Chapter 12

Energy Use in Nonresidential Sectors

New Jersey commercial energy use has risen sharply over the past decade while industrial use has dropped. Together, the commercial and industrial nonresidential sectors used 46 percent of all energy consumed in New Jersey in 1989.

This chapter examines commercial and industrial lighting, appliance and equipment use and analyzes the potential for reducing energy consumption over the next decade. The analysis finds a large potential to reduce: (1) commercial lighting consumption by 70 percent and industrial lighting consumption by 32 percent; (2) commercial air conditioning consumption by 50 percent; and (3) industrial motor drive consumption by 18 percent. To help achieve potential savings, electric utilities could enhance existing programs for commercial lighting retrofit and develop comparable programs to stimulate commercial air conditioning retrofits.

The potential for savings will vary in different parts of the state dependent upon the type of commerce and industry present, the number of buildings constructed since 1977 under the state's energy subcode and the area's weather profile. Factors of energy price, market demand for efficient technology and the availability of that technology will determine how much of the savings potential is realized in the nonresidential sectors.

The analysis in this chapter examines savings potentials for retrofits that are relatively easy to quantify. Some commercial/industrial users will not upgrade equipment but others will install efficient technology that can produce savings in excess of stated assumptions. The average over the state could reach the potential shown here at some future date; a significant portion of cost-effective efficiency gains can be achieved within the next decade.

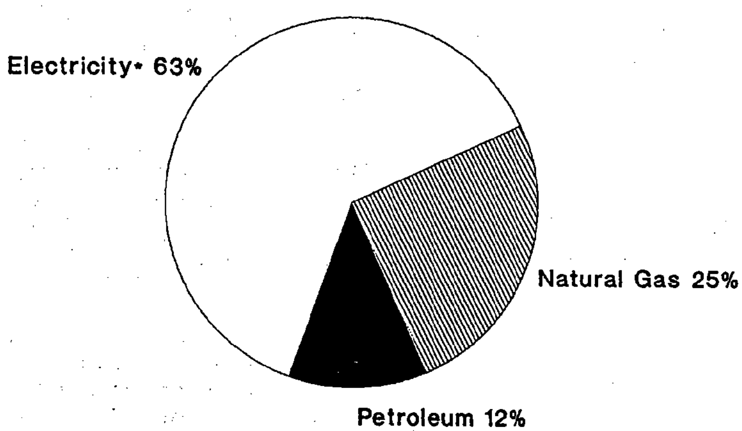
Commercial End Use

The commercial sector, as defined by the Energy Information Administration (EIA), is non-manufacturing business establishments and includes hotels, motels, restaurants, wholesale businesses, retail stores, laundries and other service enterprises; health, social and educational institutions; federal, state and local governments; and public services such as street lights, pumps and bridges.

In 1989, fuel to generate electricity for commercial consumption accounted for 63 percent of commercial energy

FIGURE 12-1

NJ Commercial Energy Consumption
1989 - 475 TBtu



Note: * Includes electrical system energy losses.
Source: EIA-0214(89)

TABLE 12-1

Commercial End Use

Commercial Appliance/Equipment	1989 Percent of Sales	1990 Sales	1989 EIA-TBtu Input
Electric	PSE&G, %	GWH	TBtu
Lighting	44%	11,629	129.3
Air Conditioning	25%	6,683	74.3
Refrigeration	9%	2,299	25.6
Motor Drive	6%	1,470	16.4
Space Heating	3%	722	8.0
Other/Misc.	15%	3,930	43.7
Commercial Electric	100%	26,733	297.3
Natural Gas	PSE&G, %	MMTHM	TBtu
Space Heating	70%	799	84.3
Water Heating	17%	190	20.1
Steam Process	2%	17	1.8
Cooking/Foodstuffs	9%	104	10.9
Air Conditioning	1%	6	0.6
Other/Misc.	2%	24	2.5
Commercial Natural Gas	100%	1,140	120.3
Petroleum	PSE&G, %	MBBL	TBtus
Space Heating, #2,6 oil	86%	8,634	49.8
Water Heating	12%	1,159	6.7
Steam Process	2%	200	1.2
Other/Misc.	0%	0	0.0
Commercial Petroleum	100%	9,993	57.6
Coal	EIA (%)	MMST	TBtu
Heating/Misc.	100%	10	0.2
Commercial EIA TBtu	100%		475.4

Note: Totals may not add due to independent rounding. GWH = gigawatt-hours; MMTHM = million therms; MBBL = one thousand barrels; MMST = million short tons. Appliance and equipment amounts calculated by % of sales. EIA, EIA-0214(89).

Sources: PSE&G 1989 Customer Energy Use Survey, Electric Customers, pp. 78-79.
New Jersey Energy Profile, 1990, for GWH, MMTHM.
DOE/EIA-0214(89) - TBtu for energy input to electric, natural gas, petroleum, coal and aggregate totals.

use; petroleum accounted for 12 percent of total end use and natural gas 25 percent. (See Figure 12-1.) Overall commercial use has risen steadily through the 1980s to 475 TBtu—about one-fifth of total statewide energy consumption.

Public Service Electric and Gas (PSE&G), the state's largest electric utility, periodically surveys commercial customers and reports their patterns of energy use. PSE&G sales account for approximately 60 percent of total New Jersey electric sales and consumption patterns of PSE&G commercial customers may be reasonably representative of commercial customers statewide as a whole. In PSE&G's service territory in 1990, the largest uses of electricity by commercial customers were for lighting (44 percent) and air conditioning (25 percent). The combined lighting and cooling load is over two-fifths of total commercial sector energy consumption. (See Table 12-1.)

Industrial End Use

The industrial sector includes manufacturing, construction, mining, agriculture, fishing and forestry industries. In 1989, petroleum accounted for 49 percent of industrial consumption, fuel to generate electricity accounted for 33 percent of consumption and natural gas supplied 17 percent of this sector's energy needs. (See Figure 12-2.)

Petroleum, the largest component of industrial use, totaled 253 TBtu or about 45 million barrels in 1989. Four-fifths of that petroleum is petrochemical feedstock for the chemical and pharmaceutical industries that account for over 3 percent of statewide non-farm employment and crude oil and feedstock for the petroleum industry that accounts for 0.2 percent of non-farm employment. Only one-fifth, approximately 49 TBtu, is fuel for combustion. The fuel component has dropped markedly since 1980 but the petroleum feedstock proportion has dropped only slightly.

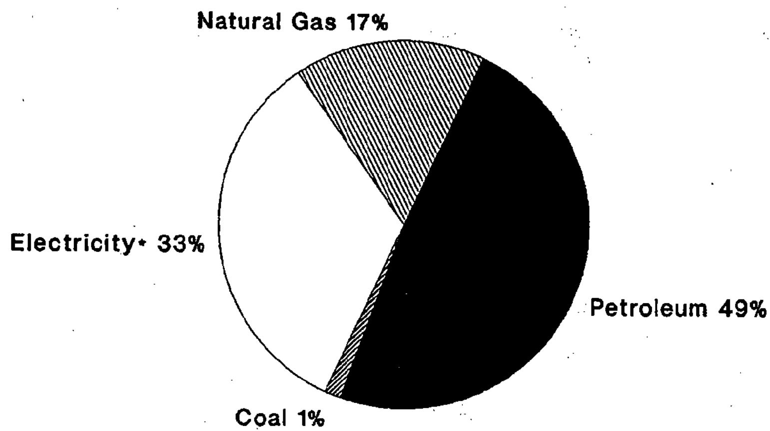
In the United States as a whole in 1980, electric motor drive accounted for the overwhelming share of industrial electric consumption.[1] In PSE&G's territory in 1990, 44 percent of industrial electric end use powered motor drives.

State Buildings End Use

Following the energy crisis of the 1970s, the State of New Jersey made energy conservation in State buildings an explicit goal and established the State Energy Conservation Bond (SECB) program to earmark funds to upgrade energy systems and weatherize State building stock for improved energy performance. Between 1979 and 1988, thermal energy consumed in State buildings dropped almost 8 percent overall and dropped 21 percent on a Btu per square foot basis. Between 1973 and 1988, electric consumption in State buildings rose almost 17 percent (in part, paralleling an increase in square footage served); however, the amount of electricity used per square foot remained almost the same during that period despite trends towards increased use of air conditioning in State building space. The State can continue to capture savings by continuing to upgrade older, less efficient heating/cooling sys-

FIGURE 12-2

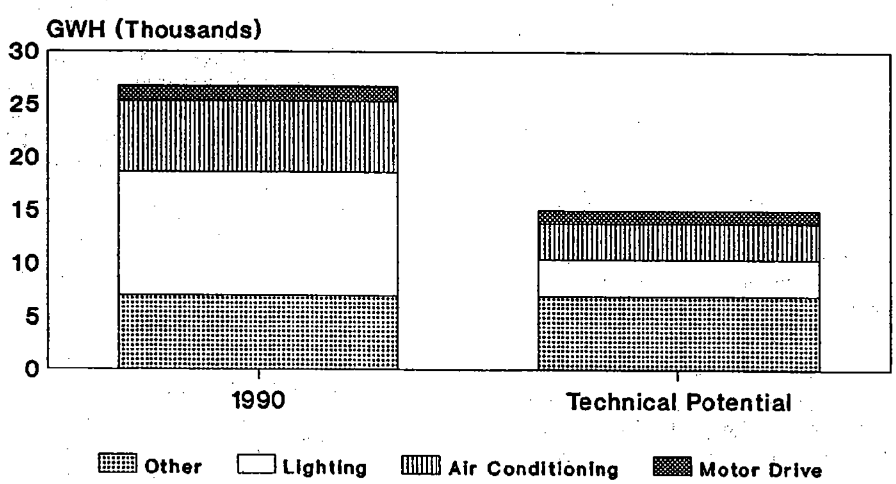
NJ Industrial Energy Consumption
1989 - 521 TBtu



Note: * Includes electrical system energy losses.
Source: EIA-0214(89)

FIGURE 12-3

NJ Commercial Electric End-Use Scenario
With Most Efficient Equipment On Market
Zero Growth in Customers or Equipment



Source: Table 12-3. See table and text for assumptions underlying calculations.
GWH - Gigawatthours

TABLE 12-2

Industrial End Use

Industrial Appliance/Equipment	1990 Percent of Sales	1989 Sales	1989 EIA-TBtu Input
Electric	PSE&G, %	GWH	TBtu
Motor Drive	44%	6,628	76.5
Lighting	32%	4,760	55.0
Air Conditioning	11%	1,612	18.6
Refrigeration	2%	316	3.7
Other/Misc.	12%	1,747	20.2
Industrial Electric	100%	15,063	174.0
Natural Gas	PSE&G, %	MMTHM	TBtu
Water Heat/Process	52%	278	45.4
Space Heating	23%	123	20.1
Other/Misc.	25%	131	21.4
Industrial Natural Gas	100%	532	86.9
Petroleum	PSE&G, %	MBBL	TBtus
Process Heat, Steam	60%	5,825	29.6
Space Heat	23%	2,250	11.4
Drying/Other	17%	1,666	8.5
Industrial Petroleum	100%	9,741	49.5
Petroleum-Unburned feedstock, asphalt, lubriciants	100%	35,351	203.3
Coal	EIA, %	MMST	TBtus
Process Heat, Steam	100%	286	7.2
Industrial Coal	100%		520.8

Note: Totals may not add due to independent rounding. GWH = gigawatthours; MMTHM = million therms = TBTU; Mbbl = thousand barrels; MMST = million short tons. Appliance/Equipment amounts allocated by % of sales. EIA, EIA-0214(89). EIA annual estimates are the best data available for petroleum consumption.

Sources: PSE&G 1990 Customer Energy Use Survey, Electric Customers pp. 157-159. New Jersey Energy Profile, 1990, GWH, MMTHM. DOE/EIA-0214(89) - TBtu for energy input to electric generation, sales of natural gas, petroleum, coal.

tems and building envelopes and by carefully maintaining peak system performance through adherence to efficient operating and maintenance procedures. See Chapter 14 for an expanded discussion of energy conservation and State buildings.

Analysis

An analysis of energy efficiency potential for commercial and industrial energy use assumes that over the next decade the most efficient appliances commercially available today could replace appliances now in use. The analysis does not consider changes in economic productivity or in the number of commercial or industrial customers.

Commercial Sector Savings Potential

Table 12-3, Figure 12-3 and Figure 12-4 show the technical potential for improved efficiency of electric appliances in the commercial sector. The four major categories of commercial electric use are: lighting, cooling, heating, and ventilation. The *Other* category includes all other use for which no conservation is projected. The potential is the amount of electricity necessary to maintain the same level of illumination, warmth and cooling in commercial buildings if all lighting, air conditioning and motors were replaced with the most efficient types available today.

The calculations indicate a potential to reduce commercial sector electric consumption by 44 percent. Lighting presents the largest opportunity to save on both a percentage and gigawatt-hour basis with a potential reduction of 70 percent. Air conditioning presents the second largest opportunity—a potential 50 percent reduction. The calculation does not include savings for refrigeration, electric space heating or miscellaneous uses.

Outside air introduced into buildings by natural infiltration or mechanical ventilation costs money for heating and cooling but dilutes indoor air pollutants. To balance economic and pollution control needs, ventilation standards or maximum allowable pollutant concentrations can be prescribed. National standards include those from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Its most recent update of ventilation codes, entitled 62-19-89, sets a minimum of 0.35 air changes per hour (0.35 ACH) or 15 cubic feet per minute per occupant (15 cfm/occupant), whichever is greater. The amended code limits for indoor radon are a maximum of four picocuries per liter. However, a maximum ambient air level standard could be more effective in protecting the public health. Codes set minimum but not maximum ventilation levels. The most effective means to maintain and improve indoor air quality is to reduce pollutant sources such as smoking and aerosol or solvent use.

Industrial Sector Savings Potential

Table 12-4 and Figures 12-5 and 12-6 illustrate the potential to improve industrial motor and lighting efficiency. The potential is the amount of electricity necessary to accomplish the same tasks in the industrial sector if all motors and lighting were replaced with the most efficient types commercially available today.

The calculations indicate a potential for an 18 percent reduction in industrial electric consumption in New Jersey. Newest commercially available technology offers the

TABLE 12-3

New Jersey Commercial Electric Conservation Technical Potential
Through Lighting and Equipment Appliance Efficiency Improvements - Zero Customer Growth

Appliance	1990 Percent of Sales (1)	1989 Sales (gwh)(2)	Appliance Type or Conservation Measure (3)	Percent Savings with Efficient Appliance (3)	Savings with Efficient Appliance (gwh)	Total Sales with Efficient Appliance (gwh)
Lighting	43.5	11,629	Davis (1987) high-efficiency bulbs (Phillips-34 Econ-o-Watt Lite White Lamps), electronic dimmable ballasts (XO Industries), specular imaging reflectors (Maximum Technology Bright Idea), day-light dimming	70.0	8,140	3,489
Air Conditioning	25.0	6,683	Load reduction from light savings; efficiency measures; economizers, high-efficiency chillers (Trane Centravac), chiller downsizing, chiller capacity modulation, filter chiller water, clean condenser coils	50.0	3,342	3,342
Ventilation/ Motor Drive	5.5	1,470	Load reduction from light savings; high-torque fan belts (Uniroyal High Torque Drive), duct/fan cleaning, high efficiency motor, variable air volume (VAV) conversion, cut duct friction, tape duct leaks, scheduled controller, occupancy sensors	18.0	269	1,201
Other	27.0	6,951	No savings assumed	--	0	6,951
Totals	100.0	26,732				

Sources: (1) PSE&G 1990 Customer Energy Use Survey, Electric Customers, p. 78.
(2) New Jersey Energy Data Profile,1990. New Jersey electric utility commercial sales of 26,732 gwh.
(3) New England Energy Policy Council, (NEEPC) Power to Spare, July 1987, Table C-1.

potential to reduce energy required for industrial lighting by almost one-third and for motor drives by nearly one-fifth.

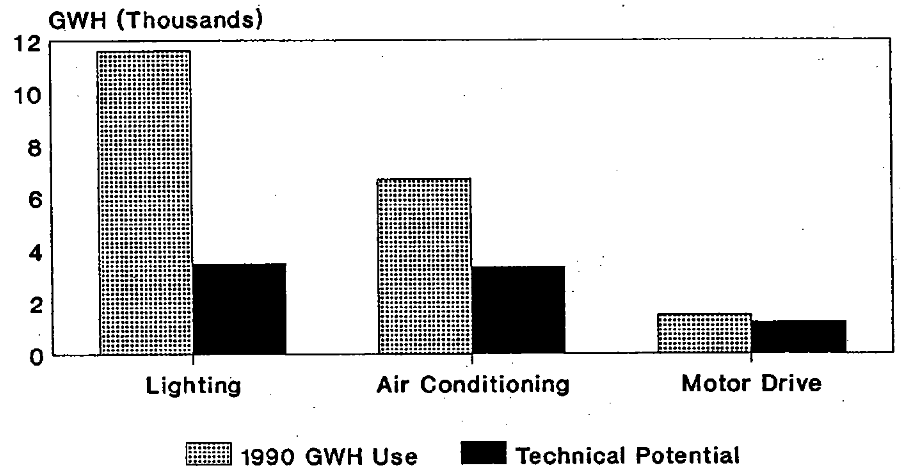
Policy, Regulation and Programs

In September 1991, the New Jersey Board of Regulatory Commissioners adopted regulations that allow utilities to earn a return on investments in conservation. The Demand Side Management Resource Plan regulations were approved after a year-and-a-half long process of Board review, modified proposals, public hearings and roundtable discussions with concerned parties. (See Chapter 8 for a more detailed discussion.) The state expects the regulations to be the driving force in promoting efficiency and accelerating the deployment of efficient technology over the next decade.

Energy efficiency improvement efforts in the United States have leveled off over the last several years. A recent publication by the American Council for an Energy-Efficient Economy noted: *The country...is losing momentum in energy efficiency. The United States reduced energy use per dollar output by an average of 2.7 percent per year between 1976-86. But the energy intensity of the U.S. economy dropped minimally in 1987, and an overall slowdown in efficiency improvements can be discerned in major end uses.*[2] The authors state that the two main reasons for the slowdown are the fall in energy prices and the federal government's reduced commitment to energy conservation in the 1980s.

FIGURE 12-4

NJ Commercial Electric End-Use Potential
With Most Efficient Appliances on Market
Zero Growth in Customers or Appliances



Source: Table 12-3. See table and text for assumptions underlying calculations.
GWH - Gigawatthours

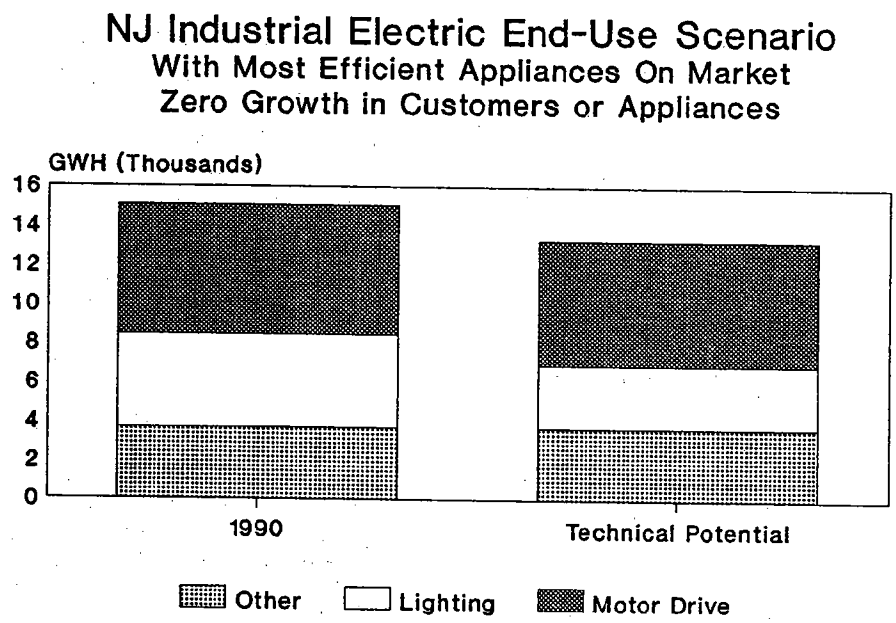
TABLE 12-4

New Jersey Industrial Electric Conservation Technical Potential
Through Equipment and Lighting Efficiency Improvements - Zero Customer Growth

Appliance	1990 Percent of Sales (1)	1990 Sales (gwh)(2)	Appliance Type or Conservation Measure (3)	Percent Saving with Efficient Appliance	N.J. Savings with Efficient Appliance (gwh)	Total Sales Efficient Appliance (gwh)
Motor Drive	44.0	6,628	Average savings from high efficiency motors and adjustable speed drives	18.3	1,213	5,415
Lighting	31.6	4,760	High pressure sodium for mercury fluorescent upgrade	32.0	1,523	3,237
Other	24.4	3,675	--	0	0	3,675
Totals	100.0	15,064				

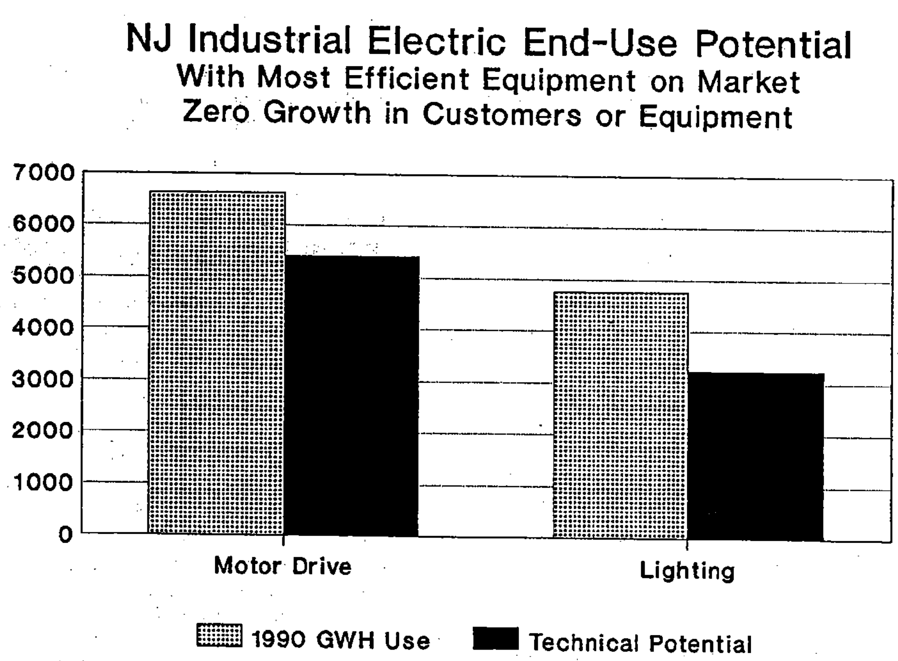
Sources: (1) PSE&G Customer Energy Use Survey, 1990.
(2) New Jersey Energy Profile1990 New Jersey electric utility industrial sales of 15,064 gwh.
(3) New England Energy Policy Council, (NEEPC) Power to Spare, July 1987, Table C-1.

FIGURE 12-5



Source: Table 12-4. See table and text for assumptions underlying calculations.
GWH - Gigawatthours

FIGURE 12-6



Source: Table 12-4. See table and text for assumptions underlying calculations.

Lighting

Lighting technology has improved substantially but its high capital cost has slowed market penetration. High frequency electronic ballasts, improved magnetic ballasts, fluorescent tubes and and screw-in fluorescent bulbs provide the same degree of illumination for considerably lower operating costs. Improved fixture designs direct light to where it is needed. Outdoor fixtures can direct light down towards street level rather than upwards towards the sky. Light-colored and reflective material can increase the amount of illumination per watt. Efficient lighting sources also generally produce less heat, thus reducing air conditioning requirements.

The American Council for an Energy-Efficient Economy (ACEEE) study proposes minimum efficiency standards for common lamps, similar to the 1987 efficiency standards recently set for appliances. Efficiency standards, the authors note, already exist for ballasts in at least four states: California, Massachusetts, New York, and Florida, while Congress recently passed a national ballast efficiency standard bill.[3] Federal ballast regulation prohibits the manufacture of standard *magnetic ballasts and, conversely, requires the use of energy-efficient magnetic ballasts or electronic ballasts. The standard [went] into effect on January 1, 1990. The regulation also contains labeling requirements to indicate compliance.*[4] The ballast efficiency regulations could result in a cumulative savings of 27,600 gwh by the year 2000.[5]

New Jersey presently has Lighting Efficiency Standards under the Uniform Construction Code, 5:23-30.18, Energy Subcode. Under 5:23-3.18(a)(1), New Jersey adopts as its standard the "IES Recommended Procedure for Light Power Limit Determination" (LEM-1). LEM-1 sets watt/sq. ft. limitations for specific applications. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has proposed a new standard, "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings," April 1988. This proposed standard sets lower watt/sq. ft. limits for many applications.

All three major electric utilities in New Jersey (AE, PSE&G and JCP&L), as well as Rockland Electric have certain lighting efficiency incentive programs currently in place.

AE, through its Save-a-Watt commercial/industrial energy-efficient lighting program, offers incentives in the form of rebates for lighting efficiency improvements when customers replace less efficient light sources with high efficiency light sources.

JCP&L has an energy-efficient lighting system program for commercial and industrial customers. This program includes rebates of $.10/watt saved through installation of energy-efficient light sources, as well as rebates for occupancy sensors.

PSE&G offers rebates to commercial customers for installation of conservation measures recommended by a Commercial and Apartment Conservation Service (CACS) audit, which may include lighting efficiency measures. (See Chapter 15 for a description of the CACS Program.) PSE&G also offers lighting rebates to commercial customers that install high efficiency lighting equipment as follows: $1.25 for each 4-foot lamp and $2.50 for each 8-foot lamp up to a maximum $5,000 rebate.

Rockland Electric provides cash incentive rebates to commercial and industrial electric customers for installation of high-efficiency lighting measures, specifically, $1.00 per lamp for replacement of standard fluorescent lamps with high-efficiency fluorescent lamps; $3 for replacement of standard fluorescent ballasts with magnetic ballasts; $5 for replacement of standard ballasts with high-efficiency electronic ballasts; $4 for compact fluorescent lamps replacing incandescents; $25/kW for occupancy sensors; $50/kW for custom projects; $100/kW for new construction; and $150/kW for custom improvements.

Cooling

The average commercial cooling use for both small and large offices in the New York/New Jersey area is about 7 kwh/square foot, which is equivalent to about 24,000 Btu/square foot. It is about 2.8 percent lower than the national average for small offices, and 3.6 percent lower than the national average for large offices. (See Appendix: Commercial Electric End Use, USDOE Region II.) There is room for improvement in this area. New energy-efficient offices consume between 10 and 15 kwh/square foot in total electric usage.[6] Therefore, 7 kwh/square foot used solely for cooling purposes may represent too high a percentage of total usage.

Perhaps more important than total consumption in commercial cooling is peak demand. All New Jersey electric utilities reach their peak demand in the summer months. This peak has risen steadily over recent years—5 to 6 percent annually—due to increased air conditioning use. In the PSE&G service territory, air conditioning electric consumption, as a percent of total commercial electric consumption, nearly doubled and rose from 14.5 percent in 1984 to 25 percent in 1989. (See Table 12-1.)

Thermal storage shifts cooling peak demand to nonpeak hours. It employs electric refrigeration at night to chill water or make ice that cools air during the daytime peaks. Approximately 40 to 50 percent of electrical demand could be moved to off-peak hours through the use of thermal storage.[7] PSE&G has initiated a program to encourage installation of thermal storage where such a system would reduce peak electric demand.

Gas air conditioning can reduce the peak load of electric utilities in New Jersey, while benefiting the gas utilities. New Jersey's gas utilities experience their heaviest gas demand in the winter heating months. Gas air conditioning can flatten the gas utilities' load profile by filling the "summer valley" with a new service, *i.e.*, cooling. At the same time, it can "shave" the cooling-related peak load of the summer peaking electric utilities. A flatter load curve is economically beneficial for both gas and electric utilities.

Electric Motor Efficiency

Approximately 80 percent of industrial electric use in 1980 was for electric motors, which range in efficiency from 80 to 90 percent. Efficiencies of 95 percent or more are possible by increasing the iron and copper content of the core and windings. Because its capital costs are only a small fraction of its operating costs, an electric motor may use more than 10 times its capital costs in energy annually. Thus, an annual energy saving of 50 to 60 percent of a motor's capital costs is possible with an increase in efficiency from 90 to 95 percent. Many industrial motors operate at fixed speeds, but in many applications (such as compressors, blowers, fans and pumps) could be reduced by up to 50 percent depending on application and duty cycle.

Industrial Processes

The industrial sector has made substantial improvements in energy efficiency since 1973.[8] The ACEEE study found that, on a national level, *Industry has made the largest gains, cutting energy requirements per unit of output by 30 percent between 1973 and 1984.*[9] Opportunities still remain for increased energy efficiency in the industrial sector.

Major energy-using industries in New Jersey are the chemical and metal industries. For the chemical industry, areas for improving energy use include energy recovery, such as cogeneration, waste heat recovery, and methods for improving chemical separation processes.[10]

The state has encouraged use of natural gas in the industrial sector for several reasons. First, natural gas comes from mostly domestic sources. Second, industrial sector use serves a critical function in the state's natural gas market since it provides an outlet for excess supplies during the nonheating season.

Findings

- In the commercial sector, electricity accounted for approximately 63 percent, petroleum for 12 percent, and natural gas for 25 percent of fuel use in 1990.
- In the industrial sector, petroleum accounted for 49 percent, electricity accounted for 33 percent, and natural gas for 17 percent of energy use in 1990.
- Electric peak demand has been rising 5 to 6 percent annually in New Jersey over recent several years.
- In the commercial sector, the primary uses for electricity are for lighting and air conditioning. The primary uses for natural gas and petroleum are space and hot water heating.
- In the industrial sector, the primary use of electricity is to power electric motors. The primary use for natural gas and petroleum is for process boiler fuel.
- On a Btu per square foot basis, thermal energy use in the State buildings sector has declined 21 percent while electric use has remained approximately the same since 1973.
- The BRC adopted a rule in September 1991 that encourages utilities to invest in high efficiency appliances and equipment rather than in construction of additional generation capacity. The rule enables utilities to earn income on Board-approved investments in conservation that yield measurable savings.

Policy

- The State should continue to promote use of more efficient cooling and lighting technologies to reduce electric consumption in the commercial sector.
- The State should promote use of thermal storage and natural gas air conditioning to reduce peak demand in the commercial sector.
- The State should promote use of more efficient motor drive technologies to reduce electric consumption in the industrial sector.
- The State should continue to identify and pursue energy savings opportunities in the State buildings sector and place strong emphasis on adhering to operating and maintenance procedures that ensure peak energy system performance.
- The State should promote cost-effective conservation in the commercial and industrial sectors by educating companies on life-cycle costing for energy-consuming equipment, system and appliance purchases.

Implementation

- Utility rebate programs should be continually evaluated to stimulate replacement of old, inefficient lighting and cooling appliances with the most efficient commercially available technology.
- Incentives should be provided to encourage use of off-peak cooling technologies as well as more efficient motor drives.
- Regulations that enable utilities to earn income on investments in conservation can lead to significant energy efficiency gains statewide. The BRC should review Demand Side Management Resource Plans submitted by the utilities pursuant to the Board's September 1991 conservation incentives rulemaking in a timely manner to ensure prompt implementation of cost-effective conservation programs.

NOTES

1. Synergic Resources Corporation, *Energy-Use Patterns and Indicators*, Vol. 2, report prepared for Electric Power Research Institute, EM-5126, (Palo Alto, CA.: EPRI, April 1987), pp. 3-163.
2. William V. Chandler, Howard S. Geller and Marc R. Ledbetter, *Energy Efficiency: A New Agenda*, (Washington, D.C.: American Council for an Energy-Efficient Economy, 1988), p. 14.
3. *Ibid.*, p. 52.
4. Howard S. Geller and Peter M. Miller, *1988 Lighting Ballast Efficiency Standards: Analysis of Electricity and Economic Savings*, (Washington, D.C.: American Council for an Energy-Efficient Economy, August 1988), p. 3.
5. *Ibid.*, p. 7.
6. Arthur H. Rosenfeld and David Hafemeister, "Energy-Efficient Buildings," *Scientific American*, April 1988, p. 81.

7. *Ibid.*
8. Marc Ross, "Improving the Efficiency of Electricity Use in Manufacturing," *Science*, vol. 244, April 21, 1989, pp. 312-317.
9. Chandler *et al.*, p. 13.
10. *Industrial Energy Use*, OTA-E-198, (Washington D.C.: U.S. Congress, Office of Technology Assessment, June 1983), p. 50.

Chapter 13

Energy Use In Transportation

Transportation accounts for over a third of energy use in New Jersey, and petroleum supplies 99 percent of that energy. Most people are dependent on automobiles, trucks, and/or buses for getting to work, shopping, moving goods, and other daily needs. This dependence helps make the state's highways the busiest in the nation and among the most congested. Reliance on single-passenger, petroleum-fueled vehicles wastes energy, hinders economic growth, and produces adverse environmental effects, such as harmful levels of carbon monoxide and ozone.

In the short-term, the most effective measures to improve mobility and reduce fuel use and air pollution for transportation will be improved rail and bus transit options, ridesharing and vanpooling. Also effective will be measures that ease congestion through traffic signal management, express buses, high occupancy vehicle (HOV) lanes, and lane reversal to handle surge loads of traffic. In the mid-term, by 2000, the state can reduce fuel use and air pollution through encouraging purchase of vehicles incorporating today's best available technological advances in fuel efficiency. Over the long-term, coordinated land use can reduce dependence on single occupancy vehicles by enabling more people to work, shop, and fulfill daily needs near their homes or within reach of mass transit.

Transportation in New Jersey Today

New Jersey, at the heart of the Boston-to-Washington megalopolis, is the most densely populated state in the country. A period of sustained economic prosperity coupled with spreading development has overloaded the transport system, particularly the highways.[1] New Jersey is 8th in the country in autos per capita (0.67/capita), and its highways are the busiest in the nation, as Table 13-1 shows.

TABLE 13-1

Comparison of Highway Use in the U. S.

State	Vehicles Per Road Mile Per Day
New Jersey	4,792
Maryland	3,742
California	4,194
New York	2,619
Pennsylvania	1,976
Texas	1,430
Wyoming	398

Source: U.S. Department of Transportation, Federal Highway Administration Highway Statistics 1989, Table VM3, p. 183, Table HM-20, p. 119.

Over the past 20 years population shifts to suburbs and rural areas, followed by the movement of employers out of the older urban centers, have changed transportation patterns. In northern New Jersey the separation between home and workplace has increased, trips to work have become longer, and total travel time has increased. The added travel is by automobile; public transit ridership has barely increased.[2]

TABLE 13-2

Per Capita Transportation Energy Use - 1989

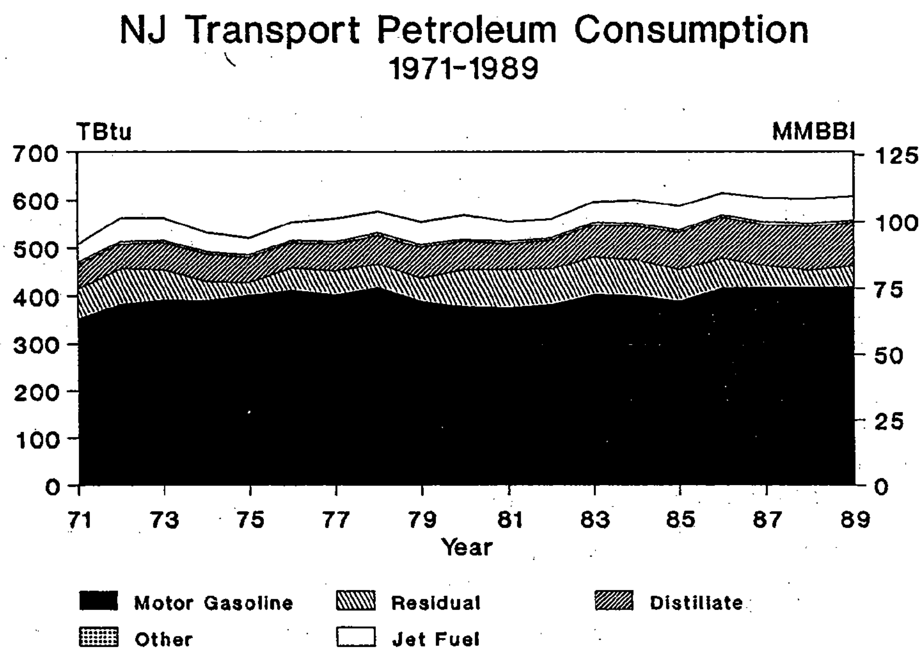
State	All Transportation MMBtu/capita	Motor Fuel gals/capita
U.S. highest	329.2	619.8
U.S. average	89.4	443.1
U.S. lowest	48.3	284.8
New Jersey	79.2	435.7
Maryland	76.0	434.8
Pennsylvania	67.8	373.7
New York	48.6	306.0
N.J. rank among states & D.C. (highest to lowest)	37th	37th

Sources: U.S. Dept. of Commerce, Bureau of the Census unpublished table for 1989.
EIA State Energy Data Report, 1960-89, Table 7, p. 21.

Energy Use

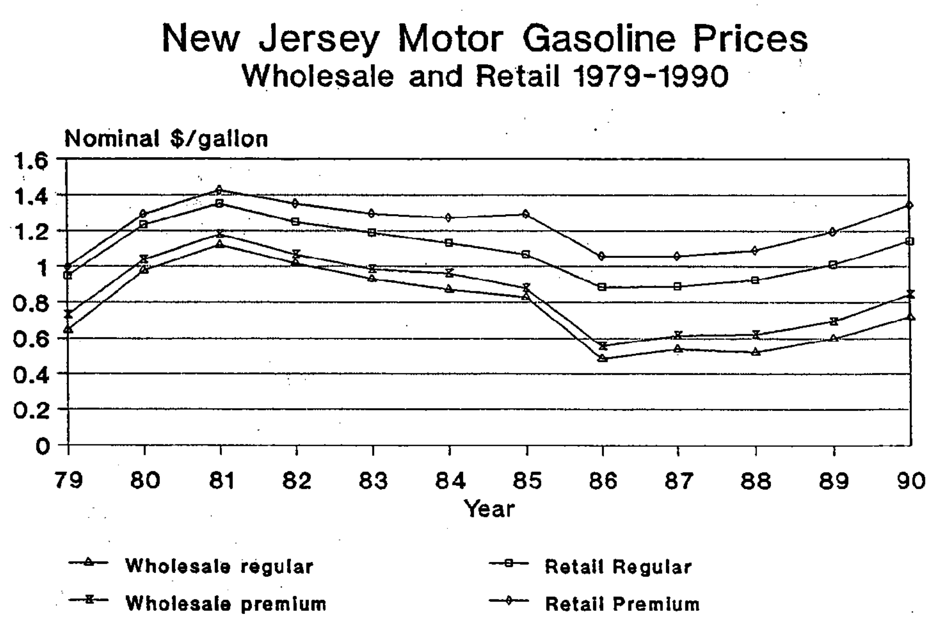
In the past six years transportation has accounted for approximately a third of New Jersey's energy use.[3] Petroleum fuels supplied over 99 percent, (612.9 TBtu), of transportation energy in 1989. (See Appendix: Transportation Energy Consumption Estimates.) Electricity used in rail and transit systems supplied the remaining 1 percent. Figure 13-1 shows the components of transport petroleum. Motor gasoline accounted for two-thirds of petroleum use in 1989, as it has over the past two decades.[4] Table 13-2 shows that compared to other states, New Jersey ranked 37th in per capita transportation energy use and 37th in per capita motor fuel use. The state uses less motor fuel than most other states but its dependence on petroleum makes it vulnerable to supply disruptions and price spikes.

FIGURE 13-1



Source: EIA-0214(89), adjusted by DEPE.

FIGURE 13-2



Note: Annual avg retail $/gal unleaded.
1990 avg $/gal 1/90 thru survey 12/90
Source: DEPE, NJ Gasoline Price Survey

Road Transport Energy Use and Costs

The number of vehicle miles traveled in New Jersey totaled 59.9 billion in 1989.[5] At one passenger per car this amounts to 27 times the mass transit passenger miles provided by the major mass transit systems shown in Table 13-3. The New Jersey Turnpike, a prime route crossing the region, accounted for 4.5 billion vehicle miles in 1989 and the Garden State Parkway for 5.2 billion miles. The Atlantic City Expressway, serving the growing casino industry of Atlantic City, had over 749 million vehicle miles traveled in 1989.[6]

From 1970 to 1985, expenditures for transport petroleum increased by about 85 percent in real terms, while personal income increased by only 55 percent.[7] The leveling off of petroleum fuel prices between 1980 and mid-1990 was in part responsible for the rise in the fuel demand during this period. (See Figure 13-2.) As noted in Chapter 3, Petroleum, the August 1990 Iraqi invasion of Kuwait triggered an upward trend in crude oil prices and almost immediate increases in retail gasoline prices. Immediately prior to this event, the price of crude oil corrected for inflation had been lower than at any time since before the 1973 Arab oil embargo. In 1988, gasoline accounted for the smallest proportion of consumer income since 1963[8] and U. S. consumers purchased gasoline at a rate of 7.3 million barrels a day (through September 1988)—a level not seen since before the oil shortages of the 1970s.[9]

Mass Transit Energy Use and Cost

Mass transit services in New Jersey include heavy rail, light rail, local bus, intercity bus, and ferry. Table 13-3 compares the state's major mass transit systems as to ridership, energy use, energy costs, and subsidies.

N.J. Transit is the statewide public transit corporation. It operates the commuter (heavy) rail service, the Newark City Subway—the state's only light rail system—and bus service throughout the state. N.J. Transit also provides operating subsidies and support for capital improvements to several private bus companies.

The Port Authority of New York and New Jersey owns and operates the Port Authority Trans-Hudson Corporation (PATH) system, connecting Hoboken, Jersey City, and Newark to New York City. The Port Authority Transit Corporation of Pennsylvania and New Jersey (PATCO), a subsidiary of the Delaware River Port Authority, operates the Lindenwold High Speed Transit Line, connecting Camden and environs to Philadelphia. The Southeastern Pennsylvania Transportation Authority (SEPTA) carries about 1,000 New Jersey residents a day to Philadelphia and surrounding communities from terminals in Trenton and West Trenton. New Jersey riders make up only about 1 percent of SEPTA's ridership.

Ferry Services

Five private companies operate nine ferry routes between northern New Jersey and New York. Combined ridership has averaged approximately 11,000 per day and is generally increasing as the operators test new routes and re-evaluate existing ones. In southern New Jersey, a private ferry service runs from the Philadelphia Naval Ship Yard to Red Bank (Gloucester County) across the Delaware River. The Delaware River and Bay Authority owns and operates the Cape May-Lewes ferry service, which carries 3,000 passengers and 2,300 vehicles per day between Cape May and Lewes, Delaware.

TABLE 13-3

Mass Transit Ridership and Energy Use
in New Jersey - 1990

Transit System	Passenger Miles	Energy Used	Energy as Percent of Operating Budget	Subsidy as Percent of Operating Budget
N.J. Transit				41.5%
bus	863,774,390	19,161,131 gals	4.8	
rail	1,020,316,368		8.7	
electric		81,202,200 kwh		
diesel		11,075,427 gals		
PATH	278,000,000	89,100,000 kwh	4.73	68%
PATCO	1,117,684	40,296,320 kwh	15.6	22%*

Note: PATH is subsidized by Port Authority bridge and tunnel tolls.
PATCO electricity use for traction power is 78%, the remainder is for maintenance facilities, lighting for trains, stations, parking lots, heating and cooling.
*Expenses not covered by revenue, are advanced in form of loan from DRPA.

Sources: N.J. Transit, PATH, PATCO.

The Port Authority started ferry service (operated by a private company) from Hoboken to Battery Park City in October of 1989 to relieve overcrowding on PATH trains. It projects the service to grow and carry over 20,000 riders a day by the year 2000.[10] None of the present ferry operators in the state receive public subsidies.[11]

Passenger Air Transport

Commercial air travel has increased rapidly in New Jersey during the 1980s, as it has across the country. Passenger traffic at Newark Airport increased from 9.22 million in 1980 to a high of 23.47 million in 1987, a rise of 255 percent. However, during the same period jet fuel use has risen by only 100 percent. Passenger traffic dropped back to just under 21 million by 1989.[12]

In response to higher fuel prices, the airline industry made substantial gains in using energy more efficiently. Like other industries subject to competitive pressures, the airlines have made substantial capital investments to decrease energy consumption per unit output. With the purchase of new aircraft, fuel costs as a proportion of total airline costs have dropped from about 60 percent in 1982 to 20 percent in 1988.[13]

Subsidies to Transport Modes

The state and federal governments subsidize the cost paid by the end user for each type of transport. Table 13-4 shows the total direct cost (excluding social costs, such as air and noise pollution) of travel per passenger mile for different transport modes.

Fares from the mass transit services of NJ Transit covered 53 percent of its operating expenses in state fiscal year 1991. During this year, NJ Transit received $218.5 million from the State and $37.7 million from the federal government.[14] This assistance represents about 40 percent of operating costs.

Congress is working toward passage of a new version of the Surface Transportation Assistance Act (STA) that expired on October 1, 1991. The bill will determine the rate and type of federal Highway and Mass Transit Trust Fund spending at least through 1996. In recent years, the federal government highway funding has outpaced mass transit funding by a ratio of 6:1. The President has proposed to widen that gap by significantly increasing highway funding over the next five years while holding mass transit support near current levels. Many public interest groups and members of Congress are calling for reprioritization of federal transportation goals to boost mass transit. Critics of the President cite the security, environmental and economic benefits of maintaining a strong mass transit system that reduces the country's dependence on imported oil, reduces auto emissions and compares favorably to the well-developed transit systems of Japanese and European trade competitors.[15]

TABLE 13-4

Comparison of New Jersey Costs for Transport Modes
(in cents per passenger mile)

Travel Mode	User Cost	Public Subsidy	Direct Cost
Auto	20.12	.59	20.71
Vanpool	9.14	.59	9.73
Train	14.28	11.02	25.30
Bus	18.22	10.61	28.83

Note: Auto / Vanpool Subsidies
= Total disbursments for highways less total receipts [excluding general fund applications]
= $1,991,722,000 - 1,436,458,000
= 555,264,000

Subsidy/passenger mile:
= Subsidy/Total vehicle miles x passengers/vehicle
= $555,264,000/58,671,000,000 x 1.6
= $555,264,000/93,873,600,000 passenger miles
= $0.00592/passenger mile or .59 cents per passenger mile

Sources: Auto costs: American Automobile Association, Your Driving Costs 1988.
Auto occupancy: 1983-84 Nationwide Personal Transportation Study, U.S. DOT, 1985, p. 15.
Vanpool costs: NJDOT comparative costs chart Feb. 1990.
Auto, van subsidy: Highway Statistics, 1989, U.S. DOT. p.40,41, 1988, p.174
Bus, rail costs, and subsidies: N.J. Transit, 1989.

Many are calling for greater flexibility for states in determining the appropriate use of federal transportation funds; given the stringent air quality standards called for by the recently enacted Clean Air Act Amendments, New Jersey leaders have argued for the ability to apply funds to mass transit to mitigate New Jersey's air quality problems. Decisions made by Congress this year will affect economic development and quality of life well into the future. For this reason, the Governor and his cabinet are working closely with the state's congressional delegation to bring federal transportation goals in line with stated environmental, energy and economic development goals.

Subsidies can also take the form of lower tax receipts. For example, businesses may deduct the cost of providing free or reduced rate parking to their employees in calculating their tax liability. The value of the parking subsidy received by their employees is also not taxable. A study by the U.S. Senate-House Committee on Taxation estimated that taxing employer-provided parking could raise $1.5 billion a year in additional federal taxes.[16]

An example of the unequal treatment of employer-provided subsidies for automobile and mass transit travel is that employers may provide parking tax free to their employees but face a $21 per month per employee tax-free limit in support of mass transit. Any subsidy in excess of $21 a month would require that the employee pay taxes on the entire amount.[17] Additional hidden subsidies to autos include the cost of highway lighting, traffic signal lights and police traffic patrols.

TABLE 13-5

Principal Mode of Transport to Work

Mode of Transport to Work	Percent of N.J.[1] Workers (1980)		Percent of U.S.A.[2] Workers (1984)	
Private Vehicle	82.7		85.5	
drive alone		64.4		
carpool		18.3		
Public Transportation	9.3		5.2	
bus		6.1		3.2
subway		0.8		1.0
railroad		2.2		0.9
taxi		0.2		0.1
Miscellaneous	6.7		5.8	
bicycle		0.3		0.5
motorcycle		0.2		0.5
walk		5.7		4.1
other		0.5		0.6
Work at home	1.3		3.5	
Total	100.0		100.0	

Note: Totals may not add due to rounding.

Sources: [1] U.S. Census Bureau, 1980 Census, Table 65, Chapter C, General Social & Economic Characteristics in New Jersey, as presented in the New Jersey Energy Master Plan 1985.
[2] U.S. Department of Transportation, Nationwide Personal Transportation Study, Nov. 1985, Table 52, p. 88-90.

Frequency of Use of Transport Modes

In New Jersey the auto is the principal means of transport: 92 percent of person trips are made by auto.[18] The scattered nature of living and commuting patterns has prevented large-scale shifts to more efficient travel modes.[19]

The last census report on New Jerseyans' travel to work, in 1980, showed a decisive majority using private automobiles. Table 13-5 compares the 1980 census report with a more recent U.S. Department of Transportation (USDOT) national survey parallels the earlier results. The USDOT survey reported a somewhat greater use of automobiles and lower utilization of public transport modes.

Analysis of Policy Options

Program Strategies

On June 6, 1990, Governor Florio signed Executive Order No. 10 that: (1) established the New Jersey Transportation Executive Council (TEC) and its Technical Advisory Group (TAG); (2) mandated that the Commissioner of Transportation ensure that the State's transportation and annual capital investment plans reflect a coordinated, statewide strategic plan for all modes of transportation and all transportation services provided by state agencies and authorities; and (3) requires each affected agency to submit a strategic business plan to the Commissioner of Transportation. The TEC includes chairpersons of the state Turnpike Authority, Highway Authority, Expressway Authority, Delaware River Port Authority, the Port Authority of New York and New Jersey, the Delaware River and Bay Authority, the Delaware River Joint Toll Bridge Commission, the Palisades Interstate Park Commission, the Atlantic County Transportation Authority, the Cape May County and Burlington County Bridge Commissions, the commissioners of the commerce and environmental protection departments, the State Treasurer, the Governor's Director of Policy, the Director of the Governor's Authorities Unit and the Governor's Counsel for Legislation and Policy. The Commissioner of Transportation chairs the council and also represents NJ Transit on the TEC.

The TEC developed a strategic plan to guide statewide transportation investments and decision making. It then recognized specific regional improvements that will maximize the use of our scarce resources and enable the state to meet its critical transportation needs. The strategic plan is presented in a series of reports published during 1990-1991. These include:

- *The Decisionmaking Framework for Transportation in the 1990s*, September 26, 1990.
- *Recommendations for Southern New Jersey*, October 25, 1990.

- *Recommendations for Northern and Central New Jersey*, November 14, 1990.
- *Recommendations for Northeaster New Jersey*, December 12, 1990.
- *Goods Movement*, April 16, 1991.

These reports are available from the Department of Transportation.

Vanpooling/Ridesharing

The ridesharing/vanpooling activities of the state were, until April 1988, carried on jointly by the DOT and the former state Division of Energy Planning and Conservation. The DOT now handles them alone. The federal Tax Reform Act of 1986 dealt such activities a severe blow by disallowing ridesharing/vanpooling business expenditures as a deduction on corporate federal income taxes. The tax code change caused many companies to abandon ridesharing efforts completely or to turn them over to private concerns.[20] Some private concerns charged more or used less convenient pick-up points, removing incentives for company employees to participate.

The DOT ridesharing program provides a toll-free telephone number advertised on highways, in newspapers, and on public television. It then attempts to match origins and destinations of those who call. DOT is developing a sophisticated computer program to match riders more effectively. The company-centered approach to ridesharing has been left to transportation management associations (TMA) to implement.[21]

High Occupancy Vehicle Lanes

Since 1970 an exclusive bus lane has been in place at the Lincoln Tunnel. The *XBL*, the most heavily traveled bus lane of its type in the world, is a contra-flow lane that permits morning New York-bound bus traffic to travel on roadway that normally handles New Jersey-bound traffic. It also utilizes an electronic toll collection system that allows buses to proceed through the toll plaza without stopping. More than 55,000 bus commuters save 10 to 25 minutes daily in commuting time by traveling via this exclusive bus lane.

High occupancy vehicle and priority bus lanes also exist at the Lincoln and Holland Tunnels as well as at the George Washington Bridge. To promote ridesharing the Port Authority offers toll discounts for cars and vans with three or more passengers. The discount offers a toll savings of 75 percent on the Bayonne and Goethals Bridges and the OuterBridge Crossing, an 83 percent savings on the George Washington Bridge and an 86 percent savings at the Holland and Lincoln Tunnels. The Port Authority sells an average 2,000 carpool ticket books per month while regular commuter ticket books that sell at a 25 to 50 percent discount (depending on the bridge or tunnel being used) sell at an average rate of 58,000 per month.[22]

Approximately 3.5 percent of the estimated 15,264 vehicles that cross the George Washington Bridge eastbound during the 7 a.m. to 9 a.m. morning rush period are high occupancy vehicles. Of these approximately 480 are carpools and 75 are buses using the HOV lane. These cars and buses carry approximately 5,500 passengers or approximately 20 percent of the 26,000 people who regularly cross the bridge eastbound during the morning rush. The toll booth serving the HOV lane has the capacity to accommodate (without que up delays) nearly double the number of carpool vehicles that presently use it.[23]

Other express bus lanes operate on Route 22 (New Providence Road) in Union County, Route 9 (Ernston Road) in Middlesex County, and along Newark city streets in Essex County.

In April 1991, the DOT began work on a feasibility study to evaluate and recommend HOV congestion management measures for Route 80 from Route 15 to Route 280 and for Route 287 from Route 22 to Route 80 in Morris and Somerset counties. The study includes a planning evaluation of the design and operational issues and a public awareness program that assesses the market potential and public attitude toward HOV lanes. If determined to be feasible, an HOV lane could be implemented on Route 80 as soon as 1995. The DOT will assess other congested highway corridors in the state for their HOV lane potential.

Transportation Management Associations

Transportation Management Associations (TMAs) are public-private partnerships formed so that employers, developers, building owners, and local and county governments can work together and collectively establish policies, programs and services to address local or regional transportation problems. TMAs address traffic, air quality, and (in some instances) employment issues through the use of transportation demand management (TDM) strategies designed to reduce the number of trips made by single-occupant vehicles and enhance the regional mobility of all citizens.

The DOT has established a grant program to encourage formation of TMAs throughout the state. Under the program, the DOT will pay for 50 percent of a TMAs operating costs up to $200,000 per year. TMAs fund the balance of their operating costs with money from county, local and private sources. In this way, the public-private partnership is formed. In 1991, the DOT funded seven TMAs: the Meadowlands Transportation Brokerage (known as Meadowlink Ridesharing) serves municipalities in the Hackensack Meadowlands and Hudson River Waterfront areas; the Greater Princeton TMA serves Mercer county and the municipalities of Plainsboro, South Brunswick and Cranbury; Morris County Rides, Inc. (MC Rides, Inc.) serves Morris County; Keep Middlesex Moving (KMM), Inc. serves most of Middlesex County; Cross County Connection targets Burlington County's, Mount Laurel, Evesham Township, Moorestown, and Maple Shade as well as Voorhees and Cherry Hill in Camden County; the Monmouth TMA of Monmouth County; and Ridewise of Raritan Valley serving Somerset County.

Meadowlinks and the Princeton TMA, both founded in 1984, emerged in response to worsening traffic conditions and signaled that the private sector intended to play a strong role in ameliorating congestion. To combat congestion, TMAs have endorsed broad programs with strategies that include: ridesharing, added parking arrangements for mass transit users, operation of shuttle buses to transit stations and malls, promotion of mass transit, monitoring of local traffic conditions, and development of local traffic reduction ordinances. Successful implementation of TDM strategies will result in more efficient use of the present transportation network and significant fuel savings. Morris County authorities estimated an energy saving of over 2 million gallons of gasoline a year, if the local ridesharing organizations were successful in reducing vehicle trips by 10 percent.[24]

Electronic Toll and Traffic Management

New Electronic Toll and Traffic Management (ETTM) technologies have the potential to significantly reduce energy consumption on State-operated toll roads and help improve air quality by reducing lines at toll facilities. With ETTM in place, vehicles would pay their toll without ever stopping at a booth by having a machine read an electronic tag or transponder affixed to the vehicle. The State expects to implement and use ETTM as a significant congestion management tool during the next decade. Although several toll agencies (New Jersey and bi-state) are currently experimenting with ETTM technologies, the key is to have all toll facilities implement compatible systems to enable roadway users to access all toll facilities with a single tag. New Jersey's goal is to become a *one tag state* by the year 2000.

Traffic Reduction Ordinances

Severe traffic congestion spurred North Brunswick Township (Middlesex County) to adopt a traffic management ordinance in October 1987. The ordinance requires businesses to conduct an annual traffic survey and to submit a traffic reduction plan. The plan requirements vary according to the size of the business or residential development, encompassing such measures as reducing peak period trips of the workforce, providing vanpool parking areas, establishing flextime work hours, running a shuttle bus service to mass transit, and sponsoring in-house or third-party rideshare programs. The ordinance affects existing businesses with 50 or more employees, proposed new residential developments of 20 or more units, and proposed new nonresidential developments with gross building space of 15,000 square feet or more. Exemptions are allowed for hotels, food and other retail establishments, shopping centers, and others as a need is shown.

While recognizing that traffic reduction is a regional problem and that North Brunswick can have little effect on total traffic volume, township leaders are attempting to reduce projected peak-hour employee trips by 40 percent for established businesses and by 30 percent for new ones.[25] The Urban Mass Transportation Administration has provided funds for implementation. The funds will help North Brunswick to publicize the ordinance widely around the state. KMM participated in the process of establishing similar ordinances in New Brunswick and Plainsboro Township. Federal and state efforts are also underway to reduce traffic congestion. As a result of the Clean Air Act Amendments passed by Congress in November 1990, employers in sever clean air non-attainment areas are required to implement programs to reduce work-related vehicle trips and miles traveled by their employees. At a minimum, each employer of 100 or more persons must increase the average passenger occupancy per vehicle in commuting trips between home and the workplace during peak travel periods by not less than 25 percent above the average vehicle occupancy for all such trips in the area. Compliance must be convincingly demonstrated by November 15, 1996.

The State is required to implement the federal Clean Air Act provisions or face a loss in federal transportation funding. State legislation, sponsored by Senator Walter Rand, is being considered to implement the federal employer trip reduction requirements. Senator Rand's legislation would authorize the Department of Transportation to administer and enforce a statewide travel demand management program.

Traffic Signal Management

Using oil overcharge funds in the late 1980s, the former state Division of Energy Planning and Conservation (DEPC) administered a program to improve traffic flow by installing traffic signals regulated by vehicle sensors. The program upgraded traffic monitoring equipment at 140 intersections on nonstate roads meeting certain traffic flow conditions. Local governments proposed the sites and paid for the labor required to do the installation. The DEPC calculated the energy savings at over one-half million gallons of gasoline per year and estimated payback at less than a year. Funds are no longer available for this program.

DOT has a similar program, although its objectives are to improve safety and traffic flow. With about 8,600 traffic signals, New Jersey has a great potential to save energy by synchronizing and regulating traffic signals.

School Bus Fleet Energy Assessment Program

The former DEPC, in collaboration with the Bureau of Pupil Transportation, Department of Education, initiated a voluntary program to improve the efficiency of school bus fleets. The activity involves bus maintenance, driver training, recordkeeping, and fuel storage and disbursement. This program, which could be extended to municipal vehicle fleets or police departments, has projected an annual energy savings of about 2 million gallons or $1.6 million (at 1987 prices) in the twelve school districts (out of 632 districts statewide) that participated in the demonstration program.[26]

Road Maintenance

Highway maintenance has certain economic and energy benefits. Maintenance is necessary to gain maximum use from the present road system. A study of the state's roads by an industry advocacy group has estimated that the added annual motor fuel cost of driving on rough, uneven road surfaces is about $502 million.[27] Well-maintained roads allow drivers to travel at more even speeds, thus improving miles per gallon.

TABLE 13-6

U.S. Energy Consumption Levels by Transportation Mode
(Average Btu's per Passenger Mile Traveled)

Year	Auto	Bus Intercity	Bus Local	Air Certified Carriers	Air General Aviation	Rail AMTRAK Intercity	Rail AMTRAK Local
1970	5,471	1,051	2,472	10,351	10,374	*	2,453
1975	5,468	976	2,814	7,883	10,658	3,677	2,962
1980	4,782	1,169	2,813	5,837	11,497	3,176	3,008
1985	4,047	1,323	2,421	5,679	11,339	2,800	3,461
1986	4,031	869	3,512	5,447	11,935	2,574	3,531
1987	3,841	939	3,542	4,753	11,218	2,537	3,534
1988	3,598	965	3,415	4,814	11,966	2,462	3,585
				Average Annual Percent Change			
1970-88	-2.3%	-0.5%	1.8%	-4.2%	0.8%	-2.8[1]%	2.1%

Note: * Data not available.
[1] Average annual percentage change is for years 1973-88.

Source: Stacy C. Davis, et. al., Transportation Energy Data Book: Edition 11, Oak Ridge National Laboratory, January 1991, Table 2.14, p. 2-25.

Incident Management

Many highways throughout the state operate at capacity and suffer disproportionately from an incident, e.g., an accident, spill, flood or other event that disrupts or prevents the flow of traffic. Federal authorities estimate that an aggressive incident management program (which requires sophisticated monitoring and high degree of cooperation among many jurisdictions' enforcement teams) can recoup as much as a third of the system's capacity. Operations such as TRANSCOM that monitors and manages traffic incidents in the northern New Jersey/New York metropolitan region, are being considered in other densely traveled portions of the state.

Smart Highways and Streets

Increasingly, the capacity of highways will have to be managed in ways that are analogous to the management of the air space at airports and trains on key rail corridors. Both involve sophisticated electronic and communication equipment between vehicle and system operator. Similar technology to manage highways is now becoming available and New Jersey should begin to explore this technology and target one or more key corridors on which to test its efficacy. Within cities, traffic flow can be substantially improved with a more broad-based application of fully computerized traffic signal control systems.

Measuring Program Effectiveness

Accurately measuring the effect of transport programs on energy use is difficult. Since most programs target traffic congestion, DOT typically measures the change in traffic congestion at signals and calculates the small amounts saved individually by thousands of drivers.

Energy Intensity

One study, summarized in Table 13-6, calculated energy intensity, in Btu per passenger mile, for different travel modes. In 1988, for local travel, the study found cars used 5 percent more energy per person than buses and 4 percent more energy per person than trains. For inter-city travel, commercial air carriers used 34 percent more energy than cars, 95 percent more than rail and 398 percent more than buses. Energy intensities depend on passenger load as well as efficiencies of the carrier.

Over the last 15 years, average fuel consumption for cars has fallen by half as a result of strengthened auto fuel economy standards.[28] Energy intensity of local bus and rail transit, which are among the most efficient forms of travel, worsened slightly due to a combination of factors: a loss of riders to autos, the addition of higher performance vehicles, and the provision of more climate control and safety features. General aviation is now the least energy efficient means of travel, but its high cost acts to limit its use.

Existing Policies Affecting Energy Use in Transportation

In recent years, stable energy prices encouraged driving, aggravated traffic congestion, increased air pollution, and caused 60 percent of New Jersey's urban roads to operate near or above peak capacity. The ability to efficiently move people and goods remains crucial to sustaining the state's

TABLE 13-7

Gasoline Taxes for Selected Industrial Countries and States 1990

Country	Current U.S. Dollars/Gallon
Netherlands	2.30
Denmark	2.65
France	2.62
West Germany	1.80
Italy	3.31
Japan	1.41
Britan	1.66
Canada	.78
U.S. Federal Tax	0.141
New Jersey	0.105
New York	0.080
Delaware	0.160
Pennsylvania	0.174
Maryland	0.185
Average U.S. State Tax	0.166
Highest U.S. State Tax	0.220
N.J. rank among 50 states and D.C. (#)	47

Note: New York levies a 4 percent state sales tax. New Jersey levies a 2.75 percent gross refinery tax.

Sources: International Taxes: New York Times, September 24, 1990, p. D5. U.S. and States Taxes: EIA Petroleum Marketing Monthly, March, 1991, p. 165.

economic prosperity.[29] Fuel prices rises that started in August 1990 may affect automobile use; however, it is too soon to project the impact that price hikes will exert on automobile use. Too, the impact may be small because the spread of workplaces through suburban areas limits alternatives for travel to work.

The state can influence transport energy use through its authority to:

- site and construct roads and allow access to them;
- fund and promote multiple passenger transportation modes, buses, trains, vanpooling, and ridesharing;
- control motor vehicle emissions to reduce pollution;
- tax gasoline and other transport fuels;
- regulate development, such as in the Pine Barrens, the Meadowlands, Atlantic City, and the coastal zone; and
- educate and inform people about alternatives.

Policies in Road Building

For many years, the state's primary means of maintaining mobility was through road building and maintenance. In recent years even the addition of lanes and roads has not eliminated congestion. Therefore, the state is turning to comprehensive planning of alternative transport modes and efforts to reduce low-occupancy auto traffic. Indications of this change are the State Highway Access Management Act and the Transportation Development District Act.[30] The state's increasing support of N.J. Transit is another example of the revised approach to transport policy.

The economic realities of the 1990s demand a strategy for transportation investment that will lead and shape development rather than react to growth. In an era when agencies must preserve and rebuild the systems constructed during the last several decades, there will not be enough money for man investments previously considered essential. Yet the increasing dominance of the global economy will make transportation ever more critical to the success of businesses and the New jersey quality of life. Thus, the transportation investments made in this decade will play a major role in determining the attractiveness and economic success of New Jersey in the 21st century.

To meet these challenges in ways that are consistent with New Jersey's dual values of mobility and environmental quality, the Transportation Executive Council formulated 10 policies that will guide the development of 1990s investments:

- Make system preservation the top priority and increase investments accordingly.
- Attack congestion without encouraging inappropriate land use.
- Make strategic investments to shape growth and leverage economic opportunity.
- Improve goods movement.
- Use transportation investments to tap a larger labor pool.
- Enhance recreational and tourism travel.
- Invest in connections.
- Move more people, not more vehicles.
- Integrate transportation and environmental goals.
- Improve planning coordination with county, local and private interests.

Policies Encouraging Shifts to Other Transport Modes:

The state subsidizes public transit use by providing approximately 36.5 percent of New Jersey Transit bus and rail operating costs. The federal government provides 6 percent of the system's funding. Bus and rail fares and other operating revenues provide the remaining 60 percent. However, this level of subsidy has been insufficient to prevent large fare increases which have led to decreased ridership.

TABLE 13-8

Transportation End Use

Transportation Equipment	1989 Percent of Sales	1989 Sales	1989 EIA-TBtu Input
Electric	DEPE %	GWH	TBtu
Trains	100%	276	1.1
Autos	0%	0	0.0
Vans	0%	0	0.0
Transport Electric	100%	276	1.1
Natural Gas	DEPE %	MMTHM	TBtu
Autos	50%	21	2.1
Vans	50%	21	2.1
Buses	0%	0	0.0
Transport Nat.Gas	100%	42	4.2
Petroleum	EIA %	MBBL	TBtus
Autos-Motor Gas	56%	63,173	340.6
Light trucks-Mgas	13%	14,973	80.7
Truck, vans-propane	0%	56	0.3
Heavy Truck-Diesel	14%	15,489	83.5
Bus-Diesel	1%	1,093	5.9
Aviation-jet	8%	9,219	49.7
Aviation gas	0%	111	0.6
Shipping-Residual	7%	7,837	42.3
Transport Petroleum	100%	111,951	603.5
Petro-lubricants	100%	709	4.3
Coal	EIA %	MMST	TBtu
	0%	0	0.0
Transport EIA TBtu	100%		612.9

Note: Totals may not add due to independent rounding.
GWH = gigawatt-hours; MMTHM = million therms;
MBBL = thousand barrels; MMST = million short tons.
Petroleum TBtu from EIA transport fuel.

Source: DOE/EIA-0214(89) Transportation Energy Consumption Estimates for New Jersey, p.211

Policies Reducing Motor Vehicle Emissions:

Motor vehicles using petroleum fuels emit significant quantities of carbon monoxide, hydrocarbons, nitrogen oxides, fine particles, and lead, each of which can adversely affect human health and the environment. The expanding vehicle population and increasing number of miles driven[31] have caused serious air pollution. In addition to pollution harming people, animals, forests, and water, growing evidence shows that motor vehicle emissions contribute to upper atmospheric changes that could modify global climate. (For further detail, see Chapter 19.)

The federal Clean Air Act and amendments to it set air quality standards. Regulations have limited motor vehicle emissions since the 1968 model year.[32] Like other states implementing the Clean Air Act, New Jersey's first steps to reduce air pollution from mobile sources (cars and trucks) included setting emissions standards, requiring periodic inspections, and limiting motor idling.[33] A number of possible state actions can enhance the emission control/inspection program, *e.g.*, adding under-the-hood inspection to check for tampering with emission control equipment, broadening emission control standards to off-road vehicles, and adopting the stringent California standards for new car certification.

Policies on Taxation of Gas and Other Fuel

The state levies a tax on the sale of gasoline and other petroleum products, and the amount of that tax affects the price and, therefore, the demand for the products. New Jersey's motor fuel tax rate is tied at fourth lowest of all the states. In general U.S. motor fuel tax rates are much lower than those of other industrialized nations. (See Table 13-7.)

Raising taxes on motor fuels to the level common in Europe would not only cause people to drive less and send a strong signal to car purchasers to select fuel efficient models but would also bring revenues for needed transport projects.

However, a motor fuel tax increase of five or ten cents may not significantly affect driving habits because the additional cost is relatively small and because people choose to drive for reasons other than cost.

The surrounding states all have higher motor fuel taxes. At present 30 percent of New Jersey's motor fuel taxes are paid by out-of-state residents who use the state's roads.[34] A motor fuel tax increase would thus be paid only in part by New Jerseyans.

Policies Regulating Development

State and local governments affect the use of energy in transportation through land use powers and their role in regulating the construction of homes, offices, and manufacturing facilities. In recent decades, these powers have taken on new significance, as population growth and social trends have caused the movement of people, and later industry and commerce, out of older cities to suburbs and rural areas. This movement has reinforced a trend toward automobile use by spreading workers and workplaces so that existing mass transit, focused on the major cities—Newark, New York, Philadelphia—is not available for many trips. Suburb to suburb travel is minimally served by mass transit systems.

The state's powers over land use are being re-examined by the State Planning Commission in the State Development and Redevelopment Plan. This plan espouses strengthening the state's tools over land use, resulting in improved viability of mass transit and the reduced need to drive. By encouraging or requiring greater mixed land use, higher development densities, and closer proximity and interconnections among developments (housing, retail, office, and industrial), the plan addresses energy use for transport to work and at other times.[35]

Strategies to Improve Energy Efficiency in Transport

Over the next decade improving the efficiency of particular transport modes appears to be the most effective strategy in reducing transport fuel use. Table 13-9 indicates the potential available for motor vehicles.

Federal Fuel Efficiency Standards

Auto fuel efficiency has improved markedly since 1975. Corporate Average Fuel Economy (CAFE) standards set by the U.S. Secretary of Transportation under the authority of the Energy Policy and Conservation Act of 1975 provided much of the impetus for change by specifying miles per gallon (mpg) standards for automobile manufacturers to increase the fuel efficiency of passenger cars and light trucks to 27.5 mpg and 21 mpg respectively for 1985 and all subsequent model years. USDOT rolled back the standards to 26.5 mpg and 19.5 mpg for 1986, 1987, 1988 and 1989 model year cars and trucks. In 1989, the USDOT raised the standard to 27.5 mpg for 1990 model year cars. The light truck standard that originally applied to trucks up to 6,000 lbs. in registered weight was extended to cover trucks up to 8,500 lbs. in weight. The standard for this expanded population was reset to 20 mpg. Several proposals before Congress would mandate major increases in auto fuel efficiency. One proposal calls for a 20 percent increase in CAFE standards over 1988 levels by 1995 and a 40 percent increase by the year 2000 for both cars and trucks. Savings generated in one year under such a proposal could exceed 2.5 million barrels per day.[36]

Fuel efficiency improvements have been cost effective: the costs of the improvements have been less than the cost of the fuel saved. Car price increases attributable to increased fuel efficiency has been more than offset by savings gained from fuel saved, i.e., not purchased, over the life of the vehicle. Such a calculation based on total costs over vehicle life is called life cycle costing.

Technology is already available to auto manufacturers to increase average new car fuel efficiency over 50 percent.[37] The improved efficiency will require only minor changes in vehicle size.[38] The continuously variable transmission alone could increase fuel economy by 12 percent over CAFE.[39] Additional improvements, such as multi-point fuel injection and variable valve timing, could improve fuel efficiency about 100 percent in future years. An American Council for an Energy-Efficient Economy analysis finds the improvements cost-effective today.[40] An Oak Ridge National Laboratory analysis, citing U.S. Department of Energy figures, calculates that fuel price increases of $1.50 to $2.00 per gallon, would justify, based on life cycle costing, fuel efficiency increases to 35-40 mpg.[41]

Gas Guzzler Tax/Gas Sipper Rebate

New Jersey could promote energy efficient cars and light trucks by a variable sales tax on autos based on fuel efficiency—a gas guzzler tax/gas sipper rebate. Designed as a revenue-neutral measure, it could raise the same amount of taxes as the present system, but reward buyers of autos in proportion to the fuel efficiency or inefficiency as compared to the CAFE standard presently in effect. (See Appendix: Gas Guzzler Tax/Gas Sipper Rebate.) One study projects a saving of 1.6-2.4 million gallons of gasoline a year for New Jersey.[42]

To reinforce the effect of such a program, annual auto registration fees could be weighted according to a similar formula favoring fuel efficient cars. However, the impact of a gas guzzler tax on registration fees would fall on lower income people to a much greater extent than the program based on new car sales. Also, as registration fees are small, the force of the signal would be relatively minor.

Impact of Transport Modes on Air Quality

Another important consequence of energy used in the transport system is the environmental effect. New Jersey is a nonattainment state for ozone and carbon monoxide according to the National Ambient Air Quality Standards contained in the Federal Clean Air Act.[43] The spring-summer of 1988 was especially poor as far as ozone pollution is concerned: ozone exceeded federally mandated levels 212 times (as measured at 14 sites) from April 1 through August 31, 1988, a very high count due partly to the hot, dry weather summer. There were 57 exceedances in 1990 and 75 by October 1991.[44]

In addition to fines, loss of federal monies, or other sanctions the federal government might eventually impose for nonattainment, New Jerseyans suffer from the detrimental health effects of exposure to high levels of these pollutants—impaired breathing and lung diseases. Recent studies indicate that exposure to ozone concentrations at or in excess of the federal standards leaves little or no margin before the potential onset of adverse health effects.[45] Gasoline-fueled vehicles are a principal source of ozone precursors and carbon monoxide emissions.

Alternative Fuels

Powering autos with alternative fuels could reduce harmful air emissions. Widespread use of nonpetroleum fuels would also lessen dependence on imported oil. Alternative fuels include compressed natural gas (CNG) and liquefied natural gas (LNG); methanol from coal, natural gas, lignite, or biomass; ethanol from renewable sources; and hydrogen from water. Electricity can also power vehicles. (See Appendix: Summary of Alternative Fuel and Vehicle Characteristics for a summary of the characteristics of the major alternative fuels as compared to gasoline.)

Another option for reducing oxides of sulfur and particulate emissions from diesel vehicles is the use of low sulfur diesel fuel in combination with particulate traps.

During the next decade, methanol and CNG have the potential to compete with gasoline and diesel on the basis of price, availability, performance, and conformance with present internal combustion engine requirements. For environmental reasons, recent tests indicate that natural gas vehicles (NGVs) have the advantage over methanol-fueled vehicles in reducing harmful emissions.[46] Four categories of emissions to consider are: (1) Exhaust Reactive Hydrocarbons (RHCs) - NGVs produce greater reductions in exhaust RHCs than methanol vehicles; (2) Evaporative Reactive Hydrocarbons - NGVs eliminate reactive RHCs compared to methanol vehicles which provide only partial reductions in omissions; (3) Carbon Monoxide (CO) - NGVs offer about a 50 percent reduction in CO compared to no reduction for methanol vehicles; and (4) Oxides of Nitrogen (NOx) - NGVs offer slight reductions in NOx compared to no reductions for methanol vehicles. Furthermore, methanol use has several distinct disadvantages. It produced formaldehyde (an ozone precursor), is poisonous upon contact to the skin and is inefficient energy-wise to produce in that the cheapest technology uses natural gas to produce methanol.

November 1990 amendments to the Federal Clean Air Act require that motor vehicle fleets registered in areas labeled for severe nonattainment of EPA emissions standards phase in the use of alternative fuels beginning in 1998. The amendments apply to fleets with 10 or more vehicles capable of central fueling. Beginning with model year 1998, 30 percent of new fleet acquisitions must run on alternative fuels; the requirement escalates to 50 percent for model year 1999 fleet purchases and 70 percent for model year 2000. The amendments also require that all private motor vehicles in severe nonattainment areas use reformulated gasoline beginning in 1995. Eighteen of the state's 21 counties (*i.e.*, all but Warren, Cape May and Atlantic counties) earned the severe nonattainment designation for ozone air pollution by virtue of the state's proximity to Philadelphia and New York City—two of nine cities nationwide ranked as severe; however, it is likely that the alternative- fueled fleet and reformulated gasoline requirements will be enforced statewide.

The Clean Air Act also requires that New Jersey implement transportation measures that will reduce vehicle miles traveled. For example, employers with 100 or more employees must develop measures to increase average vehicle occupancy. State legislation to implement this requirement is being considered.

Currently three companies in New Jersey are introducing trial fleets of NGVs.

- Elizabethtown Gas Company was the first LDC in New Jersey to convert a portion of its fleet to compressed natural gas (CNG) operation. The program has been operational since late 1989 and currently has 15 vehicles on the road, mostly passenger autos, converted for CNG usage. These vehicles are *bi-fueled*, *i.e.*, they can operate on either CNG or gasoline, under control of a dashboard mounted switch. The cost of conversion is about $2,500 per vehicle. This covers the costs of installing an aluminum CNG tank in the trunk (which

TABLE 13-9

New Jersey Technical Potential
for Change in Motor Fuel Use

Transport Mode	Percent of Vehicle Miles Traveled	Fuel Used MM Gals/Yr.	Average MPG	1991 Best Available Technology: Efficient Vehicle Type	MPG	Percent Savings with Efficient Vehicle	Fuel Savings MM Gals/Yr.	Fuel Consumed MM Gals/Yr.
Autos	74.4	2,163	20.6	1992 GeoMetro XFi	53	61.1	1,322	841
Motorcycles	.2	2	50.0		50	0.0	0	2
Light Trucks	17.5	758	13.8	Ford Ranger 2 WD Pickup	24	42.5	322	375
Heavy Trucks	7.5	758	5.9		8	26.3	199	436
Buses	.5	53	6.0		10	40.0	21	32
Totals	100.0	3,734					1,864	1,685

Note: Gallons used were calculated by dividing vehicle miles by the average MPG.

Sources: Percent of Vehicle Miles: N.J. Department of Transportation.
Average 1989 MPG figures are national averages derived from Federal Highway Administration, Highway Statistics 1989, (Washington, D.C., USDOT), Table VM-1.
MPG Rating of Efficient Vehicle Types: 1991 Gas Mileage Guide.

takes up about one quarter of the trunk space), a separate CNG fuel gauge on the dash, and several components under the hood for refueling and for *cheating* computer ignition controls so they accept the burning of CNG. Significantly, the auto manufacturers accept these CNG modifications as *standard* so that they do not void manufacturers' warranties.

- PSE&G's program, in the initial phase, involves the conversion of 30 new gasoline engines that must be *optimized* for performance and reduced emissions while burning CNG at a retrofit cost estimated between $1,500 and $3,900 per vehicle. Although cylinders for on-board storage of fuel are in short supply because only one U.S. manufacturer currently offers the product, PSE&G completed conversions on its pilot fleet in October of 1990. The re-fueling station at PSE&G's New Brunswick garage began operating in February of 1991. The lack of state building code specifications for CNG re-fueling stations led to construction delays of several months. Port Authority of New York and New Jersey has amended its regulations to permit natural gas- fueled vehicles to use its bridges and tunnels. Therefore, in an emergency, PSE&G would be able to transport its CNG vehicles to New York City to assist other utilities.
- New Jersey Transit (NJT) has ordered five CNG-modified buses from the Flxible Company. Flxible will install the fuel cylinders and dedicated CNG engine that is being manufactured by the Cummins Company in Indiana. Revenue service is planned to begin in November. PSE&G will supply the natural gas to NJT at its garage in Orange.

In May of 1991, the State of New Jersey initiated a program to test alternate fuels in a portion of its vehicle fleet. The $2 million demonstration project will test compressed natural gas and alcohol-based fuels. The State will convert or purchase over 200 vehicles to run on alternate fuels and will evaluate vehicle maintenance and operating costs, pollution emission and the overall cost-effectiveness of the vehicles. PSE&G is contributing $500,000 to the project with the $1.5 million balance coming from the state's Petroleum Overcharge Reimbursement Fund.

New Jersey Transit will soon be implementing an air quality demonstration project in Hudson County. The project is funded by the Urban Mass Transportation Administration and consists of five buses that are fitted with particulate traps and that use low sulfur diesel fuel. It is anticipated that emissions from these buses will meet Clean Air Act standards.

A key problem with introducing methanol- and CNG-powered vehicles on a large scale is the need to develop simultaneously a market for vehicles and a network of fueling stations to service them. Both methanol and CNG can be used in dual-fuel vehicles. The high cost of compression equipment necessary to fuel CNG-powered vehicles is an added barrier to its wide-spread use, but the existing natural gas pipeline network can function as a distribution system for refueling stations.

During the introductory period for alternative fuel vehicles when refueling stations are few, it will be necessary to equip vehicles to run on gasoline and the alternative fuel. Because the engines of such vehicles will have to be able to operate on either fuel, they will not be running optimally. Data on fuel efficiency, emissions, and other measurements should therefore not be considered as representative of the alternative fuel being used.

Projections

Motor fuel use equaled about three-quarters of total transport energy use in 1989 and consequently presents the most likely category for finding energy savings. Table 13-9 outlines a scenario based on best currently available technology as a baseline for measuring movement toward efficiency in motor fuel uses. The scenario shows that if the best currently available technology for motor vehicles were to be adopted and phased in over the next decade, the amount of energy that could be saved in New Jersey by petroleum-fueled motor vehicles per year is almost 2 billion gallons, more than half of present use of motor fuels.

Thus broad use of multi-point fuel injection, four-valve cylinders, and improved tires could effectively double fuel economy. However, cars twice as efficient as current models will cost $200 to $800 more. Since this cost increase will produce some resistance from both manufacturers and consumers, bold policy initiatives such as higher fuel tax, oil import fees or a gas-guzzler tax could be required to accomplish the fuel economy goal.[47]

Alternatively, if the State does not promote energy-saving technologies and policies, present trends indicate that New Jerseyans will consume about 2 percent more motor fuels in the year 2000 than they consume now.[48] The projected increase in motor fuels would occur in spite of an increase in average fuel economy for cars that will come about as old cars are replaced by new ones that have met higher CAFE standards.

Mode shifting, particularly shifting commuters from single passenger autos to ridesharing, vanpooling, or mass transit, would be the most immediately effective means for reducing congestion and reducing fuel use. What is not clear is the extent to which state policy can force those shifts without significantly raising the price of gasoline. A major force for mode shifting would come from changes in land uses so that more workers find common paths between home and work.

Findings

- Motor fuel accounts for three-quarters of the state's transport energy use.
- As a result of economic growth, population density, and its position in the densely populated Boston-Washington corridor, New Jersey has the most crowded roads in the country.
- Mass transit can play an important role in meeting mobility needs.
- Mass transit modes, rail and bus, are more efficient and cause less pollution than cars.

- Increased traffic congestion on New Jersey's roads is wasting greater amounts of energy.
- New Jersey has not attained federal air quality standards for ozone and auto emissions are a major contributor to the state's air pollution.
- Motor fuel use has increased and reached new highs.
- Higher vehicle occupancy is the most cost-effective and most quickly implemented means of reducing peak period congestion and reducing fuel use per person.
- Avoided cost calculations can compare investments in road improvements with those (such as vanpool subsidies) that would alleviate congestion without new construction. Alternatives may be less expensive in many situations.
- Vanpooling and ridesharing will reduce congestion. Additional support measures, such as parking restrictions; express lanes for high occupancy vehicles (HOVs), and lower bridge, tunnel, and turnpike tolls for HOVs are needed to increase vanpooling and ridesharing.
- Substantial improvement in motor vehicle fuel efficiency is possible.
- Fleet energy assessment programs can save large amounts of energy. Both state and municipal fleets could benefit.
- Natural gas fueled vehicles could reduce dependence on oil imports as well as improve air quality.
- Opportunities exist to employ vehicle fleets fueled by alternative fuels.
- Traffic signal management programs can reduce energy use and reduce congestion.

Policy

- The State should pursue the goal of moving more people and goods on its systems, not more vehicles. The State should encourage the use of high occupancy vehicles which minimize congestion, discourage energy consumption and improve air quality.
- The State should address metropolitan congestion in ways that will not encourage growth in single occupancy auto travel or inappropriate land development.
- The State should integrate its efforts to protect the environment and enhance mobility. While it facilitates the movement of people and goods, the State must bring itself into compliance with clean air standards.
- The State should make better use of its roadway system to improve mobility within the state and reduce congestion and concomitant air pollution. Reversible lanes and computerized signal timing should be instituted to handle surge loads of traffic.
- The State should evaluate all costs and benefits, including avoided costs, of alternative means to achieve transportation goals and choose those that best coincide with economic, public health and environmental goals.
- The State should encourage the use of alternative fuels, such as compressed natural gas, in government and commercial fleets.
- The State should encourage vehicle efficiency. It should continue, expand, or adopt programs to save energy and reduce air pollution in the operation of its own fleet, and other publicly-owned fleets.

Implementation

The State should implement demand reduction strategies that discourage the use of single occupancy vehicles and encourage alternative means of transportation through the following measures:

- Increase transit investments.
- Improve support for mass transit use to make it competitive with automobile transportation.
- Support increased tax credits for transit users.
- Continue support for transportation management associations (TMAs).
- Promote ridesharing and provide incentives.
- Establish additional HOV priority lanes where feasible.
- Develop more park'n ride lots.
- Coordinate land use and transportation investments.
- Develop experimental transit routes.
- Encourage enactment of appropriate traffic reduction ordinances.
- Encourage bicycle and pedestrian usage.

The State should implement traffic management strategies and measures that discourage peak hour road use. To do so, the State should:

- Implement employer trip reduction requirements consistent with the Clean Air Act Amendments of 1990.
- Promote flex-time, four-day work weeks, telecommuting and staggered work hours.
- Test and implement electronic toll systems where feasible to alleviate stopping at toll facilities.
- Develop *smart* highways and streets that employ the most efficient available technologies to improve traffic flow on key congested corridors statewide.
- Promote the testing of variable rates on toll roads and at river crossings to discourage peak hour solo driving and increased vehicle occupancy.
- Improve incident management capabilities to reduce traffic disruptions caused by accidents, spills or other emergency situations on state highways operating at or near capacity.
- Implement surveillance and advisory information measures to advise drivers of downstream route information.
- Implement surveillance and diversion information measures to identify less congested alternate routes.
- Make greater use of reversible lanes.
- Prioritize intersection and interchange improvements in non-attainment areas for air quality. Make air quality improvements one of the major criteria in project prioritization.

The State should evaluate the potential of market-based measures (such as revenue-neutral differential sales taxes and registration fees based on fuel efficiency ratings) to encourage the purchase of energy efficient autos and, if appropriate, propose mechanisms to implement these measures.

The State should adopt or expand improved fleet operation and evaluate purchases based on life cycle costing. To do so, the State should:

- Institute programs based on the school bus energy assessment program in all school districts and investigate the potential for similar savings by applying the program to New Jersey's transit bus operators.
- Purchase vehicles based on life cycle costs (including fuel costs) rather than on initial purchase price.
- Monitor the performance of natural gas-fueled vehicles being introduced by the gas utility companies and New Jersey Transit, and consider the use of alternative-fueled vehicles in the State fleet on a pilot program basis.

NOTES

1. Boris S. Pushkarev and Barbara L. Lawrence, *Development Trends and Transportation Implications for Northern New Jersey, New Jersey Bell Journal*, fall 1986, p. 4.
2. Pushkarev and Lawrence, p. 3-4.
3. There is good reason to believe that the EIA statistics overstate the total amount of energy used in the transport sector in New Jersey. For example, because of the lower gasoline tax in the state, gasoline prices in New Jersey are lower than most surrounding areas, and therefore many residents of neighboring states make a point of filling up their automobiles with gasoline whenever in New Jersey. The statistics on interstate traffic on the New Jersey Turnpike may also exaggerate New Jersey's energy consumption statistics. Present data indicate that 11 percent (source: N.J. Turnpike Authority, 1988) of total traffic on the Turnpike enters at one end and exits at the other without any destinations in the state. While conclusive evidence of nonresidents' purchase of motor fuel is not available, the amount of gasoline and diesel fuel purchased in the state for their vehicles would constitute an overstatement of energy consumed in New Jersey.

   Another statistical artifact can be discerned in the figures for jet fuel, resulting in a significant overstatement of energy consumed in the transport sector. The data do not reflect a change in the pattern for purchasing jet fuel that occurred after the jump in fuel prices in late 1979, which was the result of the Iranian revolution. Beginning at that time the airlines took over from the oil companies the movement of jet fuel from the Buckeye Pipeline terminal in Linden to the area airports. Consequently all purchases for the airlines operations in the region's airports (New Jersey and New York) were reported as occurring in Linden. Previously the purchases were reported by the oil companies at the airports, which were also the points of consumption. A comparison of the figures for jet fuel consumption in New Jersey and New York for the period 1980-83 offers striking confirmation:

Year	NY	NJ
	(thousands of barrels)	
1980	35,916	8,088
1981	25,381	17,518
1982	4,815	33,809
1983	3,790	37,077

   (EIA, *State Energy Data Report*, Table 202, New Jersey Transportation Energy Consumption Estimates, and Table 214, New York Transportation Energy Consumption Estimates.)

   The U.S. Department of Energy's Energy Information Administration has acknowledged the error in the reporting of jet fuel use between New Jersey and New York. In light of the size of the error introduced by the change in reporting of jet fuel sales, the N.J. Division of Energy Planning and Conservation has estimated jet fuel consumption for New Jersey from 1980-1986 based on the relative number of passengers served by the three major airports in the New York-Northern New Jersey region, *i.e.*, Newark, LaGuardia, and Kennedy. The revised estimated figures are reported in Appendix: Transportation Energy Consumption Estimates. A note to the table indicates the figures originally reported by the Department of Energy.
4. New Jersey Energy Database System, Board of Public Utilities.
5. Federal Highway Administration, *Highway Statistics 1989* (Washington, D.C.: U.S. Department of Transportation, 1988), Table VM-2, p. 182.
6. New Jersey Energy Profile, 1990 Annual Edition, p. 29.
7. New Jersey Department of Labor, NJ State Data Center.
8. *New York Times*, October 9, 1988, section 3, p. 5.
9. *New York Times*, November 29, 1988, p. D6.
10. *Newark Star Ledger*, August 26, 1988, p. 1 and 29, and Port Authority of New York and New Jersey, personal communication.
11. The largest ferry operators in New Jersey are Direct Line Commuter Service and Arcorp Properties. Direct Line runs ferry service from several points in New Jersey (Bayonne, Keyport, and Highlands) to lower Manhattan (Pier 11) as well as service from Bayonne and Jersey City to Sandy Hook and Highlands to meet demand during warmer months. Arcorp has two routes from Weehawken to Manhattan. In October 1988, Arcorp ferries carried about 4,000 passengers a day.
12. Port Authority of New York and New Jersey placed the Newark Airport 1989 passenger total at 20,927,900 in a personal communication with BPU staff in September of 1990.
13. *Journal of Commerce*, March 1, 1982, p. 1, and *New York Times*, October 27, 1988, p. A.
14. N.J. Transit, *Annual Report, Fiscal Year 1990* (Newark, N.J.: N.J. Transit, 1990) and 5/14/91 telephone conversation with Wayne Johnson.
15. *Sunday Star Ledger*, May 5,1991, section 1, pp. 1 and 46.
16. *Washington Post*, November 11, 1987. If the estimated $1.5 million in lost federal tax receipts is taken into account in calculating the subsidy to New Jersey drivers, the figure in Table 13-4 for the auto subsidy would change from -0.01 to +0.07, still not a significant figure in relation to total costs.
17. *New York Times*, July 3, 1988. See also Jesse A. Simon and Joel Woodhull, "Parking Subsidization and Travel Mode Choice," Southern California Rapid Transit District, August 1987.
18. Dwight Dively and John R. Lago, "Transportation Planning and Land-Use Decision Making," in *New Jersey Issues: Papers*

from the Council on New Jersey Affairs (Princeton, N.J.: Princeton University, 1988), p. 232.

19. See Chapter 18, Land Development Patterns for Energy Efficiency.
20. *The Asbury Park Advisor Journal* and personal communications.
21. Urban Mobility Corp., "New Jersey Ridesharing Study: Summary Final Report," unpublished study, Feb. 1988.
22. Port Authority of New York and New Jersey 12/18/90 press release and a 10/91 personal communication with Connie DellaBarca *et al* of the Port Authority.
23. N.J. Department of Transportation personal communication John Powers. Note: The estimates of commuters and vehicles crossing the bridge are based on estimated occupancy rates and a Port Authority bus/auto cound conducted in May 1990 that does not include the Palisade Interstate Parkway approach.
24. Letter of September 10, 1986 from Alex DeCroce, Freeholder Director of Morris County to Governor Thomas H. Kean.
25. Malcolm D. Rivkin, "Can Transportation Management Reduce Traffic in the Suburbs? Ask the Nuclear Regulatory Commission," *Urban Land*, November 1988.
26. Division of Energy Planning and Conservation, *School Bus Fleet Energy Assessment, Final Report* (Newark: Department of Commerce, Energy and Economic Development, January 1988).
27. The Road Information Program, "An Analysis of the Economic Impact of Increased Highway Funding in New Jersey," unpublished study, Washington, D.C., December 1987, p. 10.
28. Deborah L. Bleviss and Peter Waltzer, "Energy for Motor Vehicles," *Scientific American*, September 1990.
29. New Jersey Office of State Planning, *Infrastructure Needs Assessment, Vol. II: Transportation*, Technical Reference Document 88-29 (Trenton: N.J. Office of State Planning, January 1988).
30. See the New Jersey *1989 Transportation Plan* (Trenton: Department of Transportation) for details on Transplan.
31. Average annual miles traveled per passenger vehicle have increased from 9,560 in 1985, to 9,608 in 1986 and 10,382 in 1989, reaching levels not seen since the first oil crisis of 1973. Federal Highway Administration, *Highway Statistics, Summary to 1985, 1986, and 1989* (Washington, D.C.: 1986, 1987, 1990), Table VM-201A, Table VM-1, and Table VM-1, respectively.
32. Michael P. Walsh, "Critical Analysis of the Federal Motor Vehicle Control Program," Northeast States for Coordinated Air Use Management, July 1988, p. 1.
33. N.J.A.C. 7:27-14 & 15.
34. Thomas H. Kean, "Governor's Annual Message to the New Jersey State Legislature," Trenton, January 12, 1988, p. 89.
35. See also Chapter 18, Land Development Patterns for Energy Efficiency.
36. D. L. Bleviss, *The New Oil Crisis and Fuel Economy Technologies*, (Greenwood Press, 1988), p. 158.
37. W.U. Chandler, H.S. Geller, and M.R. Ledbetter, *Energy Efficiency: A New Agenda* (Washington, D.C.: American Council for an Energy-Efficient Economy, 1988), p. 28 and D.L. Bleviss, *The New Oil Crisis and Fuel Economy Technologies, Preparing the Light Transportation Industry for the 1990's*, Greenwood Press, 1988.
38. David L. Greene, Daniel Sperling and Barry McNutt, "Transportation Energy to the Year 2000," Oak Ridge National Laboratory, Oak Ridge, Tennessee, August 1988, p. 14-18.
39. Energy and Environmental Analysis, "Analysis of the Capabilities of Domestic Auto Manufacturers to Improve CAFE," Arlington, Virginia, 1986, and Chandler *et al*, Table 2, p. 29.
40. Chandler *et al*, p. 29-30.
41. Greene *et al*, p. 16.
42. Chandler *et al*, p. 35.
43. *Federal Register*, June 6, 1988, p. 20722-34.
44. N.J. Department of Environmental Protection, personal communication.
45. T.J. Kulle, L.R. Sauder, J.R. Hebel and M.D. Catham, "Ozone Relationships in Healthy Nonsmokers," *American Review of Respiratory Disorders*, No. 132, p. 36-41.
46. *Side-by-Side Comparison of Studies Concerning Alternative Vehicle Fuels*, American Gas Association, September 15, 1989.
47. W.W. Chandler, H.S. Geller, and M.R. Ledbetter, *Energy Efficiency: A New Agenda*, (Washington, D.C.: American Council for an Efficient Economy, 1988), pp. 28-30.
48. The projection of motor fuels consumption for year 2000 is based on submode ANL-86L in Marianne Millar Mintz, Margaret Singh, Anant Vyas, and Larry Johnson, "Transportation Energy Outlook Under Conditions of Persistently Low Petroleum Prices," *Transportation Research Record 1155* (Washington, D.C.: Transportation Research Board, 1987), p. 60-68. Submode ANL-86L, which is based on economic forecasts by Data Resources, Inc., was chosen because it best fits present trends.

Chapter 14

State Energy Efficiency Initiatives

The State of New Jersey and its seven gas and electric utilities operate conservation programs designed to reduce energy consumption in state, institutional, commercial, and residential building stock. The DEPE Office of Energy Grants and Programs (OEGP) administers most state government programs. Each utility administers a separate set of programs for its own customers.

State-run programs derive their operating funds from various sources. The State Energy Conservation Bond Program (SECB) finances improvements to state-owned and long-term leased buildings by issuing state bonds. Other state programs aid schools, hospitals, businesses, farms, and residential sector clients with funds from the United States Department of Energy (USDOE) and from the Petroleum Overcharge Reserve Fund (PORF) established by the State Legislature.

PORF money comes from U.S. oil companies charged with violating price controls that were in effect from 1973 through 1981 under the authority of the Emergency Petroleum Allocation Act of 1973. Billions of dollars in restitution were placed in escrow and eventually distributed, first to individual consumers who could prove injury, and then to states in proportion to their petroleum product purchases. USDOE and the federal courts strictly regulate state oil overcharge expenditures and require submission of detailed program/spending plans each year.[1]

In New Jersey, once the USDOE and federal courts issue spending plan approvals, the state legislature must draft and pass an appropriation bill to release the funds. Table 14-1 illustrates the oil overcharge funding sources and program destinations enabling August 1987 through August 1990 spending as defined in *N.J.S.A.* 52:18A-209 *et seq.* In May of 1990, the State Legislature extended the PORF legislation and spending deadlines to August of 1993.

Utility conservation programs operate with ratepayer funds approved by the state Board of Regulatory Commissioners (BRC). Programs adhere to commercial conservation regulations formulated by the state Department of Energy (DOE) in 1982 and 1984 and are revised as needed. The BPU reviews and approves biannual utility conservation program plans and all proposed expenditures. Table 14-2 summarizes current state and utility conservation programs. All programs, state- and utility-sponsored, that provide monies for energy improvements require an audit or feasibility study prior to project funding to ensure responsible and cost-effective spending.

State Buildings

The State of New Jersey owns or leases more than 40 million square feet of heated building space. Cost-effective retrofits of this stock can save energy and demonstrate the potential for savings in private sector buildings. The DEPE employs three approaches to control energy use in state building stock: SECB, the expanded use of cogeneration, and state building tie-ins to cost-effective district heating and cooling systems. These initiatives seek to reduce the use of fossil fuel and electricity that provide heating, cooling and power to state facilities.

In December 1974, the Governor issued Executive Order No. 13, requiring each state department to submit monthly

TABLE 14-1

New Jersey Oil Overcharge Allocations by Funding Source
Millions of Dollars - FY88-90

Dept	Program	Exxon	Stripper Well	Diamond Shamrock	Total
Department of Community Affairs	Low Income Weatherization	8.5			8.5
Department of Environmental Protection and Energy	Institutional Conservation Program	19.8	0.2		20.0
	Business Energy Improvement Program		6.8	0.2	7.0
	NJ Housing & Mortgage Finance Agency	4.0	11.0		15.0
	Resource Recovery Program		9.8	0.2	10.0
	Program Administration			1.5	1.5
Department of Human Services	Home Energy Assistance Program	30.0			30.0
	Boarding Homes & Homeless Shelters	5.0			5.0
Totals		67.3	27.8	1.9	97.0

Source: The PORF Report, Nov., 1989, DEPE, pp. 4, 21, 26, 32.
Oil Overcharge Spending Plan Overview, p. 11, 3/88.

TABLE 14-2

State and Utility Conservation Programs

Target Sector	State-Sponsored	Utility-Sponsored
State Buildings	State Energy Conservation Bond (SECB) Program District Heating & Cooling Cogeneration Initiatives	
Institutional	Institutional Conservation Program (ICP)	
Commercial/ Industrial*	Business Energy Improvement Program (BEIP) Commercial and Light Industrial Energy Technical Service (CLIENTS)	Commercial and Apartment Conservation Service (CACS)
Residential		
Low Income	Weatherization Assistance Program (WAP)	Direct Investment
All	Home Energy Rating System (HERS)	Home Energy Savings Program (HESP)
All Sectors	New Jersey Uniform Construction Code Energy Subcode	

Note: * Eligibles also include nonprofit organizations, municipalities, and farms.

electric and fuel use data. Still in force today, this order also calls for the appointment of departmental energy conservation coordinators to act as the department's primary liaison with the DEPE on energy issues. The 1977 Department of Energy (DOE) Act required state departments and agencies to submit annual energy utilization reports and conservation plans to DOE. Each plan was to detail energy reduction efforts through maintenance and operation improvements and equipment repairs and retrofits.

The State spent more than $80 million during fiscal year (FY) 1988 to supply fuel and power to state-owned facilities. Round-the-clock operations, such as hospitals, correctional facilities, higher education buildings, and state police facilities, account for the largest portion—approximately 85 percent—of State energy use.

The great diversity of state buildings presents a challenge to energy conservation and control. Structures range in size from sheds to Trenton's Labor and Industry Building and range in age from the 18th century to the present (although most were designed before energy costs escalated and consumption became a concern). Heating and ventilating systems vary widely. Over 60 percent of the total space is heated by central steam systems serving two or more buildings. Less than 50 percent of the space is air-conditioned, although this is steadily rising.

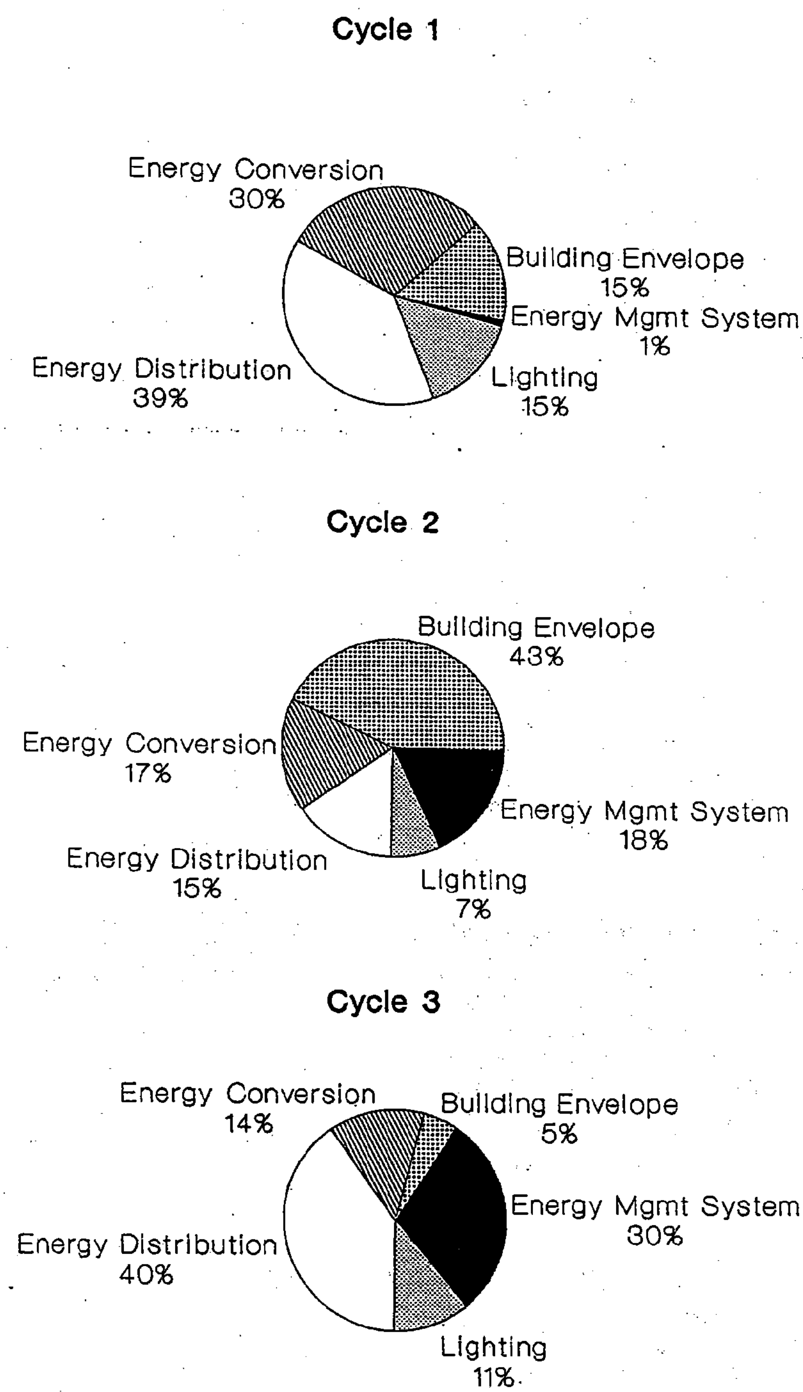
State Energy Conservation Bond Program (SECB)

The State Energy Conservation Bond Act of 1980, passed by voter referendum, provided $3 million for energy audits and $47 million for energy conserving renovations in state buildings. Figure 14-1 shows the focus of SECB program spending through three cycles by project type. Note the progressive increase of funds used to purchase and install energy management systems (EMSs).

Several projects that would have large energy benefit are stalled because the SECB funds cannot be spent to remove asbestos which is found in many older facilities. To participate in the bond program, state departments and agencies first request an energy audit and then apply for a grant to finance energy conserving renovations identified in the audit. Project applications are reviewed and ranked and funds go to those renovations with the quickest payback that can save the greatest amount of energy.

FIGURE 14-1

State Energy Conservation Bond Program
Projects by Type



Source: DEPE

By October 1991, $45 million of the $50 million bond issue had been spent or dedicated to implement eligible energy conservation projects with a payback of 10 years or less. Approximately $7 million of SECB monies funded Cycle I audits and projects during fiscal years 1981 and 1982. A $20 million legislative appropriation funded the program's Cycle II in FYs 1983 through 1988. In the autumn of 1988, the Legislature and Governor approved the final $23 million appropriation for the SECB program Cycle III in FY 1989 and beyond.

Cogeneration in State Buildings

In 1986, a Cogeneration Cabinet Committee appointed by the Governor identified 10 State facilities where cogeneration could reduce energy costs. With cogeneration, overall costs could be up to 30 percent less than costs of conventional power and heat sources in State-owned and operated facilities funded with SECB monies.[2] The committee recommended feasibility studies at 10 sites where energy costs totaled almost $28 million annually.

A major cogeneration project at the University of Medicine and Dentistry of New Jersey (UMDNJ) is now operational. Three 3.5 megawatt units are installed and a fourth is planned. The project cost over $10 million.

The committee report recommended that state cogeneration projects be bid to private investors to avoid high initial capital outlay and speed the projects. With open competitive bidding and third party contractors, current savings estimates range from 8 to 15 percent from avoided fuel and operating costs. Inclusion of avoided capital costs would raise these percentage figures.

By 1989, the state Cogeneration Evaluation Committee had selected vendors to design, construct, and operate cogeneration systems for the Vineland and Hunterdon developmental centers and Montclair and Glassboro state colleges. At least six other identified projects could generate returns adequate to justify cogeneration. Most state and county colleges and county complexes have excellent potential for cogeneration.

District Heating And Cooling for State Buildings

The state can also reduce energy cost by encouraging state building tie-ins to privately sponsored district heating and cooling (DHC) systems. A DHC system employs a large central boiler or cogenerator and channels heat to system participants via underground steam and hot water pipes. DHC systems that incorporate absorption chillers at the plant (in a four-pipe system) or at the end-user (in a two-pipe system) may also help to cool buildings and reduce air conditioning bills.

Efficient systems produce energy at lower cost and improve air quality by eliminating the use of older, unregulated boilers. Participants save on both energy and plant maintenance costs. DHC systems can help revive and attract business to the state's older cities because urban areas have sufficient density to support district projects.

Almost a decade ago, the state entered into a 20-year contract with the Trenton District Energy Company (TDEC) to participate in a two-pipe district heating system through which Trenton's Capitol Complex obtains all of its thermal energy. Operational since 1983, this system employs two diesel-driven generators to cogenerate electricity for sale to PSE&G and distributes thermal energy via nine miles of piping to 15 state buildings and to ten other public and commercial structures connected to the heating loop. The 160 MMBtu/hour boiler capacity more than satisfies the 150 MMBtu/hour system peak demand. The system produces hot water at an estimated cost of $12.95 per MMBtu.

TDEC's customers include Trenton's Capitol Complex, Trenton State Prison, Edison College, the Old Barracks and War Memorial, three public housing developments, Mercer County Courthouse and Detention Center, one school, and two commercial buildings.

Through cogeneration, TDEC consumes approximately 30 percent less fuel than that required by conventional generators and boilers. TDEC estimates that the state saves approximately 20 percent from reduced fuel, operating, maintenance and avoided capital costs.[3]

In 1989, an additional two-pipe cooling loop began to supply the Justice Complex as well as the Capital Center, Labor and Industry, and Health and Agriculture buildings with chilled water for air conditioning, enabling these customers to reduce electric consumption. A 2.8 million gallon cool storage tank constructed by TDEC on a site leased from the state also came on-line in September of 1989. The cooling system can provide 10.5 million annual ton hours of cooling with a 7,045 ton peak demand. The system is base loaded by 2,550 tons of absorption capacity that provides about 60 percent of the total cooling.

Interconnects include the State House, the Culture Complex, the Department of Education, the Division of Taxation, Edison College, the commerce department and War Memorial building.[4]

The TDEC central cooling system offers a significant environmental benefit because it replaces the common chlorofluorocarbon (CFC) refrigerant-based systems with ammonia-based steam absorption chillers. CFCs, when released to the atmosphere contribute to global warming and deplete the ozone layer.

During the 1980s, Camden, Jersey City and Atlantic City studied the feasibility of developing DHC systems in which private and public buildings could participate. Experiences in these cities showed that even if a technical study suggests the feasibility of a DHC system for a given area, a number of factors can inhibit system development. Successful development requires that expected participants firmly commit to the system, that financing can be arranged, that project timelines can accommodate all parties involved and that participants can rely on such timelines where the operation of a business and capital investments are at risk. Should DHC plans come to fruition in these or other cities, the state may yet discover opportunities for state facilities to participate and reduce costs.

State Building Energy Use

Figures 14-2 and 14-3 summarize state building energy consumption in FYs 1973, 1979, 1984 and 1988. These particular years illustrate consumption prior to any formal state building program (1979), consumption in a year when the state completed a substantial number of SECB projects (1984), and the most current available consumption figures (1988). For purposes of analysis, electric consumption is expressed in MMBtu converted by assigning the value of 11,600 Btu to each kwh. This factor reflects the units of primary energy required to produce each kwh at the plant.

Figure 14-2 depicts consumption in Btu per square foot, while Figure 14-3 depicts total Btu consumption in New Jersey state buildings. The Btu per square foot data are examined to negate the effect of increased building area on increased consumption. For example, referring to Figure 14-2, total electric consumption rose 16.9 percent between 1979 and 1988. However, on a Btu per square foot basis (Figure 14-3), there was a slight decrease (0.8 percent) in electric consumption between 1979 and 1988.

The data indicate greater reductions in thermal than in electric consumption. Between 1979 and 1988, thermal consumption decreased approximately 7.54 percent on a total Btu basis, and 21.5 percent measured in Btu per square foot. The combined electric and thermal Btu per square foot consumption of New Jersey state buildings decreased 13.0 percent between 1979 and 1988.

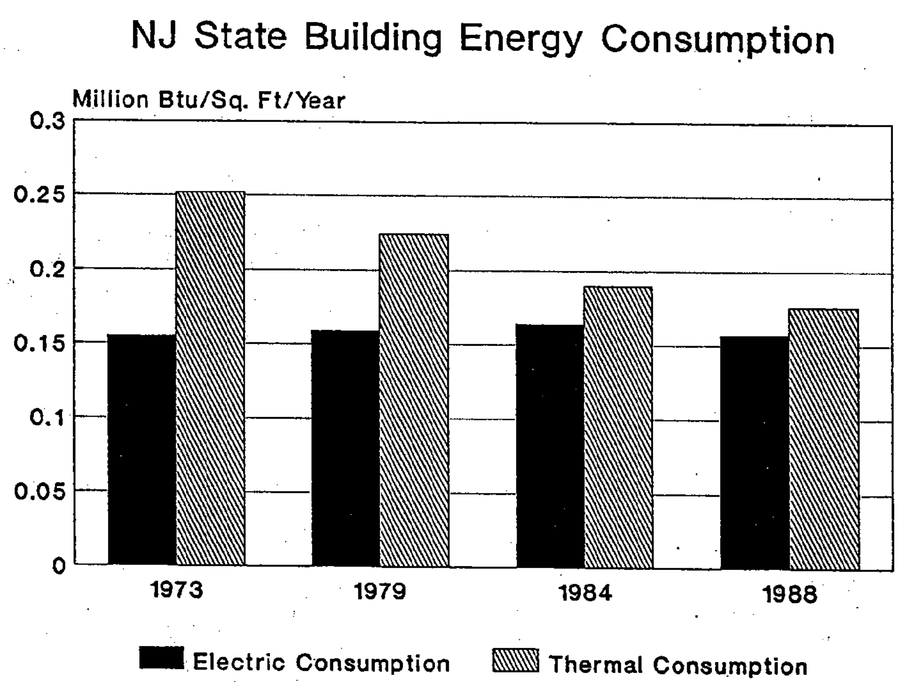
Table 14-3 depicts annual energy bills for New Jersey state departments in 1979, 1984, and 1988. The sharp rise between 1979 and 1984 (approximately $43.3 million or 85 percent) most likely reflects the sharp rise in electric and natural gas prices in this period, particularly following the 1979 oil embargo.[5]

The six-year lag in SECB appropriations between FY 83's Cycle II and FY 89's Cycle III approval delayed the implementation of many technically approved projects that could have further affected consumption and expenditures through the present. SECB projects require an average of two years to progress from application, through design, approval and contract stages, to construction.

To improve the State's ability to track energy use and costs and to identify opportunities to curb consumption in this sector, the DEPE maintains a comprehensive State Buildings Data Base. The usefulness of this data base and the success of associated monitoring efforts depend on prompt and accurate monthly reporting by all state facilities.

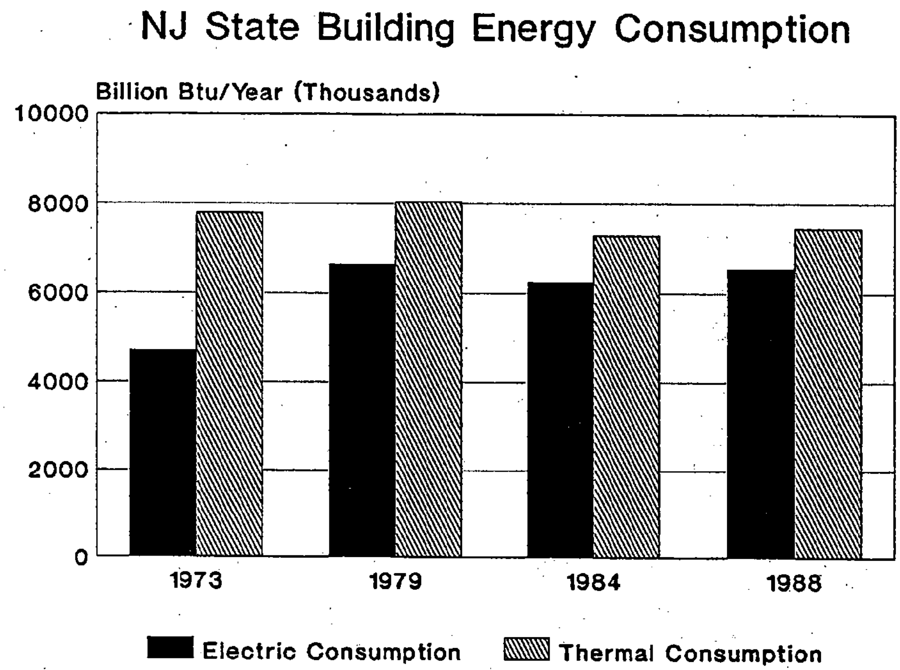
However, many factors hinder uniform reporting of data, such as lack of staff coordination, shifts in assignments, and insufficient metering. The absence of timely and accurate data limits the meaningful evaluation of the effects of SECB projects on actual consumption. Reporting problems also hamper attempts to define future SECB projects and confirm use and savings calculations.

FIGURE 14-2



Source: DEPE

FIGURE 14-3



Source: DEPE

TABLE 14-3

N.J. State Buildings
Annual Energy Bill by Department
(Thousands Dollars)

	1979	1984	1988
Law	$ 934	$ 1,489	$ 1,571
Treasury	1,830	3,996	8,670
Defense	969	1,472	1,487
Public Broadcasting	314	354	437
DEPE	979	1,761	1,849
Education	736	821	601
Higher Ed	24,487	44,963	40,451
Transportation	4,492	7,577	7,729
Human Services	11,520	21,374	15,559
Corrections	4,873	10,623	7,529
Total	$51,134	$94,431	$85,883

Note: Treasury includes costs for the Departments of Agriculture, Community Affairs, Commerce, Labor, Military and State, Veterans' Affairs, Health, the Public Advocate, Personnel, and Insurance, all located in the Capitol Complex.

Source: State Energy Conservation Bond Program

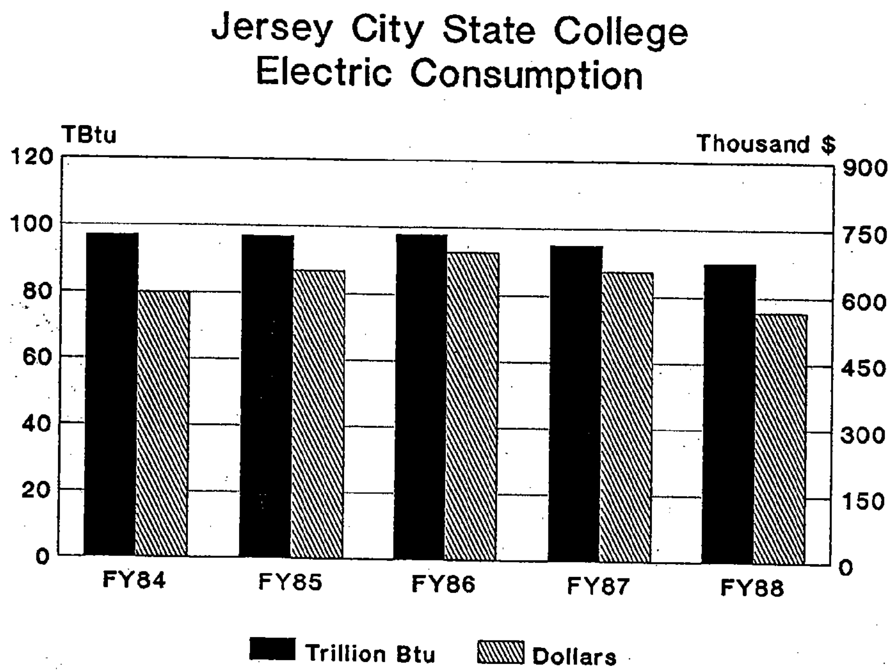
It is likely that SECB funds will be exhausted before all cost-effective improvements to state building stock are accomplished. To achieve real efficiency in this stock, the state will require additional monies to continue to finance identified energy conservation measures (ECMs).

As an alternative to legislative action to raise additional SECB funds, the state could consider shared savings arrangements as a future source of project funding. Through shared savings agreements, a private vendor may absorb all capital, maintenance, and operational costs of an energy system. The vendor obtains payment for equipment and services rendered by taking a percentage of the energy savings generated. State facilities could thus reduce energy costs without any capital outlay once SECB funds are depleted.

SECB Case Study - Jersey City State College:

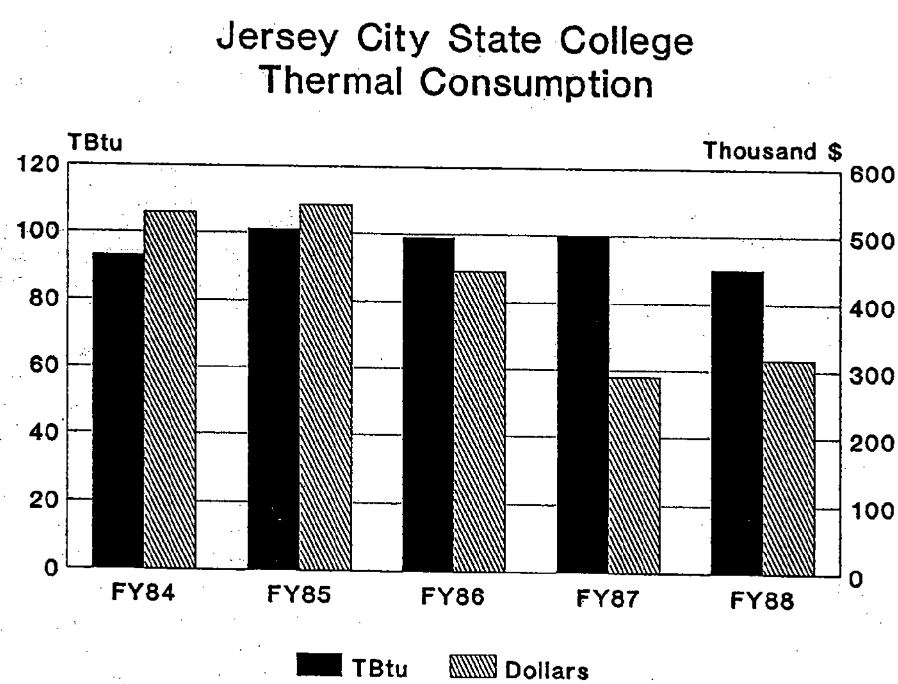
In 1984, DOE approved SECB funding for a Jersey City State College project that included the installation of an energy management system (EMS), chiller upgrades, heating, ventilating, and air conditioning (HVAC) modifications, and lighting retrofits. The improvements were designed to control consumption in five of 10 campus buildings that represent 63 percent of the college's total 485,600 square feet of space. In total, the state spent $372,394 on improvements estimated to yield $96,000 in annual energy savings annually by reducing yearly energy consumption by more than 14,600 MMBtu.

FIGURE 14-4



Source: DEPE State Building Data Base

FIGURE 14-5



Source: DEPE State Building Data Base

Figures 14-4 and 14-5 chart Jersey City State College's electric and thermal Btu consumption and expenditures from fiscal year (FY) 1984 through 1988. SECB projects were completed and became operational during FY 1987.

Between FY 1984 and FY 1986, prior to SECB project installations, electric consumption averaged 97,000 MMBtu and thermal consumption averaged more than 97,500 MMBtu at the college. By FY 1988, the first year that fully reflects savings achieved by SECB improvements, electric and thermal consumption dropped to 89,000 MMBtu. These actual savings of almost 16,000 MMBtu exceed the initial savings estimate for the project and represent an overall reduction in consumption of almost 10 percent at the college.

Further, the college's electric bill dropped 15 percent in FY 1988 to $563,600 from an average $651,600 per year in the FY 1984-1986 period. Thermal costs declined 38 percent to $316,300 in FY 1988 from an average $505,800 in the pre-retrofit period. A 35 percent drop in #6 oil prices between 1984 and 1988 triggered most of the thermal dollar savings; however, electricity prices fluctuated less than 1 percent in the same period, suggesting the significant impact of SECB-funded efficiencies on the electric side.[6]

The energy management system represented 85 percent of total project costs at Jersey City State. Project specifications estimated that the EMS alone would generate 88 percent of total project savings. Energy management systems maximize overall energy system efficiency and have proven to be a vital component of state SECB project designs.

In absolute terms, the college has reduced consumption from 581 MBtu/sq.ft. to 532 MBtu/sq.ft. via SECB program improvements. In terms of expenditures, for an initial capital outlay of $1.11/sq.ft., Jersey City State College saves $.83/sq.ft. each year in avoided energy costs relative to pre-retrofit costs.

Findings

- The State can achieve significant energy and dollar savings through energy retrofits to state building stock and through the use of energy management systems.
- The process of collecting energy consumption information from all departments for the DEPE data base needs to be improved to enhance the state's ability to identify opportunities to reduce energy consumption.
- The role of the departmental energy coordinator has not been emphasized in the past few years, thereby diminishing the energy conservation awareness throughout the State.
- Some state facilities can reduce energy costs through the use of cogeneration.
- The State may avoid large capital outlays to reap cogeneration savings by employing third-party vendors to construct and operate cogeneration systems.
- The State realized savings of approximately 20 percent through the Trenton Capitol Complex district heating tie-in and may identify similar opportunities in other cities where DHC is under study.
- The majority of all SECB funds are currently dedicated to projects; new sources of funding must be identified for the program to continue.

Policy

- Timely and accurate state building energy consumption and cost figures should be collected by each department and entered into the DEPE data base.
- All SECB projects should include sufficient metering in their design to ensure the integrity of energy data collected and to enhance the State's ability to review retrofits for cost-effectiveness.
- The State should pursue cogeneration opportunities where they would reduce costs at facilities.
- The State should consider DHC participation where state buildings' location and thermal load indicate energy rate relief through a DHC tie-in.
- The State should formulate new SECB legislation to fund projects once current monies are exhausted and should explore using shared savings agreements to finance future energy improvements to state buildings stock.

Implementation

- Department heads should assign an energy coordinator to act as a liaison for all energy matters and provide the central coordination crucial to the success of state energy monitoring and conservation retrofit efforts.
- The State should either amend SECB regulations or earmark a separate pool of funds to pay for the installation of meters wherever appropriate in state buildings to ensure that the departments will have the tools necessary to evaluate energy systems and conservation dollars spent.
- As departmental reporting procedures improve, the DEPE should provide the Legislature with an analysis of past performance and developing trends in state energy use to evaluate the extension of the SECB program.
- The State should continue to pursue the use of cogeneration in state facilities and consider tie-ins to future district heating and cooling projects when such projects can reduce costs.
- The State should pursue shared savings opportunities where studies indicate the feasibility of such agreements for state facilities. Departments and agencies should draw on the DEPE's shared savings experience in the commercial and institutional sectors to develop cost- and energy-efficient public-private partnerships.

Molly Davis

Institutional Sector Efficiency

Institutional Conservation Program (ICP)

Schools, colleges, and hospitals consume large amounts of electricity and fossil fuels. The nonprofit institutional sector requires special aid to implement energy improvements. These institutions traditionally suffer from budgetary constraints that often preclude capital expenditures for large-scale energy improvements. The Institutional Conservation Program (ICP) grants provide this sector with means to install retrofits that will pay for themselves through energy savings and avoided energy costs. Projects are funded with USDOE and PORF monies.

Legislative Authority

Under the authority of the National Energy Act of 1978, the USDOE developed the Institutional Conservation Program to provide 50/50 matching grants for technical assistance and energy conservation measures to help public and private nonprofit schools, colleges, and hospitals reduce energy consumption and operating costs through energy retrofits on institutional sector building stock.

The USDOE published the ICP regulations[7] in 1979 giving states the responsibility for and funds to conduct preliminary energy audits on schools, hospitals, and buildings owned by local government units, and on public care institutions. Further, each state was to use audit results to formulate a state plan to deliver technical assistance and promote the installation of energy conservation measures in schools and hospitals.

The then-New Jersey Department of Energy (DOE) was designated to administer the ICP in New Jersey. During 1979 and 1980, DOE commissioned audits on 90 percent of the state's existing eligible institutional buildings. Today, the DEPE Office of Energy Grants and Programs OEGP administers the ICP.

New Jersey received a total of $15.6 million for ICP from the USDOE over the first four annual program cycles from 1979 through 1982. However, in program cycles five through eight, the USDOE reduced its annual allotment to the state to approximately $1.1 million per year. During these four cycles, the state received oil overcharge funds to provide $9.8 million in grants from 1983 through 1986.

In 1986, the USDOE notified the state that New Jersey would receive approximately $75 million in Exxon oil overcharge monies. Of this total, the state earmarked $19.8 million for the ICP to be distributed over the course of three funding cycles beginning in 1987. Exxon oil overcharge monies are the major current source of ICP funding.

The Target Building Stock

The annual ICP State Plan, submitted to the USDOE by the DEPE, indicates that approximately 3,200 primary and secondary schools, 65 colleges, 114 hospitals, and 300 residential public health care facilities are eligible to participate. Buildings range in size from schools of 30,000 to 40,000 square feet to hospitals averaging 150,000 square feet and college complexes in excess of 175,000 square feet.

Preliminary ICP audits were conducted between 1979 and 1981 on almost 80 percent of the state's K-12 schools, 94 percent of its colleges, and 98 percent of all nonprofit hospitals. The audits estimated average usage rates of: 156,000 Btu/sq.ft./year for primary and secondary schools; 470,000 Btu/sq.ft./year for colleges; and 569,000 Btu/sq.ft./year for hospitals.

The audits also document great diversity in the age, size, design, and construction elements of eligible stock. Pre-World War II buildings are often noted for their composition of high-grade building materials; however, they typically lack sufficient insulation and require upgrades to inefficient heating systems. Post-1960 structures completed before the energy crisis fare the worst in terms of efficiency. Popular design elements such as single-story layout, thin walls, and high percentages of glass contribute to inefficiencies compounded by poor insulation and low-efficiency boilers installed when fuel was perceived to be cheap and expendable. Though exceptions exist, these design elements frequently prevailed and continue to affect energy consumption today.

The ICP addresses a broad range of inefficiencies that exist in this heterogeneous stock and evaluates and implements weatherization measures and energy system retrofits on a building-by-building basis.

ICP Operations

The DEPE administers ICP grants in annual cycles. To qualify, a building must have been in existence on or before April 20, 1977, and must be owned and primarily occupied by the institution requesting funds.

The ICP operates in three phases. First, the building owner must carry out an acceptable preliminary energy audit. Second, the institution may apply for a matching grant to fund a required technical assistance (TA) report. This detailed engineering study evaluates buildings and equipment for energy-saving opportunities. It recommends both low-cost and no-cost maintenance and operating procedures as well as cost-effective energy conservation measures (ECMs) that require a greater purchase and installation investment. The TA analysis must be performed by a DEPE pre-qualified professional architect or engineer. Finally, an institution may apply for a matching grant to fund identified ECMs with paybacks of two to ten years.

Typical ICP-funded ECMs include improvements to a building's heating, cooling, and distribution system, lighting upgrade projects, installation of insulation and storm windows, the addition of energy management systems to optimize operations and savings, and the installation of cogeneration systems.

ICP funds are granted on a 50/50 matching basis. However, if an institution cannot meet the matching fund requirement and is located in a hardship district as defined in the New Jersey State Plan, DEPE may grant up to 90 percent of the estimated approved project costs. Federal guidelines require state ICP administrators to set aside 10

TABLE 14-4

Institutional Conservation Program Grants, 1979-1991

Cycle #	Number of Grants Awarded	Dollars Awarded
Cycle I	155	4.7 million
Cycle II	158	4.0 million
Cycle III	208	5.4 million
Cycle IV	72	1.5 million
Cycle V	93	4.1 million
Cycle VI	66	1.8 million
Cycle VII	69	2.3 million
Cycle VIII	38	1.6 million
Cycle IX	80	15.2 million
Cycle X	70	4.9 million
Cycle XI	62	3.3 million
Cycle XII	33	2.5 million
Cycle XIII	40	2.9 million
Total	1,144	54.2 million

Source: Institutional Grants Program

percent of each cycle's funds to service hardship applications.

Since the program's inception in 1979, New Jersey schools, hospitals, and colleges have received over $54.2 million in ICP grants. DEPE records indicate that overall payback on total grants awarded through the first 10 program cycles averaged 3.5 years and suggest aggregate energy savings of more than $12 million each year statewide.

The DEPE's OEGP and USDOE monitor grantees to ensure that installed ECMs conform to specifications, but no system for post-implementation analysis of actual measured savings exists.

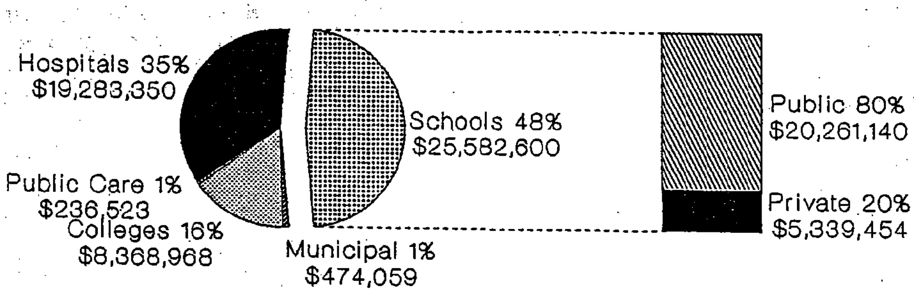
Table 14-4 summarizes the Institutional Conservation Program grant activity from 1979 through 1991. Figure 14-6 demonstrates an equitable distribution of ICP funds by client group in New Jersey over the life of the program. Federal regulations require that no single group (*i.e.*, schools or hospitals) receive more than 70 percent of the funds available within any given cycle. Although public care and municipal facilities are not eligible for grants, they are represented according to funds spent on preliminary audits at the program's inception.

The annual ICP State Plan estimates that all eligible schools and hospitals consume approximately 50 TBtu per year. Through review and analysis of actual grant recipients, the State Plan also suggests that participating schools can achieve a 15 percent reduction in energy costs

FIGURE 14-6

ICP Grants by Sector

All Cycles



Source: DEPE

by implementing low-cost and no-cost maintenance and operating procedures outlined in TA reports and can cut energy costs by an additional 16 percent through installation of eligible ECMs. For hospitals, the State Plan estimates a potential 16 percent reduction in costs through operating and maintenance procedure improvements and an average additional 13 percent reduction in costs through funded ECMs.

Extending these sample findings to the whole body of eligible institutions, the OEGP projects a total energy savings potential yet to be captured of 6 TBtu/year or almost 29 percent in hospitals and over 10 TBtu/year or 31 percent in schools throughout the state. To achieve these savings, the institutional sector will continue to require substantial aid to mobilize the capital necessary to effect energy improvements.

The USDOE and federal courts have now adjudicated virtually all oil overcharge cases and have distributed most of the resultant monies. Even if the USDOE continues the ICP after oil overcharge funds are exhausted, New Jersey's ICP will possess insufficient monies to fund many cost-effective projects capable of generating savings year after year. Such lost opportunities to capture savings and increase efficiency contribute to unnecessarily high loads and demands on utility energy supplies.

Findings

- The primary source of funding for the ICP program is PORF money, which is rapidly being depleted.
- The ICP uses USDOE and oil overcharge dollars to enable nonprofit schools and hospitals to implement cost-effective improvements that can pay for themselves in energy savings and help stabilize institutional operating costs.
- From 1979 through 1991, the state's ICP has awarded New Jersey schools, hospitals, and colleges more than $54 million in grants to fund projects with an average 3.5 year payback yielding aggregate savings of more than $12 million each year statewide.
- Few other programs offer as ideal an opportunity to reap large quantity energy and cost savings as the ICP. The high energy consumption in schools and hospitals maximizes savings possible through the installation of program-funded measures.
- Potential savings are still available through upgrades to the balance of New Jersey's institutional sector building stock.

Policy

- To harness projected savings of approximately 16 TBtu/year in schools and hospitals, the State should strengthen and continue the ICP.

Implementation

- The State should develop a future ICP funding mechanism to succeed ICP oil overcharge funding. The legislature should consider drafting legislation allowing for a special bond issue similar to the SECB bill.

C/I Freeman

Commercial/Industrial Programs

New Jersey's commercial/industrial sector accounts for 46 percent of the state's total energy consumption. Historically, the State has stressed the importance of first documenting energy consumption and potential savings, and only then extending financial assistance for improvements. The required energy audit or feasibility study provides the state with a tool to assess investments and provides profit-oriented clients with detailed payback information. Many companies may find sufficient profit incentives in audit results to implement conservation measures without financial aid. However, some clients require substantial assistance. Still others need only a slight incentive to sway their investment decision.

Initial state efforts to assist business were limited to sponsorship of technical workshops and the dissemination of energy literature. The state later expanded programs serving the commercial/industrial sector as additional oil overcharge funds were channelled to New Jersey.

Commercial and Light Industrial Energy Technical Service (CLIENTS)

The Commercial and Light Industrial Energy Technical Service (CLIENTS) was introduced in 1982. Through CLIENTS, DOE staff conducted energy audits on small businesses, light industries, nonprofit facilities, and multi-family dwellings of five or more units.

While the CLIENTS program provided the commercial/industrial sector with technical assistance to determine cost-effective energy investments, it offered no financial assistance to help small businesses implement improvements identified by the audit.

In 1983, the DOE proposed to use $2 million in oil overcharge monies for a loan interest subsidy program to provide CLIENTS audit recipients with financial incentives to implement retrofits. The result was the Business Energy Improvement Loan Subsidy Program, *N.J.A.C.* 14A:6-2, and in May 1984 the DOE began subsidizing half the interest, up to a 6 percent share, on approved energy conservation project loans obtained by CLIENTS program eligibles.

The June 1984 adoption of the Commercial and Apartment Conservation Service (CACS) regulations, *N.J.A.C.* 14A:22-1 *et seq.*, shifted audit responsibilities for small-scale commercial energy users to the utilities. DOE staff set up CACS auditor testing procedures and validated utility algorithms for CACS analyses to enable the utilities to begin to deliver CACS audits in December 1984. Through the CACS, owners/tenants of commercial buildings and multi-family dwellings using 4,500 MMBtu/year or less could obtain an energy audit from their utility for $25, $50, or $75 depending on square footage or number of dwelling units. In addition, nonprofit organizations, municipalities, and housing authorities could obtain free audits.

With the advent of the utility-sponsored CACS, CLIENTS was refocused to furnish audits to large-scale commercial energy users (ineligible for the CACS). Energy equipment/materials suppliers were enlisted to perform audits for large commercial users. The DEPE maintains a list of CLIENTS auditor firms.

Business Energy Improvement Program (BEIP)

In 1986, the Legislature named the then-Division of Energy Planning and Conservation (DEPC) to act as the state's lead agency in the distribution of $28 million in Stripper Well oil overcharge monies. The DEPC formulated a three-year spending plan that reached out to client groups not previously served by oil overcharge-funded programs. The Legislature appropriated funds in August 1987 and adopted the new Business Energy Improvement Program regulations, *N.J.A.C.* 14A:6 *et seq.*, in March 1988.

Seventeen million dollars was dedicated to improving commercial building stock efficiency and promoting energy-efficient industrial/agricultural process technologies. The plan earmarked $2 million for family-owned farm, demonstration, and Urban Enterprise Zone (UEZ) energy project grants; $250,000 for loan interest subsidies and $4.75 million for no-interest loans for commercial, nonprofit, and municipal energy retrofits; and $10 million for loan interest subsidies or revolving loans to local government units to finance the purchase of add-on equipment that could enhance the amount of energy productively harnessed and used from municipal solid waste resource recovery facilities.

Family-owned Farm Matching Grants

In 1988, principals of family-owned farms applied for matching grants to increase efficiency through retrofits, machinery replacement, or the construction of alternative energy production facilities. The State was able to grant up to $100,000 per project. The required farm match was calculated on a sliding scale based on the farm operation's income. Grants were awarded on a first-come-first-served competitive basis with consideration given to payback.

There was enormous response to the March 1988 farm grant program announcement; 594 farmers requested matching grants for $11 million worth of projects by the May application deadline. The DEPC quickly exhausted the $1.15 million in grant money to fund $1.6 million worth of projects.

The state energy division estimated that the $1.6 million in improvements will yield more than $466,000 in annual energy savings. These figures reflect an average simple payback of 3.46 years on total monies or a 2.43-year payback on program-supplied dollars. State farmers project they will save 28.9 billion Btu each year with the improvements. Grantees focused on rapid-payback diesel pump irrigation, plate cooler, and absorption chiller technologies.

New Jersey received national recognition from the National Association of State Energy Officials (NASEO) for the farm grant program with a first place prize for energy impact in 1988.

Urban Enterprise Zone (UEZ) Incremental Grants

In 1988, grants were offered to qualified UEZ businesses to cover the incremental cost of installing energy-related materials/equipment that exceed New Jersey Uniform Construction Energy Subcode requirements. To be eligible for funding, the UEZ applicants had to incorporate materials with a maximum 10-year payback into major renovations or new construction within state-designated zones. An alternative UEZ lighting grant program was developed in 1989 to use the $285,000 balance of the $500,000 originally earmarked for UEZ grants.

In 1988, the DEPC awarded $215,105 in UEZ incremental grants. Successful grantees used the funds to install energy management systems, thermal windows and doors, insulation, and high efficiency HVAC and lighting systems. Project payback on dollars awarded averaged approximately three years. Based on approved application savings calculations, the funded projects will yield savings of more than $72,000/year, equivalent to almost 5 billion saved Btu annually. This program has been completed and no funds remain.

Demonstration Program Grants

In 1988, $350,000 was allocated to fund projects that demonstrate new energy technologies and show promise for wide application in the commercial sector. An independent committee scored applications based on the projects' technical merits, transferability within the commercial sector, and the quality of project management.

DEPC's $350,000 in 1988 grant awards for demonstration projects will showcase a variety of technologies and applications. Funded projects are a solar energy system, improved industrial process technology and modified process unit design, and a resource recovery technology.

Loan Interest Subsidy Program

Also in 1988, $250,000 was allocated to the loan interest subsidy program to subsidize half the interest (up to a 6 percent DEPC share) on loans obtained by small and UEZ businesses, nonprofits, municipalities, family-owned farms, condominium and cooperative apartment owners, and 5+-unit multi-family homeowners to finance energy improvements and alternative energy production projects with a maximum 10-year payback.

The DEPC awarded businesses almost $224,000 in loan interest subsidies throughout the life of this program to offset the cost of installing more than $2.5 million worth of energy improvements. The subsidized projects enable businesses to save approximately 112.5 billion Btu/year, yielding annual dollar savings of more than $743,000. No funds remain in this program.

Zero Percent-Interest Revolving Loans

The BEIP no-interest revolving loan program aimed to distribute $4.75 million through FY 1990 to family-owned farms, individually-owned and closely-held companies, private nonprofit organizations, and municipalities for energy projects. This program sought to assist very small businesses and institutions that find it difficult to raise capital by traditional methods. The BEIP lent up to a maximum of $200,000 for energy conservation renovations or alternative energy production facility projects.

Loan recipients repay the loan from annual energy cost savings or avoided energy costs and must settle any outstanding debt at the end of the loan term with a balloon payment.

Seventy farm projects were funded from 1987 to 1990, at a cost of $2 million. Repayments average $200,000 per year, and 100 percent of the borrowers made payments in 1990. The program was closed in the autumn of 1989. All funds are depleted.

Resource Recovery Interest Subsidies and Low-Interest Loans

Ten million dollars was allocated for loan interest subsidies and low-cost revolving loans to local government units to fund energy efficient resource recovery alternative technologies so that municipal solid waste resource recovery facility operators could purchase "add-on" equipment to increase a facilities' ability to capture, sell, and put energy to efficient use. Savings or revenues generated by the projects would help defray operating costs. Acceptable energy applications, such as district heating and cooling and ash vitrification equipment, capture waste heat and maximize a facility's overall efficiency. In 1990, Governor Florio renewed emphasis on state source separation and recycling efforts and placed a moratorium on the planning, construction and state funding of resource recovery facilities statewide. A special solid waste task force appointed by the Governor issued a report in August of 1990, recommending that New Jersey increase its source separation and recycling activities and study regional solutions to solid waste disposal before building additional incineration facilities. Program monies remain earmarked as the Legislature intended pending development of regional solid waste plans.

Alternative Financing/Shared Savings Program

In addition to direct audit and financial assistance programs, OEGP provides information on alternative financing methods to commercial and institutional clients. Assuming a liaison role to cultivate partnerships, the OEGP facilitates meetings between commercial energy users and energy service companies (ESCOs) and publishes a comprehensive guide to formulating alternative finance agreements.

The DOE first explored the shared savings concept in 1982 to attempt to service state building and institutional clients unable to obtain SECB and ICP grants, and promulgated shared savings regulations, *N.J.A.C.* 14A:12-1 *et seq.*, in 1982.

Shared and guaranteed savings agreements take many shapes. In general, however, a firm or organization "performance contracts" with an ESCO that supplies energy-saving equipment to reduce energy consumption and costs. The energy user pays the ESCO by sharing the energy savings generated by the ESCO-installed equipment. Thus, the user makes no capital investment.

In a guaranteed savings agreement, an ESCO usually leases energy-saving equipment to a user and guarantees that the equipment will generate savings in excess of installation and lease costs. If actual savings fall short of the minimum dollar savings specified in the contract, the ESCO absorbs the loss. Should savings exceed those projected, the user may retain all additional savings. The lease or lease with purchase option available through guaranteed savings enables the user to spread capital equipment costs over the life of the contract.

Alternative financing agreements may become increasingly important in the future as program funding sources dwindle or disappear. The OEGP keeps pace with industry changes and legislation that could affect the feasibility of agreements and continues to act as an information clearinghouse, lending technical support and advice to interested energy users.

Findings

- State conservation initiatives in the commercial/industrial sector address energy efficiency assessment through audits and the need for financial assistance to implement energy improvements.
- The oil overcharge-funded family-owned farm matching grant program received almost $13 million worth of requests and provided $4.15 million in grants, exhausting program funds. The high subscription rate reflected strong program interest.
- Of all programs initiated in 1988 under the new BEIP regulations, grant and no-interest loan programs offered the greatest degree of assistance, attracted the largest number of participants, and resulted in the most immediate implementation of cost-effective energy improvements.
- The BEIP estimates that the $1.365 million in grants distributed to family farms and UEZ businesses in 1988 will yield annual energy savings of more than $500,000, demonstrating a 2.7 year payback on oil overcharge monies.
- The BEIP estimates annual savings of $430,000 via the implementation of $2.5 million in no-interest loan projects tentatively approved by year-end 1988.
- As New Jersey depletes its share of oil overcharge funds, the commercial/industrial sector may need to turn to alternative financing agreements with private energy service companies to reduce consumption and capture savings.
- New Jersey businesses have evidenced a desire to participate in state-sponsored energy conservation programs.

Policy

- The State should seek to further reduce energy consumption in its commercial/industrial sector that accounts for 46 percent of the state's annual energy use.

- Financial incentive programs to help commercial/industrial energy users become more energy efficient should be continued.

Implementation

- The DEPE should work with utilities to increase and improve audit delivery to the commercial/industrial sector.
- The DEPE should track and analyze response to the BEIP programs introduced in 1988 to identify the most effective means of achieving retrofits in the commercial/industrial sector.
- The State should develop legislation to enlarge the pool of revolving loan monies and to expand this program's eligible client base.
- The State should investigate the development and financing of new business energy conservation programs.
- The DEPE should continue to monitor all economic and legislative factors that affect the viability of alternative financing agreements and shall continue to provide agreement guidelines to potential users.

Weatherization Assistance Program

Without government or utility aid, low-income residents lack the means to weatherize their homes. Low-income families usually have the least disposable income or capital to invest in energy conservation improvements. Weatherizing low-income dwellings can help individual households and the state reduce consumption in this sector.

In accordance with USDOE and federal court spending directives for oil overcharge monies, the state implemented the Weatherization Assistance Program (WAP) for low-income eligibles in 1977. The federal government distributes program funds to the states based on population, past weatherization program performance, and various economic and climate-related factors. Each state must submit annual spending plans and file reports of program accomplishments.

The Governor designated the Department of Community Affairs (DCA) as WAP administrator in New Jersey. DCA administers this program through its Division of Community Resources, Office of Low-Income Energy Conservation.

Through the WAP, eligible low-income homes may obtain insulation, weatherstripping and caulking, replacement prime windows and doors, replacement storm windows and doors, window shades and heating systems depending upon audit results. The DCA may invest up to a maximum of $2,000 worth of materials and services per eligible home.

To deliver weatherization assistance, DCA grants funds to community action agencies, native American tribal organizations, community-based organizations, and units of local government who manage local weatherization programs that identify needy, eligible households and install weatherization materials to reduce energy consumption in the low-income residential sector. Residents with household incomes less than 150 percent of federal poverty guidelines can obtain WAP services through a local weatherization program.

All counties receive WAP funds for at least one weatherization project. In selecting projects, the DCA gives preference to community action agencies and nonprofit organizations that have previously demonstrated ability to meet program performance goals.

Through the WAP, DCA weatherized more that 60,000 low-income dwellings between January 1977 and December 1989. DCA estimates that it will reach an additional 22,502 homes by the close of 1993.[9] (See Table 14-5.)

TABLE 14-5

N.J. Weatherization Assistance Program
1990-1993

Source	Dollars	Planned Production
USDOE	13,000,000	6,765
Dept. of Human Services	9,856,815	3,237
Exxon	23,500,000	12,500
Total	46,356,815	22,502

Source: DCA, Office of Low-Income Energy Conservation, Gregory Adkins.

The DCA utilizes New Jersey's Residential Conservation Service (HESP) audit procedures to evaluate one- to four-family structures and the Commercial and Apartment Conservation Service (CACS) audit to assess larger multi-family dwellings. These survey tools provide customized energy reports and rank improvements in order of cost-effectiveness, thereby improving DCA's ability to prioritize project spending.

However, DCA cannot count on weatherizing 7,500 units a year after 1993 because Exxon oil overcharge monies, which fund 70 percent of these efforts, will be almost entirely expended.

By adopting the same USDOE-approved HESP and CACS audit standards used for utility low-income programs, the DCA moved towards program standardization and the goal of ensuring that low-income families will receive equal benefit regardless of whether they seek aid through WAP or through utility-sponsored low-income programs.

The DCA's WAP targets the same state residents as utility low-income seal-up and direct grant programs. The DCA and most utilities identify weatherization clients through local Community Action Programs (CAPs). Whereas DCA contracts with CAP agencies to deliver services, utilities may deliver services through their own subcontractors or through CAP contractors.

Though much of the responsibility for coordinating weatherization services falls on the local CAP agencies, these agencies may lack sufficient staff or record-keeping ability to fully track and monitor all weatherization efforts.

The State and utilities should explore ways to coordinate the WAP and utility-sponsored low-income weatherization programs to streamline the delivery of services and avoid duplication.

Findings

- The DCA uses oil overcharge funds to provide up to $2,000 per household of weatherization materials and services to the state's low-income residents.
- The DCA weatherized approximately 70,000 homes between 1977 and 1989, and estimates that more than 340,000 additional homes are program-eligible.
- Oil overcharge monies that fund a significant portion of the WAP will be depleted in 1993.
- Local CAP agencies that coordinate most state- and utility-sponsored weatherization efforts may benefit from increased staff support to fully track and strengthen low-income weatherization program delivery.

Policy

- The State should continue its efforts to weatherize low-income building stock throughout New Jersey and should coordinate more closely with utility programs that aid the same low-income population to streamline program delivery and ensure effective spending.

Implementation

- The State should identify new funding sources to continue low-income weatherization efforts in the future.
- The State and utilities should conduct a comprehensive review of their separate low-income programs to identify ways to maximize energy efficiency gains in this sector.

NOTES

1. National Association of State Energy Officials, *Exxon State Programs: Innovative Uses of Oil Overcharge Funds by State Energy Officials*, 1987.
2. P.G. Bos and S.A. Davis, *Economic Screening Guidebook for Cogeneration in Buildings*, (Wellesley, MA: ARS Group, Inc. for the Gas Research Institute, 1985), p. 1.
3. Trenton District Energy Company, *Cogenerated District Heating: Trenton, New Jersey - A Study of Energy Development in and Urban Environment*, (Trenton, NJ, 1985).
4. Trenton District Energy Company, information compiled by Don Leibowitz, President in February 1989 and April 1990 and information supplied by Joseph Sullivan, Department of Treasury, Sepetember 1990.
5. New Jersey Department of Commerce, Energy and Economic Development (DCEED) *New Jersey Energy Profile - 1987 Edition, Data Supplement* and *New Jersey Monthly Energy Profile* , September 1988.
6. *Ibid.*
7. 10 C.F.R. 450 and 455.
8. Energy Information Administration (EIA), *State Energy Data Report*, 1960-1986, (Washington, D.C.: U.S. Dept. of Energy, 1988), Table 4, p. 13.
9. Based on conversations with Greg Adkins, Supervisor, Department of Community Affairs (DCA) Low-Income Weatherization Program, November 1988.
10. *Conservation: A Review and Analysis of Regulatory Incentives*, a report by the Conservation Incentive Committee of the New Jersey Board of Public Utilities, (July 26, 1989).
11. *Petroleum Overcharge Reimbursement Fund: Past and Present Activity, Future Directions*, submitted to the Governor and Legislature by the Board of Public Utilities pursuant to P.L. 1987, c. 231 (November 1989).

Chapter 15

Utility Energy Efficiency Programs

The state's seven gas and electric utilities administer several major conservation programs to increase energy efficiency in the residential and commercial sectors. The utilities implemented these conservation programs to comply with federal and state regulations enacted in the years following the energy crisis of the 1970s. Allowable program costs, reviewed and approved by Board of Regulatory Commissioners (BRC), pass into each utility's base rates.

Programs must benefit the utility ratepayers who ultimately absorb program costs. To improve building stock efficiency, utilities offer the Home Energy Savings Program, residential loan and rebate programs, low-income direct investment programs, the Commercial and Apartment Conservation Service (CACS), and commercial sector financial incentive programs.

Legislative Authority

In January 1975, the Department of the Public Advocate petitioned the Board of Public Utilities—predecessor agency to the BRC—to adopt a Residential Insulation Program. In May 1977, the Board ordered the state's public utilities to finance cap insulation, attic ventilation fans, and automatic day/night thermostats for customers living in one- to four- family homes.[1]

The 1978 federal Residential Conservation Service (RCS) legislation[2] required gas and electric utilities to sponsor residential energy savings programs and also mandated that states devise conservation plans and require covered utilities to comply with those plans. In addition, USDOE offered states funds to implement RCS programs. New Jersey instituted its RCS program as the Home Energy Savings Program (HESP) under regulations adopted in January 1981.[3]

In 1982 the Board ordered each utility to develop comprehensive conservation, cogeneration, and load management plans.[4] Public Service Electric and Gas (PSE&G) obtained approval of its plan in November 1982 and six other utilities received approval in the following years.

In June 1984, DOE adopted the Commercial and Apartment Conservation Service (CACS) regulations, *N.J.A.C.* 14A:22-1 *et seq.*, requiring utilities to conduct energy audits for small-scale commercial energy users and multifamily dwellings not eligible for HESP. New Jersey modeled its program after an existing federal CACS program established by the Energy Security Act of 1980. DEPC revised regulations in May 1988 to expand CACS-eligibles to include farm and industrial facilities.

In the 1985 New Jersey Energy Master Plan, DOE proposed to adopt regulations governing utility conservation plans under the department's enabling legislation.[5] DOE adopted regulations, *N.J.A.C.* 14A:20-1.1 *et seq.*, requiring the seven investor-owned utilities in the state to submit energy conservation plans biennially to DOE for review and approval.

The regulations specified that each utility's plan must address the following programs geared toward creating a more energy-efficient building stock: the Home Energy Savings Program (HESP); direct investment, subsidized loan, and appliance rebate programs; and the Commercial and Apartment Conservation Service (CACS).

The utilities supplied proposals for conservation programs under the new regulations in June 1987. Utility plans submitted to the state's energy division and Board for approval began to take effect in 1989.

New incentive regulations adopted by the BRC in September 1991 require utilities to submit a Demand Side Management Resource Plan to the BRC every two years. (See Chapter 8 for more detail.) The rules allow utilities to profit on investments in conservation and allow each utility to propose programs of its choice; however, every utility must retain in its plan certain core programs including the home energy audit program and programs to assist low income households.

Home Energy Savings Program (HESP)

Increasing the efficiency of residential building stock requires major upgrades to both existing housing stock and new construction specifications.

Through HESP, the state's seven utilities, in cooperation with the BRC, offer energy audits to owners and occupants of one- to four-family homes, multi-family dwellings, mobile homes, and townhouses, who directly pay a heating bill. Utilities may charge customers up to $15 for the audit, but the state's seven utilities currently offer the energy survey free of charge. Lifeline recipients and low-income households may obtain the audit without charge.

State-certified energy auditors conduct a basement-to-attic energy survey to analyze a home's thermal shell and heating system and recommend cost-effective energy conservation measures (ECMs) that will enable a homeowner to increase comfort and reduce energy consumption and costs. During the survey, the auditor identifies and explains no-cost and low-cost maintenance and behavioral practices a homeowner can implement immediately to begin saving energy.

Within two weeks of the survey, the utility provides the homeowner with a detailed written summary of survey findings that estimates potential dollar savings as well as contractor and do-it-yourself installation costs for each recommended ECM. The report specifies each measure's payback and offers information on a variety of financing methods and incentives available to HESP participants.

HESP enables the homeowner/occupant to make informed home energy improvement decisions and to evaluate the cost-effectiveness of investing in a specific measure for his/her home. To motivate audit recipients to take action, utilities offer financial incentives to defray the cost of energy retrofits. Direct grant, loan subsidy, and appliance rebate programs provide aid tied to the level of need of various income groups.

Direct Investment Programs

Direct investment programs provide weatherization services to customers with household incomes below 150 percent of the federal poverty guidelines or those who qualify as Lifeline recipients. This population spends a disproportionate amount of total income on energy and has little or no disposable income to invest in energy retrofits.

A large part of the low-income population is also a rental population. A Minneapolis study[6] noted that renters accounted for more than 50 percent of low-income conservation workshop attendees. A loan program, even subsidized to 0 percent, is often unmanageable for this population because they possess insufficient means to repay the principal on a loan.

Prior to 1987, utility low-income sector programs assumed two forms. Low-income seal-up programs delivered $200 worth of basic low-cost weatherization measures such as weatherstripping, caulking, low-flow showerheads, faucet aerators, water heater insulation, and plastic storm windows. Eligibles could also apply to utility direct grant programs to obtain an additional $250 worth of energy retrofits.

In view of the target population's severely limited resources, the state increased the allowable expenditure for utility direct investment programs in 1986. Under new conservation incentive rules adopted in 1991, utilities must continue core low income programs in their portfolio of conservation programs.

Loan Programs

Most utilities offer their heating customers no-interest and low-interest loans to finance HESP-related energy improvements. Loans range from $500 to $4,000. Depending on the utility, a family with an annual income below either a $30,000 or $35,000 cap may qualify for a no-interest loan. Families with incomes above these caps may obtain loans at half the current consumer interest rate.

The BRC coordinates the loan subsidy programs to ensure that only cost-effective energy conservation measures are subsidized. HESP guidelines require that subsidized measures pay back within 10 years as determined by a HESP survey.

Rebate Programs

Depending on the individual utility, appliance rebate programs address either the retrofit market or the new housing market. Utilities offer rebates on electric or gas appliances ranging from air conditioners to ranges. Rebate programs encourage customers to purchase high efficiency appliances by partially or completely offsetting the incremental cost of purchasing a high efficiency model. These programs are available to all residential customers.

In the new housing market, utilities frequently offer rebates to builders to encourage the installation of high efficiency appliances in a market where the construction industry traditionally installs the least costly (and less efficient) appliances to reduce construction costs. In some cases, gas utilities offer "package deals" to builders to install a complete set of high efficiency gas appliances in new homes.

Commercial and Apartment Conservation Service (CACS)

Through CACS, owners of apartments with five or more units, family-owned farms, small businesses, manufacturing plants, nonprofit organizations, houses of worship, and municipalities may obtain an energy audit. Tenants of commercial/industrial buildings may also obtain an audit. To be eligible, a building must have had a certificate of occupancy at least two years prior to the date of the audit request and must average less than 4500 MBtu in annual energy use. The service enables recipients to cut energy costs and increase profits. Regulations require each utility to target 5 percent of its commercial customer base as an annual goal for CACS penetration.

A BRC-qualified energy specialist conducts a detailed structural and mechanical energy audit of owned or leased buildings. The customer then receives a detailed report, prepared specifically for his/her building, pinpointing areas of energy loss, and specifying estimated costs, savings, and paybacks for recommended improvements. The cost of the audit ranges from $25 to a maximum of $75, depending on the structure's size. The energy audit is performed free of charge for nonprofit organizations, including houses of worship, local governments, housing authorities, and multi-family buildings where 66 percent of the households have incomes below 150 percent of the federal poverty guidelines.

Analysis

HESP

Methods used to calculate conservation program savings differ among the utilities and government agencies. According to utility figures compiled for the DEPC's Annual Residential Conservation Service Report to USDOE, state residents save an estimated 24 MMBtu/year as a result of 60,567 audits performed during reporting year 1987/88. Utilities used several methods to estimate these savings. One utility used studies of similar programs in other states with a comparable number of heating degree days. Two utilities analyzed their own programs; two utilities made assumptions about savings and one of these plans in the future to do a study to establish savings.

The utility studies showed extremely varied savings per participant. Two of the seven utilities felt that since HESP

TABLE 15-1

New Jersey Utility
HESP Audit Program

Year [1]	Audits Performed	Utility [2] Primary Heating Customers	% Primary Heating Customers Audited	Eligible [3] Customers	% Eligible Customers Audited
1981	5,308	1,132,596	0.5	2,298,088	0.2
1982	14,676	1,144,088	1.3	2,158,657	0.7
1983	30,786	1,185,304	2.6	2,237,314	1.4
1984	49,797	1,207,808	4.1	2,129,504	2.3
1985	73,925	1,205,298	6.1	2,215,928	3.3
1986	59,002	1,418,182	4.2	1,805,737	3.3
1987	60,567	1,170,876	5.2	1,710,506	3.5
1988	61,789	1,283,001	4.8	2,081,257	3.0
1989	51,220	1,629,017	3.1	2,502,505	2.0
1990	54,186	1,681,736	3.2	2,479,714	2.2
Total	461,256				

Notes: 1 Year refers to annual RCS reporting period April 1 to March 31.
2 Primary heating customers are those for whom the electric or gas utility supplies heat.
3 Eligible customers include those who heat with oil, kerosene, coal, wood, butane, or propane and are supplied with electricity by a utility participating in the program.

Source: BRC

is an evaluation tool, no savings could be attributed. Of the remaining five, the savings estimates ranged from 0.15 MBtu to 12 MBtu per participant per year. In every case, savings are projected, but no established practice of obtaining and comparing before/after measurements (or billing analysis) exists to verify savings.

A document prepared by USDOE[7] provides a sampling of eight studies that estimate energy savings per participant in RCS programs in different climates. Choosing the calculation for a climate most like New Jersey's, the BRC projects that 12 MBtu/year per participant best expresses HESP savings in the state. Using this figure as a basis for calculation, the BRC estimates that residents saved more than 740 MMBtu from actions taken through HESP during the 1988/89 reporting year. This figure reflects a fifteen-fold increase over utility estimates. No before/after data are available.

Table 15-1 shows that since the program's inception in 1981 through December of 1989, utilities conducted HESP audits on 355,850 dwellings, or almost 18 percent of the total eligible customer base.

Applying the 12 MBtu/participant/year savings figure to the entire body of audits completed, the BRC estimates that HESP audits have enabled aggregate annual energy savings of 5,535 MMBtu/year in the state's residential sector. The BRC further estimates the potential for an additional 28,000 MMBtu in annual savings should the 2.4 million remaining HESP-eligible households in the state participate in the program.

The diverse savings estimates attributed to HESP illustrated the need for a valid and uniform method of calculating program savings to conduct meaningful cost/benefit analyses. In 1982, the utilities, together with the Board, the DOE and the Department of the Public Advocate, organized the New Jersey Conservation Analysis Team (NJCAT) to evaluate conservation programs. The seven state utilities contracted with a private consulting firm to survey utility-sponsored conservation program participants and nonparticipants on behalf of NJCAT. The research sought to determine the effects of the audit and other core utility conservation programs on the conservation behavior of the participants, as well as what actions they would have taken had they not participated in the utility-sponsored programs. Programs examined included the residential and small business energy audit programs, subsidized loan programs, seal-up and weatherization programs, and programs that offered rebates on the purchase of high efficiency appliances.

The NJCAT study, released in August 1990, presented data on program costs and associated savings to assess the relative costs and benefits of utility conservation programs. The study gave the programs mixed reviews and concluded that some programs achieved good or better than good

TABLE 15-2

New Jersey Electric Utility
Conservation Program Benefit - Cost Ratios

Program	Base Case
Rebate - Heat Pump	1.14
Rebate - Central AC	0.70
Rebate - Window AC	0.73
HESP - regular	0.66
HESP - loan	0.65
Sealup - regular	1.19
Sealup - assistance	0.44
CACS	0.48

Source: N.J. Conservation Analysis Project: Conservation Report to the NJCAT, Table E-2, August 14,1990.

cost/benefit results, but that others achieved unanticipated poor results. Overall, the measured benefits of the programs averaged approximately 70 cents for each dollar spent. Tables 15-2 and 15-3 summarize NJCAT study results. The benefit/cost results presented in the NJCAT study reflect only direct energy savings and do not include other external benefits such as reduced environmental degradation, increased comfort and increased value of homes. These factors are difficult to quantify but they are important and the study notes that their inclusion would likely change the study results. The study results also do

TABLE 15-3

New Jersey Gas Utility
Conservation Program Benefit - Cost Ratios

Program	Base Case
Rebate - Furnace/Boiler	2.00
Rebate - Water Heater	1.00
Rebate - Thermostat	1.62
HESP - regular	0.48
HESP - loan	0.29
Sealup - regular	0.92
Sealup - assistance	0.48
CACS	0.92

Source: N.J. Conservation Analysis Project: Contractors Report to the NJCAT, Table E-4 August 14,1990.

not reflect the recent increase in oil prices that resulted from the August 1990 invasion of Kuwait by Iraq. The study notes that its results are sensitive to changes in fuel prices: increased fuel costs would alter the benefit/cost ratio to reflect more favorably upon programs.

The study provides important insights into the structure of various programs that will help improve program design and concomitant benefits. A number of programs will likely be modified or terminated as a result of the study and other information gathered. The detailed analysis of program mechanics contained in the study aided the BRC in crafting new performance-based conservation incentive regulations.

Future program enhancements will be structured: (1) to ensure that conservation opportunities will continue to be made available to those most in need of reducing their energy costs and (2) to foster the proliferation of cost-effective conservation projects as efficiency gains assume an expanding role in meeting the state's future energy needs.

A study of 3,527 HESP home energy survey evaluation forms filed with DOE by audit recipients between 1983 and 1986 revealed that 86 percent of respondents reported either satisfaction or a very high level of satisfaction with the thoroughness of the HESP audit. More than 91 percent indicated that they received all information necessary to make informed decisions on conservation improvements to their homes.

An average 55 percent of the respondents planned to implement low-cost, rapid-payback measures as a result of the audit. An average 45 percent planned to implement more costly recommended measures such as attic, wall, and floor insulation based on the suggested savings these ECMs could generate. The survey results indicate that HESP audits effectively inform and motivate residents to increase home energy efficiency.[8]

PSE&G-sponsored focus groups with HESP participants, conducted in January 1988,[9] also highlighted the importance of the auditors' interaction with homeowners and the follow-up written report to educating and motivating the HESP participant to take action. PSE&G-territory audit recipients stated that they relied heavily on weatherization and retrofit advice offered by the auditor on-site and often waited for the final report to reinforce the auditor's verbal recommendations to take action.

Comments offered by focus group participants reinforced the importance of the customized on-site HESP audit in increasing residential building stock efficiency in the state. They further supported the significance of the auditor's role as educator and primary motivator to spurring homeowners to take action. The NJCAT study recommended HESP enhancements such as pre-screenings and target marketing to improve the cost-effectiveness of this program.

Direct Investments

Table 15-4 summarizes direct investment program activity through 1988 as reported to the BRC by the utilities. Through March 1990, utilities invested almost $47 million

TABLE 15-4

New Jersey Utility Low Income Residential Direct Investment Program

Year[1]	Number Performed	Dollars Invested	Dollars Per Customers	% Eligible Customers Serviced
1984	15,685	2,612,636	167	2.3
1985	25,955	4,616,284	178	3.7
1986	25,922	4,123,484	159	4.5
1987	33,115	7,581,841	229	6.0
1988	37,442	9,278,144	245	6.4
1989	37,498	9,817,536	262	n/a
1990	28,505	9,370,721	329	n/a
Total	204,122	47,300,646		

Note: [1] Year refers to annual RCS reporting period April 1 to March 31.
n/a - not available.

Source: BRC

in weatherization and retrofit measures delivered to 204,122 low-income households statewide, spending an average of almost $329 per home in the most recently reported year.

In addition to increasing the level of utility investment in low-income sector housing, the revised 1986 regulations allowed the state's energy division to monitor utility conservation programs more closely and thus help coordinate utility-sponsored low-income programs with the Weatherization Assistance Program (WAP) administered by the Department of Community Affairs (DCA) to ensure the most cost-effective use of funds.

DCA's WAP program serves the same low-income population that utility programs target, except that WAP allows a greater expenditure per unit (up to $2,000 for architectural conservation measures) and provides for complete heating system replacement (no cost limit). Low-income residents can request services from both DCA and a utility. DCA adopted the HESP audit as the evaluation tool for WAP to solve some of the coordination problems in providing weatherization services to this population. Even greater coordination is necessary to eliminate duplicative or conflicting service delivery to this sector. (See Chapter 14.)

The use of the HESP audit tool to identify appropriate ECMs in all low-income weatherization programs suggests modifying the HESP report to generate a prioritized work order that DCA and utilities could use to coordinate low-income investment efforts and delineate which low-income program should fund each measure.

This report could also streamline program administration and ensure that energy conservation efforts in the state yield the maximum savings possible.

TABLE 15-5

New Jersey Utility Low-Interest/No-Interest Loan Program

Year[1]	Customers Assisted	Utility Primary Heating Customers	% Primary Heating Customers Audited	Total Loan Dollars Per Year	Average Loan Amount Per Customer
1983	36	1,185,304	0.0	$38,041	$1,001
1984	1,425	1,207,042	0.1	4,713,561	3,308
1985	2,419	1,205,928	0.2	6,897,703	2,851
1986	1,487	1,418,182	0.1	1,031,526	694
1987	373	1,170,876	0.0	653,163	1,751
1988	341	1,283,001	0.0	776,019	2,276
1989	554	1,629,017	0.0	1,286,231	9,606
1990	1,072	1,681,736	0.1	2,872,979	10,719
Total	7,707			$18,269,223	$4,026 [2]

Note: [1] Year refers to annual RCS reporting period April 1 to March 31.
[2] Average of annual amounts.

Source: BRC

Loans

The 1988/1989 Annual RCS Report estimates statewide energy savings of 6,017.2 MBtu enabled by 341 loans issued that year. As with HESP savings estimates, utilities used a variety of calculation methods to arrive at these savings figures. Table 15-5 summarizes historic program activity.

Historically the program has not attained the level of participation expected. The $50,000 income cap and 10-year payback proviso for program and project eligibility may contribute to the low level of program utilization. The revised 1986 regulations removed the upper income cap from loan eligibility criteria, thus increasing the pool of eligibles and extending low-interest loans to a segment with sufficient disposable income to carry a loan and invest in conservation.

Regulations state a payback period to ensure that the utilities, and ultimately the ratepayers, finance only cost-effective ECMs. While a project has one payback assigned based on total cost, the actual payback on subsidy funds—only a small portion of total project cost—is much more immediate. The state and utilities could reevaluate the 10-year payback cutoff for this program in the future.

Rebates

The long period of record heat in summer 1988 as well as three voltage reductions necessitated by hot spells in the summer of 1989 showed the limited ability of utilities to stem high electric demand in extraordinary circumstances. Peak demand climbed to levels not expected to occur for at least several years, possibly a decade.

TABLE 15-6

New Jersey Utility
Air Conditioner Rebate Program

Year[1]	# Customers Assisted	Utility Primary Heating Customers	% Primary Heating Customers Assisted	Rebate Dollars Granted Per Year
1983	17,043	1,185,304	1.4	2,209,986
1984	50,090	1,207,042	4.1	7,457,997
1985	43,130	1,205,928	3.5	5,170,073
1986	53,263	1,418,182	3.7	7,836,483
1987	73,031	1,170,876	6.2	9,574,630
1988	96,912	1,283,001	7.5	12,965,973
1989	81,848	1,629,017	5.0	12,421,299
1990	47,577	1,681,736	2.8	9,205,071
Total	461,894			$66,841,512

Note [1] Year refers to annual RCS reporting period April 1 to March 31.

Source: BRC

Energy-efficient appliance rebate programs can save energy and avoid sharp demand peaks in the residential sector. Rebate programs not only help a user to conserve energy but enable electric utilities to shave peak, improving their ability to deliver energy without interruptions. New Jersey's electric utilities are summer-peaking companies and must have sufficient capacity to meet their load at peak usage. Commonly used peaking units (*e.g.*, gas turbines) are a very costly way to produce electricity. Conservation programs that help alleviate the need for peaking units by cutting summer demand peaks benefit all ratepayers.

The replacement of low efficiency air conditioners with high efficiency units and the installation of high efficiency units in new construction reduces peak load and residential energy costs. Table 15-6 documents increasing participation in utility air conditioner rebate programs.

According to the BRC figures on annual operating costs of air conditioners, replacing a moderately inefficient unit having an energy efficiency rating (EER) of 7.0 with an identically sized unit rated at 10.5 EER can reduce seasonal cooling costs by one-third. Thus, a program that defrays the purchase cost of efficient air conditioners can significantly affect the electric demand in residential building stock.

TABLE 15-7

New Jersey Utility
CACS Program Performance

Year[1]	# Customers Assisted	# Eligible Customers	$ Per Year	$ Cost per Customer Assisted
1985	2,367	166,150	435,014	184
1986	3,343	172,150	1,063,709	318
1987	3,862	169,650	1,100,503	285
1988	5,085	167,217	1,693,680	333
1989	1,208	168,000	482,711	400
1990	1,243	168,000	633,514	510
Total	17,108		5,409,131	338[2]

Notes: [1] Average of annual amounts.
[2] Estimated.

Source: BRC

CACS

Table 15-7 documents a steady growth in the number of CACS audits delivered annually since 1984. CACS provides the technical expertise and information crucial to cost-effective commercial sector energy use and improvement decisions. The growing number of CACS participants each year demonstrates this sector's increasing awareness of energy costs and savings opportunities.

The 1988 revised CACS regulations expanded program eligibility to include agricultural and industrial process-dependent businesses, increasing the total program-eligible customer base. The state and utilities have also increased the number and scope of retrofit assistance programs. Commercial sector clients may be eligible for no-interest or low-interest loans, loan interest subsidies, rebates, or grants to implement retrofits identified through CACS.

One portion of the commercial sector resists penetration via current programs. USDOE estimates that small commercial enterprises account for 19 percent of all commercial square footage and 28 percent of commercial energy consumption nationwide.[10]

A Princeton study[11] identified factors that affect small business attitudes towards conservation. Lease-determined flat rate billing for energy use, routing of utility bills—where stores are individually metered—to off-site corporate offices, perceptions that equate conservation with diminished customer comfort or visual appeal in retail and service outlets, the perception of energy costs (typically 0.5 to 1.5 percent of gross sales) as minimal, and lack of control over energy equipment and retrofits in a lease situation all act as disincentives for conservation.

The study suggests that program sponsors revise programs and promotional materials to appeal to this group's concern for comfort and target decisionmakers who select equipment separately from those those who use it. Most retrofit actions coincide with major remodeling efforts or changes in tenants. The Princeton paper recommends that conservation program sponsors track public records of building permit applications and utility records of name or service changes on accounts to approach the contractor or building owner in the process of making equipment decisions.

The CACS program has served the commercial sector in New Jersey since 1984, and in that time the scope and quality of the audit has steadily improved. The availability of state-sponsored financial assistance programs for the commercial sector has also helped CACS attract more interest. The continued offering of CACS audits and financial incentives to retrofit will positively affect the commercial sector's ability to capture energy and cost savings.

Outlook

While HESP, CACS, and other programs are achieving positive effects, the September 1991 BRC adoption of conservation incentive rules will provide greater incentive to utilities to invest in energy efficient technologies for their customers. At present, the cost to utilities of conservation measures is expensed, *i.e.*, passed on directly to ratepayers. Therefore, the utilities are financially indifferent to providing such measures; the cost is passed through, but there is no return on the investment. In addition, to the extent that these programs successfully reduce energy usage, short run revenue erosion could result. The new rules provide utilities with a clear profit opportunity for measurable energy savings.

The rules allow the utilities to recover the cost of conservation investments in rate base, the assets on which utilities may earn a profit. In this way, they will earn a return on the investment made that result in measurable savings.

Utilities and private enterprises involved in the business of equipment design, financing, marketing, sales and installation could accelerate efficiency gains in New Jersey through coordination of their respective resources. Such a partnership would result in energy savings for the state and its energy users; enhanced business opportunities for private supply houses, installation contractors and service companies; and attractive investment opportunities for utilities.

It is anticipated that the incentive regulations will foster a significant increase in availability of programs for commercial and industrial customers. Significant efficiency opportunities exist to reduce energy use for lighting, HVAC systems, motor drives and other applications. (See Chapter 12 for details.) Such programs will result in significant reductions in utility system demands as well as meaningful cuts in the operating costs of businesses throughout the state.

Data presented in Chapter 11 suggest that New Jersey's residential sector consumption could be reduced by more than one-third by the year 2000 if all home appliances were replaced with the most efficient appliances available on the market today. The USDOE and the Federal Trade Commission have made some progress in educating and motivating consumers to invest in efficiency through the appliance labeling program that requires "EnergyGuide" labels on seven types of major appliances. However, small appliances escape rating under current regulations. To achieve the scale of savings described in Chapter 10 would necessitate full penetration of the large and small consumer appliance markets.

The slow process of educating consumers to consider efficiency and payback concepts in making appliance purchase decisions and the tremendous potential for savings cited in Chapter 10 behoove the state and utilities to take a lead role in promoting efficient appliance purchases. While consumers may not yet fully appreciate the cost and energy savings that high efficiency appliances can afford them, the state and utilities realize the savings potential and its impact on electric load.

To attempt to reduce residential electric consumption by one-third by the year 2000, New Jersey's utilities should replicate innovative programs now used in other states. For example, Massachusetts' Taunton Municipal Lighting Plant leases screw-in fluorescent bulbs that use 80 percent less electricity than standard incandescents while providing virtually the same illumination. Customers obtain bulbs that would cost up to $25 retail for only 20 cents per month through the lease agreement. The use of these bulbs reduces end user costs and utility load. This approach simplifies conservation for consumer and increases the likelihood that utility customers will embrace efficient technologies.

While current conservation programs do yield savings, innovative programs that ease the burden placed on consumers to identify and find the best available technologies merit serious study in New Jersey if the state is to reduce significantly residential energy consumption by the year 2000.

Findings

- By year-end 1990, more than 460,000 households had obtained basement-to-attic home energy surveys through the statewide Home Energy Savings Program cosponsored by the state and its seven public utilities.
- Approximately 2.4 million eligible households in the state have not yet obtained a HESP audit.
- The utilities currently lack uniform methods of calculating and reporting conservation program savings, preventing validated cost/benefit analyses.
- More than 204,000 low-income households obtained free weatherization services through utility direct investment programs between 1984 and 1990.
- More than 7,700 residents obtained no-interest or low-interest loans through utility programs to implement HESP-approved home energy improvements between 1983 and 1990.
- More than 460,000 residents obtained utility rebates for the purchase of high efficiency air conditioners between 1983 and 1990. Appliance rebate programs reduce residential energy costs and shave utility peaks.
- Approximately 17,000 commercial/industrial/non-profit entities have received comprehensive CACS energy audits through 1990.
- Current conservation initiatives may be ineffective in reaching the small buildings portion of the commercial sector where utility costs are either fixed or hidden in rental charges.

Policy

- Using least cost planning principles, the state and utilities should tap potential savings in the state's residential and commercial sectors to ensure the utilities' ability to meet customer demand in the most cost-effective way possible. The BRC is developing a mechanism to allow utilities to profit on their investments in conservation.
- The BRC should review and direct implementation of programs pursuant to the new conservation incentive rules it adopted in September 1991. Conservation initiatives that stem from the rulemaking will commit utility capital and other resources to energy efficiency through a partnership with private enterprises involved in equipment design, financing, marketing, sales and installation to accelerate efficiency gains in New Jersey. This partnership will result in energy savings for the state and its energy users; enhanced business opportunities for private supply houses, independent contractors and energy service companies (ESCOs); and attractive investment opportunities for utilities.
- The BRC and electric and natural gas utilities must regularly examine the costs and benefits of conservation programs.
- Utilities must carefully weigh the cost of saved energy capturable through conservation programs against the cost of capital expansion and fuel/power importation, and must promote efficiencies when such a policy benefits ratepayers.

Implementation

- To provide HESP audit participants with reliable information, all auditors must have access to and use utility billing data.
- The BRC and electric and natural gas utilities will use the NJCAT study as a tool to develop the next generation of conservation programs. All conservation programs must be reviewed periodically to determine the need for change, expansion or elimination; however, modifications to utility conservation plans must also consider the overall economic, environmental and social goals of the state.
- The State and utilities should integrate program delivery mechanisms to deliver cost-effective services.

NOTES

1. BPU Decision and Order, Docket #767-768, 5/12/77.
2. 10 C.F.R. § 465.101 *et seq.*, (1988).
3. N.J.A.C. 14A:21-1. HESP derives its continuing authority from N.J.S.A. 52:27F as amended by P.L. 1987, c. 365.
4. BPU Decision and Order, Docket #8012-914C, 4/1/82.
5. P.L. 1977, c. 146:1, effective 7/11/77.
6. Maureen A. Quaid and Roger A. Faber, *Preliminary Evaluation of Coordinated Energy Services - A Comprehensive Low Income Conservation Program*, a joint research project of Minnegasco and the Minneapolis Energy Office, August 1988.
7. USDOE Residential and Commercial Conservation Branch, Office of State and Local Programs, *Residential Conservation Service Annual Report Guidance*, Washington, D.C., 1988.
8. DOE-contracted study of HESP Survey Evaluation Forms, 1986.
9. PSE&G-sponsored focus groups facilitated by Response Analysis, Inc. 1/19 and 20/88.
10. Paul S. Komer, Ph.D. and Richard Katzev, Ph.D., *Policies for Encouraging Energy Conservation in Small Commercial Buildings*, paper presented at the "Energy Options for the Year 2000" conference, September 1988.
11. *Ibid.*