addressing social implications of the regulation (such as economic equity, increased need for social services because of unemployment, etc.) are briefly described. While detailed analyses of these factors were outside the scope of this study, they are nevertheless identified because they are an important component of the regulatory decision-making process.

1.6 Implementation Problems and Costs

Several kinds of problems might complicate implementation of the measure to restrict hours of operation of commercial buildings. None of these, however, would seem to provide insurmountable barriers.

Some of the problems are essentially legal in nature. For example, search warrants could be required for inspection of premises. Also, the equal protection right pursuant to the Fourteenth Amendment would require that any difference in treatment among parts of the commercial sector stand on a "rational basis" to survive constitutional challenge. Labor contracts vary in their manner of treating emergency closings, and layoff procedures should be investigated.

Enforcement of the measure would have to be carried out rigorously and impartially if energy savings are to be realized. This enforcement would require improved federal-state-private-sector communication, training sessions for enforcement officers, institution of an appeal procedure, and clear definition of a "trigger point" for implementation of the measure.

Logistic problems include the preparation, printing, and distribution of large numbers of materials describing the regulation.

Implementation costs to federal and state governments are difficult to anticipate. The measure could be enforced with any degree of vigor with corresponding variations in energy savings. Reasonably rigorous enforcement costs might fall in the range \$35 million to \$50 million per year. If the measure were implemented in conjunction with the EBTRP, the implementation costs could be shared between the two plans.

Overall, the probable negative economic impacts associated with the measure seem to outweigh the positive values of energy savings. The ORNL study staff suggest that if, or when, the country is faced with a severe petroleum shortage requiring marked reduction in consumption, the government might mandate a "percentage reduction contingency plan." Each geographic sector would be allocated a percentage amount of petroleum calculated on an arbitrary base period and would cope with this reduction, using any and all measures that seem appropriate to the particular area.

Most state energy office staff who were contacted by ORNL agreed that such an approach was more effective and caused less unfavorable public reaction than uniformly mandated measures. It would appear that a detailed analysis of a percentage allocation approach, similar to this analysis, would be desirable.

2. INTRODUCTION

2.1 Background of the Study

During the past six years, beginning with the OPEC oil embargo of 1973-74 and extending through the gasoline shortages of 1979, the federal government has become increasingly concerned about measures to deal with petroleum shortages. This concern resulted in passage of the Energy Policy and Conservation Act of 1975, requiring the president to submit contingency plans to Congress for its approval. The Regulations and Emergency Planning Division of the Economic Regulatory Administration (ERA) was responsible for developing these emergency contingency plans.

In September 1978, staff from the Energy Division of Oak Ridge National Laboratory met with ERA staff to identify areas in which ORNL could supply technical support in developing the contingency plans. The support project would be a continuation of work by ORNL on problems associated with periodic shortfalls of natural gas. It was decided that ORNL staff should shift their attention to emergency measures that could conserve petroleum in the event of a severe interruption of foreign oil supply. Specifically, ORNL was asked to undertake two studies:

- Collect, screen, and recommend a very limited number of measures that could conserve oil in residential and commercial buildings and in commercial transportation. These measures were to conform to Energy Policy and Contingency Act (EPCA) guidelines.
- Provide a detailed analysis of potential energy savings and probable economic and environmental impacts of one of the measures. The measure to be analyzed was to be selected by ERA staff.

Other agencies, working with ERA, were to screen and analyze measures in other sectors, such as industrial energy use and private automobile energy use.

This report summarizes findings of the two studies undertaken by ORNL. Certain portions of the studies were subcontracted to the Energy Systems Group of TRW, and their staff conducted investigations on economic and environmental impacts of the measure selected by ERA for in-depth analysis.

Because the project was to supply suggestions for, and analyze impacts of, standby emergency regulations as called for in EPCA and developed by ERA, it was necessary to consider the basic guidelines for such measures as put forth by EPCA and ERA. ORNL also has guidelines relevant to the project.

2.1.1 EPCA guidelines

EPCA defines "emergency measures" as actions that

- decrease demand and do not increase supply;
- remain in effect initially for no more than nine months;
- may not impose a tax or user fee, may not price petroleum, and may not provide tax rebates;
- apply to all states;
- deal only with one logically consistent subject matter.

Because these emergency measures are designed to remain in effect for less than a year, they must be amenable to implementation within a few weeks.

Such emergency measures may be put into effect to counteract emergency petroleum shortages brought on by an embargo, sabotage to an oil supply, or "act of God." It is assumed that an embargo is the most likely of these emergencies.

2.1.2 ERA guidelines

The Regulations and Emergency Planning Division of ERA felt that the project should be approached in two steps:

- Phase I should provide a well-screened list of emergency measures for residential and commercial buildings and for commercial transportation. The results should include first-order estimates of petroleum-energy savings for each measure.
- Phase II should provide a detailed analysis of petroleum-energy savings and detailed information on likely economic and environmental impacts for a specific measure selected by ERA. National average results should be supplemented with selected regional detail.

2.1.3 ORNL policy guidelines

ORNL policy does not allow staff to write regulations. Therefore, ORNL participation in phase I of the project was understood to be limited to collecting a list of possible emergency measures, screening the measures by use of EPCA and ERA guidelines, and presenting a small list of well-screened measures to ERA accompanied by estimates of petroleum savings for each measure. Likewise, the detailed analysis in phase II was understood to include only a technical analysis from which ERA staff could judge the suitability of the selected measure for consideration as a proposed regulation.

2.2 Work Plan for the Study

2.2.1 Phase I: Review of possible measures

The work plan called for ORNL to undertake the following tasks over a period of about two months:

- Collect suggestions for possible emergency conservation measures by visiting a large number of agencies, public and private, that were working professionally in conservation and/or studying petroleum utilization.
- Collect conservation suggestions through a literature search on responses to the 1973-74 embargo.
- Collect conservation suggestions by calling energy offices in states that had been heavily impacted by the 1973-74 embargo.
- Collect suggestions from ORNL staff and Brookhaven National Laboratory staff.
- Collect information from federal agencies and from the American Petroleum Institute regarding petroleum use by sector, by U.S. census region.
- Compile the suggested emergency energy (petroleum) conservation measures into a single list.

- Reduce the long list, using the experience of ORNL conservation specialists, to a short, well-screened list.
- Provide first-order estimates of petroleum savings for each of the final measures.
- Report the results to ERA.

2.2.2 Phase II: In-depth analysis of one measure

The following phase II projects were scheduled for completion within seven months:

- With building energy use models and energy data series available within the Energy Division, the ORNL staff would estimate potential energy-petroleum savings resulting from the selected conservation measure.
- ORNL staff would estimate costs of implementing the measure and identify any legal constraints to implementation.
- Probable economic and environmental impacts associated with the selected conservation measure would be analyzed by an outside agency through subcontract.

2.3 Caveats

Analysis of the impacts of various conservation measures will not yield precise results, given the present level of data availability and the state of the art in analyzing complex technical-social phenomena. Data describing energy consumption, by sector, by fuel type, and by geographic region, generally become available only after 4 to 5 years. Different data sources use different definitions and supply different totals. Heat transfer characteristics of various building stocks in different climates are not well documented. Tendencies of the public to comply with, or resist, specific types of regulations are unknown. Few empirical data exist regarding the complex social and economic events that would be triggered by the conservation measures considered in this study. Therefore, while the authors have presented as much quantitative

analysis as time and data availability allow, they have supplemented this with qualitative discussions to fill in the inevitable gaps. Most results are presented as ranges of values. The report should supply ERA staff with a useful analysis, but the results should be interpreted with care and sectional caveats observed.

3. REVIEW OF EMERGENCY ENERGY CONSERVATION MEASURES APPLICABLE TO RESIDENTIAL AND COMMERCIAL BUILDINGS AND TO COMMERCIAL TRANSPORTATION

3.1 Survey of Agencies

As a first step in collecting suggestions for emergency petroleum conservation measures, ORNL staff visited with, or made telephone calls to, a number of agencies that were knowledgeable about conservation and/or the petroleum industry. The interviews were designed to find out (1) whether the agency was already engaged in a study that overlapped the objectives of this project, (2) whether the agency representatives had suggestions for measures that they felt should be considered for inclusion in the ORNL list, and (3) whether the agency had recent statistics on petroleum consumption and on possible petroleum savings related to specific conservation measures.

The following agencies were contacted:

Federal and "quasi-federal agencies"

- Conservation and Solar Applications/DOE.
- Department of Transportation.
- Interstate Commerce Commission.
- National Academy of Sciences, Building Research Advisory Council.
- National Petroleum Council.
- Regulation and Emergency Planning/ERA/DOE.
- Strategic and Contingency Planning, Policy, and Evaluation/DOE.

State agencies

- State energy offices in ten states that were heavily dependent upon petroleum and had been severely impacted by the 1973-74 embargo. The states were: California, Connecticut, Florida, Maine, Massachusetts, New Jersey, North Carolina, North Dakota, Oregon, and Wisconsin.

Private sector

- American Petroleum Institute, Washington, D.C.
- National Association of Home Builders Research Foundation, Washington, D.C.
- Syska & Hennessy, New York, New York.
- Tishman Research Corporation, New York, New York.

In addition to surveying the above-mentioned outside agencies, interviews were held with ORNL professional staff who were engaged in conservation studies related to residential and commercial buildings and transportation. David Pilati of Brookhaven National Laboratory also provided reprints of studies he had conducted that were relevant to the ORNL interests.

Specific findings are provided in the following section, but in general the federal agencies, with the exception of the Economic Regulatory Administration (ERA), were not working with emergency conservation measures. Several were concerned with long-term conservation measures. The state energy offices have been working out emergency plans for coping with various kinds of energy shortfalls. They represent a reservoir of experience that should be tapped more deeply and systematically if federal emergency plans and state plans are to reinforce each other. The private-sector agencies and the National Petroleum Council were a good source of relevant statistics.

3.2 Literature Review

Using the *New York Times Index* and the *Reader's Guide to Periodical Literature*, a survey was conducted of news articles and of articles in popular journals during the 1973-74 embargo. The survey was concerned with reported methods of coping with petroleum shortfalls both in the United States and abroad. This activity was not very productive because most of the popular reports focused on the impacts on private automobile transportation, which was not an area of ORNL responsibility.

3.3 Findings: Statistical Description of Energy Use, by Sector, in the United States

Because this study is designed to identify emergency petroleum conservation measures that could be placed in operation in the event of an oil embargo, it is necessary to have some general picture of the sources of petroleum and the use, by sector, of that petroleum.

Figure 3.1 illustrates the current "American Tragedy" — the steady increase in demand for petroleum coupled with a rapid increase in the percentage of imported petroleum. The 1973-74 embargo caused a perturbation in the general growth trend, but the increases seemingly have resumed. The 1979 gasoline shortage may cause another fluctuation. Figure 3.2 shows a breakout of the regional sources of imported petroleum. Almost two-thirds of imported petroleum comes from OPEC nations, and about half of OPEC petroleum comes from Arab OPEC nations.

Petroleum now accounts for almost half of the entire U.S. energy consumption (see Table 3.1).

Fig. 3.1. Imported share of U.S. domestic petroleum demand, 1970-77.
Source: *Annual Report to Congress, Volume III, 1977, Statistics and Trends of Energy Supply, Demand, and Prices*, p. 23, Energy Information Administration, Washington, D.C., 1978.

Table 3.2 shows the pattern for energy use in the United States during 1975. Although energy use has increased since 1975, the basic

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Fig. 3.2. U.S. crude oil imports by source region, 1976.
Source: *Basic Petroleum Data Book*, p. 76, American Petroleum Institute, Washington, D.C.

Table 3.1. U.S. energy consumption by fuel type, 1977

Petroleum	37.0 quads ^a	49%
Natural gas	19.6	26
Coal	14.1	19
Nuclear	2.7	3
Hydro	<u>2.4</u>	<u>3</u>
Total	78.8 quads	100%

^a1 quadrillion Btu = 10^{15} Btu. Source: *Annual Report to Congress, Volume III, 1977, Statistics and Trends of Energy Supply, Demand, and Prices*, p. 5, Energy Information Administration, Washington, D.C., 1978.

Table 3.2. U.S. energy consumption by sector, by fuel type, 1975

Sector of economy	Energy use ^a by fuel type (trillions of Btu)						Total
	Petrol.	Nat. gas	Coal	Nucl.	Hydro	Other	
Commercial	2,715	3,297	1,575	409	542	4	8,542
Residential	5,263	6,416	2,698	612	922	4	15,915
Indus. + agri.	8,832	8,253	6,783	560	1,095	4	25,527
Transportation ^b	17,177	764	101	27	36		18,105
Military	278	80	36	13	19		426
Total	34,265	18,810	11,193	1,621	2,614	12	68,515 ^c

^aElectricity end use has been converted to primary fuel used in generation and distribution. The conversions were computed by applying the fuel consumption distribution in the utility sector as provided in the Regional Energy Balance Statement Tables. See: *Energy Availability for State and Local Development: 1975 Data Volume*, J. B. Mills, P. L. Rice, D. P. Vogt, ORNL/TM-6951 (forthcoming).

^bAccounts for transportation in all sectors, including the private automobile.

^cThe Energy Information Administration reports U.S. energy consumption for 1975 to be 70,598 trillion Btu or 3% higher than this total. The difference is primarily in accounting for the energy used to generate electricity and to process oil and gas.

Source: Regional Economics Group, ORNL, 1979, *Regional Energy Balance Statement*, 1975.

pattern has not changed appreciably. The largest use for petroleum is in transportation, followed by industry and agriculture. Residential and commercial uses, excluding transportation, account for about 8 quads of petroleum (3.8 million bbl/day) or about one-fourth of U.S. petroleum consumption. Petroleum accounts for one-third of the nontransportation energy use of the commercial, residential, and industrial sectors.

Table 3.3 shows how the energy (virtually all petroleum) used in transportation is distributed among various modes of travel. Passenger automobiles account for about half of transportation energy use, and commercial transportation accounts for the remainder (8.7 quads or 4.1 million bbl/day). The sectors of concern in this study use almost half of all U.S. petroleum (residential, 15%; commercial, 8%; and commercial transportation, 25%).

Table 3.3. Distribution of energy use in the transportation sector by mode of travel, 1977

Travel mode	Transportation energy use (%)	
Highway		78.6
Passenger car and motorcycle	52.3	
Bus	0.7	
Truck	25.6	
Nonhighway		21.4
Rail	3.1	
Air	8.4	
Marine	5.7	
Pipeline	2.9	
Other	1.3	
		<u>100.0</u>

Source: Shonka, D. B. (Ed.), *Transportation Energy Conservation Data Book: Edition 3*, ORNL-5493 (February 1979), p. xxvii.

Since the purpose of this study is to identify potential conservation measures that would save petroleum in residential and commercial buildings and in commercial transportation, it is important to understand something about the dependence of each of the sectors on petroleum and how this dependence varies regionally. These data are displayed in Table 3.4; the federal regions referred to in the table are identified in Fig. 3.3.

Federal regions I and II use large absolute amounts of petroleum, which comprises very large percentages of total energy use in residential and commercial buildings. Regions IV and V also use large amounts of petroleum in these sectors, but the percentage dependence is lower. Regions VI to X, the western half of the country, use much smaller amounts of petroleum, and it accounts for one-fourth or less of total residential and commercial building energy use. The largest absolute consumption of petroleum for transportation, including private autos and commercial and industrial vehicles, occurs in regions IV, V, VI, and IX.

In summary, this brief analysis of data indicates:

- The United States is heavily dependent upon petroleum, using it to supply almost half of all energy consumed in the country.

Table 3.4. Regional patterns of petroleum consumption for residential, commercial, and transportation sectors, 1975

Federal region	Petroleum use by sector (trillion Btu)								
	Residential			Commercial			Transportation		
	Petro. use	Total energy use	Petro. % of total	Petro. use	Total energy use	Petro. % of total	Petro. use	Total energy use	Petro. % of total
1	600	856	70	490	606	81	983	997	98
2	1081	1,902	57	769	1126	68	1,606	1,644	98
3	561	1,617	35	286	780	37	1,626	1,702	96
4	734	2,260	32	294	1110	26	2,937	3,099	95
5	975	3,959	25	363	1838	20	3,118	3,251	96
6	423	1,680	25	83	1006	8	2,304	2,559	90
7	238	991	24	77	501	15	954	1,080	88
8	137	503	27	54	287	19	610	634	96
9	373	1,533	24	252	1021	25	2,239	2,308	97
10	141	514	23	47	266	17	800	831	96
Total U.S.	5263	15,915	33	2,715	8542	32	17,177	18,105	95

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Source: Regional Economics Group, ORNL, 1979, *Regional Energy Balance Statement, 1975*, special tabulation.

Fig. 3.3. Proportion of total commercial sector energy supplied by petroleum by federal region, 1975. Source: Regional Economics Group, ORNL, 1979, *Regional Energy Balance Statement, 1975*, special tabulation.

- Petroleum consumption is increasing each year, and imported petroleum makes up a rapidly increasing proportion of petroleum use.
- Almost two-thirds of imported petroleum comes from OPEC. The United States has become ever more vulnerable to actions that restrict petroleum imports.
- Residential and commercial sectors plus commercial transportation account for about half the total energy use in the country.
- Different regions of the country display very different degrees of reliance on petroleum to supply residential and commercial energy. The New England and the mid-Atlantic regions are especially dependent on petroleum.

3.4 Findings: A List of Potential Petroleum Conservation Measures

3.4.1 Extended list

As a result of visits with staff in the various federal, state, and private sector agencies, conferences with in-house staff, and the literature review, a large number of possible emergency measures were assembled. These ranged from the serious (reduce thermostat settings) to the not so serious (ban miniskirts). In all, 41 potentially useful measures were assembled (see Appendix A). This list was sent to a selected group of ORNL staff with the request that they review it and then meet to help reduce the list.

3.4.2 First reduction of the list

Each of the three sections of the list of measures (residential, commercial, and commercial transportation) was reviewed by a separate group of ORNL staff with expertise in the area. The major criteria for the first reduction were: (1) possibility of petroleum saving and (2) minimum economic impact. As a result of this review, the list was reduced to 16 measures. Appendix B indicates, for each of the original 41 measures, the reviewers' recommendations and the reasons for the recommendations.

For each of the remaining 16 measures, preliminary estimates of possible petroleum savings were obtained from the ORNL staff. This reduced list of 16 measures (see Appendix C) was sent again to the selected ORNL staff members for review, and a second set of group meetings further reduced the list to a final set of measures that would be proposed to ERA.

3.4.3 Final list

Tables 3.5, 3.6, and 3.7 list the measures that ORNL staff felt would provide maximum petroleum savings with minimum negative economic impact in each of the three sectors (residential, commercial, and commercial transportation). The estimated petroleum savings listed in these tables represent preliminary estimates.

Before describing these potential standby regulations in more detail, an alternative approach to emergency conservation should be mentioned. In the event of an oil embargo, the federal government could mandate a "percentage reduction contingency plan" as described in a recent FEA publication.¹ Under such a plan, each geographic sector would be allocated a certain percentage of petroleum calculated on an arbitrary base period. Officials of the geographic sector would then be free to select any combination of measures for coping with the shortage that seemed best suited to the particular situation. After public review of an initial set of standby regulations, FEA reported that the public preferred the "percentage reduction" approach as contrasted with a federal mandate of specific measures that may, or may not, best fit a specific situation. Most state energy office staff who were contacted by ORNL agreed that percentage allocation was more effective and caused less negative public reaction than mandated, uniform measures. Consequently, the first measure listed in each of Tables 3.5, 3.6, and 3.7 refers to this option. If it were selected, all other measures would be voluntary means of coping.

¹*Report on the Feasibility of Developing an Emergency Percentage Reduction Contingency Plan for Petroleum*, Federal Energy Administration, June 1977.

Table 3.5. Emergency measures to reduce petroleum consumption in residential buildings

Measure	Estimated annual energy savings (trillion of Btu) ^a			
	Potential		Assumed achievable (40%) ^b	
	Total	Petroleum	Total	Petroleum
Mandatory:				
Allocate % of supply	Savings predetermined by % allocated			
Voluntary:				
Change thermostat setting				
68°F winter; 60°F night	1,000	350	400	140
78°F summer	100	40	40	20
Set back water temperature				
120°F	400	130	160	50
Reduce infiltration				
Caulking	300	100	120	40
Polyethelene sheets, drapes	100	30	40	10
Tune furnaces	700	250	280	100
Totals: trillion Btu	2,600	900	1,040	360
bbl/day	1,200,000	425,000	500,000	170,000

^aMost of the saving (80 to 90%) accrues in the winter.

^bPercentage taken from NPC report, but compliance could vary considerably.

Source: National Petroleum Council, *Potential for Energy Conservation in the United States: 1974-1978*, p. 8, 1974.

Table 3.6. Emergency measures to reduce petroleum consumption in commercial buildings

Measure	Estimated annual energy savings (trillions of Btu) ^a			
	Potential		Assumed achievable (33%)	
	Total	Petroleum	Total	Petroleum
Mandatory:				
Allocate % of supply	Savings predetermined by % allocated			
Thermostat settings:				
68°F winter	1,100	360	360	120
78°F summer	100	30	30	10
5-10°F night setback	700	230	230	70
Cut off cooling 1 h before closing	100	30	30	10
Restrict hours of operation:				
No added temperature	400	70	130	30
Totals: trillion Btu	2,400	720	780	240
bbl/day	1,100,000	340,000	370,000	110,000

^aOver 80% of the savings would accrue during winter.

Sources: National Petroleum Council, *Potential for Energy Conservation in the United States: 1974-1978*, September 1974, p. 8.

Data from ORNL Commercial Building Energy Use Model.

Table 3.7. Emergency measures to reduce petroleum consumption in commercial transportation

Measure	Estimated annual energy savings (trillions of Btu)	
	Potential	Assumed achievable (50%)
Mandatory:		
Allocate % of supply	Savings predetermined by % allocated	
Enforce 55-mph limit on intercity trucking:		
Reduce 60-55 mph	80	40
Reduce 65-55 mph	200	100
Reduce use of government trucks		
10% reduction	20	10
20% reduction	40	20
Totals:	trillion Btu 100-240	50-120
	bbl/day 47,000-113,000	24,000-57,000

Sources: General Services Administration, *Federal Motor Vehicle Fleet Report*, Washington, D.C., July 1976, pp. 16, 26.

Shonka, D. B., Loebl, A. S., Patterson, P. D., *Transportation Energy Conservation Data Book*: Edition 2, Oak Ridge, Tenn., October 1977, p. 24.

Department of Transportation, *The Effect of Speed on Truck Fuel Consumption Rates*, Washington, D.C., August 1974, p. 14.

Motor Vehicle Manufacturers Association, *Motor Vehicle Facts and Figures*, 1977, Washington, D.C., 1977, p. 60.

Greene, David, Oak Ridge National Laboratory, personal communication, 1979.

If the percentage reduction approach is not selected, the other measures listed in the tables become candidates for standby regulations. Residential owners could be asked to reduce thermostats, use less hot water, "tighten up the house," and have oil burners tuned. Obviously, these measures could not be enforced and would depend upon voluntary compliance. Total potential petroleum savings, nationwide, would be about 0.9 quad (425,000 bbl/day) or about 1/5 of all residential petroleum consumption. Assumed compliance is very difficult to judge. Using estimates from the National Petroleum Council of about 40% compliance, the actual petroleum savings might be less than 0.4 quad (190,000 bbl/day) or about 9% of residential petroleum usage.²

Commercial buildings have a potential for petroleum savings. Mandated building temperature restrictions in commercial establishments, excluding hotels, motels, and health care facilities, might save about 0.3 quad/year or about 140,000 bbl/day of petroleum.³ Restricting the hours of operation of the buildings, along with additional temperature restrictions during hours of closure, might save another 0.1 quad or about 50,000 bbl/day. If the measures were enforced strictly, most of the potential savings (190,000 bbl/day) could be realized. However, in many regions of the country the high summer building temperatures would be accompanied by high humidity, and this could damage the contents of some commercial buildings.

Commercial transportation offers only limited opportunities for savings. As trucking companies, airline companies, bus companies, etc., attempt to maximize profit and minimize cost, the rapidly rising cost of fuel has already brought about many of the short-range measures that

²Title II of the National Energy Act of 1978, referred to as the Residential Conservation Service, will attempt to stimulate a wide range of residential conservation measures. The act requires public utilities in each state to supply energy audits for their customers and help them arrange for implementation of the suggested conservation measures.

³The president has recently put into operation the "Emergency Building Temperature Restriction Plan," but he has not restricted the hours of operation of commercial buildings. Federal funds to states for enforcement are very limited, so the measure is, in effect, a voluntary one at this time.

might be suggested. For example, airlines have already increased load factors and have reduced cruising speeds. The two measures suggested in Table 3.7 (enforce 55-mph speed limit for intercity trucks and reduce use of government trucks) might save about 0.1 to 0.2 quad (50,000 to 100,000 bbl/day) or about 1% of truck fuel.

In summary, if all of the measures proposed were put into effect and achieved reasonable compliance, the country might save approximately 1 quad of petroleum or about 2 to 3% of total U.S. petroleum use in 1977. Such a saving is reasonably significant.

4. IN-DEPTH ANALYSIS OF ONE MEASURE: RESTRICTED HOURS OF OPERATION OF COMMERCIAL BUILDINGS

4.1 Description of the Measure

After reviewing the list of possible emergency measures to reduce petroleum consumption compiled by ORNL (see Tables 3.5, 3.6, 3.7), the Economic Regulatory Administration (ERA) staff selected one of the measures for in-depth study. The analysis was to determine likely petroleum savings, economic and environmental impacts, and government costs associated with restricting the hours of operation of commercial buildings.

The measure to restrict hours of operation of commercial buildings would involve the following regulations:

1. Commercial buildings, defined as wholesale and retail trade, finance, insurance, real estate, business and repair services, amusement and recreation services, and public administration, would be required to limit hours of operation to a maximum of 60 h/week. Hotels, motels, and health care facilities would be exempted.
2. In order to provide some flexibility, but still be enforceable, several patterns of hours, each totaling 60 hr, would be available.
3. During hours of closure, thermostats must be set back to 55°F (winter) and cooling systems turned off (summer).

The measure could be implemented independently or in conjunction with the Emergency Building Temperature Restriction Plan (EBTRP), which has already been approved by ERA for submission to the secretary of energy. The latter plan mandates thermostat settings of 65°F (winter) and 80°F (summer).

"Commercial buildings," as used above, is a more restrictive definition of that sector than most. This restricted commercial sector consumes only about 2/3 of the energy attributed to the full sector.

4.2 Estimated Nationwide Energy Savings of the Measure

Figure 4.1 is a flow diagram indicating the sources of energy for the commercial sector. Approximately 6000×10^{12} Btu of energy will be delivered to end users in the commercial sector during 1980, and an additional 2700×10^{12} Btu of waste heat will be generated in order to supply the electricity used by the sector. These numbers translate to 2.8 million and 1.3 million barrels of oil equivalent per day respectively.

Energy needs of the commercial sector are met by:

Total energy consumption:

	Petroleum	Natural Gas	Coal	Hydro-Nuclear	Totals
$\times 10^{12}$ BTUs:	2,800	3,300	2,200	700	9,000
bbl/day :	1,300,000	1,600,000	1,000,000	300,000	4,200,000

- Sources: (1) Regional Energy Balance Statement, 1975, for 1975 baseline;
 (2) Corrected to 1978 on basis of Annual Report to Congress, 1978, Energy Information Administration, DOE/EIA-0173/2, Volume 2, pp. 51, 77, and 125.
 (3) 1980 commercial consumption assumed to be the same as 1978 consumption based on Annual Report to Congress, 1978, DOE/EIA-0173/2, Volume 3, p. 300.

Fig. 4.1. Estimated annual energy use by restricted commercial sector, 1980. Sources: (1) *Regional Energy Balance Statement, 1975*, for 1975 baseline; (2) Corrected to 1978 on basis of *Annual Report to Congress, 1978*, Energy Information Administration, DOE/EIA-0173/3, Volume 2, pp. 51, 77, and 125; (3) 1980 commercial consumption assumed to be the same as 1978 consumption based on *Annual Report to Congress, 1978*, DOE/EIA-0173/2, Volume 3, p. 300.

What part of this energy can be saved by the proposed conservation measure?

Because estimates of energy savings due to the restriction of hours of operation are subject to a number of uncertainties, this study reports the results of two independent approaches and presents the estimate as a range of possible savings. One approach is to survey recent studies to gather estimates of percentage savings associated with given changes in thermostat settings in commercial buildings. These percentage savings may then be applied to the energy consumption data in Fig. 4.1 to calculate absolute energy savings due to the measure. A second approach is to use the recently developed ORNL Commercial Building Energy Use Model, which can provide estimates of energy savings from reduced heating and cooling for the conditions specified in the restricted hours measure. The results of these two approaches are presented in the following two sections.

4.2.1 Estimated savings based on recent ASHRAE and NPC studies

"ASHRAE Standard 90-75: Energy Conservation in New Building Design" was released by ASHRAE's committee on standards in 1975 and was published by the Federal Energy Administration (FEA). Table III-12 of the report provides estimates of energy savings in office buildings and retail stores that could be obtained by simple energy conservation techniques (see Table 4.1).

A 3°F change in thermostat settings during winter is estimated to save about 9% of annual building energy use, and 3°F change in summer adds another 3% savings. Reduced lighting during periods when the building is open and in use could save about 7% of building energy use.

The National Petroleum Council report, "Potential for Energy Conservation in the U.S.: 1974-1978," provides estimates of possible energy savings in commercial buildings through conservation measures (see Table 4.2).

A third source of estimated energy savings by means of reduced heating and cooling is provided in exhibit 2.3 of the EBTRP. A 3°F setback (68°F to 65°F) is assumed to give savings of about 9% in most

Table 4.1. Energy savings through conservation (ASHRAE)

Measure	Percent of total annual energy use saved	
	Office building	Retail store
Thermostat increase 75°F to 78°F (summer)	3.4	3.4
Thermostat decrease 75°F to 72°F (winter)	12.4	7.3
Lighting reduced from $1 \frac{W}{ft^2}$ to $0.8 \frac{W}{ft^2}$	6.3	8.6

Source: *An Impact Assessment of ASHRAE Standard 90-75*, p. 62, March 1976.

Table 4.2. Energy savings through conservation (National Petroleum Council)

Measure	Percent of total annual energy use saved	
Establish a 10°F night setback from 65°F to 55°F for commercial buildings (winter)	5.7	
Cease cooling of building 1 hr before closing (assuming 78°F setting in summer)	0.7	
Reduce lighting to minimum acceptable levels	2.4	

Source: *Potential for Energy Conservation in the U.S.: 1974-1978*, p. 52, National Petroleum Council, Sept. 10, 1974.

regions of the country (winter), and changed thermostat settings of 77 to 80°F (in summer) would give savings of about 5%.

In summary, these studies estimate that thermostat setbacks in winter of 3°F in the 70°F range provide about 6 to 9% savings in total annual energy use; increased thermostat settings in summer to about 80°F might provide about 3% savings, but very little is achieved beyond this; and reduced lighting might add another 2 to 7%.

For purposes of this study it is assumed:

1. There would be very little added saving in summer beyond setting thermostats to 80°F.
2. Lighting, during hours of building closure, is already reduced to minimum standards; there would be some small additional savings available, but these will be ignored in the following calculations.
3. Thermostat reduction from 65°F to 55°F during hours of closure in the heating season does provide potential for savings. If thermostat reduction of 3°F in the 70°F range reduces annual commercial energy usage by about 9%, a 10°F setback from 65°F to 55°F (lower temperature range) should supply at least an equivalent energy savings — about 9%.

If commercial buildings are restricted to 60 hr/week operation, they must be closed for 108 hr/week, and their thermostats would be set back from 65°F to 55°F for 2/3 of the week. Furthermore, if a 3°F setback saves about 9% of total annual commercial building energy, a 10°F setback, at a lower temperature range, should provide at least an equivalent percentage saving but only for 2/3 of the week. Therefore the total percentage savings of commercial energy should be 2/3 of 9% or about 6%. (This agrees with the National Petroleum Council estimate in Table 4.2.)

Applying this 6% savings to the absolute national energy consumption data (1980) for commercial buildings (see Fig. 4.1), energy and petroleum savings would be possible, as shown in Fig. 4.2. A "bottom line" of savings, by fuel type, is also displayed in Fig. 4.2. It is worth noting again that these estimates involve a series of assumptions, anyone of which may have large error bands. As a check, an independent estimate has been made using an entirely different approach. This estimate is described in the following section.

4.2.2 Estimated energy savings based on application of ORNL data and models

The Energy Division of Oak Ridge National Laboratory has assembled a number of energy-related data bases and created models that use these

Assuming an even distribution of saving among fuel types:

Fig. 4.2. Estimated annual fuel savings from 6% reduction in end-use energy by the restricted commercial sector, 1980.

data to estimate consequences of different energy policy options. Among these data bases is one referred to as the Regional Energy Balance Statement (REBS), which shows supply, demand, and net imports of seven fuel types for four final consuming sectors. The 1975 data contain supply and demand information for the United States, census or federal regions, 50 states, and 173 BEAs.⁴ The REBS data were the primary source used in the calculations reported in this section.

A model of commercial building energy use was recently developed at Oak Ridge National Laboratory. The model forecasts annual commercial energy use by ten building types, five end uses, and four fuel types. Both economic factors (utilization rate, fuel choice, capital-energy

4. J. B. Mills, P. L. Rice, and D. P. Vogt, *Energy Availabilities for State and Local Development: 1975 Data Volume*, ORNL/TM-6951 (in preparation).

substitution) and technological factors (equipment efficiency, thermal characteristics of buildings) are explicitly represented in the model.^{5,6}

Model parameters are derived from engineering and econometric analyses. The model is then validated by simulating commercial energy use over the 1970 through 1975 time period.

Although the model was not designed originally to provide the kind of energy impact data required by this study, it was possible, but time-consuming, to introduce the specific parameters of this conservation measure and generate the required information.

The data in Table 4.3 compare the energy use, in absolute numbers and in percentages, for four situations: (1) a base case in which the commercial buildings remain open as they see fit and maintain thermostats at about $72 \pm 2^\circ\text{F}$ summer and winter, (2) a case representing implementation of the EBTRP with thermostats at 65°F in winter and 80°F in summer, (3) a case representing implementation of a 60-hr operation of commercial buildings with thermostats at 55°F in winter and no cooling in summer during closed hours, and (4) a case representing implementation of a 40-hr operation of commercial buildings with the same thermostat settings as in item 3.

From Table 4.3 it is obvious that the major energy saving for all building functions comes about by implementing the EBTRP. This measure saves about 20% of energy use for all functions except lighting. Implementing the 60-hr restriction on hours of operation saves some additional space heating and lighting energy. The 40-hr restriction adds very little saving to the 60-hr restriction in space conditioning, but it does contribute savings in lighting and mechanical equipment use.

The analysis in the previous section indicated that the implementation of the 60-hr plan might save 6% of the annual commercial energy usage,

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5. *NECAP-NASA's Energy-Cost Analysis Program, Part I - User's Manual and Part II - Engineering Manual*, R. H. Henninger, ed., NASA CR-2590, September 1975.
 6. W. S. Johnson and F. E. Pierce, *Energy and Cost Analysis of Commercial Building Shell Characteristics and Operating Schedules*, ORNL/CON-39 (in preparation).

Table 4.3. Energy use in the commercial sector, by function, for four building operating conditions, 1980 projected

Condition of building operation	Energy use by function (quads)											
	Heat		Cool		Water		Light		Other		Total	
No restrictions: 72 ± 2°F annual	2.3	100%	1.5	100%	0.08	100%	1.6	100%	0.58	100%	6.1	100%
Bldg. temp. restr.: 65°F and 80°F	1.8	80%	1.2	79%	0.07	80%	1.6	100%	0.47	81%	5.1	83%
60 hr open: 55°F and no a.c. during (closed) hours	1.6	70%	1.1	75%	0.07	80%	1.3	80%	0.47	81%	4.5	75%
40 hr open: 55°F and no a.c. during (closed) hours	1.6	70%	1.1	73%	0.07	80%	1.1	68%	0.40	69%	4.3	70%

Source: ORNL Commercial Building Energy Use Model.

based on space heating saving. From analysis of the ORNL energy use model, the corresponding saving would be less:

$$\frac{0.226 \text{ quads (heating energy saved)}}{6.053 \text{ quads (total annual energy used)}} = 4\% \text{ saving of annual energy use.}$$

The model, therefore, provides a more conservative estimate of energy saving (4 vs 6%).

Using this more conservative 4% saving, the fuel savings estimates in Fig. 4.2 would be reduced to 2/3 of the original values:

Petroleum saved	Natural gas saved	Other fuels saved
110×10^{12} Btu/year (50,000 bbl/day)	130×10^{12} Btu/year (65,000 bbl/day)	110×10^{12} Btu/year (55,000 bbl/day)
Total energy saved 350×10^{12} Btu/year (170,000 bbl/day)		

4.2.2.1 Alternative methods of implementing the measure. The calculations reported in the preceding section assumed that the measure to restrict hours of operation of commercial buildings was implemented as an "add on" to the EBTRP. It assumed the EBTRP was already in operation, restricting temperatures to 65°F (winter) and 80°F (summer). The new measure would restrict hours of operation of commercial buildings to 60 hr/week and further restrict temperatures to 55°F (winter) and no space conditioning (summer) during hours of closure.

ERA staff requested that estimates of energy savings be made for three alternative methods of implementing the restricted hours of operation.

Alternative 1. Assume:

- EBTRP is not in operation;
- commercial buildings are restricted to 60 hr/week opening;
- there are no temperature restrictions — the building temperatures would be set at 72°F for 24 hr/day.

The energy savings for this case represent those attributed simply to restricting hours of operation with no accompanying temperature restrictions. The savings would be those attributed to less lighting and less use of ventilating and mechanical equipment. From Appendix Table E-1, the "normal" or median operation of the various classes of commercial buildings is about 72 hr/week. A restriction to 60 hr/week represents a reduction of 1/6 in "open" time and therefore should contribute a savings of about 1/6 of total lighting and mechanical and ventilating use. (This assumes there is very little lighting or ventilating during hours of closure.) Assuming that lighting and mechanical equipment are electrically powered, the savings would amount to about 175,000 to 250,000 bbl/day distributed as follows:

Petroleum	45,000-65,000 bbl/day
Natural gas	35,000-50,000 bbl/day
Other	95,000-135,000 bbl/day
Total	175,000-250,000 bbl/day

Alternative 2. Assums:

- EBTRP is not in operation;
- hours of operation of commercial buildings are not restricted;
- building temperatures are not restricted when open but are restricted when closed to 55°F (winter) and no space conditioning (summer).

Energy savings for this case represent those brought about by severe temperature restrictions when the buildings are normally closed, but there are no mandated hours of closing nor temperature restrictions during "open" hours. The normal average hours of closure for commercial buildings is 96 hr/week or 57% of the time. The savings would be estimated, therefore, as 57% of those achieved by the EBTRP plus 96/108 or 89% of those achieved by the added setbacks for the restricted hours of

operation plan (see Table 4.3). The estimated energy savings would be about 450,000 to 600,000 bbl/day distributed as follows:

Petroleum	160,000-210,000 bbl/day
Natural gas	170,000-230,000 bbl/day
Other	120,000-160,000 bbl/day
Total	450,000-600,000 bbl/day

Alternative 3. Assume:

- EBTRP is in operation (65°F winter and 80°F summer);
- hours of operation for commercial buildings are not restricted;
- during hours of normal closure the temperatures are further restricted to 55°F (winter) and no space conditioning (summer).

This alternative represents an "add on" of the temperature restrictions of the original measure to the EBTRP without restricting the hours of operation of the buildings. The energy saving estimates are similar to those for the original measure except that the added temperature restrictions would be in effect for only 96 hr/week rather than 108 hr/week. The savings, therefore, would amount to 96/108 or 89% of those reported for the original measure:

Petroleum	50,000-75,000 bbl/day
Natural gas	55,000-85,000 bbl/day
Other	40,000-60,000 bbl/day
Total	145,000-220,000 bbl/day

4.2.2.2 Estimated energy savings for selected regions of the country. Table 3.4 revealed the substantial variation in patterns of energy use by the commercial sector in different regions of the country. The purpose of this section is to investigate these regional variations in more detail and to estimate energy savings for several regions.

Federal regions I, IV, and VI were selected for detailed analysis (see Fig. 1.1). These three regions were chosen because they differ markedly in climate and in patterns of basic fuel use. For each region, an estimate may be made of possible fuel savings brought about by implementing the 60-hr restriction on operation of commercial buildings,

assuming the EBTRP has already been implemented. The calculations for three federal regions follow:

Federal region I

1. The 1975 pattern of basic fuel use for the restricted commercial sector (as defined for this measure) for federal region I may be obtained from the REBS data (10^{12} Btu):

	<u>Coal</u>	<u>Oil</u>	<u>Gas</u>	<u>Other</u>	<u>Total</u>
Direct use	1	358	52		411
Elec. generation (inc. waste heat)	13	130	1	17	161
Totals	14	488	53	17	572

2. Since the energy saving is to be calculated for 1980, it is necessary to adjust the above figures for 1975-80 changes. The EIA Annual Report to Congress for 1978, Vol. II, pp. 50, 77, 93, and 125 provides 1975-78 increments in use of various fuels by the sector. Also, Vol. III of the EIA report, p. 300, states, "The commercial sector is the only major energy-consuming sector in which the level of energy consumed in one of the projection periods, 1977 to 1985, is below the level of energy consumption in 1977." For purposes of this estimate, the commercial sector in 1978 energy use was assumed to plateau through 1980. Applying the 1975-78 adjustment factors to the above data and assuming that the result also holds for 1980 results in the following (10^{12} Btu):

		<u>Coal</u>	<u>Oil</u>	<u>Gas</u>	<u>Other</u>	<u>Total</u>
Direct use		1	391	56		448
Elec. generation (incl. waste heat)		15	148	1	19	183
Totals	N	16	539	57	19	631
	%	2	85	9	3	100

3. The ORNL Commercial Building Energy Use Model supplied information regarding the pattern of energy consumption, by function, for region I. It also supplied estimates of percentage energy savings

caused by implementing the 60-hr restriction plan in conjunction with the EBTRP:

<u>Function</u>	<u>% of commercial sector annual energy use, region I</u>
Space heating	57
Space cooling	9
Water heating	5
Lighting	20
Other	9
Total	100

The percentage energy savings attributed to the 60-hr restriction above those obtained by the EBTRP was:

- 9.5% saving of annual space heating energy
- 5% saving of annual space cooling energy

4. Combining the above information, the total estimated energy saving during 1980 attributed to the conservative measure would be $[(0.095) (0.57) + (0.05) (0.09)] (631 \times 10^{12} \text{ Btu}) = 37 \times 10^{12} \text{ Btu}$, and if this saved energy is distributed in the same fashion as in the total energy use pattern (see item 2 above), the fuel saved in 1980 in federal region I would be:

<u>Fuel</u>	<u>Savings $\times 10^{12} \text{ Btu}$</u>	<u>bbl/day</u>	<u>Percent</u>
Coal	$(0.02) (37) = 1$	400	2
Oil	$(0.85) (37) = 32$	15,000	85
Gas	$(0.09) (37) = 3$	1,500	9
Other	$(0.03) (37) = 1$	500	3
Totals	37	17,400	100

Similar calculations were carried out for federal regions IV and VI. The following results were obtained.

Federal region IV

1980 fuel consumption, commercial sector, 10^{12} Btu :

	<u>Coal</u>	<u>Oil</u>	<u>Gas</u>	<u>Other</u>	<u>Total</u>
N	490	339	291	52	1172
%	42	29	25	4	100

Percentage of commercial sector annual energy use by function:

Space heating	33
Space cooling	28
Water heating	1
Lighting	26
Other	12
Total	100

Potential savings attributed to the 60-hr restriction above those obtained by the EBTRP were:

11% saving of annual space heating energy

4.5% saving of annual space cooling energy

Estimated fuel savings in federal region IV in 1980 would be:

<u>Fuel</u>	<u>Savings</u> <u>× 10¹² Btu</u>	<u>bbl/day</u>	<u>Percent</u>
Coal	24	11,300	42
Oil	17	7,800	29
Gas	14	6,700	25
Other	2	1,000	4
Totals	57	26,800	100

Federal region VI

1980 fuel consumption, commercial sector, 10¹² Btu:

	<u>Coal</u>	<u>Oil</u>	<u>Gas</u>	<u>Other</u>	<u>Total</u>
N	43	91	949	11	1094
%	4	8	87	1	100

Percentage of commercial sector annual energy use by function:

Space heating	31
Space cooling	36
Water heating	
Lighting	23
Other	10
Total	100

Potential savings attributed to the 60-hr restriction plan above those obtained by the EBTRP were:

10.5% saving of annual space heating energy

4% saving of annual space cooling energy

Estimated fuel savings in federal region VI in 1980 would be:

Fuel	Savings $\times 10^{12}$ Btu	bbl/day	Percent
Coal	2	1,000	4
Oil	4	2,000	8
Gas	44	21,000	87
Other	1		1
Totals	51	24,000	100

4.2.3 Summary

The studies described in the preceding sections provide the following "bottom line" results:

- Implementation of the 60-hr restriction of operation of commercial buildings would save some fuel over and above that saved by the EBTRP. The added fuel savings would fall within the following ranges:

Petroleum	50,000-75,000 bbl/day
Natural gas	65,000-95,000 bbl/day
Other	55,000-80,000 bbl/day
Total	170,000-250,000 bbl/day

These savings represent 4 to 6% of annual energy use by the commercial sector. The above estimate assumes 100% compliance rates. The estimates should be reduced if enforcement and compliance are low.

- Implementation of the 40-hr restriction measures saves very little additional space conditioning energy beyond that saved by the 60-hr restriction measure.
- Analysis of three alternative methods of defining and implementing the emergency measure yields estimates of total energy savings that vary from about 200,000 bbl/day to about 500,000 bbl/day. The savings depend upon the degree to which building temperature settings and building hours are regulated and on whether the EBTRP is implemented in conjunction with the restricted hours of operation.
- As one would expect, the commercial sectors in the various regions vary markedly in terms of fuel use for different functions:

Estimated percent of commercial sector
annual energy use by function

Federal region	Space heating	Space cooling	Water heating	Light	Other	Total
I	57	9	5	20	9	100
IV	33	28	1	26	12	100
VI	31	36		23	10	100

- Direct petroleum savings derived from implementing the 60-hr restriction measure as an "add on" to the EBTRP would vary greatly from region to region of the country. Federal regions I and II are large users of petroleum and could save appreciable amounts through conservation. Many of the other federal regions use very little petroleum and consequently have little potential for saving. These latter regions would probably question the logic of implementing restrictions that demonstrably could not conserve the scarce

commodity. Special studies of three federal regions illustrate these variations in patterns of fuel savings attributed to the 60-hr measure:

Federal region	Estimated fuel saving by type of fuel									
	Coal		Petroleum		Gas		Other		Total	
	bbl/day	%	bbl/day	%	bbl/day	%	bbl/day	%	bbl/day	%
I	400	2	15,000	85	1,500	9	500	3	17,400	100
IV	11,300	42	7,800	29	6,700	25	1000	4	26,800	100
VI	1,000	4	2,000	8	21,000	87		<1	24,000	100

4.3 Economic Impacts

4.3.1 Introduction and overview of results

The economic impacts of regulation restricting operating hours of commercial establishments are described in this section. Reductions in operating hours are related to reductions in man-hours, wages, and sales in the sector. Impacts of these reductions on aggregate economic activity are computed. Regional impacts on selected regions are also analyzed and compared.

The study's assumptions are presented in Sect. 4.3.2 and the analytic approach in Appendixes D and E. A summary of the major assumptions and their effects follows:

- The proposed regulation reduces the commercial sector's operating time to 40 to 60 hr/week for a maximum of one year.
- The energy savings obtained from implementing the regulation falls between 170,000 to 250,000 bbl/day oil equivalent.
- The energy saved in the commercial sector is used in the manufacturing sector to partially offset the assumed shortfall of 1.6 million bbl/day in the economy.
- Energy prices increase to reflect supply shortages.

Aggregate economic impacts were determined as deviations from a base-line economy which was derived using the Data Resources Inc. macroeconomic

model (see Appendixes D and E). There are few or no empirical data relating changes in commercial sector operating hours to changes in commercial sector. Consequently, the impacts on these variables from reduced operating hours could range from no effect to a proportional decline (i.e., a 1% reduction in operating hours is associated with a 1% reduction in the variables cited). The strict proportionality assumption represents a "worst case" situation and is perhaps extreme. On the other hand, an assumption of no impacts on any of the variables is equally unlikely. The approach taken in this analysis was to consider incremental levels of proportionality between 0 and 1 and to identify the level at which significant impacts on the overall economy become apparent.

Significant adverse impacts on economic activity, described herein, are evident at a proportionality factor of 0.25, even under the assumption that the commercial sector incurs no loss in sales of goods and services because of the regulation (i.e., when a 1% reduction in operating hours is associated with a 0.25% reduction only in man-hours and wages respectively). Including a declining sales assumption further aggravates these adverse economic impacts. In either case these impacts occur notwithstanding the conservative value of the proportionality factor.⁷

Table 4.4 presents regulation-induced aggregate economic impacts for the 40- and 60-hr cases with a proportionality factor of 0.25. Two sets of results are shown for each case. The first result is based on the assumption that only man-hours and wages in the commercial sector are affected by the regulation (i.e., consumer purchasing patterns are assumed to adjust to reduced operating hours, resulting in little or no loss in sales). The second result shows the additional impacts resulting from considering a loss in sales in the sector (i.e., consumer purchasing patterns are assumed not to fully adjust to reduced operating hours resulting in a decline in sales).

7. Williams, G. L., Vice-President, Operations Division, National Retail Merchants Association, personal communication and unpublished reports of NRMA.

Table 4.4. Aggregate economic impacts on selected variables relative to baseline quarterly averages^a

Percent change in variables	Regulation			
	60-hr week		40-hr week	
	Without loss of sales	With loss of sales ^b	Without loss of sales	With loss of sales ^b
Real GNP	-0.03	-0.59	-0.16	-1.91
Real personal consumption expenditures	-0.15	-1.02	-0.36	-3.00
Real gross private domestic fixed investment	0.00	0.37	0.08	-1.26
Real changes in business inventories	+4.90	+6.40	+6.40	+5.17
Real disposable personal income	-0.30	-0.74	-0.73	-2.14
Unemployment rate ^c equivalent (percentage point change)	+0.28	+0.69	+0.68	+1.99
Consumer price index: urban	0.00	-0.02	0.00	-0.08

^aBaseline economy is defined to include shortfall in crude supplies of 1.6 million bbl/day and restrictions on temperatures in selected buildings (Appendixes D and E). The averages are computed over the four quarters (1980:4 to 1981:3) during which regulation is in effect.

^bRepresents cases where loss in commercial sector sales is assumed in addition to the reductions in man-hours and wages in the sector.

^cThe baseline average unemployment rate is 6.5%. Table values may be added to this rate to obtain the total unemployment rate with regulation.

Table 4.4 indicates the following:

- The level of economic activity is adversely affected by the regulation even under conservative assumptions regarding effects of reduced operating hours on commercial operations.
- The negative impacts on the selected economic variables worsen as the regulation becomes more restrictive.
- The declining sales assumption increases the negative impact in both the 40- and 60-hr cases.
- Real disposable income and consumption are reduced substantially.
- The unemployment rate increases significantly.
- Business inventories rise as production patterns lag changes in consumption.
- Inflationary pressures ease as aggregate demand falls.

Selected economic impacts of the regulation were analyzed for regions I, IV, and VI described earlier. The impacts were determined considering regional variations in employment, wages, and sales in commercial establishments and are described in detail in Sect. 4.3.2. All three regions are adversely impacted by the regulation in proportion to the extent of their commercial sector activities. On an absolute basis, region IV would suffer the greatest loss in income and employment for all cases considered and region I the least. On a relative basis (i.e., in relation to each region's baseline economic activity) the impacts on income and employment were found to be similar to those shown nationally. These results are shown in Tables 4.5 and 4.6.

4.3.2 Factors influencing economy under regulation

4.3.2.1 Commercial sector. Establishments in the commercial sector engage in activities which can be broadly described within the following Standard Industrial Classification (SIC) divisions:

Table 4.5. Regulation-induced losses in regional
disposable income — 1980:4 through 1981:1
(billions of current \$)

Region	Disposable income (baseline)	Impacts			
		60-hr week		40-hr week	
		Without sales loss	With sales loss	Without sales loss	With sales loss
U.S.	1972.3	5.87	14.66	14.48	42.16
Region I	108.5	0.32	0.81	0.80	2.32
Region IV	293.8	0.88	2.19	2.16	6.29
Region VI	209.0	0.62	1.56	1.54	4.48

Table 4.6. Regulation-induced increases in regional
unemployment and resultant unemployment
rates — 1980:4 through 1981:3

Region	Baseline unemployment level and rate	Impacts			
		60-hr week		40-hr week	
		Without sales loss	With sales loss	Without sales loss	With sales loss
U.S.	7,000,000 (6.50%)	299,500 (6.78%)	741,000 (7.19%)	734,000 (7.18%)	2,133,000 (8.49%)
Region I	414,000 (6.55%)	17,580 (6.82%)	43,900 (7.24%)	43,400 (7.23%)	126,300 (8.54%)
Region IV	1,235,000 (7.06%)	48,400 (7.33%)	120,900 (7.75%)	119,500 (7.74%)	347,700 (9.04%)
Region VI	528,000 (4.44%)	33,800 (4.73%)	84,500 (5.15%)	83,500 (5.14%)	243,000 (6.49%)

<u>SIC division</u>	<u>Description</u>
E	Transportation, communication, electricity, gas, and sanitary services (excluding actual generation and transportation activities)
F	Wholesale trade
G	Retail trade
H	Finance, insurance, and real estate
I	Services
J	Public administration

The imposition of a 40- to 60-hr/week limit on operating time can be expected to affect significantly the operating patterns of many establishments in the retail trade and services divisions and to have a lesser or negligible effect on those in the other SIC divisions (Table 4.7).

The retail trade division includes establishments that sell merchandise for personal or household consumption and render services incidental to the sale of the goods. Establishments in the services division are engaged in providing a wide variety of services for individuals, businesses, government establishments, and other organizations. Many of these establishments would be required to cut back if regulations were imposed. Establishments such as hotels and motels, hospitals, and nursing homes are assumed to be exempt from the regulations.

Of the 12 categories of business establishments listed in Table 4.7, only seven would be affected if time of operation is restricted to 60 hr/week, because only these currently operate for longer hours. In particular, gasoline service stations that are open from 7:00 AM to 10 PM, seven days per week, would be especially hard hit. Under the 60-hr/week restriction, these service stations would reduce their hours of operation by approximately 43%, while for the 40-hr/week case, hours of operation would be reduced by 62%.

Retail and service establishments that are less affected by the regulation include general merchandise, food, apparel and accessories, and personal services. Each of these establishment's operating hours would reduce by about 17% under the 60-hr/week restriction, and by about 44% under the more stringent 40 hr/week restriction.

Table 4.7. Commercial sector establishments affected by regulation limiting hours of operation^a

Categories of business establishments	Days of operation	Hours of operation	Hours per week	Percent reduction in hours per week under regulation	
				With 60 hr per week	With 40 hr per week
Building materials, hardware, etc.	Mon.-Sat.	9-5	48		16.7
General merchandise	Mon.-Sat.	9-9	72	16.7	44.4
Food	Mon.-Sat.	10-10	72	16.7	44.4
Automotive dealers	Mon.-Sat.	9-6	54		25.9
Gasoline service stations	Sun.-Sat.	7-10	105	42.9	61.9
Apparel & accessories	Mon.-Sat.	9-9	72	16.7	44.4
Furniture	Mon.-Sat.	10-8	60		33.3
Eating & drinking	Sun.-Sat.	10-10	84	28.6	52.4
Drug stores	Sun.-Sat.	9-9	84	28.6	52.4
Other retail	Mon.-Sat.	9-6	54		25.9
Personal services	Mon.-Sat.	9-9	72	16.7	44.4
Other services	Mon.-Sat.	9-6	54		25.9

^aBased on data from ref. 8.

8. *A Study of the Impact of Reduced Retail Store Operating Hours on Sales, Employment, Economic Concentration, and Energy Consumption*, Energy Resources Co., NTIS Doc. No. PB-243579, October 1974, p. 5-17.

4.3.2.2 Income and employment effect. A reduction in operating hours has income and employment effects that are induced by a reduction in personnel requirements for operating establishments. Because of capacity constraints in many establishments, they can only effectively use a limited number of employees during any given period. Thus a reduction in operating hours is likely to produce an excess supply of labor in the commercial sector.

Table 4.8 shows that employees of eating and drinking establishments constitute a larger proportion of the employed in the commercial sector than that of any other establishments considered. Table 4.2 shows that these establishments would experience a reduction in work hours of about 20% when restricted to operate for 60 hr/week, and about 52% when restricted to 40 hr/week. As a consequence, regulation-induced income and employment effects would be severe in these establishments. Other major establishment categories in which such effects are also likely to be significant include general merchandise and food.

Appendix E presents a detailed computation of the direct income effect that occurs in the commercial sector as a result of a reduction in operating hours. The income effect stems from the translation of reduced hours of work into an income loss; the results are shown in Table 4.9. The average quarterly income loss at annual rates is \$4.5 billion when commercial establishments are restricted to 60 hr/week, and \$13 billion when establishments are restricted to 40 hr/week.

In addition to a direct loss of income to employees of these establishments, there is a secondary loss of income to the economy, as lost purchasing power of displaced workers reduces effective demand throughout the economy.

There are also secondary employment effects as released workers from the commercial sector reduce consumer demand and retard economic growth, leading to further job losses. Direct employment effects of the regulation are not easily determined because available data do not reveal the number of part-time and full-time employees that firms would choose to layoff as a direct result of the regulation. However, it is possible to estimate an overall unemployment equivalent associated with the resultant loss in income (primary and secondary). These results are presented in Appendix E.

Table 4.8. National average man-hours, wage rates, and employment in business establishments likely to be affected by regulation^a

Categories of business establishments	Normal average annual hours worked/employee (nonsupervisory employees)	Wage rate (\$/hr in current dollars)				Employment in thousands			
		1980:4	1981:1	1981:2	1981:3	1980:4	1981:1	1981:2	1981:3
Building materials, hardware, etc.	1995	5.68	5.78	5.88	5.99	626.9	634.5	639.1	643.2
General merchandise	1530	4.88	4.97	5.06	5.15	2575.7	2594.4	2612.9	2629.9
Food	1620	6.09	6.20	6.31	6.42	2183.7	2199.6	2215.3	2229.7
Automotive dealers	1975	6.35	6.47	6.59	6.70	1077.8	1085.7	1093.4	1100.5
Gasoline service stations	1950	4.46	4.54	4.62	4.70	587.9	592.2	596.5	600.3
Apparel & accessories	1485	4.45	4.53	4.61	4.69	783.9	789.6	795.3	800.4
Furniture	1785	5.71	5.82	5.92	6.03	518.0	521.8	525.4	528.8
Eating & drinking	1365	3.75	3.82	3.89	3.96	4129.5	4159.6	4189.2	4216.4
Drug stores	1560	4.61	4.70	4.78	4.86	475.9	479.3	482.8	485.9
Other retail	1815	5.46	5.56	5.66	5.76	1035.8	1043.4	1050.8	1057.7
Personal services	1710	4.70	4.79	4.87	4.96	383.0	386.0	389.0	392.0
Other services	1800	6.41	6.53	6.64	6.76	1303.0	1313.0	1323.0	1334.0

^aBased on data from ref. 5.

Table 4.9. Regulation-induced income loss in the commercial sector (quarterly
at annual rates)

Categories of business establishments	Reduction in wages with reduction in hours worked (billions of current \$)							
	60-hr week				40-hr week			
	1980:4	1981:1	1981:2	1981:3	1980:4	1981:1	1981:2	1981:3
Building materials, hardware, etc.					0.298	0.305	0.313	0.321
General merchandise	0.803	0.824	0.845	0.865	2.135	2.189	2.246	2.300
Food	0.899	0.922	0.945	0.968	2.392	2.453	2.513	2.574
Automotive dealers					0.876	0.899	0.921	0.943
Gasoline service stations	0.548	0.562	0.576	0.591	0.791	0.811	0.832	0.852
Apparel & accessories	0.217	0.222	0.227	0.232	0.575	0.590	0.605	0.619
Furniture					0.439	0.451	0.462	0.473
Eating & drinking	1.511	1.551	1.590	1.630	2.769	2.842	2.914	2.986
Drug stores	0.245	0.252	0.257	0.263	0.448	0.460	0.472	0.482
Other retail					0.665	0.683	0.700	0.716
Personal services	0.129	0.132	0.135	0.139	0.342	0.351	0.360	0.369
Other services					0.973	0.999	1.024	1.051
Total	4.352	4.465	4.575	4.688	12.703	13.033	13.362	13.686

4.3.2.3 Sales effect. In addition to the income and employment effect, there may be a sales effect that is a possible outcome of the regulation. The decline in sales was considered to occur only in the selected categories shown in Appendix E. Primarily, these declines affect department stores, other retail, eating and drinking establishments, and recreational-type services. Purchases of durable goods such as automobiles, furniture, and building materials are representative of long-term decisions for the consumers and producers. Consequently, buying patterns will adjust to the stores operating hours without affecting sales. Gasoline sales are likely to decline marginally and only in the pleasure-driving category, which is small. In the short run, individuals may find it difficult to alter commuting patterns, shopping habits, or other similar-type trips. Moreover, mass transit may not be capable of accommodating these changes unless the focus is on individuals living in large cities with well-developed transit systems.

The detailed computation of the decline in sales that could result from reduced operating hours is presented in Appendix E; the results are shown in Table 4.10. The average quarterly sales decline at annual rates is \$13.8 billion when establishments are restricted to 60 hr/week, and \$41.3 billion under the more severe 40-hr/week restriction.

4.3.2.4 Energy effect. Energy savings in the commercial sector that result from restricting operating hours are made available to the manufacturing sector, so that the energy shortfall in that sector (0.6 million bbl/day) is effectively reduced. Table 4.11 shows the regulation-induced reduction in energy demand in the commercial sector to be 0.15 and 0.175 million bbl/day for the 60- and 40-hr cases respectively. As a consequence, the energy shortfall to the manufacturing sector correspondingly declines to 0.45 and 0.425 million bbl/day respectively.

Increasing the amount of energy available to the manufacturing sector has a positive effect on industrial activity in that sector which contributes to economic growth. However, Sect. 4.3.3 indicates that this additional energy is not sufficient to offset the dampening effects on economic activity that result from losses in income and sales in the commercial sector.

Table 4.10. Regulation-induced reduction in
commercial sector sales (billions of
current \$ at annual rates)

Cases	Time period			
	1980:4	1981:1	1981:2	1981:3
60-hr week	12.8	14.1	14.1	14.1
40-hr week	38.3	42.3	42.3	42.3

Table 4.11. Energy effect of regulation (million bbl/day)

	Time period			
	1980:4	1981:1	1981:2	1981:3
Energy shortfall to manufacturing sector in baseline economy	-0.6	-0.6	-0.6	-0.6
Regulation-induced increase in energy availability				
60-hr week	+0.15	+0.15	+0.15	+0.15
40-hr week	+0.175	+0.175	+0.175	+0.175
Energy shortfall to manufacturing sector under regulation				
60-hr week	-0.450	-0.450	-0.450	-0.450
40-hr week	-0.425	-0.425	-0.425	-0.425
Index of industrial production- manufacturing baseline economy	1.449	1.478	1.496	1.505
Economy under regulation				
60-hr week	1.478	1.506	1.524	1.534
40-hr week	1.483	1.511	1.529	1.539

4.3.3 Detailed economic analysis of the regulation

The methodology used in this study assumes the energy "saved" by the conservation regulation is "spent" in the manufacturing sector to offset the economic impacts of the energy shortfall. Because earlier results indicate the negative impacts of the regulation, it is important to investigate the reasons that the manufacturing sector fails to offset these effects.

There are two explanations for this situation. First, the energy saved by the regulations is quite small and fails to stimulate industrial activity significantly. Furthermore, the supply response in the industrial sector may be quite small and cannot produce large effects in the short run. In viewing reemployment possibilities, workers' skills in the commercial and industrial sectors differ greatly. Consequently, without retraining, which is a lengthy process, the worker reabsorption rate is low.

The second explanation relies on the income loss induced by the regulation's effect on man-hours worked. As previously mentioned, the small energy savings spent in the manufacturing sector, plus the low reabsorption rate, does not fully offset this manpower-income reduction. This income loss, however, has multiplier impacts which influence economic activity in a more substantial manner. The common theme found in all scenarios can be described as follows:

- Reduce man-hours result in a decline in income.
- Aggregate demand falls as income declines and affects consumption patterns.
- Inventory buildup and the subsequent falloff in fixed investment follow the decline in aggregate demand.
- Real GNP declines relative to the baseline.
- Consumer prices soften due to reduced demand pressures.
- The unemployment rate equivalent determined from income loss increases relative to the baseline.

The economic forces that amplify the initial income loss are augmented by assuming a decline in sales, particularly in the 40-hr case. Even

without this assumption, however, the negative impacts are still significant. Figures 4.3 to 4.11 display these results over the relevant time period. Tables E-7 and E-10 (Appendix E) provide the data for all the cases described.

Fig. 4.3. Impact of regulation on real GNP without commercial sector sales decline.

Fig. 4.4. Impact of regulation on real GNP with commercial sector sales decline.

Fig. 4.5. Impact of regulation on real gross private domestic fixed investment without commercial sector sales decline.

Fig. 4.6. Impact of regulation on real gross private domestic fixed investment with commercial sector sales decline.

Fig. 4.7. Impact of regulation on real personal disposable income without commercial sector sales decline.

Fig. 4.8. Impact of regulation on real personal disposable income with commercial sector sales decline.

4.3.4 Regional economic impacts

Economic impacts were analyzed for DOE regions I, IV, and VI for the period 1980:4 to 1981:3, focusing on regulation-induced impacts on regional employment and income relative to the baseline case.

The major assumptions underlying the analysis were as follows:

- Regulations would be implemented uniformly across the regions, and responses of firms and consumers in each region would be similar.

Fig. 4.9. Unemployment rate equivalent of income loss without commercial sector sales decline.

Fig. 4.10. Unemployment rate equivalent of income loss with commercial sector sales decline.

Fig. 4.11. Index of industrial production manufacturing in the baseline and regulated economies.

- Regional impacts within the commercial sector will be proportional to the extent of the sector's activity measured by its share of sales, employment, and wages relative to national levels.
- Multiplier effects of sector-specific income and employment losses determined nationally are applicable regionally.

The analytic approach and supporting data are given in Appendix E; the results are presented and discussed here.

Regional shares of key economic and demographic variables in the 1980-81 time period are shown in Table 4.12 for the baseline case. Of the three regions considered, region I is expected to show a slight decline in its projected shares of population, labor force, employment, and income, while regions IV and VI are expected to show a modest increase.

The regional patterns of commercial sector activity (in retail trade and selected service categories) relative to national aggregate levels are shown in Table 4.13 for the 1980-81 period (see Appendix E). These patterns follow overall economic activity in the regions. It is apparent that region IV with the most extensive commercial activity will experience the greatest losses in income, employment, and sales from the implementation of the regulation.

Reductions in commercial sector wages and sales at the regional level were determined using the data in Table 4.13 (see Appendix E). These sector-specific regional impacts are shown in Table 4.14 for both the 60- and 40-hr cases.

As described previously, direct employment effects of regulation are not easily determined. However, an overall regional unemployment equivalent of income loss (both primary losses within the commercial sector and induced secondary losses elsewhere in the economy) has been computed and is presented in Table 4.15.

Below the regional level, examination of the economic profile of individual states suggests that regional aggregation masks important variations evident at the state level. Some states are growing rapidly and are likely to have greater capacity to absorb shocks than others. However, on balance, differences in economic characteristics of individual states tend to be neutralized at the regional level. Consequently, to a

Table 4.12. Key economic and demographic variables in 1980-81 relative to national^a (baseline case)

Region	Variables				
	Population (thousands)	Labor force (thousands)	Employment (thousands)	Personal income (billion \$)	Personal income employed (\$)
U.S.	223,600	107,100	98,200	2243	23,000
Region I	12,430 (5.6%)	6,333 (5.9%)	5,810 (5.9%)	123 (5.5%)	21,410 (93.1%)
Region IV	37,840 (16.9%)	17,520 (16.4%)	15,980 (16.3%)	335 (14.9%)	21,110 (91.8%)
Region VI	24,510 (11.0%)	11,895 (11.1%)	11,160 (11.4%)	238 (10.6%)	21,480 (93.4%)

^aPercent of national shown in parentheses. Income values are in current \$. See Appendix E for details.

Table 4.13. Regional shares of commercial sector activity in retail trade and selected services relative to national^a (baseline case 1980-81)

Region	Variables		
	Employment (thousands)	Wages (billion \$)	Sales (billion \$)
U.S.	18,000	214	1240
Region I	1,062 (5.9%)	11.77 (5.5%)	63 (5.1%)
Region IV	2,754 (15.3%)	31.89 (14.9%)	197 (15.9%)
Region VI	2,052 (11.4%)	22.68 (10.6%)	140 (11.3%)

^aPercent of national shown in parentheses. Wage and sales values are in current \$. See Appendix E for details.

Table 4.14. Regulation-induced reduction in wages and sales in the commercial sector^a 1980:4 through 1981:3 (billions of current \$)

Region	Impacts			
	60-hr week		40-hr week	
	Wage reduction	Sales reduction	Wage reduction	Sales reduction
U.S.	4.52	13.78	13.20	41.30
Region I	0.25	0.70	0.73	2.11
Region IV	0.67	2.19	1.97	6.57
Region VI	0.48	1.56	1.40	4.67

^aU.S. totals are from Tables 4.9 and 4.10. The data presented are for establishments in retail trade and selected service categories. For further details See Appendix E.

first (and probably reasonable) approximation, secondary effects on income and employment at the regional level (induced by primary impacts on the commercial sector) would be very similar when measured in relation to each region's baseline economy. Thus, while impacts within the commercial sector are influenced by the sector-specific economic activity

Table 4.15. Regulation-induced losses in regional disposable income^a — 1980:4 through 1981:3 (billions of current \$)

Region	Disposable income (baseline)	Impacts			
		Loss in disposable income			
		60-hr week		40-hr week	
		Without sales loss	With sales loss	Without sales loss	With sales loss
U.S.	1972.3	5.87	14.66	14.48	42.16
Region I	108.5	0.32	0.81	0.80	2.32
Region IV	293.8	0.88	2.19	2.16	6.29
Region VI	209.0	0.62	1.56	1.54	4.48

^aIncome losses at the national level are from Tables E-7 through E-10 in Appendix E, where units are given in constant 1972 \$. The implicit price deflator to convert from constant 1972 \$ to current \$ is 1.833 (1972 = 1.00) over the 1980-81 period.

in each region, impacts across all sectors are determined by each region's overall economic makeup.

Primary and secondary losses in regional disposable income and the unemployment equivalent of the income loss are presented in Tables 4.15 and 4.16 (see Appendix E). They represent impacts for the 60- and 40-hr-week restrictions on commercial sector operating hours, both with and without the addition of the loss in sales in the sector.

A comparison of the regional impacts on income and employment indicates that region IV would suffer the greatest losses on an absolute basis and region I the least. On a relative basis (i.e., with respect to each region's baseline economy) the incremental impacts are seen to be similar to those computed nationally.

The unemployed workers may have difficulty in finding employment outside the commercial sector. At a local level it is not unlikely that these unemployed workers would be forced to relocate, or become a part of the permanently unemployed. This condition places additional burdens on the local and state governments as transfer payments increase. The potential for a subsequent rise in taxes will further worsen the situation

Table 4.16. Regulation-induced increases in regional unemployment and resultant unemployment rates^a — 1980:4 through 1981:3

Region	Baseline unemployment level and rate	Impacts			
		Increase in unemployment and unemployment rate under regulation			
		60-hr week		40-hr week	
		Without sales loss	With sales loss	Without sales loss	With sales loss
U.S.	7,000,000 (6.50%)	299,500 (6.78%)	741,000 (7.19%)	734,000 (7.18%)	2,133,000 (8.49%)
Region I	414,000 (6.55%)	17,580 (6.82%)	43,900 (7.24%)	43,400 (7.23%)	126,300 (8.54%)
Region IV	1,235,000 (7.06%)	43,400 (7.33%)	120,900 (7.75%)	119,500 (7.74%)	347,700 (9.04%)
Region VI	528,000 (4.44%)	33,800 (4.73%)	84,500 (5.15%)	83,500 (5.14%)	243,000 (6.49%)

^aBased on unemployment equivalent of income loss under regulation (see Appendix E).

as consumer's disposable income is reduced. However, the temporary nature of the regulation may allow these conditions to be reversed when the regulation expires, but the reversal may not necessarily be complete.

4.4 Environmental Impacts

4.4.1 Overview of results

The impacts on the physical environment of regulation restricting the hours of operation of commercial establishments are minor, both at the national and regional levels. The criteria pollutants considered were: particulates, sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrocarbons (HC), and carbon monoxide (CO). The environmental impacts were measured as changes in the level of pollutants relative to a baseline environment described in Appendix F. The impacts were estimated from a change in the pattern of fuel use under regulation, wherein petroleum and natural gas savings in the commercial and utility sectors were assumed to be used in the manufacturing sector. These impacts at the national level are shown in Table 4.17.

Environmental impacts of regulation at the regional level were similarly estimated for DOE regions I, IV, and VI for just the 60-hr case. In all three regions the environmental impacts are also small (see Table 4.18).

The results shown in Tables 4.17 and 4.18 are presented as calculated, and no implications to accuracy are intended. In fact the exceedingly small changes in emission levels (both nationally and in the selected regions) are probably well within the margins of error associated with data from the Strategic Environmental Assessment System (SEAS) model used in this study. Additionally, since savings in the utility use of coal were not assumed to be used elsewhere, it is reasonable to expect an overall reduction in emissions for all of the criteria pollutants considered.

The human factors aspect addressing social implications of the regulation (such as economic equity, increased need for social services because of unemployment, etc.) is briefly described. While a detailed analysis

Table 4.17. Emission changes at the national level from regulation restricting commercial sector operating hours

Pollutant	Percent of change relative to national emissions	
	60-hr case	40-hr case
Particulates	<0.01	<0.01
SO _x	<0.01	<0.01
NO _x	0.03	0.03
Hydrocarbons	<0.01	<0.01
Carbon monoxide	<0.01	<0.01

Baseline national average emission levels in 1980-81 (Appendix F):

Pollutants	Quantity of pollutant (10 ³ tons)
Particulates	11,866
SO _x	26,756
NO _x	17,241
Hydrocarbons	11,691
Carbon monoxide	54,500

Table 4.18. Emission changes at the regional level from regulation restricting commercial sector operating hours: 60-hr case

Pollutants					
Percent change in emission levels relative to respective baseline emissions ^a					
	Particulates	Sulfur oxides	Nitrogen oxides	Hydrocarbons	Carbon monoxide
Region I	-0.30	-0.98	+0.38	-0.02	-<0.01
Region IV	+0.07	+0.15	+0.58	+0.01	+0.01
Region VI	+0.01	+0.12	+<0.01	-<0.01	-<0.01

^aRegional baseline emissions data are given in Appendix F.

of these factors was outside the scope of this study, they are nevertheless identified because they are important components of the regulatory decision-making process.

4.4.2 Energy impacts

The principal effect of restricted hours would be a direct reduction in energy demand in commercial establishments (petroleum fuels, natural gas, and electricity) and an indirect reduction in the use of utility fuels. The direct and indirect savings in petroleum and natural gas computed nationally (see Sect. 4.2) were assumed to be used in the manufacturing sector, as shown in Table 4.19. Distribution of these fuel savings to the manufacturing sectors in each region was assumed to be in proportion to the baseline regional shares of petroleum fuel consumption in the sectors (see Appendix F). On this basis the quantities shifted to the sector are shown in Table 4.20. Savings in the utility use of coal were not assumed to be used elsewhere.

It is interesting to note that region IV with the lowest level of fuel savings under the regulation has a substantially greater amount of fuel allocated to its manufacturing sector (over twice as much). Region VI

Table 4.19. Regulation-induced shifts of petroleum fuels and natural gas at the national level from the commercial and utilities sectors to the manufacturing sector^a
(10¹² Btu)

Fuel	From commercial sector	From utilities sector	To manufacturing sector
60-hr case			
Petroleum fuels	102	48	150
Natural gas	148	42	190
40-hr case			
Petroleum fuels	121	57	178
Natural gas	175	50	225

^aSee Sect. 4.2.

Table 4.20. Regulation-induced shifts of petroleum and natural gas at the regional level from commercial and utilities sectors to the manufacturing sector: 60-hr case (10^{12} Btu)

	Fuel	From commercial sector ^a	From utilities sector ^b	To manufacturing sector
Region I	Petroleum	22.83	8.62	15.60
	Natural gas	3.30	0.03	19.76
Region IV	Petroleum	6.57	9.96	35.70
	Natural gas	10.65	3.60	45.22
Region VI	Petroleum	3.23	0.85	9.45
	Natural gas	20.14	24.23	11.97

^aSee Sect. 4.2.

^bSee Appendix F.

on the other hand suffers a net reduction in energy availability, receiving through allocation less than half of the savings achieved. Region I has essentially no loss or gain.

4.4.3 Air emission factors

Fuel specific emissions data (tons/ 10^{12} Btu) by sector for petroleum fuels and natural gas were obtained from the SEAS data base⁹ and are shown in Table 4.21 for the three sectors of interest. These emissions factors are based on current data with the assumption of reasonable compliance with current regulations. This data base was used in a previous DOE/ERA study (Appendix F) to describe the environmental effects of mandatory building temperature restrictions. This is a conservation measure assumed to be part of the baseline case in the present study concerning restriction of commercial sector hours. In order to maintain consistency, the SEAS data base was therefore also utilized here. An alternate data base¹⁰ reflecting emission factors (by sector by fuel type)

9. The Strategic Environmental Assessment System was developed initially by the Environmental Protection Agency.

10. *Environmental Characterizations for Energy Technologies and End Uses*, USDOE, November 1978.

Table 4.21. Air emission factors derived from SEAS data
base (tons/10¹² Btu)

Pollutant	Commercial sector	Utility sector	Manufacturing sector
Petroleum fuels			
Particulates	68.10	15.00	55.40
SO _x	361.00	504.00	421.00
NO _x	207.00	357.00	253.00
Hydrocarbons	10.40	6.99	10.40
Carbon monoxide	13.90	10.49	13.90
Natural gas			
Particulates	4.85	4.85	7.28
SO _x	0.29	0.29	2.93
NO _x	58.20	175.80	336.00
Hydrocarbons	3.88	1.45	0.48
Carbon monoxide	9.70	8.24	8.25

expected in future years could also have been used in this study. However, to maintain consistency, it would have been necessary to characterize the baseline environment with the same data base. Since this step of the analysis, with the inclusion of the temperature restriction measure, was outside the scope of this study, it was decided to use only the SEAS data. Notwithstanding the specific set of emissions data considered, the environmental impacts resulting from the reduced operating hours are not expected to be significant.

4.4.4 Methodology to determine environmental impacts

The regulation-induced reduction in the use of petroleum fuels and natural gas in the commercial and utility sectors, when multiplied by the appropriate emission factors, yields the reduction in the level of the criteria pollutants from these sectors. The use of these fuels in the manufacturing sector causes an increase in emissions which were similarly determined. The net changes in pollutant levels as a conse-

quence of this shift in the pattern of fuel use are shown in Tables 4.17 and 4.18. As described earlier, savings in the utility use of coal were not assumed to be used elsewhere. This would, therefore, result in reduced emission levels for all of the criteria pollutants considered.

4.4.5 Human factors aspect of regulation-induced environmental impacts

The human factors aspect is an important consideration because regulation reducing commercial sector hours would directly affect employment, level of services, and patterns of consumer activities and would require accommodation to routines that would be different from normal. While a detailed analysis of this subject is beyond the scope of this study, a broad perspective of the issues involved is presented.

The social implications of a shortfall in energy and the imposition of mandatory temperature restriction have been dealt with elsewhere (ref. 2, Environmental Analysis). Briefly, the results indicate the following:

1. To the extent that the shortfall leads to a reduction in employment, the quality of life will be affected. The effects could be diffuse (if only a single sector of the economy such as the manufacturing sector is affected by the shortfall) or it could be pervasive if the shortfall cuts across all sectors of the economy.
2. Building temperature restrictions of 65°F in winter and 80°F in summer are consistent with standards set by OSHA, and the establishment of these levels would not bring about a significant decline in employee performance or productivity, although there would be some degree of discomfort experienced by building occupants.
3. It is difficult to predict the effects (if any) on the incidence of diseases and illness of building occupants, but they can be expected to be very small.

The imposition of additional regulations reducing the hours of operation of commercial establishments would have major effects:

1. It would exacerbate the impact on the quality of life because it would lead to higher levels of unemployment (described in Sect. 4.3) and its attendant effects on individuals, families, and their social interactions. These effects would most likely be severe on people in the lower income groups, particularly in the large metropolitan areas where concentrations of commercial establishments are very high.
2. It would impose changes, albeit temporary, on the normal shopping patterns of consumers, causing at least some inconvenience if not major readjustments and hardships.
3. If losses in tax revenues to government are substantial because of losses in incomes and sales of goods and services, they lead to either (a) a reduction in government services, which may have a more severe impact on people in the lower income groups, or (b) an increase in tax rates to compensate for revenue losses so that service levels can be maintained. It is also likely that because of increased unemployment, the demand for services such as crime prevention, medical and therapeutic services, and welfare services will increase. Should this occur, government expenditures will rise and tax rates may have to be increased to meet these costs.

The (adverse) impacts on the physical environment caused by shifts in the pattern of energy use were shown to be minor. Consequently, impacts on health are not expected to be an issue of major concern.

4.5 Implementation

If the emergency measure restricting hours of operation of commercial buildings were to be implemented, a number of issues and costs would have to be anticipated. This section describes some of these legal issues, enforcement and logistics problems, and implementation costs.

4.5.1 Legal issues

Appendix G provides a detailed listing of legal issues that may arise if a restriction on hours of operation of commercial establishments

is imposed. Overall, none of the problems is unsurmountable, but the following four issues should be analyzed carefully before implementing the measure.

- Search warrants may be required for inspection of premises. This could hamper enforcement.
- "Equal protection" rights may present problems. The regulations must not result in grossly unequal impacts on different members of the same class of establishment.
- Labor contracts generally specify layoff procedures. Emergency regulations that lead to temporary layoffs should be considered by employers and employees.
- If a state were successful in saving an energy resource as a result of the regulation, it would not be able to use the saved energy in-state if other regions were in greater need. This would probably diminish state support for the measure.

4.5.2 Other implementation problems

Enforcement of the emergency measure must be carried out rigorously and impartially if appreciable energy is to be saved. The following issues and problems should be resolved:

- DOE staff and state governors must specify channels of communication so that questions regarding the regulations may be answered quickly and accurately.
- State officials should hold training workshops for inspectors and enforcement officers. This is a time-consuming process.
- Each state (or DOE) must set up an appeals process to hear complaints from establishments that feel they have been dealt with unfairly. For example, the high humidity associated with high summer temperatures may be harmful to trade goods in certain commercial establishments, and these establishments will appeal the measure.
- Officials need to define operationally a "trigger point" that would be used to initiate the measure.

Logistical problems associated with the preparation and distribution of public information materials should be anticipated. If the proprietors of the establishments and the general public understand the regulations and the reasons for the regulations, a higher degree of cooperation should result. The following procedures should be completed well before the measure is implemented.

- DOE staff should obtain clearance for any forms that need to be used.
- DOE staff should prepare copies of the regulations, copies of brochures providing hints as to minimizing adverse impacts, and copies of training manuals for enforcement officers.
- DOE and state officials should prepare newspaper, radio, and TV releases explaining the evidence for the crisis and the rationale of the emergency measure.

A well-planned monitoring and evaluation system should be implemented as part of the emergency measure. In this way, actions that are successful may be identified and made ready for future emergencies, and actions that proved of little use may be discarded.

4.5.3 Implementation costs

The authors have not made a direct study of the costs involved in implementing this conservation plan. Rough estimates of implementation costs may be made, however, by reference to two related studies (see Table 4.22).

Even if the EBTRP estimate is adjusted for 12 months, making the total about \$11 million, the two estimates differ by almost 3:1. Both estimates were made assuming the plan would be implemented independently. The ERC plan assumes that enforcement will be difficult, since the measure will probably be unpopular both with commercial people and the general public. A large number of inspectors would be required to monitor thermostat settings and hours of closure.

If the measure to restrict hours of operation were implemented independently, the authors feel that the higher estimate by ERC, which includes much more adequate staffing, would be more appropriate. If the

Table 4.22. Estimates of implementation costs from related studies

Source of study	Estimated costs	Functions and staff time
Emergency Building Temperature Restrictions Plan (9 months costs) 1979	\$1.4 million direct federal costs 6.7 million reimbursable to state & local government	39 staff-years 278 staff-years
	\$8.1 million	317 staff-years
	(Administer, appeals, information, enforcement)	
Energy Resources Company, Inc., study for FEA, (12 months costs) 1974	\$10.0 million 6.7 14.6 0.3	Start-up 200 staff-years Admin. 190 Enforcement 1430 Other
	\$31.6 million	1820 staff-years

Sources: *A Study of the Impact of Reduced Retail Store Operating Hours on Sales, Employment, Economic Concentration, and Energy Consumption*, Energy Resources Company, Inc., 1975. *Standby Conservation Plan No. 2 - Emergency Building Temperature Restriction*, U.S. Department of Energy, 1979.

ERC estimate were corrected for about five years of inflation, it would require about \$45 million to field the same staff time. Obviously, the measure could be enforced and implemented at any degree of rigor, but any serious approach would probably cost at least \$35 to 50 million. These estimates do not include costs to the private (commercial) sector.

If the measure were implemented as an "add on" or companion to the EBTRP, the costs could be shared. Appendix H contains the "Authorities Need, Rationale, Operation" information that would be required if the measure were selected by ERA for possible implementation.

Appendix A

POSSIBLE EMERGENCY ENERGY (PETROLEUM) CONSERVATION MEASURES: AN INITIAL LIST FOR SCREENING

A.1 Emergency conservation measures for residential buildings

- Reduce thermostat setting 6°F in winter (to about 68°F); additional reduction of 8°F at night.
- Set up thermostat 6°F in summer (to about 78°F).
- Reduce water heater setting about 25°F (from about 145°F to 120°F).
- Reduce hot water used in bathing by one-third.
- Stop use of hot water for laundry.
- Reduce infiltration with polyethylene sheets over windows; caulk cracks.
- "Tune up" oil furnace burners.
- Power substitution in areas where electricity is generated from coal, hydro, or nuclear — not oil (greater use of electric or wood space heaters and less use of furnace oil).
- Reduce electric power use in regions where electricity is generated from oil. (Restrict cooking and oven use; restrict use of clothes dryers.)
- Reduce electric power use by reducing voltage or rotating blackouts.
- Use heavy curtains to close off windows at night and open to admit sun during day.
- Early cutoff of TV broadcasts so people will not stay up late and keep house heated.
- Neighbors share houses and "close down" one house; close down private residences and set up emergency centers (in case of extreme emergency).

A.2 Emergency conservation measures for commercial buildings

- Adjust thermostat settings

Winter: 68°F in apartments and motels
65°F in other commercial buildings

(also)

5°F setback at night in apartments and motels
10°F setback for other commercial buildings

Summer: 78°F and cut off cooling 1 hr before closing building

- Reduce lighting in the summer to minimum acceptable level.
- Reduce temperature of general-purpose hot water 20°F (to about 120°F).
- Establish minimum air ventilation during occupancy and zero ventilation when unoccupied.
- Tune up oil burner to best efficiency.
- Revise school year and eliminate evening classes.
- Cancel evening public activities.
- Shut down nonessential commercial operations and compensate owners and workers.
- Restrict commercial business hours.
- Mandatory vacation shutdown.
- Reduce space used (and heated) in a building.
- Cut back electrical power delivered to commercial buildings.
- Reduce street lighting by half.

A.3 Emergency conservation measures for commercial transportation

Trucks

- Improve maintenance and operating procedures — less empty hauling, direct routings, tuned engines, etc.
- Increase weight limits —

single axle	18,000 lb to 20,000 lb
tandem axle	32,000 lb to 34,000 lb
gross weight	73,280 lb to 78,000 lb
- Enforce 55-mph limit on intercity trucking.
- Reduce use of government trucks.
- Shift from truck to barge or rail where feasible.
- Insulate truck fuel lines in northern states so they can use No. 2 diesel without mixing in No. 1 diesel used in home heating.

Barge

- Increase operating efficiencies by speed reduction and shorter turnaround time.

Commercial air

- Increase load factor from 50% to 70% to decrease number of flights.
- Shift 50% of the short air hops (<200 miles) to bus.
- Reduce cruise speeds and increase cruise altitude to minimize fuel used instead of cost.
- Tow planes on ground.
- Fly direct routes.
- Reduce military training flights by using simulators.
- Use phone instead of flying.
- Segregate landing areas for fast-landing commercial planes and slower-landing private planes.

Appendix B

REVIEW OF EMERGENCY CONSERVATION MEASURES

Including Group Recommendations

B.1 Residential buildings

Reviewers: R. M. Davis, Roger Carlsmith, Eric Hirst

- Reduce thermostat setting 6°F in winter (to about 68°F); additional reduction of 8°F at night; set up thermostat 6°F in summer (to about 78°F).

Recommendation: Review further; could show significant savings; minimum economic impact; difficult to enforce

- Reduce water heater setting about 25°F (from about 145°F to 120°F); reduce hot water used in bathing by 1/3; stop use of hot water for laundry.

Recommendation: Review further, minimum economic impact; difficult to enforce

- Reduce infiltration with polyethylene sheets over windows; caulk cracks.

Recommendation: Review further, question availability of supplies; difficult to enforce

- "Tune up" oil furnace burners.

Recommendation: Review further, question technical manpower needed; difficult to enforce

- Power substitution in areas where electricity is generated from coal, hydro, or nuclear — not oil (greater use of electric space heaters and less use of furnace oil).

Recommendation: Delete; lack of space heaters; demand on generating equipment; difficult to assess economic impact, supplies of other fuels, enforcement

- Reduce electric power use in regions where electricity is generated from oil. (Restrict cooking and oven use; restrict use of clothes dryer.)

Recommendation: Delete except in extreme emergency; little savings; symbolic measure

- Reduce electric power use by reducing voltage or rotating blackouts.

Recommendation: Deleted as nationwide measure. Additional analysis desirable for regions where electricity is generated from oil.

- Use heavy curtains to close off windows at night and open to admit sun during day.

Recommendation: Review further; minimum economic impact; difficult to enforce

- Early cutoff of TV broadcasts so people will not stay up late and keep house heated.

Recommendation: Delete; heavy social impact, although this measure resulted in saving on home heating in other countries; economic impact from reduced advertising

- Neighbors share houses and "close down" one house; close down private residences and set up emergency centers.

Recommendation: Delete; difficult to implement; difficult to assess savings; unpopular as an invasion of privacy; minimum economic impact

Additions to list of measures from Review Group:

- Closing rooms in homes.

Recommendation: Review further; minimum economic impact; difficult to enforce

- Curtail oil supplies to residences; allocation.

Recommendation: Retain as possible mandatory measure; assures a predetermined percentage savings

B.2 Commercial buildings

Reviewers: R. M. Davis, R. S. Carlsmith, Eric Hirst

- Adjust thermostat settings.

Winter: 68°F in apartments and motels
65°F in other commercial buildings

(also)

5°F setback at night in apartments and motels
10°F setback for other commercial buildings

Summer: 78°F and cut off cooling 1 hr before closing building

Recommendation: Further reviews desirable; potential for significant savings; enforcement problems generally less than for residential; economic impact not great; health and safety impact a problem in motels and apartments

- Reduce lighting to minimum acceptable level.

Recommendation: Current government requirements for public buildings already in effect; further reduction primarily symbolic; enforcement difficult

- Reduce temperature of general-purpose hot water 20°F (to about 120°F).

Recommendation: Further review desirable; potential for some savings; little economic impact; enforcement could be difficult; exemptions necessary in specialized cases

- Establish minimum air ventilation during occupancy and zero ventilation when unoccupied.

Recommendation: Delete as mandatory measure; difficult to engineer and enforce; potential for savings

- Tune up oil burner to best efficiency.

Recommendation: Further review desirable; manpower requirements, ease of enforcement are questions; potential for savings

- Revise school year and eliminate evening classes.

Recommendation: Delete; potential for saving; large social impact

- Cancel evening public activities.

Recommendation: Delete; potential for saving; large economic and social impact

- Shut down nonessential commercial operations and compensate owners and workers.

Recommendation: Delete; subjective judgments required for "nonessential." "Compensation" difficult to administer and expensive to fund.

- Restrict commercial business hours.

Recommendation: Potential for saving; sizable economic impact; enforceable

- Mandatory vacation shutdown.

Recommendation: Delete; unfair economic impact on some businesses

- Reduce space used (and heated) in a building.

Recommendation: Cannot be mandatory; potential for savings; little economic impact

- Cut back electrical power delivered to commercial buildings.

Recommendation: Further technical reviews needed

- Reduce street lighting by half.

Recommendation: Further review desirable; little economic impact; probable social impact (rise in crime rate?); a symbolic measure

Measures added by reviewers:

- Allocation of petroleum to the commercial sector.

Recommendation: Further review desirable; would assure percentage saving of petroleum; enforceable

B.3 Commercial transportation

Reviewers: R. M. Davis, R. S. Carlsmith, D. G. Greene, A. B. Rose

Trucks

- Improve maintenance and operating procedures — less empty hauling, direct routings, tuned engines, etc.

Recommendation: Delete; in general, truckers are already doing this

- Increase weight limits —

single axle	18,000 lb to 20,000 lb
tandem axle	32,000 lb to 34,000 lb
gross weight	73,280 lb to 78,000 lb

Recommendation: Combine with recommendation to allow double and triple trailers plus enforcement of 55-mph speed to make package that would be economically acceptable for truckers; impact on roads needs further review; "borrows energy from future for road repair"; safety questions

- Enforce 55-mph limit on intercity trucking.

Recommendation: See weight limit recommendation; resistance by truckers if other trade-offs not given

- Reduce use of government trucks.

Recommendation: Include as symbolic measure; little opportunity for significant savings

- Shift from truck to barge or rail where feasible.

Recommendation: Delete; already being used where applicable

- Insulate truck fuel lines in northern states so they can use No. 2 diesel without mixing in No. 1 diesel used in home heating.

Recommendation: Delete; specific to a few northern regions; does not conserve; only changes types of fuel used

Barge

- Increase operating efficiencies by speed reduction and shorter turnaround time.

Recommendation: Additional technical review needed.

Commercial air

- Increase load factor from 50% to 70% to decrease number of flights.

Recommendation: Delete; load factors already at 70%; load factor up 10% this year since deregulation

- Shift 50% of the short air hops (<200 miles) to bus.

Recommendation: Additional technical review needed. Buses use 10% of energy of planes on short trips; there is available capacity on buses. May not increase savings as much as expected, since short-hop plane passengers may be filling out long-hop empty seats.

- Reduce cruise speeds and increase cruise altitude to minimize fuel used instead of cost.

Recommendation: Delete; already being done; cruise speeds have been reduced; safety is a determinant for altitude

- Tow planes on ground.

Recommendation: Delete; safety and lack of equipment are considerations; may require longer waits in air for landing

- Fly direct routes.

Recommendation: Delete; safety considerations

- Reduce military training flights by using simulators.

Recommendation: Delete; already being done to some extent. (Could be included as area of review by military.)

- Use phone instead of flying.

Recommendation: Delete; no way to assess savings; could be part of PR campaign for emergency savings

- Segregate landing areas for fast-landing commercial planes and slower-landing private planes.

Recommendation: Delete; in-place facilities a problem

Reviewers additions:

- Ground general aviation except for necessary flights (crop dusting, air ambulance, etc.).

Recommendation: Potential energy saving; travelers could be accommodated; economic impact on charter plane owners

Appendix C

A REDUCED LIST OF PROPOSED MEASURES TO DECREASE PETROLEUM CONSUMPTION

C.1 Residential buildings

<u>Measure</u>	<u>Approximate savings</u>	<u>Committee recommendations</u>
<u>Mandatory:</u>		
• Allocation of available supplies to assure a predetermined percentage saving of the supply	% saved predetermined by % allocation	Review conservation measures to determine a "reasonable" % allocation that could be met using conservation measures
• Voltage reduction plus rotating blackouts, depending on severity of shortage. (Used in regions heavily dependent on oil for electricity generation.)	Saving unknown	Additional technical review needed
<u>Voluntary:</u>		
• A combination of the following -		
<u>Reduce thermostat settings</u> to 66°F in winter and to 58°F at night; increase thermostat settings to 78°F in summer	0.3-0.8 quad	Retain measure; National Petroleum Council had data on estimated achievable savings for those temperatures
<u>Reduce use of hot water</u> by reducing hot-water heater setting to 120°F, and stop use of hot water in laundry	<0.1 quad	Retain measure; difficult to assess reduction in hot-water use in laundry; urge as supplemental conservation measure
<u>Space condition house</u> by reducing infiltration (polyethylene sheets and drapes), caulking cracks	0.2-0.4 quad	Retain measures
<u>Tune up oil furnace burners</u>		Retain measures

C.2 Commercial buildings

<u>Measure</u>	<u>Approximate savings</u>	<u>Committee recommendations</u>
<u>Mandatory:</u>		
• Allocation of available supplies to assure a predetermined percentage saving of the supply	% saved predetermined by % allocations	Review conservation measures to determine a "reasonable" % allocation that could be met using conservation measures
• Voltage reduction plus rotating blackouts, depending on severity of shortage. (Used in regions heavily dependent on oil for electricity generation.)	Saving unknown	Additional technical review needed
<u>Mandatory or voluntary:</u>		
• Establish a 68°F maximum occupied temperature level in apartments and hotels and motels in commercial establishments (hospitals and nursing homes excepted)	0.4 quad	Retain space conditioning measures
Establish a 5°F night setback below day levels in apartments and 10°F for commercial buildings during unoccupied hours; hospitals and nursing homes excepted	0.2 quad	
Establish cooling comfort level of 78°F. Cut off cooling 1 hr before occupants leave	0.1 quad	
• Restrict hours of operation for commercial businesses	0.3 quad	Retain as conservation measure

C.3 Commercial transportation

<u>Measure</u>	<u>Approximate savings</u>	<u>Committee recommendations</u>
<u>Mandatory</u>		
• Allocation of available supplies to assure a predetermined percentage saving of the supply	% saved predetermined by % allocation	Retain as suggested measure
Commercial trucking:		
• A combination of the following —		
1. Increase weight limits	0.03 quad	Delete because of road wear; safety; laws in some states
Single axle 18,000 lb to 20,000 lb		
Tandem axle 32,000 lb to 34,000 lb		
Gross weight 73,280 lb to 78,000 lb		
2. Double or triple bottoms		
3. Enforce 55-mph limit on inter-city trucking	0.1-0.2 quad	Retain
• Reduce use of government trucks 10-20%	<0.1 quad	Retain as symbolic measure
Domestic water-borne commerce:		
• Speed reduction of 10-15%	0.1 quad	Delete; small savings; difficult enforcement
Commercial air transportation:		
• Cancel short air hops (<200 miles); shift to bus	<0.1 quad	Delete; many shifts would be to private car rather than bus, decreasing savings; considerable inconvenience
• Ground general aviation planes except on essential services such as air ambulance, crop dusting	0.1 quad	Delete; falls under study by another agency for ERA

Appendix D.

SIMULATION OF ECONOMY IN THE ABSENCE OF REGULATION (BASELINE ECONOMY)

The baseline economy represents the U.S. economy after the onset of a hypothetical interruption of 1.6 million bbl/day in the imported supply of crude oil, lasting from the fourth quarter of 1980 through the third quarter of 1981. This interruption represents a loss of approximately 10% of total U.S. crude consumption expected over the 1980-81 period. In response to the interruption, mandatory restrictions on the temperature levels of selected public and private buildings are assumed to be enforced. The temperature restriction measure is expected to reduce energy demand by 1.0 million bbl/day crude oil equivalent* and moderate the impact of the interruption to a net level of 0.6 million bbl/day. The net shortfall in crude supplies is assumed to impact only the manufacturing sector, causing a decline in that sector's output. In addition, a modest increase in domestic energy prices is expected during the duration of the supply interruption.

The baseline economy was simulated using the Data Resources Inc. (DRI) model of the U.S. economy, Trendlong 03/79, with changes in three variables shown in Table D-1 corresponding to the assumptions described.

The decline in the value of fuel imports reflects the loss of 1.6 million bbl/day of crude oil at an average price of \$2.60 per barrel in 1967 dollars. The increase in domestic energy prices was assumed and reflected through an annual rate of increase in the wholesale price index for fuels, 10% higher than that shown in Trendlong 03/79. The shortfall-induced decline in the index of industrial production and manufacturing (JQINDM) was derived as follows. The index was correlated

* Based on data from ref. 1, considering reductions in demand, direct and indirect, for petroleum fuels and natural gas under mandatory imposition of thermostat settings of 65°F in winter and 80°F in summer from a year-round normal setting of 72 to 73°F. Reference 1 considers a shortfall in petroleum supplies that is 15% of U.S. petroleum consumption. In response to this shortfall, voluntary conservation measures are first assumed to be implemented leading to thermostat settings of 68°F in winter and 77°F in summer from a year-round normal setting of 72 to 73°F. The imposition of mandatory temperature restrictions is then assumed which requires thermostat settings to be further lowered to 65°F in winter and raised to 80°F in summer. The petroleum and natural gas savings induced solely as a result of the regulation are estimated to be about 0.5 million bbl/day. If the petroleum and natural gas savings from the voluntary action are also taken into account, ref. 1 estimates the total energy savings to be about 1 million bbl/day (see Sects. 1.3 and 2.1 of ref. 1 for further details, particularly the caveat on the top of p. 1.2).

with manufacturing industry shipments (SM) directly associated with value added (V). In turn, value added and energy use in manufacturing (E) can be correlated. Consequently, an empirical relationship between the index and energy consumption is obtained. Equations (1) through (3) show the form of the calculation:

$$(JQINDM)_i = a + b (SM)_i, \quad (1)$$

where

i = quarterly time period,
 $a = 0.21630$,
 $b = 0.00495$,
 SM = industry shipments in billions of 1972 \$.

The linear-regression form of Eq. (1) was derived using quarterly data from 1970 through 1978 for JQINDM and SM (from the DRI data bank) and applied to the 1980-81 time period.

In step 2 of the calculation, value added in manufacturing was related to SM according to Eq. (2), using recent historical data:²

$$(2.33) \cdot V = SM, \quad (2)$$

where

SM and V are in constant 1972 \$.

The ratio (V/E) of value added in manufacturing per unit of energy consumption, or its converse, is often cited as a measure of the energy effectiveness of industrial operations (see, for example, "Energy Consumption in Manufacturing," Ford Foundation Study, Ballinger Publishing Co., 1974). The statistics for 1976 (refs. 3 and 4) show the following:

value added in manufacturing (V) = \$382.4 billions of 1972 \$,
 energy consumption in manufacturing (E) = 12.77 quads,
 $(V/E)_{1976} = \$30/\text{million Btu}.$

Assuming this value of (V/E) to be (roughly) constant over the 1980-81 time period, the change in JQINDM resulting from a change in energy available to the manufacturing sector can be derived as follows:

$$\begin{aligned} (\Delta JQINDM) &= b \cdot \Delta SM \\ &= b \cdot (2.33) \cdot \Delta V \\ &= b \cdot (2.33) \cdot (30) \cdot (\Delta E), \end{aligned} \quad (3)$$

where

ΔE = change in energy availability (quads)
 to the manufacturing sector in each quarter
 between 1980:4 and 1981:3. ΔE can be positive
 or negative.

Equation (3) has to be interpreted with some caution. JQINDM is a production index not a production function. Consequently, interpreting the relationship shown from an "elasticity" concept may not be appropriate. For example, under an energy supply shortfall, energy consumption can be reduced (through leak plugging and belt tightening, if such measures have not been accomplished even as part of normal operations) without affecting output. Conversely, even with very energy efficient operations, any increase in energy availability other than in an existing shortfall situation cannot be translated through Eq. (3) into a corresponding increase in output, since energy is only one factor of production.

The validity of Eq. (3) is best reflected when

- industrial operations are at peak (or close to peak) efficiency from an energy utilization standpoint,
- a small to moderate energy shortfall exists which does cause a reduction in the level of industrial operations.

Under the assumption that the value of (V/E) considered herein is at least approximately representative of condition (1) cited above, Eq. (3) is a reasonable correlation between JQINDM and E.

Selected measures of economic activity in the baseline economy are shown in Table D-2. They represent conditions from which regulation-induced changes in the economy will be determined.

Table D-1. Variables influencing baseline economy

A - DRI/Trendlong 03/79

B = baseline economy

Variables	Time period			
	1980:4	1981:1	1981:2	1981:3
• <u>Value of imports of fuels and lubricants (billions of 1967 \$)</u>				
A	8.3	8.2	8.3	8.2
B	6.8	6.7	6.8	6.7
• <u>Index of industrial production—manufacturing sector (1967 = 1.00)</u>				
A	1.563	1.592	1.610	1.619
B	1.449	1.478	1.496	1.505
• <u>Wholesale price index — fuels, related products, and power (1967 = 100)</u>				
A	4.445	4.569	4.696	4.825
B	4.543	4.771	5.009	5.259

Table D-2. Selected measures of economic activity in baseline economy

Variables	Time period			
	1980:4	1981:1	1981:2	1981:3
• <u>Gross national product (billions of 1972 \$)</u>	1488.0	1504.9	1514.3	1522.1
• <u>Personal consumption expenditures (billions of 1972 \$)</u>	962.1	973.9	981.8	988.4
• <u>Gross private domestic fixed investment (billions of 1972 \$)</u>	210.3	213.8	216.1	216.3
• <u>Change in business inventories (billions of 1972 \$)</u>	9.8	11.3	9.9	9.6
• <u>Disposable personal income (billions of 1972 \$)</u>	1065.9	1071.7	1077.9	1088.5
• <u>Total employed (millions)</u>	98.9	99.7	100.4	101.0
• <u>Consumer price index — urban (1972 = 1.00)</u>	2.354	2.399	2.445	2.491

Appendix E

SIMULATION OF ECONOMY UNDER REGULATION (REGULATED ECONOMY)

E.1 Introduction

The economy under regulation was simulated for two levels of curtailment in operating hours, namely, 60 and 40 hr/week. In each instance, the magnitude of a loss in sales was varied between zero and a level determined in proportion to the reduction in operating hours for selected establishments. Notwithstanding the sales effect, a reduction in operating hours is expected to result in:

- A reduction in total man-hours through a combination of layoffs and shortened work hours leading to an aggregate loss in personal income and its attendant effects (employment-income effect).
- Energy savings in the commercial sector which are then assumed to be used in the manufacturing sector (energy effect).

Each of these outcomes was estimated and used as external inputs to the DRI model to affect the baseline economy.

E.1.1 Determination of sales effect

Commercial sector establishments likely to be impacted by regulation of operating hours are shown in Table E-1. In the case where sales are assumed to be affected, only the following five establishments are expected to incur a loss in sales and revenues (see Sect. 4.3):

- General merchandise
- Apparel and accessories
- Eating and drinking
- Other retail
- Other services

The level of sales and revenues in 1980-81 estimated nationally for these five establishments in the baseline economy is shown in Table E-2. These sales were projected from corresponding levels in 1977 at annual growth rates equal to average rates experienced between 1972 and 1977.¹

The loss in sales incurred by each establishment, assuming a proportionality factor of 0.25, is shown in Table E-3 (i.e., a 1% reduction in hours is associated with a 0.25% reduction in sales).

The loss in sales shown in Table E-3 range approximately from 1% (in the 60-hr week) to 3.3% (in the 40-hr week) of total sales in the retail trade and services sectors, which in the 1980:4 to 1981:3 time period was determined to be \$1240 billion.

Table E-1. Commercial sector establishments affected
by regulation limiting hours of operation^a

Categories of business establishments	Days of operation	Hours of operation	Hours per week	Percent reduction in hours per week under regulation	
				With 60 hr per week	With 40 hr per week
Building materials, hardware, etc.	Mon.-Sat.	9-5	48		16.7
General merchandise	Mon.-Sat.	9-9	72	16.7	44.4
Food	Mon.-Sat.	10-10	72	16.7	44.4
Automotive dealers	Mon.-Sat.	9-6	54		25.9
Gasoline service stations	Sun.-Sat.	7-10	105	42.9	61.9
Apparel & Accessories	Mon.-Sat.	9-9	72	16.7	44.4
Furniture	Mon.-Sat.	10-8	60		33.3
Eating & drinking	Sun.-Sat.	10-10	84	28.6	52.4
Drug stores	Sun.-Sat.	9-9	84	28.6	52.4
Other retail	Mon.-Sat.	9-6	54		25.9
Personal services	Mon.-Sat.	9-9	72	16.7	44.4
Other services	Mon.-Sat.	9-6	54		25.9

^aSee ref. 8.

Table E-2. Annual sales and revenues in selected commercial establishments in the baseline economy

Establishments	Sales and revenues ^a (billions of current \$)	
	1980	1981
General merchandise	112.4	121.4
Apparel & accessories	40.9	43.7
Eating & drinking	89.6	100.4
Other retail	65.9	72.1
Other services	81.7	92.1

^a Annual rate of growth in sales and revenues between 1977 and 1981 are 8, 6.9, 12.0, 9.3 and 12.8% respectively.

Table E-3. Loss in sales and revenues in selected commercial establishments from reduced operating hours (quarterly at annual rates)

Establishments	Loss in sales and revenues (billions of current \$)			
	1980:4	1981:1	1981:2	1981:3
<u>60-hr week</u>				
General merchandise	4.7	5.1	5.1	5.1
Apparel & accessories	1.7	1.8	1.8	1.8
Eating & drinking	6.4	7.2	7.2	7.2
Other retail				
Other services				
Total	12.8	14.1	14.1	14.1
<u>40-hr week</u>				
General merchandise	12.5	13.5	13.5	13.5
Apparel & accessories	4.5	4.9	4.9	4.9
Eating & drinking	11.7	13.2	13.2	13.2
Other retail	4.3	4.7	4.7	4.7
Other services	5.3	6.0	6.0	6.0
Total	38.3	42.3	42.3	42.3

E.1.2 Determination of employment income effect

Man-hours, wage rates, and employment in the business establishments likely to be affected by regulation are shown in Table E-4 for the baseline economy, considering just the nonsupervisory work force. The first ten of these establishments constitute all retail trade. The "other services"[†] category is selective because it excludes hotels, motels, health services, certain business services, motion picture production, etc., which are assumed to be unaffected by the regulation.

The wage rates during 1980-81 in each establishment were obtained with 1977 data⁵ projected using quarterly implicit price deflators for GNP obtained for the baseline economy from the DRI model (i.e., no real increases in wages were considered).

Employment by establishments in retail trade and services were derived as follows:

Employment in retail trade alone was assumed to be 78% of that in retail and wholesale trade,⁵ which is what is projected in the DRI model. Of those employed in retail trade, 88% were assumed to be in nonsupervisory roles⁵ representing approximately 14 million persons in the 1980-81 time period. Disaggregation of this work force between the ten establishments in retail trade was based on the employment distribution in 1977,⁵ which was assumed to remain unchanged through 1981.

The DRI model projects total employment in the services category. The nonsupervisory work force in services is assumed to be 89% of the total,⁵ of which 2.5% is in the "personal services" category and 8.5% in the "other services"[†] category.⁵

The average annual hours worked per nonsupervisory employee in the establishments shown in Table E-4 were assumed to remain unchanged from the levels in 1977, although the Bureau of Labor Statistics data show a declining trend due to a significant increase in part-time employees — currently estimated at over 50% of the labor force in these establishments.^{6,7}

The reduction in operating hours enforced by regulation is assumed to lead to reduction in man-hours through a combination of layoffs and shortened work hours. The ultimate effect is a loss in personal income, which in turn leads to a decrease in consumption with its attendant effects.

The total quarterly loss in personal income at annual rates across all affected establishments, over the period 1980:4 to 1981:3, is shown in Table E-5 for both the 60- and 40-hr-week operations. The income loss is derived as follows:

[†]Includes miscellaneous repair services, automotive repair, garages, amusement, and recreation services including motion picture theatres, etc.

Table E-4. National average man-hours, wage rates, and employment in business establishments affected by regulation (data for baseline economy)

Categories of business establishments	Normal average annual hours worked/employee (nonsupervisory Employees)	Wage rate (\$/hour in current dollars)				Employment in thousands			
		1980:4	1981:1	1981:2	1981:3	1980:4	1981:1	1981:2	1981:3
Building materials, hardware, etc.	1995	5.68	5.78	5.88	5.99	629.9	634.5	639.1	643.2
General merchandise	1530	4.88	4.97	5.06	5.15	2575.7	2594.4	2612.9	2629.9
Food	1620	6.09	6.20	6.31	6.42	2183.7	2199.6	2215.3	2229.7
Automotive dealers	1975	6.35	6.47	6.59	6.70	1077.8	1085.7	1093.4	1100.5
Gasoline service stations	1950	4.46	4.54	4.62	4.70	587.9	592.2	596.5	600.3
Apparel & accessories	1485	4.45	4.53	4.61	4.69	783.9	789.6	795.3	800.4
Furniture	1785	5.71	5.82	5.92	6.03	518.0	521.8	525.4	528.8
Eating & drinking	1365	3.75	3.82	3.89	3.96	4129.5	4159.6	4189.2	4216.4
Drug stores	1560	4.61	4.70	4.78	4.86	475.9	479.3	482.8	485.9
Other retail	1815	5.46	5.56	5.66	5.76	1035.8	1043.4	1050.8	1057.7
Personal services	1710	4.70	4.79	4.87	4.96	383.0	386.0	389.0	392.0
Other services	1800	6.41	6.53	6.64	6.76	1303.0	1313.0	1323.0	1334.0

Table E-5. Regulation-induced income loss in the commercial sector
(quarterly at annual rates)

Categories of business establishments	Reduction in wages with reduction in hours worked (billions of current \$)							
	60 hr week				40 hr week			
	1980:4	1981:1	1981:2	1981:3	1980:4	1981:1	1981:2	1981:3
Building materials, hardware, etc.					0.298	0.305	0.313	0.321
General merchandise	0.803	0.824	0.845	0.865	2.135	2.189	2.246	2.300
Food	0.899	0.922	0.945	0.968	2.392	2.453	2.513	2.574
Automotive dealers					0.876	0.899	0.921	0.943
Gasoline service stations	0.548	0.562	0.576	0.591	0.791	0.811	0.832	0.852
Apparel & accessories	0.217	0.222	0.227	0.232	0.575	0.590	0.605	0.619
Furniture					0.439	0.451	0.462	0.473
Eating & drinking	1.511	1.551	1.590	1.630	2.769	2.842	2.914	2.986
Drug stores	0.245	0.252	0.257	0.263	0.448	0.460	0.472	0.482
Other retail					0.665	0.683	0.700	0.716
Personal services	0.129	0.132	0.135	0.139	0.342	0.351	0.360	0.369
Other services					0.973	0.999	1.024	1.051
Total	4.352	4.465	4.575	4.688	12.703	13.033	13.362	13.686

$$Y_i = \left\{ \sum_j h_j p_j w_j \ell_j \right\}_i, \quad (1)$$

where

i = quarterly time period between 1980:4 and 1981:3, $i = 1, 4$,

j = category of business establishment affected by regulation,
 $j = 1, 12$,

h_j = normal average hours worked per employee per year,

p_j = fractional reduction in hours worked per employee
 $= 0.25 \times$ fractional reduction in operating hours,

w_j = average wage rate (\$/hour),

ℓ_j = total employment,

y_i = total income loss in the i^{th} quarter at annual rates.

The income losses under the 60-hr-week operation are significantly lower than those under the 40-hr week because of:

- Shorter proportion of normal operating hours affected (see Table E-1).
- Smaller number of establishments affected by the 60-hr-week restriction.

E.1.3 Determination of energy effects

Reduction in the operating hours of commercial establishments is assumed to save between 150,000 and 175,000 bbl/day of oil equivalent. The energy saved is assumed to be used in the manufacturing sector, alleviating the 600,000-bbl/day shortfall. As a consequence, the output from the sector is assumed to increase above levels in the baseline economy and is reflected by an increase in the index of production [Appendix D, Eq. (3)] as shown in Table E-6.

E.1.4 Simulation results

The results from the simulation of the economy under regulation incorporating the sales, employment income, and energy effects are shown in Tables E-7 through E-10 in comparison with the baseline economy. Section 4.3 contains a discussion of these results.

Legend to Tables E-7 through E-10

GNP72: gross national product in billions of 1972 \$

C72: personal consumption expenditures in billions of 1972 \$

IFIX72: gross private domestic fixed investment in billions of 1972 \$

Table E-6. Energy effect of regulation

	Time period			
	1980:4	1981:1	1981:2	1981:3
Energy shortfall to manufacturing sector in baseline economy (million bbl/day of energy)	-0.60	-0.60	-0.60	-0.60
Regulation-induced increase in energy availability (million bbl/day of energy)				
60-hr week	+0.15	+0.15	+0.15	+0.15
40-hr week	+0.175	+0.175	+0.175	+0.175
Energy shortfall to manufacturing sector under regulation (million bbl/day of energy)				
60-hr week	-0.45	-0.45	-0.45	-0.45
40-hr week	-0.425	-0.425	-0.425	-0.425
Index of industrial production manufacturing				
Baseline economy	1.449	1.478	1.496	1.505
Regulated economy				
60-hr week	1.478	1.506	1.524	1.534
40-hr week	1.483	1.511	1.529	1.539

Table E-7. Measures of economic activity under regulations

60 hr/week with no decline in sales

A = regulated economy

D = A - B

B = baseline economy

 $\% = (D/B) \times 100$

	80:4	81:1	81:2	81:3	81:4	82:1
--- GNP72						
A	1487.9	1504.3	1513.8	1521.8	1533.8	1542.5
B	1488.0	1504.9	1514.3	1522.1	1533.8	1542.5
D	-0.2	-0.6	-0.6	-0.4	-0.0	-0.0
%	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
--- C72						
A	961.5	972.4	980.0	986.5	991.8	997.9
B	962.1	973.9	981.8	988.4	991.8	997.9
D	-0.6	-1.5	-1.8	-1.8	0.0	0.0
%	-0.1	-0.2	-0.2	-0.2	0.0	0.0
--- IFIX72						
A	210.2	213.8	216.2	216.5	218.4	218.4
B	210.3	213.8	216.1	216.3	218.4	218.4
D	-0.1	0.0	0.1	0.2	0.0	0.0
%	-0.0	0.0	0.0	0.1	0.0	0.0
--- INVNF72CH						
A	10.4	11.8	10.4	10.0	11.1	11.9
B	9.8	11.3	9.9	9.6	11.1	11.9
D	0.6	0.5	0.5	0.4	0.0	0.0
%	6.1	4.3	5.4	4.5	0.0	0.0
--- YD72						
A	1062.0	1068.5	1074.9	1085.6	1086.8	1092.4
B	1065.9	1071.7	1077.9	1088.5	1086.8	1092.4
D	-3.9	-3.2	-3.0	-2.8	0.0	0.0
%	-0.4	-0.3	-0.3	-0.3	0.0	0.0
--- EHH						
A	98.9	99.7	100.4	101.0	101.6	102.1
B	98.9	99.7	100.4	101.0	101.6	102.1
D	-0.0	-0.0	-0.0	-0.0	0.0	0.0
%	-0.0	-0.0	-0.0	-0.0	0.0	0.0
--- CPIU						
A	2.354	2.399	2.445	2.491	2.518	2.562
B	2.354	2.399	2.445	2.491	2.518	2.562
D	0.000	0.000	0.000	0.000	0.000	0.000
%	0.0	0.0	0.0	0.0	0.0	0.0

Table E-8. Measures of economic activity under regulations

40 hr/week with no decline in sales						
A = regulated economy			D = A - B			
B = baseline economy			% = (D/B) × 100			
	80:4	81:1	81:2	81:3	81:4	82:1
--- GNP72						
A	1487.4	1502.6	1511.2	1518.6	1533.8	1542.5
B	1488.0	1504.9	1514.3	1522.1	1533.8	1542.5
D	-0.6	-2.3	-3.1	-3.5	0.0	0.0
%	-0.0	-0.2	-0.2	-0.2	0.0	0.0
--- C72						
A	961.0	970.5	977.3	983.3	991.8	997.9
B	962.1	973.9	981.8	988.4	991.8	997.9
D	-1.1	-3.4	-4.4	-5.0	0.0	0.0
%	-0.1	-0.3	-0.5	-0.5	0.0	0.0
--- IFIX72						
A	210.2	213.6	215.9	216.1	218.4	218.4
B	210.3	213.8	216.1	216.3	218.4	218.4
D	-0.2	-0.2	-0.2	-0.3	0.0	0.0
%	-0.1	-0.1	-0.1	-0.1	0.0	0.0
--- INVNF72CH						
A	10.7	12.0	10.5	10.0	11.1	11.9
B	9.8	11.3	9.9	9.6	11.1	11.9
D	0.9	0.7	0.6	0.4	0.0	0.0
%	8.9	6.3	6.2	3.9	0.0	0.0
--- YD72						
A	1058.2	1064.0	1069.9	1080.3	1086.8	1092.4
B	1065.9	1071.7	1077.9	1088.5	1086.8	1092.4
D	-7.7	-7.7	-8.0	-8.2	0.0	0.0
%	-0.7	-0.7	-0.7	-0.8	0.0	0.0
--- EHI						
A	98.9	99.7	100.3	100.9	101.6	102.1
B	98.9	99.7	100.4	101.0	101.6	102.1
D	-0.0	-0.0	-0.1	-0.1	0.0	0.0
%	-0.0	-0.0	-0.1	-0.1	0.0	0.0
--- CPIU						
A	2.354	2.399	2.445	2.491	2.518	2.562
B	2.354	2.399	2.445	2.491	2.518	2.562
D	0.000	0.000	-0.000	-0.000	0.000	0.000
%	0.0	0.0	-0.0	-0.0	0.0	0.0

Table E-9. Measures of economic activity under regulations

60 hr/week with no decline in sales

A = regulated economy

D = A - B

B = baseline economy

 $\% = (D/B) \times 100$

	80:4	81:1	81:2	81:3	81:4	82:1
--- GNP72						
A	1482.6	1494.3	1504.5	1512.4	1533.8	1542.5
B	1488.0	1504.9	1514.3	1522.1	1533.8	1542.5
D	-5.5	-10.6	-9.8	-9.7	0.0	0.0
%	-0.4	-0.7	-0.6	-0.6	0.0	0.0
--- C72						
A	954.3	963.8	971.1	977.2	991.8	997.9
B	962.1	973.9	981.8	988.4	991.8	997.9
D	-7.8	-10.1	-10.7	-11.2	0.0	0.0
%	-0.8	-1.0	-1.1	-1.1	0.0	0.0
--- IFIX72						
A	209.7	213.1	215.2	215.3	218.4	218.4
B	210.3	213.8	216.1	216.3	218.4	218.4
D	-0.6	-0.7	-0.8	-1.0	0.0	0.0
%	-0.3	-0.3	-0.4	-0.5	0.0	0.0
--- INVNF72CH						
A	12.6	10.5	10.0	10.1	11.1	11.9
B	9.8	11.3	9.9	9.6	11.1	11.9
D	2.8	-0.9	0.1	0.4	0.0	0.0
%	28.9	-7.6	1.4	4.6	0.0	0.0
---YD72						
A	1059.3	1062.8	1069.6	1080.3	1086.8	1092.4
B	1065.9	1071.7	1077.9	1088.5	1086.8	1092.4
D	-6.6	-8.9	-8.3	-8.1	0.0	0.0
%	-0.6	-0.8	-0.8	-0.7	0.0	0.0
---EHH						
A	98.9	99.5	100.1	100.7	101.6	102.1
B	98.9	99.7	100.4	101.0	101.6	102.1
D	-0.1	-0.2	-0.2	-0.3	0.0	0.0
%	-0.1	-0.2	-0.2	-0.3	0.0	0.0
---CPIU						
A	2.354	2.399	2.444	2.490	2.518	2.562
B	2.354	2.399	2.445	2.491	2.518	2.562
D	-0.000	-0.000	-0.001	-0.001	0.000	0.000
%	-0.0	-0.0	-0.0	-0.1	0.0	0.0

Table E-10. Measures of economic activity under regulations

40 hr/week with no decline in sales						
A = regulated economy			D = A - B			
B = baseline economy			% = (D/B) × 100			
	80:4	81:1	81:2	81:3	81:4	82:1
--- GNP72						
A	1471.3	1471.1	1481.5	1490.5	1533.8	1542.5
B	1488.0	1504.9	1514.3	1522.1	1533.8	1542.5
D	-16.7	-33.8	-32.8	-31.6	0.0	0.0
%	-1.1	-2.2	-2.2	-2.1	0.0	0.0
--- C/2						
A	939.0	944.4	949.8	955.8	991.8	997.9
B	962.1	973.9	981.8	988.4	991.8	997.9
D	-23.1	-29.4	-31.9	-32.6	0.0	0.0
%	-2.4	-3.0	-3.3	-3.3	0.0	0.0
--- IFIX72						
A	208.6	211.5	213.0	212.6	218.4	218.4
B	210.3	213.8	216.1	216.3	218.4	218.4
D	-1.7	-2.3	-3.1	-3.8	0.0	0.0
%	-0.8	-1.1	-1.5	-1.7	0.0	0.0
--- INVNF72CH						
A	17.5	7.0	8.4	9.8	11.1	11.9
B	9.8	11.3	9.9	9.6	11.1	11.9
D	7.7	-4.3	-1.4	0.2	0.0	0.0
%	78.2	-38.0	-14.7	2.2	0.0	0.0
--- YD72						
A	1049.6	1045.6	1052.7	1064.2	1086.8	1092.4
B	1065.9	1071.7	1077.9	1088.5	1086.8	1092.4
D	-16.2	-26.1	-25.3	-24.2	0.0	0.0
%	-1.5	-2.4	-2.3	-2.2	0.0	0.0
--- EHH						
A	98.8	99.2	99.6	100.0	101.6	102.1
B	98.9	99.7	100.4	101.0	101.6	102.1
D	-0.2	-0.5	-0.8	-0.9	0.0	0.0
%	0.2	-0.5	-0.8	-0.9	0.0	0.0
--- CPIU						
A	2.354	2.398	2.442	2.487	2.518	2.562
B	2.354	2.399	2.445	2.491	2.518	2.562
D	-0.000	-0.001	-0.003	-0.005	0.000	0.000
%	-0.0	-0.0	-0.1	-0.2	0.0	0.0

INVNF72CH: change in business inventories in billions of 1972 \$
 YD72: disposable personal income in billions of 1972 \$
 EHH: total employed in millions
 CPIU: consumer price index — urban (1972 = 1.00)

Note: The loss in employment relative to the baseline economy evident in all the simulation results actually reflects only a second-order effect. In Sect. 4.3 it was indicated that the primary effects on employment induced by the regulation could not explicitly be determined, but could only be measured through the loss of personal income. Using the results shown in Tables E-7 through E-10, an unemployment equivalent of income loss and a corresponding unemployment rate equivalent can be derived as follows:

$$\text{regulation-induced income loss} = \Delta YD72 = (YD72)_{\text{baseline}} - (YD72)_{\text{regulation}} \text{ in each quarterly period}$$

$$\left. \begin{array}{l} \text{average income/employed} = \\ \text{over the period 1980:4 to 1981:3} \end{array} \right\} = \frac{\text{average (YD72) baseline}}{\text{average (EHH) baseline}} = W = \$10760$$

$$\left. \begin{array}{l} \text{unemployment equivalent} \\ \text{of income loss under regulation} \\ \text{in each quarterly period} \end{array} \right\} = \frac{(\Delta YD72)}{W} = EE$$

$$\left. \begin{array}{l} \text{unemployment rate} \\ \text{equivalent of income loss} \\ \text{under regulation in each} \\ \text{quarterly period} \end{array} \right\} = (LC - EHH + EE) / LC$$

where

EHH = total employment in the baseline case in each quarter from 1980:4 through 1981:3,

LC = total labor force available for employment in each quarter from 1980:4 through 1981:3, which is the same regardless of economic conditions.

The results of the above calculations are given in Tables E-11 and E-12.

E.1.5 Regional impacts

Economic impacts were analyzed for DOE regions I, IV, and VI. The states comprising these regions are shown in Table E-13. The major assumptions underlying the analysis were as follows:

Table E-11. Unemployment equivalent of income loss at national level (thousands)

	Time period			
	1980:4	1981:1	1981:2	1981:3
60-hr week				
with no sales decline	362	297	279	260
40-hr week				
with no sales decline	716	716	743	762
60-hr week				
with sales decline	613	827	771	753
40-hr week				
with sales decline	1506	2426	2351	2249

Table E-12. Unemployment rate equivalent of income loss at national level (percent)

	Time period			
	1980:4	1981:1	1981:2	1981:3
60-hr week				
with no sales decline	7.04	6.75	6.70	6.64
40-hr week				
with no sales decline	7.37	7.14	7.12	7.10
60-hr week				
with sales decline	7.28	7.25	7.15	7.09
40-hr week				
with sales decline	8.12	8.75	8.62	8.48

NOTE: The labor force in each of the four quarters was 106.0, 106.6, 107.3, 107.9 millions respectively. The corresponding unemployment rates in the baseline economy were 6.70, 6.47, 6.43, and 6.39% respectively.

Table E-13. DOE regions considered
for analysis

	States within region
Region I	Connecticut Massachusetts Maine New Hampshire Rhode Island Vermont
Region IV	Alabama Florida Kentucky Georgia Mississippi North Carolina South Carolina Tennessee
Region VI	Arkansas Louisiana New Mexico Oklahoma Texas

- Regulations would be implemented uniformly across the regions, and responses of firms and consumers in each region would on the average be similar.
- Regional impacts within the commercial sector will be proportional to the extent of the sector's activity measured by its share of sales, employment, and wages relative to national levels.
- Multiplier effects of sector-specific income and employment losses determined nationally are applicable regionally.

Regional shares of selected economic and demographic variables are shown in Tables E-14 and E-15 for the period 1972 through 1980-81. Projections to 1980-81 were made for the baseline case, using growth rates for the variables between 1972 and 1977. Of the three regions considered, region I shows a slight decline in its shares of population, labor force, employment, and income, while regions IV and VI show a modest increase.

The regional patterns of commercial sector activity (in retail trade and selected service categories) relative to national aggregate levels are shown in Table E-16 for 1972. A comparison of data in Table E-16 (which is commercial-sector-specific by region) with corresponding data in Table E-15 (which is an aggregation over all

Table E-14. Selected national and regional economic and demographic variables^a
(1972-1981)

Region	Variables			
	Population (thousands)	Labor force (thousands)	Civilian employment (thousands)	Personal income (billions of current \$)
U.S.				
1972	207,598	86,500	81,700	932.4
1977	216,332	97,400	90,500	1518.4
1980-81 (projected)	223,583	107,100	98,218	2242.9
Region I				
1972	12,015	5,253	4,888	57.5
1977	12,244	5,828	5,379	87.9
1980-81 (projected)	12,430	6,333	5,807	123.4
Region IV				
1972	33,270	13,476	12,891	122.4
1977	35,737	15,591	14,523	214.1
1980-81 (projected)	37,842	17,520	15,976	334.9
Region VI				
1972	21,027	8,041	7,615	80.7
1977	22,896	9,995	9,416	147.2
1980-81 (projected)	24,510	11,895	11,159	238.1

^aData from ref. 2, 9, 10, 11 for 1972 and 1977.

sectors in each region) indicates that regional shares of wages and employment in the commercial sector parallel those of personal income and employment for the respective regions. It is reasonable to assume that regional shares of commercial sector wages and employment over the forecast period (1980-81) would move in tandem with those of income and employment for the respective regions.

Regional shares of commercial sector sales were projected for the 1980-81 period, using best available data on growth rates between 1972 and 1977.² As previously described (Sect. 4.3), regulation-induced losses in sales were considered to occur only in a few establishments within the retail trade and services categories (see Table E-3). The regional shares of sales in 1972 for these few establishments were found to be almost identical to those of all establishments taken together. It is reasonable to assume that this pattern would prevail in 1980-81.

Table E-15. Selected regional economic and demographic variables relative to national^a

	Variables				
	Population	Labor force	Employment	Personal income	Personal income per employed
Region I					
1972	0.058	0.061	0.060	0.062	1.031
1977	0.057	0.060	0.059	0.058	0.974
1980-81 (projected)	0.056	0.059	0.059	0.055	0.931
Region IV					
1972	0.160	0.156	0.158	0.131	0.832
1977	0.165	0.160	0.160	0.141	0.879
1980-81 (projected)	0.169	0.164	0.163	0.149	0.918
Region VI					
1972	0.101	0.093	0.093	0.087	0.929
1977	0.106	0.103	0.104	0.097	0.932
1980-81 (projected)	0.110	0.111	0.114	0.106	0.934

^aComputed from data in Table E-14.Table E-16. Regional shares of commercial sector activity in retail trade and selected services relative to national^a (1972)

Region	Variables		
	Employment (thousands)	Wages (billions of current \$)	Sales (billions of current \$)
U.S.	16,516	88.8	582
Region I	1,014 (6.1%)	5.34 (6%)	33.9 (5.8%)
Region IV	2,427 (14.7%)	11.9 (13.4%)	85.0 (14.6%)
Region VI	1,592 (9.6%)	7.7 (8.7%)	54.3 (9.3%)

^aData from refs. 2 and 12. Percent of national values are given in parentheses.

A summary of commercial sector activity at the regional level projected for 1980-81 is presented in Table E-17.

Regulation-induced losses in wages and sales in the commercial sector determined previously at the national level in 1980-81 (Tables E-3 and E-4) were assumed to be distributed regionally in proportion to their regional shares in the baseline case (shown in Table E-17). The magnitude of these regional losses in relation to those nationally are given in Table 4-14 for both the 60- and 40-hr cases. They represent two key primary regional effects of the regulation on the commercial sector.

As described previously (Sect. 4.2), direct employment effects of regulation are not easily determined. However, an overall regional unemployment equivalent of income loss (both primary losses within the commercial sector and induced secondary losses elsewhere in the economy) can be computed.

Primary and secondary losses in disposable income determined nationally in 1980-81 (see Tables E-7 through E-10) were assumed to be distributed regionally in proportion to the regional shares of income shown in Table E-15. The magnitudes of these regional income losses are presented in Table 4-15 for both the 60- and 40-hr cases, considered with and without the impacts of losses in sales in the commercial sector.

The unemployment and unemployment rate equivalents of the regional income losses were computed following the procedure shown in the preceding section. In this computation, regional values for the labor force, total employed, and income per employed in 1980-81 were determined based on their respective regional proportions shown in Table E-15 (e.g., the national labor force of 107 million in 1980-81 is distributed regionally as follows: 5.9% in region I, 16.4% in region IV, and 11.1% in region VI).

Table E-17. Regional shares of commercial sector activity in retail trade and selected services relative to national^a (baseline case 1980-81)

	Variables		
	Employment	Wages	Sales
Region I	0.059	0.055	0.051
Region IV	0.153	0.149	0.159
Region VI	0.114	0.106	0.113

^aThe national value for the variables shown are 18 million for employment, \$214 billion for wages, and \$1240 billion for sales.

Regulation-induced increases in the total number of unemployed persons and the resultant unemployment rates at the regional level are presented in Table 4-16.

Appendix F

DETERMINATION OF BASELINE CASE FOR ENVIRONMENTAL ANALYSIS

F.1 Baseline environment

The national average emission levels expected from a 1.6-million bbl/day shortfall in petroleum supplies are as follows:

<u>Pollutant</u>	<u>Level of emissions (10³ tons)</u>
Particulates	11,846
Sulfur oxides (SO _x)	26,786
Nitrogen oxides (NO _x)	17,183
Hydrocarbons (HC)	11,690
Carbon monoxide (CO)	54,498

The levels shown above were derived from ref. 1, wherein a 3-million bbl/day shortfall was assumed, and changes in national average emissions [using Strategic Environmental Assessment System (SEAS) data] were determined relative to a business-as-usual economy with no shortfall. Emission levels described in ref. 1 were interpolated in this study to reflect the effects of a 1.6-million bbl/day shortfall.

The baseline case pertinent to this study includes the imposition of restrictions on the temperature levels of selected private and public buildings, prior to restricting the hours of operation in the commercial sector. It was assumed in the building temperature restriction measure¹ that savings in utility fuel use resulting from reduced electricity demand would all be essentially in petroleum fuels and to some extent in natural gas, with the use of other fuels (coal, nuclear) remaining unchanged. As a consequence a disproportionately large amount of oil is conserved in the utility sector. This assumption seems reasonable, since this measure is expected to be the first to be implemented during a petroleum shortfall situation. Later measures implemented such as the reduction in commercial operating hours considered in this study are, however, assumed to reflect a proportional savings among all utility fuels with no further bias toward petroleum. In order to reflect the environmental impacts from the imposition of the temperature restriction measure, the emissions levels shown above were modified as follows:

The direct and indirect savings in petroleum fuels and natural gas from building temperature restrictions (determined in ref. 1) were assumed in this study to be used in the manufacturing sector (see Table F-1). Using the SEAS data and the methodology stated in Sect. 4.4, net changes in the level of the criteria pollutants from the shifts in fuel use were obtained as shown in Table F-2. By combining the net

changes in emissions from Table F-2 with the national average emission levels presented earlier, the baseline environment was characterized as shown below:

Baseline environment (national level)	
<u>Pollutant</u>	<u>Level of emissions (10³ tons)</u>
Particulates	11,866
Sulfur oxides (SO _x)	26,756
Nitrogen oxides (NO _x)	17,241
Hydrocarbons (HC)	11,691
Carbon monoxide (CO)	54,500

Regional baseline emission levels were determined from national levels based on distribution data given in ref. 1 (exhibit 3.2). These levels are shown in Table F-3.

The baseline environment represents the state of the environment from which changes arising from regulation on operating hours will be measured.

F.1.1 Fuel mix considerations

In the building temperature restriction measure, the mix of residual and distillate fuels shifted to the manufacturing sector was derived by a series of calculations. In the commercial sector, it was assumed that half of the petroleum fuels burned were residual fuels and half were distillate fuels. In the utility sector, a 90/10 distribution was assumed. Therefore, of 247×10^{12} Btu of petroleum fuels shifted from the commercial to the manufacturing sector, 123.5×10^{12} Btu was residual and 123.5×10^{12} Btu was distillate. Similarly, of a total of 549×10^{12} Btu shifted from the utilities sector, 494.0×10^{12} Btu was residual fuel and 55.0×10^{12} Btu was distillate fuel. From these calculations, the distribution of residual and distillate fuels shifted to the manufacturing sector was determined to be 78% residual (617.5×10^{12} Btu) and 22% distillate (178.5×10^{12} Btu). This distribution is very similar to that normally existing in the sector (72% residual and 28% distillate in 1976 as derived from data in ref. 3):

Table F-1. Shifts in petroleum fuels and natural gas from the commercial and utilities sectors to the manufacturing sector under regulation restricting building temperatures^a

(10¹² Btu)

Fuel	From commercial sector	+	From utilities sector	=	To manufacturing sector
Petroleum fuels	247		549		796
Natural gas	270		177		447

^aSee ref. 1.

Table F-2. Emission changes as a result of building temperature restriction

Pollutant	Change in emissions ^a (%)
Particulates	+0.17
SO _x	-0.11
NO _x	+0.34
Hydrocarbons	+0.01
Carbon monoxide	Negligible

^aFrom levels shown at beginning of Appendix F.

Table F-3. Emissions data for the U.S. and selected regions (10³ tons) (baseline case)

Region	Emissions				
	Particulates	Sulfur oxides	Nitrogen oxides	Hydrocarbons	Carbon monoxide
U.S.	11,866	26,756	17,241	11,691	54,500
Region I	227	608	672	557	2,360
Region IV	2,451	5,309	3,099	1,818	8,714
Region VI	1,511	1,930	2,428	1,692	7,583

Building temperature restriction measure

Sector	Petroleum fuels shifted	Distribution of residual and distillate fuels	Quantity of residual fuels	Quantity of distillate fuels
Commercial	247×10 ¹² Btu	50/50	123.5×10 ¹² Btu	123.5×10 ¹² Btu
Utility	549×10 ¹² Btu	90/10	494.0×10 ¹² Btu	55.0×10 ¹² Btu
Manufactur- ing	796×10 ¹² Btu	78/22	617.5×10 ¹² Btu	178.5×10 ¹² Btu

The procedure described above was used to determine the mix of residual and distillate fuels shifted to the manufacturing sector under regulation restricting commercial sector operating hours. The results are shown below:

Sector	Petroleum fuels shifted	Distribution of residual and distillate fuels	Quantity of residual fuels	Quantity of distillate fuels
60-hr case				
Commercial	102	50/50	51.0×10 ¹² Btu	51.0×10 ¹² Btu
Utility	48	90/10	43.0×10 ¹² Btu	5.0×10 ¹² Btu
Manufactur- ing	150	63/37	94.0×10 ¹² Btu	56.0×10 ¹² Btu
40-hr case				
Commercial	121	50/50	60.5×10 ¹² Btu	60.5×10 ¹² Btu
Utility	57	90/10	51.3×10 ¹² Btu	5.7×10 ¹² Btu
Manufactu- ing	178	63/37	111.8×10 ¹² Btu	66.2×10 ¹² Btu

In the context of this study, the 63/37 distribution of residual and distillate fuels use shown above in the manufacturing sector was not considered to be significantly different from that shown under the temperature restriction measure. Consequently, no adjustments to the sector-specific emission factors with petroleum fuels were made. Fuel mix considerations were not addressed at the regional level because detailed data were not available.

F.1.2 Fuel allocations to the manufacturing sector national and regional

Consumption of petroleum fuels in the manufacturing sector in 1976 is shown in Table F-4 based on data from ref. 3. The regional distribution pattern shown in Table F-4 was assumed to prevail over the 1980-81 time period. Using this pattern, the regulation-induced petroleum and natural gas savings estimated nationally in the commercial sector were allocated to manufacturing sectors in the respective regions. On this basis, region IV with a substantial level of petroleum consumption in the manufacturing sector would receive almost 25% of the total national fuel savings in the commercial sector.

Table F-4. National and regional consumption
of petroleum fuels in the manufacturing
sector - 1976
(10^{12} Btu)

Region	Petroleum fuels consumption
U.S.	1990
Region I	208 (10.4%)
Region IV	473 (23.8%)
Region VI	126 (6.3%)

Note: Data from ref. 3. Percent of national consumption in parentheses.

REFERENCES FOR APPENDIXES D, E, AND F

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5. *Employment and Earnings - December 1977*, U.S. Department of Labor, Bureau of Labor Statistics, Vol. 24, No. 12, December 1977.
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9. *State Profile of Employment and Unemployment, 1977*, U.S. Department of Labor, Bureau of Labor Statistics, October 1977.
10. *1975 Statistical Abstract of the United States*, 96th Annual Edition, July 1975.
11. *1973 Statistical Abstract of the United States*, 94th Annual Edition, July 1973.
12. *County and City Data Book 1977 - A Statistical Abstract Supplement*, U.S. Department of Commerce, Bureau of the Census, May 1978.

Appendix G

LEGAL ISSUES ASSOCIATED WITH IMPLEMENTATION OF THE EMERGENCY MEASURE

This section identifies some of the issues which may arise if a restriction of hours of operation of commercial establishments is imposed. Due to time constraints, there has been no verification of these potential problems. Thus, nothing in this section is to be understood as a complete statement of the law. Furthermore, nothing stated herein is an official legal opinion of Oak Ridge National Laboratory.

I. Authority for the regulation

A. Congressional authority

Congress has the authority to require closings of private businesses pursuant to the commerce clause (U.S. CONST. art. I, sec. 8, cl. 3).

B. Delegation of authority

Section 202 of the Energy Policy and Conservation Act [42 U.S.C. sec. 626 (1976)] requires the president to prescribe "energy conservation contingency plans," which impose "reasonable restrictions on the public and private use of energy."

1. It would appear that this delegation of authority is constitutional, based on Supreme Court decisions, since *Panama Refining Co. v. Ryan*, 293 U.S. 388 (1935), and *Schechter Poultry Corp. v. U.S.*, 295 U.S. 495 (1935), and the fact that emergency powers were delegated.
2. Delegation of similar types of authority by state legislatures to governors pursuant to the federal measures may encounter state constitutional problems. K. DAVIS, ADMINISTRATIVE LAW TREATISE 204 (2d ed. 1978).

II. Implementation

A. Enforcement

1. Search warrants. Search warrants may be required for inspection of premises. *Marshall v. Barlow's Inc.* 429 U.S. 1347 (1977).

This may present administrative problems, especially since it is estimated that businesses will increase their demands for search warrants prior to allowing inspectors to enter. *The Wall Street Journal*, January 22, 1979, at 1, col. 6.

2. Equal protection. Study of the use of this conservation measure by North Carolina indicated the potential equal protection problems pursuant to the fourteenth amendment (U.S. CONST.). Exemptions from a mandatory curtailment of hours regulation will be necessary. Any difference in treatment must stand on a "rational basis" to survive constitutional challenge.

R. Due process

1. There appears to be no valid due process claim as a result of a closing law. This is especially true in the case of an emergency measure. The closest type of case deals with Sunday and holiday closing laws, which have not been struck down on due process grounds. *Herkimer Corp. v. Village of Herkimer*, 330 N.Y.S. 2d 747 (App. Div. 1972). *Nebbia v. New York*, 291 U.S. 502 (1934) stated that due process only requires "that the law shall not be unreasonable, arbitrary, or capricious, and that the means selected shall have a real and substantial relation to the object sought to be attained," 291 U.S. at 511.

C. Labor

1. Labor contracts vary according to region, industry, union, etc. All that can be said at this point is that emergency closing is a matter for which employers and employees should prepare. Layoff procedures are often specified in the labor contracts. However, analogy could be made to procedures employed by parties to TVA's interruptible customer contracts.

III. Post-implementation problems

- A. If a particular state is successful, will its energy resources be transferred to less fortunate areas pursuant to legislation such as the Emergency Petroleum Allocation Act [sec. 15, U.S.C. Secs. 751 to 756 (1976)].
 1. Attempts by states to keep their resources within state boundaries will most likely be unconstitutional, *Hood v. DuMond*, 336 U.S. 525 (1949); *Pennsylvania v. West Virginia*, 262 U.S. 553 (1923); *West v. Kansas Natural Gas Co.*, 221 U.S. 229 (1911), especially if Congress has addressed the issue, *Hinds v. Davidowitz*, 312 U.S. 52 (1941).

- B. If some areas are successful in reducing electricity consumption, rates may have to rise, calling public commission procedures into play. A statute may grant the commission authority to modify rates in an emergency situation, *Baker v. Pennsylvania Public Utility Commission*, 332 A. 2d 735 (Pa. Commw. Ct. 1974).

IV. Conclusion

Though there may be some problems in implementing this conservation measure, at this general level of analysis, none appear to be insurmountable. On the other hand, the states may be more receptive in energy conservation contingency plans which allow them greater flexibility in achieving emergency conservation goals.

Appendix H

AUTHORITIES NEED, RATIONALE, OPERATION

H.1 Conditions of exercise

- (a) This plan shall not become effective unless the president:
 - (1) has found that putting the plan into effect is required by a severe energy supply interruption or in order to fulfill obligations of the United States under the international energy program;
 - (2) has transmitted such finding to the Congress with a statement of the effective date and manner for exercise of the plan.
- (b) This plan may remain in effect for no more than nine months, and may be earlier rescinded by the president.

H.1.1 Definitions

As used in this plan:

- (a) "Commercial sector" includes wholesale trade, retail, finance, insurance, real estate, business and repair services, amusement and recreation services, and public administration. It specifically excludes hotels and motels, health care facilities, and transportation.
- (b) "Covered building" means every building within the commercial sector as defined above.
- (c) "DOE" means Department of Energy.
- (d) "Economics" is the study of how people choose, with or without the use of money, to employ scarce productive resources to produce commodities and distribute them for consumption among various groups (after Paul A. Samuelson).
- (e) "Energy" means the capacity to perform work, such as providing heat to buildings, running motors, and providing light. Energy may be measured in British thermal units (Btu). One Btu is the energy required to increase the temperature of one pound of water 1°F. Energy in the amount of 10^{15} Btu, or one quadrillion Btu, is one quad (Q). One million barrels/day of crude oil would supply 2.2 Q of energy in one year.

- (f) "Environment" means the combination of external physical conditions that affect the growth and development of organisms, with special emphasis on air and water quality.
- (g) "ERA" means Economic Regulatory Administration.
- (h) "Fuel" means materials such as coal, oil, or natural gas burned to produce heat and/or electricity or fissionable material used in a nuclear reactor to produce heat and electricity.
- (i) "Hours of operation" means the hours per week the commercial building is open to the public to transact its normal business.
- (j) "In charge of" means to have care of, or be entrusted with the management of (a covered building).
- (k) "Operator" means any person who is in charge of the heating, cooling, or hot water of a covered building.
- (l) "Owner" means the person in whom is vested legal title.
- (m) "Secretary" means the secretary of energy or his delegate.

H.1.2 Heating and cooling

- (a) The owner of a covered building shall, with respect to such covered building:
 - (1) maintain the thermostat or thermostats controlling the temperatures of areas being heated, at no higher than 65°F during hours specified for business and no higher than 55°F during closed hours, or any other levels which the secretary determines are reasonable and necessary to reduce energy consumption;
 - (2) maintain the thermostat or thermostats controlling the temperatures of areas being cooled at no lower than 80°F during hours specified for business and all cooling turned off during closed hours, or any other levels which the secretary determines are reasonable and necessary to reduce energy consumption;
 - (3) maintain all thermostats controlling the temperatures of areas being heated or cooled within reasonable tolerances of accuracy.

- (b) Notwithstanding paragraphs (1) and (2) of subsection (a) of this section, where a "manufacturer's warranty" requires specific temperature levels for the operation of special equipment, such specified levels are permissible, and if a range is specified, that level within the range is permissible which is consistent with maximum energy savings.
- (c) Notwithstanding paragraphs (1) and (2) of subsection (a) of this section, where special environmental conditions are required to protect animal or plant life or materials, such conditions may be maintained.

H.1.3 Reports and record keeping

- (a) The owner of a covered building shall, for such covered building, complete and post in a prominent location of the covered building, within 30 days after the effective date of this plan, and shall update at such times as the secretary may require, a building owners certificate certifying compliance with the requirements of this plan, in accordance with forms and instructions provided by the secretary.
- (b) In addition to the building owners certificate, the owner of a covered building shall keep such records and in such form, and shall submit such reports and other information, as the secretary may require.

H.1.4 Operators

Notwithstanding any other provisions of this plan to the contrary, where the owner of a covered building is not the operator of such covered building, the operator and the owner shall be jointly and severally liable for the execution of owner responsibilities under this plan.

H.1.5 Customer lists

Any public utility or fuel distributor shall make available to the secretary, upon request, information deemed necessary by the secretary to administer and enforce the plan.

H.1.6 Relation to state law

- (a) This plan shall apply in every state (including the District of Columbia, Puerto Rico, or any territory or possession of the United States) and political subdivision thereof and shall preempt any law of any state or political subdivision thereof to the extent that such law is inconsistent with this plan or any rule, regulation, or order promulgated pursuant to this plan.

- (b) Notwithstanding the provisions of subsection (a) of this section, the president or his delegate, may, on his own initiative in response to a request for exemption, exempt a state or political subdivision thereof from this plan and any rule, regulation, or order promulgated pursuant to this plan, in whole or in part, during a period for which (1) the president or his delegate determines a comparable program of such state or political subdivision is in effect, or (2) the president or his delegate finds special circumstances exist in such state or political subdivision.
- (c) A state which seeks an exemption for itself or a political subdivision thereof on the ground that a comparable program is in effect shall submit to the secretary a request for exemption which shall include (1) a full description of the comparable program, (2) the amount of energy which such program will conserve, (3) the period of time during which such program will be in effect, and (4) such other information as the secretary may require, and the secretary shall review the request and make a recommendation thereon to the president or his delegate.
- (d) A state which seeks an exemption for itself, or a political subdivision thereof, on the ground that special circumstances exist shall submit to the secretary a request for exemption which shall include (1) a full description of the special circumstances, (2) a detailed explanation of why implementation of this plan, in whole or in part, is not practicable, (3) an estimation of the period of time in which the special circumstances will exist, (4) any alternative energy conservation measures which may be practicable and their expected savings, and (5) such other information as the secretary may require, and the secretary shall review the request and make a recommendation thereon to the president or his delegate.
- (e) For purposes of this section, "comparable program" means a program which deals with the same subject matter as this plan, which is mandatory, and which conserves at least as much energy in the state or political subdivision thereof as this plan would be expected to conserve in such state or political subdivision.

H.1.7 Administrative procedures

- (a) The secretary is authorized and directed to implement, administer (including determination of exceptions), monitor, and enforce this plan, and to promulgate such additional rules, regulations, or orders as are necessary or appropriate.

- (b) Section 523 of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6393) shall apply to any rule, regulation, or order having the applicability and effect of a rule as defined in Section 441 (4) of Title 5, United States Code, issued under this plan.
- (c) The secretary may delegate all or any portion of the authority granted to him under this plan to such officers, departments, or agencies of the United States, or to the governor of any state, as he deems appropriate.

H.1.8 Public information

The secretary may collect and disseminate such information in accordance with current law and policy, as he deems appropriate regarding the operation and goals of, and responsibilities under, this plan.

H.1.9 Penalties

Any person who fails to comply with any provision prescribed in, or pursuant to, this plan shall be subject to the applicable penalties set forth in Sections 524 and 525 of the Energy Policy and Conservation Act (42 U.S.C. 6394, 6395).

H.1.10 Report

The secretary shall report to Congress and the president, within 60 days after the termination of this plan, on the operation of the plan. Such report shall include an estimate of the energy conservation achieved and may include any recommendations deemed appropriate by the secretary.

H.2 Statement of the need for rationale and operation of the plan

H.2.1 Need for the plan

The Restricted Hours of Operation for Commercial Buildings Plan is intended for implementation in the event of a severe energy supply interruption or in order to fulfill obligations of the United States under the International Energy Program (IEP). An interruption of a significant portion of the United States' foreign oil supply could produce an energy crisis of even greater severity than that produced by the 1973-74 oil embargo. At the time of that embargo, the nation's inability to import sufficient quantities of oil resulted in an estimated \$10 to \$20 billion decline in gross national product and considerable economic and social disruption. Imports now exceed eight million barrels per day, and although domestic production increased from 1977-78,

it is still lower than in 1973. At the present time the United States imports, at an annual rate, almost 50% of domestic petroleum requirements, compared with less than 35% just prior to the 1973-74 embargo. Thus, the nation is in some respects more vulnerable to an interruption in foreign oil supply today than just six years ago.

Under the IEP, in an embargo or shortage situation in which only one or few member nations lose more than 7% of normal petroleum requirements, the targeted country or countries must absorb any shortfall up to 7%. The other member nations would share the remaining shortfall among themselves. In the event of a widespread shortage, in which all oil-consuming countries sustain a reduction of not more than 7% of the normal petroleum consumption rate; each participating country must absorb the shortfall itself. If the shortfall exceeds 7% but is less than 12%, each member must reduce consumption by 7%; the remaining shortfall would be shared proportionately among all countries according to the IEP sharing formula. If oil supplies should fall short by 12% or more, each participating country must restrain demand by 10% and share whatever oil is still available with other member nations.

As a participant in the IEP, the United States has pledged to comply with its emergency provisions, whereby each member must have ready a program of contingency demand restraint measures which would be sufficient to reduce demand for oil by 7 and 10% of normal consumption. These measures would likely be implemented in conjunction with shortage drawdown in case of an emergency, although the IEP agreement allows signatory countries to substitute drawdown of storage for use of demand restraint measures.

In the event of a severe petroleum shortage, three types of action are available to alleviate the adverse impact: actions to increase domestic petroleum supplies and use alternative forms of energy; actions to distribute the available supply in an equitable manner; and actions to reduce public and private demand for energy. The authorities available to the president and other public officials for taking such actions comprise the basis of the country's energy shortfall management program. The need for energy conservation contingency plans should be viewed in the context of the actions described below.

(1) Increase domestic petroleum supplies and use alternative forms of energy.

The following is a discussion of several of the primary means available to the United States to increase petroleum supplies or substitute other forms of energy for petroleum on an emergency basis. In a serious emergency, the federal government would aggressively pursue some or all of these options.

(a) Increase domestic petroleum production.

In general, the United States does not have in place substantial excess crude oil production capacity and therefore is unable to increase

domestic production by significant amounts during an emergency. However, some flexibility in domestic production does exist, and steps will be taken to assure that production is maximized during an emergency. Important to this effort is the need to provide adequate incentives during periods of relatively abundant supplies to assure that new reserves are discovered and developed, that enhanced oil recovery projects are undertaken, and that the production decline rate from existing wells is slowed and production is maintained as long as possible. In addition, in an emergency, Section 106 (42 U.S.C. 6214) of the Energy Policy and Conservation Act (EPCA) (Pub. L. 94-163) authorizes the president to require production of petroleum or natural gas at or in excess of the maximum efficient rate.

(b) Draw down existing inventories.

During periods of normal supply the nation has in inventory at various levels of distribution supplies of crude oil and refined petroleum products adequate to meet total national demand for several days. Much of the total inventory is necessary to maintain the supply system in normal operation (e.g., oil pipelines must be kept full for their efficient operation), but in general, stocks are usually adequate to provide for shortfalls of limited duration without any interruption of supply to consumers. At the beginning of January 1979, for example, crude oil stocks were estimated to be sufficient to deal with a crude oil shortfall of about 500,000 barrels a day for 60 days before reaching the level where refinery runs would have to be significantly curtailed.

Provisions of the Standby Petroleum Product Price and Allocation Regulations recently adopted by the Department of Energy (44 F.R. 3978, January 18, 1979) provide regulatory means by which stock levels can be properly managed in anticipation of and during a supply interruption. They provide that the department can update allocation base periods to reflect the most recent 12-month period of normal supplies prior to the supply emergency, thus preventing purchasers from drawing down outdated and unneeded supply entitlements, and they allow the imposition of a mandatory allocation fraction on all suppliers in anticipation of a shortfall that will result in the building of inventories to desired levels.

(c) Draw down strategic petroleum reserves.

The Strategic Petroleum Reserve (SPR) authorized in Title I of the EPCA is scheduled to reach 750 million barrels in the 1985-86 time period. As of the end of February 1979, 76 million barrels of crude oil will be in underground storage, and the Department of Energy plans to have 248 million barrels in storage by May 1980. Initial withdrawal capability will be in place by September 1979 and can be put in place sooner if necessary.

(d) Increase use of coal and other alternate fuels.

The Powerplant and Industrial Fuel Use Act of 1978 provides the president with emergency authority to ban the use of petroleum or natural gas as boiler fuel in an electric power plant or other major fuel-burning installation capable of using coal or another alternate fuel. This act also gives the president the authority to allocate coal as necessary. Emergency suspensions of air quality standards are also authorized by this law. Another way in which coal or other alternate fuels can be useful in a petroleum shortage involves the transfer of electricity through transmission lines from coal-burning or other alternate fuel power plants (including nuclear plants) to utilities which burn oil.

(e) Increase use of natural gas.

The Natural Gas Policy Act eliminated the pricing distinction between the intrastate and interstate gas markets. As a result of this action and other factors, gas supplies are relatively abundant and are available for use as substitutes for middle distillates and residual fuel oil in many markets. Propane, incremental supplies of which are derived from natural gas, is also currently available in abundant supplies.

During an interruption of petroleum supplies, utilities, industries, and commercial establishments will be encouraged to use gas, propane, and other abundant alternate fuels to the maximum extent practicable.

(2) Distribute the available supply in an equitable manner.

Supply distribution mechanisms do not increase supply, and they have limited capability for use to generally reduce demand for energy. Their principal purpose during an emergency is to provide for the distribution of the available supply of crude and product in a manner designed to assure equity and serve national priorities.

The Department of Energy's Standby Crude Oil Allocation Regulations, issued on January 9, 1979 (44 F.R. 3418, January 16, 1979), provide for four separate, progressively broader crude oil allocation systems. Phase I, the current crude oil buy-sell program, orders one or more of the 15 major refiners to supply crude oil to those small refiners (i.e., those with less than 175,000 bbl/day of refining capacity) which have demonstrated that they have lost their normal crude supplies.

Phase II, a modification of the current buy-sell program, would permit emergency allocation orders to supply major and large independent refiners.

Phase III, which could be activated in a more severe general crude oil shortage involving more than just a few major and large independent

refiners, would require that the current program be maintained for small refiners and that a separate standby program be implemented for major and large independent refiners. Under such a scheme, the large firms would share their available oil with small refiners as under the present program and with each other on a historic usage-current supply basis. In this instance, a national average supply ratio for the larger firms would be determined. Firms having more oil than the average would sell crude to those having less.

The last standby crude allocation response, for use in more extreme emergencies, would involve every refiner in the country in the same allocation scheme, eliminating the current small refiner program. All refiners' available oil and historical runs to stills would be used to calculate a national utilization rate. Refiners with more oil than the national average, including small refiners, would sell to those with less. Under some circumstances certain small refiners could be exempted from sale obligations, and in any event they would receive a slightly better price on buy-sell transactions than large refiners.

The Standby Petroleum Product Allocation and Price Regulations, published in final form by DOE on January 18, 1979 (44 F.R. 3978), provide DOE with broad new authority to allocate available supplies of refined petroleum products.

Most petroleum products are not currently subject to allocation and price controls. Only gasoline, naphtha for synthetic natural gas plant feedstocks, and natural gas liquid products are subject to controls. For those products that are not then subject to controls, DOE may in an emergency reactivate price and allocation controls through the standby product regulations, and DOE can also switch those products currently under control to the new regulations. These standby regulations may be activated to address a petroleum product supply shortage on a national basis, or on a regional basis if needed only to deal with localized supply dislocations.

A standby gasoline rationing plan is being submitted to the Congress for its approval. Because of the high cost of rationing, the complexity of its administration, and the inevitable disruptions it would cause, this plan is intended for implementation only in the event of a severe gasoline supply shortfall.

(3) Reduce public and private demand for energy.

Conservation programs seek to reduce energy consumption by promoting greater efficiency and discouraging wasteful energy usage. During an emergency energy shortage, ongoing mandatory and voluntary conservation programs such as the 55-mph speed limit and carpooling could be intensified, and other steps for the elimination of nonessential energy usage could be taken. Individual states could implement their own conservation contingency plans, as provided for within Part C (42 U.S.C. 6321-6326), of Title III of the EPCA, and take other actions as appropriate.

During a severe and prolonged shortfall, even though greater reductions in demand for energy far outweigh the supply, it is impossible to meet normal energy requirement and, even with the invocation of the above mandatory and voluntary measures, a large gap between supply and demand would remain. Assuming price controls, this gap would be narrowed only by temporarily curtailing or eliminating normal energy-consuming activities and habits.

The primary objective in formulating standby energy conservation plans is to identify those normal energy demands which can and should be cut back or eliminated on a short-term basis in order to minimize the impact of an energy shortage situation. The rationale for the selection of the Restricted Hours of Operation for Commercial Buildings Plan as a standby energy conservation measure is described in the following section.

H.2.2 Rationale of the plan

In developing the standby energy conservation plans, DOE reviewed more than 250 potential measures relating to all types of energy consumption in the transportation, commercial, residential, and industrial sectors. Each potential measure was evaluated in the light of various constraints that were imposed by the EPCA and other criteria developed by DOE.

The following evaluation criteria were used in the selection process.

- (1) No plan may be based on the use of rationing, taxes, tariffs, user fees, pricing mechanisms for petroleum products, or tax credits or deductions.

This restriction is imposed by Section 202(a) (2) of the EPCA [42 U.S.C. 6262(a) (2)] and eliminates from consideration measures which would reduce demand through mechanisms such as a tax rebate system, a tax on gasoline, or an electricity bill surcharge.

- (2) Plans must be capable of rapid payoff.

This criterion is based on the assumption that certain types of emergencies will occur suddenly, and also on the provision in Section 201(a) (1) of the EPCA [42 U.S.C. 6261(a) (1)] that no contingency plan may remain in effect more than nine months. Therefore, no measure was selected which could not have a significant demand restraint impact within 45 days following a decision to implement it.

- (3) Plans must be enforceable by federal authorities.

Although the states and localities might implement and enforce their own emergency conservation plans in the event of an energy shortage and will also be called upon to assume the delegation of enforcement and

other functions under the federal plans, these plans have been developed in such a way that they can be fully implemented and enforced at the federal level if necessary. Coordination with state and local officials will be an essential element of the enforcement strategy.

(4) The potential for energy demand reduction must be significant.

Only those measures were selected which offered the potential for a significant reduction in energy demand, either directly or through the capacity to heighten overall public awareness of the emergency situation and the need to conserve. In some cases, the lack of historical experience and the need to make many assumptions regarding human behavior make estimates of demand reduction for some proposed measures difficult to validate.

(5) No measure should impose an undue hardship on any sector of the economy.

Section 521 of the EPCA (42 U.S.C. 6391), referring in part to the contingency plans, provides as follows:

"To the maximum extent practicable, any restriction ... on the use of energy shall be designed to be carried out in such a manner so as to be fair and create a reasonable distribution of the burden of such restriction on all sectors of the economy, without imposing an unreasonably disproportionate share of such burden on any specific class of industry, business, or commercial enterprise or any individual segment thereof."

This requirement of the EPCA was considered in the selection and development of plans. Such consideration is set forth in the economic analysis of each plan prepared pursuant to Section 201(f) of the EPCA. Section 201(f) provides in part that any contingency plan "be based upon a consideration of ... the potential economic impacts of such plans."

The impact of plans on the various sectors of the economy was analyzed from a baseline which assumes an energy shortfall that in and of itself would have a substantial impact upon the nation's economy. In general, potential conservation plans that would not have a favorable overall impact measured from this baseline situation were rejected from consideration.

(6) No plan should deal with more than one logically consistent subject matter.

EPCA further requires, in Section 202(c), that a conservation contingency plan "shall not deal with more than one logically consistent subject matter."

The above criteria form a rather substantial barrier against most proposed mandatory conservation measures. A preliminary evaluation of the Restricted Hours of Operation for Commercial Buildings Plan measured against the criteria would show:

<u>Criteria</u>	<u>Plan</u>
1. No rationing, taxes, etc.	Does not ration or tax.
2. Rapid payoff in energy.	Could be implemented quickly <u>if</u> sufficient preplanning were included. Demand reduction follows quickly.
3. Enforceable by federal authorities.	Not really enforceable without a large degree of state agency and private sector cooperation.
4. Substantial energy savings.	<u>At maximum</u> , the plan could save 1/3 Q of oil and gas and 1/2 Q of total energy. A 10% petroleum shortfall would be about 4 Q of petroleum.
5. No undue hardship on any sector.	The measure would have significant income and employment impacts. Regions of the country that use little oil would incur economic impacts without benefit of direct oil saving.
6. Single subject matter.	The measure restricts hours of commercial operation and specifies thermostat setting during hours of closure.

Whether the Restricted Hours of Operation for Commercial Buildings Plan sufficiently fulfills the EPCA criteria is a matter to be decided by ERA, the Secretary, and Congress. Sections 3-6 of this report provide details regarding estimated fuel savings and economic and environmental impacts.

H.2.3 Operation of the plan

The Restricted Hours of Operation for Commercial Buildings Plan would be implemented in conjunction with a closely related standby conservation plan, the Emergency Building Temperature Restriction Plan. This latter plan restricts winter thermostat settings to 65°F, summer settings to 80°F, and hot-water settings to 105°F. This plan has been prepared for consideration by the president and Congress. The restricted hours plan may be thought of as a supplement to the temperature restriction plan.

The Restricted Hours of Operation for Commercial Buildings Plan would require that owners of commercial buildings limit the hours of commercial operation to a maximum of 60 hr/week. Several alternative patterns of hours, each totaling 60 hr, would be available. During the 108 hr/week of closure, building temperatures would be further regulated beyond the temperature restriction plan. In winter, thermostat settings would be reduced to 55°F during hours of closure, and in summer all cooling would be shut off during hours of closure.

The plan would also require that thermostats be maintained within reasonable tolerances of accuracy in order to ensure that actual temperature levels would be consistent with the required thermostat settings.

Buildings covered by the requirements of the plan include retail and wholesale establishments, entertainment facilities, government and private office buildings, finance, insurance, real estate, repair services, and the like. Specifically excluded from coverage are buildings in which over 50% of the gross square footage is used for residential purposes, hotels and other lodging facilities, and hospitals and other health care facilities. The plan also exempts from the heating and cooling restrictions those buildings or areas of buildings where specified temperature levels are required by manufacturers' warranties for the operation of special equipment (such as electronic data processing machinery) or where special environmental conditions are necessary in order to protect animal or plant life or materials.

With respect to buildings which include both commercial and residential space, it is intended to adopt regulations which will, to the extent practicable, apply only to the commercial space. Where a significant portion of a building is legitimately used for residential purposes and the individual units are not and cannot readily be equipped with their own thermostats, the entire building will generally be exempt.

Within 30 days of activation of the plan by the president, the owner of each building covered by the plan would be required to execute a self-certification form certifying compliance with the provisions of the plan. The completed form would be displayed in a prominent location in the appropriate building.

Responsibility for implementation, administration (including determination of exceptions), monitoring, and enforcement would be with DOE. However, DOE will delegate enforcement and exception functions to those states that are willing to accept them on a cost reimbursable basis, and in those cases DOE will provide general guidance and assistance, plus concurrent enforcement authority to deal with cases of great public importance. It is contemplated that where DOE retains enforcement authority, enforcement actions would follow procedures used by DOE to enforce other programs for which it has responsibility. These procedures would include on-site inspections conducted by DOE enforcement personnel.

The plan would apply in each state (including the District of Columbia, Puerto Rico, or any territory or possession of the United States) or political subdivision thereof and preempt inconsistent state or local law. The plan would provide, however, that the president or his delegate may, on his own initiative or in response to a request for exemption, exempt a state or political subdivision thereof from its application, in whole or in part, if the president or his delegate determines a comparable program is in effect or finds special circumstances exist in such state or political subdivision. These provisions are pursuant to Section 202(b) of the EPCA.

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