The New Jersey Energy Conservation Plan: A Necessary Commitment

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THE NEW JERSEY ENERGY CONSERVATION PLAN: A NECESSARY COMMITMENT

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New Jersey Department of Environmental Protection
New Jersey Department of Labor and Industry
New Jersey Department of Transportation
New Jersey Department of the Treasury
New Jersey Division of Motor Vehicles
New Jersey Public Utilities Commission
Port Authority of New York and New Jersey

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THE NEW JERSEY ENERGY CONSERVATION PLAN: A NECESSARY COMMITMENT

INTRODUCTION

During the oil embargo and price increases of late 1973 and early 1974, the United States took immediate steps to curtail energy demand. During the 6-month embargo, the executive and legislative branches of the government favored energy policy initiations that focused on extended price and allocation controls in the short term, and the longer term development of additional domestic energy supplies. However, after 6 months, the embargo was lifted and, by the end of 1975, energy demand began to rise again. Correspondingly, oil imports began to rise, in absolute terms as well as in percent of total petroleum supply, thus making the nation more dependent than ever on foreign oil imports for a substantial portion of its energy requirements. At the same time, domestic production of natural gas continued to decline, which has, as seen during the recent natural gas supply crisis, resulted in serious economic problems in many parts of the nation. For example, a December 1976 report, prepared by Princeton University's Center for Environmental Studies, stated:

> "No state in the nation, in fact, has a gas shortage greater than New Jersey in terms of both volume and percentage of curtailments. Some have lost a greater volume of gas; others have faced larger percentage curtailments - but none rank higher in both categories.... The state's access to gas seems likely to get worse rather than better for at least the remainder of the 1970s. Industrial customers already face serious deletorious impacts, and even residential consumers (the highest priority under FPC regulations) may be threatened in the event of a cold winter...."*

The growing natural gas supply shortage has revitalized national interest in and reemphasized the immediate need for energy conservation and efficiency. In December 1975, several significant conservation measures were passed by Congress. For example, the Energy Policy and Conservation Act established voluntary conservation targets for the 10 most energy-intensive industries. In addition, appliance labeling and efficiency improvement programs were enacted. And, to involve state governments in federal energy conservation efforts, a grant program was established under which the Federal Energy Administration (FEA) would set guidelines and procedures for states to receive financial and technical assistance to develop and implement statewide energy conservation plans.

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* J.L. Cecil and D. Morell, New Jersey Natural Gas Shortage: A Policy Analysis (Princeton, N.J.: Princeton University Center for Environmental Studies, December 1976), p. 2.

All 50 states have announced their intentions to participate in the grant program. To qualify for funds, a state must present to FEA a credible energy conservation plan that will save 5 percent of the state's estimated 1980 energy consumption by 1980.* At a minimum, the plan must contain six specific conservation measures:

1. Right turn on red
2. Thermal efficiency standards for new and renovated buildings
3. Lighting efficiency standards for public buildings
4. Promotion of car pools and van pools
5. Promotion of public transit
6. Energy-efficient state procurement practices.

As an early step in a longer range, more comprehensive energy conservation program for the state of New Jersey, the New Jersey State Energy Office (SEO) has prepared this state Energy Conservation Plan** for submission to FEA to obtain the financial and technical assistance available under the grant program. In the course of preparing the plan, SEO met with representatives of most state agencies responsible for administering and implementing the selected measures. In addition, meetings were held with industry representatives and public interest groups to gain their comments on and inputs to the contents of the document.

The conservation measures included in the plan were selected on the basis of their ability to save significant amounts of energy by 1980.*** Specifically, the plan includes the six measures required by FEA, which will save somewhat less than 2 percent of the state's energy requirements in 1980. In addition, to realize the remaining 3-percent savings, a number of other, mandatory conservation measures were chosen. Given the 1980 deadline, these selections were confined to measures with: (1) large, short-term energy savings potential and relatively low capital investment

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* Each state is allowed to include in its plan energy-saving measures that have been implemented since December 22, 1975, the date the enabling federal legislation was signed into law.

** The SEO was assisted in this effort by Resource Planning Associates, Inc., of Cambridge, Massachusetts, and Wilbur Smith and Associates, Inc., of Columbia, South Carolina.

***A more detailed explanation of how the measures were chosen is contained in Appendix A of this report.

requirements; (2) applicability primarily to existing stocks of buildings and vehicles; and (3) early, relatively easy implementation possibilities.

Overall, the 22 conservation measures included in the New Jersey Energy Conservation Plan will save the state approximately 110 trillion Btu annually (over 50,000 barrels of oil per day), or 6 percent of the state's projected energy use in 1980. At an assumed cost per barrel of fuel oil (equivalent) of $14.50, the annual energy savings equals $278 million to New Jersey users. The resulting $3 billion in savings through 1989 more than counterbalances the cost to the public and private sectors of about $735 million through 1989.

This report presents the plan in detail. Specifically, it: (1) describes the 22 state measures included in the plan and the magnitude of the energy savings they will produce; (2) details the implementation requirements for the measures; and (3) assesses the economic (i.e., costs and benefits) and environmental impacts resulting from implementation of the plan.

1. DESCRIPTION OF THE PLAN

The New Jersey Energy Conservation Plan contains 22 specific energy conservation measures that will save 110 trillion Btu in 1980. (See Exhibit 1-1 for a summary of these measures and Appendix B for an explanation of how these energy savings were estimated.) Broken out by end-use sector, these measures and their collective percentage contributions to energy savings are:

- Residential and Commercial

1.	Certification of thermal efficiency in existing housing	62 percent
2.	Annual furnace inspection	
3.	Individual metering in residences	
4.	Thermal efficiency standards for new and renovated buildings*	
5.	Lighting efficiency standards for public buildings*	
6.	Seven-day, day/night thermostats in public buildings	
7.	Replacement of gas pilot lights	
8.	Water conservation code**	
9.	Weatherization program**	

- Industrial

10.	Improving boiler efficiency	23 percent
11.	Waste oil recycling	
12.	Tank fuel evaporation limits**	

- Transportation

13.	Right turn on red*	10 percent
14.	Enforcement of 55-mph speed limit	
15.	Expanded inspection procedure for auto emissions	
16.	Promotion of car pools and van pools*	
17.	Promotion of public transit*	
18.	Bus replacement program	
19.	Use of drag-reduction devices on trucks	

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* Required by FEA.

** Already enacted by New Jersey.

- Utilities

20.	Current and proposed conservation measures by utilities	4 percent
21.	Financing of conservation investments by utilities	

- General

22.	Energy-efficient procurement practices.*	1 percent

Of these, six are required by FEA for inclusion in the plan, and three have already been implemented in the state of New Jersey. The additional 13 were selected by a special project team, as described in the introduction and Appendix A, and most are mandatory. In the remainder of this chapter, each of these energy conservation measures and its attendant energy savings potential is described in detail.

RESIDENTIAL AND COMMERCIAL MEASURES

Implementation of nine energy conservation measures by residential/commercial users in New Jersey will save 86.7 trillion Btu in 1980, or over $217 million a year, at a cost of $2.1 million to the public sector and $427 million to the private sector by the end of 1980. This energy savings will be realized primarily through the use of measures that require changes in existing building stock. In residential buildings, such measures include cap (roof) insulation, day/night thermostats, and annual furnace tune-ups. In commercial and other public access buildings, conservation actions include reduced lighting levels and 7-day, day/night thermostats set according to state temperature standards. Finally, in all new and renovated buildings, the measures include compliance with the national energy efficiency building code (ASHRAE 90-75). Detailed descriptions of each of these nine measures are contained in Appendix C.

Certification of Thermal Efficiency in Existing Housing

Under a measure requiring certification of thermal efficiency in existing housing, homeowners and landlords will have to install thermal efficiency equipment in their occupied or rented residential buildings either at time of sale or at time of next regular state inspection. Owners of multifamily dwellings of three or more units will be required to install equipment at the time of their first 5-year health and safety

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* Required by FEA.

inspection after January 1, 1978. Owners of attached and unattached single-family dwellings and 2-family homes must comply the first time the dwelling is sold subsequent to January 1, 1978. After installation of the equipment, homeowners must file a statement certifying compliance. Owners of single-family, low-density, low-rise dwellings must install two types of weatherization equipment, if such equipment is not already in place: (1) an automatic day/night thermostat in each unit (or units); and (2) sufficient cap (roof) insulation to meet minimum Federal Housing Authority standards for New Jersey.

Total energy savings from use of this measure are projected at 18.1 trillion Btu in 1980, or $45 million, at a cost of $408,144 to the public sector and $247 million to the private sector.

Annual Furnace Inspection

Residential/commercial building owners will have to have the oil-fired heating systems in their units inspected each year and adjusted as necessary to meet energy efficiency standards. In addition, if these systems cannot, even with adjustment, meet the standard, the owners will be required to have the systems repaired (most likely with replacement burners*).

Implementation of this measure will save 15.4 trillion Btu in 1980, or $38.5 million, at a cost of $507,489 to the public sector and $60 million to the private sector.

Individual Metering in Residences

With the individual metering in residences measure, master meters for gauging electrical consumption will be prohibited in all newly constructed or renovated multiunit residential buildings. Further, the state's Public Utilities Commission (PUC) will require that utilities halt electrical service to buildings that do not comply with the measure, once it becomes effective.

Successful implementation will save .05 trillion Btu by 1980, or $125,000, at no cost to the public sector and a cost of $680,200 to the private sector.

Thermal Efficiency Standards for New and Renovated Buildings

As of January 1, 1978, the state will require that all new or

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* A mechanism, probably federal grants, will be provided to aid the poor in replacing burners.

renovated buildings conform to the ASHRAE 90-75 energy conservation building code. The ASHRAE 90-75 code, which will be incorporated in the statewide Uniform Building Code, sets standards for energy-efficient design and construction.

Substantial energy savings will be achieved in individual buildings affected. Overall, statewide savings will be 10.7 trillion Btu in 1980, or $27 million, at no additional cost to the public sector and a cost of $35.7 million to the private sector.

Lighting Efficiency Standards in Public Buildings

With the passage and implementation of specified lighting efficiency standards for public buildings, the lighting levels in existing public buildings will be lowered, and the lighting in new and renovated buildings will have to conform to ASHRAE 90-75 lighting standards. The lighting standards for existing buildings, to be promulgated by the Department of Community Affairs (DCA), will be based on the provisions of a forthcoming ASHRAE code for existing buildings, ASHRAE 100.

Approval and use of this measure will save 14.4 trillion Btu in 1980. These savings will be worth $36 million to the state, and will cost the public sector about $1 million and the private sector about $11.7 million.

Seven-Day, Day/Night Thermostat Settings in Public Buildings

Mandatory thermostat settings for commercial and other public buildings will include: (1) during working hours, maximum thermostat settings of 65°F for retail space and 68°F for other space during the heating season (defined by the operation of heating equipment), and minimum thermostat settings of 78°F during the operation of air-conditioning equipment; and (2) during unoccupied periods, maximum thermostat settings of 55°F during the heating season, and minimum thermostat settings of 80°F during the operation of air-conditioning equipment, unless the heating, ventilating, and air-conditioning (HVAC) equipment can be shut off completely.

To achieve these settings, the measure will require the installation of 7-day, day/night thermostats or similar control equipment, and interlocks that prevent the simultaneous operation of heating and cooling systems. Finally, guidelines will be developed and promulgated on the voluntary installation of other HVAC control equipment to cut energy consumption.

Successfully implemented, the measure will save 18 trillion Btu in 1980, worth $45 million. The costs to the public and private sectors are included in the costs of the preceding measure dealing with lighting efficiency standards.

Replacement of Gas Pilot Lights

The PUC will require gas utilities to replace 50 percent of the pilot lights in residental gas heating systems with automatic ignition devices by the end of 1980. In addition, all gas ranges, dryers, and furnaces sold in the state will be required to have automatic, intermittent ignition systems. Successful implementation will save 6.85 trillion Btu in 1980, or $17 million. The public sector will incur no cost; the private sector will incur a cost of $72 million.

Water Conservation Code and Weatherization Program

The state has already begun implementing approved changes in the plumbing code that applies to new or renovated residential and commercial buildings. The provisions require low-flow shower heads and faucets to reduce water-heating requirements. Energy savings of 3 trillion Btu are possible from enforcement of this measure.

The state has also approved a measure for assisting Community Action Agencies in weatherizing low-income homes; with this program, 0.2 trillion Btu can be saved in 1980. Together, these two programs will save the state $8 million a year at no additional cost to either the public or the private sector.

INDUSTRIAL MEASURES

Effective implementation of three industrial energy conservation measures -- boiler efficiency improvement, the recycling of waste crankcase oil, and reduced evaporation of fuel from storage tanks -- will save 32.1 trillion Btu, valued at over $80 million, in 1980 for the people of New Jersey. These measures are detailed in Appendix D.

To achieve these savings, industry and government will have to spend $11.6 million and $273,130, respectively, by the end of 1980.

Boiler Efficiency Improvement

The energy efficiency of boilers rated at between 5,000 and 500,000 pounds of steam per hour can be improved by having the devices inspected and tuned twice a year. With passage of a boiler efficiency measure, the owners of these boilers will be required to do so. In addition, New Jersey's Department of Labor and Industry (DLI) will set boiler-efficiency standards; it will also train boiler operators in the energy-efficient operation of boilers. At the same time, SEO will support use of the measure by contacting attendees at FEA's industrial workshops in New Jersey and offering assistance in implementing suggested equipment efficiency measures. SEO will provide further assistance by demonstrating boiler-efficiency techniques and equipment in state-owned buildings.

This measure will be implemented by January 1978; energy savings from its use are estimated to be 22.7 trillion Btu in 1980, or $56.8 million -- the largest savings to be realized by any measure in the plan. The costs to the government and to the private sector are estimated at $241,410 and $11.6 million, respectively, by the end of 1980.

Waste Oil Recycling

SEO, DEP, and the state's Department of Law and Public Safety, Division of Motor Vehicles, will cooperate to increase the recycling of wasted crankcase oil disposed of by private automobile owners who change their own motor oil. To this end, reinspection stations will be required to provide oil collection/storage facilities from which the oil will be gathered (by private firms under contract to the state government) and recycled.

The measure will be put into effect in January 1978; in 1980, its use should have saved the state 0.8 trillion Btu, valued at $2 million. The costs to the private sector will be minimal, and the government will spend $31,720 for implementation and administration by the end of 1980.

Tank Fuel Evaporation Limits

The state's Department of Environmental Protection (DEP) recently issued regulations on the limitations of the evaporation of fuels from storage tanks. In 1980, enforcement of the measure will save 8.6 trillion Btu, valued at $21.5 million. This measure will require no public or private expenditures beyond those necessary to meet DEP standards.

TRANSPORTATION MEASURES

The plan's seven energy conservation measures designed for use by the transportation sector have the potential of generating savings of 14.2 trillion Btu in 1980. Three of the measures apply to all vehicles: right turn on red, enforcement of 55-mph speed limit, and improved emissions inspections. Three are related directly or indirectly to public transit: promotion of car pools and van pools, encouragement of public transit, and a bus replacement program. One, the use of drag-reduction devices, is applicable only to trucks. All are described in Appendix E.

Implementation of these measures will cost the public sector only $155,000 through 1980 because most of the measures will be implemented within the existing budgets of the Department of Transportation (DOT) and the Division of Motor Vehicles (DMV). The cost to the private sector will be $53 million by 1980.

Right Turn on Red

With a right-turn-on-red measure, vehicles approaching red traffic signals will be allowed to turn right after stopping at the intersection. In terms of traffic movement, right turn on red will turn red traffic signals into stop signs. The reduced engine-idling time will save 0.6 trillion Btu in 1980, which will be worth $1.5 million.

The measure was implemented in New Jersey in January 1977; consequently, there will be no further cost to the public sector, and there has been and will be no cost to the private sector.

Enforcement of 55-mph Speed Limit

In September 1977, the state of New Jersey will step up its enforcement on New Jersey's access-controlled highways of the federally mandated 55-mph speed limit. Such enforcement will save 2 trillion Btu in 1980, or $5 million, without incurring any cost for the private sector. In addition, existing budgets include the public sector's financial responsibility.

Expanded Inspection Procedure for Auto Emissions

In 1972, New Jersey began a vehicle emissions testing program to control exhaust emissions and improve air quality. Now, far more stringent automobile emissions control standards will be required. Implementation of an expanded program will save the state 3.1 trillion Btu in 1980, or $7.75 million.

Public sector costs incurred to achieve this savings have already been budgeted by state agencies. The total cost to the private sector over the period of 1978-1980 will be $49 million.

Promotion of Car Pools and Van Pools

New Jersey's SEO, the New York Energy Office, and the Port Authority of New York and New Jersey will undertake a cooperative effort to increase the use of car pools and van pools for daily commuters within New Jersey and between New Jersey and New York City. This joint task force will focus its promotion campaign on employers in target areas in New Jersey and New York.

The estimated shift from single (driver)-occupied cars to car pools and van pools will save an estimated 6.5 trillion Btu, or $16.3 million. The cost to the private sector will be nominal; the cost to the public sector in New Jersey will be $115,000 through 1980.

Promotion of Public Transit

The New Jersey Department of Transportation will undertake a marketing program to promote the use of public transportation in place of private cars.

Specifically, the department will coordinate fares, schedules, and routes among the 48 transit companies and 14 independent transit groups in New Jersey. In addition, a number of special services will be initiated, including reduced fares during low-ridership periods, express buses, and fringe parking lots at suburban public transit stops.

Overall, successful implementation will save 0.8 trillion Btu in 1980, at no additional cost to either the private or the private sector.

Bus Replacement Program

SEO is proposing, as one measure in its Energy Conservation Plan, the purchase of 800 new public transport buses for lease by transit operators in New Jersey. These buses, which will be used to increase service and replace outmoded and energy-inefficient equipment will be purchased by the New Jersey Department of Transportation using state and Urban Mass Transportation Administration funds. Thus, at no addition cost, 0.2 trillion Btu can be saved in 1980, or a dollar savings of $500,000.

Use of Drag-Reduction Devices on Trucks

The DOT will administer a program in which owners will pay lower registration fees on trucks with drag-reduction devices, such as windscreens and radial tires. Developing the guidelines for required equipment will cost DOT $40,000 in 1977. The cost to the private sector will be $4 million, which will be recovered through fuel savings. Effective use of the measure will save 1 trillion Btu in 1980, or $2.5 million.

UTILITY MEASURES

Two types of energy conservation measures included in the plan are aimed at New Jersey's utilities: (1) recently enacted or proposed actions, such as rate revisions, that are designed to save energy in the near term; and (2) the financing of energy conservation investments. These two types of measures, which are discussed at length in Appendix F, will save 5.9-6.5 trillion Btu in 1980, depending on which utility financing option is selected, at no additional cost to the public sector. The costs to the utilities will be $25 million or $10 million, also depending on the form of utility financing used. The financing measure is particularly important because it will facilitate greater public acceptance of other proposed energy conservation measures. For example, by making loans readily

available, homeowners will be much more likely to make energy-saving home improvements.

Current and Proposed Conservation Measures

Each of the seven major gas and electric utilities in New Jersey, with the approval of the PUC, has revised or has proposed revising utility rates and other actions to encourage consumers to use electricity in off-peak periods and to reduce overall energy consumption. Potential energy savings in 1980 will be 5.4 trillion Btu, at no additional cost to the government or the private sector.

Financing of Conservation Investments

The PUC is considering two alternative approaches to financing needed energy conservation investments through the utilities. Under the first approach, the PUC will require electric and gas utilities to provide loans for residential ceiling insulation for single-family, unattached houses, and for 2-, 3-, and 4-family dwellings. Under the second approach, the PUC will require gas utilities to adjust their rate structures to permit financing of ceiling insulation, day/night thermostats, and automatic ignition devices (for gas appliances) in single-family residences.

Under either approach, utility financing will start early in 1978; by 1980, energy savings will amount to 0.5 trillion Btu under the first option and 1.1 trillion Btu under the other. By the end of 1980, the total costs to the utilities and associated contractors will be $25 million or $10.2 million, depending on the approach adopted.

GENERAL MEASURE

As the 22nd measure in the Energy Conservation Plan, energy-efficient government procurement practices is aimed at an energy user category not usually included in end-use sectors, the government. The state's Department of the Treasury, Division of Purchase and Property, will establish cost-effective, centralized procurement practices that will reduce the amount of energy associated with equipment, buildings, and materials used by state and local governments in New Jersey. (A fuller explanation of the measure is included as Appendix G.) These practices will be initiated between January 1978 and January 1979.

Although the energy savings that will be generated by such procurement practices is relatively low -- 0.35 trillion Btu -- enforcement of the measure allows the state government to set an example in energy conservation.

The state government will spend $188,560 by the end of 1980 to implement and administer energy-efficient procurement practices.

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Description	1980 Energy Cost Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies*	Implementation Actions	Effective Date	Required Legislation
Residential and Commercial							
Certification of thermal efficiency in existing housing	Requires that weatherization equipment be installed in 1-2 unit residences at time of sale (statements certifying compliance to be filed with SEO) and in multi-unit dwellings by the next regular 5-year inspection.	18.1	$45,250	SEO DCA	SEO will establish installation standards for each housing type. DCA will: Publish educational materials to be sent to home-owners with utility bills. Develop and administer training programs on new standards for local building inspectors. Rule on requests for exemption for multi-unit dwellings. Regulate regular 5-year inspection of multi-unit dwellings.	1/78	Legislation is needed to require that mandatory standards be met in residential dwelling units; to add new codes to the general welfare standard for multi-unit inspections; and to require weatherization inspection for 1-2 family homes at time of sale.
Annual furnace inspection	Requires that oil-fired heating systems in residential and commercial buildings be inspected and adjusted, if need be, to meet efficiency standards.	15.4	$38,500	SEO	SEO will: Specify inspection standards. Set guidelines for adjustments. Monitor enforcement using tune-up efficiency data submitted by contractors, and random spot-checks by state inspectors.	7/78	Legislation is needed to require building owners to purchase annual servicing; to prohibit oil companies from supplying uncertified units; and to empower SEO to enforce regulations.
Individual metering in residences	Requires that only individual electric meters be allowed in new and renovated residential multi-family units.	0.05	$125	PUC	PUC will: Prohibit electric service to new and renovated, residential buildings equipped with master meters.	Immed.	None
Thermal efficiency standards for new and renovated buildings	Requires that all new and renovated buildings meet the ASHRAE 90-75 building code.	10.7	$26,750	DCA	DCA will: Adopt standards for new and renovated buildings Develop a training program for building inspectors. Enforce and monitor the new standards.	9/77	None

*SEO State Energy Office
DCA Dept. of Community Affairs
PUC Public Utility Commission
DLI Dept. of Labor and Industry
DMV Division of Motor Vehicles
DEP Dept. of Environmental Protection
DOT Dept. of Transportation
PA Port Authority of N.Y. & N.J.
UMTA Urban Mass Transit Administration
DT Dept. of the Treasury

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Descriptions	1980 Energy Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies*	Implementation Actions	Effective Date	Required Legislation
Residential and Commercial							
Lighting efficiency standards for public buildings	Requires that lighting standards be met in all public buildings. New and renovated buildings will meet ASHRAE 90-75 or similar codes. Existing buildings will meet a forthcoming ASHRAE code for existing buildings.	14.4	$36,000	DCA	DCA will: Adopt standards for new and renovated buildings. Enact standards for existing buildings and require compliance by 1980. Enforce compliance by spot-checking a sampling of building space.	9/77	Legislation is needed to empower state to enforce standards for existing buildings.
Seven-day, day-night thermostats in public buildings	Requires public buildings to have thermostats controlled by 7-day clocks with prescribed settings for occupied and unoccupied periods.	18.0	$45,000	DCA	DCA will: Establish mandatory thermostat settings during occupied periods (maximums of 65° F for retail and 68° F for other space during heating season, and minimums of 78° F during cooling season) and during unoccupied periods (55° F maximum and AC shutoff or 80° F minimum). Mandate installation of thermostat equipment and provide guidelines for voluntary installation of additional HVAC controls. Provide for enforcement based on spot-check inspections.	For settings 1/78 For equipmt. installation 9/78	Legislation is required to empower the state to set standards, require equipment installation, and enforce compliance.
Replacement of gas pilot lights	Requires retrofit of 50 percent of existing gas furnaces with electric ignition systems by the end of 1980 and that gas furnaces, ranges, and dryers purchased or installed after December 31, 1977, have electric ignition systems.	6.85	$17,125	PUC SEO	PUC will: Review utility plans for meeting furnace retrofit targets. SEO will: Promulgate legislation requiring electric ignition systems in new furnaces, ranges, and dryers.	1/78	Legislation is needed to require electric ignition systems in new gas appliances.

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Description	1980 Energy Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies*	Implementation Actions	Effective Date	Required Legislation
Residential and Commercial							
Water conservation code	Requires that faucets, shower heads, water closets, and other fixtures be designed, manufactured and installed to operate at or below specified water flow rates.	3.0	$7,500	DCA	Implemented since December 22, 1975.	6/77	Legislation is needed to incorporate water conservation provisions of National Standard Plumbing Code into N.J. Building Code as soon as it is approved in June 1977
Weatherization program	Provides assistance to N.J. Community Action Agencies for programs to weatherize low-income homes under grants from U.S. Community Services Administration.	0.2	$500	DCA	Implemented since December 22, 1975.	12/75	None.
Industrial							
Improving boiler efficiency	Sets mandatory fuel-to-steam (or hot water) standards and voluntary stack-gas temperature standards for boilers rated at between 5,000 pounds and 500,000 pounds of steam per hour and establishes programs to encourage efficient boiler operation.	22.7	$56,750	DLI SEO	DLI will: Oversee boiler efficiency certification program. Establish operator licensing program. SEO will: Follow up on FEA Industrial Workshops. Conduct boiler efficiency demonstrations.	1/78	None.
Waste oil recycling	Establishes waste oil collection centers to encourage proper disposal by "do-it-yourself" auto owners who change their own oil, and proposes programs to publicize and provide incentives for recycling.	0.8	$2,000	DMV SEO DEP	DMV will: Amend standards for granting reinspection licenses to include oil collection facilities. Require reinspection stations to contract with licensed oil collectors for pick-up. SEO will: Develop and promote widespread public education program at gas stations, supermarkets, etc. DEP will: Require oil collectors to dispose of oil in environmentally sound ways.	1/78	None.

Exhibit 1–1 (cont'd)

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Description	1980 Energy Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies	Implementation Actions	Effective Date	Required Legislation
Industrial							
Tank fuel evaporation limits	Requires compliance with DEP regulations to limit the evaporation of fuels from storage tanks.	8.6	$21,500	DEP	DEP will: Require permits for storage and transfer of liquid hydrocarbons. Require control devices to reduce hydrocarbon emissions.	3/76	None.
Transportation							
Right turn on red	Allows motorists to turn right at a red traffic signal at certain intersections after stopping.	0.6	$1,500	DOT	Implemented in January 1977.	1/77	None.
Enforcement of 55 mph speed limit	Reduces average speed of vehicles on access controlled highways through stricter enforcement of 55 mph speed limit.	2.0	$5,000	State Police DMV DOT	State Police will Increase surveillance and number of citations. DMV will: Recommend higher fines for violations. DOT will: Implement a public information program on the measure.	9/77	Legislation is needed to change Motor Vehicle Code to allow higher fines for speeding violations.
Expanded inspection procedure for auto emissions	Requires that automobiles meet Phase 3 auto emission standards.	3.1	$7,750	DMV DEP	DMV will Implement "Phase 3" auto emissions standards at state inspection stations. DEP will Administer the Phase 3 standards.	1/78	None.
Promotion of car pools and van pools	Promotes increased use of car pools and van pools for work trips in New Jersey and between New Jersey and New York City.	6.5	$16,250	DOT SEO PA	DOT, SEO, and Port Authority will Conduct market surveys of potential car pools and van pools in target areas SEO, with New York SEO, will Contact prospective employers in target areas and help develop car-pool/van-pool programs. DOT and Port Authority will: Provide computer matching services to interested employers.	late 1978	None.

Exhibit 1–1 (cont'd)

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Description	1980 Energy Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies*	Implementation Actions	Effective Date	Required Legislation
Transportation							
Promotion of public transit	Establishes a transit marketing program to encourage riders to use public transit, rather than private cars.	0.8	$2,000	DOT	DOT will: Coordinate routes, schedules, and fares of 62 transit companies in the state. Promote special services and innovations. Establish a 24-hour toll-free information service for New Jersey transit.	6/77-12/78	Legislation is needed to empower DOT to plan statewide transit, and to transfer transit regulatio from PUC to DOT.
Bus replacement program	Introduces 800 new, more efficient buses into the New Jersey bus fleet.	0.2	$500	DOT UMTA	DOT will: Apply to UMTA for federal funds to purchase 800 buses Contract for buses. Take delivery of buses and lease to state transit companies.	1/79	None.
Use of drag reduction devices on trucks	Establishes registration fee incentives for trucking companies to install wind screens and radial tires on vehicles.	1.0	$2,500	DOT DMV	DOT will: Develop guidelines for trucking companies on desirable types of drag reduction devices, including wind screens and radial tires. DMV will: Redesign registration fees to offer lower fees to trucks with drag reduction devices.	1/78	Legislation is needed to change Motor Vehicle C to permit changes in registration fees.
Utilities							
Current and proposed conservation measures by utilities	Involves electric and gas utility actions including revisions and advertising programs to encourage conservation.	5.4	$13,500	PUC	PUC and utilities will: Continue to formulate measures to encourage energy conservation by customers and monitor the results.	Current and before mid-1980	None.
Financing of conservation investments by utilities (Option 1 and 2)	Option 1 proposes that electric and gas utilities finance the installation of ceiling insulation through loans to customers who own single-, two-, three- and four-family units. Option 2 involves the financing by gas utilities of three types of conservation investments for single-family space-heating customers.	Option 1: 0.5 Option 2: 1.1	Option 1: $1,250 Option 2: $2,750	PUC SEO	PUC and utilities will: Finalize specific details of a financing program; utilities will screen and contract firms to install equipment.	2/1/78	Legislation may be nee if utilities dispute PUC jurisdiction.

New Jersey Energy Conservation Plan
Summary of Measures

Measures	Description	1980 Energy Savings (10^{12} Btu)	1980 Energy Cost Savings ($000)	Implementing Agencies*	Implementation Actions	Effective Date	Required Legislation
General							
Energy-efficient procurement practices	Proposes cost-effective procurement practices that will reduce the amount of energy required for equipment, buildings, and materials used by state and local governments.	0.35	$875	DT SEO	DT and SEO will: Establish minimum energy efficiency criteria for target equipment, buildings, and materials and assemble guidelines for purchase, use, and maintenance of procurements.	1/1/78	None.

2. IMPLEMENTATION OF PLAN

To achieve the 6-percent energy savings potential by 1980, most of the 22 conservation measures in New Jersey's Energy Conservation Plan will have to be implemented by late 1977 or early 1978. Implementation of these measures within a matter of months requires the effective coordination of a number of activities performed by various organizational units. To ensure success, all implementation participants should have a clear understanding of: (1) the roles of the New Jersey state agencies involved; (2) the legislative authority these agencies will require; (3) the schedule to be met in implementing the measures within the time frame allowed; (4) the monitoring procedures SEO will use during implementation to ensure the plan will achieve targeted energy savings objectives by 1980; and (5) the cost budget for implementing the measures.

ROLE OF STATE AGENCIES

The combined efforts of eight state agencies and organizations will be required to implement the 22 proposed energy conservation measures. The roles those agencies will play and their primary responsibilities are:

- The Department of Community Affairs (DCA) will have responsibility for six of the nine measures in the residential/commercial sector, including two measures, water conservation code and weatherization program, that have already been implemented. The four new measures will account for energy savings of 61.2 trillion Btu,* or 44 percent of the savings to be realized by the entire plan in 1980.

- The Department of Transportation (DOT) will have responsibility for all the transportation measures except the enforcement of the 55-mph speed limit and the expanded auto emissions inspections. DOT's major responsibility will be to develop public transit and car pool/van pool systems in the state.

- The Division of Motor Vehicles (DMV) and the state police in the Department of Law and Public Safety will be responsible for the enforcement of the 55-mph speed limit; DMV will implement the auto-emissions inspections program and the waste oil recycling measure.

- The Department of the Treasury, Division of Purchase and Property, will be responsible for implementing energy efficient procurement practices in the state.

- The Department of Labor and Industry (DLT) will be responsible for implementing the measure to improve boiler efficiency.

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* See Appendix B for a detailed discussion of how the energy savings were calculated.

- The Public Utilities Commission (PUC) will be responsible for implementing measures pertaining to utility conservation measures, utility financing of conservation investments, replacement of gas pilots, and individual metering in multiunit residences.

- The Department of Environmental Protection (DEP) will administer the tank fuel evaporation limits measure and the expanded inspection of auto emissions.

SEO will have overall responsibility for implementing the plan and for integrating the plan into a longer term energy program for the state. SEO will also be responsible for implementing the measure requiring annual furnace inspection, for administering the New Jersey Energy Conservation Center, and for supporting other agencies in their implementation efforts. SEO will have partial responsibility for a number of other measures, including certification of thermal efficiency in residence and the weatherization program.

REQUIRED LEGISLATIVE AUTHORITY

Ten measures included in the plan can be implemented under existing authority. These measures are:

- Individual metering in residences
- Thermal efficiency standards for new and renovated buildings
- Lighting standards for new and renovated public buildings
- Improved boiler efficiency
- Waste oil recycling
- Expanded inspection procedure for auto emissions
- Promotion of car pools and van pools
- Bus replacement program
- Current and proposed conservation measures by utilities
- Energy efficient procurement practices.

The total savings generated by this group of measures is 52 trillion Btu in 1980, which represents only 37 percent of projected savings and 2 percent of projected 1980 usage. It is possible other measures that would raise this total somewhat could be implemented under existing legislation; however, the increase would not be substantial.

Existing authority, then, does not give the state the power it needs to achieve the 5-percent FEA target. Thus, legislative action is needed in several areas. Eight measures that require some form of legislative action are:

Measure	Legislative Action Required
Certification of thermal efficiency in existing housing	Empower state (DCA/SEO) to require specific energy-measurement equipment in residences
Annual furnace inspection	Empower state (SEO) to require annual inspection
Lighting efficiency standards for existing public buildings	Empower state (DCA) to require lighting standards in public buildings
Seven-day, day/night thermostats in public buildings	Empower state (DCA) to set temperature standards
Replacement of gas pilot lights	Empower state to prohibit gas pilots in new appliances
Enforcement of 55-mph speed limit	Change fine schedules
Promotion of public transit	Transfer public transit functions from PUC to DOT
Use of drag-reduction devices on trucks	Change registration fee schedules

Implementation of this group of measures will save the state 75 trillion Btu in 1980, which is 54 percent of projected savings and almost 4 percent of New Jersey's projected 1980 usage. [The remainder of the projected savings (i.e., 12 Btu) will be generated by the utility financing measures* and measures that have already been implemented.]

Recognizing the absolute necessity of obtaining this legislative authority as quickly as possible if the plan is to achieve 6-percent savings in 1980, SEO will begin working with DCA in drafting the legislative package required to implement the measures in the residential/commercial area. SEO will also work with DMV to develop new fine schedules for speeding violations and new truck registration rates

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* The PUC may or may not have the power under existing authority to order the utilities to finance conservation investments.

SCHEDULE

Achieving the 6-percent energy savings goal also requires a carefully planned and executed action schedule in which implementation of the 22 selected measures is staggered over a 3½-year period (see Exhibit 2-1). Over the near term, i.e., during 1977, PUC will begin prohibiting master metering in new and renovated multi-unit residential buildings, and the state police will begin to enforce more stringently the 55-mph speed limit on access-controlled highways.

On January 1, 1978, the state will implement most of the measures included in the plan. After this date, a number of activities will be launched that are clearly linked to individual energy conservation measures. Specifically, homes will have to be certified for thermal efficiency at time of sale, and homeowners will have to begin having their furnaces certified for efficiency. At the same time, the state will begin enforcing thermal and lighting efficiency standards for new and renovated buildings, applying energy efficiency criteria in making procurement decisions, and contacting New Jersey-New York employers about participating in car pool/van pool programs. Gas utilities will begin replacing gas pilot lights in furnaces and water heaters, large-boiler owners will be required to have boilers inspected and tuned twice a year, and a new schedule of truck registration fees that will encourage truckers to adopt drag-reduction devices will go into effect. Finally, auto reinspection stations will begin to collect waste oil for recycling, and automobile owners will have to begin complying with the stricter auto emissions standards by submitting their cars to state inspections.

Still other measures will go into effect after January 1978. Specifically, the state will begin spot-checks of thermostat settings in public buildings in early 1978 and of lighting levels in public buildings in January 1979. In the first half of 1978, the utilities will begin financing conservation investments, and in January 1979, the state will take delivery of the first of the 800 new buses acquired under the bus replacement program.

Two other measures, promotion of public transit and utility conservation measures, will be implemented gradually as consumer habits change over time between 1978 and 1980.

If this implementation schedule were met, energy savings could equal 1 percent of 1980's consumption in 1977, grow to 3 percent in 1978 and 5-percent in 1979, and reach the full 6 percent in 1980. However, with delays, savings might slip to 2 percent in 1978, 4 percent in 1979, and 5 percent in 1980. This annual 1-percent energy shortfall is worth $145 million, money private and public users in New Jersey could save if the delays did not occur.

Failure to meet the schedule will also jeopardize FEA implementation funds for 1977 and 1978. Specifically, the amount of money the state will receive in 1978 will depend to some degree on how successful it is in meeting the implementation deadlines. If delays occurred, the state could lose significant federal funds, thereby further hurting New Jersey's chances of achieving the 6-percent goal in 1980.

MONITORING SYSTEM

Monitoring each measure's effectiveness in realizing expected energy savings is an important component of implementing the overall plan.* To this end, SEO will collect data on energy consumption, either from energy consumers or from the state agency(ies) administering the measure, to estimate the energy savings each measure generates in 1978, 1979, and 1980, and report on these energy savings to FEA as part of the state energy conservation program.

These energy savings estimates will help SEO determine how well each measure is working and whether it is generating savings that justify the attendant costs to the state government and to the private sector. SEO will use these assessments of performance to determine which of the measures should be part of the state energy program that evolves after 1980.

BUDGET

The costs of implementing and administering the plan that are not covered by existing or projected state budgets will be $807,000 in 1977, $1.24 million in 1978, and $1.26 million in 1979 and in 1980, or a total cost over the 1977-1980 period of $4.6 million.** (See Exhibit 2-2.) It is assumed this cost will be covered entirely by FEA implementation funds.

As Exhibit 2-2 shows, no cost will be incurred for 13 of the measures, representing energy savings of 43 trillion Btu and 31 percent of the total savings in the plan, because they have already been implemented,*** or because their costs are covered by existing budgets of state agencies. In a few cases (e.g., bus replacement program), federal funds other than FEA implementation funds will be used to defray part of the costs of implementation.

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* A fuller explanation of how the general monitoring system will be applied to each measure is contained in the several appendixes that describe these measures in detail.

** This figure includes the $390,000 needed by SEO through 1980 to administer the implementation of the plan, coordinate action with other state agencies, provide information on the plan to the public, and perform related activities. It also includes $1.5 million needed to finance the State Conservation Center that will provide technical information and on-site assistance to citizens and businesses requesting such help.

***Water conservation code, tank fuel evaporation limits, weatherization program, and right turn on red.

New Jersey Energy Conservation Plan
Implementation Schedule for State Actions

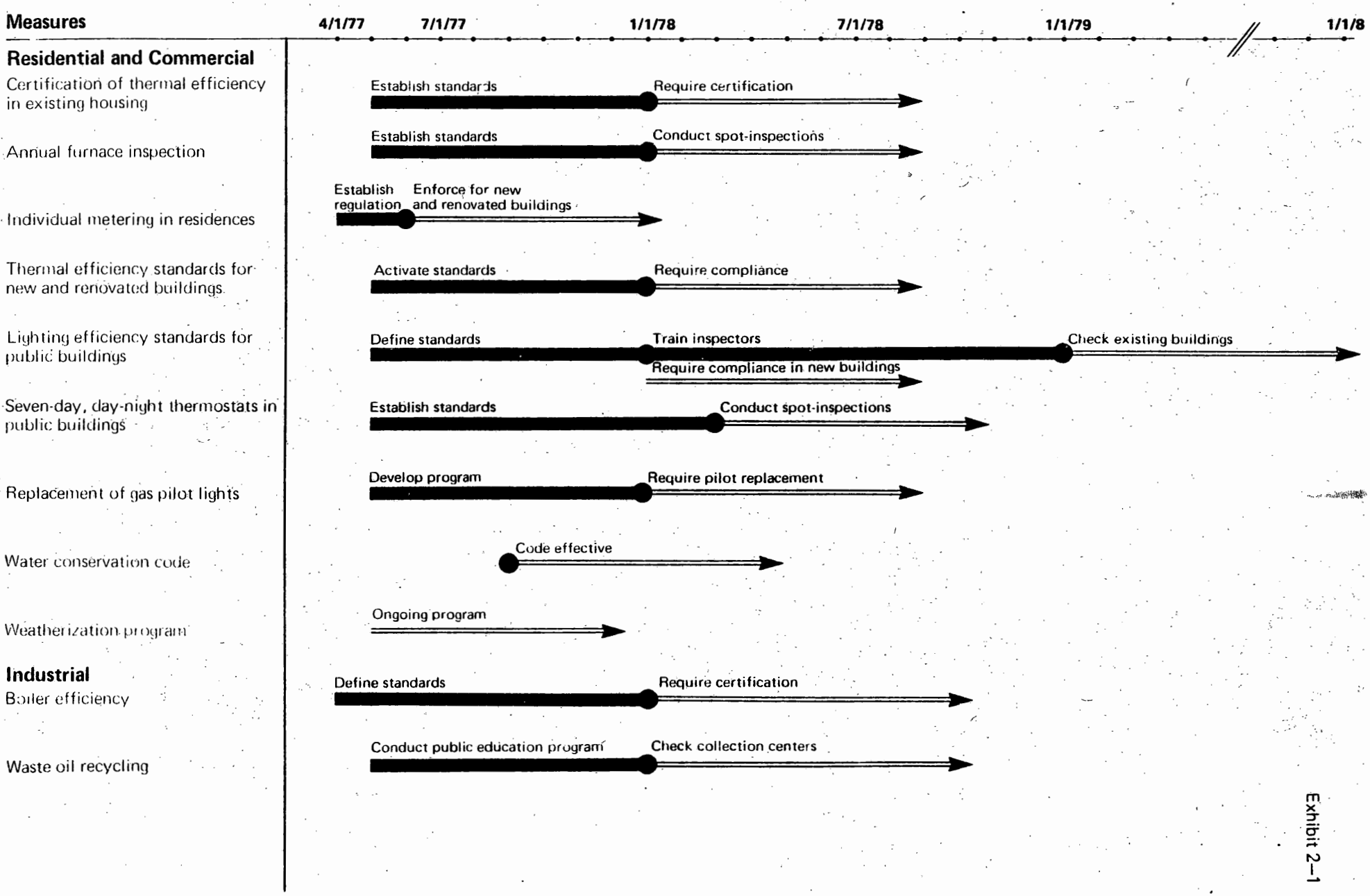

Exhibit 2–1

New Jersey Energy Conservation Plan
Implementation Schedule for State Actions

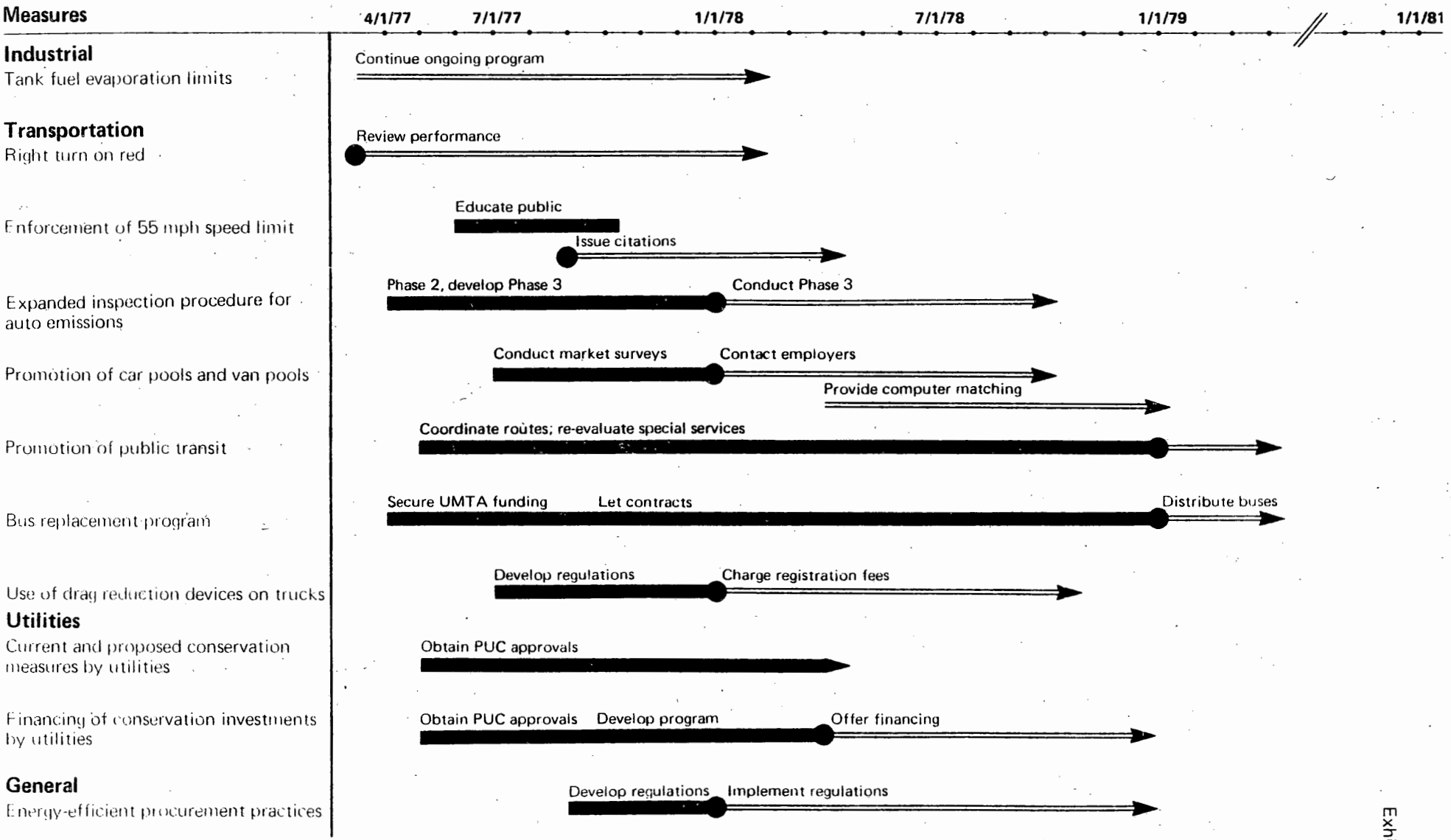

Exhibit 2–1 (cont'd)

New Jersey Energy Conservation Plan
Public Sector Costs
(Dollars)

Measure	1977	1978	1979	1980	Total
Residential and Commercial					
Certification of thermal efficiency in existing housing	314,357	33,285	30,251	30,251	**408,144**
Annual furnace inspection	67,878	146,537	146,537	146,537	**507,489**
Individual metering in residences	0	0	0	0	**0**
Thermal efficiency standards for new and renovated buildings	0	0	0	0	**0**
Lighting efficiency standards and seven-day, day/night thermostats for public buildings	187,500	325,300	315,300	315,300	**1,143,400**
Replacement of gas pilot lights	0	0	0	0	**0**
Water conservation code	0	0	0	0	**0**
Weatherization program	0	0	0	0	**0**
Subtotal	**569,735**	**505,122**	**492,088**	**492,088**	**2,059,033**
Industrial					
Improving boiler efficiency	52,170	63,080	63,080	63,080	**241,410**
Waste oil recycling	21,700	3,340	3,340	3,340	**31,720**
Tank fuel evaporation limits	0	0	0	0	**0**
Subtotal	**73,870**	**66,420**	**66,420**	**66,420**	**273,130**
Transportation					
Right turn on red	0	0	0	0	**0**
Enforcement of 55 mph speed limit	0	0	0	0	**0**
Expanded inspection procedure for auto emissions	0	0	0	0	**0**
Promotion of car pools and van pools	40,000	25,000	25,000	25,000	**115,000**
Promotion of public transit	0	0	0	0	**0**
Bus replacement program	0	0	0	0	**0**
Use of drag reduction devices on trucks	40,000	0	0	0	**40,000**
Subtotal	**80,000**	**25,000**	**25,000**	**25,000**	**155,000**
Utilities					
Current and proposed conservation measures by utilities	0	0	0	0	**0**
Financing of conservation investments by utilities	0	0	0	0	**0**
Subtotal	**0**	**0**	**0**	**0**	**0**

New Jersey Energy Conservation Plan
Public Sector Costs
(Dollars)

Measure	1977	1978	1979	1980	Total
General					
Energy-efficient procurement practices	33,775	51,595	51,595	51,595	**188,560**
Subtotal	**33,775**	**51,595**	**51,595**	**51,595**	**188,560**
Total for Measures	**757,380**	**648,137**	**635,103**	**635,103**	**2,675,723**
Additional Costs					
N.J. Energy Conservation Center	0	500,000	500,000	500,000	**1,500,000**
General Administration (SEO)	50,000	90,000	125,000	125,000	**390,000**
Total Costs	**807,380**	**1,238,137**	**1,260,103**	**1,260,103**	**4,565,723**

3. IMPACTS OF IMPLEMENTATION

In addition to the costs incurred by the public sector, New Jersey's Energy Conservation Plan will have economic impacts, in terms of both costs and benefits, in the private sector. In addition, implementation of the plan will affect the quality of the state's environment. Both kinds of impacts were estimated for the plan.

ECONOMIC IMPACTS

For the private sector as a whole, as well as for individual homeowners and building owners, the New Jersey Energy Conservation Plan is cost effective. That is, although private sector costs are large, they will be fully offset by the value of the energy savings realized by the end of 1980. Moreover, private capital invested in energy conservation through 1980 will result in energy savings through 1989 that are four times larger than total capital and other private sector costs through 1989.

Overall Costs and Benefits to Private Sector

Rough estimates of private sector costs and benefits for each measure were based on four conservative assumptions:

- The total amount of energy saved in 1977, 1978, and 1979 as a result of implementing all measures in the plan will equal 130 percent of the energy saved in 1980.
- The annual energy savings resulting from each measure will remain constant for 10 years (1980 to 1990) without additional capital expenditure after 1980.
- The value of energy saved will be $2.50 per million Btu through 1989.
- The total amount of energy saved as a result of implementing the selected measures will equal 80 percent of the sum of projected energy savings for each measure, because of the overlapping effect of various measures.

Under these assumptions, total private sector savings to 1990 will be about $3,155 million. Of this amount, a total of $362 million in energy savings will occur in 1977, 1978, and 1979, and $279 million will accrue each year from 1980 through 1989. To achieve these savings, the private sector will spend about $735 million by the end of 1989. In particular,

the private sector will invest about $510 million by the end of 1980,* of which $415 million will be used for capital investments. To sustain the energy savings from 1981 to 1990 at the 1980 level (i.e., $279 million per year), the private sector will spend about $25 million annually on noncapital expenses.

While the plan as a whole and most measures in it offer an excellent economic return to the private sector, payback periods and assumptions about private sector costs vary significantly among the measures. For clarification, measures should be considered in five groups:

- Those that require new private-sector investment and offer a payback by the end of 1980. Eight of the 22 proposed energy conservation measures require new private sector expenditures and offer a payback by the end of 1980: annual furnace inspection; individual metering in residences; thermal efficiency standards for new and renovated buildings; lighting efficiency standards; 7-day, day/night thermostats for public buildings; improved boiler efficiency; waste oil recycling; and use of drag-reduction devices on trucks. Implementation of these eight measures will generate 60 percent of the plan's total energy savings through 1990, for only 31 percent of the total private sector costs for that period. (See Exhibit 3-1 for a summary of the costs and energy savings.)

- Those that capture energy savings of existing programs and do not require any additional private sector expenditures. Eight of the 22 selected measures require private sector expenditures that are mandated under existing programs: water conservation code, weatherization program, tank fuel evaporation limits, right turn on red, enforcement of 55-mph speed limit, promotion of public transit, bus replacement program, and current and proposed conservation measures by utilities. Consequently, no additional costs will be incurred under the Energy Conservation Plan. The plan does, however, claim the associated energy savings, valued at 15 percent of the plan's total savings through 1990. (See Exhibit 3-1 for a summary of costs and energy savings.)

- Those that require new private sector investments and offer payback between 1980 and the end of 1985. Three measures -- utilities financing (second option), certification of thermal efficiency in existing housing, and replacement of gas pilots -- provide a payback between 1980 and the end of 1985. These three

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* These costs exclude private-sector costs for the promotion of car pools and van pools.

measures represent only 19 percent of the energy savings to 1990 but 44 percent of the total cost to the private sector. (See Exhibit 3-1 for a summary of costs and energy savings.)

- Those that offer no payback by 1990. Two measures do not offer a payback by 1990: expanded inspection procedure for auto emissions and the financing of conservation investments (first option). But in both cases, energy savings, about 2 percent of the plan's total savings, are a secondary benefit. (See Exhibit 3-1 for a summary of costs and energy savings.)

- Those for which private sector costs were not calculated or for which there are no private sector costs or energy savings. Private sector costs have not been calculated for promotion of car pools and van pools. In addition, there are no private sector costs connected with the energy efficient procurement practices measure. (See Exhibit 3-1 for a summary of costs and energy savings.)

Costs and Benefits to Homeowners

Implementation of the measures affecting homeowners will entail some costs to the homeowner; however, in general, the costs will be more than offset by the savings from more efficient use of energy. For example, the cost of a new day/night thermostat is approximately $110; adequate cap (attic) insulation will average $325 per house; replacement of a pilot light with automatic ignition in a gas-fired heating system will cost about $100. However, the homeowner who is obliged to make all three improvements will recover the outlay in 4-5 years because the savings resulting from those improvements is, on the average, $119.75 per year (see Exhibit 3-2). And, of course, because the installation costs are one-time investments, this amount will represent actual savings in subsequent years.

Some costs will be recurrent, however. For example, oil furnaces will have to be inspected and, if necessary, tuned annually, at an average cost of $25. However, improved efficiency of the furnace will save the homeowner about $37 per year. (Many homeowners have service contracts with oil dealers that include annual inspection and adjustment and so will not incur added costs.)

Annual automobile inspection under the new regulation will cost vehicle owners an additional $1.80 in inspection fees. For those whose vehicles do not pass the emissions test -- an estimated 23 percent of the total -- adjustments or repairs will cost $35 on average. However, the improved efficiency of the engine should reduce gasoline consumption by 10 percent (from an estimated 18-mile per gallon rate over 12,000 miles). Assuming a gasoline price of 60 cents per gallon, a $40 savings would be realized.

Beyond these economic impacts, the energy plan will produce only comparatively small changes in other terms. In terms of lifestyle, the plan will produce some attractive alternatives to driving, particularly for work trips; car pools and van pools will become more available, and public transit systems will be visibly improved. On the negative side, temperatures in stores and public buildings will be lower in winter and higher in summer.

Costs and Benefits for Building Owners

Three measures will affect owners of public buildings: lighting standards; 7-day, day/night thermostats; and furnace inspection. The value of energy savings through 1980 from all three ($274.9 million) will greatly exceed the costs of compliance through 1980 ($71.7 million).

The lighting standards will, in most cases, require nothing more than the delamping of fixtures, at an insignificant cost; some building owners may have to rewire for selective light turn-offs, at a slightly higher cost. However, these adjustments are estimated to reduce energy consumption by 20 percent, at a savings of $22 per 1,000 square feet of space* (see Appendix C).

Compliance with the 7-day, day/night thermostat measure is expected to cost approximately $25 per 1,000 square feet of floor space, but will reduce heating costs by an estimated 38.7 percent and air conditioning costs by an estimated 17 percent. These savings represent a reduction in energy costs of up to $113 per 1,000 square feet of floor space (see Appendix C). (Actual savings will vary widely according to the type of HVAC system installed and maintenance practices.)

Furnace inspection and tuning will cost $1-2 per 1,000 square feet of floor space in oil-heated buildings. Improved energy efficiency will reduce annual heating costs by 6 percent, or approximately $15 per 1,000 square feet of floor space (see Appendix C).

In addition to energy savings realized, compliance with thermal efficiency and lighting standards will reduce construction costs for new and for renovated buildings.

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* Based on lighting energy costs calculated as 50 percent of 18,500 Btu/sq ft of electricity for "lighting and other" (U.S. Federal Energy Administration, Project Independence Blueprint; Residential and Commercial Energy Use Patterns 1970-1990, (1974): Figure 1.5) multiplied by an assumed average commercial electricity rate of $0.14 per kWh.

ENVIRONMENTAL IMPACTS

Since none of the measures in the plan will induce consumers to switch fuels, the plan will result in less use of each fuel as well as lower total energy consumption. Therefore, the plan will reduce the levels of all energy-related pollutants in New Jersey. For example, of the water pollutants, dissolved solids emissions will be reduced by 850 tons in 1980; acids, by 159 tons; and suspended solids, by 152 tons (see Exhibit 3-3). Air pollutants will also be reduced: carbon dioxide, by 11.2 million tons; hydrocarbons, by over 215,000 tons; nitrogen oxides, by well over 35,000 tons. The impacts of these reductions on the state environment, however, can be determined only by comparing them with the 1980 projected emission levels in the state without an energy conservation plan, something that is outside the scope of plan preparation.

Emission reductions were estimated by assigning the energy savings from each measure to the fuels used in fuel-burning operations associated with each measure. In many cases, such as individual metering or gas pilots, the affected fuel was obvious; in many others, it was necessary to distribute the savings among several fuels. Such distribution was based on the assumption that fuels will be saved in proportion to their historical use in the affected sector in New Jersey.* Electric energy savings were allocated to fuels on the basis of projections of utility fuel use obtained from SEO, the PUC, and New Jersey utilities.

The assigned savings (by fuel and fuel-burning operation) were converted to reductions in emissions by using the conversion factors supplied by FEA. These factors are shown on the work sheets used to perform the calculations and contained in Appendix H.

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* Information on New Jersey fuel usage, by sector, was taken from Energy: A Report to the Governor of New Jersey, by the Task Force on Energy, May 1974. The data in this report are for 1972, but it is unlikely the fuel mix will change significantly by 1980.

New Jersey Energy Conservation Plan
Summary of Private Sector Costs and Energy Savings
($000)

Payback Period and Cost Assumptions[1]	Costs							Energy Savings			
	1977	1978	1979	1980	Total Through 1980	Annual After 1980	Total Through 1989	1977-1979[2]	1980	1981-1989[3]	Total 1977-1989
Payback by 1980											
New investment[4]	3,380	64,370	30,860	25,060	**123,670**	11,650	**228,490**	269,910	207,625	1,868,625	**2,346,160**
No new investment[5]	0	0	0	0	**0**	0	**0**	67,600	52,000	468,000	**587,600**
Payback between 1980 and 1985											
With utility financing Option 1[6]	0	108,870	108,870	100,770	**318,510**	0	**318,510**	81,090	62,375	561,375	**704,840**
With utility financing Option 2[7]	0	112,530	112,130	104,030	**328,690**	0	**328,690**	84,660	65,125	586,125	**735,910**
No payback by 1990											
With utility financing Option 1[8]	10,900	20,590	20,790	21,690	**73,970**	13,700	**197,270**	11,700	9,000	81,000	**101,700**
With utility financing Option 2[9]	10,900	11,800	12,700	13,600	**49,000**	13,600	**171,400**	10,080	7,750	69,750	**87,580**
Other[10]	–	–	–	–	**–**	–	**–**	22,260	17,125	154,125	**193,510**
Total with utility financing Option 1											
Unadjusted	14,280	193,830	160,520	147,520	**516,150**	25,350	**744,270**	452,560	348,125	3,133,725	**3,933,810**
Adjusted[11]	14,280	193,830	160,520	147,520	**516,150**	25,350	**744,270**	362,050	278,500	2,506,500	**3,147,050**
Total with utility financing Option 2											
Unadjusted	14,280	188,700	155,690	142,690	**501,360**	25,250	**728,580**	454,510	349,625	3,146,625	**3,950,760**
Adjusted	14,280	188,700	155,690	142,690	**501,360**	25,250	**728,580**	363,610	279,700	2,517,300	**3,160,610**

1 Worksheets showing calculations of private sector costs and energy savings by individual measure are found in Appendix H.
2 Assumes that total energy savings for 1977, 1978, and 1979 equal 130 percent of 1980 energy savings.
3 Assumes that energy savings in each year 1981 through 1989 will equal energy savings in 1980.
4 Includes costs and energy savings for eight measures: annual furnace inspection; individual metering in residences; thermal efficiency standards for new and renovated buildings; lighting efficiency standards for public buildings; 7-day, day-night thermostats in public buildings; improving boiler efficiency; waste oil recycling; and use of drag reduction devices on trucks.
5 Includes costs and energy savings for eight measures: water conservation code; weatherization program; tank fuel evaporation limits; right turn on red, enforcement of 55 mph speed limit; promotion of public transit; bus replacement program; and current and proposed conservation measures by utilities. There are no private sector costs for these measures since they are required by other, existing programs.
6 Includes costs and energy savings for two measures: certification of thermal efficiency in existing housing and replacement of gas pilot lights. Payback for utility financing Option 1 does not occur until after 1985.
7 Includes costs and energy savings for three measures: certification of thermal efficiency in existing housing; replacement of gas pilot lights; and financing of conservation investments by utilities, Option 2.
8 Includes costs and energy savings for two measures: expanded inspection procedures for auto emissions and financing of conservation investments by utilities, Option 1.
9 Includes costs and energy savings for one measure: expanded inspection procedures for auto emissions.
10 Includes energy savings for two measures: promotion of car pools and van pools (no private sector costs estimated) and energy-efficient procurement practices (no private sector energy costs or savings).
11 Adjusted energy savings are calculated by multiplying unadjusted figures by 0.8 to account for overlap in the conservation impact of proposed measures.

Exhibit 3-1

New Jersey Energy Conservation Plan
Costs and Benefits for Homeowners
(Dollars)

Requirement	One-Time Costs*	Annual Costs	Annual Savings
Cap insulation	325	–	94.25
Day/night thermostat	110	–	
Replacement of pilots in furnace (gas only)	100	–	25.50
All one-time actions (with gas heat)**	535	–	119.75
Furnace inspection (oil only)	–	25.00	37.00
Auto emissions inspections	–	1.80	0.00
Auto repairs to pass inspection, if required	–	30.00†	40.00
All annual actions (with oil heat and if car passes inspection)	–	26.80	37.00

* Not all homeowners will require additional insulation or have a gas furnace.
**Payback period = 4.5 years.
† Only about one-quarter of cars inspected will fail and require work to pass.

New Jersey Energy Conservation Plan
Environmental Impacts

Reduced Emissions of Water Pollutants* (tons)	
Acids	159
Bases	14
Dissolved solids, misc.	850
Suspended solids	152
Non-degradable organics	117
Biological oxygen demand	31
Chemical oxygen demand	192
Reduced Emissions of Air Pollutants (tons)	
Particulates	5,399
Nitrogen oxides	36,722
Sulfur dioxide	31,296
Hydrocarbons	216,634
Carbon monoxide	35,332
Carbon dioxide	11,245,000
Aldehydes	891
Reduced Solid Waste** (tons)	25,625
Reduced Thermal Rejection (Btu)	3,335
Reduced Occupational Casualties	
Occupational deaths (persons)	1.1
Occupational injuries (persons)	25.5
Occupational person-days lost	2,178.0

* These figures exclude 18,900 tons (5.4×10^6 gallons) waste lubricating oil which will, as a result of the plan, not be dumped into the state's waters (or land).

**Includes 210,000 tons of reduced volatile organic emissions due to tank fuel evaporation limits.

APPENDIX A

SELECTION OF THE ENERGY CONSERVATION MEASURES

SELECTION OF THE ENERGY CONSERVATION MEASURES

Of the 22 conservation measures included in the plan, 6 are required by FEA to be part of the plan, and 3 are measures the state has already implemented.* The remaining 13 measures, forming the bulk of the plan and accounting for 68 percent of the projected $278 million annual energy savings, were chosen by a project team composed of representatives of SEO, the contractor (Resource Planning Associates, Inc.), and the subcontractor (Wilbur Smith and Associates, Inc.).

In the belief that political pressures will keep U.S. energy prices below world levels through 1980, and that without a price incentive people will not voluntarily conserve energy, the project team concentrated on mandatory energy conservation measures.** Specifically, it considered only measures that could generate significant energy savings by 1980 and would be cost effective for New Jersey homeowners, building owners, and industries. That is, the measures selected had to apply to space heating systems, boilers, and other residential/commercial and industrial applications in which large amounts of energy were used and where savings could be achieved without major capital investments. Conversely, the 1980 deadline eliminated measures related to land use/transportation patterns and industrial processes, which waste considerable amounts of energy but require substantial capital and time to achieve energy savings. If the deadline for achieving energy savings had been 2000 instead of 1980, such measures would have played a much more prominent role in the plan than they do.

The 1980 deadline also restricted selection to measures that address existing building and vehicle stocks. For instance, the plan includes a measure that requires cap (roof) insulation and day/night thermostats in existing residences. In addition, the need to achieve the 5-percent energy savings target by 1980 meant that the measures selected had to be popular enough to attract widespread public and private support to ensure early implementation - i.e., by the end of 1977. For example, since it is harder to gain agreement on and political support of measures that

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* Water conservation code, weatherization program, and tank fuel evaporation limits. In addition, one of the six required measures, right turn on red, has recently been implemented in New Jersey.

** However, recognizing the importance of voluntary efforts, the project team has proposed as part of its plan, a New Jersey Energy Conservation Center to provide technical assistance and information to homeowners and industry requesting such support.

require retrofit of existing homes or buildings than on measures that address only new homes or buildings, the plan contains a utility financing measure to ease the financial burden of retrofit measures on New Jersey's homeowners and building owners.

Using these general selection criteria, the project team selected 22 energy conservation measures for inclusion in this plan. Broken out by end-user sector, these measures are:

- Residential and Commercial

  1. Certification of thermal efficiency in existing housing
  2. Annual furnace inspection
  3. Individual metering in residences
  4. Thermal efficiency standards for new and renovated buildings
  5. Lighting efficiency standards for public buildings
  6. Seven-day, day/night thermostats in public buildings
  7. Replacement of gas pilot lights
  8. Water conservation code
  9. Weatherization program

- Industrial

  10. Improving boiler efficiency
  11. Waste oil recycling
  12. Tank fuel evaporation limits

- Transportation

  13. Right turn on red
  14. Enforcement of 55-mph speed limit
  15. Expanded inspection procedure for auto emissions
  16. Promotion of car pools and van pools
  17. Promotion of public transit
  18. Bus replacement program
  19. Use of drag-reduction devices on trucks

- Utilities

  20. Current and proposed conservation measures by utilities
  21. Financing of conservation investments by utilities

- General

  22. Energy-efficient procurement practices.

In the process of selecting these measures, the project team met with representatives of almost all of the state agencies that must implement

and administer them, as well as with many of New Jersey's major employers and the utilities to gain their inputs to the plan. Indeed, the final form of many measures was shaped by comments made at these meetings. As a result, all of the measures selected are supported by the administering state agencies, and no measure was included that will not be financially attractive or at least acceptable to the private interests that must bear the costs of implementing them.

Beyond the immediate end of obtaining federal implementation funds, the plan is intended to act as a catalyst for discussion of other energy conservation measures that can contribute to conservation in 1980 and beyond.

APPENDIX B

CALCULATING ENERGY SAVINGS ESTIMATES

CALCULATING ENERGY SAVINGS ESTIMATES

All 22 energy conservation measures included in the plan save energy by reducing energy consumption of consuming units such as homes, commercial buildings, and private cars. To determine how much energy will be saved by each measure in 1980, the number of units affected by the measure in 1980 was multiplied by the annual energy savings the measure would produce in each unit. The resulting energy savings estimate covered all fuels and included the waste heat associated with electric generation. When the same consuming unit was affected by more than one measure, each measure tended to reduce the consumption of the unit as well as the amount of the energy savings that could be attributed to the other measure involved. As a result, the actual total savings are less than the sum of the savings estimates made for the individual measures.

The remainder of the appendix explains the approach taken in calculating the number of units affected by the measures, estimating the savings per consuming unit, and removing the overlap between measures affecting the same consuming unit.

CALCULATING NUMBER OF UNITS AFFECTED

The number of units affected by each of the measures in 1980 depends on the number of existing units and the number that will be added to and subtracted from this stock by 1980.* It also depends on how fast the measure will penetrate the existing units and those that will be built between the assumed date of implementation and the end of 1980. This in turn depends on whether the measure affects the existing stock of units, only new additions to stock, or both. Penetration also depends on the difficulty of the alterations called for by the measure, and on whether financial incentives are offered.

When the number of units affected changed during 1980, the number affected by the end of 1979 had to be estimated (the units affected

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* Estimates of 1980 units were based on extensive research conducted in the state and on conversations with knowledgeable private and government sources. The data sources used are cited in the measure descriptions in Appendixes C through G. If state-specific data sources could not be used, national sources were employed. The major national source of data was the Handbook for State Energy Conservation Plans (Volume 2 of the sourcebook), prepared by FEA.

before 1980 will generate savings during all of 1980) and added to a separate estimate of the number of units that will be affected in 1980 and generate savings in that year (units affected in 1980 will, on the average, generate savings for only half of the year). To simplify the calculations, only units affected by July 1, 1980 were included in the calculations, and these units were assumed to generate savings for the full calendar year.

Finally, the procedure for calculating the number of units affected by the utility financing measure varied slightly from that used for the other measures because the measure itself does not directly affect consuming units; rather, it generates savings because it encourages building owners to comply with other, mandatory energy conservation measures sooner than they would without such as incentive. This increases the percentage of consuming units affected before 1980, thereby increasing the savings associated with these measures.

CALCULATING PER-UNIT ENERGY SAVINGS

The second major component of the energy savings calculation is the estimate of energy saved per affected unit. By their nature, these numbers are more independent of state conditions, thereby allowing the use of various state and national data sources. In some cases, the per-unit savings are expressed directly as a number of Btu per year. More often, the savings are expressed as a percentage of the unit's present annual or seasonal usage. In these cases, it was necessary to develop data on consumption by unit, and multiply them by the percentage savings to arrive at per-unit savings. In many instances, consumption data were taken from the FEA handbook or other national sources.

REMOVING OVERLAP BETWEEN ENERGY SAVINGS ESTIMATES

An energy savings estimate was developed for each measure. Where more than one measure affected the same consuming unit, some double counting of energy savings occurred and the total savings generated by the plan were exaggerated. For instance, if each of two measures lowers space heating energy use in a house by 20 percent, the total savings from both measures is not 40 percent but 36 percent. Thus, each measure, individually, would generate more savings if the other were not implemented.

The potentially misleading results of this double counting of energy savings (i.e., inflated energy savings figures) were minimized as much as possible. For instance, where a range of values could be chosen for number of units affected in 1980, for example, the more conservative choice was usually made. Moreover, within a measure, such as the certification of thermal efficiency in existing residences, double counting was considered explicitly in calculating the savings.

Even with these precautions, some double counting did occur, especially in the residential/commercial and transportation sectors where interaction of the measures is the greatest. Although it is impossible to estimate exactly the magnitude of this double counting, perhaps as much as 20 percent of the gross 139 trillion Btu estimated for the 22 measures may be overlap. Thus, implementation of these measures will probably save only 110 trillion Btu instead of 139 trillion Btu (6 percent of 1980 projected consumption).

No attempt was made to reduce the savings estimate developed for each measure to account for this double counting; it cannot be done consistently, and it was not necessary for the plan. The original savings estimates are sufficient to calculate what percentage of total savings each measure will achieve.

APPENDIX C

NEW JERSEY ENERGY CONSERVATION PLAN
RESIDENTIAL AND COMMERCIAL MEASURES

CERTIFICATION OF THERMAL EFFICIENCY IN EXISTING HOUSING

PROGRAM MEASURE

In 1972, the residential sector used more than 25 percent of all the energy consumed in New Jersey. Of this, residential space heating accounted for 60 percent and air conditioning accounted for 2 percent (a figure that is rapidly growing).*

This measure will require that thermal-efficiency equipment be installed by specified dates in residential buildings (excluding mobile homes) that were built or renovated before 1978 and that remain in the housing stock at the end of 1980.** Single-family, low-density, and low-rise dwellings must install two types of weatherization equipment, if that equipment is not already in place: (1) an automatic day/night thermometer in each unit (or units), and (2) sufficient "cap" or attic insulation to meet minimum Federal Housing Authority standards for New Jersey, or such maximum levels as are possible for individual dwellings.

Weatherization equipment that will be required for high-rise residential units will include automatic day-night thermostats. Since the design characteristics of high-rise dwellings are such that cap insulation improvement is often impossible or does not offer significant savings to all units, other equipment, such as HVAC (heating, ventilating, and air conditioning) controls, will be emphasized.

Legislation will establish mandatory deadlines for compliance for each housing type. Multi-family dwellings of three or more units will be required to have the equipment in place by the first 5-year health and safety inspection subsequent to January 1, 1978. Single-family dwellings, both attached and unattached units, and two-family homes must comply at the first time of sale subsequent to January 1, 1978. Inspection by an authorized energy-efficiency expert **or** a statement certifying compliance will be compulsory.

Total energy savings from this measure are projected at 18.1 trillion Btu in 1980, or $45.3 million.

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* Source: New Jersey Task Force on Energy, Energy: A Report to the Governor of New Jersey, May 1974.

** All units constructed or renovated between 1978 and 1980 will be required to meet the energy-efficiency standards outlined by the ASHRAE 90-75 standard which New Jersey has adopted in the new State Uniform Building Code. This standard is required by the measure entitled "Thermal Efficiency Standards for New and Renovated Buildings" (see p. C-30).

IMPLEMENTATION APPROACH

Detailed Provisions

This program will require that all residential buildings be retrofitted with specified thermal-efficiency equipment. To assist owners, a copy of the new legal requirements and deadlines, as well as informational materials, will be sent to all residential building owners no later than September 30, 1977. The material will include information on insulation, fuel savings, measuring heat gains/losses, and other pertinent topics. A list of organizations that can assist owners on specific questions or requests will also be provided. This list will include the names, addresses, and phone numbers of contacts at local city halls, chambers of commerce, and engineering firms.

Under current New Jersey regulations, dwellings of three or more units undergo a systematic inspection every 5 years by local building inspectors. The code requirements will be amended to include thermal-efficiency standards on the list of regulations to be checked at the time of inspection.

All one- and two-family residential units will be required to pass an energy-efficiency examination at the time of sale, subsequent to January 1, 1978. A certificate of compliance with the standards must be delivered to the buyer at the time of closing on the property. It will be the duty of the seller to find an authorized inspector to perform the examination. A copy of the certificate of compliance must be forwarded by the seller's lawyer to the State Energy Office (SEO) and attached to the closing papers filed at the registry of deeds.

A system of appeals will be established to enable homeowners to file complaints concerning compliance deadlines, weatherization difficulties, and other problems.

Implementing and Administering Organizations

The New Jersey State Energy Office will establish the guidelines for this measure, including specific standards for installing equipment in each housing type.

The Department of Community Affairs (DCA), in consultation with SEO, will develop and publish the educational materials to be sent to homeowners, as well as draw up the lists of local organizations that will assist homeowners with specific questions.

DCA will send information pamphlets explaining the program to all homeowners in the fall of 1977. The electric utilities will distribute the pamphlets with their electric bills. Envelopes of bills containing the pamphlets will be appropriately labelled to ensure homeowner awareness of the material enclosed. DCA will also mail informational materials concerning

mandatory compliance to all real estate firms and agencies in the state, and, to ensure easy access for homeowners, will send certificate of compliance forms to real estate firms, municipal town halls, registries of deeds, and local attorneys.

DCA Bureau of Housing Inspection will continue to regulate the inspection of multi-family units by local building inspectors. DCA inspectors will periodically accompany local inspectors during routine residential examinations on a spot-check basis. State inspectors will also conduct energy-efficiency analyses on residences where homeowners file complaints concerning the required standards.

In addition, DCA will establish procedures to be carried out on the local level for the inspection of single-family and two-family homes at the time of sale. This will involve developing a training program for state and local housing inspectors to teach them the new thermal-efficiency inspection techniques. To expand the list of qualified experts who can inspect homes at the time of sale, the training sessions will also be open to local contractors, private engineering firms, and community officials. DCA will prepare and administer an examination to all participants in the training programs and draw up a list, to be included with the information package, of the names and addresses of qualified inspectors.

Finally, DCA will review and rule on all requests for exemption from the regulations concerning multi-family units. Officials from municipal and county boards of construction will handle appeals and complaints from owners of single- and two-family homes.

Legal Mechanisms

Enabling legislation must be passed granting SEO the power to require that thermal-efficiency standards be met in existing residential dwelling units.

DCA Bureau of Housing Inspection currently has jurisdiction over multi-family dwelling units and hotels. DCA inspects multi-family units every 5 years for compliance with health, safety, and maintenance codes. The new legislation will add an energy-efficiency code to this general welfare standard.

Currently, there is no mandatory state health or safety inspection at the time of residential sale. Legislation will be needed to establish compliance with thermal-efficiency standards as a condition of sale for one- and two-family dwellings. Under the Uniform Building Code, local boards of construction are already empowered to review and rule on citizen appeals, and this power can be expanded to include appeals on the thermal-efficiency standards.

Implementation Plan and Schedule

The requirements for certification of thermal-efficiency standards in existing residences will become effective on January 1, 1978. To ensure homeowner understanding of the standards, all educational materials will be disseminated by September 30, 1977. Training programs for inspectors will commence immediately after this. (See Exhibit C-1 for the implementation plan and schedule.)

Monitoring System

For multi-family units, no monitoring system is necessary, unless DCA reports a significant percentage of violations in its regular inspections. In the absence of this, SEO will assume that 20 percent of the units in multi-family buildings will comply each year after the measure is implemented.

For single-family and two-family houses, SEO will monitor savings from the measure based on the certificates of compliance received from the sale of homes. The certificate will specify the date of sale and the date that thermal-efficiency equipment was installed. Actual energy savings are calculated by multiplying the average annual energy savings per unit times the number of certificates that specify installation after January 1978.

Related Measures

Other proposed conservation measures in the New Jersey plan will contribute to the decline of energy consumption in the residential sector. Measures that require annual inspection and maintenance for boilers and heating systems, for instance, will greatly contribute to thermal efficiency in many residential buildings.

EXPECTED ENERGY SAVINGS

Methodology

Savings that can be attributed to the thermal-efficiency measure are a function of:

- The number of residential dwelling units in New Jersey in 1980 covered by the measure
- The annual residential unit demand for heating and cooling expected in 1980
- The anticipated energy savings as a result of weatherization equipment
- The percentage of housing that will be retrofitted by 1980 under this measure.

Certification of Thermal Efficiency in Existing Housing
Implementation Schedule

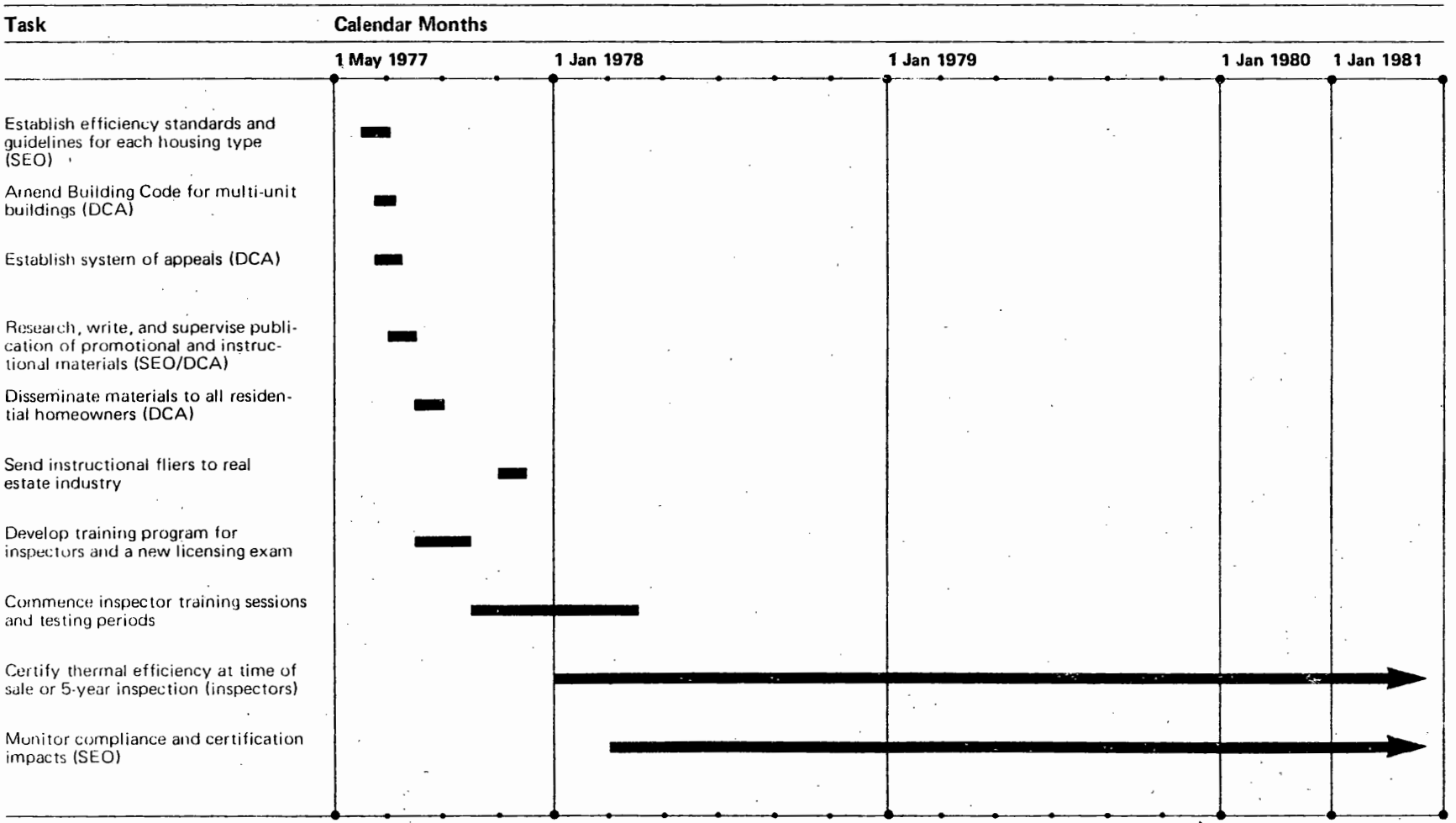

Exhibit C–1

The calculations and assumptions used to determine these figures are discussed below.

The number of residential dwelling units in 1980. The residential stock for each housing type in 1980 was calculated by taking the number of 1970 units and adding the number of additions for 1971 through 1977, then subtracting removals for 1971 through June 30, 1980, and renovations for 1978 through June 30, 1980 (see Table 1).

TABLE 1: CALCULATION OF RESIDENTIAL DWELLING UNITS IN 1980

Housing Type	1970 Units	+ Additions*	- Removals*	- Renovations*	= 1980 Total
Single-family	1,152,670	226,800	55,081	7,248	1,317,141
Low-density**	674,606	120,687	163,790	21,553	609,950
Low-rise**	206,294	78,820	18,772	2,470	263,922
High-rise**	331,227	55,650	66,016	8,688	312,173

* All projections of change (additions, removals, renovations) in the New Jersey housing stock were based on data for the Northeast region of the United States. These were multiplied by a population share factor of 14.82 percent to obtain estimates for New Jersey.

** Low-density is defined as single-family attached units and 2-4 unit dwellings; low-rise is defined as 5 or more units, 3 or less stories; high-rise is defined as 5 or more units, more than 3 stories.

Sources: U.S. Federal Energy Administration, State Energy Conservation Program: Sourcebook, Vol. 2, Tables IVA, IVB, p. 44, 1976.

U.S. Federal Energy Administration, Project Independence Blueprint, "Residential and Commercial Energy Use Patterns, 1970-1990," November 1974, Table 2.6, p. 56.

It was assumed that all new and renovated units after year-end 1977 will be required to meet the ASHRAE 90-75 thermal-efficiency standards for new construction. Since these savings are included under the savings for thermal-efficiency standards for new and renovated buildings, they were omitted here.

Mid-year 1980 was selected as a cut-off point for the calculations to account for the fact that units retrofitted in 1980 generate savings on the average for only half the year. Retrofits that occur in 1978 or 1979 will generate a full year of savings in 1980.

To derive the percentage of total units affected by the measure (see Table 2), it was assumed that between January 1, 1978, and July 1, 1980, 50 percent of multi-family dwellings (three or more units) will be subject to the 5-year health and safety inspection. Included in this category are low-rise dwellings (five or more units, three or less stories) and high-rise dwellings (five or more units, more than three stories). In addition, it was assumed that 40 percent of low-density housing (single-family attached units and 2-4 unit dwellings), will have three or more units, and thus will be subject to the inspection.

Single-family dwellings will be subject to certification at the time of sale. According to a recent study of national population trends,† 30 percent of the U.S. population moves during a 3-year period. This agrees closely with U.S. census data from 1970-1973 showing 36 percent of the U.S. population moved over a 3-year period. It was, therefore, assumed that the 30 percent/3-year rate was representative.

Between January 1, 1978, and June 30, 1980, 83.3 percent of the normal 3-year turnover will occur $\frac{2\text{-}1/2 \text{ years}}{3 \text{ years}}$. Therefore, 25 percent (.30 x .83) of single-family unattached and attached units will be turned over to new owners.

In addition, it was assumed that of the low-density category, one-third of the multi-unit dwellings, or 120,770 units, are two-family houses, and that the turnover rate of these units is equal to that for single-family homes. Therefore, 25 percent will be sold between 1978 and July 1, 1980.

TABLE 2: NUMBER OF UNITS SUBJECT TO THERMAL-EFFICIENCY MEASURE

Housing Type	Total Number of of Units 1980*	Percent of Units Subject to Measure	Number of Units Subject to Measure
Single-family: unattached	1,317,141	25	329,285
Low-density			
Single-family: attached	243,980	25	60,995
2 Units	120,770	25	30,193
3-4 Units	245,200	50	122,600
Low-rise	263,922	50	131,961
High-rise	312,173	50	156,087

* See Table 1, p. C-6.

† Illinois Department of Business and Economic Development, Illinois Conservation Feasibility Report (FEA/PL--94-163), May 1976, p. 198.

Annual residential unit demand. Space heating and cooling demands for each type of dwelling unit in 1980 (see Table 3) were based on regional demand calculations adjusted by FEA correction factors for weather differences. In the case of New Jersey, the heating correction factor is 0.93 and the cooling correction factor is 2.38.

TABLE 3: UNIT DEMAND FOR HEATING AND COOLING IN 1980

Housing Type	Number of Units Subject to Measure*	Annual Space Heating Requirement per Unit (10^6 Btu)	Annual Cooling Requirement per Unit (10^6 Btu)	Total Annual Demand (10^{12} Btu)	Percent of Total
Single-family: unattached	329,285	206.4	6.6	70.2	54
Low-density					
Single-family: attached	60,995	144.6	5.3	9.1	7
2 Units	30,193	144.6	5.3	4.5	3
3-4 Units	122,600	144.6	5.3	18.3	14
Low-rise	131,961	94.9	4.7	13.1	10
High-rise	156,087	87.6	4.5	14.4	11

* See Table 2, p. C-7.

Anticipated energy savings as a result of weatherization equipment. Studies of residential heat loss/gain and thermal-efficiency equipment show that the potential for savings varies widely depending on the type of construction material, size and design of building, number of stories, and heating system. Therefore, lacking a state survey of building characteristics and heat loss/gain experiments using various types of materials, it is difficult to estimate potential savings.

However, using assumptions based on the research that has been done, an estimate of savings is possible (see Table 4). For single-family units, the effects of "cap" or attic insulation have been well documented in several studies. Energy savings calculated in FEA's Project Independence Blueprint ("Residential and Commercial Energy Use Patterns, 1970-1990," p. 12) show 11.4 percent in a New England region, one-story home. A National Petroleum Council document (Energy Conservation in the U.S.: Short-Term Potential 1974-78, March 1974, p. 46) estimates a savings of 18-24 percent, depending

on total heat loss assumptions. The Federal Power Commission, Office of Energy Systems (Measures for Reducing Energy Consumption for Homeowners and Renters, March 1975), calculates a savings of 10-36 percent for space heating. Out of these estimates, a 15 percent energy savings is considered the most reasonable.

TABLE 4: SAVINGS FROM WEATHERIZATION EQUIPMENT

Housing Type and Equipment	Percent of Energy Saved Heating	Cooling	Percent of Housing Stock with Opportunity for Savings	New Percent of Savings Possible Heating	Cooling	Net Percent of Savings Factored for Overlap Heating	Cooling
Single-family:							
CAP insulation	15.00	5.00	44	6.6	2.2		
D/N thermostat*	10.00	N/A	100	10.0	N/A		
Total						16.0	2.2
Low-density:							
CAP insulation	7.50	2.50	60	4.5	1.5		
D/N thermostat*	10.00	N/A	100	10.0	N/A		
Total						14.1	1.5
Low-rise:							
CAP insulation	3.75	1.25	50	1.9	0.6		
D/N thermostat*	10.00	N/A	100	10.0	N/A		
Total						11.7	0.6
High-rise:							
CAP insulation	N/A	N/A	N/A	N/A	N/A		
D/N thermostat*	10.00	N/A	100	10.0	N/A		
Total						10.0	N/A

* D/N thermostat ($8^{o}\Delta$).

The Federal Power Commission source sets out a maximum cooling savings of 10 percent for a single-family dwelling, depending on climate, etc. A conservative 5 percent savings was selected for this analysis.

For low-density and low- and high-rise buildings, certain design characteristics reduce heat loss through the roof. Thus, the potential for savings will be lower than that in single-family homes. It is estimated

that low-density units receive 50 percent of the benefit of the single-family home on average, and low-rise (i.e., garden apartment units) receive 25 percent. Further, it is assumed that cap insulation improvement does not apply to high-rise units. No estimate of potential savings from HVAC controls or other insulation installation in high-rise units has been included in this calculation.

With respect to the day-night thermostat, the estimate for single-family unattached homes has also been documented,* and the possible effects on other housing types were assumed to be the same. Since the majority of units do not have central air conditioning, it is further assumed that the setback effect will have an impact only during the heating season.

Percentage of housing with opportunity for this savings. Not all units subject to the measure will be affected by it, since some already have insulation and other thermal-efficiency equipment. Precise data on the percent of housing that will be affected is not available due to lack of research on the amount of energy-efficiency equipment that now exists in the the housing stock. However, given certain assumptions, it is possible to estimate the percent of each type of housing stock that has the opportunity for savings (see Table 4).

Research on attics in unattached single-family units shows 44 percent are available for insulation.** Based on the fact that low-rise and low-density units are often rented, rather than owner-occupied, it is assumed that a greater percent of these units are not insulated and that 60 percent are available for insulation under this measure. A portion of the low-rise units have less accessible attics and, therefore, the available stock has been factored down 50 percent.

It is assumed that none of the existing housing stock is equipped with day-night thermostats; thus, 100 percent can benefit from retrofit of this equipment.

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* Technology and Economics, Inc., Cost-Effective Methods to Effect Heating and Cooling Energy Requirements of Existing Single-Family Residences, February 1975, p. 75.

** National Home Builders Association study shows 77 percent of owner-occupied N.E. homes having accessible attics; of these, 26 percent had little or no insulation and 34 percent had 2" to 3" of attic insulation. This suggests that 44 percent need insulation and have accessible attics.

The energy savings from cap insulation and the day-night thermostat will overlap in a given unit. Thus, a heat transfer equation was used to calculate net savings (Table 4, final column). The calculations were as follows:

Where WS = Winter Savings

SS = Summer Savings

AI = Attic Insulation Savings

TD = Thermostat Decrease Savings

TI = Thermostat Increase Savings

$$WS = TD\% + AI(1 - TD)\%$$

$$SS = TI\% + AI(1 - TI)\%.*$$

Calculation of Energy Savings

Total savings (see Table 5) were calculated as follows:

> Number of units in housing stock subject to measure times energy demand per unit, times energy savings (%) from thermal equipment, times potential coverage (%).

Total projected energy savings for 1980 are 18.1 trillion Btu.

TABLE 5: SAVINGS FROM THERMAL-EFFICIENCY MEASURE

Housing Type	Number of Units Subject to Measure	Total Heating Demand (10^{12} Btu)	Percent of Heating Savings	Total Cooling Demand (10^{12} Btu)	Percent of Cooling Savings	Total Savings (10^{12} Btu)	Percent of Total Savings
Single-family: unattached	329,285	68.0	16.0	2.2	2.2	10.9	60
Low-density:							
Single-family: attached	60,995	8.8	14.1	0.3	1.5	1.2	7
2 Units	30,193	4.3	14.1	0.2	1.5	0.6	3
3-4 Units	122,600	17.7	14.1	0.6	1.5	2.5	14
Low-rise	131,961	12.5	11.7	0.6	0.6	1.5	8
High-rise	156,087	13.7	10.0	0.7	N/A	1.4	8
Total						18.1	100

* U.S. Federal Energy Administration, State Energy Conservation Program: Methodologies for Estimated Energy Savings, prepared by Stanford Research Institute, 1976.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

Personnel requirements to implement this measure will be heaviest during the last half of 1977. During this period, SEO will have two men working full-time for 1.5 months on developing the standards and guidelines, and one man working half-time for 5 months as a liaison with the public and DCA on the program. DCA will need three men working full-time on the educational packages, training program materials, and lists of local and municipal assistance for homeowners. DCA staff will also prepare information packets for county registries of deed and local real estate agencies concerning mandatory inspection for energy efficiency equipment that will apply to all one- and two-family dwellings at the time of sale.

During 1977, DCA will also provide three full-time instructors to administer training programs to municipal building inspectors on the new thermal-efficiency inspection techniques. DCA may be able to integrate training programs for this measure with others for local building inspectors that will be required by the new thermal and lighting standards for new and renovated buildings. For example, sessions concerning new lighting standards could incorporate information on weatherization equipment and thereby reduce the costs listed here for training personnel.

All personnel requirements drop substantially in 1978, 1979, and 1980. DCA training programs will be offered approximately once a week for the first half of 1978 only. Total personnel costs will be $91,250 (see Exhibit C-2 for manpower requirements and costs).

Equipment costs incurred during 1977 will be expenditures connected with the development of brochures, educational materials, teaching manuals and examinations, and notices to the real estate industry and other organizations. These are largely one-time costs involving printing and publication fees. During 1978 through 1980, these costs will be limited to revision and reprinting charges.

Public utility companies will mail the initial instructional materials to homeowners in the fall of 1977.

Total implementing and administering costs for 1977 will be $314,357. In the 3 years following, the cost will be slightly over $30,000 annually (see Exhibit C-3).

Costs to the Private Sector

The costs to the private sector will be $246.5 million through 1980 (see Exhibit C-4). It is assumed that no additional financial incentives would be involved that would encourage homeowners to install weatherization equipment earlier than they would to pass the required "time of sale" or standard welfare inspections. Therefore, it is assumed that equal expenditures are made in each of the 3 years. The cost for the period is $82.2 million annually.

Certification of Thermal Efficiency in Existing Housing
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Develop standards and guidelines; assist with educational information development; monitor program	1977	3 staff	0.450	SEO	15,000	6,875
Develop instructional materials for homeowners and training materials for inspectors; inform real estate agencies and registries of deeds of requirements	1977	3 staff	1.500	DCA	15,000	22,500
Administer training programs; give exams; issue licenses	1977	3 instructors	0.250	DCA	15,000	3,750
Monitor compliance and certification impacts	1978-1980	1 staff	0.250	SEO	15,000	3,750
Administer certification program	1978-1980	1 staff	1.000	DCA	15,000	15,000
Administer training programs; give exams; issue licenses	1978	1 instructor	0.125	DCA	15,000	1,875
Annual cost	1977					33,125
	1978					20,625
	1979					18,750
	1980					18,750
Total cost						**91,250**

Certification of Thermal Efficiency in Existing Housing
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Year				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	33,125	20,625	18,750	18,750	91,250
Fringe benefits (.21 x personnel)	6,956	4,331	3,938	3,938	19,163
Travel*	182	110			292
Equipment**	262,500	1,000	1,000	1,000	265,500
Supplies					
Contractual					
Construction					
Other					
Subtotal	302,763	26,066	23,688	23,688	376,205
Indirect charges (.35 x personnel)	11,594	7,219	6,563	6,563	31,939
Total	**314,357**	**33,285**	**30,251**	**30,251**	**408,144**

* Assumes mileage for travel by DCA instructors will average 20 miles per day at $0.14 per mile.
**Includes educational materials, training program packages, and examinations.

Certification of Thermal Efficiency in Existing Housing
Summary of Costs to Private Sector
($ millions)

Type of Cost	1977	1978	1979	1980	Total
Inspectors at time of sale*	–	1.62	1.62	1.62	4.86
Day/night thermostat**	–	36.67	36.67	36.67	110.01
Cap insulation†	–	43.88	43.88	43.88	131.64
Total	**–**	**82.17**	**82.17**	**82.17**	**246.51**

* Assumes a cost of approximately $10 per visit at each 1-2 family home at time of sale and includes cost of certification statement.

**Assumes cost of $110 per unit, including labor, in 1979$.

† Assumes cost of $325 per unit, including labor, in 1979$.

If the New Jersey SEO institutes a program of tax incentives, low-interest loans, or other financial mechanisms to assist homeowners in retrofitting efforts, the timing of compliance would be advanced and the flow of expenditures altered.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

Environmental benefits will result from implementation of the residential "retrofit" measure since increasing thermal efficiency in homes will decrease overall fuel consumption. As the amount of fuel oil that is burned for home heating is decreased, so will levels of air-polluting emissions. Also, conservation of natural gas by the residential sector will help to alleviate the need for new gas supplies.

Potential negative environmental impacts from this measure include discomfort and possible health problems, particularly among the very young and the very elderly, caused by nighttime temperature reductions to the 60°F level. Also, extreme care must be taken by the do-it-yourself home insulator so that asbestos and fiberglass particles associated with certain types of attic insulation are not inhaled or used in such manner as to cause skin irritations or abrasions.

Positive socioeconomic benefits will result from increased awareness of the impact of energy conservation planning as homeowners experience savings in their home heating and cooling bills. Individuals may be encouraged to undertake additional weatherization steps in their residences, encourage participation in conservation measures in their commercial, community, and industrial enterprises, and undertake steps to conserve fuel in other areas, for example, recycling used oil from automobiles.

Local socioeconomic benefits could include employment opportunities associated with the manufacture and installation of insulation and thermostats.

ANNUAL FURNACE INSPECTION

PROGRAM MEASURE

This measure will require the annual inspection and adjustment of all oil-fired heating systems in homes, commercial buildings, and schools to meet state efficiency standards.

Energy savings in 1980 are estimated to be 15.4 trillion Btu, or $38.5 millic

IMPLEMENTATION APPROACH

Detailed Provisions

The measure will require the annual inspection and certification of all oil-fired residential and commercial furnaces and boilers. The inspections, adjustments, and certification will generally be carried out by oil distributers and retailers as part of their service contracts with building owners, although other technicians may also offer the service. Building owners will be responsible for seeing that certification is carried out. After a certain date, oil dealers will be required to stop fuel deliveries for uncertified equipment.

The New Jersey State Energy Office (SEO) will promulgate regulations specifying minimum equipment efficiencies for heating systems. The regulations will require a minimum combustion-side efficiency of 72 percent. Above this, rather than specific targets, a range of efficiencies will be established for each type of burner. This is to prevent situations where fixed targets might provide the incentive for technicians to adjust burners for maximum short-run efficiency at the expense of long-run performance over the heating season.

The regulations will specify the adjustments that should be made to boilers and furnaces to reach these efficiencies. The adjustments will be determined by the type of burner and by the results of measurements taken by the technician of stack temperature, CO_2, smoke, and draft. The regulations will specify that no adjustment is to increase the smoke output of the unit. The regulations will also specify the conditions under which the unit is to be tested (i.e., steady state), and the manner in which measuring instruments are to be applied to the unit.

If a boiler or furnace cannot be tuned up to the range of efficiencies, modifications and replacements will be required to improve the performance of the unit. These will be specified for each type of furnace.

When the tune-up is completed and the furnace or boiler is in compliance with the regulations, the technican will affix a certificate to the unit specifying his company, his name, the date, and the unit efficiencies before and after tune up.

To enforce the regulations, state inspectors will spot-check heating systems in commercial buildings, homes, and schools early in the heating season to ascertain the accuracy of efficiency measurements entered on the certificates and to assess whether the units were actually adjusted to the most practical efficiencies. The state will have the right to require additional adjustments by technicians (at no cost to owners) wherever efficiencies are found to be unsatisfactory.

As part of this program, SEO will investigate the possibility of attaching a low-cost bimetallic temperature sensor to the furnace following tune-up. This sensor would indicate when the stack temperature reaches a level sufficiently above the level when tuned-up, thus alerting the building owner to a loss in efficiency.*

SEO will conduct a training program for furnace technicians to teach them how to perform the measurements and tune-up adjustments required by the regulations. The program will consist of a number of workshops sponsored jointly by the SEO and the New Jersey Fuel Merchants Association. The workshops will be held periodically from late 1977 through 1978. Announcements and educational materials will also be prepared and mailed to oil companies to inform them of the program.

SEO will make a special effort to help schools comply with this measure, providing technical assistance to school officials and custodians. In addition, a means will be provided, probably through federal grants, to aid the poor in meeting expenses as a result of the regulations.

Natural gas heating systems are not included in the annual inspection and adjustment program because the savings resulting from annual inspection would not justify the costs to building owners. To capture conservation potential in gas heating systems, as well as additional savings in oil systems, SEO will also develop a supplemental retrofit program to go with the annual inspection and adjustment program.

The objectives of the supplemental retrofit program will be:

- To reduce the firing rate of all heating systems to minimum acceptable rates for maintaining 68°F interior temperatures during the winter heating season
- To eliminate or reduce stack draft losses during periods when the burner is not firing.

These objectives will be achieved by installing gas orifice and flue restrictors and automatic damper controls in gas and oil furnaces. This will be a one-time installation, with no requirements for inspections or adjustments in subsequent years other than those carried out under the ongoing annual inspection and adjustment program.

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* The concept of bimetallic sensors was suggested by Charles Bowser of the Massachusetts Energy Policy Office.

SEO will not initiate this program until it determines that:

- Commercially available gas orifice and flue restrictors and automatic damper controls are safe, reliable, and efficient
- The gas and oil industries are prepared to make the necessary installations
- Other retrofits to reduce heating system loads, such as the installation of cap insulation and thermostats, have been sufficiently implemented.

Since this program would not go into effect until after 1980, it is not included in the energy savings calculations.

Energy savings from retrofit installation of orifice and flue restrictors on residential gas heating systems would be between 15 percent and 25 percent of total consumption.* For oil-fired systems, field tests of reduced firing rates in well-maintained residential burners show savings averaging 14 percent.**

Implementing and Administering Organizations

This measure will be implemented and administered by the SEO. The regulations and implementation approach will be worked out in cooperation with the New Jersey Fuel Marketers Association.

Legal Mechanisms

Legislation will be necessary to: 1) require that home and commercial building owners have their oil heating systems inspected and adjusted once a year; 2) prohibit oil companies from supplying oil to uncertified units; and 3) empower SEO to issue and enforce efficiency regulations.

Implementation Plan and Schedule

The following state actions must be taken to implement the plan:

- Enact legislation
- Promulgate regulations
- Notify building owners and oil companies of the program

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* Source: U.S. Federal Energy Administration, Conservation Investments by Gas Utilities be Considered A Gas Supply Option (Preliminary Analysis), 1977, p. 8.

** National Bureau of Standards, A Study to Evaluate the Effect of Reducing Firing Rates on Residential Oil Burner Installations, 1977, p. iii.

- Train technicians
- Monitor energy savings based on unit efficiency information
- Spot-check homes and commercial buildings.

The implementation schedule (see Exhibit C-5) assumes that certification will begin in winter 1978-1979.

Monitoring System

SEO will monitor the savings that are achieved by this measure by analyzing data on furnace and boiler efficiencies provided by the oil companies. The companies performing the tune-ups will be required to compile data on the units they certify, including:

- Combustion efficiencies before and after tune-up
- Annual amount of fuel consumed
- Equipment replacements required.

The data will be broken down by burner and furnace type, and perhaps by town or county. The oil companies will be required to report this information to SEO once a year.

EXPECTED ENERGY SAVINGS

The energy savings from the measure depend on the percentage of oil-fired furnaces and boilers that would not have met the standards without the measure. For these units, the savings will differ according to whether or not the unit needs a new burner to meet the standard. Estimates for all of these percentages are based on discussions with representatives from heating system manufacturing and maintenance industries, and with persons responsible for research studies in this area.*

Based on these discussions, it is estimated that, due to rising fuel prices and voluntary conservation steps, 50 percent of New Jersey's oil-fired furnaces and boilers will achieve the efficiency standards by 1980 whether the measure is implemented or not. No savings can be claimed for these units.

For the other units, 40 percent of the total number of units will meet the standard through tune-ups alone (no equipment replacement). In each of these

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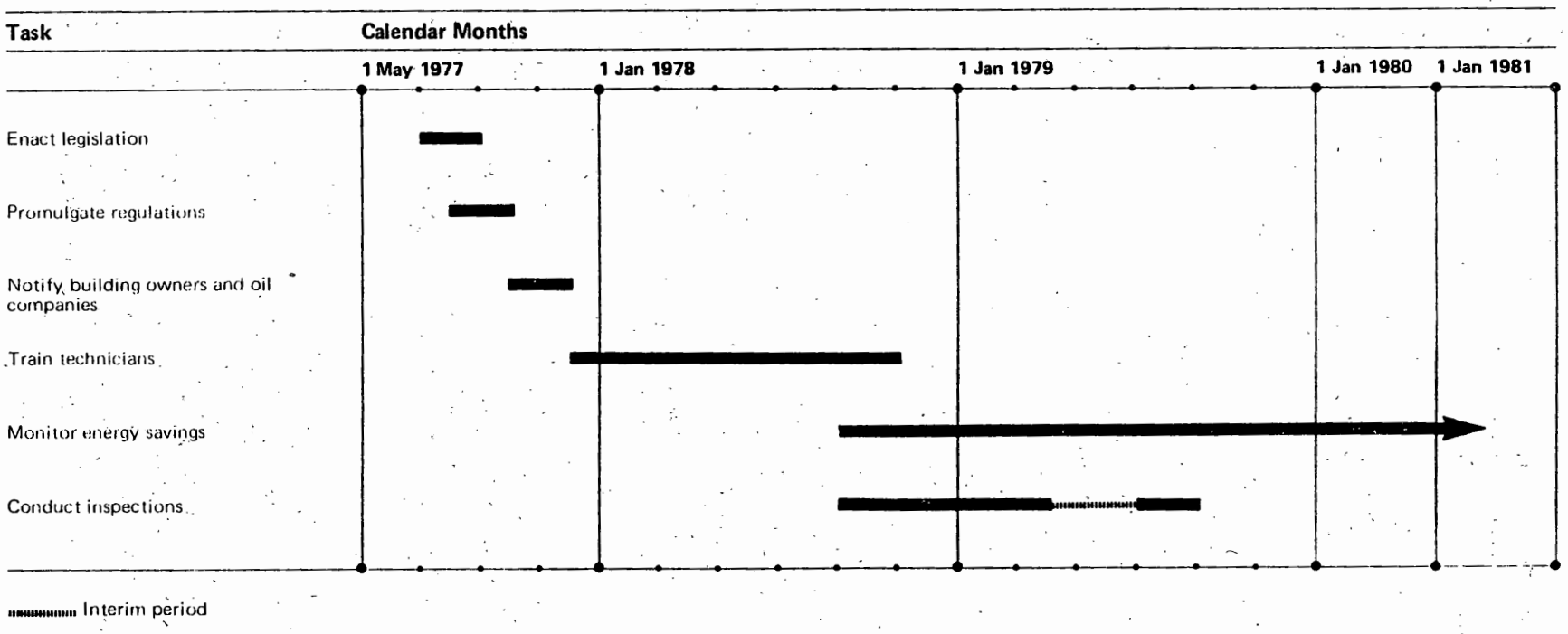
* Conversations with Larry Katzman of Walden Research, Robert Giammar of Battelle Memorial Institute, Robert Hall of the U.S. Environmental Protection Agency, Robert Chitty of the Cleaver Brooks Company, William Axtman of the American Boiler Manufacturers Association, Mike Golas of the Fuel Merchants Association of New Jersey, Stan Sherman of the New England Fuel Institute, and Mr. Bass of the New York City Department of Air Resources.

Annual Furnace Inspection
Implementation Schedule



units, the tune-up will reduce energy usage by 6 percent. The remaining 10 percent of the units will require burner replacement to meet the standards. Where a burner must be replaced, the unit will be 14 percent more efficient.

The energy savings are calculated by applying these percentages to New Jersey's predicted 1980 oil consumption for residential and commercial space heating without the measure, which is roughly 406.5 trillion Btu.* The savings calculations are:

$$\text{Energy savings} = [(.40)(.06) + (.10)(.14)]\ 406.5 \times 10^{12}\ \text{Btu}$$
$$= 15.4 \times 10^{12}\ \text{Btu}.$$

The energy savings figure is conservative since the estimate of potential savings in residential buildings was applied to all buildings, both residential and commercial. Commercial heating plants may offer greater savings potential per unit.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

Personnel requirements and costs for this measure (see Exhibit C-6) will include five SEO inspectors, assuming that 10 percent of the commercial systems and 1 percent of the residential systems will be checked for efficiency each year, and that one inspector can check 15 residential or 10 commercial systems in a day. In addition, SEO will have two administrative staff members, a special technician to assist the schools in complying with the measure, and an attorney working .10 of a man year annually. Total personnel costs will be $40,300 for 1977 and $88,550 annually for 1978-1980.

Travel costs will amount to $3,010 in 1977 and $8,400 for 1978-1980 if the inspectors and the school technician each cover an average of 10,000 miles at $.14 per mile. One-time costs for combustion efficiency testing equipment will be approximately $2,000. Total costs for the measure will be $507,489 (see Exhibit C-7).

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* Estimates of oil space heating in residences is based on 1980 residential figures as calculated in the program measure entitled "Certification of Thermal Efficiency in Existing Housing" (see p. C-1). The percentage of those units heated by oil was estimated to be 66 percent, based on data for the Northeast region contained in U.S. Federal Energy Administration's Project Independence, "Residential and Commercial Energy Use Patterns 1970-1990," November 1975. Figures for oil space heating in commercial buildings are contained in the program measure entitled "Seven-Day, Day-Night Thermostats in Public Buildings" (see p. C-65).

Annual Furnace Inspection
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Program management	1977	2 administrative staff	1.00	SEO	14,500	14,500
Assist schools with compliance	1977	1 technician	0.50	SEO	15,000	7,500
Inspect heating systems	1977	5 inspectors	1.65	SEO	10,000	16,500
Provide legal advice	1977	1 attorney	0.10	SEO	18,000	1,800
Program management	1978-1980	2 administrative staff	1.50	SEO	14,500	21,750
Assist schools with compliance	1978-1980	1 technician	1.00	SEO	15,000	15,000
Inspect heating systems	1978-1980	5 inspectors	5.00	SEO	10,000	50,000
Provide legal advice	1978-1980	1 attorney	0.10	SEO	18,000	1,800
Annual cost	1977					40,300
	1978					88,550
	1979					88,550
	1980					88,550
Total cost						**305,950**

Annual Furnace Inspection
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Year				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	40,300	88,550	88,550	88,550	305,950
Fringe benefits (.21 x personnel)	8,463	18,595	18,595	18,595	64,248
Travel	3,010	8,400	8,400	8,400	28,210
Equipment	2,000				2,000
Supplies					
Contractual					
Construction					
Other					
Subtotal	53,773	115,545	115,545	115,545	400,408
Indirect charges (.35 x personnel)	14,105	30,992	30,992	30,992	107,081
Total	**67,878**	**146,537**	**146,537**	**146,537**	**507,489**

Costs to the Private Sector

Commercial establishments and households will incur costs as a result of this program only in those instances where a service contract for annual cleaning and tune-up would not have been purchased without the program. The same is true for burner replacements or other major work required to meet minimum standards.

As stated in the energy savings calculations, 40 percent of the total number of oil-fired heating system units will need tune-ups as a result of the measure; another 10 percent will need burner replacement. However, for costing purposes, it is estimated that of the units requiring tune-ups to meet the standards, one-fourth (or 10 percent of the total) would have contracted for regular tune-ups, but that those tune-ups would not be effective enough to meet standards. More effective tune-ups will be needed; however, there will be no additional costs in terms of paying for the tune-ups per se. Thus, only 30 percent will actually incur the additional charge of a tune-up ($25). The one-time cost for burner replacement is estimated at $200 per unit.

Costs will be $38.8 million in 1978 and $10.6 million annually in 1979 and 1980; however, the value of energy savings and the payback period will make the program financially attractive (see Exhibit C-8 for costs and savings estimates).

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

Annual furnace tune-up will result in less air pollution. Energy savings will be considerable for building owners. In addition, the measure will create additional demand for technicians to carry out the tune-ups.

Despite savings, there may be some objection to the cost of the program. Homeowners, especially in lower income areas, may resist the cost of the furnace inspections and tune-ups, especially if their burners must be replaced.

Annual Furnace Inspection
Summary of Costs and Savings to Private Sector

Type of Tune-Up/ Burner Replacement	Total Tune-Ups/ Burner Replacements	Average Unit Cost ($)	Statewide Cost ($ million) 1978	1979	1980	Savings for Single-Family Home: Annual Savings	Payback Period (years)
Annual residential tune-up	408,400[a]	25	10.2	10.2	10.2	37[b]	0.7
Residential burner replacement (one-time only)	136,100[c]	200	27.2	0.0	0.0	87[d]	2.3
Annual commercial tune-up	9,600[e]	40	0.4	0.4	0.4	–	–
Commercial burner replacement (one-time only)	3,200[f]	300	1.0	0.0	0.0	–	–
Total	–	–	**38.8**	**10.6**	**10.6**	–	–

a The number of residential oil-fired heating systems in New Jersey was calculated by extrapolating data from the 1970 Census of Housing, Detailed Characteristics (1,167,762 units) out to 1980, using the ratio of total dwelling units in the 2 years (2,798,539/2,400,543). The result was then multiplied by 0.3, the proportion of these units that will begin paying for tune-ups as a result of the measure.

b The average home consumes 206.4×10^6 Btu per year for space heating. Annual savings is calculated by multiplying this figure times the cost of the oil ($3 per 10^6 Btu), times the 6 percent energy savings.

c Ten percent of the 1980 residential oil-fired heating systems.

d Annual savings is found by multiplying 206.4×10^6 Btu times the cost of the oil ($3 per 10^6 Btu) times the 14 percent energy savings.

e Thirty percent of the 1980 commercial oil-fired heating systems (RPA estimate of 32,000).

f Ten percent of the 1980 commercial oil-fired heating systems.

INDIVIDUAL METERING IN RESIDENCES

PROGRAM MEASURE

Master metering of electric services is a common practice in multi-unit residential buildings. Under master metering, utilities are able to sell electricity to a building or complex at wholesale rates, and tenants pay for the service through a standard charge prefigured into their rent. However, despite some advantages, this practice has been shown to encourage higher energy consumption patterns than those found in units with individual meters.

This measure will require individual metering for all new residential buildings with three or more units. In addition, renovated multi-unit residential buildings will be required to replace master meters with individual meters.

The projected energy savings from this measure are .05 trillion Btu in 1980, or $125,000.

IMPLEMENTATION APPROACH

Detailed Provisions

The measure will prohibit electric service to master-metered residential buildings built after July 1, 1977. Buildings renovated after this date will be required to install individual meters, if they do not already have them. The details of the measure will be based on experience with similar programs elsewhere in the United States. For example, Commonwealth Edison Company of Chicago provides no master-metered electrical service to residential customers, except for a few older buildings that, due to age and/or construction design, continue to receive master-metered service under "grandfather" clauses. This policy, mandated by the Chicago Commerce Commission, has been in effect for over 20 years, and has been defended successfully in the Illinois courts.

Implementing and Administering Organizations

The New Jersey Public Utilities Commission (PUC) will implement and administer this measure.

Legal Mechanisms

The PUC presently has the authority it needs to implement the measure.

Implementation Plan

The measure will become effective upon promulgation by the PUC on July 1, 1977. Buildings under construction at that time will be considered existing buildings. Buildings that are planned, but for which no building permits have yet been issued, will be considered new construction and will have to comply with the PUC order.

Monitoring System

The New Jersey State Energy Office (SEO) will obtain data from the Department of Community Affairs on the number of new multi-unit buildings constructed each year. SEO will also obtain data from the PUC on the per-unit consumption in individually-metered and master-metered buildings. Together, these data will enable SEO to estimate the energy savings due to the measure in each year from 1977 to 1980.

EXPECTED ENERGY SAVINGS

Individual metering is contained in the ASHRAE 90-75 building code standards, which will be adopted by the state under the measure entitled, "Thermal Efficiency Standards for New and Renovated Buildings" (see p. C-30). These standards will become effective in January 1978. From that time on, energy savings due to individual metering must be attributed to the thermal standards measure and not to this measure. Therefore, individual metering can claim savings only from dwelling units in multi-unit buildings that are built or renovated between the time PUC orders individual metering and January 1, 1978. Furthermore, savings can be claimed for only those units that would have been master-metered without the measure, or about one-third of the total. The calculation is based on the following data:

A = new units built from the time the measure is implemented on July 1, 1977, until January 1, 1978 (5,098 units) + units renovated in the same time period (5,105) = 10,203 units*

B = units built or renovated from the time the measure is implemented until January 1, 1978, that would have been master-metered without it, 1/3 x 10,203 = 3,401 units

C = average annual electricity consumption in units in master-metered buildings = 5,940 kWh/year**

D = average annual electricity consumption in units in individually metered buildings = 4,400 kWh/year.**

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* RPA estimate.

** Source: U.S. Federal Energy Administration, Energy Conservation Implications of Master Metering, prepared by Midwest Research Institute, October 1975. These figures do not include electricity for heating and other services not controlled by residents.

Energy savings = B (C-D) = 5.24 x 10^6 kWh = .0536 x 10^{12} Btu.* This estimate includes the waste heat associated with the generation of electricity.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

PUC will need the equivalent of one staff person to oversee this measure from July 1, 1977, through the end of 1977, when individual meters will become part of mandatory building design in multi-family units. Staff duties will include:

- Answering inquiries on individual and master metering, and on billing procedures and amounts
- Providing any technical assistance needed by builders converting master meters to individual meters
- Adjusting billing structure and procedures to conform to the provisions of this measure.

There will no additional costs to PUC because existing staff members will be used.

Costs to the Private Sector

The major costs of this measure will be in the private sector, assumed primarily by landlords who will convert buildings to individual metering and builders who will be required to install individual meters. The average estimated cost of installing individual meters is $200 per unit higher than for installing master meters.

Private sector costs were calculated by multiplying this factor times the total number of units affected by the measure, or $200 x 3,401, for a total of $680,200.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The major environmental impact comes from the reduction of energy use. Other effects of the elimination of master metering include increased demand for single-phase wall hour meters and increased demand for labor for new installation or conversions.

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* This figure and subsequent figures for projected energy savings have been corrected from kWh consumption to include generation and transmission losses, assuming a 30 percent overall efficiency in delivery from plant to user.

THERMAL EFFICIENCY STANDARDS FOR NEW AND RENOVATED BUILDINGS

PROGRAM MEASURE

This measure will require that all new and renovated buildings meet energy conservation building codes. The state will adopt the national energy conservation building code, ASHRAE 90-75, which specifies standards for new building design, including exterior envelope; HVAC, service water heating, electrical distribution, and lighting systems; and the selection of equipment for effective use of energy. The state will also conduct a training program to prepare local inspectors to certify compliance with the new code.

Total energy savings from this measure are projected to be 10.7 trillion Btu in 1980, or $26.8 million.

IMPLEMENTATION APPROACH

Detailed Provisions

The state will incorporate ASHRAE 90-75 into the existing statewide building code by reference. Any modifications of the code promulgated by ASHRAE will automatically become part of the New Jersey code.

ASHRAE 90-75 standards will apply to all new buildings, and will apply to renovated buildings depending on the percent of the building's value affected by the renovation. If the value of the renovation is more than 50 percent of the value of the building, the entire building will be required to meet ASHRAE 90-75 standards. If 25 percent to 50 percent of the value is affected, only that portion of the building that is renovated will be required to meet the standards. If less than 25 percent of the value of the building is affected by the renovation, only structural additions, alterations, or repairs will be required to meet the code.

A training program for local building inspectors will inform them of the new code so that they can enforce it after it goes into effect. No specific information program for construction, architectural, or engineering firms will be necessary; these groups keep current on ASHRAE regulations as a matter of course.

Implementing and Administering Organizations

The Department of Community Affairs (DCA) will implement the measure. DCA presently has jurisdiction over New Jersey's statewide building code, to which ASHRAE 90-75 will be added. In addition to defining and promulgating the new standards, DCA will be responsible for monitoring their impact and for training local inspectors.

Legal Mechanisms

Under the Statewide Uniform Building Code, DCA has the authority to set standards for all new and renovated buildings. A 13-member Code Advisory Board, which recommends the addition of subcodes to the statewide code, has already recommended the adoption of ASHRAE 90-75 as the state's energy conservation code.

DCA also has the authority it needs to administer and monitor the code. Enforcement will be carried out through the same mechanisms that govern the present building code. A new or renovated building is inspected by a local building inspector. If it complies with the code, the inspector grants a Certificate of Occupancy, which allows the builder to turn the building over to the owner for occupancy. Failure to meet the code results in expensive delays; thus, it is in the interest of the builder to comply.

Implementation Plan and Schedule

Three tasks must be accomplished to implement the measure: 1) define, review, adopt, and apply the standards for new and renovated buildings; 2) develop and conduct a training program for building inspectors; and 3) enforce and monitor the standards.

Although the Code Advisory Board has recommended the adoption of ASHRAE 90-75 for new buildings, before the DCA can apply the standards, the agency must ensure that local building inspectors will be trained to enforce them. A public hearing must also be held. DCA anticipates that the standard can be issued for public review by spring 1977, and put into effect by September 1977 (see Exhibit C-9 for implementation schedule).

The training program for inspectors is a critical step in the timely implementation of the standards. DCA will begin immediately to develop such a training program, to be held at the state university campus (Rutgers) during the summer of 1977.

DCA already has the authority to collect data on new construction. Requirements for reporting information on new and renovated buildings will be established as part of the monitoring and enforcement procedures under the Statewide Uniform Building Code. DCA has secured a federal grant to set up these procedures for ASHRAE 90-75.

Monitoring System

The State Energy Office (SEO) will assist DCA in determining how the information gathered by DCA on new and renovated construction can best be used to measure the impact of the new building code on energy use in the state. The monitoring system will be based on the certificates of compliance that local building inspectors issue to builders when buildings pass inspection. As part of the approval process, local inspectors will

Thermal Efficiency Standards for New and Renovated Buildings
Implementation Schedule

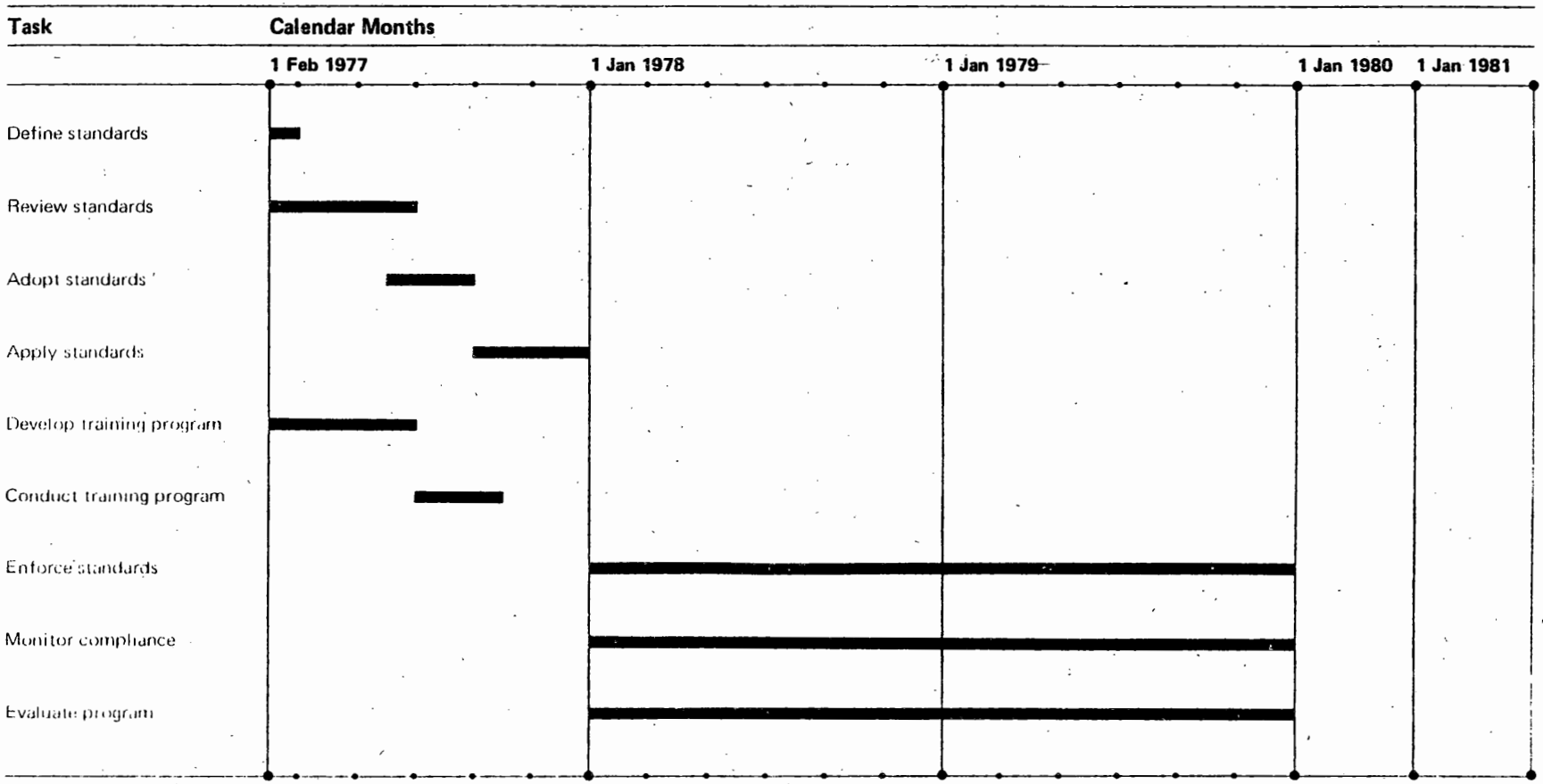

Exhibit C–9

file statements of compliance with local building offices. DCA will either receive a copy of these forms or poll local building offices once a year to obtain a report on all new construction and renovations in each town.

An estimate of the degree to which new and renovated space complies with the new code will be made, based upon the assessments of a representative sample of building code inspectors. No attempt at measuring energy use in these buildings will be made. Rather, DCA will estimate energy savings using FEA methodology and the data on building space and compliance. This information will be reported to SEO and FEA annually.

EXPECTED ENERGY SAVINGS

Energy savings for this measure have been calculated according to FEA methodology for thermal standards (see Exhibit C-11, pp. C-38 - C-47). This includes energy savings for single-family, low-density, low-rise, and high-rise residential buildings; office and retail buildings; educational buildings; hospitals and institutional buildings; and other buildings.

The figures for annual new construction in New Jersey for each of these categories were based on regional projections and were calculated using a state-to-region population ratio for residential buildings, schools, and hospitals, and a state-to-region personal income ratio for other building types. Total space for renovated buildings was calculated in a similar manner.

The annual new construction and renovation figures were then multiplied by the number of years between the time buildings comply with the new standards and the middle of 1980,* and, in the case of building renovation, by an effectiveness factor. The number of years between compliance and mid-1980 depends on the type of building; estimates for each type of building are presented in Table 1.

The total new and renovated construction between compliance and the middle of 1980 was then multiplied by FEA-supplied factors to calculate improvements in energy consumption for heating and cooling. The FEA factors are based on the difference between energy consumption in a typical unit under conventional standards, and consumption in a typical unit under the new standards. They also take into account weather, heating requirements, and cooling loads. The net result is the total energy savings in each of the building categories from implementation of the program through 1980.

Total energy savings from the measure are 10.7 trillion Btu. Energy savings by building type are shown in Table 2.

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* Units built or renovated in 1980 will, on the average, generate savings for only half a year. To approximate this, only units built or renovated up to July 1, 1980, are included and it is assumed that these units generate a whole year of savings.

TABLE 1: COMPLIANCE PERIODS BY BUILDING TYPE

Building Type	Number of Years from Permit to Completion	Assumed Date of Compliance with Standards	Number of Years from Building Operation to July 1, 1980
Single-Family	1/2	3/1/78	2 1/3
Low-Density	1/2	3/1/78	2 1/3
Low-Rise	1/2	3/1/78	2 1/3
High-Rise	1	9/1/78	1 5/6
Office	2	9/1/79	5/6
Retail	1 1/2	3/1/79	1 1/3
School	2	9/1/79	5/6
Hospital	2	9/1/79	5/6
Other	2	9/1/79	5/6

TABLE 2: ENERGY SAVINGS FROM THERMAL EFFICIENCY STANDARDS

Building Type	New Buildings (10^{12} Btu)	Renovated Buildings (10^{12} Btu)	Total (10^{12} Btu)
Single-family	2.55	0.05	2.60
Low-density residential	0.98	0.12	1.10
Low-rise	1.52	0.03	1.55
High-rise	0.77	0.09	0.86
Office	1.22	0.03	1.25
Retail & mercantile	1.50	0.03	1.53
Educational	0.62	0.03	0.65
Hospital & institutional	0.36	0.01	0.37
Other	0.74	0.03	0.77
Total	10.26	0.42	10.68

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

DCA has already budgeted the costs of implementing ASHRAE 90-75.

Costs to the Private Sector

According to FEA estimates of national economic impacts due to ASHRAE 90-75, the thermal efficiency standards will not increase costs for commercial, institutional, or industrial buildings.* For single-family detached residences, a projected increase in building costs of about $.24 per square foot has been projected. However, annual energy savings of approximately $.07 per square foot will mean a payback period of less than 3 years. For other building types, the annual energy savings are much higher, ranging from $.31 to $.70 per square foot. The estimates are presented in Table 3.

TABLE 3: IMPACTS OF ASHRAE 90-75 FOR NEW BUILDINGS

Building Type	Annual Energy Savings	Initial Construction Cost Savings	Additional Design Cost
Single-Family Residence	.07	.02	.24
Low-Rise Apartment	.31	.41	.09
Office Building	.40	.63	.16
Retail Store	.68	.18	.09
School Building	.70	.44	.15

The only important negative private sector impacts will be reduced sales of lighting equipment (minus 12 percent) and HVAC equipment (minus 8 percent). On the other hand, suppliers of insulation and siding materials, flat glass, HVAC controls, hot water heaters, and gas and electric meters will increase their sales (see Exhibit C-10). Total private sector costs through 1980 are estimated at $35.7 million.

There will also be greater demand for architectural and design engineering services. These professions should be able to meet this demand, considering current underemployment.

* Source: U.S. Federal Energy Administration, An Impact Assessment of ASHRAE Standards 90-75, Conservation Paper No. 43, August 1975.

National Economic Impacts Due to ASHRAE 90-75

	Total Annual Market ($MM)	Market Affected by ASHRAE 90-75 $MM	%	Maximum Potential Impact by ASHRAE 90-75 ($MM)	Percent of Total Market	Percent of Affected Market
Building Materials Suppliers						
Insulation	1000	595	60	+179	+18	+30
Batt	470	270	57	+ 45	+10	+17
Rigid board	460	280	61	+128	+28	+46
Loose fill	70	45	64	+ 6	+ 9	+13
Siding materials	1000	850	85	+ 12	+ 1	+ 1
Flat glass	1247	146	12	+ 7	+ 1	+ 5
Windows	903	720	80	− 19	− 2	− 3
Building Equipment Manufacturers						
Electric lamps	1177	176	15	− 16	− 1	− 9
Lighting fixtures	1450	830	57	−175	−12	−21
Gas and electric meters	173	159	92	+ 3	+ 2	+ 2
Hot water heaters	289	117	40	+ 4	+ 3	+ 3
HVAC Systems Manufacturers						
HVAC equipment	2308	1720	75	−135	− 8	−11
HVAC controls	550	410	74	+ 21	+ 4	+ 5

SOURCE: U.S. Federal Energy Administration, ***An Impact Assessment of ASHRAE Standards 90-75***, Conservation Paper No. 43, August 1975.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

There will be a positive environmental impact due to decreased fuel consumption in new and renovated buildings. However, construction supply industries, particularly insulation and HVAC equipment suppliers, will be disrupted by sharp changes in demand for their products in new and renovated buildings.

ummary Sheet for Accumulating Energy Savings for Mandatory Thermal fficiency Standards and Insulation Requirements for New and Renovated Buildings

uilding Types	Energy Savings in Billion Btu	
	Space Heating (E_h) (from Worksheet, line 4d)	Air Conditioning (E_c)
esidential Buildings		
. Single family - one unit detached	2,580.54 ($x10^9$)	85.60 ($x10^9$)
. Low density - one unit attached and 2-4 unit structures	1,074.84 ($x10^9$)	40.36 ($x10^9$)
. Low rise - structures with 5 or more units and 3 stories or less	1,606.44 ($x10^9$)	24.65 ($x10^9$)
. High rise - structures with 5 or more units and 4 or more stories	893.38 ($x10^9$)	14.26 ($x10^9$)
on-residential Buildings		
. Office buildings	1,188.93 ($x10^9$)	62.49 ($x10^9$)
. Retail stores and other mercantile buildings	1,494.10 ($x10^9$)	58.18 ($x10^9$)
. Educational buildings	617.03 ($x10^9$)	33.23 ($x10^9$)
. Hospitals and other institutional buildings	348.95 ($x10^9$)	19.31 ($x10^9$)
. Other	732.72 ($x10^9$)	35.65 ($x10^9$)
Subtotals: ΣE_h	10,536.93 ($x10^9$)	373.73 ($x10^9$) ΣE_s
	X	X
F_h	State Heating factor: 0.93 (Table IV.G)	State cooling factor: 2.38 (Table IV.G) F_c
	=	=
	9,799.34 ($x10^9$) +	889.48 ($x10^9$) = 10,688.82 ($x10^9$)
		x 10^{-12}

mmary Formula: $E_s = F_h(\Sigma E_h) + F_c(\Sigma E_c)$ Total Energy Savings = 10.69 ($x10^{12}$) E

Btu

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. X Single Family 2. ___Low Density 3. ___Low Rise 4. ___High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 349.8 $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1482

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 51.84 $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 2.875 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 123.12 $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 31.3 $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1482

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 4.64 $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 2.875 T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.25 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 2.76 $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 125.88 $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	136.68 $(x10^3)C_h$	1.74 $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	116.18 $(x10^3)C'_h$	1.06 $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	20.50 $(x10^3)C_h-C'_h$	0.68 $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	2,580.54 $(x10^9)E_h$	85.60 $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h (A_nT_n + A_rT_rF_r)$.

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. X Low Density 3. ___Low Rise 4. ___High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 139.6 $(\times 10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1482

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 20.69 $(\times 10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 2.875 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 49.14 $(\times 10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 69.8 $(\times 10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1482

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 10.34 $(\times 10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 2.875 T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.25 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 6.15 $(\times 10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 55.29 $(\times 10^6)A_nT_n + A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	129.57 $(\times 10^3)C_h$	1.86 $(\times 10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	110.13 $(\times 10^3)C'_h$	1.13 $(\times 10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	19.44 $(\times 10^3)C_h - C'_h$	0.73 $(\times 10^3)C_c - C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	1,074.84 $(\times 10^9)E_h$	40.36 $(\times 10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. X Low Rise 4. ___High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 68.4 $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1482

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 10.14 $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 2.875 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 24.13 $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 6.0 $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1482

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 0.89 $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 2.875 T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.25 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 0.52 $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 24.65 $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	113.34 $(x10^3)C_h$	2.18 $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	48.17 $(x10^3)C'_h$	1.18 $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	65.17 $(x10^3)C_h-C'_h$	1.0 $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	1,606.44$(x10^9)E_h$	24.65 $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

State Energy Conservation Program
Thermal Standards

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. ___Low Rise 4. X High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 48.2 $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1482

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 7.14 $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 2.375 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 13.39 $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 21.1 $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1482

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 3.13 $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 2.375 ___ T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.25 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 1.46 $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 14.85 $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	104.62 $(x10^3)C_h$	2.08 $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	44.46 $(x10^3)C'_h$	1.12 $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	60.16 $(x10^3)C_h-C'_h$	0.96 $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	893.38 $(x10^9)E_h$	14.26 $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h (A_nT_n + A_rT_rF_r)$

State Energy Conservation Program
Thermal Standards

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. ___Low Rise 4. ___High Rise

5. X Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). **72.8** $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. **0.1589**

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). **11.57** $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). **1.375** T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). **10.12** $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). **3.8** $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). **0.1589**

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). **0.60** $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). **1.375** T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). **0.50** F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). **0.26** $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). **10.38** $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	**150.71** $(x10^3)C_h$	**18.25** $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	**36.17** $(x10^3)C'_h$	**12.23** $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	**114.54** $(x10^3)C_h-C'_h$	**6.02** $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	**1,188.93** $(x10^9)E_h$	**62.49** $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

$$E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$$

Exhibit C-11, continued

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. ___Low Rise 4. ___High Rise

5. ___Office Building 6. X Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 99.7 $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1589

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 15.84 $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 1.875 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 21.78 $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 4.6 $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1589

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 0.73 $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 1.875 T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.50 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 0.51 $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 22.29 $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	83.79 $(x10^3)C_h$	20.04 $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	16.76 $(x10^3)C'_h$	17.43 $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	67.03 $(x10^3)C_h-C'_h$	2.61 $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	1,494.10 $x10^9)E_h$	58.18 $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

State Energy Conservation Program
Thermal Standards

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___ Single Family 2. ___ Low Density 3. ___ Low Rise 4. ___ High Rise

5. ___ Office Building 6. ___ Retail & Marcantile Buildings

7. X Educational Buildings 8. ___ Hospital and Other Institutional Buildings

9. ___ Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). **57.0** $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. **0.1482**

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). **8.45** $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). **1.375** T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). **7.39** $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). **4.9** $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). **0.1482**

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). **0.73** $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). **1.375** T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). **0.50** F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). **0.32** $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). **7.71** $(x10^6)A_nT_n+$ $A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	**135.65** $(x10^3)C_h$	**8.80** $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	**55.62** $(x10^3)C'_h$	**4.49** $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	**80.03** $(x10^3)C_h-C'_h$	**4.31** $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	**617.03** $(x10^9)E_h$	**33.23** $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. ___Low Rise 4. ___High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. X Hospital and Other Institutional Buildings

9. ___Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). **23.3** $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. **0.1482**

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). **3.45** $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). **1.375** T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). **3.02** $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). **1.8** $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). **0.1482**

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). **0.27** $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). **1.375** T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). **0.50** F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). **0.12** $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). **3.14** $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	**165.86** $(x10^3)C_h$	**23.82** $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	**54.73** $(x10^3)C'_h$	**17.67** $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	**111.13** $(x10^3)C_h-C'_h$	**6.15** $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	**348.95** $(x10^9)E_h$	**19.31** $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

Worksheet for Estimating Energy Savings for Space Heating and Air Conditioning for the Following Building Type (check one):

1. ___Single Family 2. ___Low Density 3. ___Low Rise 4. ___High Rise

5. ___Office Building 6. ___Retail & Mercantile Buildings

7. ___Educational Buildings 8. ___Hospital and Other Institutional Buildings

9. X Other

Note: States with their own data on projected annual new construction and renovation, and territories, should skip steps 1a and b and 2a and b, below.

Step 1: Calculate total new construction, in millions sq ft, of each building type from time standards take effect through 1980, in the State.

a. Enter total area of annual new construction of buildings of this type, in the Region (Table IV.A). 94.4 $(x10^6)$

b. Enter State/Region ratio (Table IV.C): Use personal income for office and retail building types; population for all other types. 0.1589

c. Enter total area of annual new construction of buildings of this type, in the State (State estimate or line 1a x 1b). 15.00 $(x10^6)A_n$

d. Enter number of years standards are in effect for new construction in State (Table IV.F). 1.375 T_n

e. Calculate total area of "new" buildings of this type as of the end of 1980 (line 1c x 1d). 13.13 $(x10^6)A_nT_n$

Step 2: Calculate renovation of each building type in millions sq ft, from time standards take effect until 1980, in the State.

a. Enter total area of annual renovation of buildings of this type in the Region (Table IV.B). 7.6 $(x10^6)$

b. Enter State/Region ratio (Same as line 1b). 0.1589

c. Enter total area of annual renovation of buildings of this type in the State (State estimate or line 2a x 2b). 1.21 $(x10^6)A_r$

d. Enter number of years standards are in effect for renovation in State (Table IV.F: may be same as line 1d). 1.375 T_r

e. Enter decimal factor relating to the degree to which the standards can be applied to renovated buildings (State estimate, or may use .25 for residential, .50 for non-residential). 0.50 F_r

f. Calculate total area of renovated buildings of this type as of the end of 1980 (line 2c x 2e)x(line 2d minus 0.5). 0.53 $(x10^6)A_rT_rF_r$

Step 3: Calculate total affected area, in millions sq ft, of new construction and renovation of this building type in State.

a. Add area of new and renovated construction in State (line 1e + 2f). 13.66 $(x10^6)A_nT_n+A_rT_rF_r$

Step 4: Calculate State energy savings, in billions of Btu, typical of this building type in the region.

	Space Heating	Air Conditioning
a. Enter typical annual unit energy consumption under conventional standards, in thousand Btu/sq ft (Table IV.D. and IV.E).	83.81 $(x10^3)C_h$	20.04 $(x10^3)C_c$
b. Enter typical annual unit energy consumption under revised standards (Table IV.D and IV.E, or State estimate if new standards differ from ASHRAE 90-75).	30.17 $(x10^3)C'_h$	17.43 $(x10^3)C'_c$
c. Calculate typical annual reduction of unit energy consumption (line 4a minus 4b).	53.64 $(x10^3)C_h-C'_h$	2.61 $(x10^3)C_c-C'_c$
d. Calculate total region-typical reduction of energy consumption for this building type (line 3a x 4c).	732.72 $(x10^9)E_h$	35.65 $(x10^9)E_c$

Step 5: Enter region-typical reduction of energy consumption (line 4d) for each building type, for space heating and for air conditioning, on Summary Sheet. (Data will then be corrected for State differences within the region and adjusted to trillion Btu.)

Formulas: $E_h = C_h - C'_h \quad (A_nT_n + A_rT_rF_r)$

LIGHTING EFFICIENCY STANDARDS FOR PUBLIC BUILDINGS

PROGRAM MEASURE

This measure will require reduced lighting levels in all public buildings.* The reductions will be achieved through a new lighting standard that specifies acceptable maximum lighting levels for various uses. The standard will be put into effect as an addition to the new statewide Uniform Building Code.

Implementation of this measure by September 1977 will result in energy savings of 14.4 trillion Btu in 1980, or $36 million.

IMPLEMENTATION APPROACH

Detailed Provisions

The state will promulgate new statewide lighting codes for existing public buildings and for new and renovated public buildings. These will specify mandatory maximum lighting levels for all non-task areas and for specific work activities within task areas. For new and renovated buildings, the standards contained in ASHRAE 90-75 will be used, and these standards will be implemented as part of the program measure entitled: "Thermal Efficiency Standards for New and Renovated Buildings" (see p. C-30).

There is currently no national lighting standard for existing buildings, but ASHRAE, in cooperation with the Illuminating Engineering Society (IES), is in the process of developing one, to be called ASHRAE 100. Until ASHRAE 100 is officially adopted, the state will develop interim state standards, based on drafts of ASHRAE 100, to allow implementation of the lighting standards by January 1978. New Jersey will adopt ASHRAE 100, when it becomes official, as part of the statewide Uniform Building Code.

Basically, the new standards for existing buildings will require building operators to delamp buildings, and, in some cases, to rewire general lighting areas so that smaller areas can be controlled by individual switches. Supplemental lighting for work task areas may have to be added.

The state will require that all existing public buildings comply with the code by the end of 1980, and building owners or managers will be notified to this effect. Extensions will be granted by the state under certain conditions.

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* Public buildings include offices, retail stores, schools, hospitals, public areas of multi-family residential dwellings, recreational facilities, and any other buildings open to the public.

The standards will have enough flexibility to allow building operators to meet the requirements in the most practical manner and with a minimum of outside technical guidance.

Certain existing buildings will be exempt from the lighting standard, including buildings of less than 4,000 sq ft, buildings that use less than 1 watt per sq ft of floor area, buildings that are neither heated nor cooled mechanically, mobile homes, and buildings that are not air conditioned. However, the program will be expanded to include office space in industrial buildings.

Owners of existing buildings will be required to notify the state when they have complied with the standard. The notification form, which will be sent to owners with the announcement of the standards, will require owners to report lighting levels before and after compliance, and the approximate square footage of illuminated areas affected.

The lighting code for new and renovated buildings will be enforced through the normal mechanisms for enforcing the statewide building code. Enforcement for existing buildings will be carried out in conjunction with the enforcement of the temperature standards in the program measure entitled "Seven Day, Day-Night Thermostats in Public Buildings" (see p. C-65).

State inspectors will spot-check public buildings to see that the standards are being obeyed. The spot-checks will be conducted on a random basis, and a representative percentage of the building stock will be checked each year. The checks, which will begin in 1979, will cover buildings built both before and after the adoption of ASHRAE 90-75. State inspectors will notify building owners or tenants of violations. The violations will be reviewed by a special board in the Department of Community Affairs, and a fine will be assessed. No building built prior to adoption of ASHRAE 90-75 will be found in violation before 1980. During 1979, the inspectors will merely inform the building tenants if lighting levels would fail to meet the code for existing buildings.

Implementing and Administering Organizations

The New Jersey Department of Community Affairs (DCA) will be responsible for implementing, enforcing, and monitoring the energy savings derived from this measure.

Legal Mechanisms

DCA presently has the legal authority to amend the statewide building code to include a lighting standard for new and renovated buildings. Legislation will be required to permit the state to implement and enforce a lighting standard for existing public buildings. The legislation will grant the state the power to inspect public buildings for compliance with

lighting standards, either the code for existing buildings (eventually ASHRAE 100) or ASHRAE 90-75, depending on when the building was built.

Implementation Plan and Schedule

Lighting standards for new and renovated buildings will be implemented in conjunction with the thermal standards for new and renovated buildings. To implement the standard for existing buildings, the following six steps are necessary (see Exhibit C-12 for implementation schedule):

- Reach agreement on the building types and building areas to be included in the standard
- Define and adopt the lighting standard (ASHRAE 100)
- Pass legislation required to apply the standard to existing buildings
- Train state inspectors to enforce the lighting standards in existing, new, and renovated buildings
- Develop data collection and monitoring systems
- Begin spot-checks.

Work on the first two tasks -- defining the buildings to be included and the standard itself -- will begin immediately. These will be accomplished through the efforts of a joint task force including members from DCA, the Building Owners and Managers Association, the Chamber of Commerce, and technical representatives from architectural and lighting engineering organizations. The Building Code Advisory Board will coordinate this activity.

Monitoring System

DCA, assisted by the State Energy Office, will monitor implementation of the lighting standard in existing buildings. DCA will measure the impact of the standard on existing space and assess the energy savings. DCA will estimate the energy savings using the data in the compliance forms received from building owners and other data it may have on lighting practices before the standard was implemented. It may be possible to revise these estimates for particular buildings using the results of spot-checks, which will begin in 1979.

EXPECTED ENERGY SAVINGS

The standard FEA methodology for state energy conservation lighting measures was used to calculate energy savings from this program (see work sheets, Exhibit C-17, pp. C-59 - C-64). In the absence of the ASHRAE 100 standard,

Lighting Efficiency Standards for Public Buildings
Implementation Schedule

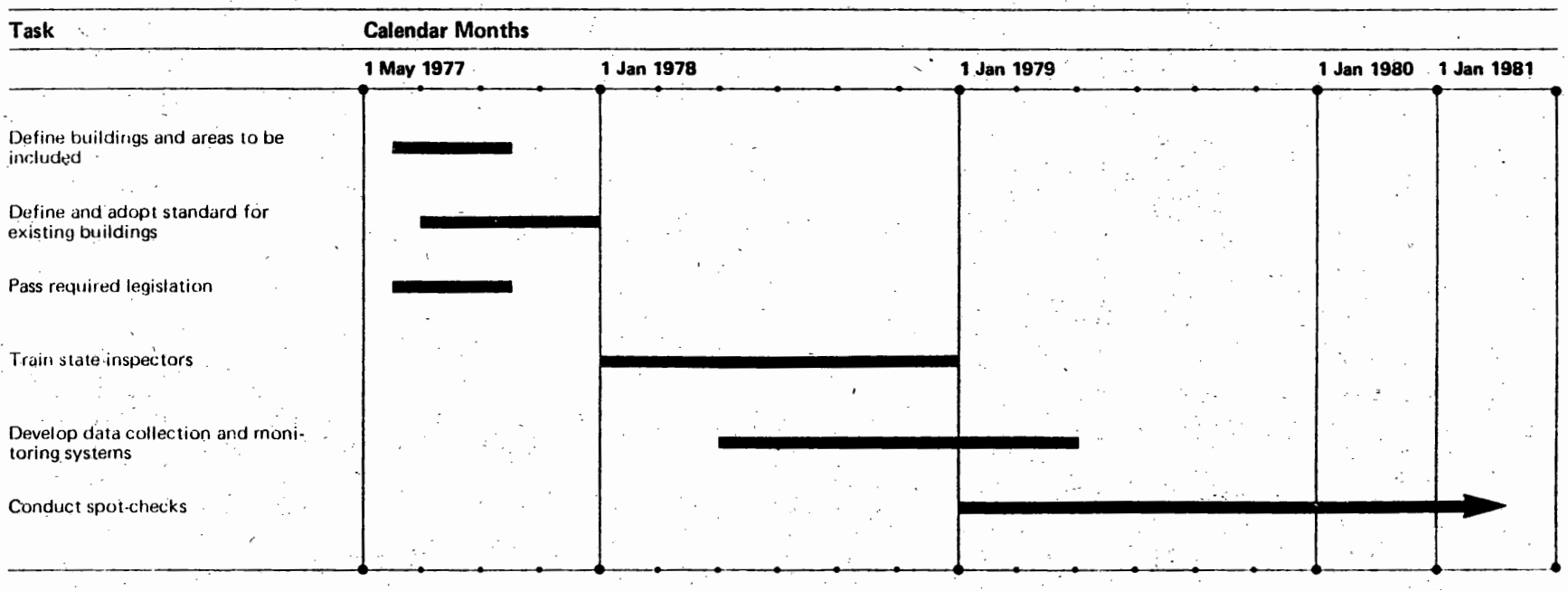

Exhibit C–12

energy savings were based on FEA's more general lighting guidelines (see Exhibit C-13) and associated energy savings (see Exhibit C-14).

Energy consumption estimates were based on FEA factors for New Jersey's share of regional building space and energy consumption for lighting. Savings were calculated by multiplying the total building space affected by the standards by an average percentage energy savings per unit, and then by the number of years the program will be in effect through the end of 1980. Separate calculations are made for new buildings and for existing and renovated buildings.

For the purposes of the calculations, it is assumed that 95 percent of new and renovated buildings will comply with the lighting standards for these buildings (ASHRAE 90-75), but that only 75 percent of existing buildings will comply with the standard for existing buildings. The remaining 25 percent of the existing buildings will either be exempt or their operators/owners will fail to operate their buildings according to the standard.

Total energy savings in 1980 will be 14.4 trillion Btu (see Table 1).

TABLE 1: 1980 ENERGY SAVINGS FROM LIGHTING STANDARDS IN PUBLIC BUILDINGS

Building Type	Energy Savings in 1980 (x 10^{12} Btu)
Office Buildings	2.3
Retail Stores	4.6
Schools	1.9
Hospitals	1.6
Other	4.0
TOTAL	14.4 x 10^{12} Btu

COSTS OF THE MEASURE

Cost to Implementing and Administering Organizations

DCA has already budgeted the costs of implementing ASHRAE 90-75 for new and renovated buildings; thus, there will be no additional costs for implementing the lighting standard in new and renovated buildings.

Recommended Maximum Lighting Levels

Task or Area	Footcandle Levels	How Measured
Hallways or corridors	10 ± 5	Measured average, minimum 1 footcandle
Work and circulation areas; surrounding work stations	30 ± 5	Measured average
Normal office work, such as reading and writing (on task only); store shelves; and general display areas	50 ± 10	Measured at work station
Prolonged office work that is visually difficult (on task only)	75 ± 15	Measured at work station
Prolonged office work that is visually difficult and critical in nature (on task only)	100 ± 20	Measured at work station
Industrial tasks	ANSI–A11.1-1973	As maximum

SOURCE: U.S. Federal Energy Administration, ***Energy Conservation Paper No. 3,*** 1974.

Energy Savings from Lighting Measures

(All costs are figured at 3 cents per kWh. Annual savings include normal ballast loss.)

Change office lamps (2,700 hr/yr) from:	to:	Annual Savings $	kWh
1 300-watt incandescent	1 100-watt mercury vapor	14.58	486
2 100-watt incandescent	1 40-watt fluorescent	12.00	400
7 150-watt incandescent	1 150-watt sodium vapor	70.80	2,360

Change industrial lamps (3,000 hr/yr) from:	to:	Annual Savings $	kWh
1 300-watt incandescent	2 40-watt fluorescent	18.69	623
1 1000-watt incandescent	2 215-watt fluorescent	48.51	1,617
3 300-watt incandescent	1 250-watt sodium vapor	54.18	1,806

Change store lamps (3,300 hr/yr) from:	to:	Annual Savings $	kWh
1 300-watt incandescent	2 40-watt fluorescent	20.55	685
1 200-watt incandescent	1 100-watt mercury vapor	7.92	264
2 200-watt incandescent	1 175-watt mercury vapor	20.10	670

SOURCE: U.S. Federal Energy Administration, ***Energy Conservation Paper No. 3,*** "Lighting and Thermal Operations Guidelines," 1974.

There will be additional costs associated with the standard in existing buildings, and these are primarily connected with the need to spot-check existing buildings. The staff members who will perform the spot-checks and administer the program at DCA are the same people who will perform these functions for the program measure entitled, "Seven Day, Day-Night Thermostats in Public Buildings" (spot-checks for temperatures and for lighting levels will be made at the same time).

The required number of inspectors is determined by the amount of building space that will be spot-checked each year. There will be about 1.3 billion sq ft of floor space in public buildings by 1980. Roughly 10 percent of this space will be in establishments of less than 4,000 sq ft and will be exempt from lighting and temperature regulations.

For the purposes of estimating costs, it is assumed that the state will spot-check 10 percent of eligible space each year and that one inspector will be able to inspect about 40,000 sq ft a day. Therefore, the state will need 12 inspectors. These inspectors will need a total of $5,000 in measuring equipment and a total travel budget of $58,800.

In addition to the inspectors, DCA will need a program administrator working full-time from June 1977 through 1980, and two staff working half-time for 1977, then three-fourths time from 1978 through 1980 (see Exhibit C-15 for personnel requirements and costs, and Exhibit C-16 for total program costs for the temperature and lighting measures).

Costs to the Private Sector

The cost of complying with the lighting standards in new and renovated buildings will be substantially outweighed by the amount of savings for building owners. Similarly, even in existing buildings, the required investments will be nominal and highly cost effective. There will also be indirect savings, such as lower maintenance costs due to the reduced number of fixtures that must be maintained.

The lighting standards in new buildings will have a significant impact on suppliers of lighting equipment and heating, ventilating, and air conditioning equipment. Manufacturers of lighting fixtures stand to lose about 12 percent of their current total market, and the combination of lighting standards and thermal standards for new buildings together result in an 8 percent decrease in the market for HVAC equipment (see Exhibit C-10, "Thermal Efficiency Standards for New and Renovated Buildings," p. C-36).

Implementation of mandatory lighting standards for new and existing buildings will have no positive economic impacts on the construction industry. Implementation of lighting standards in existing buildings could result in a substantial number of new jobs in the construction industry.

Lighting Efficiency Standards and Seven-Day, Day/Night Thermostats in Public Buildings
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Program management	1977	1 program administrator	0.5	DCA	21,000	10,500
Develop regulations and public education materials	1977	2 staff	1.0	DCA	15,000	15,000
Spot-check buildings	1977	12 inspectors	6.0	DCA	12,000	72,000
Program management	1978-1980	1 program administrator	1.0	DCA	21,000	21,000
Liaison with field engineer; public education	1978-1980	2 staff	1.5	DCA	15,000	22,500
Spot-check buildings	1978-1980	12 inspectors	12.0	DCA	12,000	144,000
Annual cost	1977					97,500
	1978					187,500
	1979					187,500
	1980					187,500
Total cost						**660,000**

Lighting Efficiency Standards and Seven-Day, Day/Night Thermostats in Public Buildings
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Year				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	97,500	187,500	187,500	187,500	660,000
Fringe benefits (.21 x personnel)	20,475	39,375	39,375	39,375	138,600
Travel*	8,400	16,800	16,800	16,800	58,800
Equipment**	2,000	1,000	1,000	1,000	5,000
Supplies***	25,000	15,000	5,000	5,000	50,000
Contractual					
Construction					
Other					
Subtotal	153,375	259,675	249,675	249,675	912,400
Indirect charges (.35 x personnel)	34,125	65,625	65,625	65,625	231,000
Total	**187,500**	**325,300**	**315,300**	**315,300**	**1,143,400**

* 10,000 miles per inspector per year at $.14 per mile.
** Measuring equipment.
***Public education materials.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The environmental impacts of this measure would be associated with the reduction in demand for electricity. In addition, since this reduction will be largest during the summer months when the air conditioning load is highest, a large portion of the energy savings will occur at times of peak demand.

Social impacts of the measure will be minimal. It has been shown that substantial reductions in lighting levels can be achieved without interfering with activities within a building. However, it is expected that there will be some resistance to retroactive standards on existing buildings.

Summary Sheet for Accumulating Total Energy Savings for Mandatory Lighting Efficiency Standards for Public Buildings

Electricity Savings in Trillion Btu
(from Worksheets, line 4a)

Office Buildings:	0.69	$(x10^{12})$
Retail Stores:	1.38	$(x10^{12})$
Schools:	0.56	$(x10^{12})$
Hospitals:	0.48	$(x10^{12})$
Other:	1.20	$(x10^{12})$
Subtotal	4.31	$(x10^{12})$ ΣL_s

Calculate total energy savings in terms of source fuel, by multiplying the subtotal by 3.33 (the factor to correct for generating efficiency).

X 3.33

Total = 14.35 $(x10^{12})$ E_s Btu

Summary Formula: $E_s = 3.33\ \Sigma L_s$

State Energy Conservation Program
Lighting Efficiency Standards

Worksheet for Total Electricity Savings in Terms of Source Fuel (in trillion Btu) for the following building type (check one):

__X__ Office ___ Retail Stores ___ Schools ___ Hospitals ___ Other

Note: Step 1 may be skipped if a State has specific State data on projected lighting energy for this building type. The five territories must skip Step 1 and provide their own data for Steps 2a and 3a.

Step 1: Calculate projected 1980 electrical energy consumption for lighting in buildings in region built prior to and following effective date of program, in trillion Btu.

a. Enter 1980 energy consumption for lighting in buildings built pre-1971 in region (Table I.C.). 14.2 ($\times 10^{12}$)

b. Enter energy for lighting in additional buildings built in region each year since 1971. (Table I.C.). 1.29 ($\times 10^{12}$)

c. Enter number of years program in effect (Table I.D.). 1.375

d. Compute no. years between beginning of 1971 and time program goes into effect (10 - line 1c). 8.625

e. Compute 1980 energy consumption for lighting in buildings in region built in 1971 through the time program goes into effect (line 1b x 1d). 11.13 ($\times 10^{12}$)

f. Compute 1980 energy consumption for lighting in all buildings in region built prior to time program goes into effect (line 1a + 1e). 25.33 ($\times 10^{12}$)

g. Compute 1980 energy consumption for lighting in buildings in region built during the years program is in effect (line 1c - 0.5)x(line 1b). 1.13 ($\times 10^{12}$)

h. Enter State/Region ratio (Table I.A., see instruction noted on table). 0.1589

Step 2: Calculate electrical energy savings in State by buildings built prior to program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built prior to effective date of standards (State data or line 1f x 1h). 4.02 ($\times 10^{12}$) L_e

b. Enter % (decimal fraction) reduction in lighting in existing buildings (State estimate: see Table I.B. for data on potential reductions). 0.2 F_e

c. Enter fraction of floor space affected (State estimate). 0.75 C_e

d. Compute electricity savings in "existing" buildings (line 2a x 2b x 2c). 0.60 ($\times 10^{12}$)

Step 3: Calculate electrical energy savings in State by buildings built since time of program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built since time of program effective date (State data or line 1g x 1h). 0.18 ($\times 10^{12}$) L_n

b. Enter % (decimal fraction) reduction in lighting in new buildings (State estimate: see Table I.B. for data on potential reduction). 0.5 F_n

c. Enter fraction of floor space affected (State estimate). 0.95 C_n

d. Compute electricity savings in "new" buildings (line 3a x 3b x 3c). 0.09 ($\times 10^{12}$)

Step 4: Calculate total electrical energy savings by new and existing buildings in the State, in trillion Btu.

a. Aggregate savings (line 2d + 3d). 0.69 ($\times 10^{12}$) L_s

Step 5: Enter savings (line 4a) for each building type on Summary Sheet.

Formula: $L_s = L_e F_e C_e + L_n F_n C_n$

State Energy Conservation Program
Lighting Efficiency Standards

Worksheet for Total Electricity Savings in Terms of Source Fuel (in trillion Btu) for the following building type (check one):

___Office __X__ Retail Stores ___Schools ___Hospitals ___Other

Note: Step 1 may be skipped if a State has specific State data on projected lighting energy for this building type. The five territories must skip Step 1 and provide their own data for Steps 2a and 3a.

Step 1: Calculate projected 1980 electrical energy consumption for lighting in buildings in region built prior to and following effective date of program, in trillion Btu.

a. Enter 1980 energy consumption for lighting in buildings built pre-1971 in region (Table I.C.). 18.1 ($\times 10^{12}$)

b. Enter energy for lighting in additional buildings built in region each year since 1971. (Table I.C.). 1.88 ($\times 10^{12}$)

c. Enter number of years program in effect (Table I.D.). 1.875

d. Compute no. years between beginning of 1971 and time program goes into effect (10 - line 1c). 8.125

e. Compute 1980 energy consumption for lighting in buildings in region built in 1971 through the time program goes into effect (line 1b x 1d). 15.28 ($\times 10^{12}$)

f. Compute 1980 energy consumption for lighting in all buildings in region built prior to time program goes into effect (line 1a + 1e). 33.38 ($\times 10^{12}$)

g. Compute 1980 energy consumption for lighting in buildings in region built during the years program is in effect (line 1c - 0.5)x(line 1b). 2.59 ($\times 10^{12}$)

h. Enter State/Region ratio (Table I.A., see instruction noted on table). 0.1589

Step 2: Calculate electrical energy savings in State by buildings built prior to program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built prior to effective date of standards (State data or line 1f x 1h). 5.30 ($\times 10^{12}$) L_e

b. Enter % (decimal fraction) reduction in lighting in existing buildings (State estimate: see Table I.B. for data on potential reductions). 0.3 F_e

c. Enter fraction of floor space affected (State estimate). 0.75 C_e

d. Compute electricity savings in "existing" buildings (line 2a x 2b x 2c). 1.19 ($\times 10^{12}$)

Step 3: Calculate electrical energy savings in State by buildings built since time of program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built since time of program effective date (State data or line 1g x 1h). 0.41 ($\times 10^{12}$) L_n

b. Enter % (decimal fraction) reduction in lighting in new buildings (State estimate: see Table I.B. for data on potential reduction). 0.5 F_n

c. Enter fraction of floor space affected (State estimate). 0.95 C_n

d. Compute electricity savings in "new" buildings (line 3a x 3b x 3c). 0.19 ($\times 10^{12}$)

Step 4: Calculate total electrical energy savings by new and existing buildings in the State, in trillion Btu.

a. Aggregate savings (line 2d + 3d). 1.38 ($\times 10^{12}$) L_s

Step 5: Enter savings (line 4a) for each building type on Summary Sheet.

Formula: $L_s = L_e F_e C_e + L_n F_n C_n$

State Energy Conservation Program
Lighting Efficiency Standards

Worksheet for Total Electricity Savings in Terms of Source Fuel (in trillion Btu) for the following building type (check one):

___Office ___Retail Stores _X_ Schools ___Hospitals ___Other

Note: Step 1 may be skipped if a State has specific State data on projected lighting energy for this building type. The five territories must skip Step 1 and provide their own data for Steps 2a and 3a.

Step 1: Calculate projected 1980 electrical energy consumption for lighting in buildings in region built prior to and following effective date of program, in trillion Btu.

a. Enter 1980 energy consumption for lighting in buildings built pre-1971 in region (Table I.C.). 15.6 ($\times 10^{12}$)

b. Enter energy for lighting in additional buildings built in region each year since 1971. (Table I.C.). 0.87 ($\times 10^{12}$)

c. Enter number of years program in effect (Table I.D.). 1.375

d. Compute no. years between beginning of 1971 and time program goes into effect (10 - line 1c). 8.625

e. Compute 1980 energy consumption for lighting in buildings in region built in 1971 through the time program goes into effect (line 1b x 1d). 7.50 ($\times 10^{12}$)

f. Compute 1980 energy consumption for lighting in all buildings in region built prior to time program goes into effect (line 1a + 1e). 23.1 ($\times 10^{12}$)

g. Compute 1980 energy consumption for lighting in buildings in region built during the years program is in effect (line 1c - 0.5)x(line 1b). 0.76 ($\times 10^{12}$)

h. Enter State/Region ratio (Table I.A., see instruction noted on table). 0.1482

Step 2: Calculate electrical energy savings in State by buildings built prior to program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built prior to effective date of standards (State data or line 1f x 1h). 3.42 ($\times 10^{12}$) L_e

b. Enter % (decimal fraction) reduction in lighting in existing buildings (State estimate: see Table I.B. for data on potential reductions). 0.2 F_e

c. Enter fraction of floor space affected (State estimate). 0.75 C_e

d. Compute electricity savings in "existing" buildings (line 2a x 2b x 2c). 0.51 ($\times 10^{12}$)

Step 3: Calculate electrical energy savings in State by buildings built since time of program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built since time of program effective date (State data or line 1g x 1h). 0.11 ($\times 10^{12}$) L_n

b. Enter % (decimal fraction) reduction in lighting in new buildings (State estimate: see Table I.B. for data on potential reduction). 0.5 F_n

c. Enter fraction of floor space affected (State estimate). 0.95 C_n

d. Compute electricity savings in "new" buildings (line 3a x 3b x 3c). 0.05 ($\times 10^{12}$)

Step 4: Calculate total electrical energy savings by new and existing buildings in the State, in trillion Btu.

a. Aggregate savings (line 2d + 3d). 0.56 ($\times 10^{12}$) L_s

Step 5: Enter savings (line 4a) for each building type on Summary Sheet.

Formula: $L_s = L_e F_e C_e + L_n F_n C_n$

State Energy Conservation Program
Lighting Efficiency Standards

Worksheet for Total Electricity Savings in Terms of Source Fuel (in trillion Btu) for the following building type (check one):

___Office ___Retail Stores ___Schools _X_ Hospitals ___Other

Note: Step 1 may be skipped if a State has specific State data on projected lighting energy for this building type. The five territories must skip Step 1 and provide their own data for Steps 2a and 3a.

Step 1: Calculate projected 1980 electrical energy consumption for lighting in buildings in region built prior to and following effective date of program, in trillion Btu.

a. Enter 1980 energy consumption for lighting in buildings built pre-1971 in region (Table I.C.). 12.5 ($\times 10^{12}$)

b. Enter energy for lighting in additional buildings built in region each year since 1971. (Table I.C.). 0.83 ($\times 10^{12}$)

c. Enter number of years program in effect (Table I.D.). 1.375

d. Compute no. years between beginning of 1971 and time program goes into effect (10 - line 1c). 8.625

e. Compute 1980 energy consumption for lighting in buildings in region built in 1971 through the time program goes into effect (line 1b x 1d). 7.16 ($\times 10^{12}$)

f. Compute 1980 energy consumption for lighting in all buildings in region built prior to time program goes into effect (line 1a + 1e). 19.66($\times 10^{12}$)

g. Compute 1980 energy consumption for lighting in buildings in region built during the years program is in effect (line 1c - 0.5)x(line 1b). 0.73 ($\times 10^{12}$)

h. Enter State/Region ratio (Table I.A., see instruction noted on table). 0.1482

Step 2: Calculate electrical energy savings in State by buildings built prior to program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built prior to effective date of standards (State data or line 1f x 1h). 2.91 ($\times 10^{12}$) L_e

b. Enter % (decimal fraction) reduction in lighting in existing buildings (State estimate: see Table I.B. for data on potential reductions). 0.2 F_e

c. Enter fraction of floor space affected (State estimate). 0.75 C_e

d. Compute electricity savings in "existing" buildings (line 2a x 2b x 2c). 0.44 ($\times 10^{12}$)

Step 3: Calculate electrical energy savings in State by buildings built since time of program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built since time of program effective date (State data or line 1g x 1h). 0.11 ($\times 10^{12}$) L_n

b. Enter % (decimal fraction) reduction in lighting in new buildings (State estimate: see Table I.B. for data on potential reduction). 0.4 F_n

c. Enter fraction of floor space affected (State estimate). 0.95 C_n

d. Compute electricity savings in "new" buildings (line 3a x 3b x 3c). 0.04 ($\times 10^{12}$)

Step 4: Calculate total electrical energy savings by new and existing buildings in the State, in trillion Btu.

a. Aggregate savings (line 2d + 3d). 0.48 ($\times 10^{12}$) L_s

Step 5: Enter savings (line 4a) for each building type on Summary Sheet.

Formula: $L_s = L_e F_e C_e + L_n F_n C_n$

Worksheet for Total Electricity Savings in Terms of Source Fuel (in trillion Btu) for the following building type (check one):

___Office ___Retail Stores ___Schools ___Hospitals _X_Other

Note: Step 1 may be skipped if a State has specific State data on projected lighting energy for this building type. The five territories must skip Step 1 and provide their own data for Steps 2a and 3a.

Step 1: Calculate projected 1980 electrical energy consumption for lighting in buildings in region built prior to and following effective date of program, in trillion Btu.

a. Enter 1980 energy consumption for lighting in buildings built pre-1971 in region (Table I.C.). 29.8 ($\times 10^{12}$)

b. Enter energy for lighting in additional buildings built in region each year since 1971. (Table I.C.). 1.78 ($\times 10^{12}$)

c. Enter number of years program in effect (Table I.D.). 1.375

d. Compute no. years between beginning of 1971 and time program goes into effect (10 - line 1c). 8.625

e. Compute 1980 energy consumption for lighting in buildings in region built in 1971 through the time program goes into effect (line 1b x 1d). 15.35 ($\times 10^{12}$)

f. Compute 1980 energy consumption for lighting in all buildings in region built prior to time program goes into effect (line 1a + 1e). 45.15 ($\times 10^{12}$)

g. Compute 1980 energy consumption for lighting in buildings in region built during the years program is in effect (line 1c - 0.5)x(line 1b). 1.56 ($\times 10^{12}$)

h. Enter State/Region ratio (Table I.A., see instruction noted on table). 0.1589

Step 2: Calculate electrical energy savings in State by buildings built prior to program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built prior to effective date of standards (State data or line 1f x 1h). 7.17 ($\times 10^{12}$) L_e

b. Enter % (decimal fraction) reduction in lighting in existing buildings (State estimate: see Table I.B. for data on potential reductions). 0.2 F_e

c. Enter fraction of floor space affected (State estimate). 0.75 C_e

d. Compute electricity savings in "existing" buildings (line 2a x 2b x 2c). 1.08 ($\times 10^{12}$)

Step 3: Calculate electrical energy savings in State by buildings built since time of program effective date, in trillion Btu.

a. Enter total projected 1980 lighting energy for buildings in State built since time of program effective date (State data or line 1g x 1h). 0.25 ($\times 10^{12}$) L_n

b. Enter % (decimal fraction) reduction in lighting in new buildings (State estimate: see Table I.B. for data on potential reduction). 0.5 F_n

c. Enter fraction of floor space affected (State estimate). 0.95 C_n

d. Compute electricity savings in "new" buildings (line 3a x 3b x 3c). 0.12 ($\times 10^{12}$)

Step 4: Calculate total electrical energy savings by new and existing buildings in the State, in trillion Btu.

a. Aggregate savings (line 2d + 3d). 1.20 ($\times 10^{12}$) L_s

Step 5: Enter savings (line 4a) for each building type on Summary Sheet.

Formula: $L_s = L_e F_e C_e + L_n F_n C_n$

SEVEN-DAY, DAY/NIGHT THERMOSTATS IN PUBLIC BUILDINGS

PROGRAM MEASURE

This measure will establish mandatory thermostat settings for public buildings during working hours and unoccupied periods.* It will require the installation of 7-day, day/night thermostats or similar control equipment, as well as interlocks between heating and cooling systems.

Energy savings from this measure are estimated to be 18 trillion Btu in 1980, or $45 million.

IMPLEMENTATION APPROACH

Detailed Provisions

Implementation of this measure will involve establishing mandatory regulations as well as recommending voluntary actions. Generally, the measure will require that all public buildings be equipped with centralized temperature controls utilizing a 7-day clock and interlocks to prevent simultaneous operation of heating and cooling systems. In addition, there will be guidelines for voluntary installation of other energy-conserving HVAC control equipment.

The regulations will allow for minor deviations from the basic requirements where they are inappropriate, and, under certain circumstances, where other equipment, systems, or approaches can be shown to achieve substantially the same objectives. Likewise, regulations establishing minimum and maximum temperature settings for control systems will be written so as to ensure that in those cases where compliance might result in increased energy use (e.g., areas with high lighting or other sources of heat that, at set temperatures, would require cooling), appropriate equipment changes or alternate settings are provided for. Thus, the regulations will be designed to meet energy conservation goals without unnecessary adverse impacts on building owners or the public.

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* Public buildings include offices, retail stores, schools, hospitals, multi-family residential housing, recreational facilities, and other buildings or areas open to the public, including, for this measure, industrial office space.

Specific requirements for installing and operating temperature control equipment will be established as part of the implementation process. Basic provisions of the measure will include:

- Thermostat settings during working hours of no higher than 65°F for retail space and 68°F for other space during the heating season (defined by the operation of heating equipment), and not lower than 78°F during the operation of air-conditioning equipment.

- Thermostat settings during unoccupied periods of no higher than 55°F during the heating season; and, during the operation of air-conditioning equipment, shutoff of HVAC equipment or, if shutoff is not possible, thermostat settings no lower than 80°F.

- Legal measures requiring that thermostat settings in public buildings be maintained in accordance with state regulations and that responsibility for compliance rests with the persons (owners or tenants) responsible for these settings. In addition, detailed regulations specifying responsibilities with respect to equipment installation and operation.

- Guidelines for voluntary installation of additional HVAC control equipment that will become mandatory for certain building types under specified conditions. Equipment will include systems that automatically shut off or slow down ventilation during unoccupied periods; enthalpy controls to enable use of cool nighttime air for air conditioning; and additional (or relocated) thermostats where existing thermostats are inaccurate or improperly located. Health and comfort of occupants and protection of building from temperature extremes will be taken into consideration.

- Statements specifying that certain institutions will be exempt from regulations upon approval by the state. For example: establishments of less than 4,000 square feet, hospitals and other health facilities, and space occupied by senior citizens or preschool children. For these institutions, voluntary compliance with the program will be requested.

A system will be established for identifying buildings that do not comply with the regulations. This will involve building inspectors authorized to perform spot-checks of building equipment, thermostat settings, and actual temperatures during occupied and unoccupied periods. Substantial fines will be levied for non-compliance, based on the degree of deviation from the regulations. The fines will increase with subsequent violations.

The program will have an appeals procedure, as well as criteria for the postponement of regulatory provisions and the waiver of fines for hardship cases or other credible circumstances.

Implementing and Administering Organizations

The Department of Community Affairs (DCA) will implement and administer the program. This will include the preparation of specific regulations. The inspectors who will spot-check thermostat settings will be organized into a separate unit, since a different level of skill, experience, and training will be required. DCA will publicize the regulations, and respond to questions from building owners concerning their responsibilities to install or modify equipment. Finally, DCA will carry out enforcement and monitor the effectiveness of the program in terms of energy savings.

Legal Mechanisms

Three types of legislative authority will be needed to implement and administer this program: 1) authority to regulate settings of thermostats and other HVAC control equipment; 2) authority to require equipment installation and modifications; and 3) authority to ensure compliance through spot-checks by inspectors.

Implementation Plan and Schedule

Regulations regarding thermostat settings will become effective upon promulgation; provisions regarding equipment installation will become effective as of January 1, 1978. It is anticipated that enforcement of the measures can begin 5 months after the program becomes law.

In addition to drafting and enacting legislation and preparing regulations, the implementation plan consists of: training inspectors, publicizing regulations, responding to inquiries, performing spot-checks of thermostat settings, monitoring savings, and conducting additional spot-checks to assess the adequacy of control equipment. (See Exhibit C-18 for the implementation schedule.)

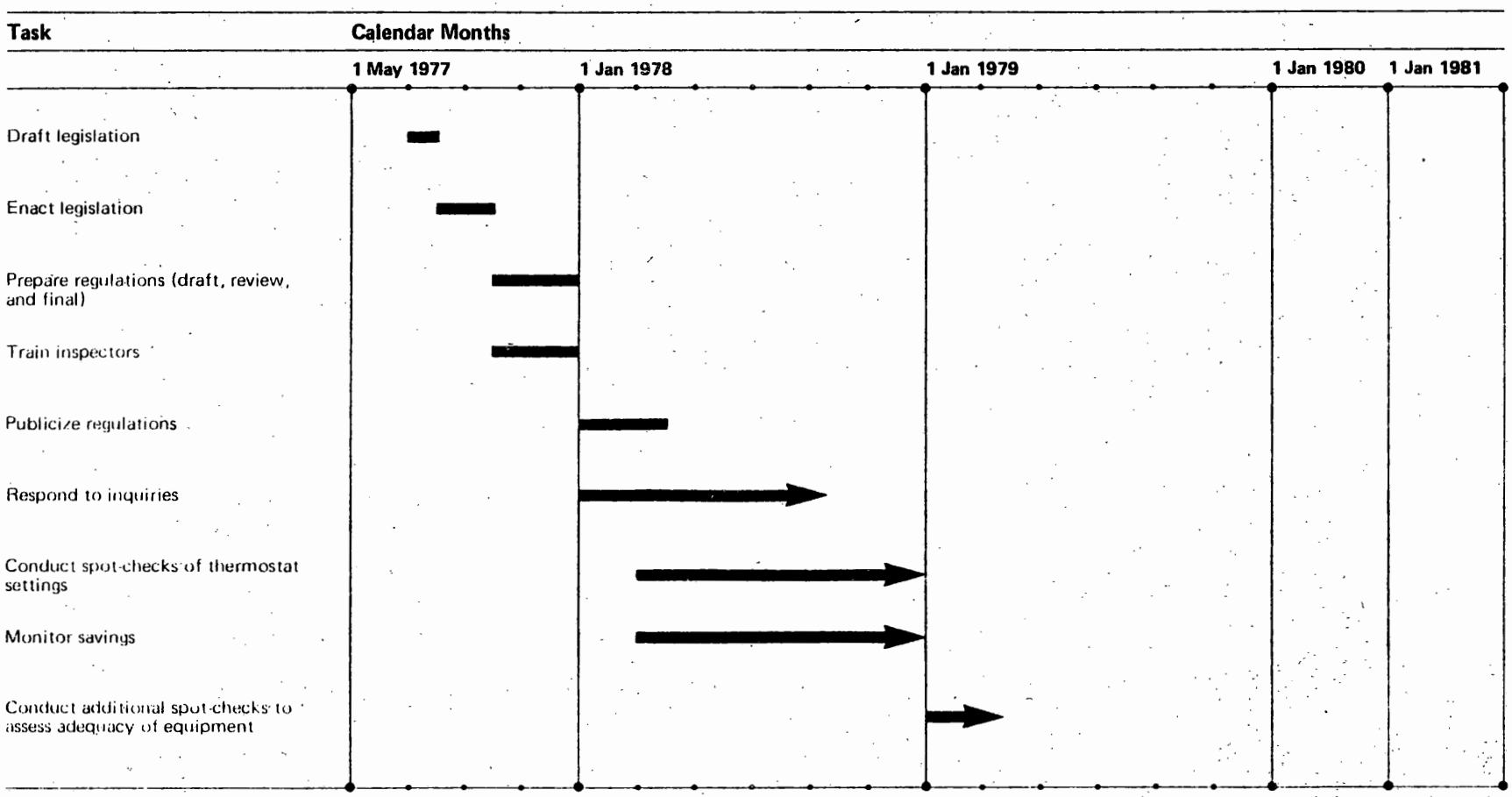
Monitoring System

DCA will keep records of thermostat settings recorded by inspectors. In 1980, the State Energy Office will calculate the effectiveness of the program, the data and estimated savings due to changed temperatures.

Related Measures

Several of the other measures included in the New Jersey Energy Conservation Plan are related to this temperature-control program. Implementation of ASHRAE 90-75 standards, which will reduce heat loss or gain, has been assumed in energy savings calculations for this measure. Other programs that could similarly reduce heat loss/gain or the operating time of HVAC equipment, but that have not been explicitly considered here, include lighting standards, mandatory furnace inspections, and generalized measures, including utility conservation investments and tax incentives for conservation measures.

Seven-Day, Day/Night Thermostats in Public Buildings
Implementation Schedule



EXPECTED ENERGY SAVINGS

Energy savings from this measure will be a function of: 1) total energy use for space heating and cooling in public buildings; 2) the proportion of buildings impacted by the program; and 3) the percent savings achieved by the reduced temperatures. Thermostat regulations and the calculations for estimating savings are significantly different for working hours and unoccupied periods. For clarity, the savings for these two periods are discussed separately.

The energy savings estimates presented here are conservative, since they are based on temperature adjustments alone. Additional HVAC control adjustments will likely yield substantial additional energy savings.

Savings During Working Hours

Energy savings of 3.6 trillion Btu are expected in 1980 from regulations that mandate thermostat settings during working hours of no higher than $65^{o}F$ in retail space and $68^{o}F$ in other space while space heating equipment is operating, and no lower than $78^{o}F$ while air-conditioning equipment is operating.

Specifically, energy savings were determined by the following formula:

$$ES_{WH} = I[(HS_R \times HE_R) + (HS_o \times HE_o) + (AS \times AE)]$$

where

ES_{WH} = 1980 energy savings estimate for working hours

I = Impact fraction (percent of building where the minimum/maximum temperature standard is met specifically as a result of the state action)

HS_R = Percent heating savings for retail buildings (from baseline heating demands, as a result of $3^{o}F$ average turndown, from $68^{o}F$ to $65^{o}F$, by the buildings impacted by the measure)

HS_o = Percent heating savings for office and other buildings, excluding hospitals (from baseline heating demands, as a result of $2^{o}F$ average turndown, from $70^{o}F$ to $68^{o}F$, by the buildings impacted by the measure)

AS = Air conditioning savings for all buildings (from baseline air conditioning demands, as a result of a $4^{o}F$ average turnup, from $74^{o}F$ to $78^{o}F$, by buildings impacted by the measure)

HE_R = 1980 energy use without the measure for space heating in retail buildings

HE_O = 1980 energy use without the measure for space heating in office and other buildings, except hospitals

AE = 1980 energy use without the measure for air conditioning in all public buildings, except hospitals.

The following values were used in the calculation:

I = 50 percent*

HS_R = 1.2 percent*

HS_O = 0.7 percent*

AS = 13 percent**

HE_R = 22.9×10^{12} Btu***

HE_O = 91.3×10^{12} Btu***

AE = 47.9×10^{12} Btu***.

The impact fraction (I) was assumed to be 50 percent based on the following considerations:

- Commercial buildings will still have a relatively poor record of temperature control in 1980 due to the widespread existence of central metering and thermostats that are controlled by tenants. Other considerations are retailers' fear of adverse competitive effects due to lower temperatures and the heat/cooling demands of office workers. Therefore, without the program, it is reasonable to project that at least two-thirds of the commercial space in 1980 would not meet the standard.

- Since the thermostat minimums/maximums are mandatory and backed up by an enforcement program, it is reasonable to project that at least three-quarters of the buildings not meeting the standard in the base case will comply with the standard by 1980.

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* Percent heating savings was calculated as the percent reduction in the inside-outside temperature difference ($T_i - T_o$, or ΔT, using T_o = 42.8, from ASHRAE data on the average winter temperature for Atlantic City, Newark, and Trenton) multiplied by the fraction of space-heating energy consumed during working hours (10 percent, from U.S. Federal Energy Administration, Energy Conservation Paper No. 20: Guidelines for Saving Energy in Existing Buildings, June 16, 1975, p. 106).

** Source: U.S. Federal Energy Administration, Energy Conservation Paper No. 20: Guidelines for Saving Energy in Existing Buildings, June 16, 1975, p. 161.

*** Source: U.S. Federal Energy Administration, State Energy Conservation Program: Sourcebook, Vol. 2., 1976.

These assumptions -- that at least 75 percent of the two-thirds that need to reduce temperatures will do so -- are the basis for the 50 percent impact fraction used in the savings calculations (.67 x .75 = .50).

The figures for energy use in 1980 without the measure for space heating in retail buildings (HE_r), for space heating in office and other buildings, except hospitals (HE_o), and for air conditioning in all public buildings, except hospitals (AE) were derived from FEA estimates (see Exhibit C-19).

Savings During Unoccupied Periods

The energy savings from temperature adjustments during unoccupied periods are much greater than the savings from adjustments during working hours. Among the factors contributing to this difference are the greater amount of time that buildings are unoccupied and the greater degree of temperature reduction that is possible during these periods. Savings in 1980 are expected to be 14.4×10^{12} Btu from regulations that mandate thermostat settings during unoccupied periods of no higher than $55^{\circ}F$ while space heating equipment is operating, and the shutoff of air conditioning systems, or if shutoff is not possible, settings of no lower than $80^{\circ}F$.

Specifically, energy savings were determined by the following formula:

$$ES_{UP} = I_H(HS \times HE) + I_A(AS \times AE)$$

where

ES_{UP} = 1980 energy savings estimate for unoccupied periods

I_H = Impact fraction for heating (percent of building inventory where the standards are met as a result of the state action)

I_A = Impact fraction for air conditioning

HS = Percent heating savings for public buildings (from baseline heating demands as a result of $10^{\circ}F$ average turndown in space impacted by the measure)

AS = Air-conditioning savings for public buildings (from baseline air-conditioning demands, as a result of compliance with the regulations by buildings impacted by the measure)

HE = 1980 energy use without the measure for space heating in public buildings, except hospitals

AE = 1980 energy use without the measure for air conditioning in public buildings, except hospitals.

1980 Inventory of Commercial Buildings and Energy Usage in New Jersey*

Type of Building	Old Buildings**	New Buildings†	Total
Retail			
10^6 sq ft	288.1	22.30	**310.4**
HE, 10^{12} Btu	22.5	0.35	**22.9**
AE, 10^{12} Btu	13.7	0.93	**14.6**
Offices			
10^6 sq ft	233.1	10.40	
HE, 10^{12} Btu	32.7	0.35	
AE, 10^{12} Btu	10.1	0.30	
Schools			
10^6 sq ft	230.6	7.70	**860.1**
HE, 10^{12} Btu	29.1	0.40	**91.3**
AE, 10^{12} Btu	4.8	0.08	**33.3**
Other			
10^6 sq ft	364.6	13.70	
HE, 10^{12} Btu	28.4	0.38	
AE, 10^{12} Btu	17.4	0.57	
Hospitals			
10^6 sq ft	89.1	3.10	**92.2**
HE, 10^{12} Btu	13.7	0.16	**13.9**
AE, 10^{12} Btu	5.1	0.13	**5.2**
Total			
10^6 sq ft	1205.5	57.20	**1262.7**
HE, 10^{12} Btu	126.4	1.64	**128.0**
AE, 10^{12} Btu	51.1	2.01	**53.1**

HE = space heating energy use
AE = air conditioning energy use

SOURCE: U.S. Federal Energy Administration, ***Sourcebook, Vol. 2: State Energy Conservation Program***, 1976, Tables IVA and IVB, p. 44, and Table IVC, p. 45 for inventory data and assumptions; and Tables IVD and IVE, p. 46, and Table IVG, p. 48, for unit energy use data and assumptions. Additional inventory data from FEA, "Residential and Commercial Energy Use Patterns 1970-1990," ***Project Independence***, Table 2.8, p. 68.

* Energy consumption figures represent total 1980 state energy use by the buildings of the appropriate type. It is assumed for these figures that the ASHRAE 90-75 standard becomes mandatory effective on September 1, 1977. It is further assumed that 1980 energy use is equal to the annual energy use of buildings in place as of July 1, 1980. All energy use figures include electrical losses.

**Old buildings are those with conventional (pre-ASHRAE 90-75) space heating and cooling needs. They include the 1970 inventory plus additions from January 1, 1971, through June 30, 1980, minus removals from January 1, 1971, through June 30, 1980, minus space impacted by the thermal standards (from FEA worksheets).

† New buildings include space constructed or renovated in accordance with 90-75 standards.

The following values were employed for the savings calculation:

I_H = .32

I_A = .23

HS = .38*

AS = .05**

HE = 114.2×10^{12} Btu***

AE = 47.9×10^{12} Btu***.

The .32 impact fraction for heating is lower than the .50 impact assumed for working hours because it is expected that, without the program, only 40 percent of the space would not have met the standards by 1980. This is likely since temperatures in retail establishments and the comfort of office workers do not play a part in decisions concerning temperatures after hours. Assuming slightly better compliance with this program than for the working hours standards -- 80 percent -- the result is a .32 impact fraction (.40 x .80 = .32).

In the case of air conditioning, the impact fraction is very low because most buildings already shut off cooling equipment after hours due to the high cost of cooling. It is assumed that only 25 percent of the space would be impacted by the measure in 1980, and that compliance would be 90 percent (.25 x .9 = .23).

COSTS OF THE MEASURE

Cost to Implementing and Administering Organizations

This program will be operated by the same staff as the measure calling for mandatory lighting standards in public buildings (p. C-48). One program administrator and two supporting staff will run both of these programs at DCA. Spot-checks for lighting and thermostat compliance will be performed by inspectors at the same time.

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* Source: U.S. Federal Energy Administration, Energy Conservation Paper No. 20: Guidelines for Saving Energy in Existing Buildings, June 16, 1975, p. 105, Figure 14, using 4,800 degree days (from ASHRAE data; the average for Atlantic City, Newark, and Trenton).

** Resource Planning Associates estimate, based on recommendations from the National Bureau of Standards. The figure is intended to be conservative in view of the wide variation in equipment and operating characteristics and the lack of published estimates of average savings.

*** U.S. Federal Energy Administration, State Energy Conservation Program: Sourcebook, Vol. 2, 1976.

The required number of inspectors is determined by the sample of building space that is to be spot-checked each year. There will be about 1.3 billion square feet of floor space in public buildings by 1980. Roughly 10 percent of this space is in establishments of less than 4,000 square feet and is exempt from lighting and temperature regulations. For the purposes of estimating costs, it is assumed that the state will spot-check 10 percent of eligible space each year. One inspector will be able to inspect about 40,000 square feet a day. Therefore, the state will need 12 inspectors (see Exhibit C-20 for personnel requirements and costs).

While the administrator is expected to begin working half-time on the program in July 1977, the inspectors will begin in October. As a result, total state personnel costs are estimated at $97,500 for 1977 and $187,500 for each subsequent year.

Additional direct charges will be incurred by the state in the form of travel costs for inspectors. In 12 inspectors each travel 10,000 miles per year, travel costs (at $.14 per mile) will total $16,800 annually. For 1977, only $8,400 will be required for travel.

Total costs for this program and the lighting program come to $187,500 in calendar 1977, $325,300 in 1978, and $315,300 in 1979 and 1980* (see Exhibit C-21 for combined program costs).

Costs to the Private Sector

The owners of commercial space will reduce operating costs to the extent that they comply with the thermostat regulations, and will incur investment costs to the extent that they install or modify HVAC control equipment. These costs could amount to $11.7 million if equipment costing an average of $25 per 1,000 square feet is required to be installed in 40 percent of the total space, excluding hospitals.

It is important, however, to weigh these costs against the savings in energy costs for building owners. The economic value of the annual energy savings from this measure is approximately $45 million, assuming an average energy price of $2.50 per million Btu.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The environmental impact of these thermostat regulations will be positive due to reduced fuel consumption. No fuel switching is expected.

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* Calculated by loading fringe benefits onto personnel costs at 21 percent, and loading overhead ("indirect costs") onto personnel costs at 35 percent.

Lighting Efficiency Standards and Seven-Day, Day/Night Thermostats in Public Buildings
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Program management	1977	1 program administrator	0.5	DCA	21,000	10,500
Develop regulations and public education materials	1977	2 staff	1.0	DCA	15,000	15,000
Spot-check buildings	1977	12 inspectors	6.0	DCA	12,000	72,000
Program management	1978-1980	1 program administrator	1.0	DCA	21,000	21,000
Liaison with field engineer; public education	1978-1980	2 staff	1.5	DCA	15,000	22,500
Spot-check buildings	1978-1980	12 inspectors	12.0	DCA	12,000	144,000
Annual cost	1977					97,500
	1978					187,500
	1979					187,500
	1980					187,500
Total cost						**660,000**

Lighting Efficiency Standards and Seven-Day, Day/Night Thermostats in Public Buildings
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Year				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	97,500	187,500	187,500	187,500	660,000
Fringe benefits (.21 x personnel)	20,475	39,375	39,375	39,375	138,600
Travel*	8,400	16,800	16,800	16,800	58,800
Equipment**	2,000	1,000	1,000	1,000	5,000
Supplies***	25,000	15,000	5,000	5,000	50,000
Contractual					
Construction					
Other					
Subtotal	153,375	259,675	249,675	249,675	912,400
Indirect charges (.35 x personnel)	34,125	65,625	65,625	65,625	231,000
Total	**187,500**	**325,300**	**315,300**	**315,300**	**1,143,400**

* 10,000 miles per inspector per year at $.14 per mile.
** Measuring equipment.
***Public education materials.

Opposition to these controls may come from those who object to mandatory governmental regulation in general. However, it is expected that the substantial cost savings will make this program attractive to owners and operators of public buildings.

Reduced temperatures during working hours may be unpopular with office workers or other building occupants. Such impacts should decrease over time as people adjust to generally lower levels of space heating and cooling. Retail customers may actually appreciate cooler winter temperatures, since many continue to wear outside clothing while shopping.

REPLACEMENT OF GAS PILOT LIGHTS

PROGRAM MEASURE

This measure will reduce the amount of energy wasted by pilot lights in gas appliances. Gas pilot lights operate continuously. In most instances, the energy they consume is not useful. An automatic electric ignition device can replace the pilot light and save most of the energy.

The measure will require that gas utilities serving New Jersey replace pilot lights with automatic electric ignition devices in 40 percent of gas furnaces operating as of January 1, 1978, by January 1980, and in 50 percent of those furnaces by January 1981. In addition, all gas furnaces, ranges, and dryers purchased or installed after December 31, 1977, will be required to have automatic intermittent ignition systems.*

Total energy savings from this measure will be 6.85 trillion Btu in 1980, or $17.1 million. Over 50 percent of these savings will come from furnace retrofit.

IMPLEMENTATION APPROACH

Implementing and Administering Organizations

The Board of Public Utility Commissioners (PUC) will implement and administer furnace retrofit; the gas utilities will be responsible for meeting retrofit targets. The New Jersey State Energy Office (SEO) will promulgate legislation requiring automatic ignition devices for new appliances.

Legal Mechanisms

PUC has the authority to require that utilities retrofit gas furnaces. Legislation will be necessary to prohibit gas pilots on new appliances.

Implementation Plan and Schedule

PUC and SEO will assist gas utilities in preparing plans for meeting retrofit targets. PUC will review and approve all plans by January 1978, when the installation of automatic ignition systems in target furnaces will start.

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* New Jersey is also investigating the desirability of requiring that the utilities retrofit gas water heaters with automatic ignition devices and that new water heaters installed after 1977 have the devices.

SEO will promulgate legislation by July 1977 requiring electric ignition systems in new furnaces, ranges, and dryers installed after December 31, 1977. SEO will notify and review comments from affected parties, such as builders and appliance manufacturers, prior to July 1977. (See Exhibit C-22) for the implementation tasks, responsibilities, and schedules for furnace retrofit and automatic ignition system programs.)

Monitoring System

Each gas utility will keep orderly, accessible records of the number of existing furnaces and completed ignition-device retrofits in its service area. Every 6 months starting in July 1978, PUC and SEO will review utility records to monitor progress. SEO will periodically check with builders, appliance manufacturers, and retailers to ensure that new gas furnaces, ranges, and dryers have electric ignition devices.

Related Measures

Related measures include:

- The New Jersey Department of Public Utilities is assessing the merits of automatic ignition systems. Its initial findings strongly favor the use of such systems. However, it is awaiting the results from other tests being conducted in New York and New Jersey before making a final recommendation.

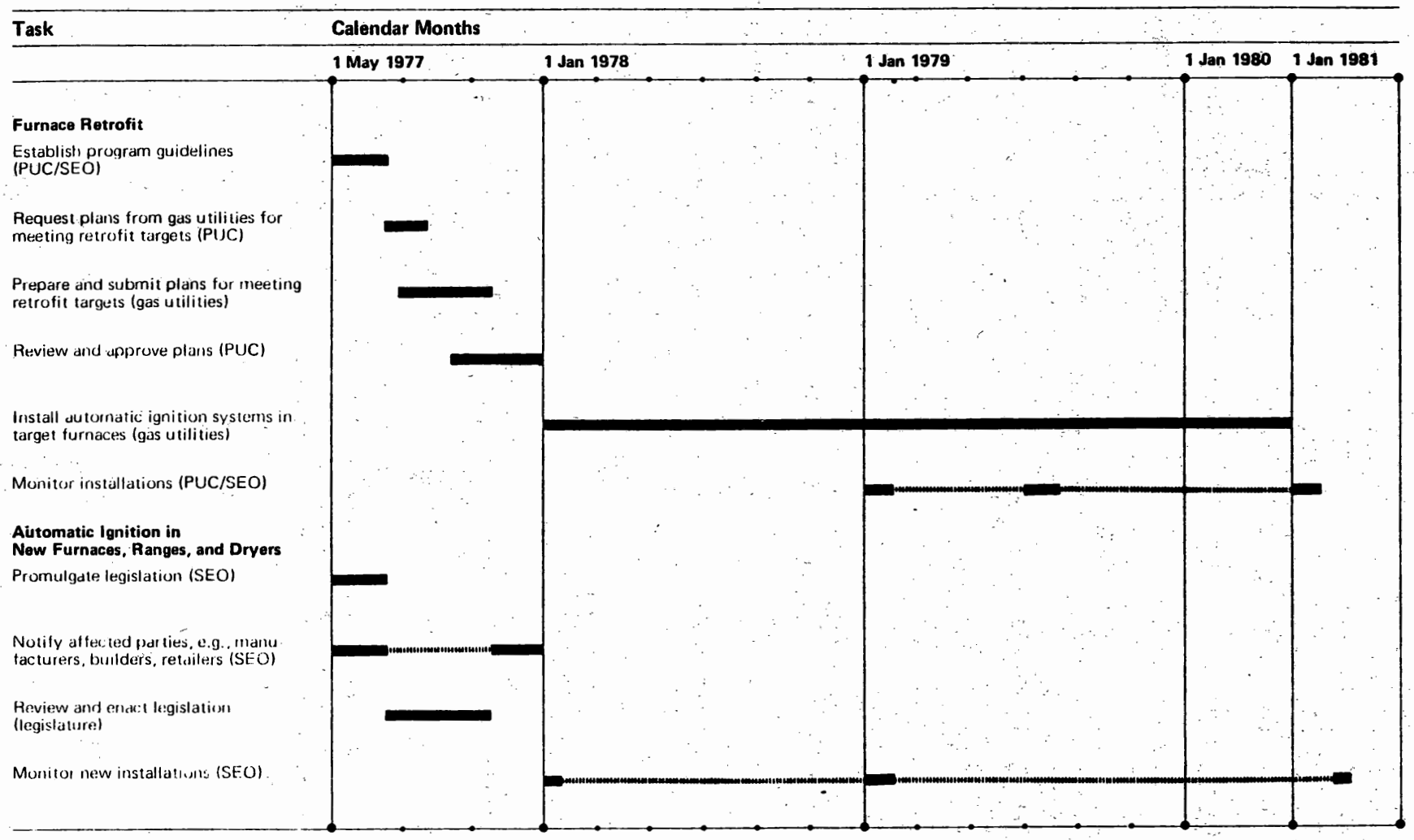
- Public Service Gas and Electric is conducting a test on 100 furnaces in which it has installed electric ignition systems.

- Brooklyn Union Gas is conducting a test on 1,700 furnaces in cooperation with the state of New York.

- The California Energy Resources Conservation and Development Commission has prohibited the use of continuous gas pilots in furnaces, swimming pool heaters, ranges, and dryers installed after July 1, 1978. The Commission is developing a retrofit program.

- FEA is considering regulation of pilot lights as one option in formulating energy-efficiency standards for appliances. It is uncertain whether FEA standards would take effect before 1981.

Replacement of Gas Pilot Lights
Implementation Schedule



ENERGY SAVINGS

The total number of furnaces, ranges, and dryers as of July 1, 1980, will be 6.27 million units (see Exhibit C-23).* Without this measure, they would use an estimated 16.7 trillion Btu in 1980. Furnaces and ranges would account for 99 percent of this consumption (see Exhibit C-24).

Total energy savings resulting from this measure are projected to be 6.85 trillion Btu for 1980. Over 50 percent of the savings are from retrofitting furnaces with electric ignition systems.

Methodology

Energy savings (ES) from the elimination of standing pilot lights in furnaces, ranges, and dryers are a function of:

- Total number of gas furnaces installed before January 1978 (F_i)
- Percent of F_i that will be retrofitted before July 1, 1980* (P_{F_i})
- Total number of gas furnaces, ranges, and dryers installed as replacement equipment between January 1, 1978, and July 1, 1980*; (F_r), (R_r), and (D_r), respectively
- Percent of replacement equipment, F_r, R_r, and D_r, that would have electronic ignition systems without state action; (P_{F_r}), (P_{R_r}), and (P_{D_r}), respectively
- Total number of gas furnaces, ranges, and dryers installed as original equipment between January 1, 1978, and July 1, 1980*; (F_o), (R_o), and (D_o), respectively
- Percent of original equipment, F_o, R_o, and D_o, that would have electronic ignition systems without state action; (P_{F_o}), (P_{R_o}), and (P_{D_r}), respectively
- Average cubic feet per day of gas consumed by pilot lights in furnaces, ranges, and dryers; (G_F), (G_R), and (G_D), respectively.

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* Savings in 1980 will result from furnaces, ranges, and dryers that are retrofitted or installed between January 1, 1980, and December 31, 1980. However, to approximate energy savings, appliances that are retrofitted or installed after July 1, 1980, are ignored and it is assumed that a full year of savings is realized for each appliance retrofitted or installed between January 1, 1980, and July 1, 1980.

Total Number of Furnaces, Ranges, and Dryers in New Jersey as of July 1, 1980

Housing Type	Housing Stock*	Furnaces**	Ranges	Dryers
Mobile homes	85,000	85,000	85,000	–
Single family	1,405,000	1,405,000	1,405,000	–
Low-density (single-family attached, 2-4 units)	675,000	340,000	675,000	–
Low-rise (5 or more units, fewer than 4 stories)	295,000	60,000	295,000	–
High-rise (5 or more units, more than 3 stories)	340,000	70,000	340,000	–
Total	**2,800,000**	**1,960,000**	**2,800,000**	**1,510,000†**

* RPA estimates based on U.S. Federal Energy Administration, ***Sourcebook Vol. 2: State Energy Conservation Programs***, 1976, Tables IV-A, IV-B, IV-C and ***FEA, Residential and Commercial Energy Use Patterns 1970-1990***, Project Independence, Blueprint (PIB), 11/74, pp. 56, 68.

**Assumes one furnace for each mobile or single-family home, for every two low-density units, and for every 5 low-rise or high-rise units.

† Assumes that 54 percent (FEA estimate) of the residences in New Jersey have dryers.

1980 Gas Consumption by Pilot Lights in Furnaces, Ranges, and Dryers

(without state action)

	Furnaces	Ranges	Dryers	Total
Total number of units in 1980	1,960,000	2,800,000	1,510,000	
Percent of units using gas*	40	73	18	
Percent of gas units with standing pilots**	100	99	30	
Number of units with standing pilots	785,000	2,025,000	81,550	
Average amount of gas used by standing pilot (cu ft/day)†	27	11	7	
Btu per cubic foot of gas	1,035	1,035	1,035	
Average energy used by standing pilot (Btu/yr)	10,200,000	4,200,000	2,600,000	
Total energy used by standing pilots (trillion Btu/yr)	**8.0**	**8.5**	**0.2**	**16.7**

* From U.S. Census (1970), ***Detailed Housing Characteristics, New Jersey.***

**RPA estimates based on discussions with manufacturers and trade associations.

† From Center for Environmental Studies, Princeton University, ***Natural Gas Waste by Pilot Lights,*** November 1975.

The relationship among these parameters can be expressed as the following equation:

$$ES_{total} = ES_{furnace} + ES_{range} + ES_{dryer}$$

where

$$ES_{furnace} = (F_i \times P_{F_i}) + [(F_r \times (1 - P_{F_r})] + [F_o \times (1 - P_{F_o})] \times [G_F \times (1{,}035^* \text{ Btu/cu ft}) \times 365 \text{ days per year}]$$

$$ES_{range} = [(R_r \times (1 - P_{R_r})] + [(R_o \times (1 - P_{R_o})] \times [G_R \times (1{,}035^* \text{ Btu/cu ft}) \times 365 \text{ days per year}]$$

$$ES_{dryer} = [(D_r \times (1 - P_{D_r})] + [(D_o \times (1 - P_{D_o})] \times [G_D \times (1{,}035^* \text{ Btu/cu ft}) \times 365 \text{ days per year}].$$

In other words, total energy savings equal the sum of the savings from furnaces, ranges, and dryers where, for example, the savings from furnaces equal the number of furnaces to be retrofitted, $(F_i + P_{F_i})$, plus the number of replacement units affected, $[F_r \times (1 - P_{F_r})]$, plus the number of original equipment units affected, $[F_o \times (1 - P_{F_o})]$, ^{r} times the average amount of energy consumed by the pilot lights that will be replaced with electronic ignition systems $[G_r \times (1{,}035^* \text{ Btu/cu ft}) \times (365 \text{ days per year})]$.

Calculation of Energy Savings

Total projected energy savings (ES) for 1980 are 6.85 trillion Btu, assuming:

F_i = 785,000 (furnaces installed before 1/78, from Exhibit C-23)

P_{F_i} = 45 (equals 40 percent by 1980 plus 5 percent between January 1, 1980, and June 30, 1980)

F_r = 130,000 (assumes that the average life of a gas furnace is 12.5 years and that there were 650,000 gas furnaces in 1970)

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* Source: Center for Advanced Computation, University of Illinois, CAC Technical Memo. No. 39: Direct Energy Use in U.S. Economy, 1967, January, 1975.

R_r = 290,000 (assumes that the average life of a gas range is 15 years and that there were 1,750,000 gas ranges in 1970)

D_r = 83,000 (assumes that the average life of a gas dryer is 13 years and that there were 430,000 gas dryers in 1970)

P_{F_r} = 0 (estimate based on discussions with appliance manufacturers and trade associations)

P_{R_r} = 10 (same as above)

P_{D_r} = 95 (same as above)

F_o = 70,000 (assumes that 140,000 new furnaces are added for 200,000 new housing units completed between January 1978 and June 1980, and that 50 percent of the new housing units will use natural gas for space heating; based on estimates from Public Service Gas and Electric Company)

R_o = 32,750 (assumes that 131,000 ranges will be installed as original equipment between January 1978 and June 1980, of which 25 percent will use gas)

D_o = 82,500 (assumes that 165,000 dryers will be installed as original equipment between January 1978 and June 1980, of which 50 percent will use gas)

P_F = 0 (estimate based on discussions with appliance manufacturers and trade associations)

P_R = 10 (same as above)

P_D = 95 (same as above)

G_F = 27 (Source: Center for Environmental Studies, Working Paper W-22: Natural Gas Waste by Pilot Lights, Princeton University, November 1975.)

G_R = 11 (same as above)

G_D = 7 (same as above).

The results of calculations for energy savings for furnaces, ranges, and dryers are shown in Exhibit C-25.

Replacement of Gas Pilot Lights: Calculation of 1980 Energy Savings

Type of Unit	Number of Units Affected	Average Energy Used by the Standing Pilot (million Btu/yr)	Total Energy Saved by Electric Ignition Systems in 1980 (trillion Btu)	Percent of Total Savings
Furnaces				
Retrofit	353,000	10.2	3.60	53
New–replacement	130,000	10.2	1.33	19
New–original equipment	70,000	10.2	0.71	10
Ranges				
New–replacement	260,000	4.2	1.09	16
New–original equipment	29,475	4.2	0.12	2
Dryers				
New–replacement	4,150	2.6	negligible	negligible
New–original equipment	4,125	2.6	negligible	negligible
Total			**6.85**	**100**

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

All government costs are covered under existing PUC and SEO budgets.

Cost to the Private Sector

The cost to retrofit a furnace is between $80 and $120. Therefore, furnace retrofits for 390,000 units will cost, on average, about $39 million between July 1977 and January 1980. The payback period is reasonable -- about 4-1/2 years -- assuming that the discount rate is 8 percent and that the price of gas is $3 per thousand cubic feet to the consumer. Retrofit could be financed by consumers and utilities. Utility financing is discussed as a separate measure.

Consumers will pay a premium of about $55* for new furnaces, ranges, and dryers with electric ignition. About 600,000 new units will be affected before 1981 at a total cost to consumers of about $33 million. The average payback period on furnaces, ranges, and dryers is estimated to be about 3 years, 7 years, and 13 years, respectively.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The impacts from this measure will be favorable. Furnace retrofit will provide employment for over 130 people, assuming that each person will install about four units a day. The political and social impacts from a reduction in gas consumption should be positive, considering the natural gas crisis during the winter of 1976-77. There may, however, be problems in assigning liability for any damage that results from mandated installation of retrofit furnaces. Reduced gas consumption is assumed to have a positive, though possibly small, impact on the environment.

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* Based on original research conducted by the Energy Resources Conservation and Development Commission of California.

MEASURES SINCE DECEMBER 22, 1975
WATER CONSERVATION CODE

PROGRAM MEASURE

The National Association of Plumbing, Heating and Cooling Contractors (NAPHCC) and the American Society of Plumbing Engineers (ASPE) have developed a National Standard Plumbing Code. This code has been adopted in New Jersey.

In October 1976, NAPHCC and ASPE held hearings on adopting a water conservation subcode as an amendment to the National Code. This subcode, which was developed by the New Jersey Department of Community Affairs, specifies maximum water flow rates for faucets, shower heads, water closets, and other fixtures.

Specifically, the prepared code changes are:

- Section 7.7.4 Water Conservation - Water Closets. Water closets shall be designed, manufactured and installed so as to be operable and adequately flushed with no more than 3.5 gallons of water per flush.

- Section 7.8.5 Water Conservation - Urinals. Urinals shall be designed, manufactured and installed so as to be operable and adequately flushed with no more than 2.5 gallons of water per flush.

- Section 7.9.4 Water Conservation - Flushometer Valves. Flushometer valves shall be designed, manufactured, installed and adjusted so as to provide no more than 3.5 gallons of water per flush to any water closet connected thereto, and no more than 2.5 gallons of water per flush for each urinal connected thereto.

- Section 7.9.8 Water Conservation - Flush Tanks. Flush tanks shall be designed, manufactured and installed so as to provide no more than 3.5 gallons of water per flush for each water closet, and no more than 2.5 gallons of water per flush for each urinal or for the equivalent length per urinal for trough urinals installed in accordance with Subsection 7.8.3.

- Section 7.11.2 Water Conservation - Lavatory Faucets. Lavatory faucets shall be designed, manufactured and installed so they shall not exceed a water flow rate of 3 gallons per minute with varying supply line pressure. Every lavatory faucet shall be provided with an aerator.

- Section 7.13.5 Water Conservation - Shower Heads. Shower heads shall be designed, manufactured and installed so as

to deliver water at a rate not exceeding 3 gallons per minute with varying supply line pressure.

- Section 7.14.2 Water Conservation - Sink Faucets. Sink faucets shall be designed, manufactured and installed so they shall not exceed a water flow rate of 4 gallons per minute with varying supply line pressure. Every sink faucet shall be provided with an aerator.

It is expected that NAPHCC and ASPE will formally adopt the water conservation subcode in June 1977. Since New Jersey already subscribes to the National Code, this action will implement the water conservation subcode in New Jersey as well. It is expected that the water code will become effective in September 1977.

EXPECTED ENERGY SAVINGS

The energy savings from this measure are estimated to be 3.0 trillion Btu in 1980. This figure is based on savings of 2.4 trillion Btu from reduced operation of household hot-water heaters and 0.6 trillion Btu from a reduction in commercial water heating and operation of water-treatment facilities. Cost savings in 1980 will be $7.5 million.

The following formula was used to calculate annual energy savings in household hot-water heaters as a result of the water conservation provisions of the building code:

$$ES = G_W \times O \times D_I \times 365 \times P_H \left[R_{TS} + (P_F \times R_{FF})\right] \times \frac{\Delta T \times D_W}{E_A}$$

The definitions of these variables and the values used for the savings calculation are as follows:

ES = Expected 1980 energy savings (Btu)

$G_W = 85$ = Average annual gallons of domestic water use per capita*

$O = 3$ = Average number of occupants per dwelling unit

$D_I = 238,390$ = Number of dwelling units affected by the code by 1980 (assumed to be all units constructed or renovated between 1/1/78 and 7/1/80, from program measure entitled, "Certification of Thermal Efficiency in Existing Housing", see p. C-1).

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* New Jersey Department of Environmental Protection, Report on the Need for Water Conservation Plumbing and Practices, 1976.

P_H = 0.50 = Proportion of water saved that would have been hot water*

R_{TS} = 0.12 = Reduction in total household water use due to shower-head provisions**

P_F = 0.09 = Proportion of G_W used in lavatory and sink faucets (assumed equal to proportion for "cooking and washing")**

R_{FF} = 0.25 = Reduction in water used due to faucet provisions*

ΔT = $90^{\circ}F$ = Temperature increase of water by hot-water heaters, on the basis of 50° inlet and 140° outlet

D_W = 8.35 = Density of water (pounds per gallon)

E_A = 0.50 = Estimated average seasonal efficiency of hot-water heaters, including electricity losses.***

To monitor energy savings, the New Jersey Energy Office will estimate actual 1980 savings based on data from the departments of Environmental Protection and Community Affairs, including:

- 1980 water use
- 1980 per capita water use, both actual and as projected prior to implementation of the water conservation code
- Unit energy consumption of New Jersey water treatment facilities in 1980
- New and renovated residential and commercial inventory from the effective date of the code to July 1, 1985.

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* RPA estimate.

** New Jersey Department of Environmental Protection, Report on the Need for Water Conservation Plumbing and Practices, 1976.

*** New England Regional Commission, "Hot Water Conservation Measures," Systems Research, February 4, 1974.

MEASURES SINCE DECEMBER 22, 1975
WEATHERIZATION PROGRAM

PROGRAM MEASURE

The New Jersey Department of Community Affairs (DCA) has provided substantial assistance to the state's Community Action Agencies (CAAs) in their programs to insulate and generally weatherize low-income homes under grants from the U.S. Community Service Administration. Approximately 100 homes have been retrofitted per month since December 1975. DCA Division of Human Services has provided on-site technical assistance and training for CAA staff, established a mobile Energy Resource Center, prepared materials for consumer awareness projects, and provided other forms of administrative and technical support.

Under this program measure, funds are used directly to weatherize low-income residences and to encourage energy conservation by others in the community through public education activities. In addition, employment and training opportunities are made available to unemployed workers. Although funding has been appropriated only through June 30, 1977, the program is expected to continue beyond that date.

EXPECTED ENERGY SAVINGS

Houses will be retrofitted at the rate of 100 per month from January 1, 1976, through June 30, 1980, for a total of 5,400 houses. The average savings per house will be 25 percent of the average annual energy consumption in single-family dwellings (138 million Btu*), or 35 x 10^6 Btu. Total savings a year in 1980 are then 5,400 x 35 x 10^6 Btu, or 0.2 trillion Btu, worth $500,000 in savings.

To monitor energy savings, the New Jersey Energy Office will collect data from DCA late in 1980 on the number of houses retrofitted with funds provided between December 22, 1975, and July 1, 1980. Assuming the most reasonable level of savings for each house, the office will then calculate actual 1980 energy savings.

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* From data in the measure entitled "Certification of Thermal Efficiency in Existing Housing" (p. C-1). This figure is approximately the same as the figure for total savings from measures listed in the New Jersey appendix of U.S. Federal Energy Administration, An Evaluation of Data Developed in 'A Study of Retrofit for Energy Savings of Homes', November 1975.

APPENDIX D

NEW JERSEY ENERGY CONSERVATION PLAN
INDUSTRIAL MEASURES

IMPROVING BOILER EFFICIENCY

PROGRAM MEASURE

The purpose of this measure is to improve the energy efficiency of boilers rated at between 5,000 pounds and 500,000 pounds of steam per hour. These boilers account for 85 percent to 90 percent of the energy consumed by boilers in the industrial and commercial sectors.*

There are three ways to increase boiler efficiency:

1. Improve maintenance and operating procedures for existing boilers

2. Increase investment in equipment to improve heat recovery or combustion in existing and new boilers

3. Increase the design efficiency of boilers that will be purchased. For example, set minimum efficiency standards for the design of new equipment.

The first two methods will be the most effective means of improving boiler efficiency by 1980.

This measure establishes mandatory fuel-to-steam (or hot water) standards to keep target boilers operating near maximum design efficiency, and sets voluntary stack-gas temperature standards to encourage investment in heat-recovery equipment. In addition, the measure calls for three programs that will encourage boiler owners and operators to help maintain boiler efficiency. These programs are:

- Testing boiler operators' knowledge of energy-efficiency procedures as a requirement for obtaining a high pressure fireman and charge energy-efficiency license to be offered by the Department of Labor and Industry

- Follow-up on Industrial Workshops sponsored by FEA

- Demonstrations of techniques and potential for energy savings using large, state-owned boilers.

Total energy savings resulting from this measure are projected to be 22.7 trillion Btu for 1980, or $56.8 million.

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* Boilers larger than 500,000 pounds of steam per hour are used mainly by utility companies and are generally considered to be efficient. Boilers smaller than 5,000 pounds of steam per hour are used primarily by small commercial and some residential users. The savings from greater efficiency of these small boilers is too small to make an efficiency improvement program cost effective.

IMPLEMENTATION APPROACH

Detailed Provisions

The measure establishes mandatory fuel-to-steam (or hot water) efficiency standards, and sets voluntary stack-gas temperature standards for affected boilers. Boiler inspection/certification will begin in January 1978.

According to boiler distributors in New Jersey, minimum fuel-to-steam (or hot water) efficiencies for each unit should be about 1 percent to 1.5 percent below maximum efficiency standards as determined by boiler manufacturers. Specific standards will be developed for various types of combustion equipment, grades of fuel, and ranges of firing rates.

Stack-gas temperature standards should be slightly higher for existing boilers than for new boilers (e.g., 350°F versus 320°F) to reflect the higher cost of retrofitting existing boilers with heat-recovery equipment. According to industry sources, both efficiency and stack-gas temperature standards should be easy to set.

All operators of target boilers must have their boilers inspected (combustion-side testing only) and brought up to standard, if necessary, twice a year. Heating boilers will be inspected once in June, July, or August, and once in January, February, March, or April, with a minimum 5-month interval between inspections. The Department of Labor and Industry (DLI) will require that each boiler have a thermometer well to measure stack-gas temperature and a socket for the ORZAT tester to measure combustion-side efficiency.

The inspections will be done by manufacturers, installation and service companies, and possibly insurance companies, and will be paid for by boiler owners. The inspectors will fill in an energy efficiency form and send the form, as proof of compliance, to the DLI. Failure to comply will result in fines that will reflect the severity of the violation. Continued noncompliance will result in boiler shutdown.

In addition, the state will take three actions to improve boiler operators' understanding of techniques for improving energy efficiency. First, DLI will offer a license to boiler operators that certifies they have a detailed knowledge of the techniques and potential for improving energy efficiency. To obtain the license, operators must pass a comprehensive test on energy-efficient practices for boilers.

The second action will be to promote and follow up on FEA Industrial Workshops held in New Jersey. These workshops provide instruction on boiler efficiency.

Finally, the state will demonstrate methods and equipment for improving efficiency to interested boiler owners. The demonstrations will use large, state-owned boilers in state buildings.

Implementing and Administering Organizations

DLI, assisted by the State Energy Office (SEO), will implement and administer the boiler efficiency certification and operator licensing programs. DLI currently monitors an annual inspection for boiler safety. As part of this function, it maintains records on every boiler in the state. In addition, DLI licenses all persons operating low-pressure and high-pressure boilers with capacities of greater than 3,450 and 207 pounds of steam per hour, respectively.

SEO will follow up on FEA's Industrial Workshops, and demonstrate techniques and equipment for improving boiler efficiency.

Legal Mechanisms

Under the New Jersey Administrative Code, DLI already has the power to regulate boilers and administer the licensing of boiler operators. SEO is already participating in the Industrial Workshops.

Implementation Plan and Schedule

Implementation will involve four programs: boiler efficiency certification, operator licensing, follow-up on FEA Industrial Workshops, and boiler efficiency demonstrations. For the certification program, DLI, with the assistance of SEO, will take the following actions:

- Identify owners and major characteristics, such as equipment type, of boilers rated between 5,000 pounds and 500,000 pounds of steam per hour. Safety inspection records from DLI Office of Boiler and Pressure Vessel Compliance will be used to identify target boilers.

- Set specific fuel-to-steam efficiency and stack-gas temperature standards for each type of boiler (defined according to type of combustion equipment, age, fuel, etc.). DLI will enlist the support of manufacturers, design engineers, and trade associations, such as the American Boiler Manufacturers Association, to set the standards.

- Notify boiler operators and inspectors of program specifics, and indicate efficiency standards and inspection/certification requirements and procedures.

- Establish an inspection program for compliance with the standards. DLI will develop reporting procedures and materials, and will authorize manufacturers, service organizations, and perhaps

insurance companies to certify boiler efficiency. The inspectors will send certification reports to DLI.

- Verify the integrity of the certifications. To do this, DLI will train an inspector to perform spot-checks on about five percent, or 300 boilers, each year.

- Periodically sample inspection/certification forms and, with the help of SEO, assess the impact of the program on fuel consumption.

Boiler inspection/certification will begin in January 1978. (See Exhibit D-1 for the implementation tasks, responsibilities, and schedule for boiler efficiency certification.)

For the operator licensing program, DLI will:

- Develop licensing procedures that will include an examination to test the operator's understanding of energy efficiency in boilers. The test will address efficiency measurements, maintenance and operating practices, available equipment, and procedures for cost/benefit analyses.

- Assemble an information package on boiler efficiency to be sent to operators for a fee. The information package will contain all materials needed to pass the exam. Materials will be drawn largely from information assembled for FEA Industrial Workshops.

- Identify and notify boiler operators and owners of the program and of the availability of the information package.

- Administer the examination.

- Evaluate the program's success in terms of the proportion of boiler operators that have received the license.

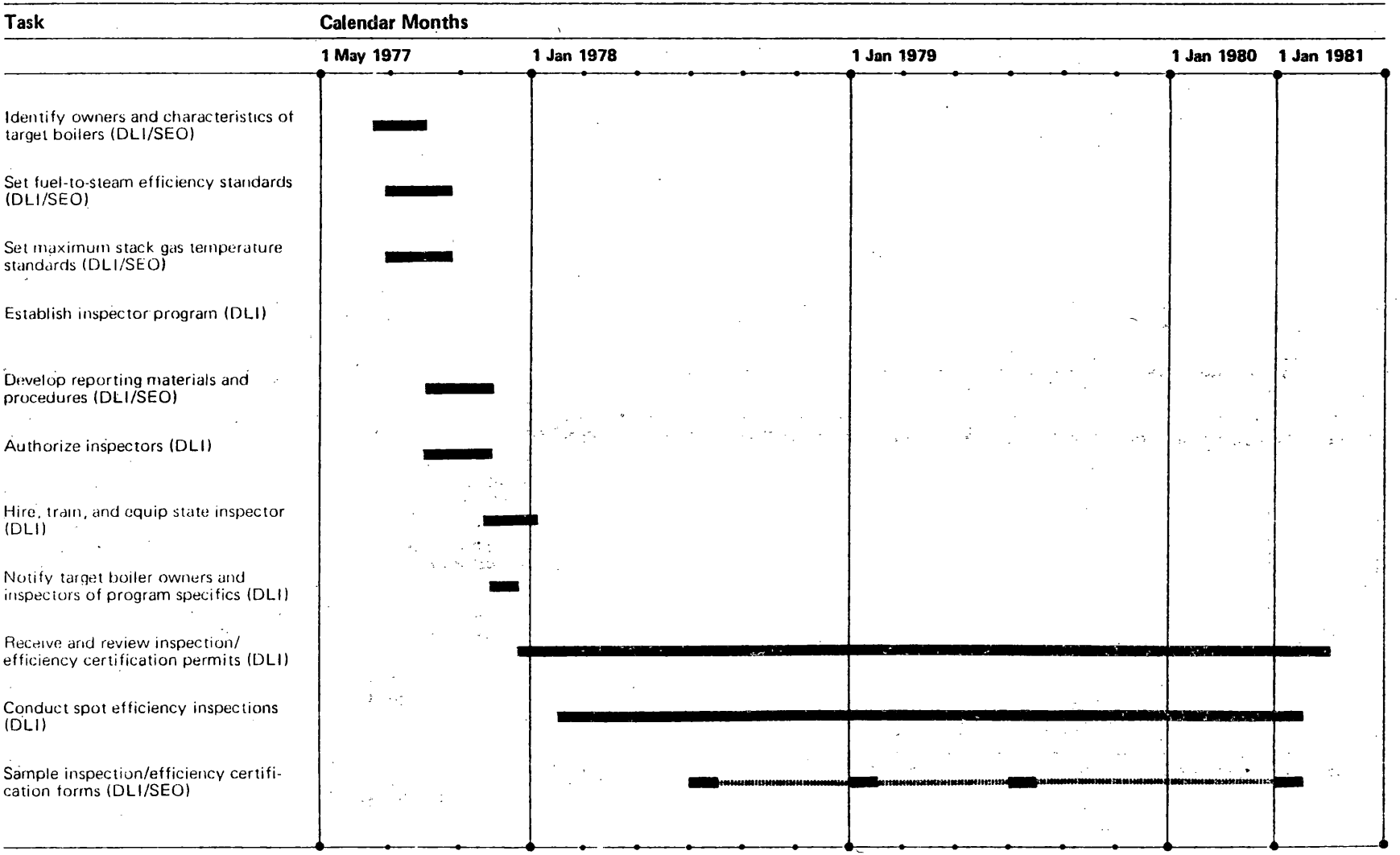
Energy efficiency licensing will begin in January 1978. (See Exhibit D-2 for the implementation tasks, responsibilities, and schedule for operator licensing.)

SEO has attended two pilot industrial workshops and is promoting future workshops. SEO will be present at as many workshops as possible and, as follow-up, will conduct telephone interviews with at least 20 percent of the attendees to evaluate improvements in boiler efficiency as a result of the workshops. (See Exhibit D-3 for the implementation tasks, responsibilities, and schedule for follow-up to the FEA Industrial Workshops.)

SEO will implement the boiler efficiency demonstration projects in four steps:

- Select appropriate state-owned boilers(s)

Improving Boiler Efficiency
Boiler Efficiency Certification Program
Implementation Schedule



Improving Boiler Efficiency
Boiler Operator Licensing Program
Implementation Schedule

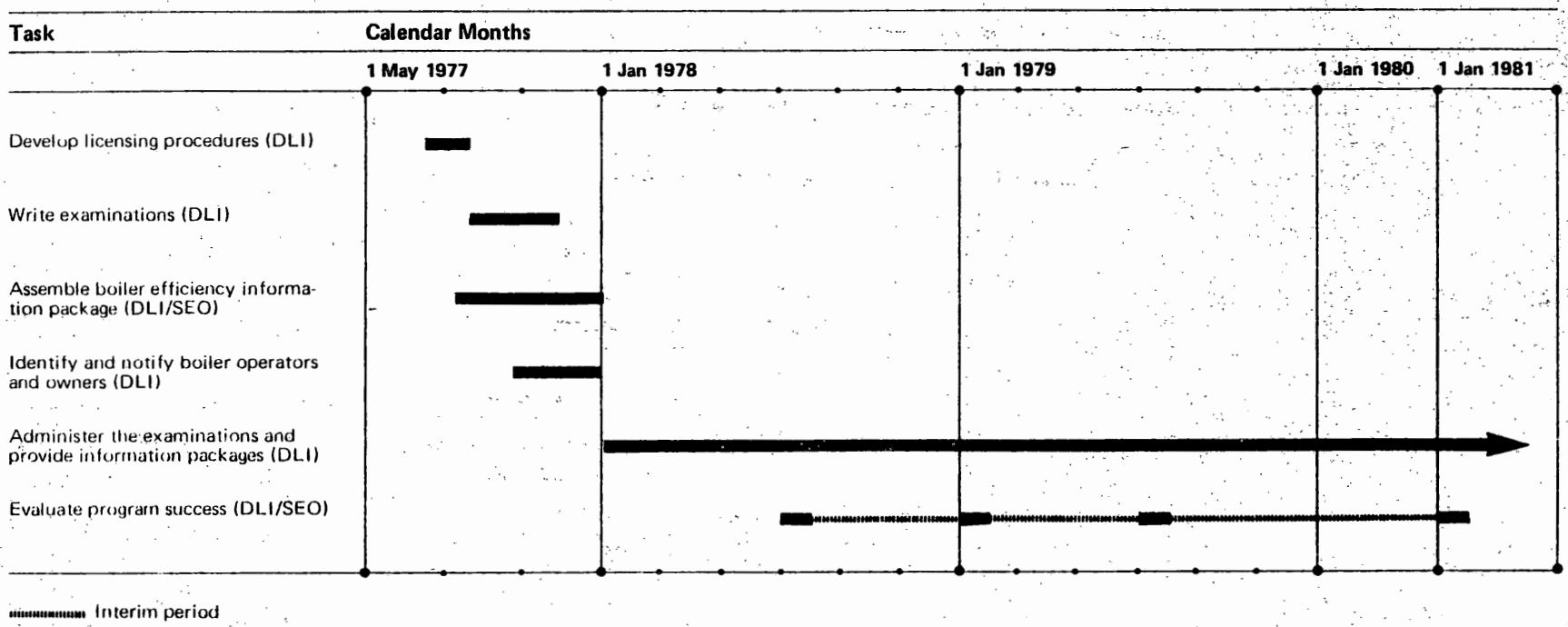
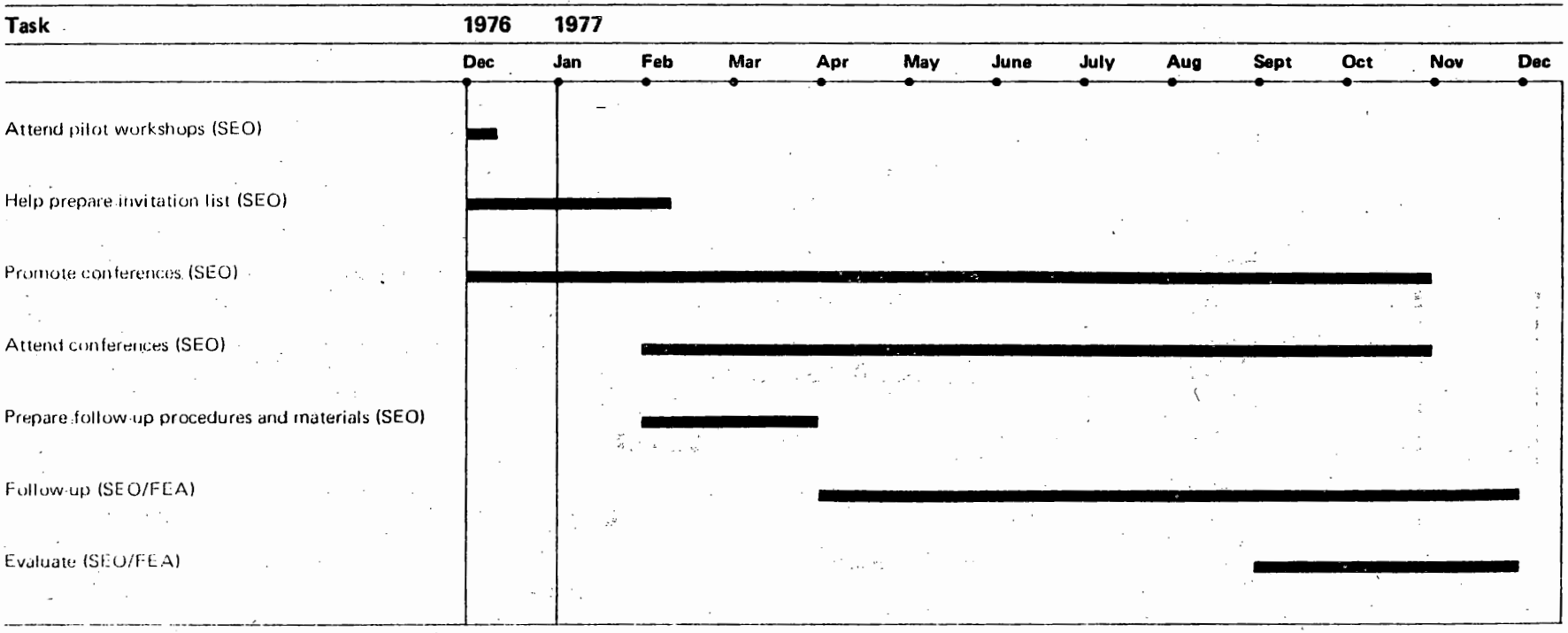
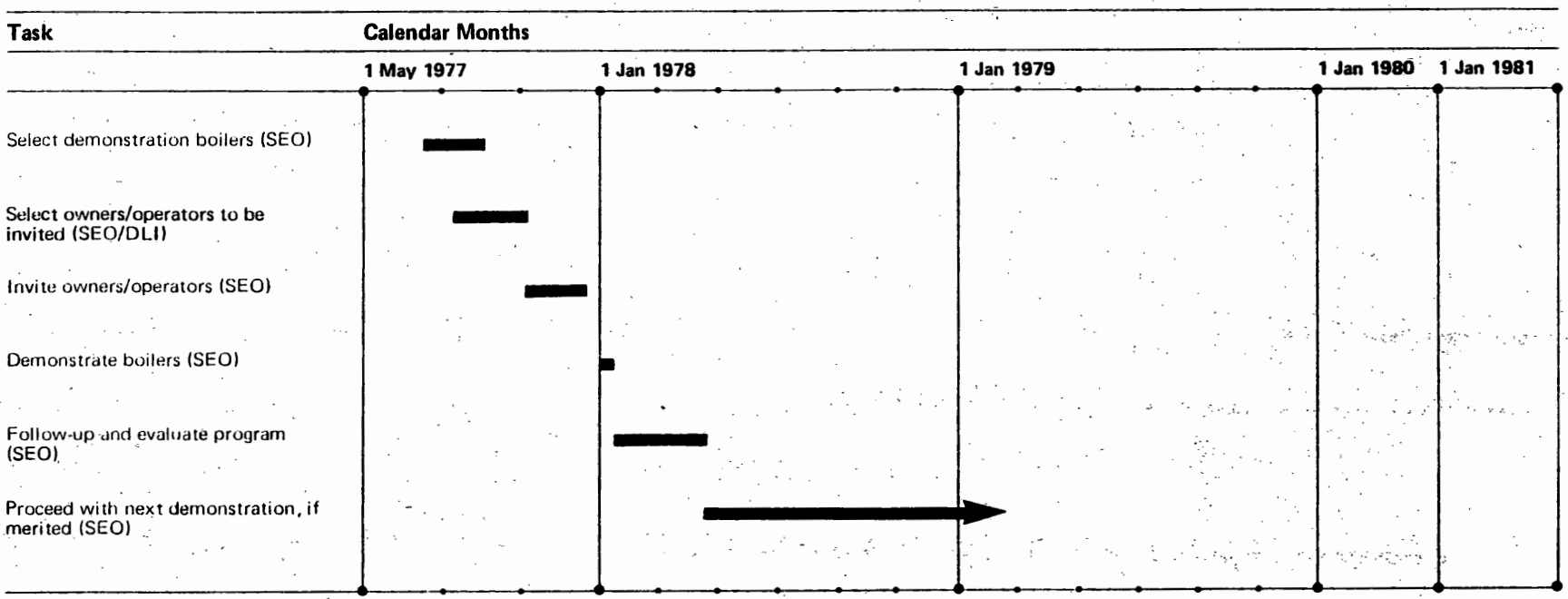


Exhibit D-2

Improving Boiler Efficiency
Follow-Up to the FEA Industrial Workshop Program
Implementation Schedule



Improving Boiler Efficiency
Boiler Efficiency Demonstration Program
Implementation Schedule



- Invite boiler owners and operators to attend demonstrations
- Conduct demonstrations showing ways to decrease boiler fuel consumption
- Telephone attendees after the demonstrations to encourage them to improve energy efficiency in their plants and to evaluate steps they may have taken as a result of the demonstration.

The first demonstration will take place in January 1978. (See Exhibit D-4 for the implementation tasks, responsibilities, and schedule for the boiler efficiency demonstration program.)

Monitoring System

DLI and SEO will sample inspection/certification forms twice a year to assess improvements in boiler efficiency. These forms will include information on operating efficiency prior to implementation of the measure, operating efficiency at the most recent inspection, and any new heat recovery or combustion equipment installed.

Related Measures

The Federal Energy Policy Conservation Act set conservation targets for the 10 most energy-intensive industries. These industries account for more than 90 percent of industry's energy use in New Jersey (see Exhibit D-5 for a summary of industry energy consumption in New Jersey). Improved boiler efficiency will be a key part of their efforts to meet the energy targets established by FEA.

ENERGY SAVINGS

Without state action, boilers rated at between 5,000 pounds and 500,000 pounds of steam per hour would use about 425 trillion Btu of energy in New Jersey in 1980. The four programs proposed in this measure will reduce energy consumption by 5.3 percent, or 22.7 trillion Btu.

Methodology

Energy savings (ES) will result from improved operating and maintenance practices and the installation of heat-recovery and combustion efficiency equipment. Savings will be a function of:

- The number of boilers in New Jersey in 1980 rated at between 5,000 pounds and 500,000 pounds of steam per hour (N).
- Average expected 1980 energy consumption per target boiler without state action (E).

Energy Consumption of 10 Most Energy-Intensive Industries in New Jersey

Industry	SIC Code	Energy Consumed in 1974	
		Billions of kWh	10^{12} Btu*
Food and kindred products	20	6.7	22.8
Textile mill products	22	2.8	9.5
Paper and allied products	26	7.3	24.9
Chemicals and allied products	28	31.4	107.1
Petroleum and coal products	29	8.6	29.3
Stone, clay, and glass products	32	12.6	43.0
Primary metals	33	7.2	24.6
Fabricated metals	34	2.8	9.5
Machinery, except electric	35	2.8	9.5
Transportation equipment	37	1.7	5.8
Total		**83.9**	**286.1**
Percent of total		**91**	**91**

SOURCE: U.S. Department of Commerce, ***Annual Survey of Manufacturers,*** 1974.

*Assumes 3,400 Btu per kWh.

- Average percent of energy saved per complying boiler as a result of improved maintenance and operating procedures (S_{mo}). This is equal to the average percentage increase in operating efficiency from improved maintenance and operation (I_{mo}) divided by the average expected operating efficiency without state action (O_e).

- Compliance rate for fuel-to-steam efficiency standards (C_{mo}).

- Average percentage of energy saved per installation of heat recovery and combustion improvement equipment (S_e). This is the average percentage of increase in operating efficiency equipment (I_{he}) divided by the average expected operating efficiency without state action (O_e).

- Proportion of the target boiler population that will install heat recovery and/or combustion efficiency equipment as a result of the measure (P_e).

The relationship among these parameters can be expressed as the following equation:

$$ES = N \times E[S_{mo} \times C_{mo} + S_e \times P_e].$$

In other words, energy savings from the measure equal the estimated energy consumed by industrial boilers in 1980 (N x E) times the average percent of energy saved per boiler as a result of improved operation and maintenance ($S_{mo} \times C_{mo}$) and as a result of new equipment installation, ($S_e \times P_e$).

Energy Savings Calculation

Total projected energy savings are 22.7 trillion Btu, assuming:

N = 8,050 boilers

E = 52.9 billion Btu per year

S_{mo} = 3.8 percent, where I_{mo} = 3 percent and O_e = 78 percent

C_{mo} = 90.0 percent

S_e = 6.4 percent, where I_{he} = 5.0 percent and O_e = 78 percent

P_e = 30.0 percent.

Therefore:

$$ES = 8{,}050 \times 52.9 \times 10^9 \text{Btu } [.038(.9) + .064(.3)] = 22.7 \text{ trillion Btu.}$$

(See Exhibit D-6 for a summary of the calculation of energy savings.)

Calculation of 1980 Energy Savings Due to Improved Boiler Efficiency

Parameter	Equation Symbol	Boiler Capacity: 5,000 to 10,000 pounds of steam per hour		Boiler Capacity: 10,000 to 500,000 pounds of steam per hour		Total	
		1975	1980	1975	1980	1975	1980
Number of target boilers	N	4,000[a]	5,500[b]	1,800[c]	2,500[b]	**5,800**	**8,050[b]**
Average expected energy consumption per target boiler (Btu x 10^9/year)	E	15.4[d]	15.1[e]	140.0[f]	137.0[e]	**54.0**	**52.9**
Average expected operating efficiency of a target boiler without state action (percent)	O_e	76[g]	78[h]	76[g]	78[h]	**76[g]**	**78[h]**
Average increase in operating efficiency per complying boiler resulting from improved maintenance and operation	I_{mo}	–	3.0[i]	–	3.0[i]	–	**3.0[i]**
Average percentage of energy consumption saved per complying boiler as a result of improved maintenance and operation	S_{mo}[j]	–	3.8	–	3.8	–	**3.8**
Compliance rate to fuel to steam efficiency standards[k]	C_{mo}	–	0.9	–	0.9	–	**0.9**
Average percentage increase in operating efficiency resulting from the installation of heat recovery or combustion efficiency equipment	I_{hc}	–	5.0[i]	–	5.0[i]	–	**5.0[i]**
Average percentage of energy saved per installation of heat recovery or combustion improvement equipment	S_e[l]	–	6.4	–	6.4	–	**6.4**
Proportion of the target boiler population that will install heat recovery or combustion efficiency equipment as a result of the measure[m]	P_e	–	30.0	–	30.0	–	**3.0**
Average percentage of energy saved as a result of the measure: T_s equals $(S_{mo} \times C_{mo}) + (S_e \times P_e)$	T_s	–	5.34	–	5.34	–	**5.34**
Total energy savings (trillion Btu/year): (ES) equals N x E x T_s	ES	–	4.5	–	18.2	–	**22.7**

a Based on boiler records compiled by the Department of Labor and Industry and discussions with boiler manufacturers. Approximates 10 percent of New Jersey boiler population in 1975.

b Assumes an annual growth rate of 6.8 percent, the average growth rate for industrial-size boilers (i.e., boilers between 10,000 pounds and 500,000 pounds of steam per hour) between 1967 and 1978. Source: KVB, Inc., ***Technical Assessment of Energy Conservation Potential in Industrial Boilers***, 1976, and W. Axtman, the American Boiler Manufacturers Association.

c Based on boiler records compiled by the Department of Labor and Industry and discussions with boiler manufacturers. Approximates 4 percent of New Jersey's boiler population in 1975.

d Assumes an average annual fuel consumption equivalent to 110,000 gallons of No. 2 fuel oil.

e Assumes a 2 percent decrease in fuel consumption due to other forces, such as increased fuel costs.

f Assumes that the energy consumption of New Jersey's industrial boilers is, on the average, equivalent to the average for the United States. Source: KVB, Inc., ***Technical Assessment of Energy Conservation Potential in Industrial Boilers***, 1976; and W. Axtman, the American Boiler Manufacturers Association.

g Based on discussion with boiler manufacturers, operators, and trade associations.

h Assumes a 2 percent increase in operating efficiency due to other forces, such as increased fuel costs.

i Conservative estimate based on: Auburn University, Department of Mechanical Engineering, ***Program for Improving Boiler Efficiency, Interim Report***, April 19, 1976; KVB, Inc., ***Technical Assessment of Energy Conservation Potential in Industrial Boilers***; and discussions with boiler manufacturers and associations.

j $S_{mo} = I_{mo}/O^e$

k RPA estimate.

l $S_e = I_{hc}/O^e$

m RPA estimate based on discussions with boiler owners, manufacturers, and trade associations.

COSTS OF MEASURE

Costs to Implementing and Administering Organizations

Boiler efficiency programs will cost New Jersey government $52,170 to implement and administer in 1977 and $63,080 in each year thereafter. DLI will bear about 75 percent of the cost, largely for the boiler efficiency certification program. (See Exhibit D-7 for a summary of costs to the implementing and administering organizations.)

Personnel requirements for implementation will include three people at DLI for boiler efficiency certification and operator licensing (working a total of 1.6 person-years each year for 1977-1980) and one person at SEO for boiler efficiency demonstration and overall coordination of boiler efficiency programs (working 0.6 person-years in 1977 and 0.4 person-years each year for 1978-1980). Total personnel costs will be $146,800 (see Exhibit D-8 for a summary of personnel costs and requirements for 1977, and 1978 through 1980).

Cost to the Private Sector

The private sector will bear three costs totaling $11.6 million by the end of 1980. First, all boilers must have a thermometer well to measure stack-gas temperature and a socket for the ORZAT testers used to measure combustion-side efficiency. The average cost of these will be $150. Second, 30 percent of the boilers will be equipped with heat recovery and/or combustion efficiency equipment at an estimated average cost of $3,000. Finally, boiler owners will pay between $30 and $100 twice a year to have each boiler inspected.

In most cases, the value of energy saved will more than offset the costs. For example, owners of an average boiler rated at 5,000 pounds of steam per hour will save about 2,500 gallons of fuel each year, or about $1,230 through improved maintenance and operation alone* and an additional $2,070 through the installation of heat recovery and/or combustion efficiency equipment.**

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* Assumes 3.8 percent reduction in energy consumption of 77,000 gallons of residual fuel oil per year at 42¢ per gallon.

** Assumes 6.4 percent reduction in energy consumption of 77,000 gallons of residual fuel oil per year at 42¢ per gallon.

ENVIRONMENTAL, SOCIAL, AND POLITICAN IMPACTS

Improved combustion, heat transfer, and heat recovery will lower stack emissions, and fuel consumption will be reduced by the equivalent of over 10,000 barrels of No. 2 fuel oil per day.

There will be some resistance from boiler owners and manufacturers. However, most owners can be convinced that the benefits outweigh the costs and no major capital expenditure is required. Most manufacturers favor the measure because it will generate more service work and increased sales of ORZAT testers, flue gas analyzers, and heat-recovery equipment.

Improving Boiler Efficiency
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Years				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	32,800	38,000	38,000	38,000	146,800
Fringe benefits (.21 x personnel)	6,890	7,980	7,980	7,980	30,830
Travel*		2,800	2,800	2,800	8,400
Equipment	500	500	500	500	2,000
Supplies	500	500	500	500	2,000
Contractual					
Construction					
Other					
Subtotal	40,690	49,780	49,780	49,780	190,030
Indirect charges (.35 x personnel)	11,480	13,300	13,300	13,300	51,380
Total	**52,170**	**63,080**	**63,080**	**63,080**	**241,410**

*Assumes 20,000 miles at $.14 per mile per year.

Improving Boiler Efficiency
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Boiler efficiency certification	1977	2 staff	1.0	DLI	14,500	14,500
Boiler efficiency certification	1977	1 inspector	0.1	DLI	23,500	2,350
Operator licensing	1977	1 staff	0.5	DLI	14,500	7,250
Boiler efficiency demonstration and general coordination	1978-1980	1 staff	0.6	SEO	14,500	8,700
Boiler efficiency certification	1978-1980	1 staff	0.3	DLI	14,500	4,350
Boiler efficiency certification	1978-1980	1 inspector	1.0	DLI	23,500	23,500
Operator licensing	1978-1980	1 staff	0.3	DLI	14,500	4,350
Boiler efficiency demonstration and general coordination	1978-1980	1 staff	0.4	SEO	14,500	5,800
Annual cost	1977					32,800
	1978					38,000
	1979					38,000
	1980					38,000
Total cost						**146,800**

WASTE OIL RECYCLING

PROGRAM MEASURE

In 1976, the New Jersey automotive sector generated 19,952,902 gallons, or 2.9 trillion Btu, of used crankcase oil.* It is estimated that, at maximum, only 60 percent of automotive crankcase oil is now being recycled. The remaining 40 percent that is not recycled is, for the most part, disposed of by individual car owners and commercial fleets operators who add or change their own oil. The drained oil either leaks out onto the roadway or driveway where the work is being done or, at best, is dumped into a nearby municipal sewage system, waterway, or back lot.

This measure will encourage the "do-it-yourself" group to save used oil for re-refining and recycling. The measure involves a public education campaign to promote individual and group support of community recycling centers. It also outlines steps to be taken on the state level for direct financial and resource support for "do-it-yourself" citizens who respond to the program. Further, the measure proposes a program that will discourage, where possible, improper or harmful disposal of collected automotive waste oil.

Total energy savings from this measure are projected to be 0.8 trillion Btu in 1980, or $2 million.

IMPLEMENTATION APPROACH

Detailed Provisions

Collection centers will be established for used oil from the do-it-yourself group at all motor vehicle reinspection stations in the state. To qualify for a reinspection license, private service stations will have to be equipped with storage facilities for used oil. In most instances, these stations are already appropriately equipped, and in many cases, the measure will formalize a practice that has already occurred on an informal basis.

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* This figure was extrapolated from 1971 data from the following sources and assumes a 2 percent annual growth rate in use.

1. U.S. Bureau of Census, Statistical Abstract of the United States, Washington, D.C., 1972.
2. U.S. Department of Commerce, Sales of Lubricating Oils and Industrial Oils and Greases (1971), MA-29C (71-1), October 1972.
3. American Society of Lubrication Engineers and American Petroleum Institute, Industrial Oily Waste Control, 1974.
4. U.S. Federal Energy Administration, Office of Conservation and Environment, Sourcebook, Vol. 2: State Energy Conservation Program, 1976.

(See Exhibit D-9 for the implementation schedule for establishing standards for reinspection stations, hiring and training staff, preparing and disseminating promotional materials, and investigating a program to provide collection containers.)

Monitoring System

Public participation in the recycling program will be voluntary. The Department of Motor Vehicles will conduct spot-checks of reinspection stations to ensure that proper facilities are available. PUC will spot-check collectors' facilities. In addition, collectors will be required to file periodic reports with the PUC on the prices, and disposal, of oil collected. These reports will be reviewed and analyzed for relevant data on the effectiveness of the measure.

ENERGY SAVINGS

Of the "do-it-yourself" group (estimated to be 40 percent of the automotive sector), 25 percent merely add oil to their supply, while 75 percent actually change their oil. Of these, approximately 85 percent discard the oil. Therefore, about 25 percent (0.40 x 0.75 x 0.85) of all automotive waste oil is potentially recoverable through the measure.*

In 1980, approximately 21.6 million gallons of automotive waste oil will be generated in New Jersey. At a value of 144,000 Btu per gallon, this is equivalent to 3.1 trillion Btu of energy. Therefore, the savings will be 25 percent, or 0.8 trillion Btu.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

During the 6-month period prior to start-up of the recycling system at local reinspection stations, the primary cost of the program will be borne by SEO. SEO will be required to develop a public information campaign and distribute published information to oil retail outlets and gas stations. Costs will be incurred developing, printing, and mailing the material. It is expected that one employee in the energy office working half-time during the last half of 1977 can manage both the generation of informational materials and the investigation of a program to supply free recycling containers.

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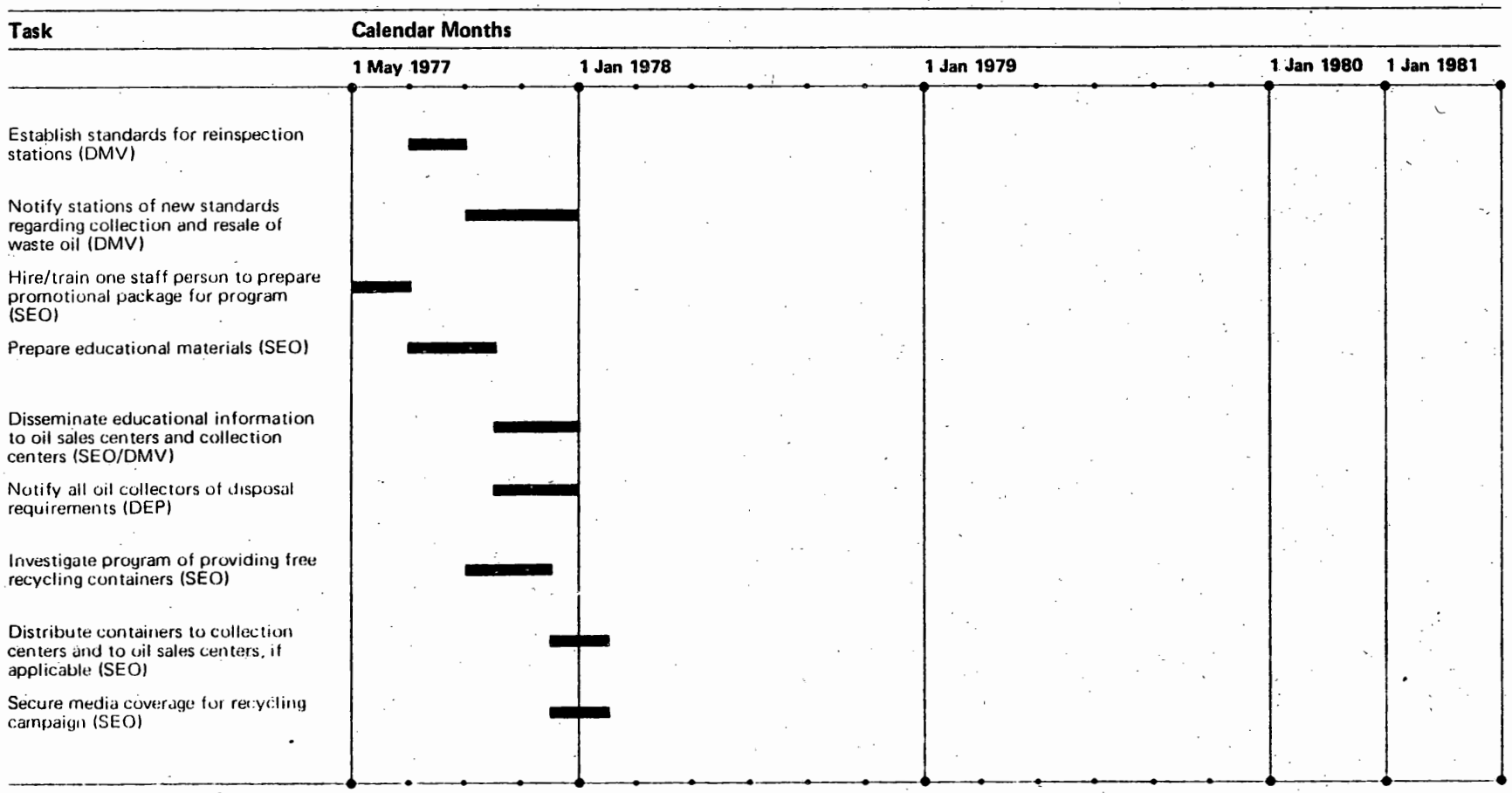
* U.S. Federal Energy Administration, State Energy Conservation Program: Methodologies for Estimated Energy Savings, prepared by Stanford Research Institute, 1976.

Waste Oil Recycling
Implementation Schedule



The measure will further mandate that all reinspection stations contract with oil collectors to pick up the used oil. These collectors will be required to sell the used oil for use as lubricant or fuel oil, rather than for land spreading or other environmentally unsound uses.

An extensive and widespread public education program will be carried out. Major retail centers that sell automotive oil (e.g., gas stations, supermarkets, department and discount stores) will be provided with educational materials, such as pamphlets and posters for display, listing collection center locations and explaining the environmental and safety hazards associated with incorrect disposal. In addition, the program will be promoted through the media with press, radio, and television coverage.

The New Jersey State Energy Office (SEO) will investigate the possibility of providing the public with free or low-cost containers for the collection of drained crankcase oil. Container distribution could occur at the point of sale, as well as at the point of collection. The manufacturing processes for containers should be taken into consideration, however. For example, if the state were to promote the manufacture of plastic containers that are made from petrochemicals, the net energy-savings from a recycling program could be significantly reduced.

Implementing and Administering Organizations

SEO will develop and disseminate the educational materials, prepare promotional programs, secure media coverage, and investigate the feasibility of distributing free or low-cost containers.

The State Department of Motor Vehicles, through its Division of Law and Safety, will amend the standards for state reinspection stations to include oil collection facilities. The Department will also require that the stations contract with a licensed collector as a prerequisite for the license application.

The Department of Environmental Protection will require that the collected oil be disposed of in an environmentally safe manner, or be processed as lubricant or fuel oil whenever possible.

Legal Mechanisms

All legal mechanisms needed to implement the measure are currently in effect.

Implementation Schedule

The recycling program for used crankcase oil will go into operation at reinspection stations on January 1, 1978. All educational materials must be distributed to collection stations and oil retail centers by that date.

At the same time, one employee at the Department of Motor Vehicles will work half-time on the project for 6 months, updating the standards for reinspection stations to include the used oil collection requirement. This employee will also organize a general mailing to all reinspection stations to inform them of the additional requirement.

No additional inspector will be required to spot-check reinspection stations for compliance. The check for oil facilities can be added to the routine inspections of these stations that are already carried out by DMV. After January 1, 1978, one PUC inspector, whose total time will equal 10 percent of a man-year, will spot-check oil collectors' facilities and review compliance forms with information on the disposal of the collected oil sent to the PUC by collectors.

Total personnel, supplies, and equipment expenditures by state agencies prior to the program's operational start-up in January 1978 will be $21,700. Annual costs for 1978-1980 will be $3,340, for a total cost of $31,720 for the program. (See Exhibits D-10 and D-11 for personnel costs and total costs, respectively.)

Costs to the Private Sector

Costs incurred by individual do-it-yourself oil changers will be minimal. For the most part, people will return used oil to collection bins at reinspection stations during normal visits for gas or car maintenance.

ENVIRONMENTAL, SOCIAL, AND ECONOMIC IMPACTS

The environmental effects of this measure will be positive. Currently, substantial amounts of crankcase oil are dumped into sewer systems, used for land spreading or oiling roads, or disposed of in other ways that contribute to environmental pollution problems. The recycling program will reduce the environmentally unsound disposal of such wastes.

Waste Oil Recycling
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Develop public campaign information	1977	1 staff	0.25	SEO	15,000	3,750
Redraft standards for reinspection stations; organize general mailing	1977	1 staff	0.25	DMV	15,000	3,750
Spot-check collectors' facilities review compliance forms	1978-1980	1 inspector	0.10	DEP	15,000	1,500
Annual cost	1977					7,500
	1978					1,500
	1979					1,500
	1980					1,500
Total cost						**12,000**

Waste Oil Recycling
Total Costs to Implementing and Administering Organizations

	Costs by Calendar Year				
Type of Costs	**1977**	**1978**	**1979**	**1980**	**Total**
Personnel	7,500	1,500	1,500	1,500	12,000
Fringe benefits (.21 x personnel)	1,575	315	315	315	2,520
Travel					
Equipment*	5,000	1,000	1,000	1,000	8,000
Supplies**	5,000				5,000
Contractual					
Construction					
Other					
Subtotal	19,075	2,815	2,815	2,815	27,520
Indirect charges (.35 x personnel)	2,625	525	525	525	4,200
Total	**21,700**	**3,340**	**3,340**	**3,340**	**31,720**

* Primarily for waste oil containers.
**Educational/promotional materials and mailings.

MEASURES SINCE DECEMBER 22, 1975:
TANK FUEL EVAPORATION LIMITS

PROGRAM MEASURE

The New Jersey Department of Environmental Protection (DEP) recently issued regulations (Subchapter 16, Chaper 27, Title 7) designed to limit the evaporation of fuels from storage tanks. These regulations require that permits be obtained for the storage and transfer of liquid hydrocarbons, and that control devices, such as floating roofs, be used to reduce hydrocarbon emissions (see Exhibit D-12 for the detailed provisions of this measure prepared by DEP). These regulations were promulgated March 1, 1976. DEP expects that industry will be in full compliance before 1980.

EXPECTED ENERGY SAVINGS

The energy savings from implementation of this program are estimated to be 8.6 trillion BTU. This estimate was derived from DEP projections that, once these regulations take effect (before 1980), 75 million gallons of petroleum products would be saved per year from storage tank losses and 12 million gallons per year from transfer and process operation losses.* These projections were adjusted downward based on the assumption that 25 percent of the savings would occur by 1980 without the measure, and then converted to Btu using the conversion factor of 5.506 million Btu/barrel of average refined petroleum products. The costs savings from the measure will be $21.5 million in 1980.

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* New Jersey Department of Environmental Protection's accompanying Notice of Public Hearing, Basis of Proposed Regulation: Control and Prohibition of Air Pollution by Volatile Organic Substances, February 21, 1975, p. 10.

CONTROL AND PROHIBITION OF AIR POLLUTION BY VOLATILE ORGANIC SUBSTANCES*

ESSENTIALS OF PROPOSED CODE

Following is a discussion of the rationale for the salient features of the proposed regulation. The comments are keyed to the subsections of the proposal. Although individual items of equipment or systems are specified in Sections of this Subchapter, such designations are intended only to indicate the standard(s) of performance desired.

7:27-16.2 - Storage of Volatile Organic Substances. Losses of volatile substances to the atmosphere from storage operations fall into two categories, those resulting from evaporation (breathing losses) and those resulting from displacement of air from the storage vessel due to changes in the volume of liquid contained therein (working losses). Temperature and degree of volatility of the substance are the principal determinants of losses by evaporation from a specified surface of liquid. Working losses generally are determined by the volume of liquid being introduced into a storage vessel and the system through which the liquid is introduced.

There are two ways in which these losses can be minimized. Temperature can be maintained as low and as constant as possible. The opportunity for the passage of vapors to the outdoor atmosphere can be restricted.

It has long been known that light colors are "cooler" than dark ones. Light colored surfaces tend to reflect the rays of the sun, thereby maintaining lower temperatures than those which are painted in darker colors. A practical application of this principle is readily apparent in the widespread use of white clothing and light colored exterior paints in warmer climates.

The proposal would reduce evaporative losses from storage operations by applying this same principle in requiring that the exterior surfaces of exposed storage tanks be painted white. According to the American Petroleum Institute, use of even a middle gray paint, increases evaporative losses by 46 percent over those which occur when white paint is used. Darker colors allow even greater emissions. The Institute further reports that evaporative losses may increase by 7 to 15 percent as the surface coating deteriorates. Therefore, the proposed regulation is designed to take advantage of the relatively inexpensive and easily utilized control

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* From attachments to N.J. Department of Environmental Protection, Notice of Public Hearing, February 21, 1975.

measure of painting storage tank exteriors white, and of maintaining such surface paint in reasonable condition.

To reduce evaporative and working losses, conservation vents or floating roofs would be required for storage vessels having a capacity of 10,000 gallons or greater. The type of control equipment is to be determined by the combination of tank capacity and vapor pressure of the substance stored, thereby taking cognizance of two principal determinants of air contaminants emitted. The terms "conservation vent" and "floating roof" are employed only to illustrate the degree of control desired. Any other apparatus or system which the Department approves as being equally or more effective will be acceptable.

In the absence of inhibiting factors, the rate of evaporation escalates as vapor pressure increases, especially when vapor pressure approaches atmospheric pressure of 14.7 psi absolute (psia). Therefore, for a substance having a vapor pressure of 13.0 psia or greater and stored in a vessel of 1,000 gallon or greater capacity, a vapor recovery system will be required. Since vapor pressure is directly related to temperature, which is not necessarily uniform throughout the substance being stored, it is intended that the temperature at which vapor pressure is to be determined will be that which is most relevant to the rate of evaporation, that (sic) at or near the interface between the liquid and vapor phases in the vessel.

Provision also is made to prevent losses through faulty and improperly maintained gauging and sampling systems. If the vapor pressure of the substance stored is 1.5 psia or greater, the systems must be vapor-tight when not in use.

7:27-16.3 - Transfer Operations. Unless precautionary measures are taken, significant vapor losses occur during the transfer of volatile organic substances from one vessel to another. Several provisions are made in the proposed code to minimize such losses.

A relatively simple and inexpensive means of reducing losses during transfer is to suppress the splashing and agitation which give rise to droplets. These liquid particles, if small enough, may be carried out of the vessel by the air being displaced or, because of the increase in the exposed liquid surface, will evaporate more rapidly.

Two regulatory proposals are targeted against the massive losses from gasoline handling operations. Transfer of this fuel into stationary or mobile receiving vessels having a capacity of 2,000 gallons or more would be prohibited unless the vessel was equipped with a vapor recovery system of 90 or more percent effectiveness, or other approved control. Losses also would be minimized at the retail sites by requiring that systems for dispensing fuel to automotive fuel tanks, on or after July 1, 1976, must maintain a vapor-tight fit with the receiving tank during transfer, prevent spillage during transfer and disconnection, collect no less than 90 percent by weight of the gasoline vapors displaced from the

receiving tank during transfer, and recover no less than 90 percent by weight of the vapors collected. The effective date is established to allow time for the purchase and installation of appropriate systems.

7:27-16.4 - Source Operations. Emissions of volatile organic substances through a stack or chimney would be limited to no more than 200 lbs/hr, the maximum emission allowed being determined from the potential emission rate that would occur were no control apparatus employed. However, the proposal gives ample consideration to emission control in coating operations (such as painting, printing and laminating with adhesives) which can be achieved through changes in proportions of solvents in the formulation, and certain relaxation is provided to encourage the development of such technology.

It is considered that no coating operation should be permitted to emit more than 200 lbs/hr of organic substances. Within this maximum, however, operations utilizing a surface coating formulation, the liquid fraction of which contains no more than 20 percent by weight of volatile organic substances when applied to the surface being coated, would be exempt from a lower maximum allowable emission rate. Until July 1, 1976, such liquid fraction could be as much as 30 percent. The time phasing is designed to permit and encourage development and wider application of existing technology while, at the same time, protecting air quality.

Similarly, within the 200 lbs/hr maximum, lesser maximum allowable emission rates would not be applicable when the surface coating formulation contains 80 percent or more by weight of solids when applied to the surface being coated. Again to further encourage developments in technology and wider utilization, the relaxation would be applicable to formulations containing 70 or more percent of solids until July 1, 1976.

7:27-16.5 - Opacity. Higher concentrations of some volatile organic substances can result in density of particles sufficient to obstruct the transmission of visible light, particularly when conditions are such as to promote condensation of vapors near the stack exit. This form of air pollution is controlled by a proposed performance standard.

7:27-16.6 - Odors. About 90 percent of the air pollution complaints received by the Department are prompted by odors. Therefore, a significant portion of the enforcement effort and a concomitant share of resources are directed to the control of air pollution caused by odorous substances. It is noteworthy that nearly all of the odorous materials involved in complaints are volatile organic substances. Hence it would be shortsighted to control a family of air contaminants for only one kind of air pollution effect caused by them without also addressing the issue of their other effects, particularly those which are of most concern to the public.

7:27-16.7, 16.8, 16.9 - Emission Information and Tests, Variances, Permit to Construct and Certificate to Operate. The proposed rules

concerning these items parallel those which appear in other air pollution regulatory measures of the New Jersey Administrative Code. The test and analytical procedures which the Department is considering to employ in the enforcement of Subchapter 16 are appended hereto. Comment also is invited on these procedures, which will be published separately from the Subchapter which is ultimately adopted.

7:27-16.10 - Applicability. Certain volatile organic substances, because of their chemical composition or the source category from which they arise, may already be subject to some provisions of N.J.A.C. 7:27. For example, a sulfur bearing organic compound such as ethyl mercaptan must conform to the requirements of N.J.A.C. 7:27-7.2 (control and prohibition of air pollution from sulfur compounds). The purpose of this section of the proposed regulation is to make clear that other relevant provisions of N.J.A.C. 7:27 are not intended to be mutually exclusive with this Subchapter and that compliance with all such provisions will be required.

7:27-16.11 - Exceptions. The provisions of the proposed regulations could be in conflict with some approvals previously granted by the Department in issuing Permits to Construct, Install or Alter and Certificates to Operate for control apparatus or equipment. In order to alleviate potential hardships which might arise from such inconsistencies, the effective date of the regulation as it applies to these specific cases will be deferred until July 31, 1977, the date by which the national ambient air quality standard for photochemical oxidants must be attained.

APPENDIX E

NEW JERSEY ENERGY CONSERVATION PLAN
TRANSPORTATION MEASURES

RIGHT TURN ON RED

PROGRAM MEASURE

This measure, which went into effect on January 1, 1977, allows motor vehicles to make a right turn at red traffic lights. The minimal amount of engine idling at intersections provided by this policy will result in 1980 energy savings of 0.6 trillion Btu, or $1.5 million.

IMPLEMENTATION APPROACH

In January 1977, the state of New Jersey adopted a program to permit vehicles to turn right at red traffic signals. This program should act to improve energy efficiency of motor-vehicle transportation by reducing the engine-idling time of right-turning vehicles stopped at red lights.

According to this policy, a car facing any red signal may, after stopping as required, cautiously enter the intersection to turn right, or to turn left from and into a one-way street. The vehicle making a turn as described above shall yield the right-of-way both to pedestrians crossing within the marked boundaries of an adjacent crosswalk and to other traffic lawfully using the intersection. This policy is now in effect at all intersections with traffic signals, except those where a turn prohibition is posted. Generally, turns are prohibited at intersections where visibility is limited, where pedestrian traffic is heavy, near school zones, where accidents frequently occur, and where a right turn on a red light would conflict with existing left turn signals.

DOT is responsible for the implementation of this measure on state highways. On other highways, responsibility rests with local traffic or public works departments. All necessary legal mechanisms associated with this measure were developed and implemented prior to January 1, 1977, and are expected to remain in effect through and beyond 1980. State and local police departments share enforcement responsibilities as appropriate.

EXPECTED ENERGY SAVINGS

In New Jersey, there are approximately 26,800 intersection approaches (i.e., streets leading into intersections) with traffic lights, including 6,800 state and 20,000 county and local intersection approaches. Of these, a total of 4,000 have been excluded from the Right Turn on Red (RTOR) program, meaning that approximately 22,800 intersection approaches are affected by the RTOR program. Energy consumption attributable to delays at intersections with traffic signals is expected to reach 9.9×10^{12} Btu per year in 1980. Therefore, there are potentially significant savings associated with the RTOR program.

Below, the method for calculating savings as well as the expected savings are presented. Energy savings (ES) were calculated using basic traffic-flow theory, specifically the queuing analysis technique.* The savings attributable to RTOR result from a reduction in vehicle delay at traffic signals. In effect, RTOR means that traffic signals act as stop signs for those turning right. The amount of reduction in delay per vehicle will be equal to the average amount of delay a vehicle may expect when approaching a stop light minus the average amount of delay to be expected when approaching a stop sign. Energy savings will be a function of:

- Number of intersection approaches affected by RTOR conversion (N), or 11,400 approaches**
- Fuel consumption of an idling vehicle (F_c), or 17.5×10^{-5} gallons per second***
- Approach volume (V_a) = $V_1 + V_2$:

  where V_1 = 10,000 vehicles per day on arterial approach
  V_2 = 4,000 vehicles per day on side street approach†
- Days per year (d), or 365
- Average percentage of right turns (R_t), or 10 percent†
- Average length of signal cycle (c), or 90 seconds†
- Green time in intersection approach:†

  where g_1 = 60 seconds (arterial approach)
  g_2 = 30 seconds (side-street approach)
- Peak hour approach volume:

  where Q_1 = 1,000 vehicles per hour (arterial)
  Q_2 = 400 vehicles per hour (side street)

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* Institute of Traffic Engineers, Transportation and Traffic Engineering Handbook, 1976, pp. 306-307.

** DOT provided the value for N.

*** Robley Winfrey, Economic Analysis for Highways, p. 342.

† Data provided by Wilbur Smith and Associates, Inc.

- Degree of saturation (approach volume ÷ saturation flow):

  where X_1 = 0.08 (arterial
  X_2 = 0.23 (side street)

- Flow rate of cross street:

  where q_1 = 0.28 vehicles per second
  q_2 = 0.11 vehicles per second

- Critical headway at cross street (T), or 5 seconds

- Average delay per vehicle (Z):

  where Z_1 = average delay in seconds (arterial approach)
  Z_2 = average delay in seconds (side-street approach)

- Conversion factor K, or 1.25 x 10^5 Btu/gallon.

The relationship among these parameters is expressed as:

$$ES = dF_c N V_a R_t \left(\frac{c-g}{c}\right)\left(Z_1 + Z_2\right)K$$

where

$$Z_1 = 0.9\left[\frac{C(1-g_1/c)^2}{2(1-g_1X_1/c)} + \frac{X_1^2}{2Q_1(1-X_1)}\right] - \left(\frac{e^{q_2t}-1-q_2T}{q_2}\right)$$

$$Z_2 = 0.9\left[\frac{c(1-g_2/c)^2}{2(1-g_2X_2/c)} + \frac{X_2^2}{2Q_2(1-X_2)}\right] - \left(\frac{e^{q_1t}-1-q_1T}{q_1}\right) .$$

Total projected energy savings for 1980, derived from the above equation, are 0.6 x 10^{12} Btu, which is equivalent to 4,000,000 gallons of motor fuel, or about one-thousandth of New Jersey's 1980 gasoline consumption.

COSTS OF THE MEASURE

DOT estimated the total costs of implementing the RTOR program at $240,000, of which $200,000 would be for turn prohibition signs (including materials and labor), and $40,000, for planning. The state has already made these expenditures.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

Reduced engine-idling time at intersections with traffic signals will result in a corresponding reduction in vehicle emissions and, hence, an increase in air quality. Furthermore, the motor fuel saved by New Jersey motorists will have a retail value of approximately $2,000,000 a year.

The political impacts of the RTOR program will be negligible.

ENFORCEMENT OF 55-MILE-PER-HOUR SPEED LIMIT

PROGRAM MEASURE

This measure will require strict enforcement of the existing 55-mph speed limit with more stringent penalties for speeding violations than are now in force, and a public information and education program advocating compliance with the 55-mph limit.

Energy savings resulting from implementation of the measure are estimated to be 2 trillion Btu in 1980, or $5 million.

IMPLEMENTATION APPROACH

Detailed Provisions

Under the measure, conventional enforcement techniques will be applied to reduce the 85th percentile speed to 55 mph on access-controlled highways, with a concomitant reduction in overall average running speed.* On the basis of a New Jersey State Policy survey, in 1976, the 85th percentile speed of vehicles using New Jersey's access-controlled highways is estimated at 58 mph and average running speed of 52.6 mph; 57.9 percent of the vehicles traveled over 53 mph.

The strict enforcement techniques mandated by the measure will reduce the number of vehicles exceeding 55 mph to 15 percent. These techniques include increased surveillance using additional speed measuring equipment and the issuance of more citations by the New Jersey State Police. A satisfactory level of enforcement will be shown by a reduction of the 85th percentile speed to 55 mph.

The state will also:

- Instruct the state police to end the practice of writing citations for lower speeds than those actually attained by violators
- Increase fines for violations
- Withhold driving privileges temporarily for less serious offenses
- Increase insurance rates for convicted speeders

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* The 85th percentile speed is that speed below which 85 percent of all traffic units travel.

- Institute a public information program to warn motorists of increased surveillance and penalties.

Implementing and Administering Organizations

The measure will be implemented and administered by the agencies presently responsible for highway law enforcement, namely, DOT (DMV) and the New Jersey State Police. DOT will develop and implement the public information and education campaigns.

Legal Mechanisms

Most legal mechanisms necessary for implementation of the measure are in place. The 55-mph speed limit, for example, is established by federal and New Jersey State laws. The proposed change in citation policy can be implemented without new legislation. However, the New Jersey legislature must amend the New Jersey Motor Vehicle Code to increase fines for speeding convictions and withdraw driving privilege for less serious violations. The public information and education program will require no additional legislation because it will be an extension of existing programs.

Implementation Plan and Schedule

Implementation of the measure entails the following actions:

- No later than July 1977, the governor will endorse the measure and direct responsible agencies to take required actions as soon as practical.
- In September 1977, the state police will adopt the more rigorous citation policy, consistent with legal limits and individual rights.
- The state police will acquire approximately 200 additional speed surveillance units and place them in operation in September 1977.
- The office of the State Attorney General will direct the state police to eliminate or reduce the practice of writing citations for lower-than-recorded speeds. This policy will be fully in force by September 1977.
- DMV will restructure fines for speeding violations and will redefine driving privileges for habitual offenders. These changes will be enacted by the state legislature and be in effect by the end of 1977.

- DOT and DMV will initiate the public information program in July, after the governor's announcement but before increased issuance of citations. The programs will include highway signs, multimedia exposure, and conventional driver-education courses.

The measure will be in effect by the end of 1977 and will continue in full force to, and after, 1980. (See Exhibit E-1 for the implementation schedule.)

Monitoring System

Customary speed checks by DOT and the state police will be used to monitor the program and will indicate when the 85th percentile speed has been reduced to 55 mph.

EXPECTED ENERGY SAVINGS

Current and Projected Energy Use

Travel in New Jersey in 1976 is estimated at 48 billion vehicle miles of travel (VMT), approximately 9.6 billion VMT (20 percent) on access-controlled highways. By 1980, travel is projected to be 54 billion VMT. Assuming that 20 percent of this total will be on access-controlled highways, 10.8 billion vehicle miles will be affected by implementation of the measure.*

The 1976 fleetwide fuel-consumption rate for automobiles is estimated to average 15 miles per gallon and is expected to increase to an average of 18 miles per gallon by 1980.** Fuel efficiency for other vehicles is expected to change only slightly between 1976 and 1980; consequently, 1980 fuel consumption is estimated to average 5 miles per gallon for trucks, 6.5 miles per gallon for new buses, and 4 miles per gallon for old buses. Assuming that 86 percent of all travel in New Jersey is automobile travel, at these consumption rates the average fuel consumption rate of all vehicles is estimated at 11.7 miles per gallon for 1976 and 13.2 miles per gallon for 1980.

Energy consumption attributable to vehicles traveling on access-controlled highways may then be estimated at 105 trillion Btu for 1976 and 106 trillion Btu for 1980 without implementation of the measure.

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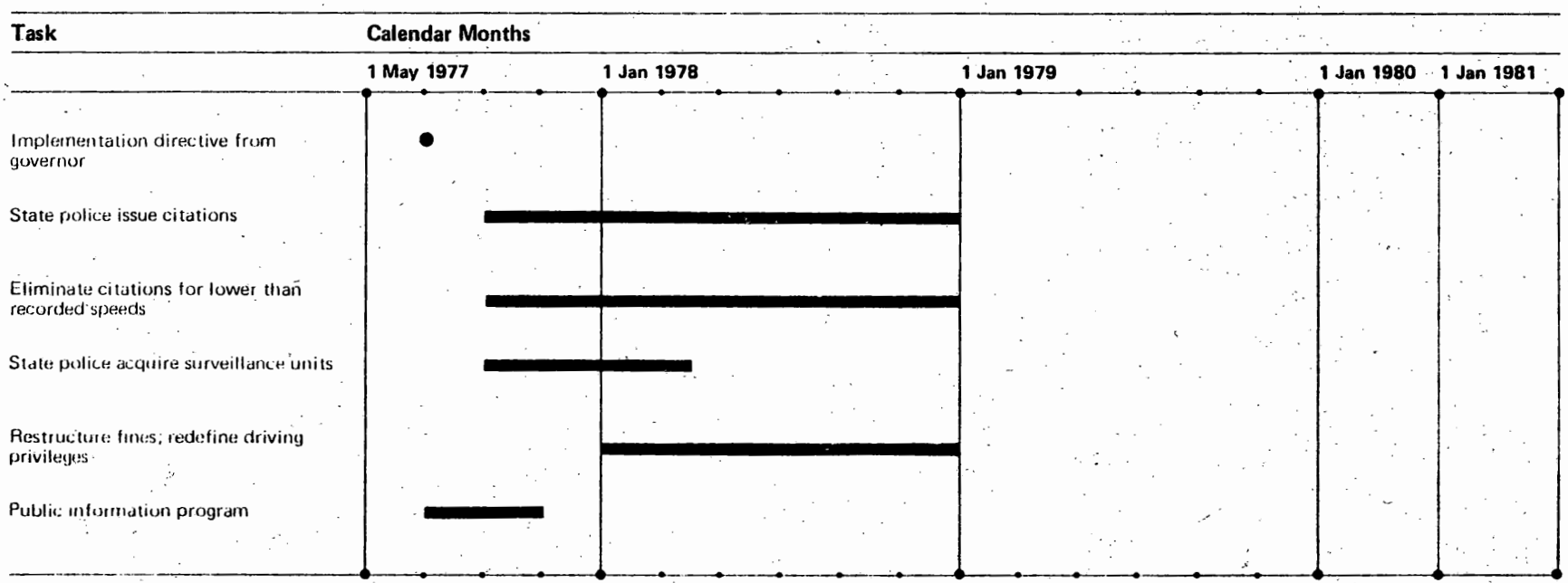
* Estimates by Wilbur Smith and Associates in NJDOT, Master Plan for New Jersey Transportation (1972).

** New Jersey Department of Environmental Protection estimates.

Enforcement of 55 mph Speed Limit
Implementation Schedule



Methodology for Calculating Energy Savings

Energy savings will result from the reduction of the 85th percentile speed from 58 mph to 55 mph. The methodology for calculating these energy savings has two major steps: calculation of the number of vehicles whose speed will be reduced to this level by implementation of the measure; and calculation of the resultant energy savings.

In the first step, vehicles are distributed into speed groups, as follows:

	1976 Distribution*	1980 Distribution (under the measure)		
Speed Group	(All vehicles) (%)	Cars (%)	Trucks (%)	Buses (%)
0-55 mph	42	85.0	85.0	85.0
55-60 mph	46	11.7	12.7	13.3
60-65 mph	9	2.5	1.8	1.5
over 65 mph	3	0.8	0.5	0.2
TOTAL	100	100.0	100.0	100.0

For the purposes of calculations, assume that:

- The 1976 distribution will be valid in 1980 if the measure is not implemented
- All vehicles, except those in the 0-55 mph group, are affected by the measure
- Each vehicle in any speed group travels at the mean speed of the group (e.g., all vehicles in the 60-65 mph group travel at 62.5 mph)
- All vehicles moving into the 0-55 mph group as a result of the measure will travel at 55 mph
- All vehicles in the over 65 mph group travel at 67.5 mph.

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* New Jersey State Department of Transportation, Bureau of Data Resources, Planning Road Inventory Speed Monitor Survey (1976).

The fuel-consumption rates in miles per gallon of cars, trucks, and buses on access-controlled highways at the assumed speeds are:

	55 mph	57.5 mph	62.5 mph	67.5 mph
Cars	22.6	21.70	19.90	18.10
Trucks	5.8	5.65	5.35	5.15
Buses	5.8	5.65	5.35	5.15

The measure produces energy savings by requiring vehicles now traveling at speeds above 55 mph (58 percent of all vehicles) to travel at lower speeds. The energy savings (ES) are equal to the amount of energy these vehicles would use in 1980 without implementation, minus the amount of energy they would use in 1980 with implementation. This may be calculated in the second step of the methodology as follows:

$$ES = V_A \left[\frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right] \text{without measure} -$$

$$V_A \left[\frac{\%\text{ added to 0-55}}{\text{mpg at 55}} + \frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right] \text{with measure}$$

$$+ V_T \left[\frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right] -$$

$$V_T \left[\frac{\%\text{ added to 0-55}}{\text{mpg at 55}} + \frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right]$$

$$+ V_B \left[\frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right] -$$

$$V_B \left[\frac{\%\text{ added to 0-55}}{\text{mpg at 55}} + \frac{\%\text{ in 55-60}}{\text{mpg at 57.5}} + \frac{\%\text{ in 60-65}}{\text{mpg at 62.5}} + \frac{\%\text{ over 65}}{\text{mpg at 67.5}} \right]$$

where V_A = estimated automobile travel on access-controlled highways by 1980
$= 9.29 \times 10^9$ VMT*

V_T = estimated truck travel on access-controlled highways by 1980
$= 1.49 \times 10^9$ VMT*

V_B = estimated bus travel on access-controlled highways by 1980
$= 0.02 \times 10^9$ VMT.*

The equation then yields:

ES = 16.4×10^6 gal gasoline
$= 2.05 \times 10^{12}$ Btu (at 1.25×10^5 Btu per gallon).

COST OF THE MEASURE

The current budget of the New Jersey State Police includes a $250,000 grant from the New Jersey State Office of Highway Safety for the purchase of 200 portable radar speed-detector units, which, with current enforcement techniques, should provide sufficient support for the intensified enforcement program.

The costs of increased levels of citation will be borne by current administrative budgets. Citations issued on access-controlled highways are processed in the district of issue, so that the added administrative workload will be distributed and the processing costs negligible.

The cost of restructuring fines for speeding violations and of withdrawing driving privileges for less serious offenses will be borne by DMV, and no additional funding is required.

The cost of educational programs will be borne by ongoing DOT and DMV programs.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

Positive environmental impacts will result from reduced fuel consumption and exhaust emissions. Reduced automobile operating cost (through

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* Estimates by Wilbur Smith and Associates based upon New Jersey State Department of Transportation (NJDOT) Master Plan for New Jersey Transportation (1972), and various DOT traffic counts throughout the state.

lower fuel consumption) and increased safety are positive social impacts. No negative environmental or social impacts are expected.

Political impacts are mixed. Two nationwide surveys indicate a positive reaction to the 55-mph speed limit; 73 percent of respondents to a recent nationwide Gallup poll and 72 percent of respondents to an Advertising Council survey favored the limit. Truck drivers have voiced opposition to it because it results in longer trip times, but some fleet owners favor the limit because it reduces operating costs. At least one major motor freight carrier, Consolidated Freightways, maintains its own unmarked radar-equipped patrol cars to enforce observance of the speed limit by company drivers.

EXPANDED INSPECTION PROCEDURE FOR AUTOMOBILE EMISSIONS

PROGRAM MEASURE

The measure, which will institute Phase 3 of New Jersey's mandatory emissions testing program, will produce energy savings by mandating more effective maintenance and tuning of automobile engines to reduce polluting exhaust emissions.

The New Jersey Department of Environmental Protection (DEP) has estimated energy savings from the testing program to be 8.8 trillion Btu by 1980, of which 3.1 trillion Btu, or $7.8 million, can be attributed to Phase 3.

IMPLEMENTATION APPROACH

Detailed Provisions

The measure establishes the regulations for the third phase of a three-part program requiring all vehicles in New Jersey to be tested for compliance with state standards for vehicle exhaust emissions. The emissions test is a regular part of the state's annual motor vehicle inspection.

The program was initiated in 1974. The first phase required owners whose vehicles had failed to meet emissions standards to have the engines adjusted and retested. The second phase, which was introduced in 1975, imposed more stringent emission standards. Phase 3 of the emissions testing program will establish even more stringent standards for heavier vehicles with high fuel-consumption rates. The Phase 3 procedures will:

- Establish more restrictive emissions standards for heavier vehicles than for light, energy-efficient vehicles
- Prohibit tampering with emission control systems
- Provide for training and certification of emission control mechanics who will apply the new standards
- Establish an upper limit on the cost of repairs required to meet the new emission standards for cars more than 9 years old
- Entitle vehicle owners (in specific cases) to reimbursement by the manufacturer for required repairs. (This provision is subject to adoption by the U.S. Environmental Protection Agency of regulations to increase the emission warranty provisions of the Clean Air Act.)

Implementing and Administering Organizations

The measure will be administered and implemented by DEP through the DMV annual vehicle inspection program.

Legal Mechanisms

DEP is empowered to implement the measure as proposed or amended after a mandatory public hearing on the measure.

Implementation Plan and Schedule

Definition of proposed regulations for Phase 3 was completed in December 1976. The remaining steps to implement the measure fully are:

- Conduct a public hearing to review the proposed regulations; this hearing is scheduled for March 1977.
- Revise training procedures and retrain employees during the 180-day waiting period following the hearing.

The Phase 3 emissions testing procedures and revised standards will become effective by January 1, 1978. By the end of 1978, all automobiles registered in New Jersey will have been tested under the new regulations. (See Exhibit E-2 for the implementation schedule.)

Monitoring System

The effects of the measure will be monitored through the annual vehicle inspection program. Inspection stations will record the number of vehicles tested and rejected. The records will be compiled by DMV and reported to DEP and SEO for evaluation.

EXPECTED ENERGY SAVINGS

Energy savings (ES) are a function of vehicle-miles travelled (VMT) and the improved fuel economy resulting from implementation of the measure. The state Bureau of Air Pollution Control estimates that savings for 1980 will be 3.1 trillion Btu.

The U.S. Federal Energy Administration has adopted a methodology for calculating energy savings that uses more complex variables. These are:

- Percent of vehicles inspected (N) = 100 percent

Expanded Inspection Procedure for Auto Emissions
Implementation Schedule

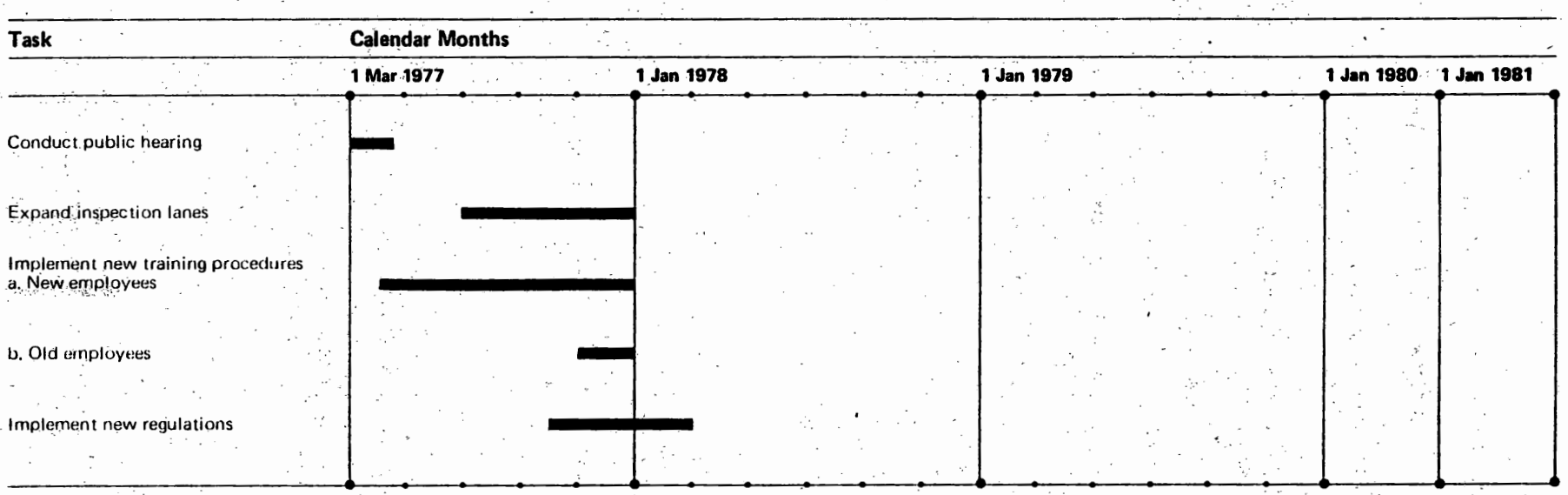

Exhibit E-2

- Percent of vehicles failing (F) = 23 percent*
- Compliance factor (K) = 1.0 (mandatory inspection)**
- Percent fuel-consumption improvement (S) = 10 percent (assuming 80 percent of travel is in urban areas)
- Deterioration factor (D) = 0.37 (accounts for deteriorating engine efficiency between inspections)**
- Annual consumption of gasoline for transportation in New Jersey (C) = 425.2×10^{12} Btu.**

Multiplication of these factors yields higher energy savings than the Bureau of Air Pollution Control computation, as follows:

$$ES = (N)(F)(K)(S)(D)(C)$$

$$= (1.0)(0.23)(1.0)(0.10)(0.37)(425.2 \times 10^{12} \text{ Btu})$$

$$= 3.6 \times 10^{12} \text{ Btu.}$$

COST OF THE MEASURE

Costs to Implementing and Administering Organizations

DMV costs for the program have already been budgeted. Existing facilities will be used to retrain DMV personnel in the application of Phase 3 regulations; some additional personnel costs will be minor. (Each inspection lane now averages 260 vehicles inspected per day; implementation of the measure will increase volume in existing lanes by an average of 8 vehicles per day.)

Costs to the Private Sector

DEP projects that savings in fuel cost of all three phases of the emission program will essentially balance the cost of the program to motorists in 1980, which is estimated to be $40.8 million.*** This figure represents the cost of inspections (fees) and reinspection costs, the $1.80 increase in vehicle registration fees imposed in 1976, and the cost of adjustments

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* Bureau of Air Pollution Control estimate.

** U.S. Federal Energy Administration estimate.

***New Jersey Department of Environmental Protection, Analysis of Proposed Amendments.

to vehicles rejected by the inspection program. On the basis of projected vehicle registration of 4,589,000 vehicles in 1980, the average cost per vehicle will be $9.00.

Approximately one-third of the private-sector cost of the program for 1980, or $13.6 million, may be attributed to Phase 3.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

This measure will result in reduced fuel consumption and exhaust emissions. There will be no adverse environmental impacts.

PROMOTION OF CAR POOLS AND VAN POOLS

PROGRAM MEASURE

The measure will increase use of car pools and van pools for work trips in New Jersey and between New Jersey and New York City.

Implementation of the measure will reduce total vehicle miles of travel, with resulting energy savings estimated for 1980 to be 6.5 trillion Btu, or $16.3 million.

IMPLEMENTATION APPROACH

Detailed Provisions

New Jersey, New York State, and the Port Authority of New York and New Jersey will initiate a joint program to encourage car pooling and van pooling in New Jersey and New York City.

- The three participants will establish a car pool/van pool steering committee, made up of representatives of NJDOT, the Port Authority, and NJSEO. The committee will:
  - Determine the cost of the program and the shares of the cost to be contributed by the states and the Port Authority
  - Identify the target areas in which the program can be implemented most successfully
  - Conduct market surveys in these areas to evaluate the program's potential
  - Provide computerized passenger-matching services to interested employers in the target areas.
- NJSEO and NYSEO will encourage employers in target areas in their respective states to sponsor car pooling and van pooling, offering incentives and disincentives such as preferential parking for car pools and van pools, limitations on employee parking spaces, and employee information programs.
- The Port Authority and NJDOT will provide their computer passenger-matching services to interested employers and to the public at large.
- The state energy offices will assist the Port Authority and NJDOT in distributing questionnaires on travel habits to employees of interested companies and in collecting responses.

The measure will build on the Port Authority's car-pooling matching program to reduce the number of vehicles using its trans-Hudson crossings.

Implementing and Administering Organizations

The measure will be implemented and administered jointly by the New Jersey and New York State Energy Offices, the New Jersey Department of Transportation, and the Port Authority of New York and New Jersey.

Legal Mechanisms

No new legal mechanisms are required.

Implementation Plan and Schedule

The car pool/van pool steering committee should be established by July 1, 1977. Target areas will be identified and market surveys completed by early 1978. Employers in target areas will be identified by NJSEO and NYSEO and contacted during the last stages of the market survey. Publicity campaigns and distribution of questionnaires will begin in the spring of 1978, after the surveys are completed. Computer matching for new program participants will begin when the first responses are received. The full benefit of the expanded program will be realized by the end of 1978. (See Exhibit E-3 for implementation schedule.)

Monitoring System

The program will be monitored mainly through vehicle-occupancy checks on New Jersey highways and at Port Authority crossings. An increase in the number of riders per vehicle will demonstrate the degree of success of the promotion programs.

As individual companies become active in the program, the state energy offices will tabulate the numbers of car pools, the numbers of employees using car pools, and related incentives. This information will be used in public relations campaigns supporting the program.

Quarterly reports to U.S. Environmental Protection Agency, now required only of early entrants in the car pool program, will be required of all new car-pooling organizations. Copies of reports will be distributed to the state energy offices, departments of transportation, and the Port Authority.

Promotion of Car Pools and Van Pools
Implementation Program

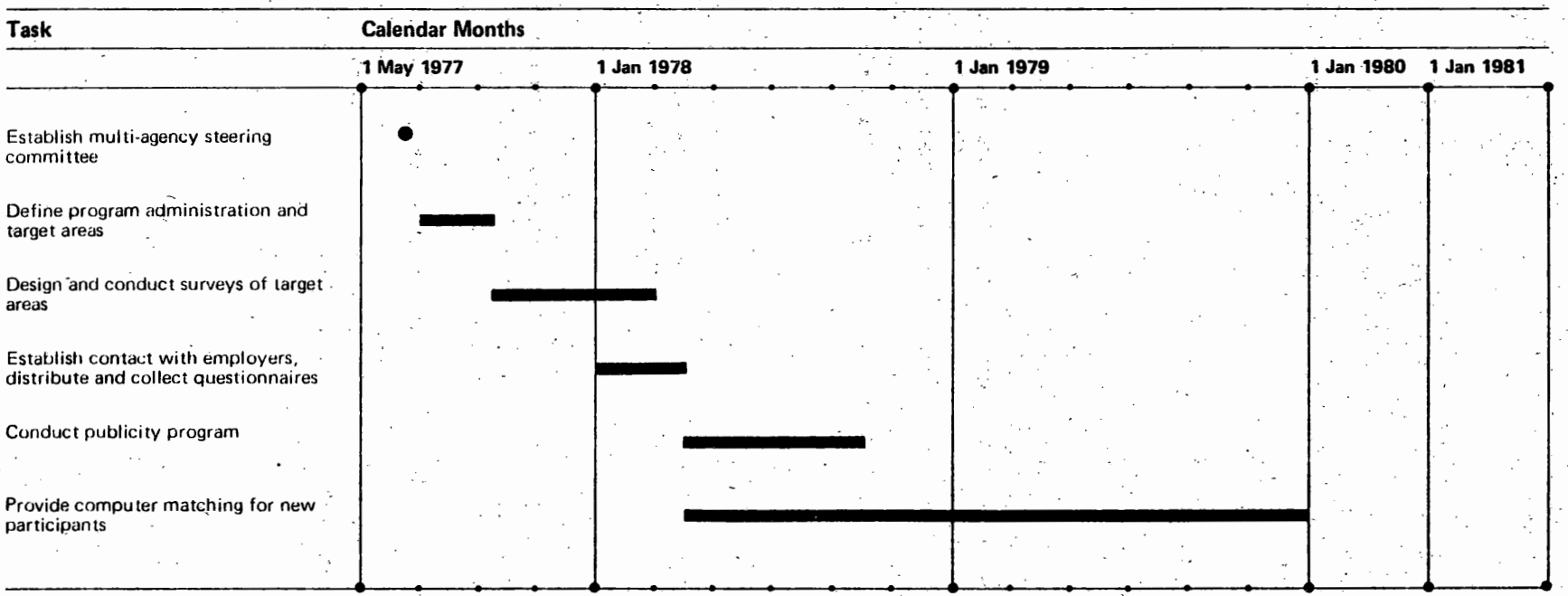

Exhibit E-3

EXPECTED ENERGY SAVINGS

Current and Projected Energy Use

In 1976, commuters traveled approximately 19.4 billion vehicle-miles in New Jersey.* Assuming a fleetwide fuel-consumption rate of 15 miles per gallon, they consumed 160 trillion Btu.** If there are no major shifts to mass transit, commuter travel for 1980 is expected to be 23.2 billion vehicle-miles and energy consumption 161 trillion Btu, assuming an improved fleetwide fuel-consumption rate of 18 miles per gallon.***

Methodology for Calculating Energy Savings

Energy savings (ES) from reduced vehicle miles of travel (VMT) is a function of:

- Projected 1980 vehicular travel (V) = 54 billion†
- Percentage (v_a) of V that is automobile travel = 86 percent††
- Percentage (C) of v_a that is commuter travel = 50 percent†††
- Estimated shift from 1-passenger vehicles to car pools and van pools (S) = 4 percent‡
- Estimated 1980 fleet fuel-consumption rate (C_R) = 18 miles per gallon
- Btu/gallon conversion factor (F) = 1.25×10††

and can be calculated, using the following equation:

$$ES = \frac{Vv_aCSF}{C_R} = 6.5 \times 10^{12} \text{ Btu.}$$

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* Wilbur Smith and Associates, from data made available by the New Jersey Department of Transportation.

** New Jersey Department of Environmental Protection data.

***Wilbur Smith and Associates, from data made available by the New Jersey Department of Transportation.

† New Jersey Department of Transportation.

†† Wilbur Smith and Associates, based on studies in other areas and additional data on commuting and other travel.

†††Wilbur Smith and Associates, from studies of the mode shift potential of high occupancy vehicle (HOV) lanes proposed for New Jersey Interstate Route 3.

‡ New Jersey Department of Environmental Protection projections.

COST OF THE MEASURE

The cost of the steering committee's activities will be absorbed in the participating agencies' budgets; no staff expansion is required.

Market surveys will be conducted by a private firm at a cost of $40,000, under contract to the state agencies; NJSEO and NJDOT will share New Jersey's fraction of this cost.

Data processing services will require no additional funding.

Estimated publicity expenses should range from $100,000 to $150,000 for each year after 1977; actual costs will depend on the extent of the campaigns and the level of free public-service advertising available. Federal grants will defray most of the publicity costs, but New Jersey will have to contribute about $25,000 each year for publicity.

The private sector's costs for the program have not been estimated.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

A positive environmental impact will be produced by the reduction in vehicular emissions. Negligible social and political impacts are expected; modified travel habits of employees may produce some minor adjustments for program participants.

PROMOTION OF PUBLIC TRANSIT

PROGRAM MEASURE

This measure involves developing a transit-marketing program to promote the use of public rather than private transportation.

Associated energy savings are estimated to reach 0.8 trillion Btu in 1980, or $2 million.

IMPLEMENTATION APPROACH

The most important component of the proposed marketing program will be the coordination of transit routes, schedules, and fares among the 48 transit companies and 14 independent transit groups in New Jersey. In particular, DOT will seek to ensure that:

- Routes and frequencies are designed to maximize system coverage and patronage without increasing required subsidies
- Only one transit company operates on any route
- Route numbers are coordinated and derived from a statewide numbering system designed by DOT
- Fares are coordinated to permit transfers between all interconnecting systems.

In addition, DOT will promote special services, including:

- Park-and-ride service to major recreation and employment centers, such as Manhattan, including use of the parking lots at the Meadowlands Sports Complex and express transit vehicles and facilities
- Subscription services to large employers, particularly those located in suburban areas
- Feeder service to commuter rail lines.

DOT will also propose and advocate innovations to improve public transit patronage during off-peak hours, including: better designed bus signs and shelters (a minimum of 10,000 new signs and 500 new shelters will be required); and lower off-peak fares with the reduction in revenues offset by an increase in peak-hour fares.

To support all these program components, DOT will undertake a concentrated advertising and public information campaign, including better transit maps and a centralized, toll-free, 24-hour statewide telephone information service to assist the public in understanding the benefits and potential of a transit system.

To carry out its program, DOT will assume the planning and regulatory powers of the Public Utilities Commission (PUC) in the proposed public transit area. Thus, DOT will be responsible for establishing transit routes and schedules, as well as for implementing and administering the program throughout the state, and PUC will confine its activities to nontransit utilities.

However, legislation will be required to: empower DOT to plan and administer the public transit program for the whole state; and to transfer transit-regulation powers, presently held by PUC, to DOT.

Assuming that the appropriate legal actions are completed, DOT will begin undertaking the program in the spring of 1977. It is expected that most program components will be instituted by the end of 1978. In particular, the statewide route-numbering system and the transit information service will be in-place by that time.

Patronage counts and on-board surveys will be used to measure the success of the marketing program. These measurement techniques will be designed to isolate the impact of the marketing program as much as possible from other influencing factors, such as general shifts in the economy or the population.

EXPECTED ENERGY SAVINGS

It is estimated that the marketing program will result in a 9 percent increase in transit patronage.* Specifically, promotion of transfers and lower off-peak fares will increase off-peak patronage by 2 percent and 14 percent, respectively. Savings associated with the increased use of mass transit are calculated in terms of:

- Estimated 1980 transit patronage (P_t), or 250 million passengers**
- Estimated increase in person trips by transit due to marketing programs (N_d), or 9 percent*
- Fuel consumption rate of automobiles (C_a), or 18 miles per gallon***

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* Data provided by Wilbur Smith and Associates.

** Based on recent trends and 1972 patronage of 313 million, as documented in: New Jersey Department of Transportation, A Master Plan for New Jersey Transportation, 1972, with Wilbur Smith and Associates expansion.

***Data provided by DEP.

- Fuel consumption rate of buses (C_b), or 5 miles per gallon*
- Average automobile occupancy (O_a), or 1.6 persons per vehicle**
- Average bus occupancy (O_b), or 30 persons per bus*
- Average automobile passenger trip length (D_a), or 8 miles***
- Average bus passenger trip length (D_b), or 5 miles*
- Average number of Btu per gallon of gasoline (K), or 1.25×10^5 Btu/gallon.

Energy savings (ES) are expressed in the following equation:

$$ES = P_t N_d \left[\frac{D_a}{C_a O_a} - \frac{D_b}{C_b O_b} \right] K = 0.8 \times 10^{12} \text{ Btu.}$$

This estimate is certainly conservative. Additional energy would be saved if bus routes were coordinated.

COST OF THE MEASURE

DOT can meet the costs of the marketing program with existing state funds. It is not expected that the state will have to provide additional subsidies to existing transit operations; in fact, subsidies may be reduced since the coordination of routes acts to lower operating costs for subsidized carriers.

If bus routes were coordinated and if only one company operated on any route, New Jersey transit companies should realize a 5-percent reduction in operating costs. As noted above, this saving may take the form of lower state subsidies to transit companies.

Other changes in service called for in the marketing plan will be self-financing. The slight loss in revenue per rider that may attend increased transfer privileges will be made up by increased patronage. Furthermore, increased peak-hour fares will compensate for revenue losses from lower off-peak fares. Subscription and park-and-ride services will be designed to cover total operating costs.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The measure will result in lower gasoline consumption and reduced emissions from vehicles. The social and political impacts of the measure are negligible.

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* Data provided by Wilbur Smith and Associates.

** Data provided by DEP.

***Port Authority of New York and New Jersey, Trans-Hudson Vehicular Origin and Destination Study, 15th Annual Report, 1972.

BUS REPLACEMENT PROGRAM

PROGRAM MEASURE

Implementation of the measure will reduce the fuel consumption of the statewide bus fleet by replacing 800 buses with new, more efficient models. Energy savings resulting from implementation of the measure are estimated at 0.2 trillion Btu in 1980, or $500,000.

IMPLEMENTATION APPROACH

Detailed Provisions

Under the measure, the state will purchase 800 new standard buses which will be leased to operators throughout the state as replacements for older buses. The provisions of the measure are:

- DOT will purchase 800 buses to its specifications.
- These buses will remain the property of the state; they will be leased to operating companies without major modification. Only readily replaceable items, such as route signs and fare collection equipment, will be changed.
- Buses can be transferred by DOT among operators as demand or ownership of routes changes.
- Buses will be designed for regular route transit service; they will be used for charter work only when not required for regular route operation.
- Operators who are leased buses will be required to transfer to the state an equal number of used buses for rehabilitation or scrapping.

Implementing and Administering Organizations

DOT will buy the buses with state and federal funding from the Urban Mass Transportation Administration (UMTA) and manage the leasing of buses to transit companies.

Legal Mechanisms

All necessary legal mechanisms are in place.

Implementation Plan and Schedule

DOT will complete an application for financial assistance to UMTA by July 1977. New vehicles will be delivered throughout 1979. (See Exhibit E-4 for the implementation schedule.)

Monitoring System

As a provision of the lease agreement, each transit operator will be required by DOT to maintain complete fiscal and operating records, including records of vehicle miles operated and fuel consumed. These data will be reported to DOT, who will estimate fuel economy trends.

Related Measures

The new buses will help to increase transit utilization, as outlined in the Promotion of Public Transit measure, by increasing patronage, reducing maintenance costs, and improving schedule adherence.

EXPECTED ENERGY SAVINGS

Current and Projected Energy Use

Energy consumption in 1976 for a statewide fleet of 3,970 buses is estimated at 2.2 trillion Btu. In 1980, the projected energy consumption without the bus replacement program is estimated at 2.4 trillion Btu.*

Methodology for Calculating Energy Savings

Energy Savings (ES) resulting from economies in fleetwide fuel consumption will be a function of:

- Average annual miles per bus (V_B) = 22,500 bus-miles[1]
- Number of buses replaced (R_B) = 800
- Fuel consumption rate of old buses (C_O) = 4 miles per gallon[1]
- Fuel consumption rate of new buses (C_N) = 6.5 miles per gallon[1]
- Btu/gallon conversion factor (F) = 1.25×10^5.

Energy savings may be calculated, using the following equation:

$$ES = V_B R_B \left(\frac{1}{C_O} - \frac{1}{C_N} \right) = 0.2 \times 10^{12} \text{ Btu}.$$

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[1] Wilbur Smith and Associates estimates.

Bus Replacement Program
Implementation Schedule

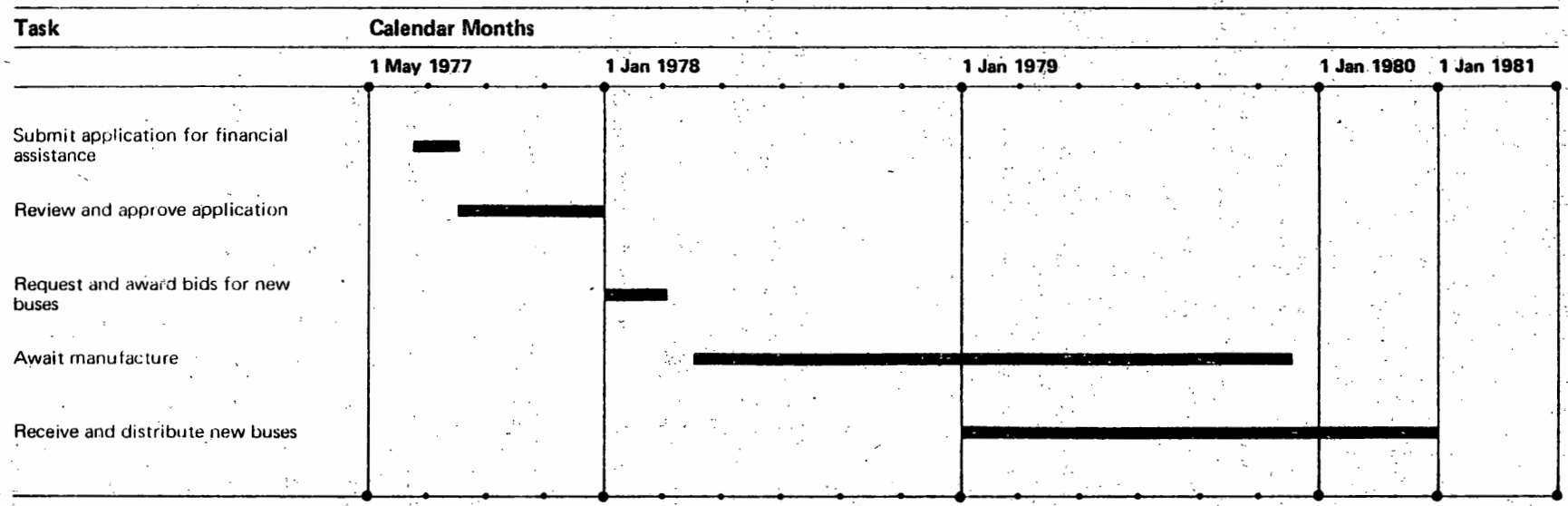

Exhibit E-4

COST OF THE MEASURE

The cost of the measure is estimated at $56 million, based upon a purchase price of $70,000 per bus. The cost to New Jersey will be $11 million; the remainder will be paid by a UMTA capital grant. These costs have already been budgeted by DOT and UMTA.

Administrative costs for the grant application will be absorbed by DOT.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

There will be a positive environmental impact from reduced fuel consumption and reduced vehicle emissions. Social and political impacts will be negligible.

USE OF DRAG-REDUCTION DEVICES ON TRUCKS

PROGRAM MEASURE

This measure is designed to encourage the use of windscreens and radial tires on tractor-trailer trucks traveling on limited-access highways as a means of reducing drag.

This measure, which will act to increase the energy efficiency of such vehicles, will result in energy savings of 1.0 trillion Btu in 1980, or $2.5 million.

IMPLEMENTATION APPROACH

This measure establishes economic incentives to encourage truck owners and operators to purchase and install drop-reduction devices, especially windscreens and radial tires. The state will charge a lower vehicle registration fee to a truck having specified drag-reducing equipment and increase fees for trucks without such equipment.

Implementing Organizations

DOT will develop guidelines for drag-reduction devices based on an inventory of technology and cost-benefit data for basic vehicle/hardware combinations. The DMV Department of Law and Public Safety will suggest appropriate revisions of the registration fees according to vehicle/hardware combinations. The state legislature will be responsible for enacting any necessary revisions of the Motor Vehicle Code as recommended by DMV.

Legal Mechanisms

The state is already empowered to establish equipment standards for trucks, but action by the state legislature will be required to amend the Motor Vehicle Code to permit differential registration fees.

Implementation Plan and Schedule

To implement this measure requires that:

- DOT determine specific equipment guidelines and prepare technical guidelines for motor freight carriers
- DMV specify revised registration fees and secure associated amendments of the Motor Vehicle Code through the state legislature.

Since windscreens and radial tires are commercially available, implementation of the measure can occur as soon as the above steps are

taken. The establishment of code revisions and equipment guidelines can occur concurrently and should be completed by late 1977. Installation of required equipment on the vehicles will occur during the following 12-month period during registration renewal.

Monitoring System

The degree to which the N.J. truck fleet shifts to windscreens and radial tires can be measured by reviewing the registration fees received. DMV and SEO will review the program semiannually to determine whether the lower registration fees as set are ensuring maximum use of this equipment. Trends in motor fuel sales will also be monitored to provide a general indication of the effectiveness of fuel conservation measures associated with trucks.

EXPECTED ENERGY SAVINGS

Current (i.e., 1976) travel in New Jersey is estimated at 48 billion VMT, of which, approximately 10 percent (6.7 billion) is heavy truck miles. Of that 6.7 billion VMT, 20 percent (1.3 billion) occurs on limited-access highways. Thus, 1976 energy consumption attributable to trucks traveling on limited-access highways is estimated at 39 x 10^{12} Btu. Truck fuel consumption is projected to reach 45 x 10^{12} Btu in 1980.*

Based upon studies conducted for the Society of Automatic Engineers** and the Federal Energy Administration,*** average savings attributable to aerodynamic drag-reduction devices and radial tires are estimated at 1,650 gallons per 100,000 truck miles and 900 gallons per 100,000 truck miles, respectively. These savings are expected to be achieved by the 1980 truck fleet.

Energy savings (ES) attributable to this measure are a function of:

- Projected 1980 travel (V_t), or 54 billion VMT
- Percent of total heavy truck travel (T_t), or 10

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* Data are provided by Wilbur Smith and Associates and are based on total VMT, percentage of truck movements, and the relative percentage of travel for each highway classification as developed by the DOT.

** Buckley, Frank T., Jr. and William S. Seksciensky, "Comparison of Effectiveness of Commercially Available Devices for the Reduction of Aerodynamic Drag on Tractor Trailers," prepared for the Society of Automotive Engineers, 1975.

*** Federal Energy Administration, Department of Transportation and the Environmental Protection Agency, "Truckers Guide to Fuel Savings," 1976.

- Percent of truck travel on limited-access highways (T_{ac}), or 20
- Savings attributable to radial tires (S_a), or 900 gal/10^5 miles
- Savings attributable to drag-reduction devices (S_d), or 1,650 gal/10^5 miles
- Percent of heavy truck fleet using fuel saving devices in 1980 (K), or 50 percent
- Percentage of heavy truck fleet with van-type trailers (K_v), or 32
- Btu/gallon conversion factor, (F), or 1.25 x 10^5.

The relationship among these parameters is expressed in the following equation:

$$ES = FKV_t T_t T_{ac}[S_a + K_v S_d] = 1.0 \times 10^{12} \text{ Btu.}$$

Total projected energy savings for 1980 are 1.0 x 10^{12} Btu, or 2 percent of 1980 truck fuel consumption.

COST OF THE MEASURE

DOT will bear the cost of developing hardware guidelines, which is estimated at $40,000. Of this sum, $32,000 is budgeted for staff research and $8,000, for initial publication and distribution of findings.

DMT will not require additional staff to prepare the revised schedule of truck registration fees. DOT expenditures described above will be covered by the increases in registration fees for those trucks not equipped with drag-reduction devices.

The costs of installing windscreens and/or radial tires will be borne by vehicle owners/operators. The current cost of the basic roof-mounted fiberglass screen, including parts and labor, is about $350-$375 per unit. It is expected that this first cost will be recovered through reduced fuel costs. Similarly, the longer life of and improved fuel economy associated with radial tires will offset the initial cost differential (relative to bias-ply tires).

Many private carriers have already installed windscreens and radial tires. While the number of carriers operating properly equipped vehicles is still insignificant relative to the total fleet, their initial experience is that the equipment is cost-effective.

Energy conservation in the motor freight industry will also be affected by another program measure -- enactment of the 55 mph speed limit.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The environmental, social, and political impacts of this measure would be negligible.

APPENDIX F

NEW JERSEY ENERGY CONSERVATION PLAN
UTILITY MEASURES

CURRENT AND PROPOSED CONSERVATION MEASURES BY UTILITIES

PROGRAM MEASURE

The New Jersey Public Utility Commission (PUC) has jurisdiction over three major electric utilities (Jersey Central Power and Light, Atlantic City Electric, and Rockland Electric*), three major natural gas utilities (New Jersey Natural Gas, Elizabethtown Gas, and South Jersey Gas), and Public Service Electric & Gas (PSE&G), which supplies both electricity and gas to a large number of consumers in the state (see Exhibits F-1 and F-2).

In recent years, particularly since the Arab oil embargo of 1973, each of these utilities has been concerned with the need for prudent use of energy, both in-house and by all types of customers. Since late 1975, several utility companies have undertaken measures that have the potential to decrease energy consumption. Over the past year, the utilities have also initiated consumer education activities and sponsored programs to promote more efficient use of energy.

Both the utility companies and PUC are presently considering a number of additional programs for possible implementation in the near future.

This document describes the conservation measures and programs currently being conducted or considered by the state's electric utilities and gas utilities (see Exhibit F-3).**

Energy savings attributable to utility measures are projected to be 5.4 trillion Btu in 1980, or $13.5 million.

Electric Utilities -- Existing Measures

Since late 1975, five energy conservation measures have been implemented by one or more of the four electric utilities in New Jersey. These measures were designed to conserve energy by decreasing electricity consumption.

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* Because Rockland Electric services several counties in New York, it is also under the jurisdiction of the New York Public Utility Commission.

** Greater detail is provided for Public Service Electric and Gas than for the other utilities for several reasons: (1) it is the largest utility in New Jersey in terms of percent of sales (63 percent of total electric sales and approximately the same percent of gas sales) and number of customers (1.3 million gas and 1.6 million electric customers); (2) it was possible to obtain information concerning both electricity and gas from this single source; and (3) PSE&G is geographically convenient to the New Jersey State Energy Office and New Jersey Public Utility Commission and was visited frequently by members of the study team. Thus, it was convenient to conduct personal interviews with company executives.

Number of Customers and Annual Sales of Electricity in New Jersey by Utility in 1975

Sector	Public Service Electric and Gas		Jersey Central Power & Light		Atlantic City Electric		Rockland Electric	
	Number of Customers	Annual Sales (MWh)	Number of Customers	Annual Sales (MWh)	Number of Customers	Annual Sales (MWh)	Number of Customers	Annual Sales (MWh)
Residential	1,461,202	7,598,964	572,494	4,477,827	276,254	1,938,724	43,606	317,756.0
Commercial	193,518	8,944,855	63,702	5,886,671	41,708	2,382,971	4,443	447,378.8
Industrial		10,065,524						
Public street and highway lighting	4,467	256,755	848	81,682	683	52,111	35	5,914.8
Other sales to public authorities			70	13,127				
Sales to railroads and railways					1	4,354		
Interdepartmental sales	1	39,911						
Total sales to ultimate customers	**1,659,188**	**26,956,009**	**637,114**	**10,459,307**	**318,646**	**4,378,160**	**48,091**	**771,278.9**
Sales for resale	3	79,393	6	254,766				30,732.8
Total sales of electricity	**1,659,191**	**27,035,401**	**637,120**	**10,714,073**	**318,646**	**4,378,160**	**48,091**	**802,011.7**

Number of Customers and Annual Sales of Natural Gas in New Jersey by Utility in 1975*

Sector	New Jersey Natural		Elizabethtown		South Jersey	
	Number of Customers	Annual Sales (therms)	Number of Customers	Annual Sales (mcf)	Number of Customers	Annual Sales (mcf)
Residential	**206,458**	**220,042,711**	**172,579**	**12,154,790**	**111,893**	**10,906,319**
Residential	71,071	19,631,499				
Residential space heating	135,177	184,842,288				
Apartment house	203	15,568,924				
Residential & gas lights			171,652	12,089,624		
Residential air conditioning			927	65,166		
Commercial and industrial	**11,205**	**77,124,387**	**10,996**	**10,852,660**	**9,982**	**14,674,018**
Commercial air conditioning			118	39,674		
Building heating and/or cooling	6,623	30,098,722	4,697	1,669,195	4,793	1,694,076
Multiple family/institutional			202	816,970		
General	4,426	12,900,494	5,930	3,454,541	4,252	4,466,981
Large volume	29	13,500,941	17	2,315,610		
Interruptible	41	17,288,026	32	2,556,670		
Other sales to public authorities	**17**	**375,364**				
Interdepartmental sales						
Total sales to customers	**217,680**	**297,542,462**	**183,575**	**23,007,450**	**121,875**	**25,580,337**
Sales for resale	1	10,953			1	
Total sales of gas	**217,681**	**297,553,415**	**183,575**	**23,007,450**	**121,876**	**25,580,337**

*Figures for Public Service Electric & Gas were not available.

Energy Conservation Measures by Utilities in New Jersey

Electric Utilities

	Public Service Electric & Gas	Jersey Central Power & Light	Atlantic City Electric	Rockland
Existing Programs	Summer/winter differential rate (residential, commercial, industrial)	Summer/winter differential rate (residential, small commercial and industrial)	Summer/winter differential rate (residential, small commercial and industrial)	Summer/winter differential rate (residential, commercial, industrial)
	Interruptible service (industrial)	Interruptible service (small commercial and industrial, transmission)		
		Revised demand charges (small commercial and industrial)	Revised demand charges (small commercial and industrial)	
	Time-of-day metering (residential)	Time-of-day metering and peak load pricing (residential)		
	Advertising/educational program (residential, commercial, industrial)	Advertising/educational program (residential, commercial, industrial)	Avertising/educational program (residential, commercial, industrial)	Advertising/educational program (residential, commercial, industrial)
Potential Programs (by 1980)			Energy efficiency requirement (residential, commercial)	
	Flattened rate (residential)	Flattened rate (residential)		
	Peak load pricing experiment (residential)			
	Modified rates for heat pumps (commercial and industrial)			

Gas Utilities

	Public Service Electric & Gas	New Jersey Natural	Elizabethtown	South Jersey
Existing Programs	Natural gas priority order (residential, commercial, industrial)	Natural gas priority order (residential, commercial, industrial)	Natural gas priority order (residential, commercial, industrial)	Natural gas priority order (residential, commercial, industrial)
	Advertising/educational programs (residential, commercial, industrial)	Advertising/educational programs (residential, commercial, industrial)	Advertising/educational programs (residential, commercial, industrial)	Advertising/educational programs (residential, commercial, industrial)

Summer-Winter Differential Rates for Electricity
(PSE&G, Jersey Central, Atlantic City, Rockland)

PSE&G proposed an increase in the summer-winter rate differential as part of the company's Petition for Rate Increase filed with the Board of Public Utility Commissioners on January 5, 1976. The proposed rate was approved as follows:

- The residential rate for use of electricity in excess of 300 kilowatt hours (kWh) during winter months (November 1 - March 31) is now 2 cents less per kilowatt (kW) than the rate for energy use during summer months.

- For general and large power service rates, the summer-winter differential was also widened.

Jersey Central Power and Light received approval from PUC in June 1976 to revise its rate structure effective July 1976:*

- For general service (total electric only) customers, the summer-winter differential of .20 cents per kW in the first 50 kW of billing demand could be expanded to .30-.40 cents.

- The same differential of approximately .07 cents for usage in excess of 800 kWh was maintained, although the newly approved tariff increased the underlying rates.

During 1976, the PUC Hearing Board recommended that Atlantic City Electric Company take steps to increase the summer tail-block on a per kW basis, and apply a lesser portion of any increase to the winter rates. Consequently, in an attempt to improve the annual load factor, Atlantic City created a summer-winter differential tariff for residential and general service customers.**

Rockland Electric Company's request for a rate increase, including a summer-winter differential for residential, industrial, and commercial customers, was approved in February 1976. The company imposes a differential rate in the third block for residential customers and in all blocks within the demand charge for industrial and commercial customers.

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* N.J. Public Utility Commission, Hearing Examiners' Report and Recommendations - Rate Design, In the Matter of the Petition of Jersey Central Power and Light Company for Approval of an Increase in Rates for Electric Service and for Charges in the Tariffs for Such Service, Docket No. 759-899, May 28, 1976.

** N.J. Public Utility Commission, Hearing Examiners' Report and Recommendations, In the Matter of the Proposed Revision of Rates of Atlantic City Electric Company Increasing Its Rates for Electric Service, Docket No. 758-842, December 17, 1975.

Interruptible Electric Service
(Jersey Central, PSE&G)

Since December 17, 1976, Jersey Central has offered interruptible service rates to general service and transmission service customers who have 1,000 kW or more of curtailable load and who agree to curtail load to a predetermined level upon at least 30 minutes prior notice by the utility.

In November 1976, PUC ordered Public Service Electric and Gas to file a rate for interruptible electric service (IES) by December 15, 1976. The rate that PSE&G proposed offers a discount to customers with electric loads in excess of 500 kW. No less than 2 hours' notice will be given to customers whose service will be interrupted. The utility has specified that service will not be curtailed more than 15 times yearly, or for greater than 150 hours.

Revisions in Industrial-Commercial Electricity
Demand Charges (Atlantic City, Jersey Central)

During mid-1976, Atlantic City Electric Company received approval from PUC to increase its rates for electric service in certain customer categories. PUC recommended that for annual general service customers, the demand charge be increased to approximately twice the percentage increase in energy charges.

In June 1976, Jersey Central also revised its rates for energy and demand charges. PUC proposed that for general service customers, demand charges be increased in relation to energy charges because, as the greater proportion is placed on the demand block, it will have the effect of benefiting high-load factor customers.*

Time-of-Day Metering and Peak-Load Pricing
Experiments (Jersey Central, PSE&G)

For the past several years, Jersey Central has been conducting an experiment on the consumption pattern of a group of customers. Since September 1976, the utility has offered an experimental rate schedule to these residential customers in order to determine the effect of peak-load pricing on their electricity consumption. In addition:

- Magnetic-tape billing devices are used to monitor energy consumption for customers billed on the optional time-of-day service schedule.

- An automatic remote metering system was installed to monitor energy use for participants in the NJ/FEA Peak-Load Pricing Program.

* N.J. Public Utility Commission, Decision and Order, In The Matter of Jersey Central Power and Light Company for Approval of an Increase in Rates for Electric Service and for Changes in the Tariffs for Such Services, Docket No. 759-899, June 10, 1976.

PSE&G is currently conducting a time-of-day study involving 500 residential customers. For this marginal cost experiment, 250 customers are monitored by registered watt-hour meters and another 250 with magnetic-tape meters. The data generated by this experiment will be used to determine a rate structure for peak-load pricing. PUC has not yet authorized a peak-load price test by PSE&G.

Electric Utility Advertising and Educational Programs (PSE&G, Jersey Central, Atlantic City, Rockland Electric)

All of the electric utilities have initiated programs to encourage employees and customers to follow energy conservation practices. PSE&G's educational program includes customer consultation, customer education, tariff changes, intracompany activities, and research and development.

In particular, the goal of the customer consultation program is to encourage customers to conserve energy and to practice efficient load management. Consultation is provided in the way of:

- Personal on-site visits to all types of customers
- Surveys or audits of customers' energy use with follow-up letters and offers of assistance
- Promotion of street light modernization (through conversion from incandescent to high-efficiency mercury vapor or high-pressure sodium vapor lamps)
- Technical bulletins.

PSE&G's customer education program in energy conservation has involved:

- Public appearances, including selected speakers at business and civic group meetings, and lecture-demonstrations for students and homeowners
- Advertising in newspapers, on radio, and on television
- Preparing literature for circulation at information centers
- Mailings to, and courses offered for, selected industrial and commercial customers
- Floor and window displays.

Electric Utilities -- Proposed Measures

In addition to measures that have already been initiated, both PUC and the utilities are currently considering a number of measures that could result in significant energy savings by 1980. Three of these are described below.

Energy-Efficient Rating Requirements
(Atlantic City)

Atlantic City Electric has proposed a change in the terms and conditions of service to ensure that only highly efficient air-conditioning equipment is installed by residential and commercial customers. If the proposed plan is approved, the company would not provide service to a customer unless the customer can produce a certificate indicating that an installed air conditioner has been properly inspected. The purpose of the inspection will be to determine whether the equipment has an energy-efficient ratio (Btu cooling capacity divided by the watts of electrical input) equal to or in excess of 7.0. The electrical inspection would be performed by a person, agency, or organization duly appointed by a county, municipality, or PUC. While Atlantic City proposed that the energy-efficient rating procedure become effective January 1, 1977, PUC authorization had not been granted at that time.

Flattened Residential Rates
(PSE&G, Jersey Central)

During January 1976, PSE&G requested approval to flatten its residential rate schedule (i.e., cost per kW would not decrease with increased consumption) as a means of reducing sales of electricity.* Although the PUC did not approve this request in its November order, it is likely that PSE&G will propose this measure again in the near future.

In 1976, Jersey Central proposed a change in the total residential rate for electricity that would increase the tail-block rate during the winter by approximately 198 percent.** Energy consumption above 800 kWh per month would be priced at $2.37 per kWh for total electric residential customers. The petition was not approved because PUC favors a more gradual approach for rate design changes.

Modified Rates for Heat Pumps
(PSE&G)

PSE&G has proposed modifying its rate schedule for heating service in existing buildings. This would allow general and large power customers with internal heat-pump equipment to qualify if they have permanently

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* N.J. Public Utility Commission, Hearing Examiners' Report and Recommendations and Decision and Order, In the Matter of the Petition of Public Service and Electric for Approval for an Increase in Electric and Gas Rates and for Changes in the Tariffs for Electric and Gas Service, Docket No. 761-8, undated.

** N.J. Public Utility Commission, Hearing Examiners' Report and Recommendations, In the Matter of the Petition of Jersey Central Power and Light for Approval of an Increase in Rates for Electric Service and for Charges in the Tariffs for Such Service, Docket No. 759-899, June 28, 1976.

installed heating equipment with a total rated capacity of not less than 25 kW. During November through May, the customer's monthly maximum demand would be reduced for billing purposes by an amount equal to one-half of the rated kilowatt capacity of such building heating equipment, provided:

- The rated capacity for determining the decrease in billing demand shall not exceed the kilowatt equivalent of the Btu heat loss, as determined by PSE&G, of the area to be heated. Comfort building heating equipment shall also include lighting where the Btu equivalent of the connected lighting equipment is 60 percent or more of the heat loss, as determined by PSE&G, of the area in which it is installed.

- The billing demand for November through May shall be equal to or more than the higher of (1) 25 kW, or (2) 50 percent of the monthly maximum demand.

While PSE&G requested that this rate modification be made effective by January 3, 1977, PUC had not indicated its intentions by that date.

Gas Utilities - Existing Measures

Two measures have been implemented by the gas utilities in New Jersey.

Natural Gas Priority Order
(PSE&G, New Jersey Natural, South Jersey, Elizabethtown)

In late 1974, PUC ordered the four gas utilities in the state to prepare and file detailed individual curtailment plans, as well as a single priority plan upon which they all agreed.

In June 1976, an order was issued by PUC to terminate existing gas service as follows:*

- Gas used for municipal street lighting shall be prohibited as of June 30, 1978 (unless an exemption based upon severe economic hardship is granted to the municipality prior to June 30, 1977)

- Gas used for nonessential or aesthetic purposes by residential, commercial, and industrial customers (e.g., outdoor gas lights, gas fireplaces, gas heating of private and public swimming pools) will be discontinued in 2 years.**

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* N.J. Public Utility Commission, Decision and Order, In the Matter of the Board's Investigation into the Natural Gas Supply and the Priority Plan for Involuntary Curtailments in the State of New Jersey, Docket No. 748-639, June 1, 1976.

** The PUC will cooperate with the Division of Consumer Affairs and other appropriate state agencies to ensure that vendors of such equipment are notified of this ban.

The June 1976 order also includes a temporary 2-year curtailment plan and directions concerning the amendment of tariffs to include appropriate penalties for customers who fail to decrease their consumption of energy.

Concurrently with the adoption of a temporary plan, PUC announced its intention to adopt a permanent plan by winter 1978-1979. Elements of this plan will include curtailments based on a system of priorities, as follows:

1. Reduce all company requirements to a minimum
2. Reduce all other firm and interruptible requirements
3. Reduce firm industrial boiler requirements of less than 1,500 thousand cubic feet per day (Mcfd) and interruptible boiler fuel of less than 300 Mcfd
4. Reduce interruptible requirements for process and feedstock
5. Reduce interruptible requirements for plant protection
6. Reduce all firm commercial boiler usage of 50 Mcfd or more
7. Reduce firm industrial requirements for process and feedstock and commercial requirements of 50 Mcfd or more
8. Reduce firm industrial requirements of less than 50 Mcfd for process and feedstock
9. Reduce firm industrial requirements for plant protection
10. Reduce residential and small commercial (less than 50 Mcfd) requirements.

Under the Natural Gas Priority Order, commitments will be permitted for new residential and small commercial use, provided the following conditions are met:

- All new construction must have full insulation, storm windows and doors, and day/night thermostats
- All conversions must have adequate conservation devices, such as insulation (full or cap), storm windows and doors and, in all instances, day/night thermostats
- A heating survey form must be submitted to PSE&G and Elizabethtown Gas before service will be connected.

Gas Utility Advertising and Educational Programs
(PSE&G, New Jersey Natural, South Jersey, Elizabethtown)

All of the gas utilities in New Jersey are engaged in ongoing programs to promote energy conservation. In March 1976, PSE&G published its Gas Participation Plan as part of a Federal Energy Administration program known as Utilities Conservation Action Now (UCAN).

As one aspect of this plan, PSE&G has been offering consultation to customers concerning energy conservation. For example, commercial and industrial customers are notified of latest developments in energy-efficient equipment and operating techniques, and residential customers are furnished with information on the use of home appliances. Using an energy conservation checklist, the company has surveyed customers and offered suggestions on additional ways to conserve energy. A survey of 1,000 large industrial customers was followed up with a letter offering assistance with any ongoing conservation efforts. Finally, technical bulletins have been prepared for marketing representatives to keep them informed of the latest developments in energy conservation for equipment, procedures, and materials.

Also related to the UCAN program, PSE&G has been cooperating with other trade and professional groups (e.g., architects, engineers, contractors, builders, and insulation dealers) on energy conservation efforts.

IMPLEMENTATION APPROACH

PUC must approve any changes in utility rates or policy. However, once the approval is granted, the utility assumes responsibility for its implementation. In most cases, the New Jersey utilities have taken the initiative in developing conservation measures, although, in a few cases, PUC has recommended that the utility take action (e.g., the PUC request to PSE&G to design an interruptible electric rate, and to the gas utilities to agree upon a priority and curtailment plan).

After a program is implemented, the utility involved makes a determination as to whether the energy consumption patterns of selected customers have changed as a result of the measure. PUC is responsible for monitoring the effect of rate changes, utility experiments, educational programs, and other energy-conservation measures.

EXPECTED ENERGY SAVINGS

Although the utilities and PUC are responsible for monitoring the effect of energy conservation programs that have already been implemented, neither is able to document that effect at this time. During the time period being considered (late 1975 to the present), a number of variables affected energy use in the state, including recessionary/inflationary

economic trends, increased costs of fuel, and programs that were implemented to spread peak load and reduce energy consumption. The utilities indicate that they cannot distinguish between the effects of each of these elements and can only evaluate the overall change in energy consumption. In addition, because the majority of measures did not become effective until mid-1976, the data is not yet complete.

Nevertheless, PSE&G, the largest utility in New Jersey, has estimated total 1976 sales of energy for the company, based on actual data collected through mid-year. PSE&G has also developed forecasts for electricity and gas demand through 1990 (see Exhibits F-4 and F-5), based on several models.* The electricity forecast, for example, reflects the following considerations:

- Time-of-day rates. The impact of these rates (not assumed in the forecast until after 1980) on energy sales is estimated to be minimal. The effect of time-of-day rates will be to shift end-use energy consumption from one time period to another, but not to significantly reduce overall energy consumption.

- Energy conservation measures. It is expected that energy conservation measures will be undertaken by industrial and commercial customers.

- Air-conditioning load growth and efficiency. Peak load will be reduced by 170 MW in 1980.

- Interruptible electric service. Peak load will be reduced by 70 MW in 1980.

- Additional insulation in buildings.

- Assumed future economic conditions.

- Price elasticity.

Although it is not possible to calculate the effect of existing programs on energy sales in 1976, or calculate the impact of additional measures that may be implemented before 1980, PSE&G's past and projected sales figures provide a basis for comparison.

Projected Electric Sales

With the exception of commercial and industrial water heating, private and public street lighting, and traffic signals, the average annual sales of electricity per customer in each revenue account category declined in the

* N.J. Public Utility Commission, Direct Testimony of William G. Michaelson, Manager - Electric Planning, In the Matter of the Board of Public Utility Commissioners Order of Inquiries into the Reasonableness of Electric Utilities Construction Programs, Docket No. 762-194, Exhibit PST-1, November 1976.

Public Service Electric & Gas—Projected Electric Sales by Revenue Account

Account	Annual Electric Sales (million kWh)				Annual Average Sales per Customer (kWh)			
	Actual	Forecast			Actual	Forecast		
	1973	1975	1976	1980	1973	1975	1976	1980
Residential	7,660	7,155	7,238	8,300	5,547	5,147	5,249	5,837
Residential heating	293	362	394	621	16,948	14,897	15,096	14,442
Water heating								
Residential	70	65	63	55	3,646	3,530	3,481	3,313
Commercial & industrial	1	1	1	1	2,374	2,433	2,778	2,941
General lighting & power								
Commercial	4,214	3,977	4,161	4,750	24,539	23,958	25,051	28,375
Industrial	680	564	612	720	108,453	93,069	100,328	116,129
Large power & lighting								
Commercial	4,227	4,516	4,870	5,710	1,589,098	1,452,090	1,462,462	1,402,948
Industrial	4,575	4,048	4,312	4,810	2,188,995	1,900,469	1,987,097	2,021,008
High tension								
Commercial	408	378	412	530	25,500,000	21,000,000	21,684,211	23,043,479
Industrial	6,463	5,443	5,626	6,770	33,314,433	27,770,409	28,558,376	32,392,345
Street lighting—private	49	56	58	66	3,801	4,180	4,328	4,521
Building heating								
Commercial	33	40	44	53	20,012	19,507	20,091	18,403
Industrial	1	1	1	1	19,943	16,418	14,925	14,493
Street lighting—public	225	232	236	252	373,134	395,230	395,310	387,402
GLP—traffic & other signals								
Commercial	25	25	24	26	6,212	6,361	6,186	6,684
Total sales to customers	29,045	26,942	28,218	32,778	17,996	16,519	17,217	19,464
Peak demand (MW)								
Summer	6,630	6,600	6,830	7,970				
Winter	4,500	4,550	4,730	5,550				

Public Service Electric & Gas—Projected Gas Sales by Revenue Account

Account	Annual Gas Sales (megatherms)				Annual Average Sales per Customer (therms)			
	Actual		Forecast		Actual		Forecast	
	1973	1975	1976	1980	1973	1975	1976	1980
Residential (normalized)								
With heating	907.0	843.0	842.0	885.0	1,843	1,646	1,616	1,602
Without heating	175.0	167.0	163.0	156.0	272	268	262	262
General (normalized)								
Commercial	66.0	65.9	67.5	68.9	777	773	780	791
Industrial	4.4	3.7	3.8	3.8	1,446	1,331	1,380	1,460
Large volume (normalized)								
Commercial	210.0	193.0	192.0	225.0	47,500	42,500	44,100	47,400
Industrial	207.0	173.0	194.0	242.0	122,800	104,200	119,000	136,700
Interruptible								
Commercial	36.0	28.0	22.0	30.0	2,403,000	1,879,000	1,467,000	1,880,000
Industrial	237.0	155.0	112.0	114.0	3,246,000	2,210,000	1,780,000	2,070,000
Off-peak service								
Commercial	13.3	15.0	14.2	14.5	251,000	283,000	263,000	275,000
Industrial	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Building heating & cooling (normalized)								
Commercial & industrial	179.0	164.0	160.0	178.0	3,125	2,757	2,677	2,850
Street lighting	0.44	0.40	0.39	0	29,600	26,900	26,100	0
Total sales to customers (normalized)	**2,052.0**	**1,823.0**	**1,787.0**	**1,932.0**	**1,595**	**1,412**	**1,375**	**1,479**

n/a—not applicable

period from 1973 (the year of the oil embargo) to 1975. PSE&G estimates that in 1976 sales per customer will have increased to exceed 1973 levels in only one-third of all accounts. Between 1976 and 1980, average sales per customer are expected to decrease for:

- Residential heating
- Residential water heating
- Large commercial power and lighting
- Commercial and industrial building heating
- Public street lighting.

PSE&G estimates that electric sales in 1976 will represent 97 percent of 1973 sales. Between 1975 and 1976, annual sales are estimated to increase by 5 percent, or 1,276 million kilowatts. In the period between 1976 and 1980, PSE&G assumes electric sales will increase by 4,560 million kilowatts.

Projected Gas Sales

PSE&G estimates that by 1980 average gas sales per customer will still be less than 1973 levels for 5 out of 12 revenue account categories:

- Residential, with and without heating
- Large volume commercial
- Interruptible commercial and industrial
- Commercial and industrial building heating and cooling
- Street lighting.

Substituting "general industrial" accounts for "large volume commercial" in the above list, total annual gas sales in 1980 are projected to be less than sales in 1973. From 1975 to 1976, total gas sales are estimated to decrease by 2 percent, while from 1976 to 1980, they will increase by 8 percent.

The projected decline in total annual gas sales from 1975 to 1976 may be attributable to measures already implemented in an attempt to reduce energy consumption. Nevertheless, the opinion of the utility industry is that energy savings occur due to a combination of factors.

The calculation of projected energy savings from utility conservation measures in 1980 is based on interviews with utility representatives and members of the New Jersey PUC, and FEA estimates.

The FEA estimate of total New Jersey energy consumption in 1980 is 1,946 trillion Btu. Other data developed by FEA indicates that electric utilities

will be responsible for 13 percent of this figure (253 x 10^{12} Btu) and gas utilities, 15 percent (292 x 10^{12} Btu).* Based on experience with energy conservation analyses at the state level, it is assumed that the energy savings attributable to utilities will be slightly greater than 1 percent for electric and slightly less than 1 percent for gas. A rough estimate, therefore, of energy savings by utilities in 1980 is 3.2 trillion Btu for electric companies and 2.2 trillion Btu for gas companies.

COSTS OF THE MEASURES

Neither the PUC nor the utilities are expected to incur significant costs due to these energy conservation measures. Current staff will be able to manage and assume any additional tasks required.

Utility customers may pay slightly higher costs for energy in the short term through increased rates; however, in the long term, customers' energy costs should decrease, if they are influenced by the measures to consume less electricity and gas.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

No substantial impacts are expected to result from the implementation of energy conservation measures by utilities.

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* U.S. Federal Energy Administration, Son of Strawman, May 1976.

FINANCING OF CONSERVATION INVESTMENTS BY UTILITIES

There are two options for the financing of conservation investments by utilities: Option 1 involves the financing, by electric and gas utilities, of ceiling insulation in single-, two-, three-, and four-family units; Option 2 involves the financing, by just gas utilities, of ceiling insulation, automatic thermostat controls, and furnace modifications in single-family units.

Expected energy savings in 1980 for Option 1 are 0.5 trillion Btu, or $1.25 million; for Option 2, projected savings are 1.1 trillion Btu, or $2.75 million. A summary comparison of the two options is presented in Table 1, and they are discussed separately below.

TABLE 1: COMPARISON OF UTILITY FINANCING OPTIONS

	Option 1	Option 2
Utility financing	electric and gas	gas
Sector affected	residential	residential
Customer categories	owners of single-, two-, three-, four-family units	single-family homeowners
Conservation devices	ceiling insulation	ceiling insulation; automatic thermostats; furnace modification
Number of units affected	54,718	11,759
Expected energy savings	0.5×10^{12} Btu	1.1×10^{12} Btu
Investment required	$21.3 million	$8.1 million
Total program cost	$25.0 million	$10.2 million

OPTION 1

PROGRAM MEASURE

Under this measure, electric and gas utilities will help finance the installation of ceiling insulation in residential units. A precedent for this type of financing by utilities was established in 1973 in Michigan when the Michigan Public Service Commission (PSC) ruled that public utility activities for the purpose of promoting and supplying residential insulation was

a legitimate function and a proper cost of service. Subsequently, the Michigan Consolidated Gas Company started a program to conserve natural gas by promoting the insulation of gas-heated homes.

During 1976, the New Jersey Board of Public Utility Commissioners (PUC) considered the proposal that New Jersey utilities finance home-insulation investments. The Department of the Public Advocate petitioned the PUC to adopt regulations requiring the "state's privately or investor-owned natural gas and electric utilities to provide the cost of insulation for their residential customers upon condition that the recipient repay the cost to the utility in monthly installments." In November 1976, a PUC Hearing Examiners' Report* recommended that such a program be instituted for a 2-year trial period. To date, the PUC has not ruled on the issue.

The program being considered by PUC is similar to that developed by Michigan Consolidated Gas, except that residential customers using either natural gas or electricity for space heating purposes will be eligible for insulation financing.** Under the program, the utility will provide a loan for the installation of ceiling insulation, and the cost will be added to the customer's regular bill. Eligibility for loans will be limited to owners of single-, two-, three-, and four-family units. In the case of a customer who receives electricity for general use from one utility, and gas for heating from another, the customer will be encouraged to contact the gas company for insulation financing.

Energy savings from this measure will be 0.5 trillion Btu in 1980.

IMPLEMENTATION APPROACH

When a customer indicates to a utility that he would like to take advantage of the Home Financing Insulation Program, his credit records will be reviewed. A utility may decide not to provide financial assistance to a customer who has made several late payments during the preceding billing year. On the other hand, if the credit check is favorable, the company will refer the customer to a list of qualified contractors.*** The contractor selected by the homeowner will provide an estimate of the cost of materials and the installation service. After all parties agree on the costs, the work will be performed.

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* N.J. Public Utility Commission, Hearing Examiners' Report and Recommendation, In the Matter of the Board's Inquiry into the Feasibility of New Jersey Utilities Financing Home Insulation, Docket No. 767-768, November 17, 1976.

** Michigan Consolidated Gas limited its program to residential customers using gas for space heating.

***All contractors participating in this program must be licensed by the New Jersey Department of Banking.

Upon satisfactory completion of the work, the homeowner will sign a customer acceptance statement and an installment agreement with the contractor, both of which will be forwarded to the utility.* The utility will then pay the contractor for his work and require a deposit or down payment (probably between 12 percent and 20 percent) from the customer. Thereafter, the utility company will charge the customer an interest rate of 1 percent per month on the unpaid balance for a maximum period of 3 years. The customer's payments will be added to his monthly bill.

According to the Consumer Credit Bureau of the New Jersey Department of Banking, utilities must adopt one of two approaches in order to act as lending institutions. First, they can lend money at an interest rate of 8 percent, and thus not violate the state usury law. Second, they can agree to buy the sales contract (e.g., the agreement between the customer and contractor) and thus be able to require a financing charge of up to 13.5 percent. If the latter method were chosen, in order to become a home financing banker, a utility would be required to obtain a license at a fee of $100 to $200 per year from the Department of Banking.

Michigan Consolidated Gas Company's financing plan requires a down payment of 20 percent and offers the customer three options for paying the balance:

- As part of the first bill after completion of the work (without interest)
- One-third to be paid in three monthly installments included as part of the first three bills after completion of the work (without interest)
- Equal monthly installments over a period of 36 months, with the first payment due as part of the first bill after completion of the work.

When the program is implemented, a monitoring plan will be devised to determine whether nonpayment by customers becomes a problem.** It has been recommended that nonpayment of a deposit and/or interest should not result in termination of service to the customer by the utility. Rather, it has been suggested that the utility be able to take a security interest in real property.

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* Michigan Consolidated Gas has devised a system that can also be used by New Jersey utilities whereby a market consultant is assigned to verify the cost estimate and satisfactory fulfillment of the contract.

** N.J. Public Utility Commission, Hearing Examiners' Report and Recommendation, In the Matter of the Board's Inquiry into the Feasibility of New Jersey Utilities Financing Home Insulation, Docket No. 767-768, November 17, 1976.

The New Jersey Hearing Examiner reviewing this case has recommended that the expense of implementing this program be factored into the tariff charged by each utility.* All pro forma statements submitted to the PUC by New Jersey utilities would indicate that the costs of operating the program exceed the interest income received and also that if the losses that do occur were distributed to each customer on a yearly basis, each customer would pay less than 50¢ per year.

Implementing and Administering Organizations

The State Energy Office (SEO) will work with the PUC and the seven major utilities in the state to develop and finalize the details of this measure. Before the measure can be implemented, the PUC must approve all aspects of the program, including the plan of operation, the return on conservation investments, and any increase in cost of service required to conduct the program. Also, before the program can be implemented, the Department of Banking must approve the loan arrangements specified by the utilities. During implementation, PUC will work with each company to monitor the effect of the measure on customers' electricity and natural gas consumption.

Legal Mechanisms

All of the utilities, (with the exception of Public Service Electric and Gas), have argued that PUC does not have the jurisdiction to mandate a financing program. In a 1975 Order, the PUC Board asserted that it did have jurisdiction, stating:

> "In this time of energy scarcity, the Board fully recognizes the need to protect our remaining supplies of energy. Regulations pertaining to the financing of insulation may be an appropriate means of protecting these energy supplies...the Board finds that it has jurisdiction to consider regulations pertaining to the financing by utilities of residential insulation."

The issue has not yet been resolved. Legislative approval of this measure may be required before the utilities agree to comply with the program.

Implementation Plan and Schedule

Before the installation work can be initiated, the following steps must take place (see Exhibit F-6 for the implementation schedule):

- PUC must approve the Hearing Examiners' recommendation that the measure be adopted

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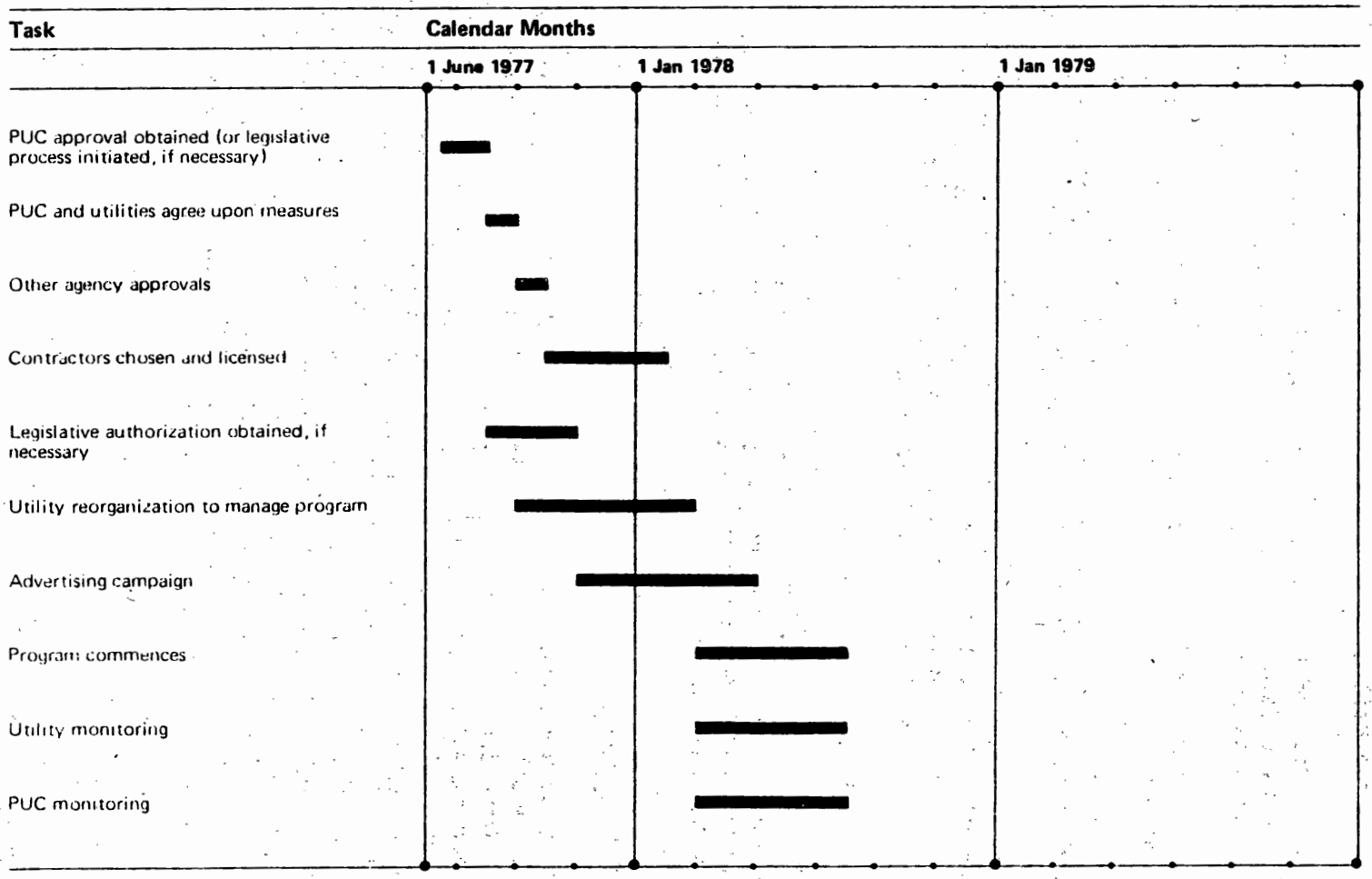
* Hearing Examiner, Thomas F. Portelli, Esq.

Financing of Conservation Investments by Utilities
Implementation Schedule



- Details of the measure must be finalized and agreed upon by PUC and the utilities
- Approvals of the provisions must be obtained from other appropriate agencies (e.g., State Department of Banking) and legislation enacted if necessary
- Contractors must be screened and licenced by the Department of Banking
- An advertising campaign must be conducted to publicize the availability of financing for insulation in residences
- Utilities must appoint persons in appropriate offices to supervise the program (Michigan Consolidated Gas, for example, handles its program through customer service and credit departments, as well as an Energy Conservation Coordinator's Office).

Monitoring System

The utilities will monitor the impact of this measure on customers' gas and electricity consumption through periodic meter checks and customer surveys. The PUC will use the data gathered by the utilities to evaluate the effect of the measure.

EXPECTED ENERGY SAVINGS

The energy savings from this measure will be in addition to those realized as a result of the measure entitled "Certification of Thermal Efficiency in Existing Housing" (see p. C-1). In that measure, it is anticipated that approximately 543,000 housing units (single-, two-, three-, and four-family units) in New Jersey will install ceiling insulation by mid-1980, resulting in energy savings of 5.9 trillion Btu. However, if financial assistance were offered, it is likely that additional homeowners will also be stimulated to insulate their homes by mid-1980. Of 218,871 units considered as "removals" (e.g., not expected to insulate by mid-1980), it is estimated that 25 percent, or 54,718, will take advantage of the availability of utility financing. Therefore, an additional 0.5 trillion Btu will be saved if utilities are required to offer financial assistance to customers for insulation investments (see Table 2).

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

To implement the insulation financing measure, PUC and SEO will utilize existing staff. Therefore, there will be no costs to the public sector.

TABLE 2: OPTION 1 -- ENERGY SAVINGS FROM UTILITY FINANCING OF INSULATION FOR RESIDENCES

Type of Unit	No. of Units Eligible for Insulation*	Removals	Additional Units That Will Insulate**	Total Heating Demand (10^{12} Btu)	Percent Savings From Insulation*	Total Energy Savings (10^{12} Btu)
Single-family: unattached	329,285	55,081	13,770	2.8	6.6	0.2
Single-family: attached	60,995					
2 units	30,193	163,790	40,948	5.9	4.5	0.3
3-4 units	122,600					
Total	543,073	218,871	54,718	8.7		0.5

* Data derived from measure entitled "Certification of Thermal Efficiency in Existing Housing"

** Represents 25% of removals.

Cost to the Private Sector

The program will not begin until the first months of 1978, thus there will be no costs incurred by the private sector during 1977. However, when the program becomes active, utilities and homeowners will have a number of additional expenses.

Michigan Consolidated Gas Company has indicated that the majority of its customer contracts have been handled through the mail in order to eliminate the need for additional personnel to answer phone inquiries. Therefore, it is estimated that each New Jersey utility will hire the minimum number of new employees to manage the financing program, as follows:

- Customer service - one person ($10,000)
- Energy Conservation Coordinator's Office - one administrative assistant ($15,000) and two consultants for on-site visits ($20,000 each)
- Market service - one consultant ($20,000).

Thus, each utility will hire five new employees with salaries totaling $85,000 in late 1977 to be prepared for program implementation in early 1978. Existing company personnel are expected to assume other tasks (e.g., billing) associated with the program.

The cost of installing insulation is expected to average $325 (1979 dollars) per homeowner. New Jersey homeowners taking advantage of utility financing will pay a total of $21.3 million to insulate their dwellings. Additional costs will accrue as interest is paid; however, this amount will depend upon the extent of down payment required. Total private sector costs for 1978-1980 will be $24,970,000 (see Table 3).

TABLE 3: OPTION 1 - PRIVATE SECTOR COSTS FROM UTILITY FINANCING OF INSULATION FOR RESIDENCES

Type of Costs	Costs by Calendar Year 1978	1979	1980	TOTAL
Personnel for seven major utilities	$ 595,000	$ 595,000	$ 595,000	$ 1,785,000
Fringe benefits (.21 x personnel)	124,950	124,950	124,950	374,850
Travel*	2,940	2,940	2,940	8,820
Equipment purchased by homeowners	7,115,000	7,115,000	7,115,000	21,345,000
Other**	831,580	--	--	831,580
Subtotal	8,537,890	7,837,890	7,837,890	24,213,670
Indirect Charges (.35 x personnel)	208,250	208,250	208,250	624,750
TOTAL	$8,877,720	$8,046,140	$8,046,140	$24,970,000

* At $.14/mile.

** Advertising and personnel training for 1978 only.

ENVIRONMENTAL, ECONOMIC, AND POLITICAL IMPACTS

Certain benefits may result from the conservation of natural gas and electricity under this measure. A smaller amount of depletable resources (e.g., natural gas, oil, coal) will be used to provide energy to the same number of customers. Thus, the environmental problems associated with the development and processing of additional energy resources (e.g., air and water pollution) will be reduced.

Local socioeconomic benefits will result if this measure is adopted. It has been estimated that 75 contractors will be involved in the insulation financing program and that an average of three new employees will be hired by each of these companies. The jobs created for installation services could be filled by unskilled persons.

With the exception of Elizabethtown Gas, all of the major utilities opposed the implementation of an insulation financing program at PUC hearings. The utilities submitted prepared testimony to that effect, and included letters from banks in New Jersey indicating that they would be willing to make home improvement loans for insulation.

OPTION 2

PROGRAM MEASURE

This measure proposes a program of conservation investments by gas utilities for ceiling insulation, automatic thermostat controls, and furnace modifications in single-family residential dwellings. Such a program has been proposed by William Rosenberg of FEA who concluded in a study that these investments by gas utilities would increase the availability of natural gas, reduce residential gas bills, and enable high-priority customers to obtain gas at a cost that would be competitive with fuel oil and lower than electricity.

Projected energy savings from this measure are 1.1 trillion Btu.

IMPLEMENTATION APPROACH

Under this measure, the four gas utilities in New Jersey (PSE&G, New Jersey Natural, Elizabethtown, and South Jersey) will be required to provide financial assistance to the owners of single-family units that use natural gas for space heating for the installation of energy-efficient equipment. Financing would be provided to cover the cost of three complementary actions that could be taken by a homeowner to reduce natural gas consumption:

- Installing ceiling insulation. Since the majority of single-family homes do not meet federal insulation standards specified for a local area (56 percent in Newark, for example), a substantial number of homeowners are likely to take advantage of the opportunity offered by this measure.

- Installing an automatic thermostat. Energy consumption could be reduced if residential users were able to install day-night thermostats that automatically reduce temperatures by 5^{o}- 7^{o}F.

- Modifying the furnace. Financing will be available to retrofit a gas furnace to a condition that allows seasonal efficiencies (generally about 60 percent) to be increased by 10 percent. An orifice restrictor, fuel restrictor, and/or electronic ignition device for a pilot light would be added for this purpose.

Utilities will recover its investment through monthly charges to all residential customers (whether or not their homes require the specified equipment). The goal of the program is to achieve 100 percent penetration of existing single-family gas-heated homes currently without conservation devices.

Implementing and Administering Organizations

The State Energy Office (SEO) will work with PUC and the utilities to develop and finalize the details of this measure. Before the measure can be implemented, the PUC must approve all aspects of the program, including the plan of operation, the service contract between the utility and implementing organization, and a method for recovering payments through rates imposed on customers. During the implementation phase, the PUC will work with each company to monitor the effect of the measure on customers' natural gas consumption.

Two approaches are being considered for the implementation of the measure. Under the first alternative, a gas utility would arrange for contractors to install the equipment. Under the second alternative, the utility would establish a wholly-owned subsidiary to supervise the installation of conservation devices. Independent contractors would install the equipment under contract to the subsidiary, and the utility would make regular payments to the subsidiary to cover expenses associated with the conservation activities. Under either option, the utility would include these payments in its rates through a purchased-gas adjustment clause or through periodic rate adjustments.

The conservation subsidiary could presumably arrange for debt financing, with payments ensured by a cost-of-service contract. In financing the subsidiary, the utility would also presumably not be restricted by the provisions of its bond indenture. Rosenberg's analysis assumes a 75 to 25 debt equity ratio, a debt life of 15 years with straight-line depreciation, a debt rate of 9.5 percent, and an allowed 17 percent after-tax return on equity.*

Legal Mechanisms

The New Jersey Statutory Authority (NJSA 48: 2-23) grants the PUC the power to require "any public utility to furnish sage, adequate, and proper service, including furnishing and performance of service in a manner that tends to conserve and preserve the quality of the environment...and to maintain its property and equipment in such condition as to enable it to do so."** Thus, the PUC claims that it could legally impose this mandatory measure on the four natural gas utilities in New Jersey. However, legislative approval may be required before the measure can be adopted.

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* William G. Rosenberg, "Conservation Investments by Gas Utilities as a Gas Supplies Option," Public Utilities Fortnightly, January 20, 1977.

** U.S. Federal Energy Administration, Memorandum: Legal and Regulatory Analysis of Conservation Proposal for Energy Resource Development, December 8, 1976.

The costs associated with the conservation investments would be included in the rate base for all residential customers with single-family units, whether or not they choose to have improvements financed and installed by the utility. The issue of unlawful discrimination has been raised regarding those customers whose homes are not adequately insulated and those who do not choose to accept the utility's offer of financial assistance. Previous cases before the New Jersey PUC have established the precedent for allowing promotion activities (e.g., credit incentives for conservation actions) to be conducted by a utility, provided that the option is available to all customers in a residential rate class and that any resulting benefits (e.g., lower unit costs in the long-term) accrue to all such customers. Nevertheless, the issue of rates for residential customers may be difficult to resolve.

Implementation Plan and Schedule

Five to 10 years will probably be required to achieve the goal of providing financial assistance, as necessary, to 100 percent of each utility's existing single-family customers. The implementation schedule could be affected by factors such as the size of a utility's service area, the availability of adequate supplies of equipment, and the thermal efficiency of existing single-family homes.

Before the installation work can be initiated, the following steps must take place (see Exhibit F-6 for the implementation schedule):

- The PUC must approve the Hearing Examiners' recommendation that the measure be adopted
- Details of the measure must be agreed upon by the PUC and utilities
- Legislation must be enacted, if necessary
- Each utility must choose contractors to perform the installation work
- An advertising campaign should be conducted to publicize the availability of financial assistance for conservation activities.

Monitoring System

The utilities will monitor the impact of this measure on customers' gas consumption through periodic meter checks and customer surveys. The PUC will use the data gathered by the utilities to evaluate the effect of the measure.

Related Measures

The utility financing program would be dependent upon the implementation of two other measures as part of a state energy conservation plan: (1) Certification of Thermal Efficiency in Existing Housing, and (2) Replacement of Gas Pilot Lights.

EXPECTED ENERGY SAVINGS

The availability of financing from gas utilities for energy-efficient equipment in single-family residential dwellings is expected to add to the 1980 energy savings projected for the two other measures cited above.

Certification of Thermal Efficiency in Existing Housing

In the analysis conducted as part of the certification program, it was determined that 390,280 single-family (unattached and attached) residences would be affected by the requirement that energy-efficient modifications be made prior to inspection and/or sale. Assuming that 39 percent of these residences use gas for space heating, 152,209 homeowners using gas for heating would be likely to implement the specified improvements for certification.* It is estimated that 25 percent of the customers with gas heating units categorized as "removals" (e.g., not expected to make modifications by mid-1980) will be likely to consider the availability of financial assistance a sufficient incentive to effect improvements in their homes by mid-1980. Therefore, 11,759 homeowners would save a total of 0.3 trillion Btu (see Table 4).

TABLE 4: OPTION 2 -- ENERGY SAVINGS FROM UTILITY FINANCING OF CONSERVATION INVESTMENTS IN SINGLE-FAMILY HOMES

Type of Unit	No. of Gas-Heated Units for Certification Measure	Removals	No. of Units That Will Take Advantage of Financing	Total Heating Demand (10^{12} Btu)	Percent Savings From Investments	Total Energy Savings (10^{12} Btu)
Single-family: unattached	128,421	21,482	5,371	1.1	16.0	.2
Single-family: attached	23,788	25,551	6,388	.9	14.1	.1
Total	152,209	47,033	11,759	2.0		.3

* For this case, we have assumed that the percentage of homes currently heated by natural gas (39 percent) will not change. In light of the current gas shortage, it is unlikely that many more homeowners will opt to use gas for space heating.

Replacement of Gas Pilot Lights

It was determined that 5.6 trillion Btu can be saved by July 1980 if pilot lights in existing gas furnaces are replaced with automatic (electric) ignition devices. Under the measure, the gas utilities are responsible for arranging, before January 1980, the installation of these devices in 40 percent of the gas furnaces operating as of January 1, 1978. Another 50 percent of these gas furnaces will be fitted with electric ignition devices by January 1, 1981. In addition, all gas furnaces purchased or installed after December 31, 1977., will be required to have automatic intermittent ignition systems.

If the utility is also required to provide financial assistance to customers to improve gas furnace efficiency, it is assumed that an additional 15 percent savings, or 0.8 trillion Btu, could be realized. Thus, total projected energy savings resulting from the requirement that gas utilities offer financial assistance to single-family homeowners for the installation of conservation devices is estimated to be 1.1 trillion Btu.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

The PUC will be able to use existing staff to implement this measure. Accordingly, no public sector costs will be directly associated with the program.

Cost to the Private Sector

The private sector costs for the utilities will be approximately 57 percent of those calculated for Option 1 because only four of the seven utilities will be involved in this measure. Thus, the four will hire new employees with salaries totalling $339,150 annually (1978-1980) to implement the program.

The cost of materials and installation per homeowner, in 1979 dollars,* will be: $325 for insulation; $110 for thermostat installation; and $140 to install at least two of three furnace devices -- orifice restrictor, electric ignition system, or flue restrictor.** Assuming an average cost of $575 per home and 100 percent saturation of single-family gas-heated homes in New Jersey that could use financing of energy-saving equipment, the total investment would be $8.1 million. Total private sector costs for 1978-1980 will be $10,179,653 (see Table 5).

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* Because actual installation of these devices will occur between 1978 and 1980, 1979 dollars have been used.

** These cost estimates are based on William Rosenberg's case study analysis of the potential implementation of such a program by PSE&G. ICF Incorporated, Preliminary Analysis-Conservation Investments as a Gas Utility Supply Option, December 1976.

TABLE 5: OPTION 2 - PRIVATE SECTOR COSTS FROM UTILITY FINANCING OF CONSERVATION INVESTMENTS

Type of Costs	Costs by Calendar Year 1978	1979	1980	TOTAL
Personnel for gas utilities	$ 339,150	$ 339,150	$ 339,150	$1,017,450
Fringe benefits (.21 x personnel)	71,222	71,222	71,222	213,666
Travel*	1,676	1,676	1,676	5,028
Equipment purchased by homeowners	2,705,000	2,705,000	2,705,000	8,115,000
Other**	472,400	--	--	472,400
Subtotal	3,516,048	3,117,048	3,117,048	9,750,114
Indirect Charges (.35 x personnel)	118,703	118,703	118,703	356,109
TOTAL	$3,708,151	$3,235,751	$3,235,751	$10,179,653

* At $.14/mile.

** Advertising and personnel training for 1978 only.

ENVIRONMENTAL, ECONOMIC, AND POLITICAL IMPACTS

Certain environmental benefits will result if this measure is included in New Jersey's state energy conservation program. A reduction in gas consumption would alleviate some of the pressure to produce additional natural gas supplies and thus reduce potential environmental side effects that could be harmful.

Local economic benefits will accrue as a result of employment opportunities associated with the manufacture and installation of conservation equipment. This could be particularly beneficial in urban areas where there is high unemployment. The jobs involved in implementing this measure, particularly the installation phase, could be filled by unskilled persons. It has been estimated that the implementation of this program measure at a national level could result in 72,200 man-years of additional employment per year.

Politically, the implementation of this measure may create difficulties between PUC and the four gas utilities. Each of the utilities, with the exception of Elizabethtown Gas, has expressed reluctance to become a financing institution. PSE&G has indicated, for example, that it has never received a request from a customer for financial assistance. Since 1973, 100,000 PSE&G customers have added insulation to their homes on their own initiative. Furthermore, PSE&G feels that local banks are more than willing to provide loans for conservation-related investments. It is possible that the gas utilities in New Jersey would appeal a PUC order to provide financing to customers.

APPENDIX G

NEW JERSEY ENERGY CONSERVATION PLAN
GENERAL MEASURE

ENERGY-EFFICIENT PROCUREMENT PRACTICES

PROGRAM MEASURE

The Division of Purchase and Property of the Department of the Treasury (DT) is the centralized procurement body for most state agencies.* The department makes available to state agencies open-ended contracts with selected vendors for purchases of equipment and supplies. Contracts are awarded on the basis of competitive bidding. In addition, any item required for agency use that will cost $2,500 or more must be open to public bidding. All contracts entered into by the state are also available to local purchasing units (e.g., municipalities, school districts, counties) under the New Jersey Local Public Contract Law.

This measure will establish procurement practices that will reduce the amount of energy required for equipment, buildings, and materials used by the state and local governments in New Jersey. To accomplish this, DT will set mandatory minimum operating efficiency standards for many vehicles, appliances, and buildings procured by state agencies and establish guidelines for the purchase of energy-efficient materials (e.g., paper that requires less energy to produce and transport). In addition, DT will assemble energy-wise and cost-effective guidelines for the purchase, use, and maintenance of equipment, buildings, and materials. Local governments will be encouraged to conform to state procurement criteria.

Total energy savings from this measure will be .35 trillion Btu, or $875,000, in 1980. Over 70 percent of the savings will come from energy-efficient procurement criteria for buildings.

IMPLEMENTATION APPROACH

Detailed Provisions

DT, assisted by the State Energy Office (SEO), will adopt procurement criteria designed to reduce energy consumption to the maximum extent that is cost-effective. Specifically, DT will write open term procurement contracts only for:

- Automobiles and trucks that meet minimum mileage standards. Different standards will be set for various vehicle categories determined by expected use (e.g., inner city versus highway

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* Exceptions are the state Division of Buildings and Construction (which is in charge of purchases associated with the leasing and construction of state buildings), Rutgers University, and several highway agencies (N.J. Highway Authority, N.J. Turnpike Authority, Garden State Parkway Authority, and the Atlantic City Authority) that control their own purchasing requirements for road maintenance only.

driving) and vehicle type (e.g., station wagon versus two-door sedans). EPA's mileage ratings will be used to assess vehicle efficiencies wherever possible.

- Selected appliances that exceed minimum energy-efficiency ratings (EERs). These appliances include air conditioners, photocopiers, refrigerators/freezers, water heaters, dishwashers, clothes dryers, clothes washers, television sets, ranges and ovens, humidifiers and dehumidifiers, and electric typewriters. Soon, FEA will be issuing efficiency targets for most of these appliances. DT will use these targets to set minimum efficiencies. The minimum appliance efficiency allowed in procurement contracts will, in general, be at least 20 percent higher than that of the average equipment on the market.

- Existing buildings purchased or leased by the state government that exceed minimum energy-efficiency standards. These standards will include requirements for thermal and lighting efficiencies. ASHRAE guidelines for existing buildings will probably be adopted as state procurement criteria.

- Energy-intensive materials that consume the least amount of energy among the cost-effective options available. For example, recycled paper may be purchased rather than new paper if it requires less energy to produce.

Each bidder for state procurement contracts will be required to supply adequate energy-related information to determine if his equipment, building, or material meets minimum energy efficiency criteria.

In addition to setting minimum energy-efficiency criteria, DT will provide guidelines for the purchase, use, and maintenance of each affected procurement item. The objective of the guidelines will be to assist the government purchaser in procuring the most energy-efficient product, given the range of acceptable items covered by the state contracts. For example, the air-conditioning guidelines would indicate appropriate unit capacity for various cooling areas.

Implementing and Administering Organizations

DT, assisted by SEO, will implement and administer this program. DT will use federal energy efficiency targets, testing procedures, and purchase, use, and maintenance guidelines wherever possible.

Legal Mechanisms

All legal mechanisms needed to implement the measure are in effect. DT has the authority to establish procurement criteria. All state contracts that reflect procurement criteria are available to local purchasing units. A special bill is currently before the New Jersey legislature to incorporate energy-efficiency standards for buildings into the leasing and purchasing considerations of the state Division of Buildings and Construction.

Implementation Plan and Schedule

DT and SEO will identify procurement items for which energy-efficient practices are both desirable and practical. These target items will be divided into three groups according to their potential for energy savings and the availability of information needed to set standards and guidelines for purchase, use, and maintenance of the items. DT will institute energy efficient practices for the first group by January 1978, the second group by July 1978, and the third group by January 1, 1979 (see Table 1).

Table 1: Items Subject to Energy-Efficient Procurement Practices

Implementation by 1/1/78	Implementation by 7/1/78	Implementation by 1/1/79
Appliances	Appliances	Appliances
Air Conditioners	Refrigerators/ Freezers	Photocopiers
Vehicles	Water Heaters	Television Sets
Passenger	Dishwashers	Electric Typewriters
Truck	Clothes Dryers	Materials
Buildings	Clothes Washers	Paper
Leased	Ranges & Ovens	Road-Bedding
Owned	Humidifiers/ Dehumidifiers	

DT will hire and train two staff persons who will be responsible for instituting the new procurement practices. These persons will oversee the preparation of contracts for target items that conform to energy-efficiency criteria. In addition, they will assemble information that will assist government procurers in the energy-efficient selection, use and maintenance of purchased items.

DT will prepare contracts only for procurement items that meet energy-efficiency criteria. In setting criteria, DT will rely heavily on life-cycle costs, energy efficiency targets, testing procedures, and other information developed by federal agencies, such as FEA, and trade associations, such as the Air Conditioning and Refrigeration Institute. Once criteria are established, DT will notify bidders of required information, procedures, and forms. The information required will include energy consumption and life-cycle cost data. Once bids are received, they will be reviewed and the appropriate contracts will be prepared.

To assist government procurers, DT will also prepare information packages for each of the target procurement items. These packages will be sent to all state and local procurers. A letter encouraging energy-efficient purchasing practices and the use of state contracts will be enclosed. A copy of the letter will be sent to the head of each local and state agency. (See Exhibit G-1 for the implementation tasks, responsibilities, and schedule for energy-efficient procurement.)

Monitoring System

DT's Division of Purchase and Property and SEO will sample purchase orders to monitor the impacts of the program.

Related Programs/Measurers

FEA is promulgating test procedures, labeling rules, and energy-efficiency targets for all consumer products using more than 100 kWh/year. These appliances include refrigerators and refrigerator-freezers, freezers, dishwashers, clothes dryers, water heaters, air conditioners, home heating equipment, television sets, kitchen ranges and ovens, clothes washers, humidifiers and dehumidifiers, central air conditioners, and furnaces.

The General Services Administration (GSA) is preparing a guide for the implementation of life-cycle costing for the Federal Supply Service. As part of this effort, GSA is developing life-cycle costing techniques for all appliances for which FEA is developing energy-efficiency targets.

EXPECTED ENERGY SAVINGS

Energy-efficient procurement of vehicles, appliances, and buildings will save 0.35 trillion Btu in 1980. Energy savings were calculated by multiplying:

- The number of units purchased in 1976 times
- The number of years between the implementation date and July 1, 1980* times

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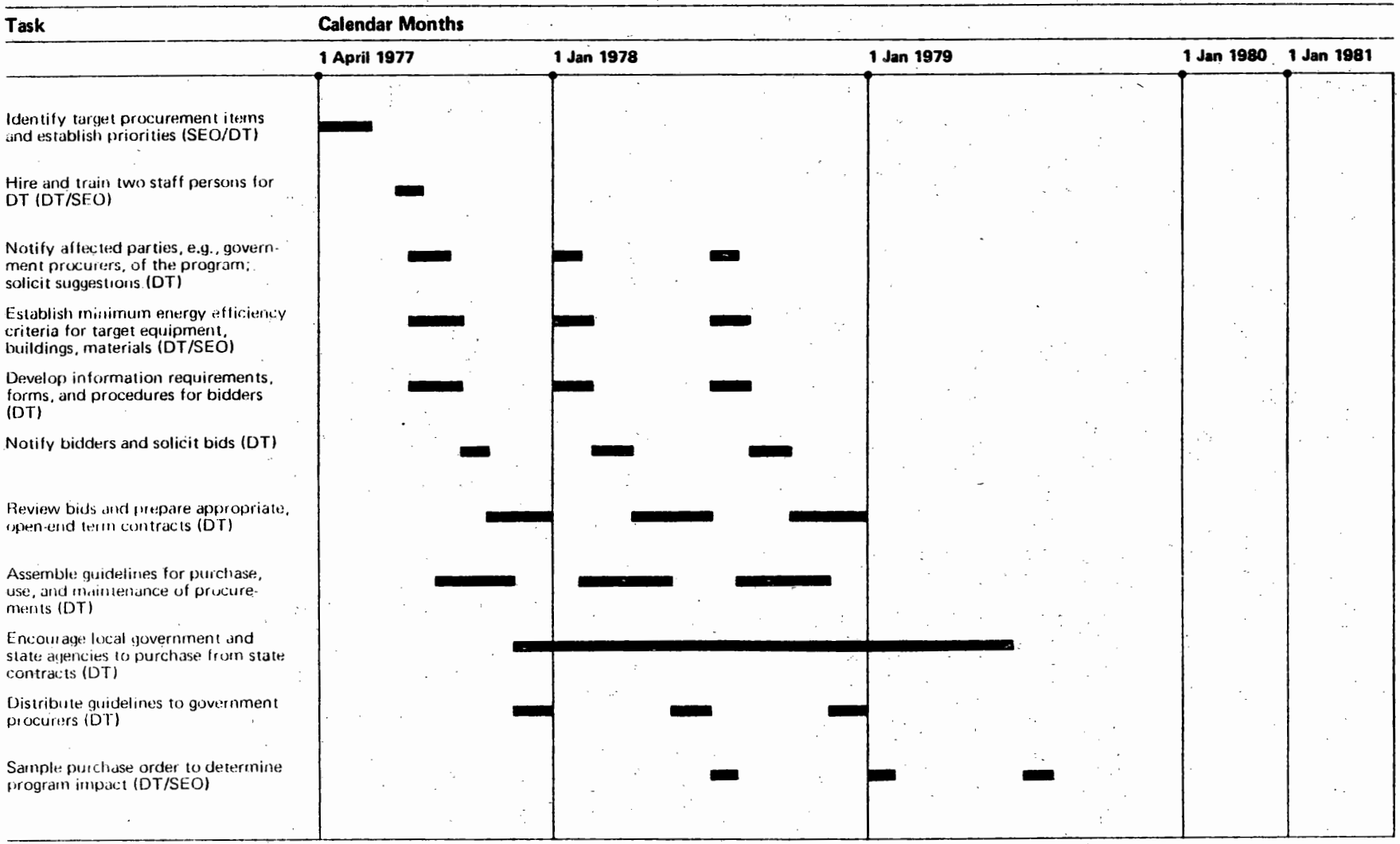
* Items purchased in 1980 will, on the average, generate savings for only half a year. To approximate this, only items purchased up to July 1, 1980, are included and it is assumed that these generate a whole year of savings.

Energy-Efficient Procurement Practices
Implementation Schedule*



*Tasks are scheduled according to the periods when energy-efficient procurement practices are instituted for specific groups of procurement items. These dates are January 1, 1977, January 1, 1978, and January 1, 1979.

- The energy consumption per unit per year without state action times
- The percent decrease in energy consumption resulting from energy-efficient procurement practices.

The energy savings calculations for each item are shown in Exhibit G-2.

COSTS OF THE MEASURE

Costs to Implementing and Administering Organizations

Energy-efficient procurement practices will cost SEO and DT $33,775 to implement in 1977 and $51,195 to implement and administer in each year thereafter. The largest portion of this cost, $33,775 in 1977 and $51,195 in each year thereafter, is for personnel. DT will require two staff to work full-time to develop energy-efficiency standards, assemble guidelines, promote energy-wise procurement, and monitor the program's impact. SEO will need a staff person to work one-fourth of a man year in each year to assist DT (see Exhibit G-3 for a summary of personnel requirements and costs, and Exhibit G-4 for a summary of total costs to implementing and administering agencies).

Costs to the Private Sector

The private sector will not have any direct costs as a result of the procurement program.

ENVIRONMENTAL, SOCIAL, AND POLITICAL IMPACTS

The procurement program will make proposed energy conservation measures more palatable to the private sector by showing that the government is willing to take careful steps to reduce its own energy use. Energy-efficient procurement practices will also demonstrate techniques that business and private citizens can apply to their purchasing.

The environmental impacts associated with this measure are positive, but minimal. Reduced energy use for government vehicles, appliances, buildings, and materials will reduce air and water pollution by amounts that are relatively small.

Calculation of Energy Savings from Energy-Efficient Procurement of Vehicles, Appliances, and Buildings

Procurement Item	Amount Procured in 1976*	Implementation Date	Years to July 1, 1980	Amount Procured Between Implementation Date and July 1, 1980	Energy Consumption** Without State Action in 1976 (10^6 Btu/unit)	Decrease in Energy Consumption (percent)	1980 Energy Savings (10^9 Btu)
Vehicles							
Passenger	1,360	1/1/78	2.5	3,400	96.0	20	65.0
Trucks	330	1/1/78	2.5	825	140.0	20	23.0
Subtotal	**1,690**			**4,225**		**40**	**88.0**
Appliances							
Air conditioners	360	1/1/78	2.5	900	17.8	21	3.0
Photo copiers	150	1/1/79	1.5	225	30.7	20	1.0
Refrigerators/freezers	270	7/1/78	2.0	540	24.4	23	3.0
Water heaters	150	7/1/78	2.0	300	33.0	13	1.0
Dishwashers	30	7/1/78	2.0	60	13.6	15	0.1
Clothes dryers	180	7/1/78	2.0	360	55.2	15	3.0
Clothes washers	180	7/1/78	2.0	360	2.8	15	0.2
Television sets	300	1/1/79	1.5	450	4.0	10	0.2
Ranges and ovens	90	7/1/78	2.0	180	24.1	7	0.3
Humidifiers/dehumidifiers	105	7/1/78	2.0	140	9.0	21	0.3
Electric typewriters	750	1/1/79	1.5	1,125	0.3	10	0.03
Subtotal	**2,565**			**4,640**			**12.1**
Buildings (sq ft)							
Leased	1,200,000	1/1/78	2.5	3,000,000	0.275	20	165.0
Owned	600,000	1/1/78	2.5	1,500,000	0.275	20	83.0
Subtotal	**1,880,000**			**4,500,000**			**248.0**
Total							**348.0**

* Information provided by the State Treasury, Division of Purchase and Property, except for photocopiers, television sets, and electric typewriters figures. These are RPA estimates.

** All energy consumption figures except for passenger vehicles are from U.S. Federal Energy Administration, ***Sourcebook, Vol. 2: State Energy Conservation Program***, 1976. The passenger vehicles figure came from General Service Administration, ***Life-Cycle Casting Workbooks***, 1976.

Energy-Efficient Procurement Practices
Personnel Costs to Implementing and Administering Organizations

Task	Year	Staff Requirements	Man-years	Organization	Salary ($)	Annual Cost ($)
Set energy efficient procurement criteria; assemble procurer guidelines; monitor program effectiveness	1977	2 staff	1.00	DT	14,500	14,500
Assist DT to set energy efficient procurement criteria; assemble procurer guidelines; monitor program effectiveness	1977	1 staff	0.25	SEO	14,500	3,625
Set energy efficient procurement criteria; assemble procurer guidelines; monitor program effectiveness	1978-1980	2 staff	2.00	DT	14,500	29,000
Assist DT to set energy efficient procurement criteria; assemble procurer guidelines; monitor program effectiveness	1978-1980	1 staff	0.25	SEO	14,500	3,625
Annual cost	1977					18,125
	1978					32,625
	1979					32,625
	1980					32,625
Total cost						**116,000**

Energy-Efficient Procurement Practices
Total Costs to Implementing and Administering Organizations

Type of Costs	Costs by Calendar Year				
	1977	1978	1979	1980	Total
Personnel	18,125	32,625	32,625	32,625	116,000
Fringe benefits (.21 x personnel)	3,805	6,850	6,850	6,850	24,355
Travel					
Equipment*	5,000	500	500	500	6,500
Supplies**	500	200	200	200	1,100
Contractual					
Construction					
Other					
Subtotal	27,430	40,175	40,175	40,175	147,955
Indirect Charges (.35 x personnel)	6,345	11,420	11,420	11,420	40,605
Total	**33,775**	**51,595**	**51,595**	**51,595**	**188,560**

* Primarily, for printing standards and guidelines.
**Mailing costs to localities and agencies.

APPENDIX H

WORK SHEETS

Private Sector Costs and Energy Savings, H-1—H-4
Environmental Impacts, H-5—H-20

NEW JERSEY ENERGY CONSERVATION PLAN PRIVATE SECTOR COSTS AND ENERGY SAVINGS ($000)

RESIDENTIAL AND COMMERCIAL	TYPE	COSTS ANNUAL 1977	1978	1979	1980	After 1980	TOTAL Through 1980	Through 1989	ENERGY SAVINGS[1] 1977-1979[2]	1980	Total 1977-1989[3]
Certification of thermal efficiency in existing housing	TOTAL	0	82,170	82,170	82,170	0	246,510	246,510	58,825	45,250	511,325
	Capital[4]		80,550	80,550	80,550		241,650				
	Other		1,620	1,620	1,620		4,860				
Annual furnace inspection	TOTAL	0	38,800	10,600	10,600	10,600	60,000	155,400	50,050	36,500	435,050
	Capital		28,200	0	0	0	28,200				
	Other		10,600	10,600	10,600	10,600	31,800				
Individual metering in residences	TOTAL	680	0	0	0	0	680	680	163	125	1,413
	Capital	680					680				
	Other	0					0				
Thermal efficiency standards for new and renovated buildings	TOTAL	2,700	11,000	11,000	11,000	0	35,700	35,700	34,775	26,750	302,275
	Capital	2,700	11,000	11,000	11,000		35,700				
	Other	0	0	0	0		0				
Lighting efficiency standards and 7-day, day-night thermostats for public buildings	TOTAL	0	5,900	5,800	0	0	11,700	11,700	105,300	81,000	915,300
	Capital		5,900	5,800			11,700				
	Other		0	0			0				
Replacement of gas pilot lights	TOTAL	0	26,700	26,700	18,600	0	72,000	72,000	22,237	17,125	193,487
	Capital		26,700	26,700	18,600		72,000				
	Other		0	0	0		0				
Water conservation code	TOTAL	0	0	0	0	0	0	0	9,750	7,500	84,750
	Capital										
	Other										
Weatherization program	TOTAL	0	0	0	0	0	0	0	650	500	5,650
	Capital										
	Other										
TOTAL RESIDENTIAL AND COMMERCIAL SECTORS	TOTAL	3,380	164,570	136,270	122,370	10,600	426,590	521,990	281,775	216,750	2,449,275
	Capital	3,380	152,350	124,050	110,150	0	389,930				
	Other	0	12,220	12,220	12,220	10,600	36,660				

[1] Assumes an average energy cost of $2.50 per million Btu.

[2] Assumes that total energy savings for 1977, 1978, and 1979 equal 130 percent of 1980 energy savings.

[3] Assumes that energy savings in each year 1981 through 1989 will equal energy savings in 1980.

[4] Considers only capital costs through June 1980.

INDUSTRIAL	TYPE	COSTS ANNUAL 1977	1978	1979	1980	After 1980	TOTAL Through 1980	Through 1989	ENERGY SAVINGS 1977-1979	1980	Total 1977-1989
Improving boiler efficiency	TOTAL	0	4,670	3,462	3,462	1,047	11,594	21,017	73,775	56,750	641,275
	Capital		3,623	2,415	2,415	0	8,453				
	Other		1,047	1,047	1,047	1,047	3,141				
Waste	TOTAL	0	0	0	0	0	0	0	2,600	2,000	22,600
	Capital										
	Other										
Tank fuel evaporation limits	TOTAL	0	0	0	0	0	0	0	27,950	21,500	242,950
	Capital										
	Other										
TOTAL INDUSTRIAL SECTOR	TOTAL	0	4,670	3,462	3,462	1,047	11,594	21,017	104,325	80,250	906,825
	Capital		3,623	2,415	2,415	0	8,453				
	Other		1,047	1,047	1,047	1,047	3,141				
TRANSPORTATION											
Right turn on red	TOTAL	0	0	0	0	0	0	0	1,950	1,500	16,950
	Capital										
	Other										
Enforcement of 55 mph speed limit	TOTAL	0	0	0	0	0	0	0	6,500	5,000	56,500
	Capital										
	Other										
Expanded inspection procedure for auto emissions	TOTAL	10,900	11,800	12,700	13,600	13,600	49,400	171,400	10,075	7,750	87,575
	Capital	0	0	0	0	0	0				
	Other	10,900	11,800	12,700	13,600	13,600	49,000				
Promotion of carpools and vanpools	TOTAL	Not Estimated							21,125	16,250	183,625
	Capital										
	Other										

TRANSPORTATION (continued)	TYPE	COSTS ANNUAL 1977	1978	1979	1980	After 1980	TOTAL Through 1980	Through 1989	ENERGY SAVINGS 1977-1979	1980	Total 1977-1989
Promotion of public transit	TOTAL	0	0	0	0	0	0	0	2,600	2,000	22,600
	Capital										
	Other										
Bus Replacement program	TOTAL	0	0	0	0	0	0	0	650	500	5,650
	Capital										
	Other										
Use of drag reduction devices on trucks	TOTAL	0	4,000	0	0	0	4,000	4,000	3,250	2,500	28,250
	Capital		4,000				4,000				
	Other		0				0				
TOTAL TRANSPORTATION	TOTAL	10,900	15,800	12,700	13,600	13,600	53,000	175,400	46,150	35,500	401,150
	Capital	0	4,000	0	0	0	4,000				
	Other	10,900	11,800	12,700	13,600	13,600	49,000				
UTILITIES											
Current and proposed conservation measures by utilities	TOTAL	0	0	0	0	0	0	0	17,550	13,500	152,550
	Capital										
	Other										
Financing of conservation investments by utilities: option 1	TOTAL	0	8,790	8,090	8,090	100	24,970	25,870	1,625	1,250	14,125
	Capital		7,115	7,115	7,115	0	21,345				
	Other		1,675	975	975	100	3,625				
Financing of conservation investments by utilities: option 2	TOTAL	0	3,660	3,260	3,260	0	10,180	10,180	3,575	2,750	31,075
	Capital		2,705	2,705	2,705		8,115				
	Other		955	555	555		2,065				
TOTAL UTILITY SECTOR (Assuming financing option 1)	TOTAL	0	8,790	8,090	8,090	100	24,970	25,870	19,175	14,750	166,675
	Capital		7,115	7,115	7,115	0	21,345				
	Other		1,675	975	975	100	3,625				
TOTAL UTILITY SECTOR (Assuming financing option 2)	TOTAL	0	3,660	3,260	3,260	0	10,180	10,180	21,125	16,250	183, 625
	Capital		2,705	2,705	2,705		8,115				
	Other		955	555	555		2,065				

GENERAL	TYPE	COSTS ANNUAL 1977	1978	1979	1980	After 1980	TOTAL Through 1980	Through 1989	ENERGY SAVINGS 1977-1979	1980	Total 1977-1989
Energy efficient procurement practices	TOTAL	0	0	0	0	0	0	0	1,138	875	9,890
	Capital										
	Other										
TOTAL GENERAL	TOTAL	0	0	0	0	0	0	0	1,138	875	9,890
	Capital										
	Other										
TOTAL WITH UTILITY FINANCING OPTION 1											
Unadjusted	TOTAL	14,280	193,830	160,520	147,520	25,350	516,150	744,270	452,560	348,125	3,933,810
	Capital	3,380	167,090	133,580	119,680	0	423,720				
	Other	10,900	26,740	26,940	27,840	25,350	92,430				
Adjusted [1]	TOTAL	14,280	193,830	160,520	147,520	25,350	516,150	744,270	362,050	278,500	3,147,050
	Capital	3,380	167,090	133,580	119,680	0	423,720				
	Other	10,900	26,740	26,940	27,840	25,350	92,430				
TOTAL WITH UTILITY FINANCING OPTION 2											
Unadjusted	TOTAL	14,280	188,700	155,690	142,690	25,250	501,360	728,580	454,510	349,625	3,950,760
	Capital	3,380	162,680	129,170	115,270	0	410,500				
	Other	10,900	26,020	26,520	27,420	25,250	90,860				
Adjusted [1]	TOTAL	14,280	188,700	155,690	142,690	25,250	501,360	728,580	363,610	279,700	3,160,610
	Capital	3,380	162,680	129,170	115,270	0	410,500				
	Other	10,900	26,020	26,520	27,420	25,250	90,860				

[1] Energy savings reduced by 20 percent to account for overlap between measures.

TALLY SHEET OF REDUCTIONS IN EMISSIONS - WATER

	Acids	Bases	Dissolved Solids	Suspended Solids	Non-degradable Organic	Biological Oxygen Demand	Chemical Oxygen Demand
Gasoline vehicle	-	-	-	-	-	-	-
Diesel bus	-	-	-	-	-	-	-
Refinery, vehicle fuel	-	-	.19	.36	1.13	.36	2.19
Space heat, commercial gas	-	-	-	-	.12	-	-
Space heat, commercial distillate oil	-	-	3.86	7.33	23.16	7.33	44.97
Space heat, commercial residual oil	-	-	1.63	3.18	10.07	3.18	19.48
Space heat, commercial, coal	-	0.41	10.95	2.37	-	-	-
Space heat, residential, gas	-	-	-	-	.29	-	-
Space heat, residential, distillate oil	-	-	10.75	20.43	64.78	20.43	125.26
Electric generation, gas turbine (gas-fired)	-	-	-	-	-	-	-
Electric generation, gas turbine (oil-fired)	-	-	-	-	-	-	-
Electric generation, steam (gas-fired)	-	-	-	-	-	-	-
Electric generation, steam (residual oil-fired)	-	-	-	-	-	-	-
Electric generation, steam (coal-fired)	159.24	13.16	822.50	118.44	17.11	-	-
TOTAL	159.24	13.57	849.88	152.11	116.66	31.30	191.90

TALLY SHEET OF REDUCTIONS IN EMISSIONS - AIR

	Particulates	Oxides of Nitrogen	Sulfur Dioxide	Hydro-carbons	Carbon Monoxide	Carbon Dioxide (10^3)	Aldehydes
Gasoline vehicle	914	4,393	221	2,963	31,249	1,098	-
Diesel bus	70	1,996	146	196	1,212	131	32
Refinery, vehicle fuel	2	12	11	12	1	-	2
Space heat, commercial gas	54	888	2	23	57	356	29
Space heat, commercial distillate oil	553	2,345	1,326	359	724	820	110
Space heat, commercial residual oil	335	948	2,259	152	15	355	31
Space heat, commercial, coal	182	52	310	20	85	46	1
Space heat, residential, gas	136	1,876	5	58	142	897	71
Space heat, residential, distillate oil	1,053	1,860	3,668	999	559	2,285	305
Electric generation, gas turbine (gas-fired)	-	-	-	-	-	-	-
Electric generation, gas turbine (oil-fired)	179	1,690	645	159	891	379	20
Electric generation, steam (gas-fired)	105	4,175	4	280	3	866	48
Electric generation, steam (residual oil-fired)	945	11,907	17,317	1,032	90	2,643	233
Electric generation steam (coal-fired)	871	4,580	5,382	111	304	1,369	9
TOTAL	5,399	36,722	31,296	6,634	35,332	11,245 x 10^3 tons	891

TALLY SHEET OF REDUCTIONS IN EMISSIONS - OTHER

	Thermal Reject	Occupational Death	Occupational Injury	Occupational Man-Day Loss	Solid Waste
Gasoline	-	-	-	-	-
Diesel bus	-	-	-	-	-
Refinery, vehicle fuel	-	.0003	.02	1.2	23
Space heat, commercial gas	5.2	.001	.18	542.0	-
Space heat, commercial distillate oil	-	.007	.48	24.1	463
Space heat, commercial residual oil	-	.003	.20	10.5	201
Space heat, commercial, coal	-	.029	.50	37.8	3,565
Space heat, Residential, gas	13.1	.003	.44	13.2	-
Space heat, residential, distillate oil	-	.019	1.34	67.2	1,290
Electric generation, gas turbine (gas-fired)	-	-	-	-	-
Electric generation, gas turbine (oil-fired)	-	.004	.26	12.8	246
Electric generation, steam (gas-fired)	12.6	.011	1.14	46.9	-
Electric generation, steam (residual oil-fired)	27.7	.040	3.39	156.1	1,492
Electric generation, steam (coal-fired)	3,276.8	.999	17.37	1,266.8	18,345
TOTAL	3,335.4	1.116	25.50	2,178.6	25,625

ELECTRIC GENERATION, STEAM (RESIDUAL OIL-FIRED)
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-degradable Org.			
Biological Oxygen Demand			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	(30.4)*	31.09	945
Oxides of Nitrogen	383.0	31.09	11,907
Sulfur Dioxide	(557)*	31.09	17,317
Hydrocarbons	33.2	31.09	1,032
Carbon Monoxide	2.9	31.09	90
Carbon Dioxide	85000.0	31.09	2,642,650
Aldehydes	7.5	31.09	233
OTHER			
Thermal Rejection (Btu)	0.8900	31.09	27.67
Occupational Death (Men)	0.0013	31.09	0.04
Occupational Injuries (Men)	0.1090	31.09	3.39
Occupational Man-Day Loss	5.0200	31.09	156.07
Solid Waste Tons	48.0000	31.09	1,492.32

* Local utilities must be consulted to take account of abatement factors for particulates and sulfur emissions.

ELECTRIC GENERATION, STEAM (COAL-FIRED)
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	12.1	13.16	159.24
Bases	1.0	13.16	13.16
Dissolved Solids, Mis.	62.5	13.16	822.50
Suspended Solids	9.0	13.16	118.44
Non-degradable Org.	1.3	13.16	17.11
Biological Oxygen Demand			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	(66.2)*	13.16	871
Oxides of Nitrogen	348.0	13.16	4,580
Sulfur Dioxide	(409)*	13.16	5,382
Hydrocarbons	8.4	13.16	111
Carbon Monoxide	23.1	13.16	304
Carbon Dioxide	104000.0	13.16	1,368,640
Aldehydes	0.68	13.16	9
OTHER			
Thermal Rejection (Btu)	249.0000	13.16	3,276.840
Occupational Death (Men)	0.0759	13.16	.999
Occupational Injuries (Men)	1.3200	13.16	17.370
Occupational Man-Day Loss	96.2600	13.16	1,266.78
Solid Waste Tons	1394.0000	13.16	18,345.04

* Local utilities must be consulted to take account of abatement factors for particulates and sulfur emissions.

DIRECT EMISSIONS FROM AUTOMOBILE OPERATION
(Environmental Impact per 10^{12} Btu of Gasoline)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-degradable Org.			
Biological Oxygen Demand			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	62	14.74	914
Oxides of Nitrogen	298	14.74	4,393
Sulfur Dioxide	15	14.74	221
Hydrocarbons	201	14.74	2,963
Carbon Monoxide	2,120	14.74	31,249
Carbon Dioxide	74,500	14.74	1,098,130
Aldehydes			
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)			
Occupational Injuries (Men)			
Occupational Man-Day Loss			
Solid Waste Tons			

DIRECT EMISSION FROM DIESEL BUS OPERATION
(Environmental Impact per 10^{12} Btu of Diesel Oil)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-degradable Org.			
Biological Oxygen Demand			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	45.7	1.54	70
Oxides of Nitrogen	1,296.0	1.54	1,996
Sulfur Dioxide	94.8	1.54	146
Hydrocarbons	127.0	1.54	196
Carbon Monoxide	787.0	1.54	1,212
Carbon Dioxide	85,000.0	1.54	130,900
Aldehydes	20.7	1.54	32
OTHER			
Thermal Rejection (Btu)			
Occupational Death (Men)			
Occupational Injuries (Men)			
Occupational Man-Day Loss			
Solid Waste Tons			

EMISSIONS FROM PRODUCTION AND DISTRIBUTION
OF VEHICLE FUELS
(Environmental Impact per 10^{12} Btu of Vehicle Fuels)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.	0.4	.47	.19
Suspended Solids	0.76	.47	.36
Non-degradable Org.	2.41	.47	1.13
Biological Oxygen Demand	0.76	.47	.36
Chemical Oxygen Demand	4.66	.47	2.19
AIR (TONS)			
Particulates	3.2	.47	1.50
Oxides of Nitrogen	26.0	.47	12.22
Sulfur Dioxide	23.5	.47	11.05
Hydrocarbons	26.0	.47	12.22
Carbon Monoxide	3.0	.47	1.41
Carbon Dioxide	-	-	-
Aldehydes	4.15	.47	1.95
OTHER			
Thermal Rejection (Btu)	-	-	-
Occupational Death (Men)	0.0007	.47	.0003
Occupational Injuries (Men)	.05	.47	.02
Occupational Man-Day Loss	2.5	.47	1.18
Solid Waste Tons	48.0	.47	22.56

SPACE HEAT, COMMERCIAL, NATURAL GAS
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	-		
Suspended Solids	-		
Non-degradable Org.	.02	5.84	.12
Biological Oxygen Demand	-		
Chemical Oxygen Demand	-		
AIR (TONS)			
Particulates	9.25	5.84	54.02
Oxides of Nitrogen	152.06	5.84	888.03
Sulfur Dioxide	.314	5.84	1.83
Hydrocarbons	3.95	5.84	23.07
Carbon Monoxide	9.72	5.84	56.76
Carbon Dioxide	61,000.0	5.84	356,240.00
Aldehydes	4.9	5.84	28.62
OTHER			
Thermal Rejection (Btu)	.89	5.84	5.20
Occupational Death (Men)	.0002	5.84	.001
Occupational Injuries (Men)	.03	5.84	.18
Occupational Man-Day Loss	92.8	5.84	541.95
Solid Waste Tons	-		-

SPACE HEAT, COMMERCIAL, DISTILLATE OIL
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	.4	9.65	3.86
Suspended Solids	.76	9.65	7.33
Non-degradable Org.	2.4	9.65	23.16
Biological Oxygen Demand	.76	9.65	7.33
Chemical Oxygen Demand	4.66	9.65	44.97
AIR (TONS)			
Particulates	57.26	9.65	553.0
Oxides of Nitrogen	242.98	9.65	2,345.0
Sulfur Dioxide	137.45	9.65	1,326.0
Hydrocarbons	37.17	9.65	359.0
Carbon Monoxide	75.0		724.0
Carbon Dioxide	85,000.0	9.65	820,250.0
Aldehydes	11.4	9.65	110.0
OTHER			
Thermal Rejection (Btu)	-		-
Occupational Death (Men)	.0007	9.65	.007
Occupational Injuries (Men)	.05	9.65	.48
Occupational Man-Day Loss	2.5	9.65	24.13
Solid Waste Tons	48.0	9.65	463.20

SPACE HEAT, COMMERCIAL, COAL (26.2×10^6 Btu/ton)(1% Sulfur)
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	.99	.41	.41
Dissolved Solids, Mis.	26.7	.41	10.95
Suspended Solids	5.77	.41	2.37
Non-degradable Org.	-		
Biological Oxygen Demand	-		
Chemical Oxygen Demand	-		
AIR (TONS)			
Particulates	443.9	.41	182.0
Oxides of Nitrogen	125.8	.41	52.0
Sulfur Dioxide	755.4	.41	310.0
Hydrocarbons	48.34	.41	20.0
Carbon Monoxide	206.1	.41	85.0
Carbon Dioxide	111,000.0	.41	45,510.0
Aldehydes	1.33	.41	1.0
OTHER			
Thermal Rejection (Btu)	-		
Occupational Death (Men)	.07	.41	.029
Occupational Injuries (Men)	1.22	.41	.50
Occupational Man-Day Loss	92.2	.41	37.80
Solid Waste Tons	8,696.0	.41	3,565.36

SPACE HEAT, RESIDENTIAL, NATURAL GAS
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	-		
Suspended Solids	-		
Non-degradable Org.	.02	14.71	.29
Biological Oxygen Demand	-		
Chemical Oxygen Demand	-		
AIR (TONS)			
Particulates	9.24	14.71	136.0
Oxides of Nitrogen	127.5	14.71	1,876.0
Sulfur Dioxide	.31	14.71	5.0
Hydrocarbons	3.96	14.71	58.0
Carbon Monoxide	9.68	14.71	142.0
Carbon Dioxide	61,000.0	14.71	897,310.0
Aldehydes	4.86	14.71	71.0
OTHER			
Thermal Rejection (Btu)	.890	14.71	13.09
Occupational Death (Men)	.0002	14.71	.003
Occupational Injuries (Men)	.03	14.71	.44
Occupational Man-Day Loss	.90	14.71	13.24
Solid Waste Tons	-		-

SPACE HEAT, RESIDENTIAL, DISTILLATE OIL
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	.4	26.88	10.75
Suspended Solids	.76	26.88	20.43
Non-degradable Org.	2.41	26.88	64.78
Biological Oxygen Demand	.76	26.88	20.43
Chemical Oxygen Demand	4.66	26.88	125.26
AIR (TONS)			
Particulates	39.16	26.88	1,053.0
Oxides of Nitrogen	69.18	26.88	1,860.0
Sulfur Dioxide	136.45	26.88	3,668.0
Hydrocarbons	37.17	26.88	999.0
Carbon Monoxide	20.80	26.88	559.0
Carbon Dioxide	85,000.0	26.88	2,284,800.0
Aldehydes	11.34	26.88	305.0
OTHER			
Thermal Rejection (Btu)	-		
Occupational Death (Men)	.0007	26.88	.019
Occupational Injuries (Men)	.05	26.88	1.34
Occupational Man-Day Loss	2.5	26.88	67.20
Solid Waste Tons	48.0	26.88	1,290.24

ELECTRIC GENERATION, GAS TURBINE (OIL-FIRED)
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	-		
Suspended Solids	-		
Non-degradable Org.	-		
Biological Oxygen Demand	-		
Chemical Oxygen Demand	-		
AIR (TONS)			
Particulates	35	5.12	179
Oxides of Nitrogen	330	5.12	1,690
Sulfur Dioxide	126	5.12	645
Hydrocarbons	31	5.12	159
Carbon Monoxide	174	5.12	891
Carbon Dioxide	74,000	5.12	378,880
Aldehydes	4	5.12	20
OTHER			
Thermal Rejection (Btu)	-		
Occupational Death (Men)	0.0007	5.12	.004
Occupational Injuries (Men)	0.05	5.12	.26
Occupational Man-Day Loss	2.5	5.12	12.80
Solid Waste Tons	48.0	5.12	245.76

SPACE HEAT, COMMERCIAL, RESIDUAL OIL
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids	-		
Bases	-		
Dissolved Solids, Mis.	0.39	4.18	1.63
Suspended Solids	0.76	4.18	3.18
Non-degradable Org.	2.41	4.18	10.07
Biological Oxygen Demand	0.76	4.18	3.18
Chemical Oxygen Demand	4.66	4.18	19.48
AIR (TONS)			
Particulates	80.06	4.18	355.0
Oxides of Nitrogen	226.9	4.18	948.0
Sulfur Dioxide	540.5	4.18	2,259.0
Hydrocarbons	36.4	4.18	152.0
Carbon Monoxide	3.47	4.18	15.0
Carbon Dioxide	85,000.0	4.18	355,300.0
Aldehydes	7.5	4.18	31.0
OTHER			
Thermal Rejection (Btu)	-		
Occupational Death (Men)	.0007	4.18	.003
Occupational Injuries (Men)	.049	4.18	.20
Occupational Man-Day Loss	2.52	4.18	10.53
Solid Waste Tons	48.02	4.18	200.72

ELECTRIC GENERATION, STEAM (NATURAL GAS-FIRED)
(Environmental Impact per 10^{12} Btu)

Impact	Col. A Coefficient for Reduction	Col. B Energy Reduction	Col. C Resultant Emission Reduction
WATER (TONS)			
Acids			
Bases			
Dissolved Solids, Mis.			
Suspended Solids			
Non-degradable Org.			
Biological Oxygen Demand			
Chemical Oxygen Demand			
AIR (TONS)			
Particulates	7.4	14.20	105.0
Oxides of Nitrogen	294.0	14.20	4,175.0
Sulfur Dioxide	0.3	14.20	4.0
Hydrocarbons	19.7	14.20	280.0
Carbon Monoxide	0.2	14.20	3.0
Carbon Dioxide	61,000.0	14.20	866,200.0
Aldehydes	3.4	14.20	48.0
OTHER			
Thermal Rejection (Btu)	0.89	14.20	12.64
Occupational Death (Men)	0.0008	14.20	.011
Occupational Injuries (Men)	0.08	14.20	1.14
Occupational Man-Day Loss	3.3	14.20	46.86
Solid Waste Tons			

State of New Jersey
STATE ENERGY OFFICE
DEPARTMENT OF PUBLIC UTILITIES
BOARD OF PUBLIC UTILITY COMMISSIONERS
101 COMMERCE STREET
NEWARK, NEW JERSEY 07102

May 4, 1977

Ms. Janet Drechsler
MSM Regional Study Council
20 Nassau Street
Princeton, N.J. 08540

Dear Ms. Drechsler:

Pursuant to your request, enclosed please find a copy of the New Jersey State Energy Conservation Plan.

If you have any comments on the plan I would appreciate hearing from you.

Very truly yours,

Charles Richman

Charles Richman
Acting Administrator

CR:eg
Enclosure