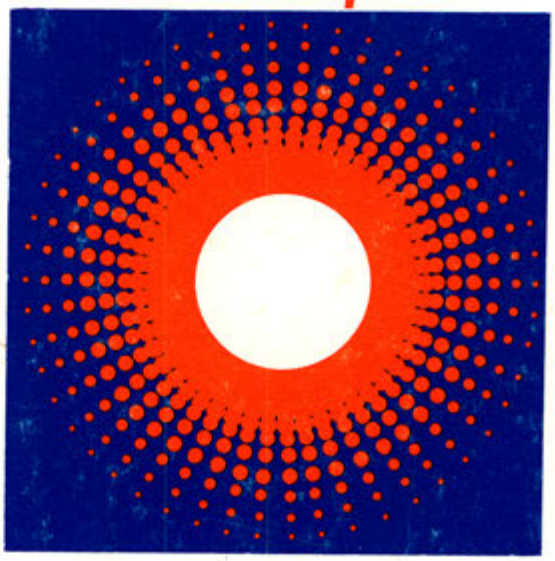
NEW YORK STATE ENERGY MASTER PLAN

and Long-Range Electric and Gas Report



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FINAL REPORT MARCH 1980

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Acknowledgements

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The Draft State Energy Master Plan and Long-Range Electric and Gas Report was produced by the State Energy Office's Division of Policy Analysis and Planning. Other Energy Office units also provided assistance to the Division in preparing the Plan and Report. The staff of the New York State Energy Research and Development Authority provided additional assistance and are the principal authors of Section V-H. The staff of other state agencies, including the Department of Transportation, the Public Service Commission, the Department of Environmental Conservation, the Department of Commerce, the Department of Social Services and the Office for the Aging also were of great assistance.

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2. Consultants

Several important energy areas were studied by consultants to the Office. Key works included:
Analysis of NYS Coal Supply, Demand and Price: 1979-1994; ICF, Incorporated, Washington, D.C.
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Estimates of the Costs of Renewable Energy Technologies for NYS, Urban Systems Research and Engineering, Inc., May 1979
The Economics of Solar Hot Water Systems in NYS, Polytechnic Institute of NY.
An Assessment of Hydropower Restoration Expansion in NYS, Vol. 1, R.S. Brown, and A.S. Goodman, Polytechnic Institute of NY, Prepared for NYSERDA, August 1978.
Survey of Cogeneration Potential of Selected NYS Industries, Acres American, Inc. June 1979.
Wood Energy Survey, 1979, Cooperative Extension, Agricultural Engineering Department, Cornell University.
The Impact of Present and Future Utility Rates on Non-Utility Generators in NYS, Robert L. Elgin, Cambridge, Massachusetts.
The Impact of Rising Energy Costs on the Elderly Poor in NYS, Welfare Research Inc., Albany, NY, January 1978.
Energy Conservation in Multi-Family Housing: A Framework for Policy for NYS, Rutgers University, Center for Urban Policy Research.
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Review of NYS Economic and Demographic Activity With a National and Regional Context, Roy Bahl, Director, Metropolitan Studies Program, Syracuse University.

3. Task Forces

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4. Funding Awards for Draft State Energy Master Plan

1. The Sierra Club, Atlantic Chapter; Environmental Planning Lobby; Safe Energy Coalition of New York State; Mid-Hudson Nuclear Opponents; Oswego County Farm Bureau; Scenic Hudson Preservation Conference; Friends of the Earth; Labor Action Coalition of New York; Center for the Hudson River Valley; Public Utility Law Project; Hudson River Sloop Clearwater; Suffolk for Safe Energy Inc.; Long Island Farm Bureau; and Citizens for Safe Energy.
2. The New York State Association of Counties; the New York State Association of Towns; and the New York State Conference of Mayors.
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4. The New York State Municipal Electric Utilities Association.
5. The Jewish Labor Committee.
6. The Northeast Section of the American Nuclear Society,
7. The St. Lawrence Planning Board.
8. The Lakeshore Alliance.
9. Consumer Action Now; the Energy Task Force; the League of Women Voters; and the New York State Alliance to Save Energy.
10. The Cayuga Lake Conservation Association.
11. The New York Public Interest Research Group Inc.; the New York Statewide Senior Action Council Inc.; the Economic Opportunity Council of Saratoga County; the Community Action Planning Council of Jefferson County; the Fillmore-Leroy Area Residents Inc,; and the Schenectady Community Action Program Inc.
12. The New York State Building and Construction Trade Council—AFL/CIO.

5. Energy Planning Process and Proceedings to Date

The 1979-1980 State energy master planning and long-range electric and gas system planning proceedings commenced on January 12, 1979, with the issuance by the State Energy Office of a public notice in accordance with the planning regulations (9 NYCRR 7845.1). The public notice provided a brief description of the planning process and invited applications for funding of interested persons (Energy Law, Section 5-114; Part 7842 of the planning regulations) and for party status (Energy Law, Sections 5-110 and 5-112; Part 7846 of the planning regulations).

Under the planning regulations, any interested person except a major energy supplier or Federal or State agency was eligible to apply for a portion of a $200,000 fund established by Section 5-114 of the Energy Law, to defray fees of experts retained to participate in the energy planning hearings. (On May 4, 1979 the Board issued an Order allocating $190,000 to 12 grantees).

On April 1, 1979, the member systems of the New York Power Pool (NYPP), the New York Gas Group (NYGG), and other major energy suppliers submitted their long-range plans to the Energy Office, in accordance with Energy Law Sections 5-110 and 5-112 and the regulations issued thereunder. This marked the first time in the State that major petroleum suppliers and major coal suppliers were required to submit to the State data and information including their long-range plans for consideration in the development of a comprehensive long-range energy plan. Thereafter, public hearings were held on six days in May to receive unsworn public statements on the suppliers' plans and in connection with the development of the Draft Plan and Report. Written comments were also received for a period of 30 days after the conclusion of the hearings.

On August 7, 1979, the State Energy Office issued, pursuant to Energy Law Sections 5-110 and 5-112, a document which consisted of both the Draft Plan and Report. Following its receipt, the Board designated Sol Schreiber, Esq., as Hearing Office to conduct hearings on the Draft Plan and Report. The Board also published notice of submission of the Draft Plan and Report and public hearings thereon, in accordance with the planning regulations (9 NYCRR 7854.1).

The planning regulations called for two series of hearings to be conducted by the Board with respect to the Draft Plan and Report. At the first series of hearings, interested persons and public officials were afforded an opportunity to offer unsworn statements on the Draft Plan and Report. These hearings were held in New York City on September 6, 1979; Syracuse on September 10, 1979; Buffalo on September 11, 1979; and Mineola on September 20, 1979. A total of 193 people spoke or submitted testimony at these four public hearings or during the 30-day comment period following the hearings.

At the second series of hearings, all interested persons and organizations who had requested to be made a party to the planning proceeding were afforded an opportunity to sponsor witnesses and to question witnesses sponsored by others, including the Energy Office staff. Of the scores of persons and organizations which requested and received party status to these hearings, 24 parties actively participated by sponsoring witnesses and questioning the witnesses of other parties. A list of participants is contained in this Appendix.

Prehearing conferences were conducted by the Hearing Officer on August 29 and September 28, 1979 in Albany to identify those matters on which testimony would be submitted and to elicit the names of expert witnesses who would sponsor that testimony, and to formulate procedures to assure that the hearings proceeded in an orderly and efficient manner.

Direct testimony of 92 witnesses was prefiled on September 5, 1979 and rebuttal testimony of 43 witnesses was

prefiled on September 21, 1979. On October 2, 1979, the Hearing Officer submitted to the Board recommended hearing procedures, together with an identification of the matters on which the questioning of witnesses should be permitted, a schedule of witnesses to be questioned, the sequence for questioning witnesses, and an allocation of time permitted the parties to question witnesses.

On October 4, 1979, the Board met in Albany and approved the recommended procedures and schedule proposed by the Hearing Officer. The Board also directed that transcripts of the proceedings be filed in Albany, Syracuse, Rochester, Buffalo, New York City and Mineola to assist the parties in preparing their briefs.

The second series of hearings were held in Albany for 11 hearing days between October 19 and November 9, 1979. During these hearings, 32 parties submitted initial briefs to the Board on November 26, 1979. At the request of the Hearing Officer, the Board permitted the parties to submit reply briefs by December 5, 1979. Twenty parties submitted reply briefs to the Board, receipt of which marked the conclusion of the second series of hearings.

SEQR

In accordance with the State Environmental Quality Review Act ("SEQRA"; Article 8 of the Environmental Conservation Law) and regulations issued thereunder, the Energy Office issued a Notice of Determination of Significance on May 31, 1979, in connection with the preparation of the Draft Plan and Report, This notice indicated the intention of the Energy Office to prepare a Draft Environmental Impact Statement (DEIS). A copy of this Notice was published in the Environmental Notice Bulletin on June 6, 1979.

On August 7, 1979, the Energy Office issued the DEIS as Appendix F to the Draft Plan and Report and filed a copy with the Commissioner of the Department of Environmental Conservation. On August 7, 1979, the Energy Office also sent a Notice of Hearing and Completion of the DEIS to the Department for publication in the Environmental Notice Bulletin.

On August 10, 17 and 24, Notices of Hearing and Completion of the DEIS were published in newspapers of general circulation in Albany, New York City, Buffalo and Syracuse. An additional notice was published in Newsday on September 10. These notices stated that public hearings would be held in New York City on September 6, Syracuse on September 10, Buffalo on September 11, and Mineola on September 20, to allow interested persons an opportunity to comment on the DEIS, in addition to the Draft Plan and Report.

On September 10, copies of the DEIS were mailed to each of the nine regional offices of the Department of Environmental Conservation. Also, on September 10, the Notice of Completion of the DEIS was sent to the State Clearinghouse and the twelve regional clearinghouses designated under the Federal Office of Management and Budget circular No. A-95.

In addition to statements made at the four public hearings, submission of written comments was permitted for a period of 30 days following the hearings. Following receipt and review of these comments, the Board prepared a Final Environmental Impact Statement which was issued on (date to be determined). Copies of the final statement were filed on that date with the Commissioner of Environmental Conservation and in each of its nine regional offices, in accordance with SEQRA. In addition, Notice of Completion of the Final EIS was sent on (date to be determined) to the Department of Environmental Conservation for publication in the Environmental Notice Bulletin.

APPENDIX B

Summary of the Plans of Major Energy Suppliers

1. INTRODUCTION

Section 5-110 of the Energy Law requires that the Energy Office prepare a draft State Energy Master Plan including, among other things, a summary of the plans of the State's major energy suppliers for meeting forecasted energy requirements, as well as descriptions of new energy sources. Pursuant to this requirement, the Office adopted regulations (9 NYCRR, Parts 7840-7866) in early January, 1979 which defined and required registration of major natural gas, petroleum, electric and coal suppliers and required submission of comprehensive plans for meeting forecasted demand by April 1979. This Appendix summarizes the plans which were received by the Office in compliance with those regulations.

2. MAJOR NATURAL GAS SUPPLIERS

A. Background

The 1979 New York Gas Report was submitted in response to the requirements of 9 NYCRR, part 7862—Natural Gas Plans, by the New York Gas Group (NYGAS)[1]. A summary of the supply projections and plans of these major natural gas suppliers to meet forecasted demand follows.

B. Gas Supply Demand Balance

On a statewide basis, gas supplies were projected to exceed demand throughout the forecast period except for a small deficiency (less than 1 percent of requirements) in the final forecast year, as shown in Figure B-1.

Thus, all projected firm, terminable and interruptible demand was projected to be satisfied throughout the planning period, with the exception of the final forecast year which could require curtailment of interruptible and/or terminable loads, but not firm requirements. On both a winter season basis and a peak day basis, a surplus of gas was projected to exist throughout the planning period.

A summary of supply/demand projections on an individual company basis is presented in Figure B-2.

C. Gas Supply Sources

1) Interstate Suppliers—In projecting gas supplies via the major pipelines, NYGAS member companies included little gas from sources other than "lower 48" production. One exception was the inclusion of PEMEX (The Mexican Government Oil Company) gas by six New York distribution companies.

FIGURE B-1

STATEWIDE TOTALS
MMDT*

(Sendout Year, Nov. 1 - Oct. 31)

	79-79	79-80	83-84	88-89	93-94
Total Demand	613	611	628	644	668
Net Gas Supply	631	655	649	649	662
Surplus or Deficiency	18	44	21	5	-6
Deficiency Allocation					
Total Underground Storage Injection	2				
Retail Interruptible Customers	4	0.4	3	6	8
Terminable Customers	1	1	.3		1
Surplus Allocation					
Peak Shaving Not Utilized	0.4	0.4	.4	.4	.4
Available New Sales	22	40	21	10	2
Unused Gas	3	4	3	1	

* Numbers do not add due to rounding

2) Indigenous Resources—Production from onshore areas within the State was forecast (by NYGAS) to decline by about 14 percent over the planning period. Production from the New York portion of Lake Erie was estimated to commence in 1985 at a level of 2.8 MMDT and increase steadily to 4.0 MMDT in 1994. NYGAS indicated that drilling activities in the North Atlantic Outer Continental Shelf have been disappointing, and therefore, the production potential from this source could not be evaluated at the time of submission. NYGAS also indicated that methane produced from biomass is not projected to be a significant source of gas in this planning period.

3) Supplemental Supplies—No additional LNG, SNG or Propane-Air facilities were planned by NYGAS member companies during the planning period. The Brooklyn Union Gas Company (BUG), has contracted with Distrigas Corporation for 13.6 MMDT/yr. of gas[2], the source of which is Algerian LNG, which would flow via displacement from Everett, Massachusetts. BUG has also contracted to purchase small quantities of methane produced from a sanitary landfill on Staten Island.

D. Gas Demands

Total demand for natural gas in New York State was projected by NYGAS to grow by a total of 9.1 percent over the planning period (a compound average rate of 0.61 percent/year). The largest percentage growth was projected for the industrial sector followed by the commercial and residential sectors. Non-space heating residential sales were forecast to decline 18.1 percent over the planning period, the only firm demand for which negative growth was projected. The portions of total demand represented by firm terminable and interruptible classes were projected to remain relatively constant. However, the percentage of total demand represented by each sectoral demand was forecasted to

[1]The New York Gas Group is a trade association comprising 14 of the State's 21 natural gas distribution companies and accounting for 99% of the natural gas delivered within the State. Member companies are: The Brooklyn Union Gas Company, Central Hudson Gas & Electric Corporation, Columbia Gas of N.Y., Inc., Consolidated Edison Company of N.Y., Inc., Corning Natural Gas Corporation, Long Island Lighting Company, National Fuel Gas Distribution Corporation, New York State Electric and Gas Corporation, Niagara Mohawk Power Corporation, Orange and Rockland Utilities, Inc., Syracuse Suburban Gas Company, Inc., Rochester Gas and Electric Co., Inc., St. Lawrence Gas Co., and The Pavilion Natural Gas Co.

[2]Subject to FERC approval.

FIGURE B-2
SUMMARY OF NYGAS SUPPLY AND DEMAND PROJECTIONS
MDT
(SENDOUT YEAR, NOV. 1-OCT. 31)

Company		1978-79	1979-80	1983-84	1988-89	1993-94	Percent Change 1978-79 to 1993-94
Brooklyn Union Gas Company	Supply	99309	106937	106862	106956	113383	14.2
	Demand	101437	97492	102016	107978	116319	14.67
	Surplus/Deficiency	-2128[4]	9445[1]	4846[1]	-1022[2]	-2936[2]	---
Central Hudson Gas & Electric	Supply	7986	8212	9753	9224	8742	9.5
	Demand	9026	9275	9382	9512	9642	6.8
	Surplus/Deficiency	-1040[2]	-1063[2]	371[3]	-288[2]	-900[2]	---
Columbia Gas of New York	Supply	21483	23675	23315	22570	22758	5.9
	Demand	18957	19434	20558	21698	22758	20.0
	Surplus/Deficiency	2526[3]	4241[3]	2757[3]	872[3]	0	---
Consolidated Edison Co. of New York	Supply	88664	94252	93718	88216	87092	-1.8
	Demand	84557	86032	89560	90188	90188	6.7
	Surplus/Deficiency	4107[1]	8220[1]	4158[1]	-1972[2]	-3096[2]	---
Corning Natural Gas Corp.	Supply	6192	6200	6100	5935	5805	-6.2
	Demand	5541	5548	5584	5631	5678	2.5
	Surplus/Deficiency	651[1]	652[1]	516[1]	304[1]	127[1]	---
Long Island Lighting Co.	Supply	45361	50676	48002	47863	47863	5.5
	Demand	47934	48842	51209	50914	49908	4.1
	Surplus/Deficiency	-2573[2]	1834[1]	-3207[2]	-3051[2]	-2045[2]	---
National Fuel Gas Distribution Corp.	Supply	144569	144542	131430	131904	130600	-9.7
	Demand	127143	125368	122380	123263	128454	1.0
	Surplus/Deficiency	17426[1]	19174[1]	9050[1]	8641[1]	2146[1]	---
New York State Electric & Gas Corp.	Supply	40723	40653	41177	41989	42002	3.1
	Demand	41095	41007	41177	41989	42002	2.2
	Surplus/Deficiency	-372[2]	-354[2]	---	---	---	---
Niagara Mohawk Power Corp.	Supply	92388	91525	91660	91717	93867	1.6
	Demand	92388	91525	91660	91717	93867	1.6
	Surplus/Deficiency	---	---	---	---	---	---
Orange and Rockland Utilities Inc.	Supply	24428	26148	28865	28350	29173	19.4
	Demand	24732	25012	26132	27532	28932	16.9
	Surplus/Deficiency	-304[2]	1136[1]	2733[1]	818[1]	241[1]	---
Pavilion Natural Gas Company	Supply	2787	2810	2942	3108	3280	17.7
	Demand	2787	2810	2942	3108	3280	17.7
	Surplus/Deficiency	---	---	---	---	---	---
Rochester Gas & Electric Co.	Supply	47013	47979	50963	55356	60479	28.6
	Demand	47013	47979	50963	55356	60479	28.6
	Surplus/Deficiency	---	---	---	---	---	---
St. Lawrence Gas Co.	Supply	6565	7275	9500	10600	11650	77.5
	Demand	6565	7275	9500	10600	11650	77.5
	Surplus/Deficiency	---	---	---	---	---	---
Syracuse Surburban Gas Co.	Supply	3760	3890	4523	4880	5030	33.8
	Demand	3760	3890	4523	4880	5030	33.8
	Surplus/Deficiency	---	---	---	---	---	---

Disposition of Surplus or Deficiency
[1]Allocated to new sales.
[2]Curtailment of interruptible customers.
[3]Unused gas—refused supply from pipeline.
[4]Volumes withdrawn from underground storage.

change, with industrial and commercial demands capturing a greater portion of total demand.

E. Research Development and Demonstration

Detailed information regarding the long-range research, development and demonstration (RD&D) plans of NYGAS member companies was submitted as Volume 2 of the 1979 New York Gas Report.

Gas related RD&D is performed and sponsored by the Department of Energy (DOE), the Gas Research Institute (GRI), and the New York State Energy Research and Development Authority (NYSERDA). NYGAS member companies contribute to both GRI and NYSERDA and participate in the gas-related projects of these organizations. Additionally, individual member companies sponsor internal R&D programs. Figure B-3 is a summary of the estimated RD&D expenditures by NYGAS companies for 1979 through 1983.

FIGURE B-3

RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAM PLAN EXPENDITURES, 1978-1983
SUMMARY OF ALL NYGAS OPERATIONS

	Actual		Estimated									
	1978		1979		1980		1981		1982		1983	
	$000	%	$000	%	$000	%	000	%	$000	%	$000	%
1. Total company expenditures for internal and contractor programs	1,475.0	23	2,272.8	30	3,056.6	32	3,579.4	33	4,181.8	33	4,692.6	33
2. Company contributions to gas industry RD&D programs												
a. Gas Research Institute	743.1		2,328.0		3,176.8		4,071.3		5,081.4		5,973.9	
b. New York State Division of the Budget—NYSERDA	3,288.2		2,915.7		3,246.9		3,327.4		3,398.1		3,484.3	
c. Other programs expenditures	1,039.0		130.4		29.4		29.4		29.4		29.4	
Total industry group	5,070.3	77	5,374.1	70	6,453.1	68	7,428.1	67	8,508.9	67	9,487.6	67
3. Total RD&D expenditures	6,545.3	100	7,646.9	100	9,509.7	100	11,007.5	100	12,690.7	100	14,180.2	100

The GRI was created as the national gaseous fuels R&D organization. Funding is provided via a surcharge on interstate gas sales as well as cofunding through DOE and independent sources. The major portion of GRI's funds are allocated to gas supply projects. Budgeted funding for 1979 is divided among six program areas as follows (cofunding levels included):

GRI 1979 BUDGET WITH COFUNDING

	GRI		Government		Industrial	
Program Area	$1000	% of GRI	$1000	% of Govt	$1000	% of Ind.
Supply	20,228	50.6	45,339	70	2,395	48
Economics/Systems Analysis	2,100	5.3	750	1.2	—	—
Operations-Distribution	1,725	4.3	2,000	3	—	—
Conservation	9,805	24.5	15,720	24.2	2,595	52
Basic Research	4,100	5.0	—	—	—	—
Planning & Administration	2,000	10.3	1,200	1.8	—	—

The goals of GRI as reflected in funding for these program areas represent the efforts of many individual companies throughout the country. By contrast the 1979 internal RD&D budget of NYGAS member companies is divided among five program areas as follows:

NYGAS COMPANIES 1979 INTERNAL R&D BUDGET

	$1,000	% of Total
Supply	164	7.2
Operations/Distribution	1145	50.4
Conservation/Utilization	525.3	23.1
Environmental/Safety	54.1	2.4
Other	384.6	16.9

F. Pipeline System Expansion Plans

No plans were indicated to modify or expand the intrastate natural gas transfer capability of NYGAS member companies.

3. MAJOR PETROLEUM SUPPLIERS

A. Background

Major petroleum suppliers were required to submit plans conforming with Parts 7863 and 7865 of the State Energy Master Planning Regulations.

Thirty-eight companies were sent the Regulations and requested to respond. Thirty-four companies responded by registering as major suppliers to New York State. Of the 34 companies, 30 submitted data. These companies include: Allied Chemical, Agway, Amerada Hess, Atlantic Richfield Co., Standard Oil (Indiana), Ashland, Scallop, Castle Coal & Oil, Chevron, Cibro, Cities Service, Conservative Gas Division of National Propane Corporation, Consolidated Gas, Crown Central, Exxon, Gulf, Mobil, New England, Northern Propane, Northville Industries, Pargas, United Refining, Pyrofax, Royal, Shell, Suburban Propane, Sun, Texaco, Getty and Standard Oil (California).

Four companies (Union Oil, Pennzoil, Columbia Hydrocarbon, and Central Petroleum) requested and received exemptions from the reporting requirements because they did not fully meet the definition of "major petroleum suppliers."

In addition, on February 23, 1979, Commissioner Larocca issued an order directing that a broad investigation of the oil industry be conducted. The information obtained in compliance with the compulsory process used in that investigation assisted SEO in the development of the Master Plan. The companies examined were: Exxon, Texaco, Shell, Mobil, Gulf, and Metropolitan Petroleum.

Major petroleum suppliers generally indicated in their submissions that no specific plans were made for New York's needs. Rather, companies consider their operations on a larger regional level, such as New England, the Northeast, East Coast, or PAD district. Thus, depending on the individual company, the applicability of the reports vary. The petroleum suppliers also indicated that, in general, regional level plans are not prepared on a fifteen year basis. Long term planning was reported by the major petroleum suppliers as being done on a U.S. or worldwide basis.

B. Price

The oil company crude price forecasts were limited and qualified. Most companies hesitated to project prices because the domestic and world political situations are fluctuating too rapidly to foresee. Also, the forecasts that were submitted were made prior to the June 26, 1979 OPEC meeting and the announcement by President Carter of phased crude decontrol. The submissions, generally, did not address future petroleum product prices.

1) Domestic

In almost all cases, the oil companies followed DOE leads on price projections and adopted the underlying assumption that price controls would be continued in some form through 1985. In this scenario, the companies said upper tier prices would equal landed cost of Arabian light crude in the U.S. plus additional costs attributed to quality and location. Lower tier prices, however, would remain suppressed and were only anticipated to reach allowed levels.

2) Foreign

The oil companies contend that future oil prices will reflect general inflation rates, the growing availability of foreign non-OPEC supplies and a decreasing demand for oil. The companies also project a rise in real OPEC prices. Inflation rates used by the companies ranged between 5, 6, and 7 percent/yr over the forecast period. Companies that failed to identify actual dollar amounts projected that future price increases could rise as much as 1-6 percent annually above inflation rates.

MAJOR PETROLEUM SUPPLIERS' PROJECTIONS OF CRUDE OIL PRICES AND INFLATION 1980, 1985 (CURRENT DOLLARS)

	1980	1985
Foreign	13-26	23-28
light crude	25-26	—
heavy crude	13-17	—
Domestic	12-16	13-26
Annual Average Inflation (percent)	5- 7	5- 7

C. Exploration and Production

The fully integrated multinational and large independent companies supplying New York all indicated they have accelerated efforts in oil exploration, development and production both abroad and within the U.S. These efforts are expected to expand even further throughout the planning period. Overseas, much expansion is planned or occurring in the lesser developed countries. Domestically, most efforts are occurring in the West, Alaska, and the Gulf Coast. The exploration on both fronts is located onshore and offshore. The companies project, however, that in the late 1980's fewer opportunities will remain to expand oil production from known reserves in OPEC and other areas. Simultaneously, the companies say that although a plateau in production may be reached in the 1990's, OPEC oil will still supply the largest portion of world demand.

D. Transportation and Marketing

Most companies submitting data indicated that they will continue to supply petroleum products to New York. However, they projected changes in the manner of distribution and the types of products and services available.

Projections generally indicated a shift, at the retail level, away from direct company-operated outlets to branded distributors. On the part of large, integrated companies, a trend is projected toward fewer stations pumping higher volumes. In summary, the plans indicated that the gasoline supply surplus of 1977 allowed independent dealers the opportunity to expand their operations since suppliers were plentiful. Many of these expansions were in urban areas with concentrated populations. The independents were successful in cutting into the market shares and, in some cases, profits of the large integrated companies. As this happened, major company direct operated stations suffered earnings losses. The profits previously used to offset losses or low profit levels in more rural areas were lost. This in turn made all operations less profitable. If this trend continues,major companies project that they may be forced to withdraw

from entire marketing areas, which could leave rural areas with fewer available retail outlets. However, products are projected to remain available for redistribution. Another area where major companies have indicated consideration of withdrawal is in the home heating oil area, with projections indicating that this market would likely be taken over by resellers.

Propane companies forecast an increase in growth in the propane market. This is projected to occur as the chemical market sector grows slowly through 1985 due to improved economics for petro-chemical light hydrocarbon feedstocks. Also, propane is projected to be more widely used as a motor fuel as fleet vehicle conversions increase.

Many companies predict a loss in the amount of available gasoline as the direct result of the Federal Government lead phase-down program, since there is less yield from a barrel of crude oil when refining unleaded motor fuel.

Major companies, in general, indicate little change in present refinery capacity. Adjustments projected to occur will be in response to regulations implementing the Clean Air Act Amendments of 1977 requiring tighter emission controls to meet air quality standards and to prevent deterioration in attainment areas.

Some companies also projected, with regard to direct operations, a change in transportation of product. Many companies own fleets of trucks to carry products to retail outlets. Since independent truckers are hauling at lower rates than the companies, some have begun phasing out their own fleets.

An increase was projected in-storage capacity in New York and a change in the location of those facilities. This will enable companies to store larger amounts of product nearer to the market. In addition, a greater amount of intercompany exchange of products is projected in order to lessen or avoid transportation charges.

E. Demand and Interfuel Substitution

Most companies project growing energy demands until the turn of the century. However, demand is projected to grow at less than historical rates. Overall projected total U.S. energy demand will grow at between 2-4 percent per year. Oil, as a scarce fuel, is projected to be allocated to a greater extent to meet transportation and petrochemical needs.

Significant conservation is projected to affect all sectors. The industrial sector will continue to eliminate heat losses and employ new operating techniques and more efficient equipment. In the transportation sector, automobiles are projected to achieve the mandated 1985 new car standards. Motor gasoline consumption by the mid-1980's is projected to be below the current level, despite an increase in fleet size of about 25 percent. In the residential and commercial sectors, higher prices and various government initiatives are projected to bring about more efficient appliances, improved insulation and optimization of space heating and water temperatures.

Many companies indicated that an increasing share of growing energy demands will be met in the near term by use of other fuels. The companies forecast that the bulk of the demand will be met through expanded use of coal, due to the present nuclear moratorium. However, it is also estimated that coal will not be able to meet longer term needs and nuclear will expand its market share. Some companies project that synthetic oils could yield approximately 2 MMB/D by 1990. Heavy oil will be developed first followed by either coal liquefaction or shale oil. Projections were unsure which would preceed the other.

The companies forecast a decline of 1-3 percent of domestic oil production. However, there is no direct mention of enhanced recovery programs in the plans.

F. Summary

Overall, the suppliers' submissions provided substantial historic information that was particularly useful in explaining the past and present distribution systems both in and around the State. The information also provided a detailed description of New York's sources of supply. The discussions of synthetic fuels, particularly projected timeframes for commercialization and anticipated yields were all reflected in the U.S. petroleum forecast.

However, the companies' submissions on future plans for supplying New York were very weak. Although, most companies stated they planned to continue providing New Yorkers with oil, the submissions lacked detail on how this would occur and whether distribution changes are necessary.

Projections on future world supply sources were vague and failed to address lesser developed country production. Also, there was a limited attempt to project specific crude prices and almost no attempt to estimate product prices.

4. MAJOR ELECTRIC SUPPLIERS

A. Background

On April 1, 1979, the members of the New York Power Pool (NYPP) submitted their long-range demand forecasts, supply plans, and research and development plans to the State Energy Office pursuant to Parts 7849 and 7861 of the Regulations.

The member companies of the New York Power Pool are Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., Long Island Lighting Company, New York State Electric and Gas Corporation, Niagara Mohawk Power Corporation, Orange & Rockland Utilities, Inc., The Power Authority of the State of New York, and Rochester Gas and Electric Corporation.

B. Electricity Demand and Energy Requirements

Forecasts of winter and summer peak demand, by company, as contained in the Power Pool Plan are shown in Figures B-4 and B-5, respectively. Figure B-6 shows company forecasts of energy requirements for member systems of the Power Pool. The Power Pool set forth two supply plans, one being a reliability plan and the other an energy strategy plan. The reliability plan focuses on achieving the reliability criteria established by the Pool based on analyses of the capabilities of the State electric systems, interconnections with neighboring systems, and emergency operating procedures. The reliability criteria equates to a pool-wide 22% reserve margin, which translates to an 18% reserve margin for each member system due to diversity in peak load occurrence among member systems.

The Pool's energy strategy plan involves the acceleration of schedules for planned non-petroleum generation capacity in order to permit a greater reduction in oil consumption than would be achieved with reliability criteria. The plan focuses on the acceleration of nuclear and coal unit additions.

Figure B-7 illustrates the Power Pool's generating capacity expansion plan. Figure B-8 illustrates the impact of the implementation of the Power Pool's energy strategy plan upon generation mix and total electric energy requirements. Figure B-9 provides a summary of proposed additions to the State's bulk power transmission system.

FIGURE B-4

WINTER: INDIVIDUAL SYSTEM PEAKS FOR MAJOR LOAD AND/OR FRANCHISE AREA(S) AT TIME OF SYSTEM PEAKS (IN MEGAWATTS)

Year	Cent Hud	Con Ed	LILCO	NYSEG	Niagara Mohawk			O & R	PASNY	RG&E
					West	Central	East			
Actual										
1978	623	4901	2456	2138	2205	1759	1536	515	2500	941
Forecast										
1979	650	4850	2550	2240	2230	1770	1550	545	2657	990
1980	670	4870	2630	2320	2240	1810	1590	560	2706	1030
1981	710	4915	2710	2410	2290	1870	1650	580	2811	1070
1982	735	4960	2800	2520	2350	1910	1710	600	3028	1120
1983	765	5025	2890	2640	2400	1970	1760	615	3113	1160
1984	790	5090	2980	2770	2450	2030	1820	630	3190	1180
1985	820	5175	3070	2890	2500	2090	1880	650	3279	1230
1986	850	5260	3160	3010	2540	2140	1940	670	3357	1270
1987	880	5345	3260	3130	2590	2200	2000	690	3463	1300
1988	915	5430	3330	3260	2640	2260	2050	715	3545	1350
1989	940	5515	3430	3410	2680	2310	2110	740	3775	1410
1990	980	5605	3540	3560	2720	2380	2170	760	3857	1440
1991	1015	5695	3650	3730	2760	2430	2230	780	3949	1490
1992	1050	5785	3760	3910	2810	2490	2280	800	4021	1550
1993	1080	5900	3880	4100	2850	2550	2340	820	4097	1600
1994	1115	6015	4000	4300	2900	2600	2400	840	4180	1660

FIGURE B-5

SUMMER: INDIVIDUAL SYSTEM PEAKS FOR MAJOR LOAD AND/OR FRANCHISE AREA(S) AT TIME OF SYSTEM PEAKS (IN MEGAWATTS)

Year	Cent Hud	Con Ed	LILCO	NYSEG	Niagara Mohawk			O & R	PASNY	RG&E
					West	Central	East			
Actual										
1978	614	6714	2997	1729	2027	1503	1472	662	2348	983
Forecast										
1979	670	6950	3130	1790	2050	1610	1400	720	2403	1030
1980	700	6985	3230	1850	2060	1640	1430	735	2447	1030
1981	720	7045	3330	1920	2120	1680	1480	760	2535	1090
1982	750	7125	3440	2010	2160	1720	1530	785	2663	1130
1983	774	7230	3550	2110	2200	1770	1580	800	2899	1170
1984	805	7360	3660	2210	2240	1820	1630	820	2969	1200
1985	830	7515	3780	2300	2290	1870	1680	835	3064	1240
1986	860	7640	3850	2400	2330	1920	1730	865	3134	1280
1987	890	7765	3930	2500	2370	1970	1790	885	3240	1320
1988	920	7890	3980	2610	2410	2020	1840	920	3309	1370
1989	950	7990	4060	2720	2450	2070	1900	950	3502	1420
1990	980	8115	4140	2840	2490	2130	1950	985	3567	1460
1991	1015	8270	4220	2980	2530	2180	2010	1010	3640	1510
1992	1050	8400	4300	3120	2580	2230	2070	1035	3705	1570
1993	1080	8555	4390	3280	2620	2290	2120	1060	3768	1620
1994	1115	8715	4480	3450	2670	2330	2190	1090	3851	1680

FIGURE B-6

ANNUAL ENERGY REQUIREMENTS
(MILLIONS OF KILOWATT HOURS)

FORECAST

Year	Central Hudson	Con-Edison	LILCO	NYSE&G	Niagara Mohawk	Orange & Rockland	PASNY	RG&E	Total NYS (1) (2)
1970	3629	29800	13985	12000	32925	3225	16236	5763	118091
1980	3723	29900	14345	12400	33248	3300	16521	5924	119913
1981	3874	30150	14715	12900	34266	3375	16922	6102	122881
1982	4007	30600	15230	13500	35022	3470	17774	6312	126413
1983	4147	31125	15748	14100	35892	3570	18901	6504	129987
1984	4289	31925	16260	14800	36769	3670	19349	6706	133768
1985	4435	32700	16690	15400	37658	3775	19807	6915	137380
1986	4589	33325	17170	16100	38514	3895	20266	7142	141001
1987	4744	34075	17640	16800	39408	4015	20766	7378	144826
1988	4904	34950	18050	17600	40283	4140	21279	7632	148838
1989	5066	35600	18510	18400	41149	4270	22128	7887	152821
1990	5233	36400	18990	19200	42064	4410	22891	8142	156870
1991	5405	37250	19650	20200	42921	4565	23370	8428	161324
1992	5586	38150	20150	21200	43814	4725	23840	8724	165719
1993	5765	38775	20540	22300	44708	4895	24243	9032	169882
1994	5953	39775	20990	23500	45602	5065	24714	9352	174469

(1) Beginning in the Winter of 1982-83, PASNY has included the City of Jamestown and the Village of Freeport in its forecast.

(2) Because of uncertainties concerning the future plans of the Urban Development Corporation (UDC), it is not presently clear to what extent its loads may be served by the Power Authority and/or Consolidated Edison. Consequently, loads of UDC have been included in the individual load forecasts beginning in 1989 of both these utilities and total loads for the New York Power Pool have been adjusted to provide for inclusion of UDC only once on a statewide basis.

FIGURE B-7A

SUMMARY OF MAJOR ADDITIONS TO GENERATING CAPACITY 1979-1994

Station and Unit	Company	Location	Fuel	Summer Capability MW	Energy Strategy Date	Capacity Reliability Date
Mitchell Gardens 1&2	LILCO (3)	Hempstead	Solid Waste	32	3/79	5/79
Oswego 6	(1)	Oswego	Heavy Oil	850	2/80	2/80
Shoreham 1	LILCO	Shoreham	Nuclear	820	12/80	5/81
Nine Mile Point 2	(1)	Scriba	Nuclear	1080	11/84	11/85
Somerset	NYSEG	Niagara Co.	Coal	850	11/84	11/85
Prattsville	PASNY	Prattsville	—	1000	5/87	5/89
Sterling	(1)	Sterling	Nuclear	1150	5/88	5/90
Lake Erie 1	NMPC	Pomfret (5)	Coal	850	(2)	(2)
Jamesport 1	(1)	Jamesport (5)	Nuclear	1150	5/89	5/91
700 Fossil	PASNY	Undetermined	Coal	700	5/89	5/91
Greene County	PASNY	Cementon (5)	Nuclear	1200	11/89	11/91
Lake Erie 2	NMPC	Pomfret (5)	Coal	850	(2)	(2)
Jamesport 2	(1)	Jamesport (5)	Nuclear	1150	9/90	5/93
New Haven 1	(1)	New Haven (5)	Nuclear	1250	5/92	5/94
New Haven 2	(1)	New Haven (5)	Nuclear	1250	5/94	5/96
Hydro Expansion	NMPC	Various (4)	Hydro	205	(4)	(4)
PASNY New Hydro	PASNY	Various (4)	Hydro	8	(4)	(4)

[1]See Table 4-A.

[2]While the Lake Erie units do not carry a specific service date, licensing and limited design activities would continue to permit installation at any time to meet company or Pool requirements beginning in 1987.

[3]This plant is being built in conjunction with the Town of Hempstead.

[4]Hydro expansion is planned at numerous sites. See Table 4-B.

[5]The site identified represents the preferred location presented in Article VIII proceedings.

TYPE OF UNIT
SN — Steam Turbine (Nuclear)
ST — Steam Turbine (Non-Nuclear)
GT — Gas Turbine
HY — Conventional Hydro
PS — Pumped Storage

FIGURE B-7b
COMPANY AND PERCENTAGE OF OWNERSHIP

Plant	Central Hudson	Consolidated Edison	LILCO	NYSE&G	Niagara Mohawk	Orange & Rockland	RG&E
Oswego 6					76		24
Nine Mile Pt. 2	9		18	18	41		14
Sterling	17				22	33	28
Jamesport 1			50	50			
Jamesport 2			50	50			
New Haven 1			50	50			
New Haven 2			50	50			

FIGURE B-7c
NMPC HYDRO CAPACITY ADDITIONS

Energy Strategy Date (Nov.)	Capacity (MW)
1982	10
1983	9
1984	2
1985	73
1986	38
1987	8
1988	0
1989	2
1990	2
1991	11
1992	25
1993	25
1994	0

PASNY New Hydro

Energy Strategy Date (May)	Capacity (MW)	Site
1982	3	Kensico
1983	5	Ashokan

FIGURE B-8a

NYPP PLANNED GENERATION MIX

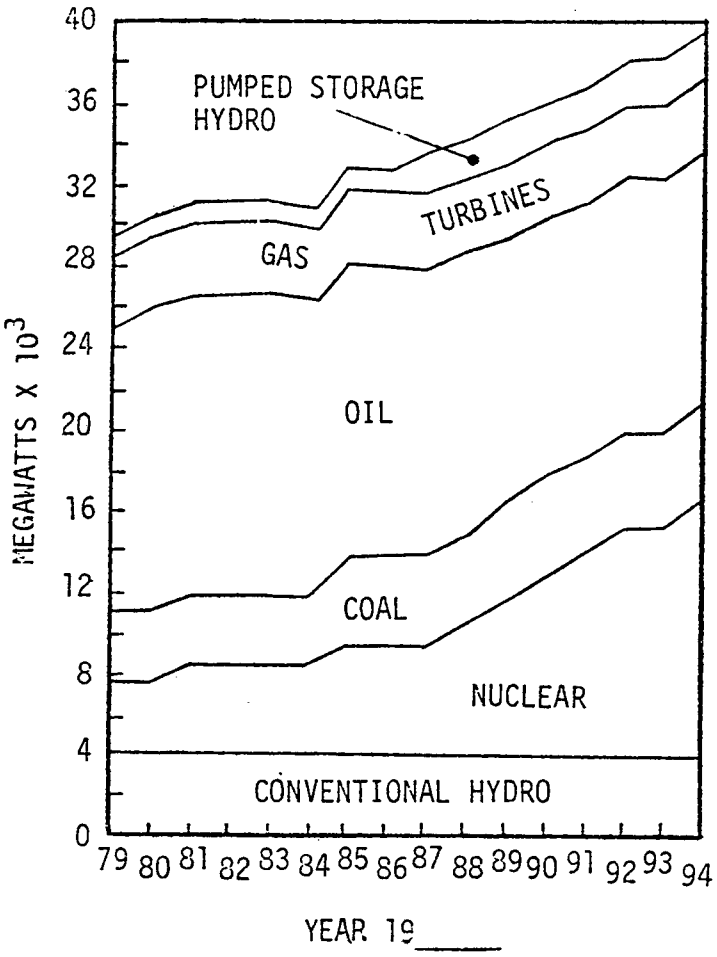


FIGURE B-8b

GENERATION MIX (PERCENT)

	1979		1987		1994
	NYPP	U.S.*	NYPP	U.S.*	NYPP
Nuclear	12	10	17	20	32
Coal	12	40	13	43	12
Oil	59	24	52	18	40
Hydro	17	14	18	11	16
Gas	0	12	0	8	0

FIGURE B-8c

TOTAL ELECTRIC REQUIREMENTS (PERCENT)

	1979		1987		1994
	NYPP	U.S.*	NYPP	U.S.*	NYPP
Nuclear	19	15	23	27	42
Coal	17	49	17	49	16
Oil	43	16	43	13	28
Hydro	21	10	17	7	14
Gas	0	10	0	4	0

* National Electric Reliability Council "8th Annual Review," August 1978.

FIGURE B-9

PROPOSED TRANSMISSION FACILITIES
1979-1994

	765 kv		345 kv		230 kv		115/138 kv	
	Over-head	Under-ground	Over-head	Under-ground	Over-head	Under-ground	Over-head	Under-ground
Scheduled Facilities (Circuit Mile)	297	0	684	84	36	8	307	33
Planned but Not Scheduled Facilities (Circuit Mile)	455	0	96	28	0	0	148	0
Total Scheduled & Unscheduled Facilities (Circuit Mile)	752	0	726	112	36	8	455	33

New York State's investor-owned utilities are members of the Empire State Electric Energy Research Corporation (ESEERCO), which performs and sponsors R&D programs in areas of common concern to the State's utilities. The Power Authority, although no longer a member of ESEERCO, continues to provide financial support for some ongoing projects. ESEERCO sponsors research programs being carried out by individual utility companies, groups of utilities, state and national energy research organizations, government agencies, fuel suppliers and equipment manufacturers. In addition to their participation in ESEERCO, the State's utilities also provide direct support for internal research programs and for such organizations as the Electric Power Research Institute and the New York State Energy Research and Development Authority. Total budgeted funding of R&D programs amounts to $57,232,000 for 1979, divided among the following program areas:

Category	Amount	Percentage of Total
General R&D Support	$ 4,570,000	8.0
Hydroelectric Power	$ 558,000	1.0
Nuclear Power	$12,273,000	21.5
Fossil Fuels	$11,194,000	19.6
Advanced Power Systems	$ 8,251,00	14.4
Transmission	$ 3,251,000	6.2
Distribution	$ 5,667,000	9.9
Stations and Substations	$ 2,640,000	4.6
Customer Utilization	$ 3,279,000	5.7
Environmental Assessment	$ 5,200,000	9.1

The five year R&D program plan submitted by ESEERCO calls for expenditures totalling $68,302,000 in 1984, distributed as follows:

Category	Amount	Percentage of Total
General R&D Support	$ 6,364,000	9.3
Hydroelectric Power	$ 201,000	0.3
Nuclear Power	$10,713,000	16.0
Fossil Fuels	$14,019,000	20.5
Advanced Power Systems	$12,624,00	18.5
Transmission	$ 5,621,000	8.2
Distribution	$ 5,173,000	7.6
Stations and Substations	$ 2,396,000	3.5
Customer Utilization	$ 3,545,000	5.2
Environmental Assessment	$ 7,646,000	11.2

As indicated the program projects a shift in funding emphasis away from nuclear power and toward fossil fuels, advanced power systems and environmental assessment.

5. Major Coal Suppliers

A. Background

On April 1, 1979 or shortly thereafter, submissions were received from 42 major coal suppliers, of which seven requested that all, or some part, of their submittals be kept confidential in accordance with the Regulations. According to the data contained in these submissions, these coal suppliers provided nearly 10 million tons of coal to New York State consumers in 1978. This may be compared to the total consumed in the State in that year which was approximately 12.5 million tons. Major coal suppliers which provided information are indicated in Figure B-10.

FIGURE B-10

MAJOR COAL SUPPLIERS WHICH SUBMITTED PLANS

Bastian, Robert J. Co., Inc.
Berwind Coal Sales, Co.
Bethlehem Mine Corporation
Blue Diamond Coal Company
Bradford Coal Company, Inc.
C & K Coal Company
Centralia Coal Sales, Co.
Connecticut Coal Inc.
Consolidation Coal Company
Eastern Associated Coal Corp.
Fisher Mining Company
Foreston Coal
Gem Coal Company
General Coal Company
Glacial Minerals, Inc.
Glenn Coal Company
Island Creek Coal Sales Co.
Jens, W.G. Coal Company
Jones & Brague Mining Co.
Kent Coal Mining Company
King Powellton Mining, Inc.
Kittanning-Freeport Coal Co.
Louis Gulotta & Co., Inc.
Manhattan Coal Company
McKean Coal Company
P & M Mining Company
Pratt Mining Company
Reddinger Coal Co., Inc.
R.E.M. Coal Co., Inc.
Ringgold Coal Mining Co.
Somerset Mines, Inc.
Stephens, W.H. Corp.
Sullivan Mines, Inc.
Sunbeam Coal Corp.
United Eastern Coal Sales Corp.
X-Cello Corporation
Zapata Fuels, Inc.
—Mears Coal Co.
—Doverspike Bros. Coal Co.

B. Summary of the Plans

Fourteen of the companies responding presented some discussion of future plans. These plans, however, contained

very little information on plans for meeting New York's forecasted coal requirements. Generally, the companies indicated that coal production is currently demand constrained and that adequate supplies of coal are available at competitive prices to meet any projected increases in demand.

Only one company provided detailed data on existing mines from which coal is supplied to State users. These mines are also used to supply coal to areas other than New York and therefore the information was not useful in determining adequacy of future supplies to the State.

One company emphasized the proximity of the anthracite reserves in Pennsylvania (in excess of 5 billion tons) to New York State, and indicated that these coal resources should be an important part in future energy supplies to the State.

One company which produces coal from the "Blue Gem" seam in eastern Kentucky noted that this source of coal should only be considered temporary because of high mining costs, and that when alternatives are found, it will no longer be used to supply New York. Another company, also producing coal from this source, noted that it will continue to do so as long as the demand exists.

None of the companies presented any discussion of research and development activities either by themselves or others nor was there any discussion of coal use in new technologies such as synthetic fuels, coal-oil mixtures or fluidized-bed combustion. Constraints to further coal production, other than demand, were most often identified as governmental regulations, labor problems, and higher mining costs. Several suppliers indicated that coal use will grow in the Northeast and New York State. Reasons given for this growth were: continued unavailability of natural gas; high cost and unreliable foreign oil; problems with nuclear energy; and the fact that coal is a proven technology and facilities can be constructed and operated in a predictable, economic and environmentally sound manner.

Several companies indicated that their plans include the addition of new equipment, rail sidings, loading and cleaning facilities as well as mine expansions and new mine openings if the demand for their coal increases.

Thirteen suppliers submitted their projections of future coal prices. Most of the others stated that it was too difficult or impossible to do so because of uncertainties such as changing governmental policies, future market conditions and inflation. All but one of the projections were for coal produced in western Pennsylvania and only one set of projections was for anthracite coal. The projections are presented below.

PROJECTED FUTURE COAL PRICES—¢/MMBTU

	0 - 0.6	.61 - 1.90		1.91 - 2.80		2.81[a]	Anthracite
	None	96	2.34[a]				
	Made	136		121	133	133	157[b]
5th Yr.		141		124	150		
		150		125	140-160		
		300		129			
	None	137					
	Made	173	450-475	147	185	178	165
10th Yr.		201	700-750	154	240		
		240		176	200-250		
		313		178			
	None	221		196	350		175
15th Yr.	Made	225		250	300-375		
		285		266			
		350					

[a]District 8—Eastern KY
[b]Only one projection made.

The information provided by the major coal suppliers did not contain data and plans that were specific, in most cases, to New York State. However, the information was not without value. The insights gained through the submittals, and in additional discussions with many of the suppliers, provided a greater understanding of the complexity of the industry, the main participants, and the forces that are of most influence on it. Coal mining is a highly competitive industry, responding to changing market conditions and regulatory environment. Mine owners, labor, local mining communities, environmental interests, government and coal consumers all have an interest in the future of the industry.

APPENDIX C

Forecast of New York State Energy Requirements
Technical Overview

1. *INTRODUCTION*

Under Sections 5-110 and 5-112 of the New York State Energy Law the State Energy Office is required to prepare a draft State Energy Master Plan and a Long-Range Electric and Gas Report, which contain, among other things, a forecast of State energy requirements, including electric and gas demands for 5, 10 and 15 year forecast periods, and the bases for those forecasts.

The State Energy Office, as required, has taken into consideration, among other things, the following factors:

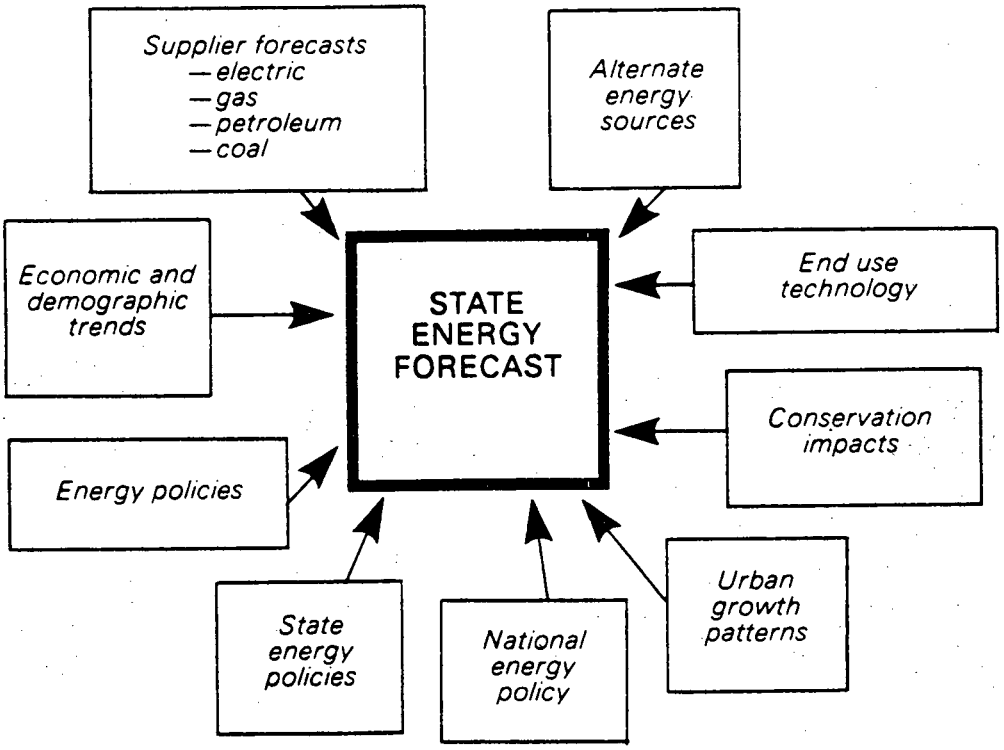
- Economic growth and development trends, including changing patterns of population growth, urban development, transportation modes, and building designs, which might significantly affect energy consumption in the State;
- The extent to which energy conservation measures and new energy technologies may affect the State's energy requirements;
- The extent to which the development of indigenous energy resources may contribute to meeting the State's energy requirements;
- The impact of national energy policies on the State's energy needs and on available sources of supplies; and
- The impact of alternative energy sources and energy conservation upon the economy of the State, the health, safety and welfare of the people of the State, and the quality of the State's environment.

Figure C-1 illustrates schematically the factors affecting the development of the forecast, presented in Section IV of the Energy Master Plan.

This appendix fulfills the legislative requirements to present the bases for the forecast of energy requirements for 5, 10 and 15 year periods. It sets forth the following:

- Overview of New York State Energy Forecasting System.
- Discussion of base year (1978) New York State energy consumption accounts data which serves as the basic accounting framework for the forecast.

FIGURE C-1
STATE ENERGY FORECAST



- Review of each of the four sectoral energy use forecasting models and techniques, including a discussion of the model structure and forecasting techniques, data base and basic assumptions, as well as the macro-econometric model of the State's economy.
- Discussion of the basis for the energy price assumptions by sector of use and fuel type.
- Presentation of the detailed forecast of New York State energy requirements by sector, end use and fuel type in tabular form. (See Figure C-16)*
- Description of the general approach and methodology for preparation of the electric utility service area electricity sales (KWH) and peak demand (MW) forecasts.

II. OVERVIEW OF ENERGY FORECASTING SYSTEM

This section describes the principal needs SEO responded to in developing its forecasting capability, the approach to the forecast in relation to previous forecasting efforts, an overview of the forecasting system model structure, and the basic assumptions underlying the forecast. The section concludes with a brief discussion of the inherent limitations of the forecast.

A. Needs

The SEO prepared this forecast with several important needs and considerations in mind:

- The need to develop an analytic and forecasting capability independent of forecasts submitted by the major energy suppliers.
- The need to develop an energy forecasting system capable of providing a framework for examining relationships and interactions among energy use, economic activity, prices, and public policy—as implied in the legislative directive.
- The need to analyze energy requirements in terms of basic building blocks of energy use: specific end uses, such as space heating, air conditioning, hot water heating, cooking and clothes drying.
- The need to address energy use within a total energy (all fuel forms) context that is sensitive to the potential for substitution among competitive fuels for specific end uses, wherever appropriate.
- The need to analyze the responsiveness of various energy uses to price changes.
- The need, to the extent possible, to examine in an explicit manner, the impact of efficiency improvements related to mandated energy efficiency standards and conservation measures.
- The need, in view of inherent forecast uncertainties, to begin to develop a capability for analyzing the sensitivity of a baseline or most likely forecast to alternative assumptions or scenarios.

B. The Approach to the Forecast

The State Energy Office forecast of State energy requirements is unique in four important aspects.

First, the SEO forecast reflects the impact of recent dramatic OPEC price increases and rising energy prices, generally.

Second, the SEO forecast takes into account the impact of federal and State energy legislation, including the National Energy Act of 1978, and programs authorized by such legislation through June 30, 1979. Thus, it reflects important current federal and State conservation policies and programs, including the recently promulgated State Energy Conservation Construction Code.

Third, the SEO forecast is the first integrated forecast of energy requirements for all major fuel forms: electricity, natural gas, petroleum products, and coal. This approach permits analysis of the potential for substitution among competitive fuels for specific end uses.

Finally, the SEO forecast reflects a combined econometric and engineering end use approach, seeking to build on the respective strengths of each. Such an approach combines two advantages: the price responsiveness capability of the econometric approach and the capability of the engineering approach to examine the impacts of efficiency standards

*The Energy Planning Board, upon review of the alternative forecasts in the Energy Master Plan and Long-Range Electric and Gas Report proceeding record, approved the SEO draft Plan energy forecasts with several modifications.

In reviewing the basis for the draft Plan forecasts, the Board recognized fully the uncertainties inherent in any forecast and, further, the need to review the basic forecast assumptions in view of events and developments since the submittal of the draft Plan in August, 1979.

The Board weighed carefully the estimated impacts of changes in numerous factors upon the end use requirements forecast generally, and the long-range electric demand forecast, specifically, and concluded that the electric demand forecast should be reviewed with respect to two factors:

> "Updating the world oil price assumption (and the resulting impact on petroleum product prices) would, according to SEO, result in both a significant reduction in petroleum product consumption and an increase in electricity use. The growth in electric energy use would increase by approximately 0.1 percent per year, and electricity peak demand growth would increased by approximately 0.1 percent per year, with a resulting increase in 1994 peak demand of approximately 400 MW. Implementation of the recently enacted State lighting standards legislation will reduce growth in electric energy use by approximately 0.1 percent per year. The impact on electricity peak demand would be a reduction in 1994 peak demand of approximately 425 MW. These two effects thus approximately counter-balance one another with respect to the overall impact on electric energy (KWH) and peak demand (MW) growth rates. (Opinion and Order p. 33).

The forecast of end use energy requirements presented herein reflects the Board's finding that electricity sales (KWH) will increase an average 2.1 percent annually, as forecast in the draft Plan. (Note: The electricity sales forecast by end use presented in Figure C-16 has not been adjusted for the impacts of the higher than assumed 1980 oil prices).

More importantly, the forecast of electricity peak demand (MW) presented herein reflects the Board's finding that electricity peak demand will increase an average 1.8-1.9 percent annually over the forecast period, reflecting moderate improvements in the load factor. The draft Plan had forecast that electricity demand would increase an average 2.1 percent annually.

> "Our review of the record convinces us that the statewide load factor will improve in the future. And, in view of the inherent limitations in the SEO load factor assumption . . . the Board concludes that the SEO projection of a constant load factor should be modified to reflect a moderate improvement."
>
> "The revisions result in an electric peak demand forecast of 1.8-1.9 percent, which is adopted by the Board." (Opinion and Order, p. 60).

To the extent that world oil and petroleum product price assumptions presented in this Plan fail to reflect fully recent OPEC pricing actions, the forecast of end use energy requirements (primarily petroleum) presented herein (Figure C-16) will be overstated; price-induced conservation impacts presented herein will tend to be understated; and the assessment of the potential for renewable resources presented herein will tend to be understated.

and conservation on specific energy end uses.

Figure C-2 compares the general scope and methodology of SEO forecast with other forecasts prepared within the last two years. The New York Power Pool and New York Gas Group forecasts, prepared earlier in 1979, were submitted to the Energy Office as part of the Energy Master Plan process. In addition, three electricity forecasts were prepared by participants in Phase II of the 1978 149-b Long-Range Electric System Planning proceedings.

C. Overview of Model Structure

The New York State Energy Forecasting System is a system of linked computer-based models and forecasting techniques. The system embraces five major components: four energy use models broken down by sector—residential, commercial, industrial, and transportation—and an underlying macro-econometric model.

The energy use model in each sector analyzes specific building blocks of energy use or end uses based upon a range of assumptions. State economic activity (provided by the macro econometric model), prices, national and State energy policies, and fuel supply availability or constraints or assumptions are all considered. (See Figure C-3)

Several points in the development and structure of the Forecasting System merit attention. First, the State Energy Office, after an exhaustive investigation of existing methodologies, selected the most appropriate models and either adopted them directly or improved upon them.

The Office, however, concentrated combined staff and consultant resources on developing residential and commercial sector models, since those two sectors account for 52 percent of the total energy consumption and 71 percent of electricity consumption, respectively.

Existing State and national models were employed where appropriate. For example, the transportation forecasting techniques developed by the New York State Department of Transportation formed the basis for forecasting energy demand in the transportation sector. The Long Run Annual Economic Forecasting Model developed by Wharton Econometric Forecast Associates, Inc. supplied the national economic activity input to the State model.

Second, the Forecasting System blends econometric and engineering end use methodologies and techniques, as appropriate. By combining the two, the State Energy Office seeks to improve upon prior State energy demand forecasts. Its hope is to integrate demand for conventional fuels and renewable resources with estimates of all relevant variables impacting such demand—including current State and national economic activity, energy prices, and improvements in energy end use technology.

The combined approach shifts the focus of inquiry to the point of actual energy consumption, thus recognizing the impact of energy efficiency standards, conservation measures, and new energy technologies. Each sectoral model contains a mix of engineering and economic data, as appropriate.

The Forecasting System thus seeks to build upon the respective strengths of the econometric and engineering end use forecasting approaches. At the same time it overcomes the limitations of each.

D. Basic Assumptions

The forecast of New York State energy requirements rests on several major assumptions:

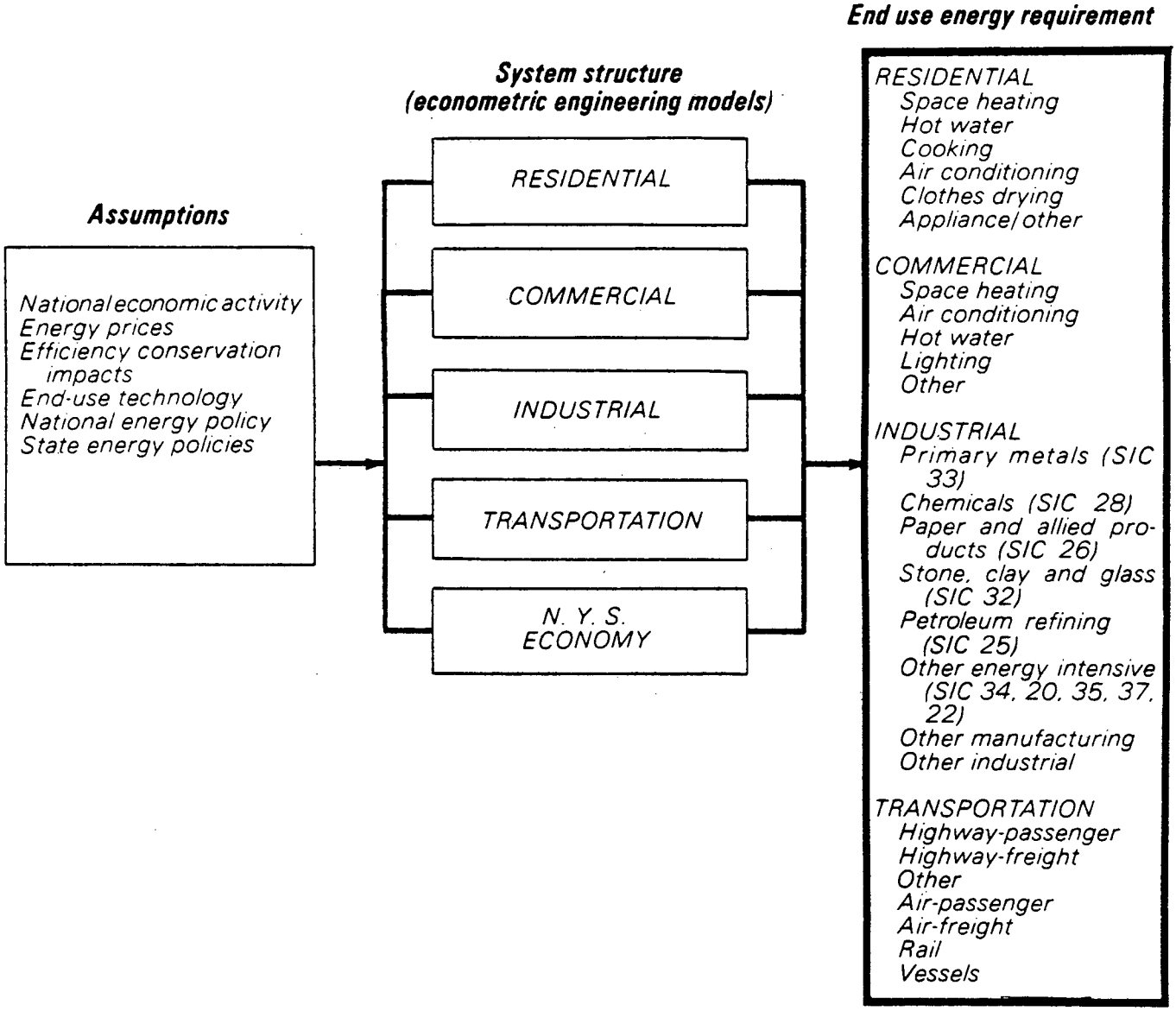
- Energy Prices
  - •• The real price of energy, driven by world oil prices, will continue to increase. Energy will thus account for an increasing share of household disposable income, business costs, and gross State product generally.
  - •• The real world oil price will increase, at an average annual rate of two percent per year through 1985 and at three percent per year thereafter.
  - •• Consumers will react in an economically rational manner in conservation (i.e., paybacks of 2-5 years will be perceived to be much more desirable than 8-12 year paybacks) and fuel choices (i.e., if natural gas is available and less expensive than oil, it will dominate).

FIGURE C-2

COMPARISON OF NEW YORK STATE ENERGY MASTER PLANNING PROCEEDING END-USE ENERGY REQUIREMENTS FORECASTS

		Fuel Type				Approach/Methodology					
Forecast	Year	Electricity	Natural Gas	Oil	Coal	Econometric	Engineering End Use	Price Sensitivity	July OPEC Price Increase Incorporated	End Use Specific Forecast	Conservation Impact by End Use
State Energy Office	1980	X	X	X	X	X	X	Yes	Yes	Yes	Yes
National Economic Research Associates	1979	X				X	To some extent	Yes	No	To some extent	To some extent
New York Power Pool	1979	X				X	To some extent	Yes	No	"	"
Public Service Commission (PSC)/ Consumer Protection Board (CPB)	1978	X				X		Yes	No	No	"
Cornell Group/New York Public Interest Research Group, Inc., et al	1979	X	X	X	X	X		Yes	No	No	No
Energy Systems Research Group/ Sierra Club, et al	1979	X					X	To some extent	No	Yes	Yes
New York Gas Group	1979		X				X	"	No	No	No

FIGURE C-3
ENERGY FORECASTING
NEW YORK STATE



•• Refer to Section IX of this Appendix for a discussion of the basis for the energy price assumptions.

- Economic Activity
  - •• The State's economy will experience moderate economic growth over the forecast period—a rate of growth well above the limited growth of the mid-seventies but below that of the pre-embargo period. Figure C-4 shows the growth rate for key economic indicators, in general and by sector, in relation to the forecast of State energy requirements.
  - •• It is important to note that this forecast is fully supportive of the energy requirements of a moderate growth economy. It is consistent with national post-embargo trends which amply demonstrate that there is no fixed relationship between energy and economic growth in a period of significant energy price, public policy and institutional change.
- National and State Energy Policy
  - •• National and State energy legislation, including the National Energy Act of 1978, and programs authorized by such legislation through June 30, 1979, are taken into account.
  - •• Domestic oil decontrol will occur in a phased manner over the next several years.
- Conservation
  - •• Figure C-5 indicates the major State and federal conservation legislation and programs taken into account in the forecast of State energy requirements.
- Energy Supply
  - •• Petroleum products, while generally available, will become increasingly more costly relative to other fuels.
  - •• Greater quantities of natural gas will be available in the 1980's than in the 1970's, but at an increased cost.

FIGURE C-4

SELECTED ECONOMIC ACTIVITY AND ENERGY CONSUMPTION INDICATORS, 1960-1994

Economic Activity	1960	1973	1978	1994	Average Annual Percent Change 1960-1973	1973-1978	1978-1994
General							
Gross State Product (Millions 72$)	89.3	137.1	137.0	197.7	3.4	0.0	2.2
Personal Income (Billions 72$)	63.5	96.0	96.2	147.2	3.2	0.3	2.5
Per Capita Income (Billions 72$)	3790	5249	5393	7603	2.5	0.8	2.0
Residential Sector							
Customers	n.a.	n.a.	6268	7150	n.a.	n.a.	0.8
Commercial Sector							
Commercial Employment	4032	5220	5320	6577	2.0	0.4	1.3
Industrial Sector							
Manufacturing Output	21.3	32.7	32.2	53.4	3.3	-0.2	3.0
Energy Consumption							
End Use Energy Consumption (TBTU)	2343	3240	3167	3408	+2.5	-0.5	+0.5
Electricity Consumption (TBTU)	168	340	360	501	5.6	+1.1	+2.1
Total Primary Energy Consumption (TBTU)	2741	4120	4073	4668	+3.2	-0.2	+0.9
Ratio of Primary Energy Consumption Growth to GSP Growth					.94	n.a.	.41

n.a.—not available

- Miscellaneous
  - •• The electricity demand (sales) forecast implicitly incorporates recent trends with respect to load management, marginal cost pricing and rate structure. Beyond that, the specific load management program and rate structure changes currently underway at certain utilities have been implicitly accounted for in developing the peak demand forecast in Section XII.

E. Inherent Limitations

Recent events, such as the OPEC pricing actions, the Iranian situation, and Three Mile Island emphasize the uncertainties of energy forecasting. Energy forecasting is, at best, an imprecise art. Energy demand forecasting, a relatively new discipline, is limited by the general constraints on forecasting.

The most general constraint is the fact that a forecast of energy requirements is essentially a series of estimates that are, in turn, based on assumptions about key variables. Should any of the basic assumptions prove inaccurate, the energy requirements forecast would change. For example, two key factors driving the forecast of energy requirements are the assumptions of world oil prices and the forecast of State economic activity. Should world oil prices or State economic activity deviate from anticipated levels, it may be necessary to revise the energy requirements forecast.

The Energy Law recognized the uncertainties in energy forecasting. Section 5-110(a) requires, at least, a biennial review of the State Energy Master Plan and Section 5-112 (3b) mandates a biennial review of the Long-Range Electric and Gas Report.

Furthermore, in recognition of such uncertainties, the SEO has started development of a capability to examine the sensitivity of forecasts of State energy requirements to alternative sets of assumptions or scenarios.

III. BASE YEAR ENERGY CONSUMPTION ACCOUNT DATA

This section describes the development of the 1978 base year energy consumption accounts data for the forecast of State energy requirements.

A. Basic Framework

The State Energy Office prepares and publishes annually a basic set of energy consumption accounts for the State generally consistent with federal concepts and definitions. This set of accounts provides estimates of energy consumption by sector of use and fuel type for the period 1960-1977. Refer to New York State Energy Office, Energy Consumption and Supply Statistics, published in 1979 for information with respect to basic sources of specific data by sector of energy use and fuel type.

FIGURE C-5
CONSERVATION LEGISLATION AND PROGRAMS

Residential Sector

- State Energy Conservation Construction Code.
- Home Insulation and Energy Conservation Act of 1977.
- Federal Appliance Efficiency Standards and State efficiency standards for room air conditioners (Chap. 826, Laws of 1977) and hot water heaters (Chap. 439, Laws of 1977).
- Weatherization Assistance for Low-Income Persons.
- National Energy Act Act (NEA) Residential Energy Conservation Program.
- NEA Residential Energy Tax Credit.

Commercial Sector

- Energy Conservation Construction Code.
- Lighting Efficiency Standards for government buildings.
- NEA Energy Conservation Programs for Schools, Hospitals, Buildings Owned by Units of Local Government, and Public Care Institutions.
- NEA 10 percent investment tax credit for qualifying energy property.

Transportation Sector

- EPA Auto Efficiency Standards.
- 55 MPH speed limit.
- Right-Turn-on-Red.
- NEA Gas Guzzler Tax.

B. Preliminary 1978 Estimates

The Office prepared preliminary 1978 estimates of energy consumption by sector and fuel type based upon actual annual data wherever available and in instances where full year data was unavailable, upon an extrapolation of partial year data and past relationships.

C. Adjustments

The Energy Office, in order to refine the base year energy consumption accounts for forecasting purposes made several basic adjustments, including:

- removing coking coal from industrial coal consumption data, in order to exclude all major feedstocks from the base year end use consumption data.
- shifting a component of natural gas consumption from the industrial to the commercial sector, in order to assure consistency with treatment of other fuel forms.
- reconciling electricity consumption data by sector with its New York State Power Pool estimation under the uniform customer accounting system.
- reconciling the natural gas consumption data by sector with the New York Gas Group.
- incorporating the Office estimates of renewables (wood and solar) consumption in 1978. Refer to Appendix D for a discussion of the derivation of these estimates.

D. Development of End Use Data

The Office next developed preliminary 1978 estimates of energy consumption by end use and fuel type for each sector through a combination of procedures based upon actual reported data, whenever available, or on an allocation based upon research carried out in conjunction with the sectoral forecasting models.

E. Weather Normalization

To adjust for climatic factors which can affect space heating consumption from year to year, the Office used a weather normalization procedure to adjust preliminary 1978 natural gas and petroleum product space heating estimates. Electricity space heating consumption which accounts for a small proportion of total consumption was not adjusted since the effects of such an adjustment would be limited.

The Office assumed that the impact of space heating upon consumption is proportionate to the ratio of actual degree days to degree days in a normal year. The U.S. Weather Bureau defines a normal year as an average of the annual degree days over the last 30 years. The population weighted number of degree days in New York State in 1978 was 5.8 percent higher than normal.

F. Results

Figure C-6 presents the preliminary estimate of sector and fuel type. The preliminary 1978 weather normalized data corresponds with the data presented in Figure IV-22 of the Energy Master Plan.

IV. RESIDENTIAL SECTOR

The residential model, developed by staff of the State Energy Office, provides a framework for forecasting residential energy requirements by seven end uses and four fuel types for each electric service territory in the State.

This model relates energy requirements by end use to the following factors: forecasts of customer growth, an econometric assessment of fuel choice, a base year unit consumption level and annual changes in that level based upon a blend of economic factors, efficiency improvements mandated by State and federal regulations and new energy technologies.

Specific end uses include: space, heating, water heating central air conditioning, room air conditioning, cooking, clothes drying, and a final category including other appliances, lighting, and miscellaneous household uses of electricity.

Figure C-7 presents a schematic overview of the residential sector of the New York State energy forecasting system.

The following material summarize the methodology used by the SEO.

A. Model Structure

The SEO residential energy use model is an extremely comprehensive model, detailing residential energy consumption by end use, fuel type and electric utility service territory. The following chart gives a representation of the information provided for each utility service territory.

	Fuel Type			
End Use	Electricity	Natural Gas	Fuel Oil & Kerosene	Other
Space Heat	X	X	X	X
Water Heat	X	X	X	X
Cooking	X	X	X	X
Clothes Drying	X	X		
Room Air Conditioning	X			
Central air Conditioning	X			
Other Appliances	X			

The basic paradigm of the residential model is that of fuel

FIGURE C-6

PRELIMINARY ESTIMATES OF NEW YORK STATE ENERGY CONSUMPTION, 1978, ACTUAL AND WEATHER-ADJUSTED

End Use Requirements	1978* Trillion BTU Actual	Weather-Adjusted
By Sector		
Residential	1008.3	966.6
Electricity	111.1	111.1
Natural Gas	349.1	334.2
Petroleum Products	524.9	498.4
Wood and Other	23.2	23.2
Commercial	699.2	673.1
Electricity	145.0	145.0
Natural Gas	137.0	131.7
Petroleum Products	416.0	395.2
Other	1.2	1.2
Industrial	380.2	380.2
Electricity	95.9	95.9
Natural Gas	105.0	105.0
Petroleum Products	120.1	120.1
Coal (excluding coking) & Others	59.2	59.2
Transportation	1105.8	1105.8
Electricity	7.8	7.8
Petroleum Products	1098.0	1098.0
Gasoline	776.8	776.8
Total End Use Requirements	3139.5	3126.0
Electricity End Use Requirements	359.8	359.8
Electric Utilities**	906.0	906.0
Total Primary Energy Requirements	4099.5	4032.0

*Preliminary SEO estimates.

**End use consumption is the energy consumed directly by the sector and differs from primary energy consumption by excluding electricity generation and transmission losses.

choice at the time of the investment decision, fuel choice being a function primarily of relative prices. In addition to prices income plays a role, especially in the determination of air conditioning purchase decisions and, implicitly, in other household appliance purchase decisions.

The end use analysis comes about in the determination of unit demands over time, those demands being related to engineering factors such as, housing unit envelope and device technology, appliance technology and so forth.

The investment decision is the appropriate economic process to model for consideration of durable equipment. This decision (for a particular end use) posits the choice as being a function of the relative purchase and operating costs of the particular equipment under consideration, e.g. space heating equipment choice should be related to the costs of purchasing a particular system, as well as the costs of running it, the latter being mainly fuel costs.

In addition, certain equipment choices seem to be conditioned on what other kinds of equipment are in existence in the dwelling unit. Gas water heaters and stoves, for example seem to follow, somewhat,the choice of gas space heating system.

Other reasons for a particular choice of equipment exist. Historical patterns, as well as consumer tastes, also play a very important role. In some cases, such hypotheses were tested. For the most part, though, price and personal income seem to play fairly strong roles in the determinants of equipment choice.

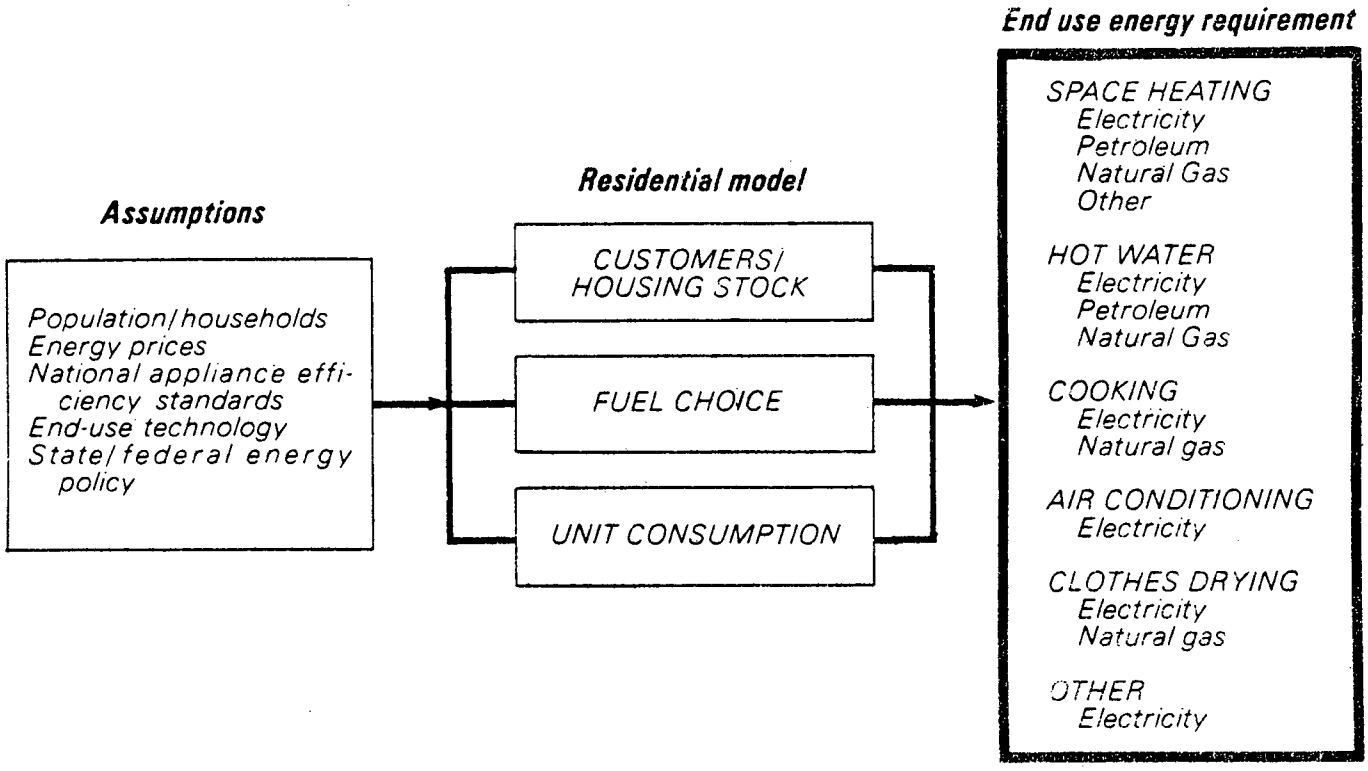
Income plays a role in two major residential model end uses: air conditioning choice, and consumption for "other appliances." Generally, air conditioning choice is not one of fuels, but of "yes" vs. "no." On this basis it would be logical to see income, as well as operating costs (as measured by price) act as an explanatory variable. An air conditioner is not often considered a necessity by residential customers. The economic literature has shown that ownership of air conditioners is indeed subject to an income effect, with the latter coming into play after a certain level of income is spent on necessities.

Income and price also play a role in the determination of "other appliance" consumption. For this end use, a relatively standard Houthakker-Taylor (HT) formulation was used. This formulation models electricity consumption as a function of lagged consumption, a moving average of prices and a moving average of income.

One final point that must be made concerns the flexibility of econometric/end use analysis for scenario evaluation, especially with respect to conservation. Conservation stems from two major sources, at a superficial level they are price induced conservation and non-priced induced conservation. Both cases are treated in the current approach.

Since prices are exogenous to the system, different price

FIGURE C-7
ENERGY FORECASTING SYSTEM: RESIDENTIAL SECTOR
NEW YORK STATE



growth rates have varying implications for conservation. Generally in the model, higher relative prices induce shifts away from a particular fuel-using device and into one using a cheaper fuel. Since equipment owners have certain costs which must be amortized, the above change or rolling over of stock takes place gradually over time, dependent on both new customer formation rates, and upon equipment lifetimes.

B. Data Base

The residential model data base was defined on the basis of the seven electric utilities. It exhausts the population of the State, except for municipals. Utility residential customers, i.e., those electric customers consuming energy under a residential tariff serve as the basic activity variable.

These definitions were chosen in order to get a clear picture of residential energy consumption. An alternative definition might have included people who live in large apartment complexes and consume electricity or gas under commercial tariffs. Thus, there is a trade-off between a clean but somewhat incomplete count of residential and "apartment-based" customers consumption which is mixed in with commercial consumption data. In describing residential behavior, the Office decided that the clean-but-short-set of data would be appropriate. Then that behavior could be used to infer behavior in the remaining portion of the residential population.

The data sources for the residential model are varied, due to the paucity of certain kinds of engineering data in a form useful for economic analysis. Customer counts came from the electric utilities themselves and served as the multiplier to convert unit consumption into total consumption for each utility, fuel type, and end use. Aside from customer counts, there are three other major data requirements for the model: the number of customers consuming a particular fuel for particular end use, the unit consumption by fuel type for a particular end use, and the actual amounts of fuels consumed in each end use.

The latter, known as the "energy consumption data," came from utility reports and from the Federal Energy Data System (FEDS) state energy consumption data base—a databank set up by DOE. The data are broken out by sector of use and fuel type, but not by end use. This data base comes largely from standardized sources and is consistent with SEO energy consumption accounts. It serves as an overall control total for the energy consumption data.

Reported electric and gas utility data (which generally agrees with the FEDS data base) were used at a substate level. These data represent the basis for verifying electric and gas consumption numbers for residential customers. Various tariffs provided information on electric or gas space heating consumption as appropriate. In addition, the utilities report various end use consumption data that the Office adjusted to determine unit consumption. The unit consumption data are the result of engineering efficiencies, consumption levels to maintain certain levels of comfort, and energy needs to operate particular devices.

The final data requirements is the number of customers consuming a particular fuel for a particular end use—a variant of "saturation." These estimates were developed from various sources, including utility reports, and the 1960 and 1970 Censuses. The customer numbers by end use multiplied by unit demands yield total energy consumption.

C. Assumptions

1) Customers

The residential model, as noted, used a customer defini-

tion consistent with that reported by the electric utilities as those who consume power under a residential tariff. Customer counts are different from household counts for several reasons, the major one being the fact that some dwelling units may be master metered, wherein one meter serves all of the residential households in an apartment building. When several families live together and share a meter, another opportunity occurs for customers and households to differ.

The service area in which the largest relative discrepancy occurs is that of Consolidated Edison, although, in fact, each service area shows some misalignment of customers and households.

The Office has used the customer forecasts published by the electric utilities (except for Con Ed where household forecasts were adjusted by the ratio of customers to households). The Office used these particular assumptions for several reasons. First, an activity count which would exhaust all energy using customers in an electric service territory, yet still retain the purity required by the behavioral relations was necessary. For example, gas customers, as an alternative, would be unacceptable since not everyone has a gas hookup. The assumption that each household has an electric hookup is very nearly true, or true enough to be reasonable.

The second reason for using the customer forecasts published by the electric utilities is that they represent a strong element in the utility forecasting procedure. The electric utilities use the population numbers (and sometimes the household numbers) published by the New York State Department of Commerce. The utilities convert demographic data into customer counts, using the utilities' analytical strength in this area and their intimate knowledge of their service territories. The resulting set of customer forecasts is generally consistent with New York State demographic projections, published by the New York State Department of Commerce.

2) Prices

Section IX of this Appendix presents the residential sector energy price assumptions.

3) Non-Price Conservation

Non-price conservation is related to implementation of energy conservation construction codes and appliance efficiency standards. Non-price conservation relates to unit consumption, as opposed to the customer fuel choice decision affected primarily by price conservation.

Non-price conservation rolls in over time as new housing envelopes, devices and appliances meeting prescribed codes come on line. In addition, keeping track of old and new dwelling units and equipment stocks allows identification of potential stock available for retrofitting.

Refer to Section V-B: Conservation, for further discussion of specific proposals and rationale.

a. Forecast (Baseline)

Figure C-8 indicates the current conservation legislation and programs taken into account in the SEO baseline forecast.

New Housing

- In new single family and low density housing constructed after January 1, 1979, the Energy Conservation Construction Code requires a reduction in space heat demand of approximately 15 percent below a pre-code house through a combination of envelope and device efficiency influences.
- In low and high rise residential buildings thirty percent savings are required.

Existing Housing

- No such existing code affects retrofits of existing housing. Therefore, the rate of voluntary retrofits of envelopes and devices is the key to reduced consumption in these homes.
- The baseline forecast assumes that an envelope retrofit of a pre-code home with no or only minimal insulation will achieve 12 percent savings of space heat end-use consumption, based upon standard engineering studies and estimates.
- The forecast assumes a device retrofit of a gas or oil heated home will achieve 15 percent savings. The forecast assumes a simultaneous retrofit of envelope and devices will achieve 25 percent savings.
- Sixty percent of the State's single family homes are assumed to have undertaken envelope retrofits by January 1, 1979, based upon SEO studies and estimates. Hence, these homes were assumed ineligible for envelope retrofits in the future.
- Low income homes (as defined by the DOE Weatherization Program) were also treated separately.

Appliances

- The Energy Conservation Code also affects water heating and air conditioning in new homes. However, the Office assumed that the federal standards will override the Code's savings requirements for these end-uses.
- Appliances in existing housing, including water heaters and air conditioners, are assumed to turn over at a rate dependent on average life assumptions for each appli-

FIGURE C-8
RESIDENTIAL SECTOR CONSERVATION LEGISLATION AND PROGRAMS

- State Energy Conservation Construction Code.
- Home Insulation and Energy Conservation Act of 1977.
- Federal Appliance Efficiency Standards and State efficiency standards for room air conditioners (Chap. 826, Laws of 1977) and hot water heaters (Chap. 439, Laws of 1977).
- State ban on sale in New York State after June 1, 1980, of appliances with gas pilot lights.
- State requirements for refrigerators and freezers sold in NYS after January 1, 1980, to be equipped with a manually operated switch to shut off the heating unit; and for electric dishwashers to have a switch to eliminate the heating phase of the drying cycle (Chap. 750, Laws of 1977).
- Series of PSC orders from 1974-1977 establishing minimum insulation standards for new and expanded natural gas and electric service.
- PSC order of April 20, 1976, banning master metering of electricity.
- PSC order of August 21, 1974, banning new natural gas connections for heating swimming pools.
- PSC order of January 30, 1973 banning natural gas use for new and existing outdoor and decorative lighting.
- Weatherization Assistance for Low-Income Persons.
- National Energy Act (NEA) Residential Energy Conservation Program.
- NEA Residential Energy Tax Credit.

ance. Replacement appliances are assumed to be of the higher efficiencies that will be required by the appliance efficiency standards, as noted above.

b. Proposed Case

The Office prepared a modified scenario of residential end use energy requirements based upon full implementation of the proposals outlined in the proposed conservation element of the State Energy Master Plan. Refer to Section V-B of the Plan for a detailed discussion of the specific proposals referred to in the following discussion.

New Housing

- In new single family and low density housing constructed after January 1, 1981, the amended Energy Conservation Construction Code would require a reduction in space heat demand of approximately 20 percent below a pre-1979 house through a combination of envelope and device efficiency influences.
- In low rise and high rise housing forty percent savings would be required.

Existing Housing

- The proposed case would require 80 percent efficiencies for replacement oil and gas furnaces. The penetration of these devices would be a function of average life, the possibility of early retirement of the devices, and the effects of fuel switching.that would cause a new device to be purchased.
- Envelope retrofits of existing homes, where they take place, are assumed to achieve greater savings than assumed in the forecast— on the order of 15 percent rather than 12 percent. Therefore, the combination of an envelope retrofit and a new furnace in an existing home would result in 27 percent savings.
- Envelope retrofits of low income homes are treated separately from other homes on an implementation schedule of seven years.

Appliances

- Water heating requirements for new housing are assumed to drop 25 percent due to a combination of code effects, appliance efficiency standards, use of flow restrictors, and reduced thermostat settings. Water heating requirements, are assumed to fall in existing homes where equipment is replaced or retrofitted and similar use of flow restrictors and thermostat setbacks are practiced.
- Air conditioning savings are a function of the combined effects of the code and appliance efficiency standards in new housing. In existing housing, the appliance efficiency standards result in air conditioning savings through turnover of the stock.
- The appliance efficiency standards bring savings to all other appliances in the proposed case in exactly the same manner as in the forecast.

c. Potential Case

The Office prepared a second modified scenario of residential end use energy requirements based upon full implementation of a second conservation scenario including additional far-reaching mandatory conservation measures. Refer to Section V-B of the Energy Master Plan for a detailed discussion of the scenario.

New Housing

- In new single family and low density housing constructed after January 1, 1986, the amended Energy Conservation Construction Code under this scenario would require a reduction in space heat demand of approximately 30 percent below a pre-1979 house through a combination of envelope and device efficiency influences.
- Sixty percent savings would be required of low-rise and high rise housing.

Existing Housing

- Only in this scenario does a code apply to existing housing. By 1994, all housing not previously retrofitted is assumed to use 20 percent less space heating energy than pre-1979 housing through envelope retrofits.
- Device retrofits are assumed to take place in the homes that had envelope retrofits before 1979. A low percentage of total homes are assumed to have a combination envelope/device retrofit resulting in 32 percent space heat energy savings.
- By 1994, all homes are assumed to have reduced water heating requirements by 30 percent as a result of appliance efficiency standards, installation of insulating jackets on older water heaters, use of flow restrictors, and the practice of thermostat setbacks.

Appliances

- Air conditioning end use is reduced below what the appliance efficiency standards would bring about due to the codes for new and existing housing.
- All other end-uses achieve savings in accordance with the appliance efficiency standards.

4) Fuel Supply

The Office assumed that adequate supplies of natural gas will be available to meet demand at the assumed prices. Refer to Section V-D: Natural Gas, of the Energy Master Plan for a detailed discussion of natural gas supplies.

D. Results

The Office applied the baseline residential end use model growth rates to preliminary 1978 consumption accounts data base in order to develop the forecast of residential requirements for 1980, 1984, 1989 and 1994, as presented in Figures C-16. Several adjustments and assumptions were necessary to align the results of the forecasts model with the data base on a consistent basis.

Section V-B of the Energy Master Plan presents a summary of the demand impact of the alternative scenarios in the forecast.

V. COMMERCIAL SECTOR

The Office contracted with Charles River Associates to develop the commercial sector model by adapting to New York State a model originally developed at Oak Ridge National Labs and used extensively nationally. This model provides a framework for forecasting commercial energy requirements by five end uses and four fuel types for three geographic regions in the State—New York City, New York City suburbs, and Upstate. Eight building types are analyzed: private office, retail/wholesale, health care, educational, state, federal, and local government, and a final category of miscellaneous buildings. The model relates energy requirements by end use to the following factors: a forecast of commercial sector economic activity, an assessment of fuel choice, base year unit consumption based upon a range of factors, similar to those noted for the residential model.

The end uses include: space heating, air conditioning, water heating, lighting, and a miscellaneous category, including such auxiliary uses as data processing.

Figure C-9 presents a schematic overview of the commercial sector of the New York State energy forecasting system.

The following material summarize information contained in a report, *Development of a Commercial Sector Energy Use Model for New York State,* prepared by Charles River Associates for the New York State Energy Office.

A. Model Structure

The econometric-engineering commercial energy demand model represents an extension of the capital-stock approach used in most econometric studies. This approach views energy demand as a product of two factors: the first is the stock of energy-using capital measured in terms of maximum potential energy requirements; and the second is a utilization factor that represents actual utilization of equipment relative to the maximum utilization possible. In the short run (i.e., that period in which the stock of capital is fixed), only the utilization factor can change in response to exogenous changes such as fuel price increases. In the long-run, the utilization factor as well as the efficiency and fuel characteristics of capital stock can change as well.

Changes in utilization are modelled using shortrun econometric fuel price elasticities; fuel choice is forecast with an econometric fuel choice model and changes in equipment efficiency are determined using engineering and cost information for space heating and cooling equipment and econometric estimates for the other end uses (lighting, water heating, and other).

Three characteristics of this model distinguish it from traditional modelling approaches. First, reliance on engineering relationships to determine future heating and cooling efficiency provides a more sound basis for forecasting long-run changes in space heating and cooling energy use requirements than can generally be determined through econometric studies alone. Second, the simulation model uses a variety of engineering data on the energy using characteristics of commercial buildings; and third, the model provides estimates of energy use detailed by five end uses, four fuel types, and eight building types.

This appendix presents a summary of the model structure. Figure C-10 is a schematic representation of the model structure. Additions to the stock of end-use systems are determined by subtracting existing equipment stock (which depends on the age distribution and depreciation of existing stock) from stock demand forecasts.[1] Thus the stock of end-use equipment is divided, in each forecast period, into new additions (whether for new buildings or for replacement of worn out systems) and the existing stock.

Existing systems retain efficiency and fuel use characteristics of the previous period. The efficiency of new systems is determined endogenously in the model in one of two ways. For space heating and cooling systems, engineering relationships between operating cost and initial cost for alternative heating and cooling system designs are used along with estimated discount rates (which reflect commercial establishment's preferences on trading future savings for increases in equipment costs) and fuel prices to determine choice of equipment efficiency. This efficiency determination is equivalent to choice of efficiency using a minimum life cycle cost criterion.

Fuel price and efficiency elasticities are used to estimate the efficiency of the other end-use systems (water heating, lighting, and other end uses). These efficiency elasticities are econometrically determined from a pooled cross-section

[1]The stock of energy-using capital (i.e., end use equipment) is measured in the model by the stock of commercial floor space. Floor space is a fairly accurate measure of energy using capital since most commercial end-use systems are designed on the basis of floor space served. For instance, lighting systems are installed to provide minimum illumination levels per square foor of floor space; heating and cooling systems are also designed according to the area served.

FIGURE C-9
ENERGY FORECASTING SYSTEM: COMMERCIAL SECTOR
NEW YORK STATE

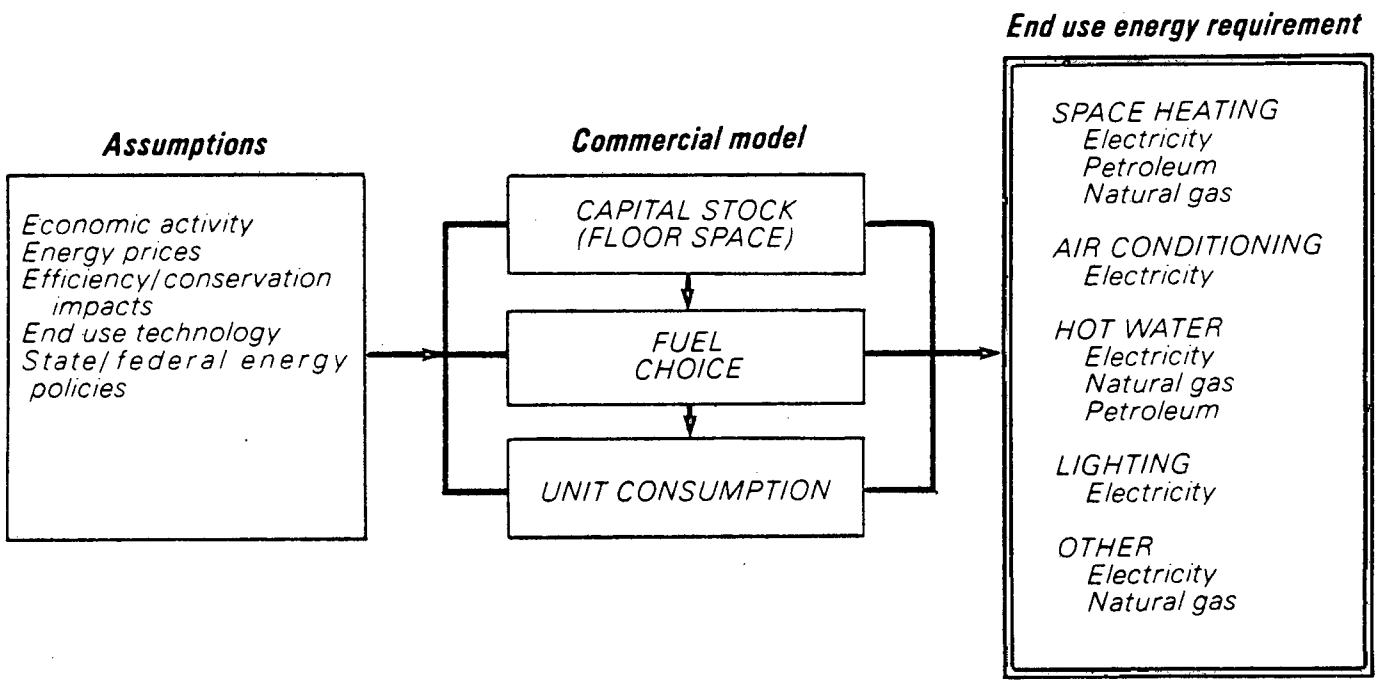
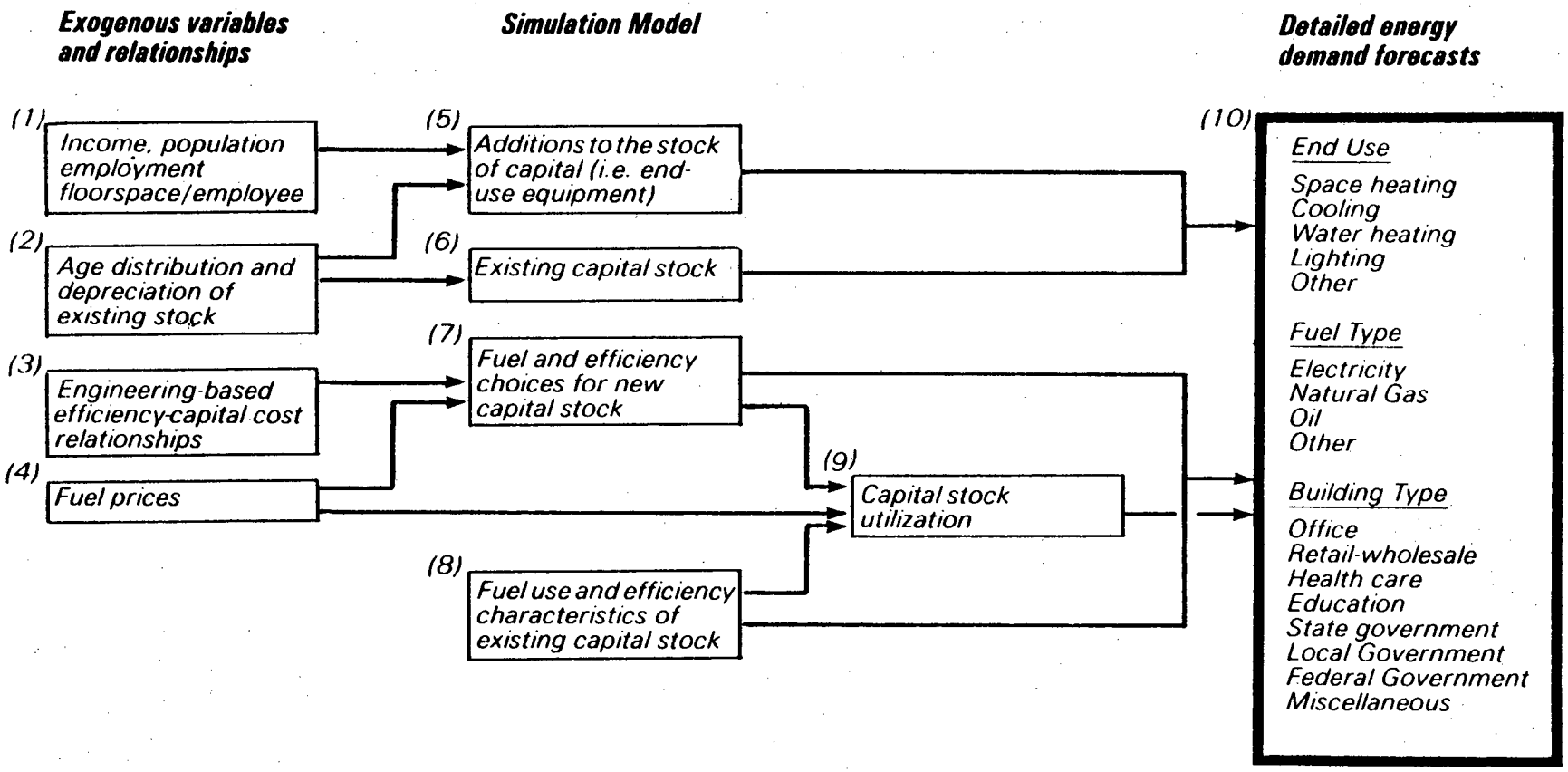


FIGURE C-10

SCHEMATIC REPRESENTATION OF THE NEW YORK STATE ENERGY OFFICE COMMERCIAL ENERGY DEMAND MODEL



time series analysis of state-level commercial energy use. Short-run elasticities are netted out of long-run price elasticities to implicitly determine the price induced efficiency change.

Fuel prices and efficiencies of new systems determine fuel choice characteristics of new space heating systems. Since the price of delivering the end-use service is the relevant price variable, fuel prices must be weighted by efficiencies. For instance, if the price of oil increases by 10 percent but new space heating equipment is 10 percent more efficient, one would not expect to observe a change in the space heating thermostat setting (i.e., a change in utilization) since the cost of providing space heating services has not changed.

The econometrically estimated fuel choice model mentioned above is used to estimate changes in space heating fuel choices. We assume that water heating fuel choices follow those of space heating. Lighting and cooling are almost entirely fueled by electricity. The "other" end use, which represents mostly electromechanical uses, is fueled entirely by electricity except for the retail/wholesale sector where we have included some gas use in the other end use to represent laundry and restaurant gas uses.

Equipment utilization which reflects intensity of equipment use depends both on equipment efficiency and fuel price. Changes in utilization are modelled using fuel-specific short-run price elasticities. For equipment that has not been added or replaced in the previous year, utilization will change relative to utilization of the previous year only as a result of changes in fuel prices. Since utilization of equipment actually depends on the price of producing the end-use service, fuel price changes must be weighted by efficiency changes in those cases where new or replacement equipment has been installed in the current year.

The model, as outlined, provided a forecast of energy requirements by end use and fuel type for each of three regions in the State: New York City, New York City suburbs and the remainder of the State.

B. Data Base

1) Floor Space Data by Age of Building

Floor space data were developed by building type using employment data and estimates of floor space per employee. The floor space per employee ratios incorporate an estimated time trend based on national trends from 1965-1975.

2) Energy Use Requirements

The energy use parameters (EUI) represent energy use required to provide end use services for each end-use/fuel type/building combination. These parameters are developed to be consistent with fuel uses in building types as determined from data provided by NYSEO, with floor space stock data by building type, and with EUI's from engineering studies to prototype commercial buildings.

Total fuel use is determined by EUI parameters, floor space stock estimates, and estimates of the fraction of floor space served by each fuel/end-use combination. It is consistent with estimated fuel use in 1978.

The energy consumption series are based on a variety of sources. Electricity data are developed from commercial sector utility series presented in the 1979 New York Power Pool Report. Gas consumption corresponds to commercial sector and public authorities' gas consumption as reported in the federal energy data system (FEDS) data series. The electricity and gas series were adjusted to remove consumption in master metered apartments.

3) Employment Data by Building Type

Employment series were developed that correspond roughly to the eight building types using U.S. Department of Commerce County Business Patterns data for previous years. Employment forecasts were obtained from the SEO macromodel.

4) Fuel Prices

The state energy price data series developed by the U.S. Department of Energy was used to construct historical series.

C. Assumptions

1) Prices

Section IX of this appendix presents the commercial sector energy price assumptions.

2) Employment Forecasts

The forecast of commercial sector employment, discussed in Section VII of this appendix, provided the statewide control total for allocation to the three commercial sector subregions. SEO staff allocated the control total based upon review of the New York Regional Model economic activity forecast for the New York City region, as well as recent national, State and metropolitan trends.

3) Floor Space Per Employee Estimates

Floor space per employee trends since 1965 were extrapolated over the forecast period.

4) Elasticities

Elasticities (for lighting, water heating, and other end uses) used in determining efficiency increases in end use equipment are from an Oak Ridge National Laboratory (ORNL) study. Engineering relationships also were developed at ORNL. Short run elasticities, used in the model to represent behavioral changes in response to fuel price increases, were based upon econometric studies of the commercial sector.

5) Air Conditioning

The penetration of air conditioning was assumed to increase at 0.4 percent per year in existing buildings. This estimate is consistent with an examination of end use trends for the nation over the 1965 to 1975 period. The percent of new floor space assumed to be air conditioned was 90 percent, a judgmental estimate based upon engineering estimates.

6) Electromechanical Energy Use

Electromechanical energy use requirements were assumed to increase annually at 6 percent of the base year value, a trend which corresponds to national estimates.

7) Non-Price Conservation

Non-price conservation is related to implementation of construction codes and lighting efficiency standards.

a. Forecast (Baseline)

The programs affecting conservation in the commercial sector are the Energy Conservation Construction Code, the Lighting Standard for government buildings, and the NEA

Energy Conservation Programs for Schools, Hospitals, and Buildings Owned by Units of Local Government, and Public Care Institutions. Refer to Section V-B: Conservation, of the Energy Master Plan for a discussion of these programs.

- Commercial buildings constructed after January 1, 1979, are subject to the Energy Conservation Construction Code's requirements for heating, cooling, water heating, and lighting efficiency, based on the ASHRAE 90-75 standard. Studies by A. D. Little of the ASHRAE standard indicate that up to 60 percent energy savings may be achieved through Code compliance. Charles River Associates investigated the sources of the possible 60 percent savings and determined that approximately one-third of that amount could be directly attributed to the architectural/engineering requirements of the Code. The remaining savings are dependent largely on the behavior of the building's maintenance people and occupants. That is to say, the Code in and of itself will result in 20 percent savings. The building occupants and managers must make maximal use of the savings potential offered by the environment and equipment provided by the Code in order to maximize savings. Hence, the Code was estimated to result in 20 percent savings in new commercial buildings for purposes of the forecast.
- Similarly, the Lighting Standard for government buildings, the Schools and Hospitals Program, and the conservation programs for Local Government Buildings and Public Care Institutions were credited with approximately one-third of their estimated potential savings in buildings they impact.

b. Proposed Case

The Office prepared an alternative scenario of commercial end use energy requirements based upon full implementation of the proposals outlined in the proposed conservation element of the State Energy Master Plan. Refer to Section V-B of the Plan for a detailed discussion of the specific proposals referred to in the following discussion.

The proposals affecting commercial sector conservation are a more stringent Energy Conservation Code, a mandatory lighting standard for all non-residential buildings, and the assumption of greater savings resulting from the Schools and Hospitals Program.

- Commercial buildings constructed after January 1, 1981, are assumed to be subject to a more stringent Code which would approximately double the savings directly attributable to the Code's architectural/engineering requirements. Hence, the proposed case Code was estimated to result in 40 percent savings in new commercial buildings for the proposed case.
- The proposed case assumes the lighting standard to be mandatory for all non-residential buildings and assumes about 95 percent compliance with those standards in the commercial sector.
- Assuming that some type of follow-up to the Schools and Hospitals, Local Governments, and Public Care Institutions programs occurs to increase savings achieved through proper use of buildings and equipment by occupants and building managers, the proposed case credits these buildings with approximately two-thirds of their potential savings under their respective programs.

c. Potential Case

The Office prepared a second alternative scenario forecast of commercial end use energy requirements based upon full implementation of additional far-reaching conservation measures. Refer to Section V-B of the Energy Master Plan for a detailed discussion of the scenario and specific measures.

- The Energy Conservation Construction Code and the Lighting Standard mandatory for all nonresidential buildings are assumed in the potential case to achieve 10 percent greater savings than these programs would achieve in the in the forecast or proposed case had behavioral influences been allowed to show energy savings there.
- Full potential savings impacts are credited to schools, hospitals, local government buildings, and public care institutions.
- The potential case further assumed a mandatory retrofit program applies to existing commercial buildings. The retrofits are assumed to be completed by 1990 resulting in 15 percent space heat energy savings per retrofitted building.

D. Results

Figure C-16 of this appendix contains the commercial sector forecast of energy requirements by end use and fuel type. Certain adjustments were necessary to align the forecasting model base year consumption data with the Energy Office preliminary 1978 energy consumption accounts data.

Section V-B: Conservation, presents a summary of the demand impact of the alternate scenarios on the forecast.

VI. INDUSTRIAL SECTOR

The industrial model, developed by the SEO staff, employs an econometric approach to forecast energy requirements by eight industry or industry groupings. This approach relates energy consumption by industry to forecasts of economic activity (output and employment), fuel choice, and relative energy prices. The model makes forecasts, individually, for the five most energy intensive manufacturing industries combined, all other manufacturing industries, and other industrial energy uses, including construction and mining.

Figure C-11 presents a schematic overview of the industrial sector of the New York State Energy forecasting system.

A. Model Structure

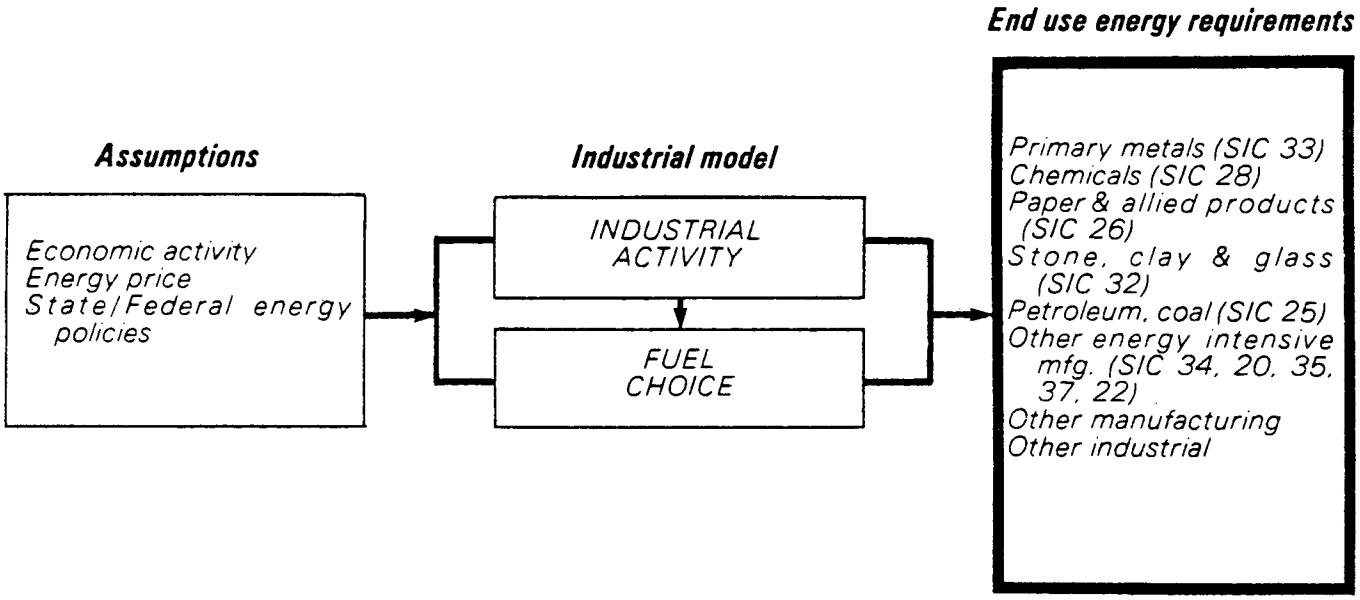
The Office modelled industrial energy consumption by industry on the basis of energy intensity. The five most energy intensive industries (SIC's 26, 28, 29, 32 and 33) were modelled individually. The next five most energy intensive (SIC's 20, 22, 34, 35 and 37) were treated as one group. The remaining industries (SIC's 23, 24, 25, 27, 30, 31, 36, 38 and 39), considered to be "non-target" industries, were also considered as a group.

Energy intensity is defined to be consumption in a given industry per unit of output. The ten most energy intensive industries are referred to as the "target" industries. Since these industries consume the most energy per unit of output, they would be the most likely candidates for conservation strategies.

The basic configuration of the energy equations was consumption as a function of output and prices relative to the average price of all the purchased fuels. Employment plays a part in the equation for purchased fuels which also includes our prices. In estimating the equations, actual historical values for the independent variables were used.

The equations forecast energy consumption by fuel type for the top five target industries, the next five as a group and the non-target industries as a group. Summing up the con-

FIGURE C-11
ENERGY FORECASTING SYSTEM: INDUSTRIAL SECTOR
NEW YORK STATE



sumption numbers for each industry or industry group by fuel type yields the total amount of that fuel used in the manufacturing sector. By identity, total energy consumption in the industrial sector is the sum of the total consumption of each fuel type.

B. Data Base

The energy cost and consumption data used for modelling the industrial sector in New York State was taken from the Annual Survey of Manufacturers (ASM), published by the U.S. Bureau of the Census, for the years 1974, 1975 and 1976. This data was available at the state level by two-digit SIC code and by fuel type.

The ASM data reflects the result of industry surveys conducted by the Bureau of Census. It is independent of any other government sources of energy consumption, such as the U.S. Department of Energy's FEDS data base. The advantage of using the ASM industrial data is that, in addition to the detail provided, it is strictly and consistently defined to be SIC's 20 through 39.

The data is provided in terms of "purchased fuels and electric energy" used by the industries, as well as the amount paid for the energy used by the industries. The ASM includes in the "purchased fuels" category, distillate oil, residual oil, bituminous and anthracite coal, coke and breeze, natural gas, "other fuels", and "fuels not specified by kind". The amount paid for this energy is also available in these same categories. An implicit price of each fuel type was derived by dividing the amount paid for a particular type of energy by the amount of that fuel type used.

Two basic sets of data were used in estimating the equations employment and industrial output. Statewide employment numbers at the two-digit SIC level for the historical period were taken from data published by the Bureau of Labor Statistics (BLS). The historical data for industrial output was primarily taken from the ASM.

The ASM energy cost and consumption numbers, on the other hand, do not form complete data series. The primary limitation is that the data published by the ASM, exist only for the years 1962, 1967, 1971, 1974, 1975 and 1976. It was therefore necessary to restrict our "historical period" to the years 1974, 1975 and 1976 for the purpose of estimating our equations. This yields a continuous series of data and has the added advantage of reflecting post-embargo behavior.

There were a few cases of missing observations due to disclosure problems on the part of the ASM in relation to a particular SIC and fuel type. The problem of missing data occurred in the smaller less energy intensive SIC's, which were treated as a group rather than separately modelled.

C. Assumptions

1) Economic Activity

Figure C-12 presents the State economic activity forecast.

2) Prices

Section IX of this appendix presents the fuel specific price assumptions for the industrial sector.

3) Non-Price Conservation

The industrial sector tends to respond rather quickly to changing energy prices. Further, there is no State or federal legislation mandating industrial energy efficiency standards. Therefore, no non-price induced conservation was incorporated in the forecast.

4) Near-Term Gas Supplies

Industrial energy requirements through 1980 were adjusted to reflect recent oil to natural gas switching as natural gas supplies became available and oil prices increased dramatically. These adjustments were based on actual sales for the first five months of 1979 and a careful review of the increased gas sales to large industrial customers recorded since early 1978.

D. Results

The Office applied industrial model growth rates to the

preliminary 1978 energy consumption accounts data base in order to develop the forecast of industrial energy requirements for 1980, 1984, 1989 and 1994, as presented in Figure C-16. Several adjustments were necessary to align the results of the forecast model with the data base on a consistent basis.

VII. TRANSPORTATION SECTOR

For the transportation sector, the Office relied on forecasting techniques developed by the New York State Department of Transportation (NYSDOT). NYSDOT techniques relate energy consumption by mode of travel, prices, fuel efficiency standards, and other factors. The techniques provided forecasts of transportation energy requirements for the following seven modes: highway-auto, highway-freight, air-passenger, air-freight, rail, vessels, highway and non-highway other.

In general Figure C-13 illustrates the forecasting approach, assumptions and end use energy requirements information provided by the transportation sector forecasting techniques.

This appendix summarizes the methodology used by NYSDOT.

A. Model Structure

The techniques for forecasting vehicle miles of travel (VMT) and energy consumption used by NYSDOT vary with the mode of travel under consideration. Energy consumption forecasting techniques for highway-automobile, highway-freight, air-passenger and air-freight, which account for 89 percent of the estimated 1978 consumption deserve special attention.

1) Highway-Auto

The forecasting technique used for automobile gasoline consumption consists of several linked variables: a forecast of vehicle miles of travel, assumed corporate automobile fleet efficiency (CAFE) standards pursuant to the Energy Policy and Conservation Act (EPCA) of 1975, and sensitivity of gasoline consumption to price changes.

The DOE vehicle miles of travel forecasting technique consists of a standard regression equation relating vehicle miles of travel to aggregate measures of the level of economic activity, such as gross State product, employment, and personal income. VMT, as forecasted by DOT will grow at approximately its recent historic rate of approximately two and one half percent throughout the forecast period. VMT for other transportation modes were assumed to grow at their respective historic rates.

The gasoline consumption forecasting technique relates gasoline consumption for a given level of vehicle miles of travel to an assumption about corporation automobile fleet efficiency standards and a gasoline price elasticity assumption.

2) Highway-Freight

The forecast of highway-freight gasoline and diesel consumption was based on a trended forecast of total truck registrations and of the light trucks' share of those registrations. No CAFE standards were applied to heavy trucks, but the efficiency of light trucks was adjusted in accordance with an assumed CAFE standard for light duty trucks of 18 MPG by 1989.

3) Air-Passenger and Air-Freight

The DOT forecasting technique for air-passenger and air-freight represents an adaptation of a standard econometric forecasting technique used by U.S. Department of Transportation Federal Aviation Administration. This technique employs a standard regression equation to relate revenue passenger miles; revenue ton miles, and jet fuel consumption to aggregate measures of economic activity.

4) Other Modes

For forecasting energy consumption of all other modes, NYSDOT used a generally uniform approach which related consumption to vehicle or ton miles of travel.

5) Data Base

The NYS Department of Transportation relied upon standard federal and State statistics on vehicles, vehicle miles of travel, energy consumption and economic activity as the data base for mode-specific (i.e., highway-automobile, air-passenger, rail, etc.) forecasting techniques.

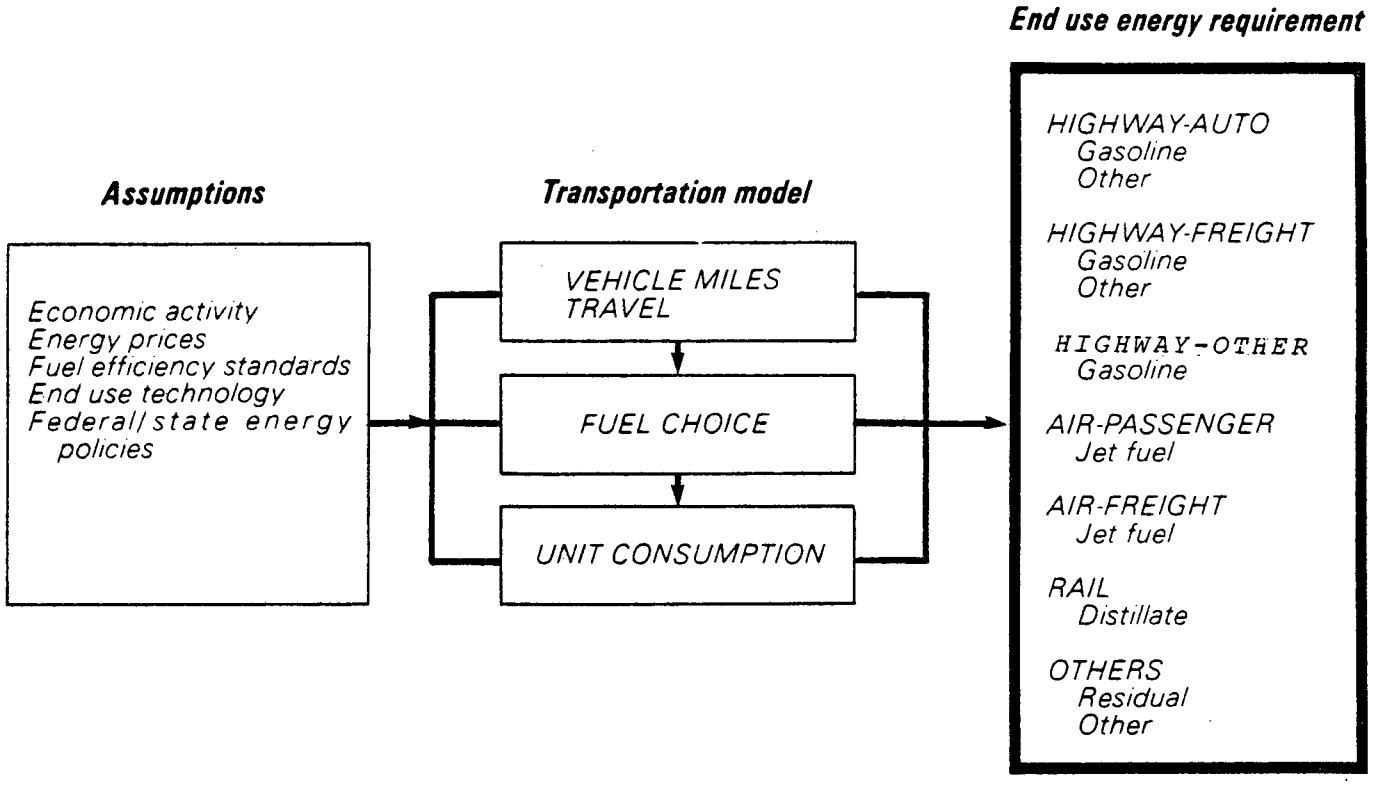
B. Assumptions

NYSDOT used the following assumptions, as specified by the Energy Office, for the development of the forecasts.

FIGURE C-12
SELECTED INDUSTRIAL SECTOR ECONOMIC ACTIVITY INDICATORS, 1960-1994

Economic Activity	1960	1973	1978	1994	Average Annual Percent Change 1960-1973	1973-1978	1978-1994
General							
Gross State Product (Billions 72$)	89.3	137.1	137.0	197.7	3.4	0.0	2.2
Personal Income (Billions 72$)	63.5	96.0	96.3	147.2	3.2	0.3	2.5
Per Capita Income (Billions 72$)	3790	5249	5393	7603	2.5	0.6	2.0
Industrial Sector							
Manufacturing Output (Billions 72$)	21.3	32.7	32.2	53.4	3.3	-0.2	3.0

FIGURE C-13
ENERGY FORECASTING SYSTEM: TRANSPORTATION SECTOR
NEW YORK STATE



1) Economic Activity

Aggregate forecasts of State economic activity were used as indicated in Section VIII of this appendix.

2) Price and Price Elasticity

Gasoline price assumptions over the forecast period were used as detailed in Section IX of the appendix. The price elasticity of gasoline consumption was assumed to be .15; in other words, a ten percent increase in gasoline prices was assumed to result in a 1.5 percent decrease in gasoline consumption.

3) Non-Price Conservation

a. Forecast (Baseline)

The only non-price induced conservation that is folded into the forecast occurs due to the EPA corporate average fleet efficiency (CAFE) standards for passenger automobiles, taxis, and light duty trucks. For passenger automobiles, the CAFE standard reaches 27.5 miles per gallon in 1985 and remains constant thereafter. For light duty trucks, the CAFE standard reaches 18 MPG in 1989. Taxis have been temporarily exempted from the CAFE standards, but are assumed to be required to meet a minimal standard (8 MPG) beginning in 1983, increasing to 15 MPG by 1995.

b. Proposed Case

The Office prepared an alternative scenario of transportation end use energy requirements based upon full implementation of the proposals outlined in the proposed conservation element of the State Energy Master Plan. Refer to Section V-B of the Plan for a detailed discussion of the specific proposal referred to in the following discussion.

The Conservation element of the State Energy Master Plan proposes that Congress adopt more stringent automobile fleet efficiency standards. This standard is assumed to rise by one-half MPG each year after 1985 and level off at 30 MPG in 1990.

c. Potential Case

The Office prepared a second alternative scenario of transportation end use energy requirements based upon full implementation of a second conservation scenario, including additional far reaching conservation measures. Refer to Section V-B of the Energy Master Plan for a detailed discussion of the scenario and the specific proposal noted below.

The Potential Case of the conservation element of this Plan investigates the effects on automobile gasoline consumption resulting from CAFE standards approaching today's estimate of the technological limits of the auto industry. For this scenario, the CAFE standard is assumed to rise by one MPG per year from 1991 through 1995, reaching a standard of 35 MPG in 1995. This change makes the rate of growth in gasoline demand hover around zero percent for the remainder of the forecast period.

C. Results

Figure C-16 presents the forecast of transportation sector energy requirements by end use and average annual growth rates of energy consumption by mode of travel over the forecast period.

Several adjustments were necessary to align the DOT data

bases with the SEO preliminary 1978 energy consumption accounts.

Section V-B: Conservation presents a summary of the demand impact of the alternative scenarios on the forecast.

VIII. STATE ECONOMETRIC MODEL

The State macroeconometric model is integrated with the SEO Energy Forecasting System (EFS). The macro model is a fairly detailed analytic description of the major economic processes occurring in New York State. The premise of the macromodel is that the equations describing the processes are valid over the forecast period as well as over history.

A. Model Structure

The economic framework in which the macro model was constructed consists of a standard accounting mechanism and economic behavior of aspects which fit into the accounting system. In addition, the New York State model draws upon an existing model of the national economy, the latter supplying assumptions to the State model.

The framework of the macro model is specified along four major dimensions: output, employment, unit wages, and earnings or income. The output dimension is made up of the value added in each of the sixteen major sectors of the New York State economy which we have chosen to analyze. These sectors are defined to be exhaustive, that is, these sections account for all output or activity in the State. The employment sectors as well as those of wages and income are defined in similar detail. The model is set up to forecast standard aggregate measures of economic activity, as well as the relevant components.

The output, employment, and income forecasts then feed into the various sectoral energy models as appropriate (these links are described elsewhere). It is important to note that these three key vectors and their components are determined simultaneously in the macro model, i.e., whatever the numbers happen to be, they are consistent with all other numbers in the forecast. This simultaneity is what underlies the complexity of forecasting.

The three major processes are each divided into sixteen important sectors. Those sectors are agriculture, mining, contract construction, regulated industries, wholesale and retail trade, finance, insurance,and real estate, services, state government, local government, and seven subsectors within the manufacturing sector. The Office modelled stochastically the economic behavior for output, employment, and wages in each of the sectors, Identities are then used to combine the components into meaningful aggregates. Thus, the identities—the various "bottom lines" do indeed represent detailed components of economic behavior.

A generic description of the equations follows. Each of the equations in each of the segments is composed of two kinds of explanatory variables, combined in various ways as appropriate. There is a state level determinant and a national level determinant. The rationale for such national explicatory is that New York is very much part of the national economic picture, and that the economic situation in the nation does in fact influence events in New York. The role of State level variables is also clearcut in that the various sectors each depend on each other as customers and as suppliers.

The relationships among the explanatory variables are complex, as regional competitive effects play important roles as determinants of economic activity. In many cases, especially in the output sectors certain relative numbers are used to explain processes. For instance, the ratio of NY labor costs to those of the nation might be used as a measure of competitive position.

At this point, it is necessary to emphasize the link between our model and the economy of the nation. The model is linked to the Wharton Long-Term Annual and Industrial Model, exploiting the expertise of this forecast of the national economy.

The macro model can be summarized in terms of some key identities. It should be noted that each of the terms of the identities may itself be either an identity or a behavioral variable.

The first identity is for Gross State Product.

1) GSP=XAG+XMG+XCC+XMFG+XTCU+XWRT +XFIR +XSV+XGOVF+XGOVSL

Manufacturing is itself an identity of seven components—the five most energy intensive industries, the next five industries together, and the ten least energy intensive.

2) XMFG=X26+X28+X29+X32+X33+XTARGRP+XNTAR

The X refers to real value added, and the other descriptors refer to the particular industry group.

3) ETT=EAG+EMG+ECC+EMFG+ETCU+EWRT+EFIR +ESV+EGOVF+EGOVSL

4) EMFG=E26+E28+E29+E29+E32+E33+ETARGRP+ ENTAR

Employment times wages equals earnings for a particular industry group, and earnings combined with other income components to make personal income:

5) PYTSFJ=ERNT+RID+TR-SOC-RADJ

This identity says simply that residence adjusted real personal income is the sum of employee earnings plus rent, interest, dividends and transfers, less employee contributions to Social Security, less the residence adjustment.

The basic flow of the model is from output to employment to earnings and income via wage rates. However, labor costs and hence employment and wages play a role in output determination, just as wages and output play a role in the demand for labor. Thus, although it is possible to conceptualize a logical flow of economic processes, the model mirrors reality in that many of these phenomena are in fact co-determined.

B. Data Base

The data base for the macroeconometric model consists of standard State and federal economic activity data series.

C. Assumptions

The Wharton Annual Long-Term Model provided the forecast of national economic activity. The Wharton forecast of GNP average annual growth rate for the period 1978-1990 was 2.8 percent.

D. Energy Prices

Section VIII of this Appendix presents the energy price assumption used in the macroeconometric model.

E. Results

Figure C-14 presents a summary of the forecast of State economic activity.

IX. ENERGY PRICE ASSUMPTIONS

The New York State Energy Office prepared a set of energy price assumptions by sector of energy use and fuel type for use in preparation of the forecast of State energy require-

FIGURE C-14
SELECTED ECONOMIC ACTIVITY INDICATORS, 1960-1994

Economic Activity	1960	1973	1978	1994	Average Annual Percent Change 1960-1973	1973-1978	1978-1994
General							
Gross State Product (Billions 72$)	89.3	137.1	137.0	197.7	3.4	0.0	2.2
Personal Income (Billions 72$)	63.5	96.0	96.3	147.2	3.2	0.3	2.5
Per Capita Income (Billions 72$)	3790	5249	5393	7603	2.5	0.6	2.0
Commercial Sector							
Commercial Employment (Thousands)	4032	5220	5320	6577	2.0	0.4	1.3
Industrial Sector							
Manufacturing Output (Billions 72$)	21.3	32.7	32.2	53.4	3.3	-0.2	3.0

ments. In addition, the energy price assumptions presented here served as the basis for analysis conducted in relation to the various supply plans, including conservation, renewables, conventional fuels and the electric system.

A. Methodology

1) Policy Assumptions

- National and State energy legislation, including the National Energy Act of 1978, and programs authorized by such legislation through June 30, 1979, will be fully implemented. The components of the National Energy Act of 1978 are: National Energy Conservation Act of 1978, Powerplant and Industrial Fuel Use Act of 1978, Public Utility Regulatory Policies Act of 1978, Natural Gas Policy Act of 1978 and Energy Tax Act of 1978.
- Domestic oil decontrol will occur in a phased manner over the next several years.

2) World Oil Prices

The forecast of world oil prices rests on the following major assumptions.

- Crude oil export prices through 1980 in all producing nations will reflect OPEC pricing decisions.
- The real world oil price will increase, beginning in 1980, at an average annual rate of 2 percent per year through 1985 and 3 percent per year thereafter.

Review of National Energy Plan II price assumptions, the Energy Information Administration, U.S. Department of Energy, DOE report, *Energy Supply and Demand in the Midterm, 1985, 1990 and 1995* and the *Energy Master Plan* submissions of major petroleum suppliers serving New York State support these conclusions. Past history suggests that the actual pattern of change might well resemble a series of increases followed by a period of constant price rather than a continuous smooth rise in price. Real prices increase more rapidly after 1985 because new crude oil discoveries and production are not expected to keep pace with demand for petroleum products.

3) Petroleum Product Prices

- The January 1978 to mid-year 1979 pricing pattern will continue through 1980.
- After 1980, prices will reflect real increases in refiner acquisition costs but changes in other expenses related to retail product prices will track inflation rates.
- Refiner acquisition costs of domestic and foreign crude oil reach parity by 1985.
- The 1980 sector price relationships for particular products will continue through 1994.

a. Price Changes 1978-1980

Recent pricing patterns, with the exception of residual fuel used in the electric utility sector, were extended through the close of 1980 to estimate average annual 1980 price levels. The resulting prices were adjusted for inflation to convert them to a 1978 base. January 1978 to June 1979 price trends were determined after thorough review of data from Energy Office price surveys, industry trade journals, daily newspaper price postings and price service reports.

Recent price trends were continued through the second half of the 1978-1980 period because the overall gain in refiner acquisition cost is expected to approximate the rise that occurred in the first half. OPEC crude oil price increases effective July, 1979 will combine with the impact of phased decontrol on domestic crude oil prices to raise refiner acquisition costs.

Electric utility residual oil prices between mid-1979 and December 1980, were projected to increase at the same rate as were residual fuel prices in other sectors. The worldwide crude oil shortage of early 1979 accelerated prices of low sulfur residual oil, a fuel predominantly obtained from the import market and used in utility boilers, faster than the price of any other petroleum product. This trend is unlikely to characterize the second half of the 1978-1980 period. Indeed, utility residual oil price should move upwards at a somewhat slower rate because higher crude oil costs are expected to be spread more evenly over all products. Phased decontrol will have little impact on utility residual oil costs but OPEC increases will have a major effect.

b. Price Changes 1984 and Beyond

Petroleum product prices were projected for 1984, 1989 and 1994. Price changes between these benchmark years are assumed to occur in a uniform manner.

Real petroleum product prices (in 1978 dollars) were based solely on expected real increases in refiner expectations for crude oil acquisition costs. These higher costs were distributed to each petroleum product in the ratio of that product's price during the prior actual forecast year to the refiners crude oil cost for the same period. Jet fuel is a kerosene based product, so prices for this fuel were not independently projected. Instead, jet fuel prices were forecast to move in the same manner as kerosene.

4) Natural Gas Prices

The Office reviewed a wide range of natural gas price assumptions prepared by the federal government, the New York Gas Group, the American Gas Association and others, including projections prepared by the Energy Information Administration, U.S. Department of Energy published in *Energy Supply and Demand in the Midterm, 1985, 1990 and 1995.* All of these forecasts had been prepared prior to the recent OPEC price increase.

The Natural Gas Policy Act of 1978 sets forth the basic framework for natural gas pricing over the next decade. The Office's natural gas price assumptions assume full implementation of that legislation with respect to all key provisions, including natural gas price decontrol in 1985 and incremental pricing for industrial consumers.

In addition, the Office considered a range of factors which will affect natural gas prices, including availability of supplies, (conventional and nonconventional sources), federal regulatory policy with respect to use under boilers, and transmission and distribution factors.

5) Coal Prices

The Office reviewed numerous coal price assumptions prepared by the federal government, major coal suppliers and ICF, Inc. among others, including projections prepared by the Energy Information Administration, U.S. Department of Energy published in *Energy Supply and Demand in the Mid-Term, 1985, 1990 and 1995.*

Numerous factors will affect coal prices in the future. Important factors include federal and State regulatory actions, primarily implementation of the PIFUA, and the Clean Air Act Amendments of 1977, demand, availability of supplies, transportation costs, environmental costs associated with land reclamation, labor agreements, production costs, and depletion costs.

B. Energy Price Assumptions

Figure C-15 presents the set of New York State energy price assumptions by sector of energy use and fuel type prepared by the Energy Office for 1978, 1980, 1984 and 1994.

This set of energy price assumptions was used on a consistent basis in all the energy forecasting models. While the price assumptions are Statewide, assumptions for sectoral forecast models with substate detail reflect the regional differences in base year prices.

X. FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994.

Figure C-16 presents the official New York State Energy Office forecast of energy requirements by sector, end use and fuel type for 1978, 1984, 1989 and 1994.

XI. ELECTRIC UTILITY SERVICE AREA ELECTRICITY SALES (KWH) FORECASTS

The Office prepared forecasts of electric utility demand (sales) by service area as an integral part of the forecast of State energy requirements.

Figure C-18 presents a schematic summary of the SEO forecast methodology at the substate level.

This section reviews the methodology used for the development of electric utility service area sales forecasts for each of the four demand sectors.

A. Model Structure

1) Residential

The residential energy forecast model described in Section IV of this appendix provided the forecast of residential electricity demands (sales) by end use for each electric utility service area.

Several minor adjustments were necessary to align the forecasting model data base with the preliminary 1978 energy consumption accounts data base which, in turn, is consistent with the New York Power Pool reported consumption in 1978. PASNY's own residential sales forecast was used for PASNY.

2) Commercial

The commercial sector energy forecast model described in Section V of this appendix provided the framework for development of electric utility service area commercial demand (sales) forecasts.

Commercial sector electricity sales forecasts were developed for three regions of the State: New York City, New York City suburbs (i.e., Nassau, Suffolk, Westchester, Orange and Rockland counties), and upstate New York. These regional forecasts, except for New York City were then apportioned to utility service areas within each region in conformance with the relationship among the utilities' 1979 NYPP forecasts of commercial sales. The forecast for the New York City area was used for Con Edison since the two are largely coterminous, PASNY's own commercial sales forecast was used for PASNY.

3) Industrial

The SEO industrial sector energy forecasting model described in Section VI of this appendix provided electricity sales forecasts for each of the State's five most energy intensive manufacturing industries, the next five most energy intensive industries combined, and other manufacturing industries combined.

The SEO translated the Statewide industrial sector forecast to electric utility service areas through an eclectic method that included the consideration of the forecasts and underlying methods, data and assumptions of the respective NYPP members, forecasts prepared last year by participants in Phase II of the Long-Range Electric Plan 149-b hearings, an industry weighted average growth rate for each utility, recent industrial sales growth trends and regional prospects for manufacturing sector growth.

4) Transportation

The Office incorporated the forecasts of the New York State Power Pool for the transportation sector, which accounts for only 2 percent of total electricity sales.

B. Assumptions

FIGURE C-15
NEW YORK STATE ENERGY PRICE ASSUMPTIONS BY SECTOR AND FUEL TYPE, 1978-1994

	1978 Constant Dollars										Average Annual Percent Change			
	1978		1980		1984		1989		1994		1978-1980	1980-1984	1984-1989	1989 1994
	$/ UNIT	$/ MMBTU	$/ UNIT	$/ MMBTU	$/ UNIT	$/ MMBTU	$/ UNIT	$/ MMBTU	$/ UNIT	$/ MMBTU				
Crude Oil														
Foreign Acquisition Cost	14.47/bbl	2.57	20.26/bbl	3.60	21.93/bbl	3.90	25.18/bbl	4.48	29.18/bbl	5.19	18.3	2.0	3.0	3.0
Domestic Acquisition Cost	10.62/bbl	1.89	14.42/bbl	2.56	21.93/bbl	3.90	25.18/bbl	4.48	29.18/bbl	5.19	16.5	11.0	3.0	3.0
Composite	12.46/bbl	2.22	16.99/bbl	3.02	21.93/bbl	3.90	25.18/bbl	4.48	29.18/bbl	5.19	16.8	6.6	3.0	3.0
Residential														
Natural Gas	3.37/mcf	3.24	3.64/mcf	3.50	4.26/mcf	4.10	5.08/mcf	4.89	5.92/mcf	5.70	4.0	4.0	3.6	3.0
Distillate	.51/gal	3.68	.72/gal	5.19	.82/gal	5.91	.92/gal	6.63	1.02/gal	7.35	18.8	3.3	2.3	2.1
Kerosene	.52/gal	3.82	.73/gal	5.41	.83/gal	6.15	.93/gal	6.89	1.03/gal	7.63	18.5	3.3	2.3	2.1
Electricity	.064/kwh	18.76	.068/kwh	19.90	.074/kwh	21.69	.080/kwh	23.33	.084/kwh	24.65	3.0	2.1	1.5	1.0
Commercial														
Natural Gas	2.53/mcf	2.44	2.79/mcf	2.69	3.46/mcf	3.33	4.52/mcf	4.35	5.80/mcf	5.58	5.0	5.5	5.5	5.0
Distillate	.49/gal	3.53	.70/gal	5.05	.80/gal	5.77	.90/gal	6.49	1.00/gal	7.21	19.5	3.4	2.4	2.1
Residual	.42/gal	2.81	.60/gal	4.01	.69/gal	4.61	.78/gal	5.21	.87/gal	5.81	19.5	3.6	2.5	2.2
Kerosene	.50/gal	3.70	.71/gal	5.26	.81/gal	6.00	.91/gal	6.74	1.01/gal	7.48	19.2	3.3	2.4	2.1
Electricity	.053/kwh	15.53	.056/kwh	16.48	.062/kwh	18.17	.061/kwh	19.60	.071/kwh	20.72	3.0	2.5	1.5	1.0
Industrial														
Natural Gas	2.36/mcf	2.27	2.65/mcf	2.55	3.41/mcf	3.28	4.50/mcf	4.33	5.87/mcf	5.65	6.0	6.5	5.5	5.5
Distillate	.49/gal	3.53	.70/gal	5.05	.80/gal	5.77	.90/gal	6.49	1.00/gal	7.21	19.5	3.4	2.4	2.1
Residual	.42/gal	2.81	.60/gal	4.01	.69/gal	4.61	.78/gal	5.21	.87/gal	5.81	19.5	3.6	2.5	2.2
Kerosene	.50/gal	3.70	.71/gal	5.26	.81/gal	6.00	.91/gal	6.74	1.01/gal	7.48	19.2	3.3	2.4	2.1
Coal	50.00/ton	2.08	53.05/ton	2.21	59.71/ton	2.51	66.57/ton	2.80	73.50/ton	3.09	3.0	3.0	2.0	2.0
Electricity	.053/kwh	15.53	.056/kwh	16.48	.062/kwh	18.17	.067/kwh	19.60	.071/kwh	20.72	3.0	2.5	1.5	1.0
Transportation														
Gasoline	.692/gal	5.34	.918/gal	7.35	1.053/gal	8.43	1.182/gal	9.46	1.297/gal	10.38	15.2	3.5	2.3	1.9
Jet Fuel	.35/gal	2.59	.56/gal	4.15	.66/gal	4.89	.76/gal	5.63	.86/gal	6.37	26.4	4.2	2.9	2.5
Electric Utility														
Residual	.30/gal	2.00	.43/gal	2.87	.52/gal	3.47	.61/gal	4.08	.70/gal	4.68	19.5	4.9	3.2	2.8
Coal	33.51/ton	1.41	35.55/ton	1.50	40.01/ton	1.68	44.61/ton	1.88	49.25/ton	2.07	3.0	3.0	2.0	2.0
Distillate	.383/gal	2.76	.55/gal	3.97	.67/gal	4.83	.78/gal	5.62	.89/gal	6.42	19.5	5.1	3.0	2.7

FIGURE C-16

FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994 (TBTU)*

1978

	Electricity	Natural Gas	Petroleum Products	Other (Coal, Wood and Other)	Total
Residential	111.1	334.2	498.4	23.2	966.9
Space Heating	6.9	255.7	454.8	22.2	739.6
Water Heating	8.6	44.3	42.0	0.6	95.5
Cooking	4.8	29.7	1.6	0.4	36.5
Clothes Drying	6.9	4.5	---	---	11.4
Central A/C	1.4	---	---	---	1.4
Room A/C	6.1	---	---	---	6.1
Appliances, Lighting and Other	76.4	---	---		76.4
Commercial	145.0	131.7	395.2	1.2	673.1
Space Heating	15.4	91.5	356.9	1.2	465.0
Cooling A/C	33.2	---	---	---	33.2
Water Heating	2.5	10.0	38.3	---	50.8
Lighting	70.3	---	---	--	70.3
Other	23.6	30.2	---	---	53.8
Industrial	95.9	105.0	120.1	59.2	380.2
Mfg.-Energy Intensive Industries	65.8	81.7	95.1	44.1	286.7
Primary Metals (SIC 33)	21.0	22.8	13.3	7.2	64.3
Chemicals (SIC 28)	8.8	13.1	17.2	8.6	47.7
Paper & Allied Products (SIC 26)	6.4	5.2	24.2	10.0	45.8
Stone, Clay and Glass (SIC 32)	4.7	12.0	7.5	8.6	32.8
Petroleum & Coal (SIC 29)	1.1	0.5	2.2	0.8	4.6
Other (SIC 34, 20, 35, 37, 22)	23.8	28.1	30.7	8.9	91.5
Mfg.-Other	28.2	21.2	13.0	15.1	77.5
Other Industrial	1.9	2.1	12.0	---	16.0
Transportation	7.8	---	1098.0	---	1105.8
Highway	---	---	802.9	---	802.9
Auto	---	---	560.0	---	560.0
Freight	---	---	242.9	---	242.9
Other	---	---	17.2	---	17.2
Air	---	---	183.0	---	183.0
Passenger	---	---	142.7	---	142.7
Freight	---	---	40.3	---	40.3
Rail	7.8	---	19.2	---	27.0
Vessel	---	---	75.7	---	75.7
TOTAL	359.8	570.9	2111.7	83.6	3126.0

* Sectoral and end use forecasts by fuel type have not been adjusted for the impacts of the recently enacted State lighting standards and the higher than assumed 1980 petroleum product prices.

FIGURE C-16 cont.

FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994 (cont.)*
1980

	Electricity	Natural Gas	Petroleum Products	Other (Coal, Wood and Other)	Total
Residential	113.3	348.6	489.1	27.8	978.8
Space Heating	8.1	268.5	445.4	26.7	748.8
Water Heating	9.0	45.9	42.1	0.6	97.6
Cooking	4.9	29.7	1.6	0.4	36.6
Clothes Drying	7.0	4.5	---	---	11.5
Central A/C	1.5	---	---	---	1.5
Room A/C	6.2	---	---	---	6.2
Appliances, Lighting and Other	76.6	---	---		76.6
Commercial	153.2	138.7	387.5	1.0	680.4
Space Heating	15.6	96.5	349.8	1.0	462.9
Cooling A/C	36.5	---	---	---	36.5
Water Heating	2.6	10.3	37.7	---	50.6
Lighting	72.4	---	---	--	72.4
Other	26.1	31.9	---	---	58.0
Industrial	101.6	117.0	102.6	57.0	378.2
Mfg.-Energy Intensive Industries	70.7	91.2	81.1	42.9	285.9
Primary Metals (SIC 33)	22.6	25.9	10.7	7.5	66.7
Chemicals (SIC 28)	9.5	13.9	14.9	8.2	46.5
Paper & Allied Products (SIC 26)	7.5	6.2	19.7	9.0	42.4
Stone, Clay and Glass (SIC 32)	5.3	12.8	5.3	8.3	31.7
Petroleum & Coal (SIC 29)	1.4	0.7	2.0	0.6	4.7
Other (SIC 34, 20, 35, 37, 22)	24.4	31.7	28.5	9.3	93.9
Mfg.-Other	28.9	23.6	9.7	14.1	76.3
Other Industrial	2.0	2.2	11.8	---	16.0
Transportation	8.7	---	1073.1	---	1081.8
Highway	---	---	771.2	---	771.2
Auto	---	---	528.4	---	528.4
Freight	---	---	242.8	---	242.8
Other	---	---	17.6	---	17.6
Air	---	---	188.2	---	188.2
Passenger	---	---	147.9	---	147.9
Freight	---	---	40.3	---	242.8
Rail	8.7	---	20.9	---	29.6
Vessel	---	---	75.2	---	75.2
TOTAL	376.8	604.3	2052.3	85.8	3119.2

* IBID.

FIGURE C-16 cont.

FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994 (cont.)*

1984

	Electricity	Natural Gas	Petroleum Products	Other (Coal, Wood and Other)	Total
Residential	119.9	378.2	461.1	36.4	995.6
Space Heating	10.5	294.4	418.6	35.4	758.9
Water Heating	9.8	49.1	41.0	0.6	100.5
Cooking	5.2	29.8	1.5	0.4	36.9
Clothes Drying	7.6	4.9	---	---	12.5
Central A/C	1.7	---	---	---	1.7
Room A/C	6.5	---	---	---	6.5
Appliances, Lighting and Other	78.6	---	---		78.6
Commercial	162.8	141.6	388.7	0.7	693.8
Space Heating	17.3	98.2	350.6	0.7	466.8
Cooling A/C	40.1	---	---	---	40.1
Water Heating	2.7	10.4	38.1	---	51.2
Lighting	74.9	---	---	--	74.9
Other	27.8	33.0	---	---	60.8
Industrial	113.2	119.5	97.4	61.0	391.1
Mfg.-Energy Intensive Industries	77.5	91.0	75.2	45.0	288.7
Primary Metals (SIC 33)	22.9	24.0	9.7	7.6	64.2
Chemicals (SIC 28)	10.2	14.0	13.6	9.0	46.8
Paper & Allied Products (SIC 26)	8.5	7.9	17.6	8.4	42.4
Stone, Clay and Glass (SIC 32)	6.3	10.8	4.7	8.2	30.0
Petroleum & Coal (SIC 29)	2.7	0.5	1.2	0.5	4.9
Other (SIC 34, 20, 35, 37, 22)	26.9	33.8	28.4	11.3	100.4
Mfg.-Other	33.5	26.2	10.1	16.0	85.8
Other Industrial	2.2	2.3	12.1	---	16.6
Transportation	10.4	---	1036.9	---	1047.3
Highway	---	---	711.5	---	711.5
Auto	---	---	468.5	---	468.5
Freight	---	---	243.0	---	243.0
Other	---	---	18.8	---	18.8
Air	---	---	201.0	---	201.0
Passenger	---	---	158.2	---	158.2
Freight	---	---	42.8	---	42.8
Rail	10.4	---	24.5	---	34.9
Vessel	---	---	81.1	---	81.1
TOTAL	406.3	639.3	1984.1	98.1	3127.8

* IBID.

FIGURE C-16 cont.

FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994 (cont.)*
1989

	Electricity	Natural Gas	Petroleum Products	Other (Coal, Wood and Other)	Total
Residential	130.0	417.5	424.6	39.0	1011.1
Space Heating	13.7	329.6	385.2	38.0	766.5
Water Heating	10.8	52.1	38.0	0.6	101.5
Cooking	5.7	30.1	1.4	0.4	37.6
Clothes Drying	8.6	5.7	---	---	14.3
Central A/C	1.9	---	---	---	1.9
Room A/C	6.9	---	---	---	6.9
Appliances, Lighting and Other	82.4	---	---	---	82.4
Commercial	175.2	143.8	397.6	0.3	716.9
Space Heating	19.7	98.8	358.4	0.3	477.2
Cooling A/C	45.3	---	---	---	45.3
Water Heating	2.8	10.3	39.2	---	52.3
Lighting	78.8	---	---	---	78.8
Other	28.6	34.7	---	---	63.3
Industrial	124.5	110.2	97.2	64.0	395.9
Mfg.-Energy Intensive Industries	84.8	84.2	74.2	46.9	290.1
Primary Metals (SIC 33)	23.1	19.6	9.0	7.7	59.4
Chemicals (SIC 28)	11.0	13.2	12.5	8.9	45.6
Paper & Allied Products (SIC 26)	9.4	9.1	17.2	8.0	43.7
Stone, Clay and Glass (SIC 32)	7.5	7.6	4.4	8.0	27.5
Petroleum & Coal (SIC 29)	3.7	0.3	0.8	0.4	5.2
Other (SIC 34, 20, 35, 37, 22)	30.1	34.4	30.3	13.9	108.7
Mfg.-Other	37.3	23.9	10.4	17.1	88.7
Other Industrial	2.4	2.1	12.6	---	17.1
Transportation	12.2	---	1042.7	---	1054.9
Highway	---	---	677.4	---	677.4
Auto	---	---	432.4	---	432.4
Freight	---	---	245.0	---	245.0
Other	---	---	20.5	---	20.5
Air	---	---	223.6	---	223.6
Passenger	---	---	176.2	---	176.2
Freight	---	---	47.4	---	47.4
Rail	12.2	---	29.7	---	41.9
Vessels	---	---	91.5	---	91.5
TOTAL	441.9	671.5	1962.1	103.3	3178.8

* IBID.

FIGURE C-16 cont.

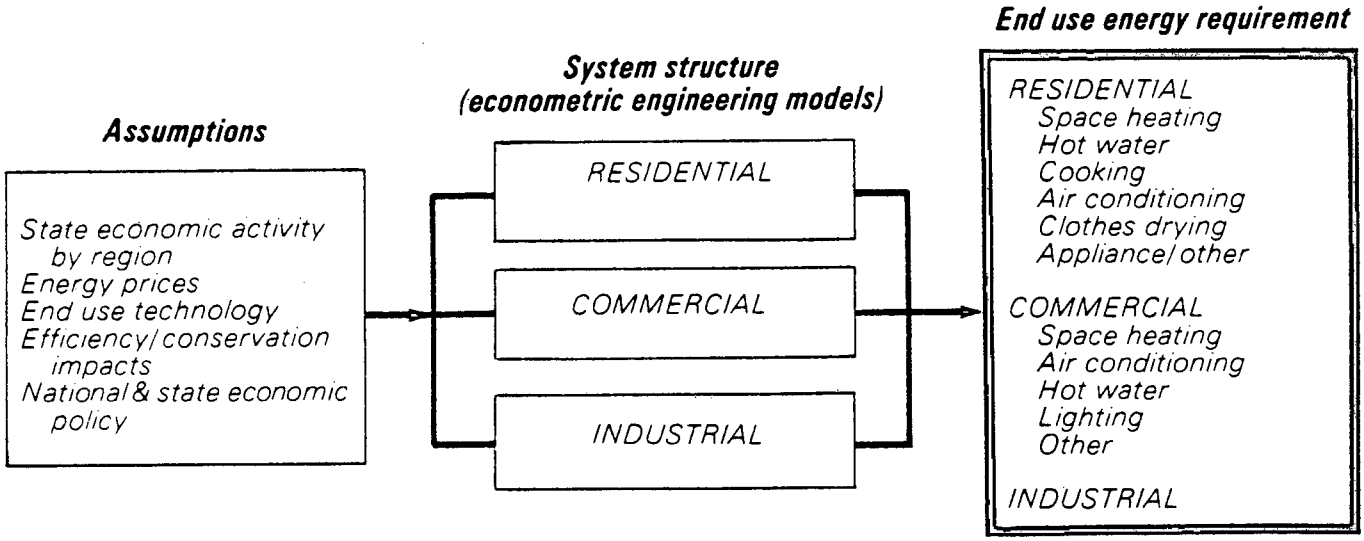
FORECAST OF NEW YORK STATE ENERGY REQUIREMENTS BY SECTOR, END USE AND FUEL TYPE, 1978-1994 (cont.)*

1994

	Electricity	Natural Gas	Petroleum Products	Other (Coal, Wood and Other)	Total
Residential	142.9	455.2	380.2	41.6	1019.9
Space Heating	17.2	363.6	345.9	40.6	767.3
Water Heating	11.8	54.2	33.0	0.6	99.6
Cooking	6.1	30.3	1.3	0.4	38.1
Clothes Drying	10.1	7.1	---	---	17.2
Central A/C	2.2	---	---	---	2.2
Room A/C	7.4	---	---	---	7.4
Appliances, Lighting and Other	88.1	---	---		88.1
Commercial	201.4	151.1	432.3	---	784.8
Space Heating	23.5	101.8	388.5	---	513.8
Cooling A/C	55.9	---	---	---	55.9
Water Heating	3.2	10.6	43.8	---	57.6
Lighting	87.7	---	---	--	87.7
Other	31.1	38.7	---	---	69.8
Industrial	143.4	107.4	113.2	66.0	430.0
Mfg.-Energy Intensive Industries	94.1	80.2	84.7	46.3	305.3
Primary Metals (SIC 33)	24.1	15.3	9.1	6.9	55.4
Chemicals (SIC 28)	12.3	14.9	15.2	9.1	51.5
Paper & Allied Products (SIC 26)	10.4	10.0	19.3	7.8	47.5
Stone, Clay and Glass (SIC 32)	8.7	4.8	4.3	6.6	24.4
Petroleum & Coal (SIC 29)	4.3	0.2	0.6	0.4	5.5
Other (SIC 34, 20, 35, 37, 22)	34.3	35.0	36.2	15.5	121.0
Mfg.-Other	46.5	25.1	14.3	19.7	105.6
Other Industrial	2.8	2.1	14.2	---	19.1
Transportation	13.0	---	1159.8	---	1172.8
Highway	---	---	731.1	---	731.1
Auto	---	---	476.9	---	476.9
Freight	---	---	254.2	---	254.2
Other	---	---	22.3	---	22.3
Air	---	---	261.4	---	261.4
Passenger	---	---	206.1	---	206.1
Freight	---	---	55.3	---	55.3
Rail	13.0	---	36.4	---	49.4
Vessel	---	---	108.6	---	108.6
TOTAL	500.7	713.7	2085.5	107.6	3407.5

* IBID.

FIGURE C-17
ENERGY FORECASTING SYSTEM:
SUBSTATE FORECASTS
NEW YORK STATE



Refer to Section II of this appendix for a summary of specific assumptions used in the electricity utility service area forecasts.

C. Data Base

The Office, noted previously, used the New York Power Pool data base for electricity consumption (sales) by utility service area.

D. Results

Figures C-18 and C-19 present the SEO forecast of electricity demand (sales) by sector in 1994 for each of the New York Power Pool measures, and average annual percentage changes over the forecast period.

XII. ELECTRIC UTILITY SERVICE AREA PEAK ELECTRIC DEMAND (MW) FORECASTS

Figure C-20 depicts the actual New York State interconnected systems summer peak for the years 1970-1978 and the Energy Planning Board approved forecast of electric peak demand.

The Energy Planning Board approved a peak demand forecast of an average increase of 1.8-1.9 percent annually. The Board noted that a fully reliable peak load forecasting methodology has not yet been developed. Review of the record, however, convinced the Board that the statewide load factor will improve in the future. The Board therefore concluded that the SEO projection of a constant load factor should be modified to reflect a moderate improvement. The Board considered a projected increase in statewide load factor from 62.9 to 64.5 (similar to that forecast by NYPP) to be reasonable. This would result in a reduction in the 1994 peak demand projected by SEO in the Draft Plan of approximately 717 MW.

In addition, the Board concluded that the SEO peak load projection should be revised using the appropriate percentage allowance for transmission losses and company use rather than the absolute amounts contained in the utilities' forecasts. This revision results in an additional reduction of statewide peak demand of 180 MW.

These revisions result in an electric peak demand forecast of 1.8-1.9 percent, which is approved by the Board. Figure C-21 indicates the derivation of that forecast from the forecast of peak demand in the Draft Plan.

This forecast takes into account Base Case conservation impacts and development of biomass and solar energy as discussed in Sections V-B and V-C. To the extent that proposals for further development in these areas are adopted or enacted, the forecast of electric energy peak demand growth can be expected to decrease.

The Board also derived a peak demand forecast for each utility by taking the individual company sales forecasts approved herein and applying the individual load factors projected by the NYPP member companies. These load factors are consistent with the overall load factor underlying the statewide coincident peak demand forecast of 1.8-1.9 percent annually, and reasonably represent the company-specific load factor improvements which should be achievable. The resultant peak demand forecasts for the individual NYPP members are presented in Figure C-22.

FIGURE C-18

SEO FORECAST OF NEW YORK POWER POOL ELECTRICITY REQUIREMENTS (SALES) FORECAST BY UTILITY AND SECTOR, 1978-1994 (MILLIONS OF KWH)

	1978					1994				
UTILITY	RES	COMM	INDUS	TRANS	TOTAL	RES	COMM	INDUS	TRANS	TOTAL
Central Hudson	1203	993	1126	0	3322	1656	1474	1698	0	4828
Con Ed	9806	15144	1648	0	26598	10120	19132	1955	0	31207
Long Island Lighting Company	5559	5403	1312	164	12438	7207	8142	2105	0	17454
NYS Electric & Gas	4220	3619	2632	0	10471	6192	5566	5052	0	16810
Niagara Mohawk	8024	9310	11972	1	29307	10844	13206	15566	15	39631
Orange & Rockland	1081	1061	727	0	2869	1369	1782	1448	0	4599
Rochester Gas & Electric	1702	1883	1518	0	5103	2239	2720	2843	0	7802
PASNY	967	5096	7164	2135	15362	2249	7016	11361	3795	24421
NY Power Pool	32562	42509	28099	2300	105470	41876	59038	42028	3810	146752

FIGURE C-19

SEO FORECAST OF NEW YORK POWER POOL ELECTRICITY REQUIREMENTS (SALES) BY UTILITY AND SECTOR, 1978-1994: AVERAGE ANNUAL GROWTH RATE

Total Power Pool	Residential	Commercial	Industrial	Transportation	Total
Central Hudson	2.0	2.5	2.6	—	2.4
Con Ed	0.2	1.5	1.1	—	1.0
Long Island Lighting Company	1.6	2.6	3.0	—	2.1
NYS Electric & Gas	2.4	2.7	4.2	—	3.0
Niagara Mohawk	1.9	2.2	1.7	18.4	1.9
Orange & Rockland	1.5	3.3	4.4	—	3.0
Rochester Gas & Electric	1.7	2.3	4.0	—	2.7
PASNY	5.4	2.0	2.9	3.7	2.9
TOTAL	1.6	2.1	2.6	3.2	2.1

FIGURE C-20

INTERCONNECTED SYSTEMS ELECTRIC DEMAND AND FORECAST OF ENERGY PLANNING BOARD, NEW YORK STATE (1969-1994)

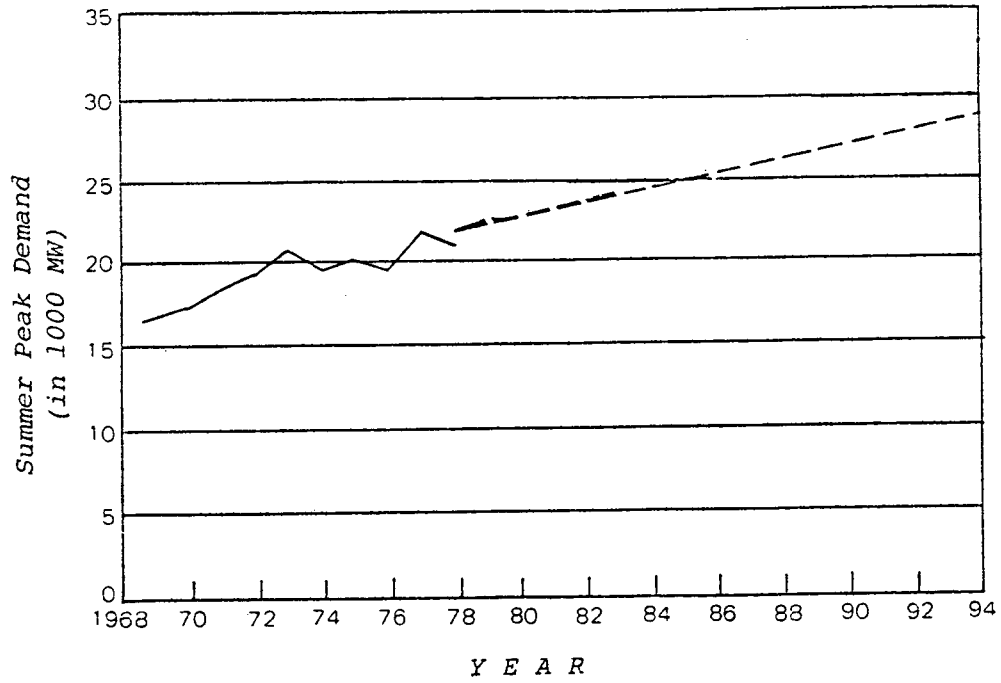


FIGURE C-21

ELECTRICITY PEAK DEMAND

	Impact (MW)	1994 Summer Peak (MW)	Incremental Impact on Growth Rate (%)	Average Annual* Growth Rate (%) (1979-1994)
SEO Forecast (Draft Plan)		29336		2.09
Board Adjustments				
• Impact of Higher Oil Prices	+400	29736	+.09	2.18
• Impact of Lighting Standards	−425	29311	−.10	2.08
• Revision of Energy to Peak Methodology	−180	29131	−.04	2.04
• Impact of Improving Load	−717	28414	−.16	1.88

* Growth rate resulting from cumulative changes.

FIGURE C-22

ELECTRIC PEAK DEMANDS AND GROWTH RATES BY UTILITY, 1978 and 1979

	Summer Peak (MW)			Winter Peak (MW)		
	1978	1994	Growth Rate (%)* (79-94)	1978	1994	Growth Rate(%)* (79-94)
CHE&G	614	964	2.47	623	964	2.61
CE	6714	7710	0.54	862	5313	0.40
LILCO	2997	4203	1.83	2456	3749	2.39
NYSEG	1729	2742	2.78	2138	3413	2.69
NMPC	5002	6890	2.11	5500	7558	2.05
O & R	662	1088	2.80	515	839	2.88
RG&E	983	1531	2.71	941	1514	2.87
PASNY	2348	3854	3.35	2500	4180	3.17
TOTAL	21049	28982		19535	27530	
Coincident	20418	28414	1.88	18939	27257	2.10

* These growth rates are based upon weather normalized 1979-1994 peak projections.

APPENDIX D-1

Renewable Resources

1) BASE CASE PROJECTIONS

A. Residential Solar Systems

1) Methodology

Active Solar—Domestic Hot Water (SF homes)

$TBTU = \Sigma_i$ # $systems_i$ x $unit\ demand_i$ x %DHW requirements satisfied by solar equipment

Where, # $systems_i$ ⟶ # systems using $fuel_i$ as a backup

Unit $demand_i$ ⟶ i=electricity, 12.5 MMBTU/yr
i=oil, 50.0 MMBTU/yr
i=natural gas, 42.0 MMBTU/yr

% DHW requirements=50%

Active Solar—Space Heat (SF homes)

$TBTU = \Sigma_i$ # systems x $unit\ demand_i$ x % SH requirements satisfied by solar equipment

Where, # $systems_i$ ⟶ # systems using $fuel_i$ as a backup

Unit $demand_i$ ⟶ i=electricity, 44 MMBTU/yr
i=oil, 180 MMBTU/yr
i=natural gas, 150 MMBTU/yr

% SH requirements=60 % new housing, 40% retrofit

Passive Solar—Space Heat (SF homes)

$TBTU = \Sigma_i$ # $systems_i$ x $unit\ demand_i$ x % SH requirements satisfied by passive design

Where, # $Systems_i$ ⟶ # systems using $fuel_i$ as a backup

Unit $demand_i$ ⟶ i=electricity, 44 MMBTU/yr
i=oil, 180 MMBTU/yr
i=natural gas, 150 MMBTU/yr

% SH requirements=60% new housing; 30% retrofit

2) Assumptions

- Active solar systems are assumed to replace electric hot water and space heat end uses in single-family homes only, due to economics.
- Gas and oil may be backed out in isolated cases, i.e., upper income groups employing the technology to achieve a degree of fuel independence. The results of this are assumed negligible.
- 11% of residential hot water customers will use electricity in 1994. This represents an upper bound for the penetration of active solar hot water systems.
- 2% of residential space heat customers will use electricity in 1994. This represents an upper bound for the penetration of active solar space heat systems.
- A survey conducted by SEO[1] indicated there were 2000 active solar domestic hot water; ‹ 50 active space heat; 200 passive systems in New York State in 1979. These systems were in single family homes located primarily in the downstate region of the State.
- In 1994 there will be 8050 domestic hot water and 250 active space heat systems in New York State. This is approximately a four-fold increase over 1979.
  - •• The active solar hot water installations represent .3% of total hot water customers, or 2.4% of the electric hot water customers.
  - •• The active solar space heat installations represent .008% of total space heat customers, or .4% of the electric space heat customers.
- Passive solar applications are assumed to displace oil, natural gas, and electricity as fuels for space heating in single-family homes. Applications in multi-family units are assumed negligible.
- Fuel splits are based on the fuel mix of the State in 1979 (oil-61%; gas-34%; electricity-1%; other-4%) with the following adjustments:
  - •• "other" fuels are combined with electricity
  - •• due to the rapidly rising price of home heating oil, oil is assumed to be displaced in a proportion greater than its share in the current fuel mix.

As a result,

- •• % passive backing out oil = 85%
- •• % passive backing out natural gas = 10%
- •• % passive backing out electricity = 5%

- In 1994, there will be 2100 passive houses, a ten-fold increase over 1979, representing .06% of the single-family housing stock. These additions occur primarily in new housing.
- The total number of solar installations in 1994 is 10,400, a five-fold increase over 1979.
- The low incidence of solar installations is consistent with findings in other parts of the nation. For example, in California, where state government subsidy of solar has been greater than that of New York and where the climate is more suitable to solar applications, the market penetration of solar equipment is falling far short of government expectations. Optimistic estimates indicate that there are 50,000 solar installations in California to date, many of which relate to swimming pools. An intensive program to stimulate development of the solar market was started in 1976. The program was designed to achieve 1.5 million solar installations by 1985. Even with stepped up government action, California officials have lowered their expectation to 20% of the 1976 goal—300,000 installations or a six-fold increase over 1978. New York's fivefold increase in solar installations in 1994, seems consistent with California's expectations of a six-fold increase in 1985, given, the economics of solar in New York and the lack of state government incentives and favorable climate.

B. Residential Wood

1) Methodology

$TBTU = \sum_{i=1}^{3}$ # $systems_i$ x $annual\ cord\ consumption_i$ x BTU/cord x $conversion\ efficiency_i$

Where, i = 1 Fireplace
i = 2 Wood Stove
i = 3 Wood Furnace

[1]State Energy Office, *Survey of Solar Penetrations*, 1979. (Unpublished Draft).

FIGURE D-1-1
BASE CASE—ACTIVE SOLAR

	1979		1984		1989		1994	
	# system	% market	# system	% market	# system	% market	# system	% market
RES/NEW*								
• Downstate	---	---	200	.3%	325	.5%	768	1%
• Upstate	---	---	100	.06%	200	.1%	400	.2%
• Total for 5 yr. interval	---	---	300	.1%	525	.2%	1168	.5%
• Cumulative Total (NEW)	---	---	300		825		1993	
RES/RETRO**								
• Downstate	1500	.2%	2000	.28%	3175	.39%	4557	.5%
• Upstate	500	.03%	700	.04%	1000	.05%	1500	.08%
• Cumulative Total (RETRO)	2000	.09%	2700	.11%	4175	.2%	6057	.3%
TOTAL SYSTEMS (NEW & RETRO)	2000	.08%	3000	.1%	5000	.2%	8050	.3%
SPACE HEAT								
RES/NEW*								
• Downstate	---	---	---	---	---	---	50	.06%
• Upstate	---	---	---	---	---	---	---	---
• Total for 5 yr. interval	---	---	---	---	---	---	50	.02%
• Cumulative Total (NEW)	---	---	---	---	---	---	50	
RES/RETRO**								
• Downstate	---	---	---	---	---	---	200	.02%
• Upstate	---	---	---	---	---	---	---	---
• Cumulative Total (RETRO)	---	---	---	---	---	---	200	.007%
TOTAL SYSTEMS (NEW & RETRO)	---	---	---	---	---	---	250	.008%

* The numbers are additive across the forecast period. The Cumulative Total represents the total number of new systems to date.
** The numbers are not additive. The number in each 5 year interval represents the total number of retrofit systems to date.

FIGURE D-1-2
BASE CASE—ACTIVE SOLAR
(TBTU)

	1979	1984	1989	1994
HOTWATER	.012	.018	.031	.05
SPACE HEAT	---	---	---	.004

Annual cord consumption fireplace = 1.5
Annual cord consumption wood stove = 3.7
Annual cord consumption wood furnace = 7.0
BTU/cord = 24×10^6
Conversion efficiency fireplace = .1
Conversion efficiency wood stove = .5
Conversion efficiency wood furnace = .7

- The fuels displaced by wood burning are in proportion to the current upstate rural/suburban fuel mix since most wood use is expected to occur in this region. The proportions remain constant throughout the forecast period.

% of wood replacing electricity 7%
% of wood replacing oil 83%
% of wood replacing natural gas 10%

- The annual cord consumption and conversion efficiency of each wood burning appliance was obtained from the Wood Energy Survey conducted by the Cornell Cooperative Extension Service[2]
- Current use of wood in the State (1978) was obtained from the Wood Energy Survey conducted by the Cornell Uni-

[2]Cooperative Extension Agricultural Engineering Department Cornell University, *Wood Energy Survey*, 1979.

FIGURE D-1-3
BASE CASE—PASSIVE SOLAR

	1979		1984		1989		1994	
	# system	% market	# system	% market	# system	% market	# system	% market
SPACE HEAT								
RES/NEW* (Total for 5 yr. interval)	200	.1%	300	.13%	500	.23%	800	.35%
• Cumulative Total (NEW)	200		500		1000		1800	
RES/RETRO**	—	—	50	.002%	150	.005%	300	.01%
TOTAL SYSTEMS (NEW & RETRO)	200	.008%	550	.02%	1150	.005%	2100	.06%

* Numbers are additive across the forecast period. The Cumulative Total represents the total number of new systems to date.
** Numbers are not additive. The number in each 5 year interval represents the total number of retrofit systems to date.

FIGURE D-1-4
BASE CASE—PASSIVE SOLAR TBTU

	1979	1984	1989	1994
TOTAL	.016	.04	.10	.27
Replacing:				
Electricity	.0001	.0004	.0009	.001
Oil	.01	.03	.07	.21
Natural Gas	.006	.01	.03	.06

versity Cooperative Extension. The survey indicated that 8% of New York State households burned wood for heating purposes in 1978.

—2.4% used fireplaces
—4.8% used wood stoves
— .8% used wood furnaces

- The following growth was assumed:

Fireplaces—a study conducted for DOE by Booz Allen[3] showed that 750,000 fireplaces were sold in the U.S. in 1978. It is assumed that 4% of these (30,000) were sold in NYS. Due to rapidly rising fuel prices, in particular, home heating oil—the fuel most often displaced by wood, this growth of 30,000 fireplaces per year is assumed through 1984. The growth is assumed to decline to 7500 fireplaces/year (1% of 1978 national sales) from 1985-1994, because the market will be close to economic saturation.

Wood Stoves—a study conducted for DOE by Booz, Allen[4] showed that one million wood stoves were sold in the U.S. in 1978. It is assumed that 4% of these (40,000) were sold in NYS. Due to rapidly rising fuel prices, in particular home heating-oil—the fuel most often displaced by wood, this growth of 40,000 wood stoves per year is assumed through 1984. The growth is assumed to decline to 10,000 stoves/year (1% of 1978 national sales) from 1985-1994, because the market will be close to economic saturation.

Wood Furnaces—a study conducted for DOE by Booz, Allen[5] showed that 60,000 wood furnaces were sold in the U.S. in 1978. It is assumed that 4% of these (2400) were sold in NYS. Due to rapidly rising fuel prices, in particular home heating oil—the fuel most often displaced by wood, this growth of 2400 wood furnaces per year is assumed through 1984. The growth is assumed to decline to 600 furnaces per year (1% of 1978 national sales) from 1985-1994, because the market will be close to economic saturation.

[3]Booz, Allen and Hamilton, *Assessment of Proposed Federal Tax Credits for Residential Wood Burning Equipment*, March 21, 1979.
[4]Ibid.
[5]Ibid.

C. *Industrial Wood Fuel Consumption*

1) *Methodology*

Primary Wood Industry

TBTU—# companies using wood x annual cord consumption/company x BTU/cord

Where, annual cord consumption/company=6,182 (obtained from SEO Survey of Primary Wood Industry)

BTU/cord = 24×10^6

2) *Base Case Assumptions*

- A survey conducted by the State Energy Office (SEO) indicated that the primary wood industries were the only users of wood fuel in 1979. The survey showed that 24.6 percent of these companies used wood fuel. The base forecast assumes that this remains the case through 1994.
- Annual SIC growth rate is 0.79%; obtained from New York State Department of Commerce.
- SEO survey data indicates: 74 percent oil usage, 5 percent coal usage, 21 percent gas usage, as present consumption pattern by primary wood industries. Base forecast assumes no significant departure from this fuel mix.

FIGURE D-1-5
RESIDENTIAL WOOD FUEL
BASE CASE

	1978	1979	1984	1989	1994
TOTAL HOUSEHOLDS (10^6)	6.30	6.45	6.90	7.30	7.70
FIREPLACE					
% Using Fireplaces	2.4%	2.8%	4.8%	5%	5.2%
# Fireplaces	.152	.182	.332	.367	.402
Total Annual Cord Consumption (10^6)	.228	.273	.498	.550	.603
Total TBTU Burned/yr.	5.4	6.5	11.9	13.2	14.4
Total TBTU Recovered/yr.	.50	.65	1.1	1.3	1.4
WOOD STOVES					
% Using Wood Stoves	4.8%	5.3%	7.9%	8.1%	8.4%
# Wood Stoves (10^6)	.307	.347	.547	.597	.647
Total Annual Cord Consumption (10^6)	1.13	1.28	2.02	2.20	2.39
Total TBTU Burned/yr.	27.1	30.7	48.4	52.8	57.3
Total TBTU Recovered/yr.	13.0	15.3	24.2	26.4	28.6
WOOD FURNACE					
% Using Furnaces	.80%	.81%	.88%	.89%	.9%
# Furnaces	.050	.052	.062	.065	.068
Total Annual Cord Consumption (10^6)	.350	.364	.434	.455	.476
Total TBTU Burned/yr.	8.4	8.7	10.4	10.9	11.4
Total TBTU Recovered/yr.	6.0	6.1	7.4	7.6	7.9
TOTAL TBTU	19.5	22.0	32.7	35.3	37.9
ELEC	1.3	1.5	2.2	2.4	2.6
OIL	16.3	18.3	27.3	29.4	31.6
GAS	1.9	2.2	3.2	3.5	3.7

D. Biogas

- *Methane from Landfills*—The Fresh Kill project on Staten Island is assumed to be the only source of gas from landfills during the forecast period. Presently, the project area is 400 acres, and will initially involve about 1.5 million tons/year of the present input of about 3 million tons/year. Total annual energy output is projected at about 2-2.3 BCF/year. The project will come on line in 1981 at 1 BCF/year and work up to full capacity of 2.0 BCF/year in 1984. The project is expected to double in size in 1987 with an annual energy output of 4.5 BCF/year. The gas generated will be upgraded, compressed, and fed into the gas distribution system.
- *Methane from Sewage Treatment Plants*—Present gas generation at NYC sewage treatment plants is .81 BCF/year, of which 73% (.59 BCF/year) is used internally. The remainder of the gas is flared. By 1984, 87% (.70 BCF/year) of the gas generated will be used on site. This remains the case through 1994.

E. Resource Recovery

1) Methodology

The amount of energy that can be generated from resource recovery facilities depends on the heat content of the incoming waste and the type of technology utilized. Since

FIGURE D-1-6
INDUSTRIAL WOOD FUEL CONSUMPTION
BASE CASE

	1979	1984	1989	1994
Total Companies	178	185	193	200
% Using Woodfuel	24.6%	24.6%	24.6%	24.6%
# Using Woodfuel	44	46	48	49
Annual Cords Consumed	272,008	284,372	296,736	302,918
Total Annual TBTU	6.53	6.82	7.12	7.27
Displacement (TBTU):				
Natural Gas	1.37	1.43	1.49	1.53
Oil	4.83	5.05	5.28	5.38
Coal	.33	.34	.35	.36

FIGURE D-1-7
BIOGAS
BASE CASE (BCF/YEAR)

	1979	1984	1989	1994
Landfill	0	2.0	4.5	4.5
Sewage Sludge	.59	.70	.70	.70

the base case estimates of steam and electricity were derived from the facilities listed in Figure D-1-8, the data regarding the specific facilities were used where available. The following equations were used to compute the energy output of the various resource recovery technologies for those facilities where insufficient data were available.

— Steam Generation Systems: System efficiency = .60

BTU content of steam output/year = BTU content of solid waste/year x system efficiency

— Electric Generation Systems: system efficiency = .22
: system efficiency = heat rate of 15,500 BTU/KWH
: capacity factor = .65

BTU content of electric output/year = BTU content of solid waste/year x system efficiency

kilowatt hours of electric output/year = BTU content of solid waste/year ÷ heat rate

kilowatts of net peak capacity = kilowatt hrs/yr of electricity ÷ capacity factor x 8760 hr/yr

— Cogeneration Systems*: average electric generating efficiency = .18
: average steam generating efficiency = .16
: assume system efficiency of .22 when electricity alone is generated

BTU content of electric output/yr from cogeneration = BTU content of solid waste/yr x electric generation efficiency

BTU content of steam output/yr from cogeneration = BTU content of solid waste/yr x steam generation efficiency

kilowatts of net peak capacity = kilowatt hrs/yr of electricity ÷ capacity factor x 8760 hr/yr

— There are 9 x 10^6 BTU/ton of processable solid waste.
— Resource recovery facilities are assumed to operate 300 days/year.

2) Assumptions

- There are 4 resource recovery projects now under construction or in shakedown operation. In addition, there are 16 projects in an active planning stage for which the basic energy product has been selected.
- Information about timing, tonnage, and technology for the 20 projects was obtained from the New York State Resource Recovery and Solid Waste Management plan[6] and subsequent discussions with staff of the Department of Environmental Conservation. Some data were obtained through contacts with individual project sponsors and by review of specific project reports.

F. Small Hydroelectric

1) Assumptions

- There are currently 800MW of small hydroelectric energy in New York State.
- In 1994, an additional 725MW is expected to be developed as depicted in Figure D-1-10.

G. Cogeneration

1) Assumptions & Methodology for Electric Capacity

- To determine 1984 total cogeneration
  - •• Total existing cogeneration is added to planned cogeneration to obtain a 1984 total. (See Figure D-1-12.)

1979 total cogeneration	= 523.46
+1979 planned cogeneration	= 41.30
1984 total cogeneration	= 564.76

  - •• under the Base Case, no additional incentives for cogeneration occur in the next five years and only those facilities which currently cogenerate or already have made plans to begin cogeneration are operating.
- To determine 1989 and 1994 totals:
  - •• industrial cogeneration is expected to remain in the same ratio to total industrial electric usage for the five selected SIC classifications as in 1978.

$$\frac{\text{(1978 industrial cogeneration) } 451.5\text{MW}}{\text{(1994 industrial cogeneration) } x} = \frac{\text{(1978 total electric usage) } 42.0}{\text{(1994 total electric usage) } 59.8}$$

$x = 642.85$

  - •• no additional incentives for cogeneration are offered. The only growth occurs in relationship to increased electric demand in SIC's 26, 28, 29, 32 and 33, the most energy intensive classifications which are most amenable to cogeneration.
  - •• the ratio of industrial cogeneration to institutional, commercial and other cogeneration is assumed to remain the same as in 1978.

$$\frac{\text{(1978 industrial cogeneration) } 451.5}{\text{(1978 total cogeneration) } 523.5} = \frac{\text{(1994 industrial cogeneration) } 642.9}{y}$$

$y = 745.4$

*The total efficiency of the cogeneration systems discussed is approximately .58 when .47 of the BTU output is steam and .11 is electricity. For the purpose of this analysis, it is assumed that resource recovery facilities operating in a cogeneration mode would be cogenerating electricity and steam one-third of the time. Electricity alone would be produced two-thirds of the time. The result is an annual output of steam at .16 efficiency and electricity at .18 efficiency.

[6]Department of Environmental Conservation, *New York State Resource Recovery and Solid waste Management Plan*, August 1978.

FIGURE D-1-8

ESTIMATED ENERGY OUTPUT OF RESOURCE RECOVERY PROJECTS FOR WHICH THE BASIC TYPE OF ENERGY OUTPUT IS KNOWN

PROJECTS	SOURCES OF SOLID WASTE	ENERGY OUTPUT	TONS PROCESSED AND ENERGY RECOVERED 1979 (1000 tons)	1979 (10^{12} Btu)	1984 (1000 tons)	1984 (10^{12} Btu)	1989 (1000 tons)	1989 (10^{12} Btu)	1994 (1000 tons)	1994 (10^{12} Btu)
Hempstead	Town	Electric*	286	0.39	572	0.78	572	0.78	572	0.78
Monroe	County	Electric (SF)*	250	0.50	500	0.99	500	0.99	500	0.99
Albany	City	Steam	—	—	219	1.18	219	1.18	219	1.18
Hooker Chemical	Niagara Co. Erie Co.	Steam/Elec.*	—	—	767	4.83	767	4.83	767	4.83
Glen Cove	Town	Steam/Elec.*	—	—	51	0.16	51	0.16	51	0.16
Oneida	County	Steam	—	—	45	0.25	45	0.25	45	0.25
Brookhaven	Town	Steam	—	—	300	1.62	300	1.62	300	1.62
Broome	County	Steam	—	—	120	0.65	120	0.65	120	0.65
Cattaraugus	County	Steam	—	—	45	0.25	45	0.25	45	0.25
Chemung	County	Steam	—	—	60	0.32	60	0.32	60	0.32
Dutchess	County	Gas	—	—	120	0.63	120	0.63	120	0.63
Multi-Town	Towns of Babylon Huntington Islip	Steam/Elec.*	—	—	900	2.33	900	2.33	900	2.33
Westchester	County	Electric*	—	—	550	0.96	550	0.96	550	0.96
Washington	County	Steam	—	—	45	0.25	45	0.25	45	0.25
Multi-County	Cortland Co. Cayuga Co. Tompkins Co. Tioga Co.	Steam	—	—	221	1.19	221	1.19	221	1.19
New York City	NY City	Steam	—	—	900	4.86	900	4.86	900	4.86
Port Authority UDC-CEA	NY City	Electric (SF)	—	—	—	—	900	1.78	900	1.78
UDC-CEA	NY City	Electric (SF)	—	—	—	—	600	1.19	900	1.78
Port Authority Ind. Park	NY City	Steam/Elec.*	—	—	—	—	900	2.76	900	2.76
PASNY	NY City	Electric (SF)	—	—	—	—	900	1.78	900	1.78
TOTALS	—	—	536	0.89	5415	21.25	8715	28.76	9015	29.35

*SF—Electricity generated through the use of solid waste to replace fuels now being used at existing facilities.

•• there will be no additional incentives in the non-industrial sector and growth is assumed to remain in approximately the same proportion to the industrial sector.

- Linear growth is assumed between 1984 and 1994 to obtain the 1989 total.

1994 total cogeneration	= 745.4
−1994 total cogeneration	= 564.7
total difference	= 180.7
÷	2
	90.4
+1984 total cogen.	564.7
1989 total cogen.	655.1

2) Assumptions and Methodology for Steam Generation

To obtain a projection for steam supplies produced in cogeneration modes, the following analysis was used:

- Because of the differing ratios of steam to electricity produced in various cogeneration technologies, a cross section of facilities was examined to obtain a ratio between lbs/hour of steam and KW of electricity. Examination of

FIGURE D-1-9

BASECASE—RESOURCE RECOVERY

	1979	1984	1989	1994
Electricity (MW)	32	208	298	298
TBTU (Steam)	--	17.3	23.4	24.0

FIGURE D-1-10
SMALL HYDROELECTRIC CAPACITY TO BE DEVELOPED BY 1994

Site	MW Capacity	Owner/Developer
Granby	10	Niagara Mohawk
Trenton	9	Niagara Mohawk
Hudson Falls	60	Niagara Mohawk
Fort Edward	10	Niagara Mohawk
Glen Park	20	Niagara Mohawk
Union	2.4	Niagara Mohawk
Dolgeville	2.6	Niagara Mohawk
South Glens Falls	16	Niagara Mohawk
Feeder Dam	2	Niagara Mohawk
Sherman	8	Niagara Mohawk
Sugar Island	2.4	Niagara Mohawk
Oswegatchie	1.4	Niagara Mohawk
Felts Mills	11	Niagara Mohawk
Hadley	25	Niagara Mohawk
Spier	25	Niagara Mohawk
Ashokan and Kensico Reservoirs	7.8	PASNY
Hinckley Reservoir	4.2	PASNY
	20.7	NYSERDA demonstration projects
	187.3	NYS Electric and Gas Co.; Rochester Gas and Electric; Orange and Rockland Power Co.; PASNY
	300	Private corporations, municipalities, private cooperatives, individuals
TOTAL	725	

FIGURE D-1-11
TOTAL SMALL HYDROELECTRIC CAPACITY

	1979	1984	1989	1994
MWe	800	1002	1202	1525

nineteen industrial and seven institutional sites showed that on an average, 7.7 lbs/hour of steam was produced per KW of electricity in the cogeneration mode.

- The number of MW of electricity produced was then multiplied by 8760 hours (annual hours) to obtain an annual total of steam produced. This number was transposed to BTU's by assuming 1000 BTU/lb of steam, an approximate average of useful energy from steam for process purposes.

2. PROPOSED CASE PROJECTIONS—IMPACT OVER THE BASE CASE

A. Residential Solar Systems

- Due to economics,[7] active solar systems are assumed to replace electric hot water and space heat end uses in single family homes. Hence, the upward bound for the penetration of active systems in the Base Case applies in the Proposed Case (i.e., 11 percent HW; 2 percent SH).

[7]Polytechnic Institute of New York, *The Economics of Solar Hot Water Systems in New York State* (Unpublished Draft).

- In 1994, as a result of the programs proposed in this plan there will be:
  - 31,950 additional active solar hot water installations. This represents and additional 1 percent of the total hot water customers, or an additional 10 percent of the electric hot water customers.
  - 1000 additional active solar space heat installations. This represents an additional .03 percent of total space heat customers, or an additional .6 percent of the electric space heat customers.
  - 66,900 additional passive solar installations. This represents and additional 2.3 percent of the single family housing stock. Passive applications are assumed to displace oil, natural gas, and electricity as fuels for residential space according to the fuel mix of the State, as described in the Base Case assumptions.

B. Residential Wood Systems

As a result of the programs proposed in this plan, the following growth in the use of wood for residential space heat was assumed:

- Fireplaces—same as the Base Case.
- Wood Stoves—an additional 40,000 wood stoves per year are assumed to be purchased in NYS through 1994.
- Wood Furnaces—an additional 2400 wood furnaces/year are assumed to be purchased in NYS through 1994

As a result, 1.3 million households will use wood stoves or furnaces as a supplemental source of space heat in 1994.

FIGURE D-1-12

EXISTING COGENERATION FACILITIES IN NEW YORK STATE

Name	Location	(KW) Electric Capacity
Industrial		
Allied Chemical	Syracuse	55000
Allied Chemical (2)	Buffalo	10000
Amstar Corporation	Brooklyn	9500
Bethlehem Steel	Lackawanna	48000
Boise-Cascade Co.	Beaver Falls	2500
Buffalo Color Corp.	Buffalo	5000
Clevepak Co.	Piermont	6000
Commerce Labor I Co.	New York	24000
CPS International	Yonkers	5000
Eastman Kodak	Rochester	125000
GAF	Binghamton	7000
General Electric	Schenectady	28000
Georgia Pacific	Lyons Falls	7000
Hanna Furnace	Buffalo	5000
International Paper	Tonawanda	2000
International Paper	Hudson	28000
International Paper	Ticonderoga	30000
International Salt	Watkins Glen	8000
Lederle Labs	Pearl River	insignificant
Newton Falls Paper Mills	Newton Falls	5000
Proctor & Gamble Co.	Staten Island	14500
Republic Steel Co.	Buffalo	10000
Refined Syrups & Sugar Co.	Yonkers	4000
Revere Sugar	Brooklyn	2500
Ronzoni Inc.	Long Island City	1600
St. Regis Paper Co.	Deferit	7000
United States Gypsum	Oakfield	600
Upson Company	Lockport	1300
TOTAL INDUSTRIAL COGENERATION		451500
Institutional, Commercial and Other		
Brooklyn Developmental Center	Brooklyn	4250
Kings Park Psy. Ctr.		3000
Kings Plaza	Brooklyn	11000
NY Telephone Bldg.	New York City	5000
Rockdale Village	Queens	18000
Saw Mill Rv. Tennis Crts.	Mt. Kisco	210
Starret City	Brooklyn	18000
Warbasse Houses	Brooklyn	12500
TOTAL INSTITUTIONAL, ET AL, COGENERATION		71960
TOTAL EXISTING COGENERATION	—NYS—	523,460

FIGURE D-1-13

PLANNED COGENERATION FACILITIES IN NEW YORK STATE

Name	Location	(KW) Electricity Capacity
Industrial		
Miller Eastern Brewing	Fulton	6000
Seal-Pak Packaging	New York City	1005
Unspecified, design completed/underway	Downstate	17000
TOTAL INDUSTRIAL COGENERATION		24005
Institutional, Commercial and Other		
Big Six Towers	New York City	4200
Bronx Community College	New York City	7300
West 42nd Street	New York City	5600
TOTAL INSTITUTIONAL, ET AL., COGENERATION		17300
TOTAL PLANNED COGENERATION		41305

FIGURE D-1-14
TOTAL ENERGY CONTRIBUTION FROM COGENERATION
BASE CASE

	1979	1984	1989	1994
MWe	523.5	564.7	655.1	745.4
TBTU Steam	35.4	38.2	44.3	50.4

FIGURE D-1-15
PROPOSED CASE—IMPACT OVER THE BASE CASE
ACTIVE SOLAR

	1979		1984		1989		1994	
	# system	% market	# system	% market	# system	% market	# system	% market
HOTWATER								
RES/NEW*								
• Downstate	---	---	2300	2.7%	2675	4.1%	5232	7%
• Upstate	---	---	700	.4	800	.6	1600	.8
• Total for 5 yr. interval	---	---	3000	.9	3475	1.6	6832	2.5
• Cumulative Total (NEW)	---	---	3000	---	6475		13307	
RES/RETRO**								
• Downstate	---	---	3200	.4%	9325	.6%	12143	1.4%
• Upstate	---	---	800	.05	4200	.25	6500	.3
• Cumulative Total (RETRO)	---	---	4000	.2	13525	.5	18643	.6
TOTAL SYSTEMS (NEW & RETRO)	---	---	7000	.3	20000	.7	31950	1
SPACE HEAT								
RES/NEW*								
• Downstate	---	---	100	.1%	200	.3%	250	.3%
• Upstate	---	---	---	---	---	---	50	.03
• Total for 5 yr. interval	---	---	100	.04	200	.09	300	.13
• Cumulative Total (NEW)	---	---	100		300		600	
RES/RETRO**								
• Downstate	---	---	100	.01%	200	.03%	300	.03%
• Upstate	---	---	---	---	---	---	100	.005
• Cumulative Total (RETRO)	---	---	100	.004	200	.008	400	.01
TOTAL SYSTEMS (NEW & RETRO)	---	---	200	.008%	500	.01%	1000	.03%

* Numbers are additive across the forecast period. The cumulative total represents the total number of new systems to date.
** Numbers are not additive. The number in each five year interval represents the total number of retrofit systems to date.

FIGURE D-1-16
PROPOSED CASE—IMPACT OVER THE BASE CASE
ACTIVE SOLAR TBTU

	1979	1984	1989	1994
HOTWATER	---	.04	.12	.20
SPACEHEAT	---	.004	.01	.02

FIGURE D-1-17

PROPOSED CASE—IMPACT OVER THE BASE CASE
PASSIVE SOLAR

	1979		1984		1989		1994	
	# system	% market	# system	% market	# system	% market	# system	% market
SPACE HEAT								
RES/NEW*								
(Total for 5 year interval)	---	---	4200	1.9%	14700	6.8%	22000	9.7%
• Cumulative Total (NEW)	---	---	4200		18900		40900	
RES/RETRO**	---	---	3100	.13%	20000	.79%	26000	.95%
TOTAL SYSTEMS (NEW & RETRO)	---	---	7300	.3%	38900	1.4%	66900	2.3%

* Numbers are additive across the forecast period. The Cumulative Total represents the total number of new systems to date.

** Numbers are not additive across the forecast period. The number in each five year interval represents the total number of retrofit systems to date.

FIGURE D-1-18

PROPOSED CASE—IMPACT OVER THE BASE CASE
PASSIVE SOLAR TBTU

	1979	1984	1989	1994
TOTAL	---	.57	2.82	5.33
Displacing:				
Electricity	---	.007	.03	.07
Oil	---	.52	2.60	4.80
Natural Gas	---	.04	.19	.46

C. Industrial Wood Fuel Consumption

- As a result of the program proposed in this plan, the number of primary wood industries using wood fuel is expected to grow 5 percent annually, achieving an additional 25.4 percent penetration in 1994, or 50 percent of the primary wood industries.
- Fuel mix and annual cord consumption/company are expected to remain the same as the Base Case.
- There will be some wood conversion in the non-wood industries; however, the total contribution is assumed to be minimal during the forecast period.

D. Resource Recovery

- Assumes an additional 41,000 tons of municipal solid waste per day will be available to be used for resource recovery in 1994.
- Assumes that 50 percent of the processable municipal solid waste will be used for resource recovery (20,500 tons per day).
- Assumes that cogeneration and steam generation technologies will penetrate faster than new electrical generation and new electric replacement (refuse derived fuel) at a rate of 25 percent over the 1984 penetration of the existing four technologies used in resource recovery as shown in Figure D-1-21.
- Using the average energy efficiencies previously described in the base case the energy output and megawatt capacity can be projected.
- 9,431 tons per day can be used in new electric generating capacity (cogeneration and new electric). Thus, based on the average of projects previously described in the base case, 1000 tons per day of municipal waste is approximately 31 MWe.

$$\frac{9431.25T}{1000T} = \frac{x\,MWe}{31} = 292 \text{ new additional megawatts in 1994}$$

- The energy output from stem generation and replacement electric can also be determined using the formulas described in the base case.

Technology	Tons per day		TBTU's per ton		Efficiency factor		Days of operation		TBTU
Steam (only)	5893.75	x	9×10^6	x	.6	x	300	=	9.55
Electric Replacement	5175.00	x	9×10^6	x	.22	x	300	=	3.07
Cogeneration Steam	7431.25	x	9×10^6	x	.16	x	300	=	3.21
Cogeneration Electricity	7431.25	x	9×10^6	x	.18	x	300	=	3.61
						New additional TBTU's in 1994			19.44

FIGURE D-1-19

RESIDENTIAL WOOD FUEL
PROPOSED CASE—IMPACT OVER THE BASE CASE

	1979	1984	1989	1994
TOTAL HOUSEHOLDS (10^6)	6.45	6.90	7.30	7.70
FIREPLACES				
% Using Fireplaces	---	---	---	---
# Fireplaces (10^6)	---	---	---	---
Total Annual Cord Consumption (10^6)	---	---	---	---
Total TBTU Burned/year	---	---	---	---
Total TBTU Recovered/year	---	---	---	---
WOOD STOVES				
% Using Wood Stoves	---	2.8%	5.4%	7.7%
# Wood Stoves (10^6)	---	.200	.400	.600
Total Annual Cord Consumption (10^6)	---	.740	1.48	2.22
Total TBTU Burned/year	---	17.7	35.5	53.2
Total TBTU Recovered/year	---	8.8	17.7	26.6
WOOD FURNACES				
% Using Furnaces	---	.17%	.32%	.46%
# Furnaces	---	.012	.024	.036
Total Annual Cord Consumption (10^6)	---	.084	.168	.252
Total TBTU Burned/year	---	2.0	4.0	6.0
Total TBTU Recovered/year	---	1.4	2.8	4.2
TOTAL TBTU	---	10.2	20.5	30.8
Displacing:				
Electricity	---	.7	1.4	2.1
Oil	---	8.5	17.1	25.7
Natural Gas	---	1.0	2.0	3.0

FIGURE D-1-20

INDUSTRIAL WOOD FUEL CONSUMPTION
PROPOSED CASE—IMPACT OVER THE BASE CASE

	1979	1984	1989	1994
Total Companies	178	185	193	200
% Using Wood Fuel	---	6.7%	15.4%	25.4%
# Using Wood Fuel	---	12	29	51
Annual Cords Consumed	---	74,184	179,278	315,282
TOTAL ANNUAL TBTU	---	1.78	4.28	7.53
Displacing:				
Natural Gas	---	.37	.91	1.57
Oil	---	1.32	3.14	5.58
Coal	---	.09	.22	.38

FIGURE D-1-21

PENETRATION OF RESOURCE RECOVERY TECHNOLOGIES

Technology	Base case facilities tonnage	Percent	Proposed new penetration	Proposed new tons per day
Steam (only)	2075	23	(+25%) 28.75	5893
Cogeneration	2618	29	(+25%) 36.25	7431
Electric (new)*	1122	12.4	(−23%) 9.97	2000
Electric (replacement)	3200	35.5	(−27%) 25.24	5175

*Assumes 1 new electric at 2,000 tpd minimum size.

FIGURE D-1-22
PENETRATION OF RESOURCE RECOVERY TECHNOLOGIES (1989)

	Percent 1994 mix	Distributed equally	New tons per day
Steam	28.75	31.86	1672
Cogeneration	36.25	40.17	2108
New Electric*	9.97	0	0
Electric Replacement	25.24	27.97	1468

* Since no new electricity is assumed to be added to the penetration rate of 1994, the electricity is then distributed evenly through the three technologies.

- From 1984, when the first new additional facilities will begin to come on line, the amount of solid waste processed is assumed to increase linearly through the ten year period of 1984-1994.
- The additional amount of processed municipal solid waste would then be 5,248 tons per day in 1989.
- Assuming the same 25 percent increase over the 1984 penetration of the existing four technologies, a smaller tonnage of waste would be devoted to new electric generation than would be economically feasible. (DEC assumes that a new electric generation facility is not economically feasible with less than 2000 tons per day.)
- The percent of new electric generation is then distributed evenly throughout the three remaining technologies to arrive at the penetration rates shown in Figure D-1-22.
- To determine new megawatts in 1989

$$\frac{2108 \text{ TPD}}{1000 \text{ TPD}} = \frac{x}{31} = 65 \text{ megawatts of additional in 1989}$$

- To calculate the new TBTU's of steam:

Technology	Tons per day		TBTU's per ton		efficiency factor		days of operation		TBTU Total
Steam only	1672	x	9×10^6	x	.6	x	300	=	2.71
Electric replacement	2108	x	9×10^6	x	.22	x	300	=	1.25
Cogeneration	1468	x	9×10^6	x	.16	zx	300	=	0.63

Thus, in 1989 there will be an additional 4.59 TBTU's of steam.

	1989		1994	
	Tons per day (1000)	10^{12} TBTU's	Tons per day (1000)	TBTU's
Steam	1672	2.71	5893.75	9.55
Electric (new)	0	0	2000.00	---
Electric replacement	1468	1.25	5175.00	3.07
Cogeneration	2108	.63	7431.00	3.21
	5248	4.59	20500.75	15.83
Increments over base MWe =		65MWe		292MWe
TBTU (steam) =		4.59		15.83

E. Small Hydro

- The Polytechnic Institute of New York (PINY) and NYSERDA have conducted an inventory of small hydro sites in the State and have determined that 3000MW of new capacity can be developed, excluding environmental and economic constraints.
- 1050MW of this capacity can be expected to be developed by 1994 as a result of the programs proposed in this plan. The development will be at those sites where the ownership is known; there has been an interest expressed in developing the incremental or refurbished capacity; there exists a high probability in obtaining a license; the cost of producing power at the site will be $\leq$60 mills/KWH.
- The following table shows the additional electric capacity by 1994 from small hydroelectric facilities.

F. Cogeneration

1) Proposed Case Projections for Electric Capacity

- To determine 1984 total cogeneration:
  - in addition to existing and planned cogeneration, all potential nonindustrial sites come on line by 1984 (Figure D-1-25)

1984 base case	= 564.7
+1984 potential non-industrial	= 67.34
1984 proposed case	= 632.04

- To determine 1989 total cogeneration:
  - all industrial sites identified in a report prepared by Acres American Inc.[6] as potential cogenerators along with all other sites identified as having compatible steam and electric loads for cogeneration are assumed to come on line by 1989.

1984 proposed case	= 632.04
+identified potential	= 153.88
1989 proposed case	= 785.92

- To determine 1994 total cogeneration:
  - all industrial sites identified in a survey conducted by PASNY[7] regarding potential cogeneration facilities are assumed to be added by 1994.

1989 proposed case	= 785,92
+PASNY identified sites	= 289.00
1994 proposed case	= 1074.92

[6]Acres American Inc. Survey of Cogeneration Potential of Selected New York State Industries, June 1979.
[7]Power Authority of the State of New York, Survey of PASNY Industrial Customers Concerning Cogeneration, June 1979.

FIGURE D-1-23
SMALL HYDROELECTRIC POTENTIAL
(PROPOSED CASE)

Developer/Owner	Megawatts Potential Capacity	
Utility Sector		
Central Hudson	0	
Consolidated Edison	0	
LILCO	0	
New York State Electric & Gas	85	
Niagara Mohawk	337	
Orange and Rockland	14	
Rochester Gas & Electric	16	
	452	TOTAL
Other Sectors		
Industrial	234	
Private	77	
Localities	119	
State (PASNY)	47	
United States Government	54	
	531	TOTAL
Non-inventoried sites*	68	TOTAL
	1051	TOTAL

* Sites not included in PINY inventory but have been located and identified by NYSERDA staff.
N. B. Does not preclude a utility from acquiring and rehabilitating a site presently owned by other sectors because of utility expertise, capital and other factors.

FIGURE D-1-24
PROPOSED CASE—SMALL HYDROELECTRIC CAPACITY
IMPACT OVER THE BASE CASE

	1979	1984	1989	1994
MWe	—	73	198	325

FIGURE D-1-25
POTENTIAL COGENERATION SITES
(PROPOSED CASE)

1984 Additions Name	Location	(KW) Electric Capacity
Binghamton General Hospital	Binghamton	1232
Binghamton Psyc. Center	Binghamton	935
Richmond Community College	Bronx	600
Brooklyn Union Gas Co.	Brooklyn	1500
Central Islip Psyc. Center	Central Islip	5500
Cornell University	Ithaca	17000
Craig Developmental Center	Sonyea	1500
Creedmore Psyc. Center	Queens Village	2000
Good Samaritan Hospital	Suffern	1092
Gowanda Psyc. Center	Helmuth	1050
Harlem Valley Psyc. Center	Wingdale	3689
J.N. Adams Devel. Center	Perrysburg	500
Letchworth Village Dev. Ctr.	Thiells	1500
Mercy Hospital	Buffalo	2800
Middletown Psyc. Center	Middletown	1000
Pilgrim Psyc. Center	West Brentwood	4500
Rochester Institute of Technology	Rochester	6666
Rochester Psyc. Center	Rochester	1250
Rockland Psyc. Center	Orangeburgh	1000

1984 Additions (cont'd)	Location	(KW) Electric Capacity
Rome Developmental Center	Rome	750
St. Lawrence Psyc. Center	Ogdensburg	1000
SUNY College at Geneseo	Geneseo	3379
Wassaic Developmental Center	Wassaic	1500
TOTAL 1984 COGENERATION ADDITION		67343
1989 Additions		
Albany Felt Co.	Albany	1500
Colt Industries	Syracuse	20000
Corning Glass Works	Corning	24000
Dunkirk Ice Cream	Dunkirk	3000
Entermanns Bakery	Bay Shore	2000
Freihofer Co.	Troy	774
General Foods	Avon	4644
Grumman Aircraft	Bethpage	1500
Hammerhill Paper Co.	Oswego	5200
Hercules Inc.	Glens Falls	4800
Manning Paper Co.	Green Island	4100
Native Textiles	Glens Falls	1700
Nestles Co. Inc.	Fulton	9600
Nitec Paper Co.	Niagara Falls	19500
Norton Coated Abrasive Inc.	Troy	5080
Norwich Eaton Pharmaceutical	Norwich	1700
Salada Foods	Little Falls	10780
Schenectady Chemicals	Schenectady	10000
Scott Paper	Fort Edward	10000
Thatcher Glass Mfg.	Elmira	9700
Thomson Plant	Thomson	4300
1989 TOTAL COGENERATION ADDITION		153878
1994 Additions*		
Airco		6000
Alcoa Inc		52000
Ayerst Lab		5000
Carbarundum		40000
Diamond Int.		11000
Dresser Transmission		44000
DuPont Company		29000
General Motors		66000
Oneida Ltd.		14000
Union Carbide (2)		14000
Watkins Salt		8000
TOTAL 1994 COGENERATION ADDITION		289000

* This data derived from "Survey of PASNY Industrial Customers Concerning Cogeneration" and did not contain location of facilities.

2) Proposed Case Projections of Steam Generation (refer to methodology outlined in the Base Case)

FIGURE D-1-26
ENERGY CONTRIBUTION FROM COGENERATION
PROPOSED CASE—IMPACT OVER THE BASE CASE

	1979	1984*	1989*	1994*
MWe	—	67.3	130.8	329.5
TBTU steam	—	4.6	8.8	22.3

* These numbers do not equal total additions shown in proposed case but only represent the difference between the proposed case and the base case totals of the same year.

APPENDIX D-2

NATURAL GAS

1. Future Sources

A. Supply Forecast Methodology

Potential future U.S. supply sources must be the prime consideration in projecting future New York gas supplies which are almost completely dependent upon major U.S. pipeline companies. The supply forecast methodology used herein consists of projecting future U.S. potential supplies and inferring from this a gas flow via interstate pipeline companies to New York State, based on the historic share of U.S. gas supplies flowing to New York State via such pipeline companies.

A more desirable and logical approach is to develop a forecast for the specific interstate pipeline companies serving New York State, however, given the time and resource constraints associated with this initial plan, the inclusion of such a forecast was not feasible. Accordingly, our goal is to develop the data and modelling techniques necessary to produce such a forecast for subsequent plans.

The resulting forecast is neither a precise indication of the volumes of gas that will actually flow into New York State over the next 15 years, nor assurance that the necessary supplemental gas supply projects will come to fruition. It is extremely difficult to project future gas supplies with a high degree of certainty, especially beyond 5 years, because of changes in federal and state regulations and policies affecting natural gas production and consumption. The forecast of gas supply which follows is, however, one which is likely to be realized and does provide a reasonable approximation of gas supplies which are likely to become available for U.S. and New York State consumers.

B. Future U.S. Gas Supply

In addition to conventional sources, future potential U.S. sources include: increased Canadian imports, Mexican imports, Alaskan gas, SNG from coal gasification, LNG imports, and gas from domestic resources requiring new technologies to produce commercially. At this time, however, several factors which will significantly influence the acquisition of these potential sources are undecided pending solidification of federal policy.

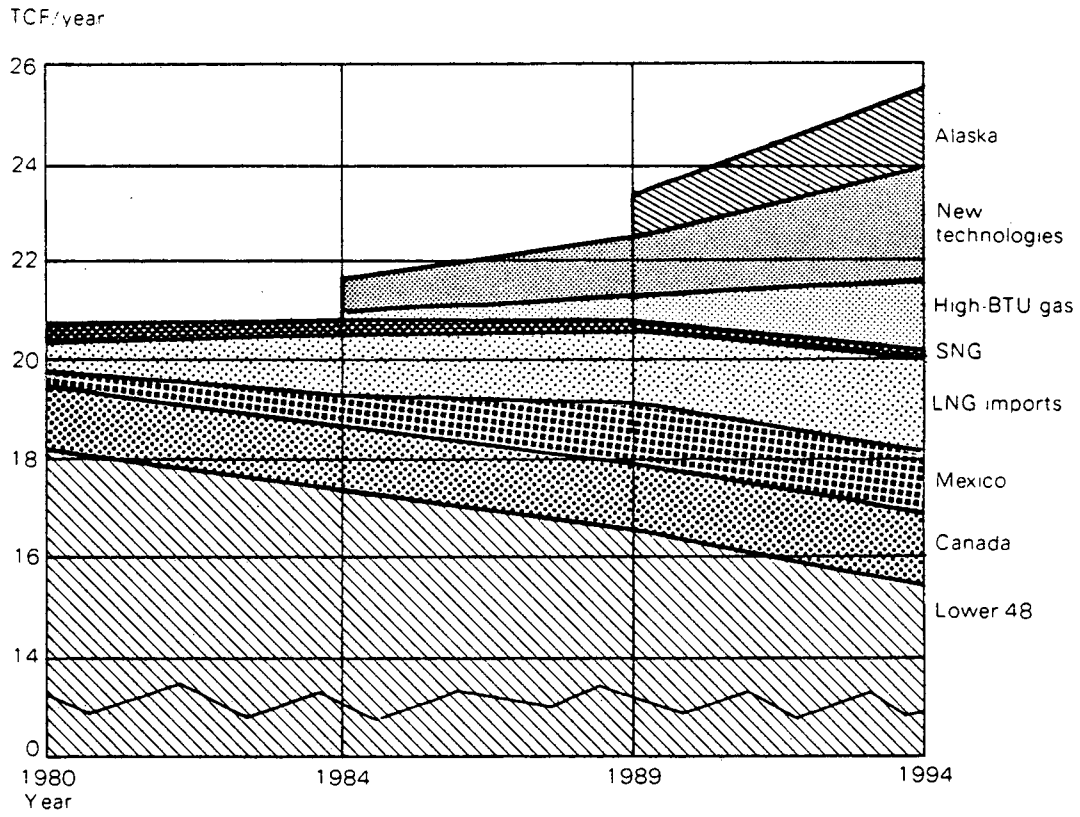
The potential of each potential U.S. gas supply source is discussed below. Tabular and graphic summaries Figures

FIGURE D-2-1(a)
ESTIMATED CONTRIBUTION TO U.S. GAS SUPPLY FROM ALL SOURCES (TCF/yr)

	1980			1984		
Source	Low	Expected	High	Low	Expected	High
Lower 48 Production	17.3	18.2	18.4	16.5	17.4	18.5
Alaska	—	—	—	—	—	—
Canada	1.1	1.3	1.4	1.1	1.3	1.4
Mexico	.2	.25	.3	.5	.62	.75
LNG Imports	.4	.57	.57	.9	1.3	1.7
SNG From Light Distillates	.25	.30	.30	.20	.25	.30
High Btu Gas From Coal	—	—	—	.05	.075	.10
New Technologies	—	—	—	.45	.67	.90
TOTALS	19.25	20.6	20.97	19.7	21.6	23.65

	1989			1994		
Source	Low	Expected	High	Low	Expected	High
Lower 48 Production	15.6	16.5	19.2	14.7	15.5	17.5
Alaska	.5	.87	1.2	1.4	1.6	2.5
Canada	1.0	1.5	2.0	1.0	1.5	2.0
Mexico	1.0	1.25	1.5	1.0	1.25	1.5
LNG Imports	1.0	1.50	2.0	1.25	1.87	2.5
SNG From Light Distillates	.15	.20	.25	.05	.10	.20
High Btu Gas From Coal	.30	.45	.60	.9	1.35	1.8
New Technologies	.90	1.35	1.80	1.6	2.4	3.2
TOTALS	20.45	23.6	28.55	21.9	25.57	31.2

FIGURE D-2(b)
ESTIMATED CONTRIBUTION TO U.S. GAS SUPPLY FROM ALL SOURCES (TCF)



D-2-1(a) and (b) are considered to be reasonable estimates of the actual obtainable contribution from each source. Acquisition of these supplies will require both a commitment to and from the gas industry as well as pursuit through federal and state policy.

2. Lower 48 Production (Conventional Resources)

Perhaps the Natural Gas Policy Act of 1978 can remedy declining domestic (lower 48) production, by encouraging the development of deep onshore and offshore reserves. The actual affect is, of course, unproved, and a consensus of opinion does not exist regarding estimated production as a result of this law.

A. Resource Base

Natural gas conventional resources are classified into two groups, proved reserves and potential supply. Proved reserves are the current estimated quantity of natural gas which analysis of geologic and engineering data demonstrate with reasonable certainty to be economically recoverable from existing reservoirs. Potential supply is the prospective quantity of gas yet to be found, which is further classified into; probable, possible and speculative supplies. Estimates of proved reserves and potential supply for conventional U.S. gas production are tabulated in Figure D-2-2.

B. Production Capability

DOE/EIA analysis reports[1] provide projections for three supply, demand and cost assumptions for lower 48 productions[2] as follows:

Lower 48 Production (TCF/yr)

	1980	1985	1990	1995
Low Supply/High Demand	18.29	16.07	14.60	13.85
Medium Supply/Medium Demand	18.72	17.38	16.50	16.14
High Supply/Low Demand	19.07	17.77	16.32	17.10

These are in general agreement with projections of conventional lower 48 gas supply contained in the National Energy Plan II, which are 16-18 TCFin 1985 and 12-14 TCF in 2000.

The American Gas Association (AGA) has developed a forecast[3] of conventional (lower 48 states) production that shows overall production can be maintained at about the current level through 1990. A growing share of this production will come from deep onshore and offshore areas. This AGA analysis is based on the Potential Gas Committee's estimate of total potential reserves, the most optimistic of all such estimates. Substitution of other resource estimates into the AGA analysis would yield proportionally lower results.

The high or optimistic estimate of potential gas supply from lower 48 production included in this forecast is based on AGA's estimate; the expected case is not as optimistic as AGA projections in the long run, because the R/P and F/P

[1]Energy Supply and Demand in the Midterm: 1985, 1990 and 1995 (April 1979); and Short-Term Projections of Energy Supply in the U.S.

[2]Actually includes South Alaska (1976 production was .27TCF).

[3]Forecasted Production of Lower 48 Conventional Natural Gas Under the House/Senate Gas Pricing Compromise: Energy Analysis, September, 1978.

FIGURE D-2-2

ESTIMATES OF REMAINING RECOVERABLE U.S. NATURAL GAS RESOURCES (TCF)

Year End	Source	Potential Reserves		Total of Potential Reserves	Proved Reserves*	Total Proved & Potential*
		Old Fields	New Fields			
1977	Shell	—	315	315	208	523
1978	Potential Gas Committee	199	820	1019	200	1219
1974	Exxon	111	287	398	237	635
1974	U.S. Geological Survey	202	488	690	237	927
1974	National Academy of Sciences	118	530	648	237	885
1974	Moody	65	485	550	237	787
1974	Average of Major Oil Company's (Garrett)	100	500	600	237	837
1973	Mobil Oil Company	65	443	508	250	758

* As of year of estimate.

trends since 1968 have been factored in and the belief that the best strategy is diversification of future supply sources. Therefore, the contribution from this source is shown as declining to 15.5 TCF in 1995; the low case is 95 percent of SEO's expected case.

New York State's contribution to this supply from its indigenous resources is expected to consist of continued onshore production and development of offshore Lake Erie resources. The estimated contribution from these sources to U.S. supplies is shown below:

Contribution to U.S. Gas Supply From N.Y.D. Indigenous Resources (BCF/yr)

Year	Onshore Production[4]	Offshore Production[5]	Total
1980	16.2	.3	16.5
1984	21.0	2.3	23.3
1989	22.9	4.9	27.8
1994	23.5	7.5	31.0

3. Alaskan Supply

A. Resource Base

Proved reserves in Alaska total 31.6 TCF: 26 TCF for the North Slope and 5.6 TCF for South Alaska. Potential reserves are estimated at 76 TCF.

B. Production Capability

North Slope gas basically is being reinjected at this time. Very small quantities are being produced to fuel compressors for the Alaskan oil pipeline, but essentially, no significant production is occurring. South Alaskan gas is being produced (1976 production was 269,111 MMCF) for local consumption and also is being liquefied and exported to Japan (49,779 MMCF in 1976). The Jones Act prohibits the interstate transportation of goods by foreign flag ships and since no LNG tankers fly a U.S. flag, transporting this gas to U.S. markets in an LNG mode is effectively prohibited at this time.

To deliver North Slope gas to market, approximately 4787 miles of pipeline (Alcan project) must be constructed. (Approximately 2759 miles in Alaska and Canada, with the remainder, 2028 miles in the contiguous States.) The estimated cost of the project is about $11 billion ($6.76 billion in 1975 dollars), which will result in a delivered cost of about $3-5/MCF ($2.09-$3.39/MCF in 1975 dollars).[6] Because of this relatively high cost, Congress by implementing the NGPA has determined that the cost of Alaskan gas will be "rolled in," that is, averaged with all other gas in the purchasers system.

Capacity of the line is projected to be 2.4 BCF/ day, (average), .876 TCF/yr with the potential to increase to 3.4 BCF/day and possibly higher by installing additional compressor stations and increasing horsepower.

Estimates of the potential contribution to U.S. gas supply from this source are shown:

	Alaskan Gas (TCF/yr)		
	1985	1990	1995
DOE/EIA[7]	.79-.90	.9	.94-1.2
AGA[8]			
South Alaska	.1	.2	.3
North Slope	.7	1.4	2.2

The completion of the entire Alcan line is discounted until after 1984. Forecasted contributions, expected and high, for year 1989 assume completion of the Alcan line and

[4]Continued onshore production estimated by NYGAS plus an estimate of production anticipated from the PENNY Project.

[5]Based on "An Examination of Issues Related to U.S. Lake Erie Natural Gas Development," September, 1978, Argonne National Laboratory.

[6]Decision and Report to Congress on the Alaskan Natural Gas Transportation System—Committee on Energy and Natural Resources United States Senate, October, 1977.

[7]Energy Supply and Demand in the Midterm: 1985, 1990 and 1995 (April, 1979).

[8]Gas Energy Review, February, 1979.

operation at 2.4 BCF/day and 3.4 BCF/day, respectively; 1994 contributions assume increased horsepower or the construction of a second major delivery system.

The potential contribution of South Alaskan gas is not included in this forecast specifically, however, this is another potential source of gas which should be pursued.

4. Canadian Supply

A. Resource Base

The Canadian National Energy Board (NEB) estimates remaining reserves of marketable gas from conventional producing areas at 66.1 TCF, with an ultimate potential for such gas at 147 TCF (with a range of 127 to 157 TCF). NEB has also estimated marketable gas discovered in frontier areas at 14.5 TCF, but has not estimated the ultimate potential of these sources which the Geological Survey of Canada estimates to be roughly 163 TCF (with a range of 97-302 TCF). All of these estimates are conservative in comparison to those of most of the Canadian gas industry. The current reserves surplus (established reserves only, excluding frontier reserves) is calculated by the NEB at 3.8 TCF.[9]

B. Export Potential

Authorization of additional exports by the NEB has been studied and the Board considers three cases of total firm volumes licensable, and extensions of those cases licensable on an interruptible basis. These cases are shown, with the extensions shown in parentheses.

Only NEB established reserves from conventional sources were considered in determining licensable volumes.

Other estimates of Canadian gas exports to the U.S. are shown below:

Canadian Exports
(TCF/yr)

	1985	1990	1995
AGA[10]	1.4	1.1	1.0
DOE/EIA[11]	1.29	1.23-1.26	.38-.96

NEB's determination of increased licensable firm volumes[12] are the basis of the near term low forecast, the addition of interruptible volumes for the expected forecast, and the high case estimates the effect of including the frontier supply; 1990-94 forecasts are an extrapolation of these assumptions.

5. Mexican Supply

A. Resource Base

Proved and probable natural gas reserves in Mexico total 137.5 TCF according to PEMEX[13] the government oil company. About two-thirds of this estimate is associated with the production of oil, which requires that the natural gas be marketed, reinjected to enhance oil recovery (to the extent possible) or flared as the oil is produced. The earliest wells have shown a gas/oil ratio of 1 MCF/BBL, however, new wells drilled in 1977 showed a gas/oil ratio up to 6 MCF/BBL.[14]

B. Export Potential

PEMEX is finishing construction of a 48-inch, 800 mile pipeline which will parallel the Mexican Gulf Coast. Delivery of PEMEX gas to U.S. markets will require construction of a 90-mile pipeline to connect with the U.S. interstate pipeline network.

Six U.S. interstate gas pipeline companies have contracted with PEMEX to purchase up to .3 BCF/day of the gas at specified shares as follows: Tenneco, 37.5 percent (112.5 MMCF/day); Tetco, 27.5 percent (82.5 MMCF/day); El Paso, 15.0 percent (45 MMCF/day); Transco, 10 percent (30 MMCF/day); Southern Natural and Florida Gas Companies, 10 percent (30 MMCF/day). This directly benefits New York State gas consumers because Tenneco, Tetco, and Transco, who combined, currently supply about 74 percent (indirectly) of New York State's requirements, have a combined 75 percent share of the PEMEX gas. New York State should lobby to bring pressure on the Federal Government to conclude contracts for additional volumes of Mexican gas since it would be a significant supplemental source of new gas for the U.S. and New York State in particular.

Our forecast of potential supply uses AGA projections[15] for the low case and 125 percent and 150 percent (of AGA's projections) for the medium and high cases because of the vast reserves and export potential Mexico has.

6. LNG

Currently, there are three operational baseload LNG import projects in the U.S., all relying on the same source, Algeria, for a total of 407 BCF/yr of imported gas. One LNG project is currently under construction and will also receive its supply, 168.4 BCF/yr, from the same source, with initial delivery expected in 1980/81. The estimated average cost for all these projects is $2.41/MCF.[16]

Licensable Increased Exports
(BCF/yr)

	1980	1981	1982	1983	1984	1985	1986	1987	TOTAL Firm	TOTAL Firm & Interruptible
Case 1	200	200	200	200	(200)	(200)	(200)	(200)	800	1600
Case 2	500	500	500	(500)					1500	2000
Case 3	400	400	200	200	(200)	(200)	(200)	(200)	1200	2000

[9]Canadian Natural Gas, February, 1979.
[10]Gas Energy Review, February, 1979.
[11]Energy Supply and Demand in the Midterm: 1985, 1990, and 1995 (April, 1979).
[12]Currently effective contracts are: 1.08 TCF in 1980; .948 TCF in 1984; .547 TCF in 1989; and, .008 TCF in 1994.
[13]Mexico: The Promise and Problems of Petroleum, Committee on Energy and Natural Resources, U.S. Senate, March, 1979.
[14]The Energy Daily, December 14, 1978.
[15]Gas Energy Review, February, 1979.
[16]Gas Delivered into the Pipeline: Source Figure D-2-3.

Estimates of the potential contribution that LNG will make to the total U.S. gas supply are tabulated below:

	LNG Imports (TCF/yr)			
	1980	1985	1990	1995
DOE/EIA[17]	N/P	.59-.99	.63-1.22	.76-1.26
AGA[18]	.4	1.6	2.0	2.5

N/P/: Not Provided

The prospects for increased LNG imports are enhanced by increasing world production of associated natural gas which must be reinjected (to the extent possible), flared—which is a complete waste—or produced.

Future LNG import facilities will not be constructed in densely populated areas under new strict siting criteria.

As of December, 1978, eight additional LNG import projects were planned which would have resulted in total deliveries of at least 1695.5 BCF/yr. (385 BCF/yr commencing 1982; 982.5 BCF/yr commencing 1983; 182 BCF/yr commencing 1984; and 146 BCF/yr commencing 1985). Figure D-2-3 summarizes the status of U.S. LNG facilities, both operational and planned. Available cost estimates average $3.34 MCF.[19] The ERA has rejected two LNG projects but the applicants are seeking rehearings. Projections for 1984, low, expected and high are based on the assumption that 25 percent, 50 percent and 75 percent, respectively, of the planned projects will come to fruition. Projections for 1989 and 1994 are based on AGA forecasts (high) and 75 percent and 50 percent of AGA's projections for expected and low cases, respectively.

7. SNG

Currently there are 13 SNG plants in the U.S. all, with the exception of a small Hawaiian plant, located in the northeast. Figure D-2-4 summarizes the current status of U.S, SNG plants. Available cost estimates average $4.15/MCF.[20] The major attraction to building these plants was the minimum environmental impact, low capital investment requirements, low operating cost, and ease of construction (approximately two years).

Estimates of the contribution to U.S. gas supplies from this source are tabulated below:

	SNG (TCF)/yr (From Naphtha and NGL)			
	1985	1990	1995	2000
AGA[21]	.5	.5	.5	.5
NEP II[22]	.2-.5	N/P	N/P	.2-.5
DOE/EIA[23]	.15	.15	.15	N/P

N/P: Not Provided

The future of new SNG plants should be viewed as further dependence on foreign oil, as added demand for products such as naphtha will probably be met by imports. While the above forecasts show a stabilized supply from this source, new SNG plant construction will require feedstocks for which competition from other industries, such as petrochemical feedstock, will increase. If secure sources of feedstock become available for SNG plants this source of gas supply and peak-shaving capability should be fully encouraged. However, it appears that the feedstock problem will persist, new SNG plants will not be constructed,and the existing stock of SNG plants will decrease by attrition. Accordingly,this forecast reduces the expected contribution from this source from its current level of about .3TCF/yr to .1TCF/yr by the end of the forecast period.

8. New Technologies

Tapping the vast potential resources of unconventional geologic formations requires the development of new technologies for economically viable production of natural gas. This projection considers only four of these potential sources: Devonian shales, tight sands, coalbed methane, and geopressurized acquifers. While other unconventional sources are currently being explored, their contribution to U.S. gas supplies is judged to be small until near the end of this planning period.

Estimates of the contribution to U.S. gas supplies from these sources are tabulated below:

Estimated Contribution of Gas from New Technologies (TCF/yr)					
	1980	1985	1990	1995	2000
AGA[24]	N/P	.9	1.8	3.2	5.0
GRI[25]	N/P	1.21	N/P	N/P	10.2
NEP II[26]	N/P	.3-.8	N/P	N/P	1-5
ERDA[27]	N/P	.6	N/P	N/P	4.9

N/P: Not Provided

The estimate of the contribution from these four sources used herein, for the low, medium, and high cases are based on 50 percent, 75 percent and 100 percent of the AGA projected contribution from these sources. A description of each follows:

A. Geopressured Aquifers

Geopressurized resources consist of methane, free or dissolved in brine, trapped in sedimentary rock at high pressures. Large geopressurized areas underlie the Texas and Louisiana Gulf Coast at depths of 5,000 to 15,000 feet. The resource (gas-in-place) base is estimated at 3,000 to 100,000 TCF. The estimated recoverable gas range is 150 to 2000 TCF, with 160 TCF estimated recoverable at marginal cost up to $4/MCF.[28] There is no current production however, testing is underway to more precisely define the resource base as well as R&D to enable production.

B. Western Tight Sands

Tight sandstone formations in the U.S. are estimated to

[17]Energy Supply and Demand in the Midterm: 1985, 1990, and 1995 (April, 1979).
[18]Gas Energy Review, February 1979
[19]Gas Delivered into the Pipeline: Source Figure D-2-3.
[20]Gas delivered into the pipeline. (1977 costs) Source: Figure D-2-4.
[21]Gas Energy Review, February 1979
[22]NEP II, Table IV-5.
[23]Energy Supply and Demand in the Midterm: 1985, 1990 and 1995 (April 1979).
[24]Energy Supply Review, February 1979; Includes Devonian shale, tight sands, geopressurized gas, gas from coal seams, gas from biological waste and peat gasification.
[25]Gas Research Institute—GRI 1979-83 Five Yr. R&D Plan and 1979 R&D Program; Based on a study performed by TRW Energy Systems Group for GRI, (expected case only is shown). Includes Devonian shale, tight sands, geopressurized gas and gas from coal seams.
[26]NEP II Table IV-5 Includes tight sands, Devonian shale, coal bed methane and geopressurized methane.
[27]Market Oriented Program Planning Study, April 1977.
[28]1975 Dollars: Source: ERDA, "Market Oriented Program Planning Study," June 1977.

FIGURE D-2-3
STATUS OF LNG SUPPLEMENTAL GAS PROJECT

Status	Project Name/Sponsor	Receiving Terminal Location	Source of LNG	Initial Delivery	Contract Length	Annual Volume/BCF/yr	FERC Status	Est. Cost Delivered Into Pipeline* $/MMBtu
Operational	Distrigas	Everett, MA	Algeria	1978	20 yrs.	42	Approved	3.20
	El Paso I Columbia LNG Corp. & Con. Sys. LNG Co.	Cove Pt. MD	Algeria	1978	25 yrs.	237	Approved	1.88 Columbia 2.01 Con. Sys.
	Southern Energy Co.	Elba Is., GA	Algeria	1978	25 yrs.	128	Approved	1.61
Under Construction	Trunkline LNG Co.	Lake Charles, LA	Algeria	1980/81	20 yrs.	168.4	Approved	3.37
Planned	El Paso II	Port O'Connor, TX	Algeria	1983	20 yrs.	365	Pending	2.82
	Eascogas LNG, Inc.	Rossville, S.I. NY	Algeria	1983	—	143	Pending	—
	Tenneco	W. Deptford, NJ	—	—	—	—	Pending	2.82
	Pacific Lighting Corp.	Pt. Conception, CA	Indonesia	1982	—	197	Pending	3.57
	&PG&E Co.		S. Alaska	1982	—	73	Pending	3.64
				1985	—	146	Pending	—
	Tenneco	—	Trinidad & Tobago	1984	—	182 (min.)	To Be Filed	—
	NPG-LNG, INC.	Ingleside, TX	—	—	—	—	Pending	—
	Columbia LNG Corp. and Con. Sys. LNG Co.	Cove Pt., MD	Iran	1982	—	115	Pending	—
	S. California LNG Terminal Co.	Deer Canyon, CA	Indonesia or Ecuador, or Saudi Arabia	1983	—	474.5	Pending	—

TOTAL—2270.9 BCF

SOURCE: AGA Gas Supply Review, December 1978

* As of December 31, 1978.

FIGURE D-2-4
STATUS OF SNG-FROM-PETROLEUM PLANTS

Company	Location	Type	Feedstock Source*	Design Volume 1000 BBL/day	SNG Design Capacity /Day	Baseload of Seasonal Operation	1977 Annual Production (BCF)	Average SNG Cost per MMBTU
OPERATIONAL PLANTS								
Algonquin SNG	Freetown, MA	Naphtha	D	26.8	120	Seasonal	18.0	—
Ashland Oil, Inc.	Tonawanda, NY	Naphtha	D/I Crude	11.0	60	Baseload	18.2	$3.60-$4.00
Boston Gas Co.	Everett, MA	Propane	I - Exxon	10.0	40	Seasonal	1.6	—
Brooklyn Union Gas Co.	Brooklyn, NY	Naphtha	D - Exxon	13.7	60	Seasonal	4.9	—
Columbia LNG Corp.	Green Springs, OH	LPG, NGL	I - Canada	70.0	250	Baseload	75.5	$4.26
Trans. Co.	Chesapeake, VA	LPG	I	6.45	29.5	Seasonal	1.1	$4.35
Consumers Power Co.	Marysville, MI	NGL	Canada & D	50.0	225	Baseload	17.1	$4.00-$4.50
Gasco, Inc.	Oahu, HI	Naphtha	I	3.0	16.6	Baseload	3.3	—
Northern Illinois Gas Co.	AuxSable, IL	NGL	D	32.0	185	Baseload	65.4	—
		Naphtha	D	16	75			
Public Service E&G Co.	Harrison, NJ	Naphtha	D	4.0	20	Seasonal	0	—
Public Service E&G Co.	Linden, NJ	Naphtha	I	25.0	125	Seasonal	3.3	—
Baltimore G&E Co.	Sollers Pt., MD	Naphtha	D	12.0	60	Seasonal	.8	—
Peoples Gas Light Co.	Elwood, IL	Naphtha	D	33.0	160	Baseload	36.7	—
	TOTAL Naphtha - 144.50 TOTAL LPG, NGL - 168.45				TOTAL - 1351.1		TOTAL - 245.9	
PLANNED PLANTS								
Philadelphia Gas Works	Philadelphia, PA	Naphtha	D	13.0	60	—	—	—
Indiana Gas Co.	Marion Co., IL	Naphtha	D/F	10.9	60	—	—	—

D=Domestic, I=Imported, F=Foreign
SOURCE: AGA Gas Energy Review, April 1979

contain a total of 793 TCF of gas resource base in five areas; Green River Basin, Wyoming, 240 TCF; Piceance Basin, Colorado, 210 TCF; Uinta Basin, Utah, 150 TCF; Northern Great Plains Basin, Montana, and the Dakotas, 130 TCF; and San Jan Basin, New Mexico, 63 TCF. It is estimated that up to 170 TCF of this resource is recoverable at marginal cost up to $4/MCF.[29]

C. Eastern Shales

Eastern shales of the Devonian geologic era are estimated to contain 600 TCF of gas-in-place. Gas recovery, however, poses some special problems because these shales have a lower gas-filled porosity, a lower reservoir pressure and very low gas permeability, compared to tight sands. Estimated recoverable resource at marginal cost up to $4/MCF is 30 TCF.[30]

D. Coalbed Methane

It is estimated that 750 TCF of methane may be present in shallow and deep coalbeds in the United States. That is roughly equal to the total proved and potential conventional natural gas reserves in this country. Estimated recoverable reserves at marginal-cost up to $4/MCF is 350 TCF.[31]

9). High BTU Coal Gasification

There is adequate technology available to build first generation coal based high-BTU gasification plants, and two such projects are in the active planning stage. The most significant constraint for the private sector is economics both in terms of attracting capital and loan guarantees for repayment of principal and interest. A plant with output capacity of 250 MMcf/day (.091 TCF/yr) is estimated to cost about $1.2 billion, ($0.942 billion in 1975 dollars)[32] producing gas at about $5-6/MCF. Considering the overwhelming percentage of U.S. fossil fuel resources represented by coal, this potential source of gas should be aggressively pursued.

Estimates of the contribution from this source to total U.S. gas supplies are tabulated below:

High BTU Coal Gasification (TCF/yr)

	1985	1990	1995	2000
DOE[33]	.2	.4-.9	N/P	N/P
AGA[34]	.1	.6	1.8	3.3
NEP II[35]	0-.1	N/P	N/P	1-2

N/P: Not Provided.

To enable construction of such plants, Federal assistance with respect to pricing arrangements ("rolled in"), loan guarantees, and perhaps direct subsidy of both R&D and pilot plant construction may be necessary. Construction of first generation plants will demonstrate the technology on a commercial scale,as well as provide the opportunity to refine the technology so that second generation plants will produce a more competitive product.

The projections used in this forecast for contribution from this source (low-medium-high) are based on 50 percent, 75 percent, and 100 percent of the AGA forecasts of same.

10. Future New York State Supply

Our projection of future gas supplies available to New York State is inferred from the U.S. forecast by applying a historic ratio of US/NYS gas supplies. Figure D-2-5 below, shows U.S. supply per year between 1968 and 1978 and New York State supply from pipeline suppliers and the ratio of the latter to the former. Over this period, this ratio averaged .03330.

The period 1968 through 1978 was selected because: (1) New York lost significant volumes of gas from 1971 through 1977 due to curtailment; coupled with an early (1971) partial moratorium on,growth makes the NY/US ratio on the conservative side; and (2) this eleven-year period somewhat averages the inter-intra-state dedication ratio since the intrastate market started its rapid growth in 1971. With price deregulation, it is reasonable to assume that such an average will occur in the future if not tilt in favor of the interstate market since the intrastate market was fairly well saturated before enactment of the NGPA.

The NYS forecast obtained by applying this ratio to the U.S. forecast is shown in Figure D-2-6, also shown is the sensitivity to loss of combinations from supplementals included in the U.S. forecast. While the forecast is seemingly insensitive to the loss of several of the supplemental sources in the first half of the forecast period; it must be recognized that these sources can only be developed with sufficient lead time, and therefore require action in the next few years to result in gas supplies in the next fifteen years. This is evidenced by inspection of the New York gas supply forecast without supplementals.

11. Other Potential Sources of Future Gas Supplies

A summary of other potential sources of future gas supplies, not specifically included in our forecast, is given below.

A. Prohibitions Against Certain Uses of Gas

The Powerplant and Industrial Fuel Use Act (PIFUA) requires DOE to adopt regulations to reduce or eliminate the use of gas at electric powerplants and major fuel burning installations. Preliminary estimates are that 1985 gas consumption could be reduced by 1 TCF/yr, and by 1990 up to 3 TCF/yr. New York State should actively intervene at ERA to encourage expeditious implementation of the PIFUA.

B. In-Situ Coal Gasification

By burning underground coal in place a low-or-medium BTU gas is formed. This gas can be upgraded through catalytic methanation into pipeline quality gas. A vast resource base exists, but technological barriers and uncertain production economics must be overcome.

C. Renewable Sources

Renewable sources include gas from marine biomass converted to gaseous fuel via thermal decomposition or anaerobic digestion; gas from land biomass—producing gas by the same processes; gas from organic and municipal wastes (at large scale commercial sewage treatment plants); and by peat gasification.

D. Hydrogen

Hydrogen is a potential substitute or supplement for nat-

[29]Ibid.
[30]Ibid.
[31]Ibid.
[32]Great Plains Gasification Project, FERC Initial Brief, January, 1979.
[33]Overview of Technology Commercialization Assessment, November 1978.
[34]Gas Energy Review, February 1979.
[35]NEP II, Table IV-5. Includes medium-BTU gas from coal gasification.

FIGURE D-2-5

	U.S. Net Gas Supply[36]	NYS Net Gas Supply[37]	Ratio NYS/US
1968	18,960	731	.03855
1969	20,390	775	.03800
1970	21,370	802	.03753
1971	22,130	831	.03755
1972	22,430	748	.03335
1973	22,250	638	.02867
1974	21,510	674	.03133
1975	19,780	585	.02957
1976	20,170	635	.03148
1977	19,560	578	.02955
1978	19,610	603	.03075
			Average .03330

[36]Source: EIA Annual Report to Congress 1978, Vol. 2.
[37]Source: New York Gas Reports (NYGAS) and Annual Reports of member companies filed with the PSC.

FIGURE D-2-6

NYS SUPPLY FORECAST
(ALL SUPPLEMENTALS INCLUDED)
(BCF/yr)

	Low	Expected	High
1980	641	686	698
1984	653	719	787
1989	681	786	951
1994	729	851	1039

SENSITIVITY TO LOSS OF SUPPLEMENTALS
NYS SUPPLY
(BCF/YR)
(expected CASE ONLY)

	No Mexican	No Increased Canadian	No Mexican & Inc. Canadian	No Alaskan
1980	678	679	671	686
1984	699	708	687	719
1989	744	755	713	757
1994	810	802	760	798

	No Add'l LNG	No New Technologies	No High BTU Coal Gas	No Supplementals*
1980	686	686	686	671
1984	695	697	717	638
1989	755	741	771	593
1994	808	772	807	539

*Mexican, Increased Canadian, Alaskan, Additional LNG, New Technologies, and High BTU Coal Gas.

ural gas. It is produced with current technology, but at prohibitive costs. New technologies such as thermochemical decomposition of water are now under development.

E. SNG From Oil Shale

After coal, oil shale is the most abundant potential source of raw materials for making SNG. The development of a hydro-gasification process is ongoing and may lead to the pilot plant stage.

F. Gas Hydrates

Gas hydrates are ice-like compounds containing gas entrapped and bound to water molecules. Natural gas hydrates may occur naturally in perma-frost zones and some ocean sediments. The Soviet Union has conducted most of the research on gas hydrates, but North American Arctic drilling has reportedly confirmed their existence. The estimates of (world) in-place gas are huge, up to 30 million TCF, but no production cost and recoverable resource estimates exist.

APPENDIX D-3

Petroleum

1. PETROLEUM SUPPLY OVERVIEW

A. World and U.S. Outlook

The U.S. energy problem is twofold: one worldwide and one domestic. The worldwide problems are multifarious, complex, and rarely limited to energy. However, the two problems are related and have a single major intersection: U.S. oil imports.[1]

Cumulative world oil production through January, 1978 is estimated at 404 billion barrels, or only 36.6 percent of known oil reserves,[2] and 19.9 percent of the estimated 2030 billion barrels of ultimately recoverable supplies.[3] At the 1977 worldwide production rate of 21.7 billion barrels, the remaining known and ultimately recoverable reserves (see Figure D-3-1) represent 32 and 75 years of oil supply respectively. These reserves must be accessed to meet projected

[1]"Thinking Through the Energy Problem", Thomas C. Schelling, Committee for Economic Development pp. 8-10.

[2]Defined as proved and prospective reserves from discovered fields; estimated at 1105 billion barrels by Moody and Esser (Mobil Oil Corp.)

[3]Represents 1975 Moody and Esser (Mobil Oil Corporation) estimates as discussed in "Outlook for World Oil into the 2lst Century," by PIRINC, May, 1978.

FIGURE D-3-1
REMAINING KNOWN OIL RESERVES AS OF JANUARY 1, 1978
(1,000 BBL)

ASIA-PACIFIC	
Australia	2,130,000
Bangladesh	—
Brunei	1,800,000
Burma	25,000
Rep. of China (Taiwan)	10,200
Guam	—
India	2,600,000
Indonesia	9,600,000
Japan	55,000
Korea, South	—
Malaysia	2,800,000
New Zealand	110,000
Okinawa (R.I.)	—
Pakistan	200,000
Philippines	25,000
Singapore	—
Sri Lanka	—
Thailand	—
Total Asia-Pacific	19,355,200

WEST EUROPE	
Austria	141,400
Belgium	—
Cyprus	—
Denmark	375,000
Finland	—
France	50,000
Germany, West	480,000
Greece	150,000
Ireland	—
Italy-Sicily	645,000
Netherlands	60,000
Norway	5,750,000
Portugal	—
Spain	150,000
Sweden	—
Switzerland	—
United Kingdom	15,400,000
Yugoslavia	275,000
Total West Europe	23,476,400

MIDDLE EAST	
Abu Dhabi	28,000,000
Bahrain	240,000
Dubai	1,400,000
Iran	58,000,000
Iraq	31,000,000
Israel	1,000
Jordan	—
Kuwait	65,400,000
Lebanon	—
Divided (Neutral) Zone	6,260,000
Oman	2,400,000
Qatar	3,760,000
Saudi Arabia	163,350,000
Sharjah	11,300
South Yemen (Aden)	—
Syria	2,000,000
Turkey	125,000
Total Middle East	361,947,300

AFRICA	
Algeria	8,440,000
Angola-Cabinda	1,200,000
Cameroon	140,000
Congo Rep.	400,000
Egypt	3,100,000
Ethiopia	—
Gabon	500,000
Ghana	—
Ivory Coast	—
Kenya	—
Liberia	—
Libya	23,500,000
Madagascar	—
Morocco	100
Mozambique	—
Nigeria	17,400,000
Senegal	—
Sierra Leone	—
Somalia	—
South Africa	—

FIGURE D-3-1

AFRICA (Con't.)	
Sudan	—
Tanzania	—
Togo	—
Tunisia	2,250,000
Zaire	135,000
Zambia	—
Total Africa	57,072,100
WESTERN HEMISPHERE	
Argentina	2,400,000
Bahamas	—
Barbados	1,500
Bolivia	150,000
Brazil	1,220,000
Chile	400,000
Colombia	710,000
Costa Rica	—
Dominican Republic	—
Ecuador	1,100,000
El Salvador	—
Guatemala	16,000
Honduras	—
Jamaica	—
Martinique	—
Mexico	31,250,000
Netherlands Antilles	—
Nicaragua	—
Panama	—
Paraguay	—
Peru	655,000
Puerto Rico	—
Trinidad & Tobago	700,000
Uruguay	—
Venezuela	17,870,000
Virgin Islands	—
United States	26,500,000
Canada	6,800,000
Total W. Hemisphere	89,772,500
Total Non-Communist	551,623,500
COMMUNIST AREAS	
USSR	67,000,000
China	20,000,000
Other	3,000,000
Total Communist	90,000,000
TOTAL WORLD	641,623,500

NOTE: All reserve figures except those for the USSR are proved reserves recoverable with present technology and prices. USSR figures are "explored reserves", which includes proved, probable, and some possible.

SOURCE: Oil and Gas Journal, December 31, 1979.

world demand levels. Based on presently known reserves, the OPEC countries will probably continue as the largest single source of conventional crude oil throughout the world.

Several projections of non-Communist world supply and demand have been made (see Figure D-3-2). Demand between 1978 and 1990 ranges from a low of 51.6 MMB/D in 1978 to a high of 67.3 in 1990. Forecasts for 1983 alone show demand ranging from 55.8 MMB/D to 57.7 MMB/D. Estimates of the availability of world oil supplies to meet these anticipated demand levels also vary. These projections range from 50.8 MMBBL/D in 1978 to 67.3 MMBBL/D in 1990.

During 1983 available supplies are projected at levels between 55.8 MMB/D to 58.2 MMB/D.

Comparative forecasts for U.S. oil supplies (see Figure D-3-3) show a range of between 17.9 MMB/D to 20.3 MMB/D in 1980, and 18.9 MMB/D to 22.5 MMB/D in 1990. The Energy Information Administration's most recent forecast indicates an oil supply of 19.7 MMB/D in 1995.

Regardless of the forecasts, it is essential that the U.S. diversify its supply sources because a number of uncertainties exist that govern exploration and production of oil in any one region.

1) OPEC

The U.S. presently depends on the OPEC nations for 70 percent of its total imports, OPEC's proved reserves indicate that it could supply both U.S. and worldwide needs through 1994. However, it would be imprudent for the U.S. and other industrialized consuming countries to continue depending on Middle East oil to meet demand. Recent events, i.e., the Iranian coup in early 1979, and its subsequent turmoil,

FIGURE D-3-2
WORLD OIL SUPPLY DEMAND (1978-1990)
COMPARATIVE FORECASTS
(MMB/D)

	1978		1983			1985			1990
	Dodge	Osten**	Safer***	Dodge	DOE****	CIA*****	Dodge	Osten	Osten
Demand									
United States	18.9	18.7	21.2	20.4	—	—	21.0	20.7	22.0
Rest of Non-Communist World	32.7	33.2	34.6	37.3	—	—	39.5	40.4	45.3
Total	51.6	51.9	55.8	57.7	57.6	60.3	60.5	61.1	67.3
Supply									
Non-OPEC	20.2	19.4	29.3	24.2	23.4	24.0	24.6	24.2	28.8
U.S.	10.8	10.3	11.0	9.9	10.5	9.2	9.5	10.0	10.6
Canada	1.6	—	2.2	1.8	1.8	1.5	1.8	—	—
Mexico	1.3	1.5	3.0	2.9	—	2.8	3.5	4.0	6.0
Net Communist Exports	1.0	1.0	3.0	0.4	0.0	0.2	0.0	0.0	0.0
OPEC	30.6	32.5	26.5	34.0	34.2	36.3	36.4	36.9	38.5
Saudi Arabia	8.7	—	6.5	10.5	—	10.5	12.5	—	—
Iran	5.2	—	3.0	4.5	—	5.0	4.5	—	—
Total	50.8	51.9	55.8	58.2	57.6	60.3	61.0	61.1	67.3
Inventory Change	(0.8)	—	—	0.5	—	—	0.5	—	—
OPEC Capacity	—	36.8	—	—	—	—	—	37.9	37.9

* Philip L. Dodge, Merrill Lynch, Pierce, Fenner and Smith.
** Janes A. Osten, Data Resources, Inc.
*** Dr. Arnold Safer, Irving Trust.
**** A. Denny Ellerman, U.S. Department of Energy
SOURCE: The above four oil projections were presented at the April, 1979, "Outlook for Crude Oil" Conference sponsored by the Energy Bureau, Inc.
***** Everett M. Ehrlich, CIA as published in National Journal, May 26, 1979.

repercussions of U.S. participation in the Israeli-Egyptian Peace Treaty, the announcements by numerous OPEC member nations that production cutbacks will be initiated in 1980, the Palestine problem, and Soviet intervention in Afganistan make OPEC one of the least secure sources of oil.

To meet even the lowest projection of what OPEC oil will supply, two variables must be examined. First, whether OPEC will be able to produce the necessary quantities, and second, whether the cartel will want to produce these oil supplies.

Current sustainable OPEC crude oil productive capacity per year is estimated at 39.3 MMB/D.[4] To maintain production levels to satisfy demand in the longterm, OPEC members will have to continue expanding or, at a minimum, replacing and upgrading this capacity. In some instances, individual OPEC nations would not be able to do so without damaging ultimate resources recovery. Several others may find it undesirable to increase capacity. Therefore, a few nations may be required to increase output to higher levels, and it is questionable whether these adjustments are easily achievable with OPEC's current technology. Reported low reservoir pressures in Saudi Arabia's largest field, Ghawar, and in some of its other fields, only reinforce this skepticism.[5] Similarly, Iraqi fields, which were developed by Soviet technology, are experiencing flooding problems, thus making their future expansion uncertain. Water encroachment in the oil fields in Kuwait also pose technical problems for expansion of production in that nation. Other OPEC members, such as Indonesia and Venezuela, are already experiencing production declines because of decreasing reserves.

OPEC's decision whether or not to produce at increased levels to satisfy international oil demand will depend on many factors including: future oil prices, members' ability to absorb the additional income from greater production, individual long-term national economic development plans, and the cartel's perception of the lifespan of its oil reserves versus how long the international marketplace will demand crude oil as a major energy resource. This decision is complicated further by the fact that OPEC must sustain its high oil price, in real terms, to achieve internal goals. As OPEC members become reliant on the increased income from oil, and as the members become more adept, sophisticated, and involved in international and domestic monetary management, an increase in real revenues can be expected. This recently was the case when OPEC voted to increase the market price of crude in June, 1979 and in January, 1980. Achieving real price increases much earlier than anticipated may discourage or delay expansion of future production capacity in other OPEC nations.

2) Foreign Non-OPEC

Future foreign non-OPEC oil production of most significance to the U.S. will be from Canada, and Mexico and other lesser developed countries (LDC's). The actual level of

[4]Petroleum Intelligence Weekly.
[5]"The future of Saudi Arabian Oil Production," Senate Committee on Foreign Relations, International Economic Policy Subcommittee, April, 1979.

FIGURE D-3-3
UNITED STATES OIL SUPPLY INCLUDING IMPORTS
COMPARATIVE FORECASTS
MMB/D

Forecast	Year			
	1980	1985	1990	1995
Energy Information Adm., DOE[a]	17.9	18.0	19.4	20.6
Energy Information Adm., DOE[b]				
Total Oil Supply		19.1	19.5	19.7
Domestic Supply		10.6	11.2	11.7
Net Oil Imports		8.5	8.3	8.0
National Energy Plan II, DOE				
Total Oil Supply		19.5		
Domestic Supply		10.7		
Net Oil Imports		8.8		
U.S. Department of Commerce[c]		18.1		
The Pace Company[d]	19.8	19.3	18.9	
Petroleum Industry Research, Inc.[e]				
Total Oil Supply	20.3	21.1	22.5	
Domestic Oil Production	10.0	10.7	10.8	
Net Oil Imports	10.3	10.4	11.7	
Texaco[f]	19.9	21.8	20.2	19.5
Exxon[g]	20.3	20.9		

a. Energy Information Administration, DOE Annual Report to Congress, April, 1978, Projections of Energy Supply and Demand and Their Impacts, Vol. 2, 1977.

b. Energy Information Administration, April, 1979, Energy Supply and Demand in the Midterm: 1985, 1990, and 1995, moderate case (series c) forecasts, Tables 4 through 8.

c. Office of Energy Programs, January 20, 1977, Forecast of Likely U.S. Energy Supply/Demand Balances for 1985 and 2000 and Implications for U.S. Energy Policy. (Working Document).

d. Pace Company, August, 1977, *Petroleum's Role from Now to End of Century, In Petroleum/2000, Oil and Gas Journal.*

e. PIRINC, "Outlook for World Oil into the 2lst Century" prepared for Electric Power Research Institute, May, 1978, Tables 5-3 and 5-4 (intermediate case).

f. Granville, Maurice E., August, 1977, *Petroleum's Role from Now to End of Century: In Petroleum/2000, Oil and Gas Journal.*

g. Exxon Corporation, Exxon Company, U.S.A.'s Energy Outlook, 1978-1990, May, 1978.

that production will depend on future government policies and technical advances in the discovery and recovery of oil supplies.

a. Canada

Canada's production is projected to increase. Discoveries at West Pembina and Elmworth could add several billion barrels of proven reserves to present levels. The increased production of the Athabasca tar sands (see synthetic fuels) could also add several hundred thousand barrels/day of oil over the next five years.[6] Production of as much as 1 MMB/D could be achieved by the end of the century.[7]

In November, 1974 the Canadian National Energy Board announced its plan to phase out crude oil exports to the U.S. after 1981. The subsequent crude oil allocation program established by the Federal Energy Administration (predecessor to DOE) adversely affected the two refineries in Western New York, which had relied solely on Canadian oil supplies. This Canadian export policy, coupled with its high export fees of $5-$6/barrel, discouraged the U.S. from increasing its petroleum imports from Canada. However, the Canadian National Energy Board subsequently decided in 1979 to license heavy oil separately from the phase-out plan. U.S. firms now are negotiating for increased levels of supply. In June, 1979, the U.S. and Canada reached further agreement on joint research and development efforts. To assure that the U.S. secures Canadian oil and refined products, U.S. government negotiations must continue to influence Canada's national philosophy.

b. Mexico

Proven reserves in Mexico have increased from 2 billion barrels in 1974 to an estimated 30 billion barrels in late 1978. Based on these proven reserves alone, oil production could reach 5-6 million B/D by 1985. By then, however, it is foreseeable that the proven reserves will be much larger than is currently known, because the possible oil reserves have been estimated at over 100 billion barrels. A conservative view of Mexican oil production suggests that 2.2 MMB/D is likely by 1980 and at least 3 MMB/D by 1983.[8] Of some concern to the U.S., however, is Mexico's decision to diver-

[6]Arnold Safer, "Outlook for World Oil, 1978-1983", p. 4.
[7]"Outlook for World Oil Into the 2lst Century", Petroleum Industry Research Foundation, Inc. for the Electric Power Research Institute, May, 1978, pp. 7-8.

[8]Arnold Safer, p. 4.

sify the number of countries to whom it exports. Also, its internal National Development Plan presently limits the amount of oil it is willing to produce for export.[9]

c. Other Non-OPFC LDC's

Other non-OPEC lesser developed countries, specifically Latin American nations, produced over 1.2 MMB/D in 1977. These nations include the Caribbean, Brazil, Argentina, Columbia, and Peru. Present trends suggest that current production rates will increase to 2 MMB/D by 1983.[10] Further, potential for these nations is being expanded almost uniformly as each has accelerated its exploration and production, in both onshore and offshore areas.[11]

The level of exports from these countries will probably expand at a rate slower than the growth in new production. Increased internal petroleum requirements, combined with the need to supplement existing production, will reduce export potential.[12]

d. Communist Countries

Another source of oil in the world will be Communist nations. In 1978, Sino-Soviet exports to the West reached an estimated 2 MMB/D. By 1980, expanding Chinese and Soviet production will increase these exports to 2.5 MMB/D; by 1983, they may reach 3 MMB/D.[13]

Recent trade agreements and U.S. commitments to technological exchanges with China enhance this possibility. Also, China's progress toward restructuring its tax and joint venture laws will stimulate this potential.[14] However, one drawback to oil from China is the high residuum content of its reserves. Costly cracking facilities must supplement the normal refinery process to increase the percentage of vehicle fuels and petrochemical feedstocks obtainable from its crude oils. Ta-Ching field in Manchuria and the Shing-Li field in Shantung, the largest producing fields, both possess this low quality crude.[15]

3) USA

Annual domestic production is projected to rise from the 1978 level of 8.7 MMBBL/D to 10.0 MMBBL/D in 1980 and to 10.7 MMBBL/D by 1985 (Figure D-3-3). The potential for new U.S. oil reserves has been estimated at 120-150 billion barrels.[16] These supplies will come from Alaska, the Outer Continental Shelf, and from expanded federal leasing programs and enhanced recovery techniques in the Lower 48 states.

a. Alaska

Alaskan reserve estimates forecast as much as 30 billion barrels of oil presently undiscovered, with nearly 10 billion barrels located in present producing North Slope and Southern regions.[17] However, recent unpublished studies by the U.S. Geological Survey, indicate significantly increased estimates of oil reserves. The report, which updates the 1975 Geological Survey, raises the estimated reserves in the Navarin Basin, alone, by a ten-fold factor. These reserves must be produced. Problems facing the industry from recent passage of lands protection and Alaska State tax laws must be overcome. The Trans-Alaskan Pipeline System (TAPS) must be expanded from its present 1.2 million BBL/D capacity. Production projections of 1.5 to 1.8 MMB/D[18] can then be fulfilled by 1985.

Unfortunately, U.S. oil production has been declining since 1971, primarily because the large reserves of Alaskan oil discovered in 1968 could not be produced until a transportation system was built. Technically, a pipeline could have been put into operation within two or three years after the reserves were identified. However, environmental disputes, among other things, delayed the project for some time.[19]

b. OCS

The U.S. also has a large oil potential in its offshore areas. Undiscovered recoverable resources are estimated at 17.7 billion barrels.[20]

Since recent exploration on the Atlantic Outer Continental Shelf, the Gulf of Mexico and other offshore regions have been discouraging, the new discoveries will perhaps come from Alaska.[21]

Accelerating present OCS leasing schedules will also realize increased potential supplies. Accelerating lease schedules by 25 percent has the potential of adding 243 MMB/yr by 1995. This would raise present projections of 971 MMB/yr[22] to 1214 MMB/yr.

To accelerate the schedule of lease sales and production, obstacles must be overcome— these include the present leasing program itself. The present process is inherently time consuming because of the bottlenecks stemming from mandatory coordination and participation by federal, State, and local government agencies and interested public groups at all stages.[23]

However, in October, 1979, the U.S. Department of Interior, in compliance with the OSC Lands Act Amendments of 1978, issued a draft environmental impact statement on a proposed accelerated leasing schedule. If adopted, the new five year schedule would make available OCS areas where either no previous sales have been held, or no recent sale or development has occurred. The leasing of nearly 29 MM acres of land between 1980-1985 has a potential yield of 9 billion barrels of oil. This program will help achieve DOE's production goals for energy resources on federal lands.

Further, technological problems and water problems exist. Water depth does not restrict exploratory drilling, but limits

[9]"Mexico: The Promise and Problems of Petroleum", U.S. Senate Committee on Energy and Natural Resources, March, 1979, p. 169.
[10]Arnold Safer, p. 5.
[11]"Petroleum and Gas in Non-OPEC Developing Countries: 1976-1985", World Bank Staff Working Paper No. 289, April, 1978.
[12]"Energy Supply and Demand Balances and Financing Requirements in Non-OPEC Developing Nations Gordian Associates Inc., "Energy Needs, Uses and Resources in Developing Countries", Brookhaven National Laboratory. "Petroleum and Gas in Non-OPEC Developing Countries: 1976-1985", World Bank.
[13]Arnold Safer, "Outlook for World Oil 1978-1983", p. 5. See, however, contrary projections in Figure D-3-2 above.
[14]Platt's Oilgram News, McGraw-Hill, Inc., January-July, 1979.
[15]"China and United States Policy", Report of Senator Henry M. Jackson to U.S. Senate Committees on Armed Services and Energy and Natural Resources, March, 1978.
[16]Arnold Safer, "The Economics of U.S. Oil Supplies", October 17, 1977, p. 1.
[17]"Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000", Executive Summary Report, U.S. Department of Energy, Office of Policy Analysis, p. 3-5.
[18]National Energy Plan II, Section II, p. 5.
[19]Ibid, p. 6.
[20]National Energy Plan II, Section IV, p. 7.
[21]Ibid, p. 6.
[22]"Federal Leasing and Outer Continental Shelf Energy Production Goals", U.S. Department of Energy, Leasing, Policy Development Office, February, 1979, p. vi, Table 1.
[23]Ibid, p. 112.

production and development.[24] Production platforms, subsea completion systems, and pipeline transportation are greatly affected by water depth, seafloor permafrost, and ice movements. New technology is being tested but has not yet advanced enough to overcome problems of great water depth.

c. Lower-48 States

Lower 48 domestic production of premium quality crude is diminishing. It must be extended by use of enhanced recovery techniques and an expanded program to open up inland properties in the Federal domain.

Enhanced recovery already provides an estimated 240,000 BBL/D to 370,000 BBL/D. Under very conservative assumptions, production should reach 470,000 BBL/D within the next two to three years. However, this projection includes only acreage already developed, new (1976) starts already in process, and conversion of existing cyclic steam projects to steam drive. Tertiary recovery alone could expand the average output rate at existing wells from 35 percent to 50 percent.[25]

The current federal phased decontrol of domestic crude oil prices will offer greater incentives for enhanced oil recovery. New production from certain enhanced recovery techniques (such as tertiary recovery) is entitled to the world oil price, effective June 1, 1979. Since January 1, 1980, producers have been allowed to "release" specified volumes of lower-tier oil to the upper-tier to help finance their investments in enhanced oil recovery projects.

Finally, the Department of Energy is jointly funding with industry various R&D projects in enhanced oil recovery. The authorizations have been lowered to counterbalance additional revenues expected from decontrol. DOE's funding will focus on specific technical problems. The Department's budget authorizes $54 million in FY 1979 and $21 million in FY 1980. Industry will have to provide additional funds for field testing in FY 1980 and 1981 with the release of lower tier oil prices to upper tier levels.

The National Energy Plan II indicates that by 1985 enhanced recovery has the potential for a 400,000-800,000 BBL/D incremental production above current levels. By 1985, this additional oil will slow declining U.S. production rates and supplement U.S. supplies, thus potentially reducing imports.

Expanding production of onshore reserves, such as the Elk Hills Naval Petroleum Reserve, could supplement present supply levels by 150,000-250,000 BBL/D by 1980. Presently, only 10,000 BBL/D are being produced.[26]

4) Synthetic Petroleum Sources

Supplemental synthetic crude oil supplies from shale, tar sands, coal, and from heavy oils, are not now produced commercially on a large scale, but will play an increasing role in the future.

The actual volume of crude oil recoverable from these various resources depends on the commitment by government and industry to advance and perfect conversion processes and new technologies. The President's July, 1979, announcement to establish an Energy Security Corporation offers one alternative for providing the incentives needed to realize a synthetic liquid fuels industry. Legislation to finance the massive synthetic fuels program has passed both Houses of Congress and is being negotiated in conference. Recently, the President added gasohol to this undertaking.

a. Shale Oil

In the U.S. alone, shale oil reserves contain about 4.05 trillion barrels of oil equivalent.[27]

Production levels for U.S. oil shale plants could be as high as 300,000 BBL/D in the 1990's, if the oil shale technologies prove economically and environmentally adequate.[28] The President has proposed a limited $3/BBL oil shale production tax credit. The tax credit would provide an economic incentive for industry to demonstrate commercial oil shale production by the mid-1980's.

b. Tar Sands

U.S. tar sands hold 27 billion barrels of oil in place.[29] The Canadian Athabasca tar sands, which U.S. companies are helping produce jointly with Canada, also contain nearly 900 billion barrels of bitumen, the organic constituent in sand.[30]

The National Energy Plan II estimated that the cost of producing oil from tar sands and upgrading it for use in a conventional refinery was $7-$16/BBL. Production levels will depend on the price and the markets, and on the pace at which Canada decides to develop the Athabasca region.[31] It is probable that some of this oil will end up in the U.S. because of the U.S. participation and the close proximity of the two nations.

c. Coal Liquefaction

Coal is the most plentiful energy resource in the U.S. Oil from coal is possible by the mid-1980's, and significant capacity can be built in the 1990's if oil prices rise sharply.[32] Expectations for synthetic crude oil from liquefaction processes range from 250,000 BBL/D.

There are presently two known processes for converting coal into liquid fuels: direct and indirect liquefaction. Direct liquefaction produces a relatively large proportion of heavy products usable as substitutes for residual oil; but only 20-40 percent is equivalent to middle distillate and lighter quality fuels. Indirect liquefaction produces a gaseous fuel in the first stage which is then converted to gasolines. This process is more costly but the fuels are more desirable.

d. Heavy Oils

Another major source of oil will be heavy crude oil found in Venezuela, Canada, and the U.S. The shifting economics in today's petroleum market is making heavy oils competitive with light oils.[35] Venezuela's reserves are estimated at

[24]Ibid, pp. 128, 148.
[25]Hearings before the U.S. Senate Committee on Energy and Natural Resources, July 17, 1978, "Incentives for Tertiary Enhanced Recovery Techniques: Crude Oil Production", p. 51.
[26]"Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000", Draft Report, Volume U.S. Department of Energy, February 21, 1979, p. 3-12.
[27]Hearing before the U.S. Senate Committee on Energy and Natural Resources, "Oil Shale Technologies", February 16, 1978.
[28]NEP II, Section IV, p. 18.
[29]Synthetic Fuels Data Handbook: U.S. Oil Shale, U.S. Coal, Oil, Sands, Second Edition, Cameron Engineers, Inc., p. 268.
[30]Ibid, p. 259.
[31]NEP II, Section IV, p. 18.
[32]NEP II, Section IV, p. 19.
[33]"Energy Supply and Demand in the Midterm: 1985, 1990, 1995," U.S. Department of Energy.
[34]DOE Policy Evaluation Staff Study directed by Edward Blum.
[35]"OPEC Prices Make Heavy Oil Look Profitable", Science Magazine, Vol. 204, June 22, 1979, p. 1283.

500 billion barrels and Canada's at 200 billion barrels. Venezuela's Orinoco Oil Belt is now projected to reach production levels of at least 1 MMB/D by the end of the century.[36] The U.S. possesses 100 billion barrels, with California alone holding 30-35 billion barrels.[37] With proper front end financing, the domestic oils could be quickly produced to supplement conventional oil supplies and reduce import dependence.

[36]"Outlook for World Oil into the 2lst Century", Petroleum Industry Research Foundation, Inc. pp. 7-8.

[37]Arnold Safer, "Energy Economics", Financing Heavy Crude Oil Through Indexed Mortgage Bonds.

APPENDIX D-4a

Coal Use by Region and Volume Consumed

The geographic location of a facility using coal is a key consideration in determining the demand for coal. The precise location of a consumer will affect the most likely source of supply and the mode and cost of transporting the fuel. For the purpose of analyzing the locational distribution of coal users in New York, the State was divided into five regions as shown in Figure D-4a-1: Southern Tier, Adirondacks, Erie-Niagara-Lake Ontario, Catskill-Hudson and Greater New York City.

Figure D-4a-2 presents a summary of the consumption by regional distribution of coal consumers in the State. Slightly over 50% of the number of coal users and 65.9% of the total amount of coal coming into the State is consumed in the Erie-Niagara-Lake Ontario region. Four of the ten electric utility plants, all the coke plants and three of the seven cement/lime plants are located in this region. These facilities account for much of the predominance of coal use in this region. The Southern Tier region is the second largest user of coal and is the location of the six remaining coal-fired electric generating plants.

In understanding present and future coal use in the State, an important consideration is the amount of coal consumed by each firm. The amount of coal a firm uses partially determines the price it pays, the applicable environmental regulations, and the economic desirability and technical feasibility of switching to alternative fuels. Figure D-4a-3 provides a summary of the different quantities of coal consumed by users in each sector in the State. The majority of users consume between 100 and 100,000 tons of coal annually. Most of these users fall within the industrial and retail sales sectors. The electric utility, cement and lime, and metallurgical sectors generally tend to consist of users who consume more than 100,000 tons per year. Of the 19 users who do consume more than this amount per year, ten are utilities, three are coke plants, four are cement or lime firms and two are other industrial users. The amount these 19 users consumed (14 million tons) constitute almost 93% of the total amount of coal consumed in the State.

FIGURE D-4a-1
REGIONAL BREAKDOWN OF COUNTIES

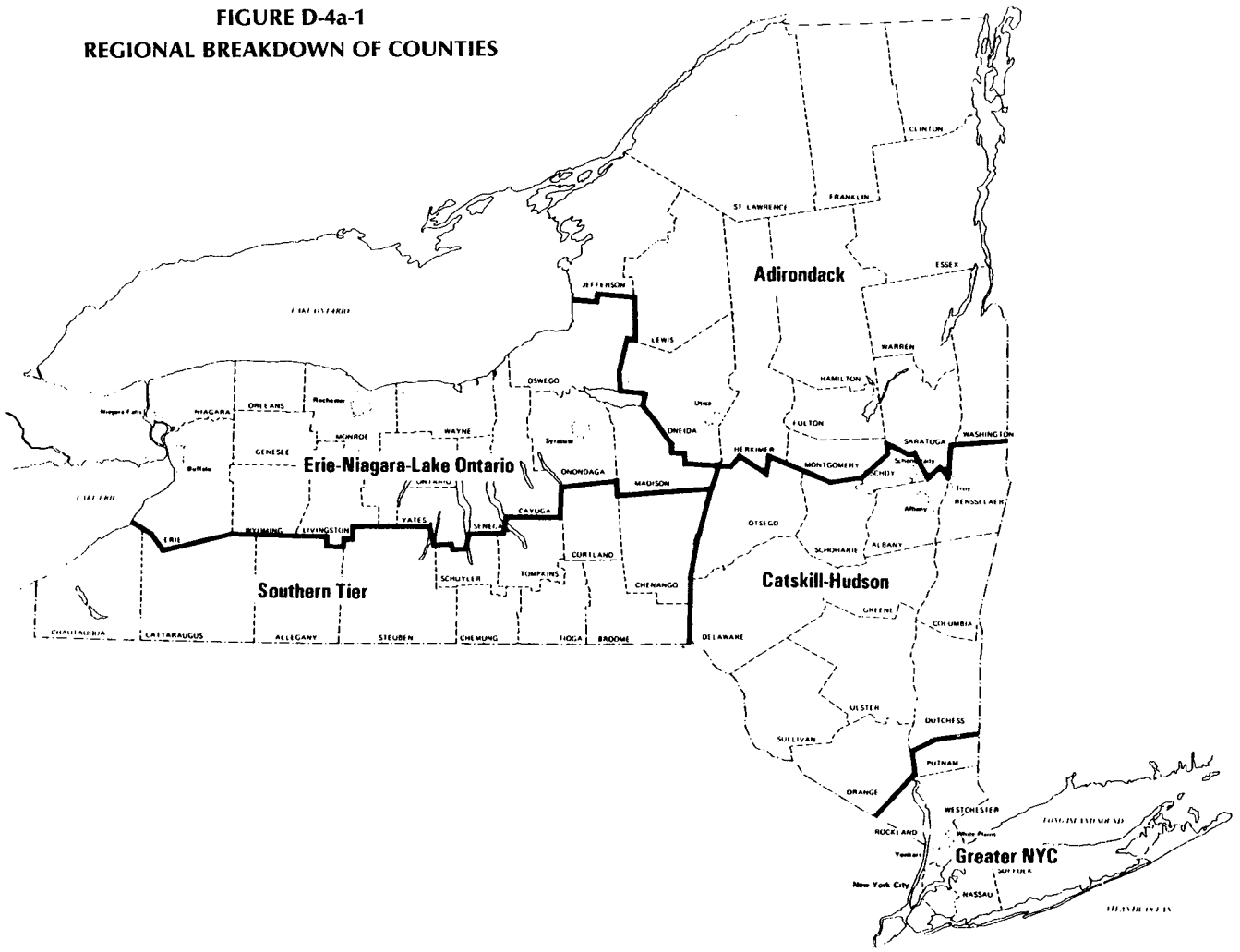


FIGURE D-4a-2
COAL USAGE BY REGION, 1978

Region	Installation #	Installation %	Consumption in 1978 Tons	Consumption in 1978 %
Southern Tier	15	17.7	3,376,180	26.8
Erie-Niagara-Lake Ontario	44	51.8	8,298,210	65.9
Catskills-Hudson	12	14.1	734,570	5.8
Adirondacks	11	12.9	143,110	1.1
Greater N.Y.C.	3	3.5	30,220	.2
TOTAL	85	100.0	12,582,290	100.0

SOURCE: Survey of 1978 Coal Consumption in New York State (Jan. 1979)

FIGURE D-4a-3
NEW YORK STATE MAJOR COAL CONSUMERS IN 1978

Number of Users	Range of Coal Consumed/User (tons/year)	% of Total Coal Consumed (tons/year)
5	more than 1,000,000	56.6
14	100,000—999,999	36.2
35	10,000—99,999	6.6
26	100—9,999	0.6
7	less than 100	0.0
87		

NOTE: This table includes New York State Electric & Gas Corp.'s share of coal consumed at the Homer City Plant which was approximately 2.5 million tons in 1978.

SOURCE: Survey of 1978 Coal Consumption in New York State (January, 1979)

APPENDIX D-4b

Anthracite Coal

1. BACKGROUND

Anthracite coal is considered separately from bituminous and lignite coal because the problems and potential associated with the production and consumption of anthracite are much different.

Anthracite coal consumption in the Nation peaked in 1917 when over 100 million tons were mined, with over 80 million tons consumed by the home, commercial and industrial space heating market. By 1977, only 4.67 million tons of anthracite was used in the Nation. Figure D-4b-2 shows anthracite consumption since 1960 for the United States and New York State.

A. Characteristics

Anthracite coal is a hard, high-fixed carbon, low sulfur coal with a relatively high ignition temperature. It can be used with efficiency only after it is cleaned and sized at preparation plants which break up the large pieces, remove impurities and separate the coal into standard sizes. The following compares the significant properties of prepared anthracite and eastern bituminous coal:

B. Location of Reserves

Anthracite reserves are geographically located in Northeastern Pennsylvania near the densely populated and highly industrialized Northeastern Region of the United States. Ninety-six percent of the anthracite reserves are located within 150 miles of one-sixth of the population of the U.S.. Generally, more than one-half of total anthracite shipments remain within Pennsylvania with most of the remainder being used in New York and New Jersey. Increasingly, the transportation of anthracite is by truck.

(3) Uses of Anthracite

The major uses of anthracite are for residential, commercial and small industrial space heating and electric power generation. However, anthracite is also used in chemical processes, the coking industry, cement plants and for nonferrous metallurgical uses.

2. FUTURE OUTLOOK

The potential for increases in future anthracite consumption in the Nation and New York State are difficult to predict for several reasons. First, and most important of these, is the changing market conditions. In the past, the primary use of anthracite was in the residential and commercial space heating market where the major competition was oil and gas. However, with the steadily declining market in this sector, it now appears that the greatest potential for increases in consumption is with electric utilities and with industry. The extent of this expansion is difficult to assess because of current uncertainties, economic, technological, and regulatory, for new power plants and other fuel burning installations.

(1) Environmental Regulations

Recent amendments to the Clean Air Act give special consideration to anthracite coal. This allows a "flexible interpretation" of the requirements for new steam-electric generating facilities to the extent that anthracite coal could become competitive as a boiler fuel. The term "flexible interpretation" means that an anthracite-fueled power plant built at a given location would be required to have sulfur dioxide emissions as low as a bituminous plant at the same site but scrubbing is not required as long as those emission levels are met. Because of the relatively lower sulfur content of anthracite, a flexible interpretation means that little or no SO2 pollution control equipment would be required for an anthracite plant compared to a bituminous plant. For anthracite coal to be competitive, however, the economic advantage provided by the reduced requirement for pollution control equipment must outweigh the higher costs of mining and using anthracite. The environmental benefits that would result from the necessity to open a large open-pit anthracite mine in eastern Pennsylvania through reclamation of previously mined lands, as well as the socio-economic benefits to this area, could be substantial.

A large anthracite-fired electric generating facility in New York City, only about 100 miles from the mine, could result in a significant decrease in dependence on imported petroleum as well as cost savings, to the electric consumers in that region.

E. Future Consumption

The "flexible interpretation" role brightens the future of anthracite coal in New York State. However, it will take further government incentives to make anthracite competitive with bituminous coal. Up to 100,000 tons per year of anthracite may be used in New York State in 1994. This estimate assumes some form of financial incentive from the State and Federal governments and that future environmental regulations continue to give an advantage to anthracite. Otherwise, consumption in 1994 might be negligible. Anthracite consumption will probably not be in addition to bituminous coal but would rather replace it.

FIGURE D-4b-1
QUALITY CHARACTERISTICS OF COAL

	Anthracite	Eastern Bituminous
Sulfur Content	0.6%	0.7 - 2.8%
Heat Content (Btu/lb)	12,510	12,070 - 13,680
Volatile Matter	4.4%	35.9%
Fixed Carbon	95.6%	64.1%
Ash	11.0%	6.9%

SOURCE: DOE Anthracite Task Force, Anthracite Task Force Report, November, 1977.

FIGURE D-4b-2
ANTHRACITE COAL CONSUMPTION IN NEW YORK STATE AND THE NATION (THOUSAND TONS)

		New York State		
Year	U.S.	Total	Residential/ Commercial	Industrial
1960	15,196	3,675	2,706	969
1961	14,198	3,463	2,724	1,039
1962	12,788	2,783	1,893	896
1963	11,705	2,386	1,575	811
1964	12,159	2,009	1,284	725
1965	10,667	1,577	975	602
1966	9,724	1,434	859	575
1967	9,064	1,121	649	472
1968	8,458	1,015	567	448
1969	8,206	1,014	546	468
1970	7,038	873	472	401
1971	6,525	915	477	438
1972	5,543	722	363	359
1973	5,183	679	348	331
1974	5,067	603	284	319
1975	4,851	531	206	325
1976	4,935	531	206	325
1977	4,672	503	165	338

APPENDIX D-4c

1. Short-Term National Coal Production

Short-term (through 1983) estimates of coal production have been determined by detailed survey of existing and planned mines. The long-term forecasts are based on anticipated demand for coal and reflect the least costly source of supply to satisfy these demands. For the longer-term period, coal production is estimated to equal forecasted consumption.

As shown in Figure D-4c-1, planned national production is estimated to increase from 822 million tons in 1979 to 930 million tons in 1983. For the Northern Appalachian region over the same time period, production capacity is expected to decline from 184 million tons to 176 million tons. Lack of growth in coal produced in Northern Appalachia is the result of anticipated mine retirements more than offsetting new mine openings. The associated decline in demand can be attributed primarily to the minimal increase in electricity growth demand in the Northeast and the shift to lower-sulfur coal by existing facilities to satisfy environmental requirements.

FIGURE D-4c-1

PRODUCTIVE CAPACITY ESTIMATES (MILLIONS OF TONS)

	Total U.S.	Northern Appalachia
1979	822	184
1980	898	187
1981	930	185
1982	936	180
1983	930	176

SOURCE: ICF, Survey of Mine Capacity: 1976; 1979 (in progress).

APPENDIX D-4d

Coal Conversions and New Technologies

1. Background

The United States currently imports approximately 44% of its petroleum. The imports contribute significantly to the nation's trade deficit, and have been shown, in recent years, to be undependable. Complicating this situation is the fact that easily recoverable domestic supplies of oil are dwindling. Although secondary and tertiary methods for recovery of petroleum and development of techniques to recover exotic forms of natural gas will extend supplies, it is evident that the nation's fuel mix must change to assure adequate supplies of energy in the future.

Any reasonable scenario of fuel mixes in the years ahead must include coal, our most abundant fossil fuel. Based on currently accepted estimates of reserves, there are sufficient quantities of this resource to supply the country for many years to come. In fact, if the current annual production of 700 million tons per year were to double or even triple, there should be enough coal to last for several hundred years. Of course, it must be recognized that coal will constitute only a portion of any fuel mix, which will be made up of many different energy sources. The percentage of energy demand ultimately met by coal will depend on economic feasibility and the development of coal utilization technologies which are acceptable from both a social and environmental standpoint. It is likely that near term increases in the use of coal will be due primarily to direct combustion. But long term environmental considerations demand that improved technologies for coal utilization be promoted if the full potential of coal as an energy source is to be realized.

New York State's increasing dependence upon oil and gas to meet its energy needs has been brought about by several factors. First, these fuels were easy to transport and required far less equipment for handling at the site than would be required for coal. The additional equipment needed for coal combustion is not only costly but requires skilled personnel to operate and maintain. Accordingly, use of coal is today almost exclusively limited to utilities and to those industries large enough to cope with these costly problems. Furthermore, direct combustion of coal by residential and commercial users will be resisted because of the inconvenience relative to oil or gas. Any coal that is consumed by these users will almost certainly be limited to anthracite, which is a much cleaner coal than bituminous.

Figure D-4d-1 shows fuel use by type and sector in the state during 1977.[1] Note that coal contributed about 8.5% to the total energy consumption of all sectors combined. Almost all coal consumption was limited to utility (52.3%) and industrial (46.2%) use.

Three utilities in the state currently burn coal at 9 different locations. Assuming a heat content of 23,956,000 BTU per ton of bituminous coal, the 180.7 x 10^{12} BTU attributed to electric utilities fired by coal during 1977 equates to 7,540,000 tons of coal (which is equivalent to about 31 x 10^{6} BBL of oil on a heating value basis). This is approximately half the quantity consumed by utilities during the mid to late 1960's. In other words, by using the same quantity of coal that was used 10 years ago, an additional 28 million bbls. of oil per year could be saved.

Industrial coal use is more widespread although a relatively small number of users account for a large percentage of the total. Coke producers, kiln operators, and a few chemical plants are responsible for most of the consumption. The 1977 industrial consumption of coal was about 6.5 million tons. Similar to the utility trend, this is about half the tonnage that was consumed by industry in the mid 1960's.

[1]Table prepared by New York State Energy Office

FIGURE D-4d-1
N.Y.S. FUEL USE BY TYPE AND SECTOR
1977
ENERGY DEMAND 10^{12} BTU

	Electric Utility	Residential	Commercial	Industrial	Transportation	Total
Total Coal	180.7	3.7	1.2	159.7	—	345.3
Anthracite	—	3.7	0.5	8.6	—	12.8
Bituminous	180.7	—	0.7	151.1	—	332.5
Natural Gas	4.2	338.3	125.7	112.3	—	580.5
Hydro	271.0	—	—	—	—	271.0
Nuclear	219.3	—	—	—	—	219.3
Total Petroleum Products	563.2	520.2	408.5	114.3	1058.4	2664.6
Distillate	23.5	447.5	85.9	44.1	64.9	665.9
Residual	539.7	38.3	316.1	57.1	50.0	1001.2
Gasoline	—	—	—	—	765.0	765.0
Kerosene	—	21.9	4.0	6.9	—	32.8
Jet Fuel	—	—	—	—	177.1	177.1
LPG	—	12.5	2.5	6.2	1.4	22.6
TOTAL ENERGY DEMAND	1238.4	862.2	535.4	386.3	1058.4	4080.7
Electric Sales (million KWH)		29763	32472	37089	2231	101555

Analysis of the table shows that coal contributed 14.7% of the energy input of electric utilities. The other energy sources were petroleum (45%), hydro (22%), nuclear (18%) and natural gas (0.3%). In the industrial sector, coal contributed over 41% to the energy input. The majority of this was input to coking facilities. Other energy inputs to industry were petroleum (30%) and natural gas (29%).

In the future, increases in coal use can result from a variety of developing coal utilization technologies, producing both liquid and gaseous fuel forms designed to provide environmentally sound replacements for both oil and natural gas.

Promulgation of "The Powerplant and Industrial Fuel Use Act" (FUA) and the "Energy Supply and Environmental Coordination Act" (ESECA) provided a regulatory framework for forcing conversion from oil and gas to coal or some other "alternate fuels" at utilities and major fuel burning installations. Incentives to convert should also result from the rapidly escalating costs of petroleum and natural gas and the uncertainty of their supply. But without more extensive incentive programs emanating from both federal and state levels, the penetration of coal and other alternate fuels can be expected to occur at a slow pace.

The following sections address the potential and expected increases in coal utilization in the various sectors (i.e., utility, commercial, industrial, etc.) by 5 year intervals through the year 1994. The first section deals with conversions to coal resulting from the "Energy Supply and Environmental Coordination Act" and "The Powerplant and Industrial Fuel Use Act." Subsequent sections discuss penetration of coal, including anthracite coal, and/or coal derivatives into the fuel mix as a result of new technologies. In each section, ranges of coal utilization are given which reflect the variety of factors that will ultimately determine quantities of coal consumed.

2. *Conversions*

A. *ESECA and FUA*

The penetration of coal into the energy mix in the next several years is likely to result primarily from prohibition orders issued under the "Energy Supply and Environmental Coordination Act" of 1974 and "The Powerplant and Industrial Fuel Use Act" of 1978. Although the mechanics of the two Acts are somewhat different, the intent of both is to reduce consumption of oil and gas. Essentially, they prohibit use of oil and gas in new utility fossil fuel burning units and in the new major fuel burning installations (MFBIs) at facility types other than utilities. Additionally, restrictions will be placed on usage of oil and gas at existing utility units and MFBIs.

New and/or existing facilities which are prohibited from burning gas or oil could be exempted from such orders for any of several reasons. These include adverse environmental impact, unreasonable costs, and site limitations. Under ESECA, the Federal Department of Energy (DOE) is required to prove that a facility can convert without encountering the above problems. However, an order issued under FUA would not require the DOE to prove that a facility could reasonably be expected to convert. Instead, the order would become effective unless the applicant proved that an exemption was warranted. The likelihood of facilities obtaining such exemptions must be considered in attempting to predict coal usage from ESECA and FUA orders. Because this is at best difficult, the following discussion on coal penetration presents several scenarios.

(1) *The Utility Sector*

Nine utility plants in New York were identified as likely candidates for conversion under ESECA. Assuming all 9 converted and used conventional direct coal combustion, the increased coal consumption would be approximately 11.4 million tons per year.[2] This figure could be even higher if 1) the proposed DOE interim regulation is finalized and 2) it is concluded from application of the regulation that an 850 MW facility, currently under construction, is subject to FUA and 3) the facility does not obtain an exemption. Under these assumptions, the increased coal usage by this facility alone could be 1.9 million tons per year. Accordingly, the maximum possible increase in coal consumption of existing units and units under construction in the utility sector caused by ESECA and FUA is 13.3 million tons per year. This assumes that 1) no additional existing units in the utility sector will be ordered to convert to coal under FUA and 2) the facilities originally identified as having potential to burn coal are eventually converted.

It is improbable that all the above facilities would be converted to direct coal combustion. It is more likely that some of these facilities will apply for and obtain exemptions. It is impossible to determine how many exemptions will be issued. However, assuming that 2 of the 3 facilities which received prohibition orders under ESECA (out of the 9 identified candidates) are the conversions to take place, the increased coal consumption would be approximately 1.8 million tons per year. However the minimum increase in coal use for utility conversion would be zero if no plant converted.

Thus, the range of possible conversion tonnage as a result of ESECA and FUA is quite wide. The extent to which conversions will actually occur will be dependent on a number of other variables, none of which are controlled by the end-user. These include at least the following:

- relative cost and availability of alternative fuels, particularly oil
- air pollution regulations
- coal supply dependability (including transportation)
- nuclear policy
- government policy and incentives
- solid waste disposal regulations

Certain of these variables can be affected by using coal technologies, other than direct coal combustion, such as liquefaction or gasification. The potential for using such technologies, either voluntarily or to comply with an ESECA or FUA prohibition order, will be discussed under the appropriate technology section.

The timeframe for the projected conversions is shown in the following table for the years 1984, 1989, and 1994. Ranges are presented for each 5 year interval.

Increased Coal Consumption in Utility Sector From Direct Coal Combustion Under ESECA and FUA Orders (by million barrels of oil equivalent per year)

	1984	1989	1994
Range	0-26	0-43	0-50
Expected	19	22	22-30

Each 1 million tons of coal saves about 3.8 million barrels of oil. The expected values in the table assume that several of the original candidates will obtain exemptions and will not convert. The expected values can vary significantly

[2]Based on 1977 New York Power Pool average consumption of 2270 tons of coal per year per installed megawatt.

given the uncertainty of the variables listed above and should only be used with caution.

2) The Industrial and Commercial Sectors—MFBIs

The complexity of predicting likely conversions under ESECA and FUA increases when looking at the industrial and commercial sectors. The capital expenditure for converting MFBIs is more difficult to offset than utility conversions. This is a result of:

- lower consumption of coal at MFBIs than at utilities resulting in less fuel savings over the life of the converted facility and
- proportionately higher transportation costs associated with lower coal use.

There were no conversion orders issued to MFBIs under ESECA. Although some existing MFBIs are likely to receive orders under FUA, it is possible that none will convert given the numerous exemption possibilities that exist. However, it is expected that new major fuel burning installations will be affected by FUA.

The range for increased coal use in the industrial sector resulting from FUA will depend on the number of existing units converted and the number of MFBIs constructed in the future. The lower end of the range for increased coal consumption resulting from FUA ordered conversions could realistically be zero given the same variables listed in the previous section and the opportunity for exemptions under FUA. It is not intended to imply that petroleum or natural gas will continue to be primary energy sources, but only that too many variables exist to state positively that increased coal consumption will result from conversion of existing MFBIs and/or construction and operation of new MFBIs within the next 15 years. Likewise, it would be speculative to attempt to project an upper limit of increased coal use from FUA ordered conversions. There are currently fewer than 100 MFBIs burning oil in the state. They consume approximately 20,000 bbls. per day. Assuming that FUA ordered conversions resulted in a decrease of 10 percent or 2,000 bbl. per day, there would be an increased coal consumption of approximately 190,000 ton per year assuming direct coal combustion. This is probably the maximum conversion that could be expected at existing facilities and would probably occur by the year 1989. The projection is limited to 10 percent of the potential because some units will not convert and some may use other technologies. These reasons also limit other projections made later on. Of course, FUA will also apply to new MFBIs but it would be too speculative to attempt to determine how many such units will be constructed and operated on coal and/or coal derivatives during the next 15 years.

3. New Technologies

A. Coal-Oil Mixtures (COM)

As the name implies, COM is a mixture of coal and oil. Its principal advantages are that it is liquid and can be handled with relative ease compared to coal and possibly combusted in oil fired boilers with minor modifications. The coal is suspended in either distillate or residual oil. Advantages vary depending on the type of oil used. A stable mixture is absolutely essential if COM combustion is to become a reality and the use of residual oil increases the stability of the mixture. Although the use of lighter distillate oil is somewhat less stable, its lower sulfur content and its typically lower particulate emissions make its use particularly attractive from the environmental standpoint.

A mixture of coal and oil has the potential to replace approximately 35 percent of the normal oil fuel quantity, on a heating value basis, when blended in a mixture consisting of 50% by weight of pulverized coal in residual oil. Adding water to the mixture can result in an even greater oil savings, but the following penetration estimates are conservative in that they assume a 50-50 coal-oil mixture.

Assuming COM has potential for penetration in the utility, commercial and industrial sectors of the State and assuming that it were to ultimately replace all residual oil in such facilities, it could save approximately 51 million barrels (about 21 million from industrial and commercial facilities and 30 million from utilities) of oil per year based on 1977 demand. This is not, of course, a realistic assessment of the likely penetration of COM. It is an absolute maximum which in all probability will not occur because some facilities will not convert and some that do will select other technologies. However, it clearly indicates that if only a fraction of this potential market is reached by COM, a significant reduction in oil consumption could result. It should be noted that facilities now using natural gas could convert to COM. However, the recent Federal Department of Energy Policy on natural gas makes this substitution highly speculative. Additionally, it is assumed that COM will not replace distillate oil which is typically used in smaller facilities.

Facilities which consume COM must meet applicable environmental standards. It is quite possible that particulate emission controls will be required. In fact, the potential increase in air pollutant emissions could be a barrier to increased COM use.

However, the major obstacle to COM penetration is preparation and distribution of the mixture. It has been estimated that a preparation facility would have to produce at least 50 million gallons of mixture annually to be economical. This clearly demonstrates that facilities in New York State, other than utilities, cannot justify construction of a plant for preparing COM for their own use. Accordingly, a COM supplier would have to be assured of many dependable markets before constructing a preparation facility unless that supplier were a utility which was using COM on site.

Any projection of the penetration of COM must make certain assumptions concerning, for example, expected fuel costs, the sufficiency of markets, or the degree of government support. All of these factors will have an impact on the extent that COM will enter the fuel mix within the next 15 years. If such potential barriers to COM adoption are minimized, there is reason to believe that COM can effectively penetrate the fuel mix, perhaps achieving as much as ten percent of its industrial and commercial sector potential by 1994. This would replace about 2.1 million barrels of oil (10% of 21 million) per year and would require about 550,000 tons of coal per year. Additionally, it is projected that COM could replace, in the utility sector, residual oil used at plants with a total generating capacity of 1700 MW. This could save 5 million barrels of oil per year and would require 1.35 million tons of coal.

Such a result is not likely to occur until successful demonstration of COM combustion has been carried out. Consequently, New York State must encourage, promote and support such a demonstration. If it is shown that the mixture can be reliably combusted in a boiler designed for oil then the above yearly oil saving could be achieved. The time required to adequately demonstrate this technology and develop markets makes it likely that COM would not enter the fuel mix until after 1984. However, a failure to demonstrate and to resolve the other above mentioned problems could result in no COM use by 1994. The following table

shows the projected range of COM utilization over the next 15 years (by million barrels of oil replaced).

1984	1989	1994
0	0-3.6	0-7.2

B. Fluidized Bed Combustion (FBC)

Fluidized bed combustion for burning coal is a process by which coal is introduced and combusted in a bed of non-combustible material. The bed is fluidized by blowing air through the bottom of the firebox. As the coal burns, the bed becomes red hot. The fluidity and the continuous intermixing of the material maintains a realtively constant temperature throughout the bed preventing formation of either "hotspots" or "coldspots". The heat is transferred directly to tubes immersed in the bed and located on the surrounding walls. The direct contact between bed and tubes results in a higher rate of heat transfer than obtained in a conventional coal boiler.

Fluidized bed combustion has several advantages from an environmental standpoint. The relatively low temperature in the firebox results in a substantial reduction in nitrogen oxide emissions compared to conventional coal fired boilers. This is especially appealing because Federal EPA is considering lowering the emission standard. Furthermore, the use of limestone and dolomite as bed materials will reduce sulfur dioxide emissions. The sulfur reacts with the calcium carbonates and magnesium carbonates to form sulfates. It is not unusual to obtain a removal efficiency of 90% of such sulfur compounds.

There is a negative side regarding environmental impacts. Fluidized bed combustion emits fine particulates which escape collection. Further study of the effects of these emissions is required. Equally as troublesome is the quantity of solid waste produced. Although the waste is dry, as compared to the wet waste produced in a flue gas desulfurization scrubber, it contains considerably greater quantities of solids, due to the amount of limestone and dolomite which are required to remove sulfur in an FBC unit. This waste is currently being studied by the Federal EPA, who will determine whether it is to be considered and treated as a toxic waste. If it is categorized as toxic, waste disposal costs will increase considerably.

There are several problems which must be overcome before FBC technology will alter the fuel mix. These problems include the lack of demonstrated operating performance, uncertainty about future environmental regulations, the apparent availability of oil and gas, and the relative cost of a FBC unit as compared to an oil or gas fired boiler. Projects now underway may provide answers to the first question. Potential environmental barriers will be clarified when EPA can adequately evaluate the fine particulate emissions and the solid waste and determine what standards will be applicable.

The market for fluidized bed combustion over the next 15 years will probably be limited to the larger industrial and institutional facilities. Although DOE has targeted 4 specific industries for demonstration purposes, there is no reason that this technology cannot be used at all facility types with combustion units having heat inputs greater than 100 million BTU per hour provided the above problems can be eliminated. However, it is unlikely that more than 10 percent of the oil in the potential market can be replaced by FBC by 1994.

Indeed, it is possible that an unsatisfactory resolution of the above problems could push use of FBC technology back by at least 15 years. Accordingly, it is possible that FBC will not be used in New York State by 1994. The following table shows ranges of potential FBC utilization through 1994 (by million barrels of oil replaced using 1977 consumption figures).

1984	1989	1994
0	0-.4	0-.75

A decrease of 750,000 barrels will increase coal consumption by about 200,000 tons/year.

C. Low BTU Gasification

Low BTU gas (LBG) is produced by combustion of coal with air and steam. The gas produced is composed mostly of hydrogen, nitrogen and carbon monoxide. The heating value of the gas is in the range of 100-180 BTU per standard cubic foot. It can be used in conventional gas fired equipment.

Low BTU gasifiers are technically proven for certain types of coal, primarily western non-caking coals. Second generation equipment for gasifying eastern bituminous coals will require demonstration before commercialization can be expected to occur.

There are several potential environmental problems which will probably delay the introduction of this technology into the fuel mix. The components of the gas produced have not been adequately identified and could pose unique health problems. It is possible that the liquid wastes will contain toxic materials and be subject to The Toxic Substance Control Act (TSCA). Additionally, solid waste disposal must comply with regulations enforcing provisions of The Resource Conservation and Recovery Act. Costs associated with controlling pollutants to meet the applicable environmental regulations can significantly affect the potential use of low BTU gas in the future.

Although the environmental restrictions may demand expensive flue gas controls, the needed technology does exist. In fact, given adequate stack gas cleaning, low BTU gasification may offer the best alternative as a fuel source for air pollution non-attainment areas.

A second factor which might encourage owners to use this technology is interruptible gas service. Local production of low BTU gas from coal could provide a more stable source of supply and in some instances, eliminate the potential for service disruptions.

There are three substantial barriers to the commercialization of this technology in New York State. The first one, which has already been mentioned, is the inability of existing gasifiers to use eastern bituminous coal. Consequently, western coal would have to be transported to New York State at high costs. This is a technology problem which may be resolved when the second generation gasifiers are developed. The second problem is the high cost of low BTU gas as compared with direct coal firing and the current price of natural gas and oil. Low BTU gas may be non-competitive with direct coal firing but it has specific markets where solid coal is not a competing fuel. As the cost of oil and natural gas increase, the relative economics of coal technologies will become more favorable. The third barrier is the uncertainty of government policy. Industry is not likely to invest in low BTU gasification as long as supplies of natural gas are available at reasonable costs. Potential users are developing a "wait and see" attitude and will undoubtedly continue to forestall decisions on this technology until federal policy is clarified.

The low BTU value of this gas makes its transport highly unprofitable. Accordingly, potential users of this technology

must be located near the gasification facility. The DOE commercialization report has identified the following industries as most likely users: glass, primary metal, iron ore beneficiation, metal finishing, cement, lime, brick, and food. There are over 20 such industries in the State which use gas in sufficient quantities. Assuming the above barriers are resolved satisfactorily, it is projected that a maximum penetration of low BTU gas would be 1 trillion BTU by 1994. Failure to resolve the above problems could mean-that there will be no penetration of this technology by 1994. The following chart shows projected ranges of penetration related to time (in million barrels of oil equivalent per year).

1984	1989	1994
0	0-0.1	0-0.2

D. Medium BTU Gasification

Medium BTU gas (MBG) is produced in the same manner as low BTU gas except that oxygen is used in place of air. The resulting product has a heat value of 300 to 600 BTU per standard cubic feet. A significant advantage of this gas over low BTU gas is that the higher heat content allows for medium BTU gas to be economically transported up to about 100 miles. Accordingly, many customers can be serviced from a single medium BTU gasification production facility. However, technological problems are encountered which are similar to those found with low BTU gas. These problems are currently being researched and solutions are expected such that medium BTU gasification could be "on line" within 15 years.

There are also additional problems which will impede the entrance of medium BTU gas into the fuel mix. First, pipelines will be necessary if several customers are supplied from the same production facility. The costs will be high and necessary construction permits may be difficult to obtain. Second, the distribution of this gas to several users may be regulated, perhaps requiring the formation of a new utility or distribution through an existing utility.

Another potential problem is the cost required to provide oxygen to the process. A medium BTU gasification production facility will have to have large outputs (about 50 billion BTU-day) in order to meet the high cost of oxygen production and remain competitive.

An optimistic projection is that one plant producing medium BTU gas might be operable in New York State by 1994. The development of second generation technology and substantial increases in natural gas curtailment must precede the utilization of medium BTU gas. However, this should occur prior to 1989 and construction and operation of one medium BTU gasification facility in New York State within 15 years is a real possibility. In fact, a conceivable upper limit might be construction and operation of 2 such facilities. But due to the nature of the several assumptions underlying this optimism, the lower end of the range must again be zero.

The following chart shows the potential range of penetration of this technology by 1994 (in million barrels of oil equivalent per year).

1984	1989	1994
0	0-3	0-6

E. Liquefaction

There are two different methods for liquefying coal: Direct and indirect hydrogenation. The indirect methods are commercially available while the direct routes need further development. The direct processes produce a liquid which is suitable as a replacement for fuel oil. This is the end-use which holds most promise as a market for products from liquefaction plants.

It is unlikely that liquefaction plants will be constructed in New York State, since it is more economical to have a mine mouth operation and transport the liquid as opposed to shipping the coal. Accordingly, environmental problems in New York State will be limited to emissions from combusting the liquefied coal. Tests which have already been run show that emissions from combusting liquefied coal are within applicable environmental standards.

There are, however, other major problems confronting this technology. The capital requirements of a new facility are significant. Government financial support may be necessary to encourage commercialization. Additionally, the direct hydrogenation processes must be demonstrated.

The penetration of liquefied coal in the New York State fuel mix within the next 15 years depends on world oil costs, DOE policy, and availability of capital for constructing liquefaction plants. The largest potential market within New York State is the utility sector in the New York City metropolitan area. Liquefied coal provides an environmentally compatible alternative to the oil which the utility sector now consumes.

The use of liquefied coal will require substantial support by DOE. If such support is provided, this technology could significantly alter the fuel mix. It is conceivable, given DOE support and the proper economic climate, that liquefied coal could contribute significantly to utility oil requirements in the metropolitan New York area by 1994.

Consolidated Edison's oil requirements for 1978 were about 38 million barrels according to the report submitted by the Power Pool pursuant to requirements of Article III, Section 5-112. Assuming no projected increase in oil consumed, the use of coal at Arthur Kill and Ravenwood could reduce oil requirements to 23 million barrels annually. A commercial liquefaction plant producing 70,000 barrels per day, operating 90% of the time, could supply all of this oil if the output were dedicated exclusively to Con Edison. However, because of the various fuels and technologies available, it is projected that liquefied coal could, as an upper limit, replace 30% of the oil (about 7 million barrels per year). A lower limit would of course be zero given the uncertainty of factors affecting development of this technology. The projection of liquefaction penetration is given in the following chart (million barrels/yr. oil).

1984	1989	1994
0	0	0-7

F. High BTU Gasification

The technology for high BTU gasification is similar to that used for medium BTU gasification, with the addition of a methanation stage. Similar technological problems exist in that high caking eastern bituminous coals are not suited to existing technology. The process is therefore limited to use of western coals. Another problem is that while all the hardware components have been proven in other processes, they must now be integrated in unique ways to provide the high BTU gas. This will probably present some problems.

This technology is similar to liquefaction in that plants producing high BTU gas will most likely be located at the mine mouth. It is more economical to transport the gas than the coal. Accordingly, the environmental impact in New

York State that will result from combustion of the substitute gas will be minimal.

There is a major barrier to commercialization of high BTU gas. Specifically, the cost of a production plant at commercial scale will be very high and capital required may be difficult to obtain due to risk factors. Government support will be required.

Given adequate government support, high BTU gasification could be a reality soon. There is really no lower or upper limit of the penetration of this technology. In fact if inadequate supplies of natural gas exist to meet demand as early as 1984, the difference can possibly be made up by this technology.

G. Coal Gasification for Combined Cycle Electric Generation (CGCC)

CGCC is a technology where clean gasified coal is fed to a gas turbine to drive a generator. Steam, generated from the waste heat, drives a second generator.

These plants have less environmental impact than direct fired plants. However, the cost is higher if current technology is utilized. This situation may be remedied by the development of high temperature gas turbines. Additionally, hot gas clean-up needs to be developed. Utility companies, the most probable adopters of CGCC, have little or no incentive to risk the use of such new technologies at the present time.

Although CGCC could be perfected by 1994, it would be too speculative to propose a range of penetration for this technology.

H. Fuel Cells

Hydrogen rich gas is produced by reacting water with coal at high temperatures in a gasifier. The gas is cleaned and the hydrogen is passed through an electrode in the fuel cell. Oxygen (air) is passed through the other electrode. The hydrogen splits into hydrogen ions and electrons. The ions combine with the oxygen to form water and the electrons pass through an external circuit to create DC current. The DC power is converted to AC power which is compatible with existing equipment. Additionally, heat can be recovered from the hot flue gases and used to produce steam.

This technology offers significant advantages over conventional technology from an environmental standpoint. But it has yet to be adequately demonstrated, and it will be some time before its potential users, the utility sector, are likely to see it as a proven technology worthy of investment.

Although this technology has been supported by utilities, government and environment groups, further development is required and projection of its use by 1994 would be highly speculative.

I. Penetration of Anthracite Coal

During 1977, the use of anthracite coal in New York State (approximately 500,000 tons) was limited to the residential, commercial and industrial sectors. Utilities did not use anthracite. There are major reasons for the relatively minor use of anthracite as a fuel. The reasons depend upon the sector, but in general are:

- inconvenience (residential and commercial sectors)
- high cost associated with mining, handling and combustion.

The 1977 consumption is typical of what exists today.

There are reasons to look at anthracite as a potential fuel source in the future. The primary reason from New York State's standpoint is that it would reduce petroleum and gas consumption and would result in less environmental degradation than the use of bituminous coal.

The potential markets for anthracite are:

- residential, commercial, industrial space heating
- electric utilities
- industrial processes

Any increase in consumption will require a comprehensive effort on the part of both federal and local governments. Loan guarantees and tax relief are examples of financial incentives government can provide. Furthermore, government should promote and encourage use of this fuel in centralized heating systems and industrial parks. Government facilities are candidates for conversion to anthracite. It is unlikely that increased anthracite use will occur in single family residences, duplexes or other smaller buildings.

The utility and industrial sector will only turn to this fuel if financial incentives are provided for its use. The only incentive for utilities would be if anthracite could be used without the necessity to scrub out sulfur dioxide. Otherwise, it is cheaper to use bituminous coal. Industry prefers anthracite for certain process uses such as iron and steel, chemical and certain smelting operations.

Increases in anthracite use in New York State are difficult to predict. Without substantial government support, the increase will probably be minimal. For purposes of base projections, zero increased consumption will be assumed if no incentives are provided. If government support is provided and if environmental regulations favor anthracite such that the scrubbing of SO_2 at new electric generating facilities is not required, then it is projected that consumption could increase by 2 million tons per year by 1994. This assumes a single 850 MW power plant in the utility sector firing anthracite (1.9 million tons) plus 100,000 tons used at other sources. Anthracite usage, if predicted to increase by 20 percent in 1994, will require an additional 100,000 tons per year. The following table shows the potential range of increases in anthracite consumption assuming no incentives for the bottom end of the range and government financial incentives for the upper end (millions of barrels of oil equivalent).

1984	1989	1994
0	0-.2	0-.4

APPENDIX E

Economic Impact Analysis

1. INTRODUCTION

The New York State Energy Master Plan and Long-Range Electric and Gas Report represents a unique effort by the State of New York to plan its energy future in an integrated manner. The comprehensive set of plan proposals, if implemented, will have a significant economic impact upon the State's economy.

One primary thrust of the Plan is to mitigate the rising cost of energy and assure an ample supply of reasonable cost energy through the diversification of energy supply. Mitigating the rising cost of energy will favorably effect the state's economy in three basic ways.

- It will improve the State's competitive economic position for attracting business and industry.
- It will increase the amount of discretionary income that may be spent on goods other than energy services, thereby increasing the standard of living.
- It will decrease the loss of income from the state's economy. Nearly all of the energy consumed in New York State, either directly, or indirectly for producing electricity, is imported. Reducing the state's energy costs, therefore, results in a smaller share of income leaving the state to pay for these imports. The reduction in income leakages causes, through the multiplier effect, an increase in the earnings and employment potential within New York State.

This appendix sets forth an economic impact assessment of the key proposals contained in the State Energy Master Plan. Since the limitations of economic impact analysis of energy policies at the state level preclude a comprehensive assessment at this time, the impact analysis focuses upon the following three major proposals.

- assessment of the State's proposed electric system supply plan, including both the capacity expansion plan and the proposed conversion of oil-fired capacity to coal.
- a comparison of the plan's residential and commercial conservation proposals with the base case, and
- a comparison of direct renewable resource proposals (wood and solar) with the base case.

Highlights of the economic impact assessment of these four proposals, are summarized in Figure E-1.

2. SUMMARY

A. Electric Supply Plan

In considering the economic effects of an electric supply plan, a demand forecast and future electricity supply plan is required. In the case of the Energy Master Plan, additional generating capacity of 8594.2 megawatts is proposed. Economic impacts are estimated from the expenditures on construction and operation of energy supply facilities which are required to meet the increased capacity expansion proposed by the SEMP.

It is estimated that for a net addition of 8594.2 MW of generating capacity, the SEMP electricity capacity expansion plan would generate 287,623 employee years and $5,111.70 million of earnings in New York State over the entire life of the capacity expansion plan. This translates into the creation of 1,800 more jobs and $31.55 more of annual earnings on the average for the 15 year planning period, or 3,600 more jobs and $63.1 million more of annual earnings over the base case, at full implementation, by 1994.

The SEMP's proposed conversion of certain oil-fired plants to coal will reduce the State's dependence on foreign oil and save consumers $2.39 billion over the life cycle of the plants. It is estimated that conversion to coal will create approximately 171,575 more employee years add $3,088.13 million more of earnings over the remaining life cycle of the converted plants.

B. Energy Conservation

Conservation is an important part of the overall SEMP energy supply strategy. The proposed conservation meas-

FIGURE E-1
A SUMMARY OF THE ECONOMIC IMPACTS OF KEY ENERGY MASTER PLAN PROPOSALS

Program	Employment (thousands of jobs)	Annual Earnings (millions of dollars)	Annual Net Savings (millions of dollars)
Conservation[1]	29.019	522.367	445.34
Renewables[2]	10.856	194.793	59.61
Electric, Capacity Expansion Plan	3.600	63.100	---
Conversion of Oil Fired Capacity	6.863	123.530	95.56
to Coal[3]	(1.454)	(26.182)	
Total	50.338	903.79	600.51

[1]Energy Master Plan Conservation proposals affecting the residential and commercial sectors are contained in Section V-B: Conservation.

[2]Direct renewable resources (wood and solar) proposals are contained in Section V-C: Renewable Resources.

[3]The numbers in parentheses represent employment and earnings impacts exclusive of the impacts generated from net savings to consumers. (See Figure E-10)

ures will reduce the annual consumption of electricity, natural gas, and oil by 10 TBTU, 33.2 TBTU, and 60.8 TBTU, respectively by 1994. The total capital investment required for the conservation program is estimated at $2.22 billion. Assuming a 30 year life of capital investment, the annual net savings to New York consumers is estimated at $445.34 million by 1994.

It is estimated that over the 15 year planning period, the proposed conservation programs would generate added employment and earnings in the State, over the business as usual scenario, of 217,640 employee years and $3.92 billion.[1] This translates into the creation of 14,510 more jobs on the average for the 15 year planning period, or 29,019 more jobs at full implementation of the proposed programs by 1994. Likewise the conservation programs create approximately $261.183 million more of annual earnings on the average for the 15 year planning period or $522.37 million more of annual earnings at full implementation of the proposed programs by 1994.

C. *Renewable Energy Resources*

The State Energy Master Plan encourages the use of renewable energy resources. Two of the proposed renewable energy sources are wood and solar. Both would serve to lower the consumption of conventional fuels in the residential sector.

Over the 15 year planning period the proposed renewables program would generate additional employment and earnings in New York State of 81,842 employee years and $1.46 billion respectively. This results in the renewables program creating approximately 10,856 more jobs and $194.79 million of annual earnings at full implementation of the proposed program by 1994.

The remainder of this appendix presents:

- a brief review of the role of energy in the State's economy,
- the approach and methodology used in the economic impact analysis,
- the comparative economic impacts of conventional energy supply facilities and of alternative energy supply, i.e., conservation and solar technologies,
- the economic impact assessment of SEO electric supply plan,
- the comparative economic impact analysis of the proposed residential and commercial sector conservation measures with the baseline forecast, and
- the comparative economic impact analysis of the direct renewable resources (wood and solar) proposals with the baseline forecast.

3. *ENERGY AND THE STATE'S ECONOMY*

Recent trends in New York State's energy consumption highlights the State's dependence on imported petroleum products. High energy costs and the volume of fuel imports directly affect the State's economy. To ease New York's dependence and its high fuel cost problems, a major transition in the mix of fuels consumed in the State is necessary. As oil becomes more expensive, a transition to natural gas in homes and to coal in electric generation is highly recommended.

The linkage between energy and the State's economy is briefly discussed below:

A. *Energy and Employment*

In the past, inexpensive energy was readily available. That availability has tended to reduce job opportunities in energy consuming industries by encouraging substitution of energy for labor in the production process. The energy supply industries, being very capital intensive with a small labor component have not compensated for the reduction in job opportunities.

Although the unemployment rate in NYS has improved considerably from the early 1970's, it is still of grave concern. The jobless rate in 1979 on an average annual basis remained one full percentage point above the national average, although recently the gap has narrowed. An answer to creating jobs with a minimum reduction in wages may lie in conservation technologies which are comparatively more labor intensive than the more conventional supply technologies. Another alternative is in new energy supply technologies that reduce or slow the rise in energy costs and stimulate the use of indigenous resources. Energy planning thus has assumed an important role in the State's economic development. Special attention must be given to the relationship between energy policy and employment which is of paramount concern to developers.

B. *Gross State Fuel Bill*

The State's total fuel bill and the percentage of the gross state product (GSP) being spent on it, have risen rapidly. For example, between the years 1973-1978, the gross fuel bill for the State rose by more than 50 percent (in constant 1972 dollars). The reverberations of such a sharp rise rippled through the State economy, eventually causing a larger portion of personal income to be spent on fuel bills. The fuel bill for the residential sector, as a percentage of GSP and disposable state income rose approximately 38 percent and 42 percent, respectively, between 1973-1978. Lowering the amount of disposable income that may be spent on goods other than energy services essentially lowers earnings and employment potential within the State, since a larger share of income leaves the state (due to the state's large dependence on imported fuels), and a larger share of income is spent on less labor intensive services, i.e., energy supply.

In 1978, the gross State fuel bill, consisting of all fuels, including electricity purchased by residential, commercial, industrial and transportation sectors, reached approximately $16.5 billion. The SEO energy price projections for 1979-1994 point to further increases at a rate greater than the rate of inflation.

The energy industry is much more capital intensive than other industries, and a large portion of the expenditures on fuels and energy goes to foreign or domestic imports. The ever growing share of income being spent to pay the fuel bill, therefore, jeopardizes the economic growth and stability of the state's economy.

C. *High Cost of Energy*

Over the years, New York consumers have been disproportionately reliant on petroleum products and on imported petroleum products in particular. Due to unprecedented increases in petroleum prices, New York State suffers more from higher energy costs than do most of the other states in the Nation. For example:

- Electricity costs per million BTU for the industrial sector were 31 percent higher than for the U.S. in 1975.[2]

[1]A business as usual scenario implies an energy supply and demand situation which would exist in lieu of the implementation of the proposed energy policy.

[2]Federal Energy Administration, Office of Energy Systems Data, Federal Energy Administration State BTU Data Base (FEA) Washington, D.C. 1976.

- New York manufacturers' cost per million BTU's of purchased fuels and electric energy was approximately 24 percent higher than the national average in 1975. Only nine states paid a higher cost per million BTU than New York.[3]

SEO price assumptions by sector and fuel type indicate that New York will continue to see rising energy prices. In fact, prices of all fuels will rise through 1994, at different rates for different fuels.

For example, in the residential sector the Energy Office forecasts a 76 percent increase in the price of natural gas between 1978-1994. Electricity prices in the same sector will rise an estimated 32 percent for that same period. Kerosene and distillate oil prices will increase by 98 percent and 100 percent, respectively. Despite the fact that the cost of natural gas increases at a faster rate than electricity, it will not be the most expensive fuel for satisfying energy needs. At $5.70/10^6$BTU in 1994, natural gas will still be cheaper for homes than electricity at $24.65/10^6$BTU

Similarly, in the commercial sector the Energy Office forecasts a 107 percent and a 33 percent increase in prices for oil and electricity respectively, between 1978-1994. However, oil will not be the most expensive fuel for satisfying energy needs in the commercial sector. Oil at $5.81/10^6$BTU will still be cheaper than electricity at $20.72/10^6$BTU in 1994.

D. Economic Effects of Fuel Imports

New York State is the third largest energy user in the Nation. However, since only about 7 percent of its energy demands are met with indigeneous resources, the state suffers serious economic consequences. The most serious consequence of this dependence on imported fuels is its impact on state's labor market.

Dependence on out-of-state fuel supplies in 1978 cost New York's economy nearly $9 billion, up from $3.8 billion in 1972. This cost is expected to rise by $2.7 billion by the end of 1981. The exact amount of employment and earnings lost within New York State from spending on oil imports depends on specific alternative expenditures. In other words, if a $15,000 average earnings per worker is assumed in New York, a $100 million leakage from the state, if kept internally, could have created 6,666 jobs. The respending effect of this income by consumers would in turn create additional jobs and earnings over the initial impacts generated from the in-state savings. Thus, a large outflow of funds on imported fuels has a devastating effect on the State's economic well being.

4. APPROACH

Unlike an environmental impact statement capable of being judged on its own merits, an economic impact statement is of little value unless it can be compared with the economic impacts of an alternative energy policy. Environmental impacts of a proposed energy policy can be judged in light of the environmental quality and effluent standards. However, there are no comparable economic standards for judging economic impacts of a proposed energy policy.

For a meaningful comparative economic impact analysis, competing energy strategies must provide the same energy service. Also, the same set of assumptions regarding economic parameters—such as prices, discount rate, etc.—should be used to create suitable economic indicators for a comparative economic impact analysis.

[3]Annual Survey of Manufactures, Fuels and Electric Energy Consumed, 1976, Table D.

Since no other comparable energy plan exists, a quantitative economic impact analysis of the entire SEMP is untenable. Instead, a quantitative impact analysis is presented of the Plan's major proposals by comparing them to the base case or business as usual scenario.

One other point deserves mention. It is the actual expenditure on energy supply technologies that creates earnings and employment opportunities within an economic system. Because of the unavailability of data, the economic impact analysis does not depend on the actual schedule of expenditures from a given energy proposal. Instead, the economic impact calculations in this analysis are based on a levelized yearly expenditure schedule.[4]

A. Methodology

To model the economic impacts of key energy proposals, the Input-Output model is used. By allocating the total amount of expenditure, i.e., change in final demand, to respective energy supply technologies, as proposed in the Plan, the I-O model calculates the resultant earnings and employment impacts generated in New York State. A description of the Input-Output model and its inherent limitations is presented in the Addendum to this Appendix.

B. Major Assumptions and Caveats

- It is assumed that the proposed policies of the SEMP will be fully in effect by 1994. The rate of implementation of proposed policies is assumed to be linear between 1980 and 1994. This assumption implies that the total economic impact of a proposed SEMP policy over the 15 year planning period is equal to 7.5 times the annualized economic impacts in the final year. This is nothing more than the simple average.
- All economic impacts are based on the assumption of levelized expenditure schedules and a linear rate of implementation of the SEMP proposals between 1980 and 1994. However, the realized year by year economic impacts and the cumulative economic impacts over the 15 year planning period may deviate substantially from the estimated yearly or cumulative impacts over the same period. Therefore, the estimated economic impacts *over the life of a given proposal* more accurately represent the actual impacts realized in that period.
- All results are presented in 1979 dollars using the method of computing present worth explained in the Addendum.
- A small increase in the output of an industry may be accommodated without hiring new personnel. This can be accomplished by giving higher compensation for overtime to employees or by substituting capital for labor in the production process. Thus earnings and employment may not be strictly proportional to the industrial output. Hence, the computed earnings and employment impacts may somewhat overestimate the actual creation of earnings and employment.

5. COMPARATIVE IMPACT ANALYSIS OF CONVENTIONAL ENERGY SUPPLY TECHNOLOGIES WITH CONSERVATION AND SOLAR TECHNOLOGIES

Figures E-2 and E-3 on the following pages trace the economic impacts of the selected technologies for 1 MW of capacity. Figure E-4 presents the estimated impacts of Figures E-2 and E-3 in a direct comparable manner by ranking

[4]The levelized yearly expenditure schedule is calculated as follows: Expenditure per year = amortized capital cost per year plus annual operation and maintenance cost and fuel cost.

FIGURE E-2

NEW YORK STATE ANNUAL EARNINGS IMPACT OF EXPENDITURES ON VARIOUS ENERGY TECHNOLOGIES (1979$)[1]

Energy Technology	(1) Cost per 1 MW per year, including capital, O & M and fuel expenditure (1000$)	(2) Earnings (1,000$)[2] Per 1 MW capacity Direct	Total	(3) Per 1,000 dollar expenditure[3] Direct	Total
Coal Generation	227.00	2.90	15.39	.0128	.0678
Nuclear Generation	287.19	4.76	28.97	.0166	.1009
Hydro Generation	176.58	1.44	7.07	.0082	.0400
Oil Generation	297.21	2.10	12.12	.0071	.0408
Pump Storage Generation	168.54	.61	3.21	.0036	.0190
Resource Recovery Generation	92.76	6.16	34.94	.0664	.3767
New Homes—Conservation	55.56	3.46	21.07	.0623	.3792
Existing Homes—Conservation	132.37	7.68	52.06	.0580	.3933
Residential Solar Hot Water System	1095.61	73.03	415.51	.0666	.3792

[1]Capital Expenditure is assumed to be distributed evenly over the life of the investment. For conservation and solar technologies, a MW credit has been computed assuming a 65 percent capacity factor for an alternative powerplant.

[2]Impacts are ordinarily calculated for capital, O & M and fuel expenditures. For the New York State region, however, impacts resulting from fuel expenditures are assumed to be negligible.

[3](3) = [(2) ÷ (1)]

FIGURE E-3

NEW YORK STATE EMPLOYMENT IMPACTS OF EXPENDITURES ON SELECTED ENERGY TECHNOLOGIES[1]

Energy Technology	(1) Cost per 1 MW per year, including capital, O & M and fuel expenditures (1000$)	(2) Employment Per 1 MW capacity Direct	Total	(3) (jobs)[2] Per 1 million dollar expenditure[3] Direct	Total
Coal Generation	227.00	0.16	0.86	0.70	3.79
Nuclear Generation	287.19	0.26	1.65	0.91	5.75
Hydro Generation	176.58	0.08	0.40	0.45	2.27
Oil Generation	297.21	0.11	0.58	0.37	1.95
Pump Storage Generation	168.54	0.03	0.18	0.18	1.07
Resource Recovery Generation	92.76	0.44	2.12	4.74	22.85
New Homes—Conservation	55.56	0.20	1.07	0.36	19.26
Existing Homes—Conservation	132.37	0.41	2.65	3.09	20.02
Residential Solar Hot Water System	1095.61	3.98	21.20	3.63	19.35

[1]Capital expenditure is assumed to be distributed evenly over the life of the investment. For conservation and solar technologies, a MW credit has been computed assuming a 65 percent capacity factor for an alternative powerplant.

[2]Impacts are calculated for capital, O & M and fuel expenditures. For the New York State region, however, impacts resulting from fuel expenditures are assumed to be negligible.

[3][(2) ÷ (1)] x 10^3.

FIGURE E-4

RANKING OF COSTS WITH ANNUAL STATE EARNINGS, AND STATE EMPLOYMENT IMPACTS OF SELECTED ENERGY TECHNOLOGIES

Ranked by Cost per MW/yr ($1,000) (ascending order)	Ranked by Total Annual State Earnings per 1 Thousand Dollar Expenditure (descending order) ($1,000)	Ranked by Total State Employment per 1 Million Dollar Expenditure (descending order) (jobs)
New Home Conservation 55.56	Existing Home Conservation .3933	Resource Recovery 22.85
Resource Recovery Generation 92.76	Residential Solar Hot Water System .3792	Existing Home Conservation 20.02
Existing Home Conservation 132.37	New Home Conservation .3792	Residential Solar Hot Water System 19.35
Pump Storage Generation 168.54	Resource Recovery .3767	New Home Conservation 19.26
Hydro Generation 176.58	Nuclear Generation .1009	Nuclear Generation 5.75
Coal Generation 227.00	Coal Generation .0678	Coal Generation 3.79
Nuclear Generation 287.19	Oil Generation .0408	Hydro Generation 2.27
Oil Generation 297.21	Hydro Generation .0400	Oil Generation 1.95
Residential Solar Hot Water System 1095.61	Pumped Storage Generation .0190	Pumped Storage Generation 1.07

normalized cost, annual earnings and employment impacts, respectively. One important finding is that the five conventional technologies are relatively more expensive and less likely to generate any substantial amount of earnings and employment for the State than a comparable expenditure on New Home, Existing Home or Resource Recovery technologies. This is attributable to the high capital intensity of the conventional five relative to the non-conventional technologies. A closer examination reveals the following points:

- There is a substantial variance in cost, earnings impacts, and employment impacts among different technologies.
- Conservation and solar technologies per MW equivalent of generating capacity have lower costs and higher employment and earnings than conventional generating capacity. This occurs even without consideration of any impacts created from consumer savings resulting from conservation
- Residential solar hot water systems are expensive and would find a limited market except in the New York City metropolitan area where the cost of electricity is high.
- Conservation measures for residential homes are cost effective relative to any conventional technology for supplying electricity. Conservation for existing homes is much more expensive than conservation for new homes and the average life of the existing home is less. (assumed to be 30 years, versus 50 years for a new home)

6. ECONOMIC IMPACT ANALYSIS OF ELECTRIC SUPPLY PLAN

A. Economic Impact Analysis of the Electric System Capacity Expansion Plan as Proposed in the State Energy Master Plan

The long-range Electric System Capacity Expansion Plan set forth in the SEMP recommends the expansion of existing capacity at various levels for different energy supply technologies.

For analysis purposes, it is assumed that the cumulative capacity expansion of the five coal plants approved by the Planning Board is 3600 MW of capacity. The proposed capacity expansion plan for oil plants, Pumped Storage Hydro, Dam and Hydroelectric, Nuclear and Resource Recovery plants is assumed to be 119, 1,000, 725, 852.2, and 298 megawatts, respectively. The projected capacity increase of imported Canadian Hydro is assumed to have negligible impacts in New York State since it is the Canadian economy that will be directly effected by the capacity expansion. However, inclusion of Canadian Hydro in the capacity expansion plan may not be detrimental to the State economy. This is because Canadian Hydro is a relatively low cost supply option. The savings accrued to NYS consumers from a low cost supply option will increase the amount of discretionary income that may be spent on goods other than energy services. However, in absence of an alternative capacity expansion plan the economic impacts accruing from the cost savings cannot be precisely estimated and therefore such impacts are not included in the current analysis.

Each energy supply technology has different capital and operation and maintenance expenditures per MW of generating capacity. Also, individual supply technologies have different retirement policies. It is therefore imperative that technologies comprising the plan be suitably weighted to arrive at the aggregate earnings and employment impact potential of the capacity expansion plan.

Figure E-5 summarizes the estimated employment and annual earnings impacts of the SEMP Electric Supply Plan, with a suitable weighting scheme (see note to Figure E-5). Figure E-5 shows the weighted composite cost of the pro-

FIGURE E-5

NEW YORK STATE EMPLOYMENT AND ANNUAL EARNINGS IMPACTS OF SEMP ELECTRIC SYSTEM CAPACITY EXPANSION PLAN

(1)	(2)	Includes Only Proposed Capacity Expansion (3)		(4)		(5)	
Weighted Cost per 1 MW per year, including Capital, Operation and Maintenance and Fuel Expenditure	Earnings				Employment		(jobs)	
(1000$)	per 1 MW Direct	Capacity Total	per $1000 Direct	expenditure[1] Total	per 1 MW Direct	Capacity Total	per $1 million Direct	Expenditure[2] Total
203.81	2.299	12.510	.01166	.06310	0.13	0.71	0.67	3.60

NOTE: Capital expenditures is assumed to be distributed evenly over the life of the investment. Impacts are calculated for capital, O&M and fuel expenditures.

The following weighting scheme is used to normalize the costs and economic impacts of the energy supply plan:

$$\frac{\Sigma(EI)_i(MW)_i\,(YR)_i}{\Sigma(MW)_i\,(YR)_i}$$

i = a particular supply technology in a given plan.
EI = economic impacts, i.e., cost, employment and earnings.
MW = total MW capacity (or credit) of a supply technology.
YR = useful life (retirement policy) of supply technology.

[1][(2) ÷ (1)]

[2][(4) ÷ (1)] x 10^3

FIGURE E-6

TOTAL ECONOMIC IMPACTS OF THE NEW YORK STATE ENERGY MASTER PLAN'S ELECTRIC SYSTEM CAPACITY EXPANSION PLAN[1]

Economic Impact (millions of dollars)	SEMP
Total Capital Cost	46,408.528
Total O&M Cost	3,040.116
Total Fuel Cost	17,862.75
Total Cost	67,311.394
Total State Earnings	5,111.7013
Total State Employment (employee-years)	287,623.4
Total Capacity Added[2] (MW)	8,594.2
Total Cost/MW	7.8322
State Earnings/MW	.5948
State Employment/MW (employee year/MW)	33.4671

[1]All impacts are given in 1979 dollars and computed over the life of the investment.

[2]Includes Imported Canadian Hydro MW Capacity.

posed generation mix to be $203.81 thousand per MW per year. The total cost over the entire life of the various supply technologies for the 8594.2 MW capacity expansion is $67,311.39 million as listed in Figure E-6. By supplying 8594.2 MW of new generating capacity, the SEMP creates an estimated $5111.70 million of earnings and 287,623 employee years in New York State.

The earnings impacts of the Capacity Expansion Plan over the entire life of the various supply technologies, for the total amounts of capacity they add are estimated by 57 industry classifications and outlined in Figure E-7. The associated employment impacts are depicted in Figure E-8.

Extrapolating further, the 57 industry specific employment impacts in Figure E-7 are aggregated into 10 industry classifications enabling a detailed breakdown of total employment impacts of the SEMP capacity expansion plan by employee occupation. The employee occupation breakdown is given in Figure E-9.

It should be kept in mind that the total cost of the Electric System Supply Plan, (including capital costs, operation and maintenance costs, and fuel costs) is a direct function of the proposed mix of energy supply technologies comprising the plan. For example, since a nuclear supply facility has a large part of its total cost per MW per year as capital expenditures, and a coal facility has a large part of its total cost per MW per year, consisting of fuel expenditures (an expenditure that is assumed to have negligible impacts within the State); a plan advocating more generating capacity supplied by nuclear facilities will ultimately create more direct economic impacts within the State.

An electricity supply system heavily dependent on a single fuel is likely to be more vulnerable than a system with a more diverse fuel base. This is clearly seen in the situation faced by the City of Los Angeles at the time of the Arab embargo in 1974, and by Ohio during the United Mine Workers strike in the winter of 1978. The electricity supply in Los Angeles is tied mainly to oil. In Ohio it depends mainly on coal. Consequently, when the fuel supplies of oil and coal were disrupted, the electricity supply faced serious cutbacks in both cases. The Master Plan advocates a capacity expansion with a diversified fuel base. It includes resource recovery plants, imports of Canadian hydro, coal generation, conversion from oil to coal, and small hydro—none of which exceed 35 percent of the planned capacity addition indicated in the Master Plan. A diversified fuel base also implies that the State will be less vulnerable to any erratic price behavior of any one fuel type.

B. Economic Impacts of Converting Existing Oil-Fired Capacity to Coal

In the face of steeply climbing petroleum prices and supply uncertainties, the SEMP proposes to convert certain electric generating plants that are currently burning oil into coal fired generating plants.[5] It is estimated that 6,387 MW of capacity that is currently oil fired can be retrofitted to burn coal at a capital cost of $963 million.[6] This conversion will save an estimated $3.35 billion in fuel over the life cycle of the plants.[7] The capital expenditure of retrofitting and the net savings create 171,563 employee years and $3.08 billion of earnings in New York State over the remaining life cycle of the plants. Assuming 25 years of remaining life for the generating plants, this translates into creating on the average 6,863 job opportunities and $123.53 million of annual earnings over 25 years. (See Figure E-10).

[5]For further details, refer to: Department of Public Service, staff report recommending the conversion of selected oil-fired power plants to coal, July 17, 1979.

[6]The plants included in the estimates are: Albany 1-4; Arthur Kill 20, 30; Danskammer 3, 4; Lovett 4, 5; Port Jefferson 3, 4; Ravenswood 10, 20, 30; EF Barrett 1, 3; Northport 1-4.

[7]Present value of life cycle fuel cost savings and coal conversion costs were estimated by PSC. Life cycle costs savings of coal conversions are estimated assuming 6 percent rate of increase in the prices of coal and oil assuming and 11 percent discount rate.

7. COMPARATIVE ECONOMIC IMPACT ANALYSIS OF ENERGY CONSERVATION[8]

Conservation is an important part of the overall energy strategy of the SEMP. The master plan proposes various conservation measures, such as changes in residential and commercial construction codes, and retrofit insulation of hospitals and schools, to name a few. Conservation programs directly reduce the State's dependence on imported fuels and bring savings to New York State consumers. Additional employment and earnings are generated in the State, over the business as usual case, in which conservation measures are not included. The additional earnings and employment opportunities are created from two sources: (1) capital investment on conservation technologies and (2) net savings to consumers—i.e., fuel savings over the life of the investment minus the cost of the conservation investment.

The proposed conservation measures will reduce the annual consumption of electricity, natural gas, and oil by 10.0 TBTU, 33.2 TBTU and 60.8 TBTU by 1994. The total capital investment required for the conservation program is estimated at $2.22 billion. Assuming a 30-year life of the

[8]The I-O Model described in the Addendum is a technique for the quantitative estimates of economic impacts. However, available data are not detailed enough for as complete a quantitative impact analysis as in the electric system plan.

FIGURE E-7

STATE ENERGY MASTER PLAN INDUSTRY SPECIFIC EARNINGS IMPACT (10^6 DOLLARS)

Electric Capacity Expansion Plan

SIC	Industry Name	Direct	Total
01	Farms	0.147	1.269
07	Agricultural Services	0.639	2.977
08+09	Forestry and Fisheries	0.040	0.202
10	Metal Mining	0.064	0.725
11	Coal Mining	0.019	0.027
13	Crude Petroleum and Natural Gas	0.256	1.153
14	Nonmetallic Mineral Mining and Quarrying	0.553	2.842
15-17	Contract Construction	6.814	178.167
19	Fabricated Metal Products	0.383	0.780
20	Food and Kindred Products	42.628	201.603
21	Tobacco Manufacturers	1.049	4.683
22	Textile Mill Products	1.981	45.534
23	Apparel and Other Fabricated Textile Products	21.062	99.670
24	Lumber and Wood Products, Excl. Furniture	2.317	6.402
25	Furniture and Fixtures	3.506	13.535
26	Paper and Allied Products	6.262	45.311
27	Printing, Publishing and Allied Products	13.996	64.354
28	Chemicals and Allied Products	8.804	56.829
29	Petroleum and Related Industries	6.307	30.894
30	Rubber and Miscellaneous Plastic Products	3.596	18.129
31	Leather and Leather Products	4.886	24.870
32	Stone, Clay and Glass Products	12.936	40.105
33	Primary Metals Industries	40.770	81.597
34	Fabricated Metals Products	27.604	150.431
35	Machinery Except Electrical	49.763	350.432
36	Electrical Machinery	42.987	173.130
371	Motor Vehicles	6.436	25.488
372-379	Other Transportation Vehicles	6.880	16.365
38	Instruments	5.705	30.269
39	Miscellaneous Manufacturing	3.958	22.226
40	Railroad Transportation	6.958	32.165
41	Local Suburban and Highway Passenger Transportation	7.388	28.931
42	Motor Freight Transportation and Warehousing	10.910	49.491
44	Water Transportation	1.425	8.064
45	Air Transportation	3.602	14.857

FIGURE E-7 (cont)

STATE ENERGY MASTER PLAN INDUSTRY SPECIFIC EARNINGS IMPACT (10^6 DOLLARS)

Electric Capacity Expansion Plan

SIC	Industry Name	Direct	Total
46	Pipeline Transportation	0.003	0.089
47	Transportation Services, Incl. Carrier Affiliates	0.559	10.819
48	Communications	19.211	81.542
49	Public Utilities	21.506	131.109
50	Wholesale Trade	80.302	498.546
52-59	Retail Trade	166.780	864.021
60	Banking	18.506	514.937
61+67	Credit Agencies and Holding Investment Companies	3.994	18.082
62	Security and Commodity Brokers, Dealers and Services	20.818	96.060
63	Insurance Carriers, Incl. Solicitors	21.909	84.578
64	Insurance Agents, Brokers and Services	0.013	37.326
65+66	Real Estate and Combinations	3.366	16.481
70	Lodging Places	5.589	23.335
72+76	Personal and Miscellaneous Repair Services	21.051	87.994
73	Miscellaneous Business Services	50.872	156.242
75	Auto Repair and Services	8.882	36.959
78	Motion Pictures	1.791	15.560
79	Amusement and Recreation Services, Excl. Motion Pictures	8.780	37.308
80	Medical and Other Health Services	48.122	190.463
81+89	Legal and Miscellaneous Professional Services	51.051	184.850
82	Private Educational Services	22.303	86.429
84+86	Museums and Nonprofit Membership Organizations	29.918	115.458
TOTAL		957.964	5111.701

FIGURE E-8

STATE ENERGY MASTER PLAN INDUSTRY SPECIFIC EMPLOYMENT IMPACT (1,000 EMPLOYEE YEARS)

Electric Capacity Expansion Plan

SIC	Industry Name	Direct	Total
01	Farms	0.012	0.109
07	Agricultural Services	0.057	0.258
08+09	Forestry and Fisheries	0.002	0.012
10	Metal Mining	0.002	0.027
11	Coal Mining	0.001	0.001
13	Crude Petroleum and Natural Gas	0.010	0.046
14	Nonmetallic Mineral Mining and Quarrying	0.020	0.109
15-17	Contract Construction	0.312	7.784
19	Fabricated Metal Products	0.015	0.032
20	Food and Kindred Products	2.199	10.579
21	Tobacco Manufacturers	0.054	0.246
22	Textile Mill Products	0.113	2.652
23	Apparel and Other Fabricated Textile Products	1.496	7.213
24	Lumber and Wood Products, Ex. Furniture	0.140	0.378
25	Furniture and Fixtures	0.214	0.844
26	Paper and Allied Products	0.349	2.523
27	Printing, Publishing and Allied Products	0.718	3.158
28	Chemicals and Allied Products	0.345	2.281
29	Petroleum and Related Industries	0.152	0.742
30	Rubber and Miscellaneous Plastic Products	0.142	0.726
31	Leather and Leather Products	0.247	1.280
32	Stone, Clay and Glass Products	0.638	1.979
33	Primary Metals Products	1.432	2.919
34	Fabricated Metals Products	1.238	6.633
35	Machinery Except Electrical	1.831	12.851
36	Electrical Machinery	1.941	7.994
371	Motor Vehicles	0.188	0.772
372-379	Other Transportation Vehicles	0.220	0.562
38	Instruments	0.290	1.571
39	Miscellaneous Manufacturing	0.201	1.142
40	Railroad Transportation	0.277	1.290

FIGURE E-8 (cont)

STATE ENERGY MASTER PLAN INDUSTRY SPECIFIC EMPLOYMENT IMPACT (1,000 EMPLOYEE YEARS)

Electric Capacity Expansion Plan

SIC	Industry Name	Direct	Total
41	Local Suburban and Highway Passenger Transportation	0.326	1.301
42	Motor Freight Transportation and Warehouse	0.532	2.418
44	Water Transportation	0.061	0.357
45	Air Transportation	0.158	0.667
46	Pipeline Transportation	0.000	0.004
47	Transportation Services, Incl. Carrier Affiliates	0.234	0.446
48	Communications	0.776	3.270
49	Public Utilities	0.758	4.539
50	Wholesale	5.213	33.936
52-59	Retail Trade	10.916	58.550
60	Banking	1.055	33.331
61+67	Credit Agencies and Holding and Investment Companies	0.229	1.037
62	Security and Commodity Brokers, Dealers and Services	1.169	5.475
63	Insurance Carriers, Incl. Solicitors	1.257	4.840
64	Insurance Agents, Brokers and Services	0.001	2.136
65+66	Real Estate and Combinations	0.196	0.967
70	Lodging Places	0.396	1.665
72+76	Personal and Miscellaneous	1.468	6.248
73	Miscellaneous Business Services	3.241	9.428
75	Auto Repair and Services	0.525	2.183
78	Motion Pictures	0.131	1.153
79	Amusement and Recreation Services, Excl. Motion Pictures	0.639	2.758
80	Medical and Other Health Services	2.624	10.588
81+89	Legal and Miscellaneous Professional Services	2.905	10.373
82	Private Educational Services	1.216	4.804
84+86	Museums and Nonprofit Membership Organizations	1.647	6.430
TOTAL		52.326	287.623

capital investment, the estimated annual net savings to New York consumers is $445.34 million.

Figure E-11 lists the annual earnings and employment impacts of the proposed conservation programs for the residential and commercial sectors by major fuel types. Over the 15-year planning period, the proposed conservation programs would generate additional employment and earnings of 217,640 employee years and $3.91 billion. This translates into conservation programs creating approximately 14,510 more jobs on the average for the 15 year planning period, or 29,019 more jobs at full implementation of the proposed programs by 1994. Likewise the conservation programs create approximately $261.18 million more of annual earnings on the average for the 15 year planning period, or $522.37 million more of annual earnings at full implementation of the proposed programs by 1994.

8. COMPARATIVE ECONOMIC IMPACT ANALYSIS OF RENEWABLE ENERGY RESOURCES[9]

The SEMP encourages the use of renewable energy resources. Such renewables as wood and solar, as substitutes for conventional fuels, make better use of the State's indigenous resources. This reduces the outflow of income and creates employment within the State. The SEMP proposes a small penetration of solar technologies, most of it in the residential sector. This will ultimately reduce electricity and oil consumption in homes. It is estimated that a capital investment of $108.3 million and $317 million would save .29 TBTU of electricity and 4.80 TBTU of oil a year. Solar technologies that back out electricity essentially consist of residential hot water systems. These systems are quite expensive and would find a limited market except in the New York City metropolitan area where electric costs are high. Passive solar systems essentially substitute construction expendi-

FIGURE E-9

STATE ENERGY OFFICE
ELECTRIC CAPACITY EXPANSION PLAN
STATE EMPLOYMENT BREAKDOWN BY OCCUPATION, DIRECT AND TOTAL

Occupation Name	Direct	Total
Professional and Technical	7.97	34.36
Management and Administrators	6.21	38.06
Sales workers	4.94	33.99
Clerical workers	9.82	60.84
Craft and kindred	5.71	32.12
Operative except transport	6.77	33.61
Transport equipment operatives	2.15	11.66
Nonfarm laborers	2.29	13.05
Private household workers	0.00	0.00
Other service workers	6.42	29.70
Farm	0.06	0.31
TOTAL[1]	52.35	287.71

[9]Ibid.

[1]May not equal total in figure E-8 due to rounding.

FIGURE E-10

ECONOMIC IMPACTS OF PROPOSED ELECTRIC SYSTEMS SUPPLY PLAN: COAL CONVERSION

(millions of dollars)		(employee years)
Present Value of Conversion Cost[1]	Earnings Impact	Employment Impact
963.00	654.551	36,364
Net Savings to Consumers		
2,389.000	2,433.58	135,199
TOTAL IMPACTS	3,088.131	171,563

[1]Present value estimates are calculated on the basis of completing the conversion from oil to coal by 1983.

NOTE: Present value of conversion cost and net savings to consumers of the proposed oil to coal conversion are reported in "Staff Report Recommending the Conversion of Selected Oil Fueled Power Plants to Coal," New York State Public Service Commission.

FIGURE E-11

ECONOMIC IMPACTS OF PROPOSED ENERGY CONSERVATION PROGRAMS

Annual Energy Savings and Total Capital Investments by Fuel Type (millions of dollars)		RESIDENTIAL	
		Annual Earnings Impact (millions of dollars)	Employment Impacts (employee years)
RESIDENTIAL			
Electricity:			
Savings	40.59		
Investment:	267.00	40.448	2,247
Natural Gas:			
Savings	86.61		
Investment:	852.00	85.358	4,742
Oil:			
Savings	129.76		
Investment:	711.00	129.788	7,210
Total:			
Savings	256.96		
Investment:	1830.00	255.594	14,199
COMMERCIAL			
Electricity:			
Savings	127.05		
Investment:	102.70	129.245	7,180
Natural Gas:			
Savings	19.20		
Investment:	75.05	19.430	1,079
Oil:			
Savings	116.30		
Investment:	217.25	118.098	6,561
Total:			
Savings	262.55		
Investment:	463.18	266.773	14,820
TOTAL			
Electricity:			
Savings	167.64		
Investment:	369.70	169.693	9,427
Natural Gas:			
Savings	105.81		
Investment:	927.05	104.788	5,821
Oil:			
Savings	246.06		
Investment:	928.25	247.886	13,771
Total:			
Savings	519.51		
Investment:	2225.00	522.367	29,019

tures for an imported fuels expenditure. This helps to slow the flow of income from the State's economy and creates new employment and earning opportunities.

Wood is abundantly available in New York. The use of wood for residential space heating would reduce oil consumption and save consumers money. The increased earnings and employment come from (1) capital investment in wood stoves and furnaces; (2) expenditures for wood as a fuel source; and (3) net savings to consumers—i.e., the net fuel savings over the life of the investment minus the cost of the investment in wood stoves and furnaces and wood as fuel.

The proposed penetration of wood and solar sources of renewable energy would reduce the total consumption of oil by 33.96 TBTU by 1994, at a capital cost of $664 million. Assuming a 50-year life of capital investment for solar technologies (i.e., life of new solar homes) and a 15-year life of capital investment in wood stoves and furnaces, the annual net savings to consumers is pegged at $59.61 million by 1994.

Over the 15-year planning period, the proposed renewables program would generate additional employment and earnings of 81,842 employee years and $1.46 billion.[10] It translates into renewables program creating approximately 10,856 more jobs and $194.79 million of annual earnings at full implementation of the proposed program by 1994 (see Figure E-12).

[10]These calculations only include the renewables program which affect oil consumption directly—i.e., the solar hot water systems and the small amount of proposed penetration of passive solar systems which reduce electricity consumption are not included.

FIGURE E-12

ECONOMIC IMPACTS OF PROPOSED RENEWABLE ENERGY RESOURCES PROGRAM: RESIDENTIAL SECTOR

Wood Replacing Oil[1] (millions of dollars)		Earnings Impact	Employment Impact (employee years)
Annual Energy Saving	213.75	---	---
Annual Fuel Cost	147.99	105.261	5,848
Investment	347.00	23.711	1,317
Annual Net Energy Savings	42.627	43.422	2,412
TOTAL		172.394	9,577
Passive Solar Replacing Oil[2] (millions of dollars)			
Annual Energy Savings	23.33	---	---
Investment	317.00	5.092	283
Annual Net Energy Savings	16.99	17.307	996
TOTAL		22.399	1,279
TOTAL (millions of dollars)			
Annual Energy Savings	237.08	---	---
Annual Fuel Cost	147.99	105.261	5,848
Investment	664.00	28.803	1,600
Annual Net Energy Savings	59.61	60.729	3,408
TOTAL		194.793	10,856

[1]Assuming a 15 year life of the investment for wood replacing oil.

[2]Assuming a 50 year life of the investment for passive solar replacing oil.

ADDENDUM

A. I-O Model

Conceptually, the I-O model is a convenient means of representing the endless chains of actions and reactions among industries. This characteristic of the I-O model is used to estimate the total economic impacts of an exogenous change in final demand sales in an economic system. The first step is to identify an initial change in the system. Usually this means estimating a change in the final-demand sales of a particular industry or set of industries. In the context of this analysis it implies estimating the expenditure on an energy supply technology and allocating this cost into appropriate industrial classifications. The I-O model then summarizes the many rounds of economic effects that are set off by the initial change in final demand.

Industry-specific input-output multipliers for New York State have been supplied by the Regional Industrial Multiplier System (RIMS) developed by the Regional Economic Analysis Division of the Bureau of Economic Analysis (BEA) in the U.S. Department of Commerce.

The major steps in conducting an I-O impact analysis are iterated in a step-wise procedure below:

- The first step in the use multiplier coefficients is to construct a table of itemized expenses for all materials and components which are assembled into the energy supply technologies. Once completed, the itemized expenditures are classified into SIC (Standard Industrial Classification) codes representing each industry's place in the economy.* The technologies for which an industrial breakdown of costs were not available, were handled by assuming industrial classification of suitable surrogate technologies.

The use of surrogates allows an estimation of the impacts of a change in final demand in the surrogate industry. This represents an approximation of the actual impacts of the desired technology, which until now were unestimable. The loss in accuracy is sacrificed for the ability to estimate the relative magnitude of impacts. In the case of conservation and renewables, industry "surrogates" are chosen which seem most closely to simulate the type of activities involved in the production and installation of the particular technologies.

Of course, this step entails equating the energy supply technology to the surrogate industry(ies). In such cases it is only possible to estimate aggregate economic impacts implying that impacts cannot be be broken down by industry classification.

For building conservation measures into existing homes, Maintenance and Repair Construction was used (RIMS industry 1710). This sector involves the same type of construction labor as do most building conservation measures, and the share of total spending used to purchase materials is comparable with that of conservation retrofitting. For New Home Conservation, New Residential Construction is used (RIMS industry 1507). Also, for Residential Solar Hot Water Systems RIMS industry 1507 is used. This sector involves the same type of products as the solar industry, and it has the same share of spending on materials and components as studies have found to be true of the current solar energy industry.

The methodology used in the calculation of economic impacts for surrogates is the same as discussed below. The surrogate industry in fact, represents the conservation technologies bill of goods, i.e., expenditure classification comprised of 57 input industries. The steps required for allocating the aggregate expenditures by industrial classifications suggested above are bypassed. Other surrogates used are:

. . . Wood (as fuel source) — wood products (RIMS industry 2499).

. . . Wood Stoves and Furnaces—household appliances (RIMS industries 3639).

. . . Resource Recovery—same as for coal generation.

- Expenditures by SIC are transformed from purchaser's prices to producer's prices—the value of the product at the site of production. This is accomplished by removing transportation amd trade margins from the purchaser's prices of the goods. The costs accumulated in trade and transportation industries are used in calculating I-O impacts.
- Estimating the portion of expenditure met by State industrial output entails multiplying the expenditure by SIC classification by the location quotient for that industry. This is necessary because only a portion of the required inputs are supplied by industries located in New York State. For a given industry, the location quotient is the industry's proportion of State total earnings divided by the same proportion for the nation.*
- The 1967 RIMS model relates inputs and outputs in values prevailing in that year. This implies that the structural relationship embodied in the RIMS model are benchmarked on 1967 prices. Inputs of costs other than 1967 costs would distort the direct and indirect requirements derived from the interindustry coefficients of the I-O matrix. Thus, prices of the original bill of goods (costs) are deflated to 1967 dollars. After computation of multiplier effects, the economic impacts (in 1967 dollars) are reinflated to current year dollars.
- The measurement of impacts, in terms of earnings and employment, is much more meaningful for assessing the implications of a given change in final demand than is the I-O concept of gross output. The earnings impacts resulting from the multiplier effect are calculated by mutiplying the increased output in each industry by that industry's earnings/gross output ratio (amount of earnings per dollar of output); supplied by BEA. Once the impact in terms of earnings is estimated, it is possible to transform earnings into employment impacts. The State employment impacts are calculated by multiplying earnings in each industry (in 1967 dollars) by that industry's employment/earnings ratio (amount of labor per 1967 dollar of earnings).
- To avoid confusion, earnings impacts are reported over the life of the investment expenditure. The exact earnings per incremental change in final demand is not estimated.

* Energy supply costs were estimated by SEO. For conventional energy supply technologies SIC breakdown of capital and O&M costs were obtained from Bechtel National, Inc., "Data Base for Energy Supply Planning Model, 1978" and "Manpower, Materials, Equipment and Utilities Required to Operate and Maintain Energy Facilities" prepared by the Stanford Research Institute, 1975.

* Location quotients were estimated by the BEA for New York State economy for the year 1980.

Employment impacts are reported in employee years. Employee years can refer to a variety of employee-time combinations. For example, two employee years can represent two persons working full time for one year, or one person working full time for two years. It does not represent actual jobs created.

B. Additional Assumptions

Since none of the three major fuels used for electric generation (coal, nuclear, oil) are either substantially produced or processed within New York, their employment and earnings impacts within the State are assumed to be negligible, Also, it is assumed that economic impacts within New York State of the imported Canadian hydro power will be negligible.* It is assumed that no new transmission lines are to be built to import Canadian hydro.

The costs for all supply technologies are developed by SEO. Resource recovery (RR) plants need special mention. The estimate of capital cost per MW for RR was computed by dividing the total capital cost for the 19 plants (estimated by SEO) by the total MW equivalent of net estimated BTU recovery from these plants. The operating and maintenance cost per MW per year were estimated to be seven times more than for the coal generating plant. Fuel cost (or credit) per MW per year was estimated by assuming that: 1) on an average, resource recovery plants burn five percent of the annual coal consumption per MW for a coal plant; and 2) on an average, 6,338 tons of garbage is burned per MW per year, for which a $12 credit per ton is given, including tipping fee and the value of recovered resources. These assumptions imply a credit of $71,200 per MW per year for fuel cost for the resource recovery plants.

Most of the earnings and employment impacts of the resource recovery plants are net impacts. In other words, it is assumed that jobs and earnings associated with disposing of the garbage by conventional methods (landfill) are negligible compared with the impacts created by burning the same garbage as fuel in electric generating plants.

Finally, expenditures on electricity supply technologies are made in different amounts and at different times. Therefore, it is important to measure all expenditures in constant dollars. For instance, the present worth of the future expenditures should be calculated for comparing the economic impacts of various electric supply technologies or plans.

The escalation rate beyond 1979 for all energy supply technologies for capital, O&M and fuel expenditures is assumed to be the same and equal to the discount rate for calculating present worth of future expenditures. Of course, this is a simplifying assumption which is made for the ease of calculation. The capital cost inflation estimated by SEO for various electric supply technologies varies less than one percent. O&M cost inflation for all technologies is assumed to be the same in the electric supply plan.

The simplifying assumption for calculating present worth of future expenditures is unlikely to change any conclusions reached in this analysis.

C. Normalization of Economic Impacts

Perhaps the most important point in a comparative economic impact analysis of competing energy scenarios is that impacts be carefully normalized—for a proper comparison. The following assumptions have been made for a normalization of the economic impacts of various energy supply technologies.

- The most useful unit for comparing energy technologies is the energy services they provide. This concept becomes particularly important when accounting for the impacts of solar and conservation technologies. Energy saved because of these technologies is computed, and is imputed to credit the contribution of conservation and solar technologies. The rationale is, had these technologies not been introduced, a certain amount of generating capacity would have been required to satisfy the energy services served by conservation and solar technologies.
- To aggregate energy services, a common unit of measurement has to be selected. The electricity capacity expansion plan is expressed in megawatts of new generating capacity to be added. Therefore, megawatt (MW) has been chosen as the fundamental unit of observation—i.e., all impacts will be normalized by MW capacity.
- There are vast differences in the capital costs and operating and maintenance costs of energy supply technologies. Therefore, all economic impacts must be aggregated over the entire life of a supply technology.
- Since supply technologies have varied life spans, it is also important to normalize economic impacts by the useful life of the supply technology. Thus, for the electricity capacity expansion plan, the economic impacts should be normalized by the MW capacity of various generating technologies and their useful lives suitably weighted. See Figure E-5.

D. Inherent Limitations

The Regional Industrial Multiplier System relates inputs and outputs in values prevailing in the year 1967. This introduces a degree of uncertainty in the multiplier analysis. Changes in inter-industry relationships over time resulting from technological innovation and various other structural shifts in the economy, cannot be accounted for in the RIMS model.

It should be noted that the total gross output change measured by the multipliers is the difference between the output of the economy with the final demand change and the output without it. It further assumes no changes occur in the economy other than those associated with the change in final demand.

The regional input-output forecast is limited, because the model upon which it is based is static. However, due to the complex and time-consuming nature of constructing dynamic input/output models, the I-O model used is the most up-to-date model available.

*Since the cost of those fuels will be borne by NYS consumers, they are included in computing the cost per MW capacity of relevant technologies.

APPENDIX F
STATE OF NEW YORK
ENERGY PLANNING BOARD

STATE ENERGY MASTER PLANNING AND LONG-RANGE ELECTRIC AND GAS SYSTEM PLANNING PROCEEDING

OPINION AND ORDER

ISSUED: MARCH 20, 1980

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STATE OF NEW YORK
ENERGY PLANNING BOARD

At a meeting of the Energy
Planning Board held in
the City of Albany on
February 8, 1980

BOARD MEMBERS PRESENT:

James L. Larocca	—Commissioner, State Energy Office Chairman, Energy Planning Board
Charles A. Zielinski	—Chairman, Public Service Commission, concurring
Robert F. Flacke	—Commissioner, Department of Environmental Conservation, concurring
Ira M. Millstein	—Designee of the Speaker of the Assembly, concurring
David E. Blabey	—Designee of the Temporary President of the Senate, concurring in part and dissenting in part

STATE ENERGY MASTER PLANNING AND LONG-RANGE
ELECTRIC AND GAS SYSTEM PLANNING PROCEEDING

OPINION AND ORDER

(Issued: March 20, 1980)

INTRODUCTION

Section 3-101(7) of the Energy Law[1] provides that it shall be the energy policy of the State to conduct energy planning in an integrated and comprehensive manner through development of a long-range State Energy Master Plan, which shall provide the framework for energy related decisions made throughout the State.

Sections 5-110 and 5-112 of the Energy Law[2] require that the State Energy Office prepare, consistent with State energy policy (set forth in Energy Law, Section 3-101), a Draft State Energy Master Plan (Draft Plan) and Draft Long-Range Electric and Gas Report (Draft Report) and submit these documents to the Energy Planning Board (Board)[3] for review and approval.

In the development of the Draft Plan, the State Energy Office must consider, among other matters: economic growth and development trends, and the potential impacts of energy conservation, new energy technologies, indigenous energy resources and national energy policies. The State Energy Office must consider the effects of all of these factors on the State's economy, the public health, safety and welfare and the State's environment (Energy Law, Section 5-110(a)).

The Draft Plan must contain, at least:

- A forecast of State energy requirements for five, ten and fifteen year forecast periods, together with the bases for such forecasts;
- A summary of the plans of the State's major energy suppliers for meeting forecasted energy requirements, including descriptions of new energy sources;
- An identification and analysis of emerging trends related to energy supply, price and demand; and
- A statement of specific energy policies, together with the reasons therefor, and recommendations for such administrative and legislative actions as the State Energy Office has determined are desirable to implement State energy policy (Energy Law, Section 5-110(b)).

The Report must contain ". . . specific findings with respect to projected long-range electric and gas demands in the state within the forecast periods, and with respect to supply requirements, together with estimates of the cost of electricity and gas to consumers . . ." (Section 5-112(3)(b)).

Upon approval by the Energy Planning Board, and adoption by the State Energy Office, the statute provides that the Plan and Report serve a variety of purposes, principally:

- Public and Private Sector Planning. The State Energy Master Plan will "provide the framework for energy-related decisions made throughout the State" (Energy Law, Section 5-110). In addition, the Governor stated, when signing the legislation, that the Plan "shall control all energy related decisions made by the State and will be the guide for energy-related decisions in the private sector." (Governor's Memorandum of Approval, McKinney's 1978 Session Laws, p. 1838).
- Public Service Law Article VIII and Article VII Decisions. On and after January 1, 1980, the specific findings with respect to projected electric demands in the Report are binding on the State Board on Electric Generation Siting and the Environment (Siting Board) with respect to any determination of need for future steam electric generating facilities under Article VIII of the New York Public Service Law (Energy Law, Section 5-112(3)(c)). In addition, the Siting Board must find that a proposed facility is consistent with the "long-range planning objectives for electric power supply in the state" established by the Plan

[1]Adopted pursuant to Chapter 707 of the Laws of 1978.

[2]Ibid

[3]The members of the Energy Planning Board are: the Commissioner of Energy, appointed by the Governor to serve as Chairman, the Chairman of the Public Service Commission, the Commissioner of Environmental Conservation, the Temporary President of the Senate or his designee and the Speaker of the Assembly or his designee. David Blabey, Esq., has been appointed by the Temporary President of the Senate to serve as his designee on the Board. Ira Millstein, Esq., has been appointed by the Speaker of the Assembly to serve as his designee on the Board.

before it may grant an application for a certificate under Article VIII (Public Service Law, Section 146(2)(e)). Moreover, on and after January 1, 1980, the specific findings with respect to projected electric and gas demand are binding on the Public Service Commission with respect to any determination of need for major electric and gas transmission facilities under Article VII of the Public Service Law (Energy Law, Section 5-112(3)(c)).

The Plan and Report also serve the purpose of coordinating State recommendations regarding Federal energy policy.

PROCEEDINGS TO DATE

The 1979-1980 State energy master planning and long-range electric and gas system planning proceeding commenced on January 12, 1979, with the issuance by the State Energy Office of a public notice in accordance with the planning regulations (9 NYCRR 7845.1).[4] The public notice provided a brief description of the planning process and invited applications for funding of interested persons (Energy Law, Section 5-114; Part 7482 of the planning regulations) and for party status (Energy Law, Sections 5-110 and 5-112; Part 7846 of the planning regulations).

Under the planning regulations, any interested person except a major energy supplier or Federal or State agency was eligible to apply for a portion of a $200,000 fund established by Section 5-114 of the Energy Law, to defray fees of experts retained to participate in the energy planning hearings.[5]

On April 1, 1979, the member systems of the New York Power Pool (NYPP), the New York Gas Group (NYGG), and other major energy suppliers submitted their long-range plans to the Energy Office, in accordance with Energy Law Sections 5-110 and 5-112 and the regulations issued thereunder. Thereafter, public hearings were held on six days in May before Hearing Officer, Richard Goldsmith, Esq., to receive statements on the suppliers' plans and in connection with the development of the Draft Plan and Report. Written comments were also received for a period of 30 days after the conclusion of the hearings.

On August 7, 1979, the State Energy Office issued, pursuant to Energy Law Sections 5-110 and 5-112, a document which consisted of both the Draft Plan and Report. Following its receipt, the Board designated Sol Schreiber, Esq., as Hearing Officer to conduct hearings on the Draft Plan and Report. The Board also published notice of the submission of the Draft Plan and Report and public hearings thereon, in accordance with the planning regulations (9 NYCRR 7854.1).

The planning regulations called for two series of hearings to be conducted by the Board with respect to the Draft Plan and Report. At the first series of hearings, interested persons and public officials were afforded an opportunity to offer statements on the Draft Plan and Report. These hearings were held in New York City on September 6, 1979; Syracuse on September 10, 1979; Buffalo on September 11, 1979; and Mineola on September 20, 1979. A total of 193 people spoke or submitted testimony during these four public hearings and the 30-day comment period following the hearings.

At the second series of hearings, all interested persons and organizations who had requested to be made parties to the planning proceeding were afforded an opportunity to sponsor witnesses and to question witnesses sponsored by others, including the Energy Office staff. Of the scores of persons and organizations which requested and received party status to these hearings, 26 parties actively participated by sponsoring witnesses and questioning the witnesses of other parties. A list of participants is annexed hereto as Appendix A.

Prehearing conferences were conducted by the Hearing Officer on August 29 and September 28, 1979 in Albany to identify those matters on which, testimony would be submitted, to elicit the names of expert witnesses who would sponsor that testimony, and to formulate procedures to assure that the hearings proceeded in an orderly and efficient manner.

Direct testimony of 92 witnesses was prefiled on September 5, 1979 and rebuttal testimony of 43 witnesses was prefiled on September 21, 1979. On October 2, 1979, the Hearing Officer submitted to the Board recommended hearing procedures, together with an identification of the matters on which the questioning of witnesses should be permitted, a schedule of witnesses to be questioned, the sequence for questioning witnesses, and an allocation of time permitted the parties to question witnesses.

On October 4, 1979, the Board met in Albany and approved the recommended procedures and schedule proposed by the Hearing Officer. The Board also directed that transcripts of the proceedings be filed in Albany, Syracuse, Rochester, Buffalo, New York City and Mineola to assist the parties in preparing their briefs.

The second series of hearings was held in Albany for 11 hearings days between October 19 and November 9, 1979. During these hearings, 58 witnesses were questioned. Following the hearings, 32 parties submitted initial briefs to the Board on November 26, 1979. At the request of the Hearing Officer, the Board permitted the parties to submit reply briefs by December 5, 1979. Twenty parties submitted reply briefs to the Board, receipt of which marked the conclusion of the second series of hearings.

SEQR

In accordance with the State Environmental Quality Review Act (SEQR; Article 8 of the Environmental Conservation Law) and regulations issued thereunder, the Energy Office issued a Notice of Determination of Significance on May 31, 1979, in connection with the preparation of the Draft Plan and Report. This notice indicated the intention of the Energy Office to prepare a Draft Environmental Impact Statement (DEIS). A copy of this Notice was published in the Environmental Notice Bulletin on June 6, 1979.

On August 7, 1979, the Energy Office issued the DEIS as Appendix F to the Draft Plan and Report and filed a copy with the Commissioner of the Department of Environmental Conservation. On August 7, 1979, the Energy Office also sent a Notice of Hearing and Completion of the DEIS to the Department for publication in the Environmental Noiice Bulletin.

On August 10, 17 and 24, Notices of Hearing and Completion of the DEIS were published in newspapers of general circulation in Albany, New York City, Buffalo and Syracuse. An additional notice was published in *Newsday* on September 10. These notices stated that public hearings would be held in New York City on September 6, Syracuse on September 10, Buffalo on September 11, and Mineola on September 20, to allow interested persons an opportunity to comment on the DEIS, in addition to the Draft Plan and Report.

[4]The State Energy Office adopted the planning regulations, with Board approval of certain provisions as required by the statute, on December 21, 1978 and on July 9, 1979.

[5]On May 4, 1979, the Board issued an Order allocating $190,000 to 12 grantees.

On August 10, copies of the DEIS were mailed to each of the nine regional offices of the Department of Environmental Conservation. Also, on August 10, the Notice of Completion of the DEIS was sent to the State Clearinghouse and the twelve regional clearinghouses designated under the Federal Office of Management and Budget Circular No. A-95.

In addition to statements made at the four public hearings, submission of written comments was permitted for a period of 30 days following the hearings. Following receipt and review of these comments, the Board prepared a Final Environmental Impact Statement (FEIS) which was issued on February 4, 1980. Copies of the final statement were filed on that date with the Commissioner of the Department of Environmental Conservation (DEC) and in each of DEC's nine regional offices, in accordance with SEQR. In addition, the Notice of Completion of the FEIS was also sent on that date to the Department of Environmental Conservation for publication in the Environmental Notice Bulletin.

In reviewing the Draft Plan and Report, the Board has given careful consideration to the FEIS. The document has helped the Board identify and compare the environmental impacts of alternative energy demand and supply strategies presented in these proceedings. The Board is satisfied that consistent with sound economic and other essential considerations, the energy policies, forecasts, and recommendations for legislative and administrative action contained in the Draft Plan and Report, as modified herein, to the maximum extent practicable, minimize or avoid adverse environmental effects disclosed in the FEIS.

DRAFT STATE ENERGY MASTER PLAN—APPROACH AND CONTENT

Sections 5-110 and 5-112 of the Energy Law detail the requirements of the Plan and Report, respectively, with respect to, among other things, preparation and content. With respect to preparation, the Energy Office and the Board each conducted a single set of hearings, during which issues related to the Plan and Report were considered together. The Draft Plan and Report were developed as a single, integrated document.

The process set forth in Energy Law Sections 5-110 and 5-112 and the Plan both underscore the integrated and interrelated nature of energy planning called for in Section 3-101. Section 5-112, which pertains to the Long-Range Electric and Gas Report, requires that the Report contain not only forecasts of electricity and gas demand, but also forecasts of supplies to meet these demands and a forecast of the cost of electricity and gas to consumers over the planning period. For the Board to make findings with respect to electricity demand, supply and cost requires that we not only project the appropriate mix of electric generating facilities (i.e., nuclear, coal, oil, hydroelectric, renewable resource facilities, and others) but also that we forecast the demand, supply and cost of other fuel forms.

During the hearings, the staff of the Department of Environmental Conservation moved the Board for an order severing the planning proceeding. In its motion, DEC staff argued that the Board should first consider electricity and gas load forecasting matters, and, after issuance of the Report, proceed with consideration of the Draft Plan.

At a meeting of the Board held on October 4, 1979, the Board unanimously voted to deny the motion, insofar as it concerned the conduct of the hearings. Insofar as the motion concerned the Board's deliberation, the motion was tabled.

We have carefully evaluated the integrated manner in which the Draft plan and Report were developed. We find that the Energy Office has complied with both the intent and the specific requirements of the law in preparing the Draft Plan and Report as a single integrated document. Further, we are convinced that the effort to integrate the final Plan and Report is advisable as a matter of policy.

Accordingly, we deny the DEC staff's motion as it pertains to our own deliberations and find the approach in compliance with the law.

The Draft Plan and Report presents forecasts of the State's energy requirements for the next fifteen years. The Draft Plan also analyzes current and future energy supply options, including conservation, renewable energy resources, natural gas, petroleum, electricity and coal. Also discussed in the Draft Plan are such important subjects as research and development, energy financing, and the impact of rising energy costs on low income households.

In each section of the Draft Plan, there is contained a series of recommended legislative and administrative actions designed, as the case may be, to improve the efficiency of energy use; decrease the use of oil; increase the use of renewable energy resources, coal and natural gas; reduce the burden of financing energy projects; and lessen energy-related impacts on the poor.

* * * * * * * *

The following portions of this Opinion will address, in detail, the specific energy policies from which the various recommendations for legislative and administrative actions flow, the forecasts of energy requirements, and the energy supply plan elements which the Board finds are reasonable and appropriate for inclusion in the Plan and Report.

This proceeding marks the State's first effort at developing a comprehensive and integrated State Energy Master Plan and Long-Range Electric and Gas Report. We have accomplished a significant amount in this first effort, although we recognize that much more needs to be done. Indeed, we have called for numerous additional studies to be undertaken to address matters of particular interest and concern to us. These studies will assist us in our future review of the Plan and Report.

Moreover, we intend to monitor the progress of our recommendations for legislative and administrative action contained herein and will take those actions necessary to further their implementation. We also intend to monitor on-going developments in the energy field and, if circumstances warrant, modify the Plan and Report accordingly.

STATE ENERGY POLICIES

In Section 3-101 of the Energy Law, the Legislature set forth the broad energy policy of the State:

". . . to obtain and maintain an adequate and continuous supply of safe, dependable and economical energy for the people of the state and to accelerate development and use within the state of renewable energy sources, all in order to promote the state's economic growth, to create employment within the state, to protect its environmental values, to husband its resources for future generations, and to promote the health and welfare of its people;

. . . to encourage conservation of energy in the construction and operation of new . . . buildings, and in the rehabilitation of existing structures . . .

. . . to encourage the use of performance standards in all energy-using appliances and in industrial and commercial applications of energy-using apparatus and processes;

. . . to encourage transportation modes and equipment which conserve the use of energy;

. . . to foster, encourage and promote the prudent development and wise use of all indigenous state-energy resources . . .; and

. . . to encourage a new ethic among its citizens to conserve rather than waste precious fuels; and to foster public and private initiative to achieve these ends at the state and local levels."

These broad objectives have been refined during the course of the planning process into a set of specific energy policies required by Energy Law, Section 5-110(b)(4). These energy policies, listed and discussed below, are the major themes of the Plan, from which recommendations for legislative and administrative action flow. Together, these policies provide clear direction to State efforts to fashion its energy future.

With the exception of the policies relating to nuclear energy and natural gas, which are discussed in detail in portions of this Opinion which follow, the energy policies listed below have been largely unopposed during the hearing process.

Upon careful review of the record, the Board concludes that the following specific energy policies should be approved:

1. The State's consumption of petroleum products must be reduced. The economic costs and vulnerability to disruption resulting from the State's continued disproportionate reliance on oil strongly support actions to shift to less costly and/or more secure energy sources.

The State's petroleum dependence exceeds the national average by 20 percentage points (66% vs. 46%). Over 70 percent of New York's petroleum is imported either as refined product or crude oil. Nearly 90 percent of the petroleum products consumed in the electric utility sector (primarily residual oil) are refined from foreign crude oil. New York consumes more OPEC oil than any other state. Thus, among all States, New York is most vulnerable economically to increases in world oil prices and the political instability of its supply.

This vulnerability is a clear threat to the health and welfare of the State's citizens. World crude oil prices increased 86 percent during 1979, and when coupled with decontrol of domestic crude oil, raised New York's oil bill $4.8 billion or 55% in 1979. This drain of wealth threatens the competitive economic position of the State and threatens prospects for growth in New York employment.

2. Conservation and renewable resources must make a greater contribution to energy supply and will require substantial additional government support to do so, at least in the near-term. In many applications, conservation and renewables appear to be the least costly, most economically productive and environmentally benign means to satisfy a portion of the State's current and anticipated energy requirements. Government action must enhance the respective contributions to be made by conservation and renewables in meeting those requirements.

Conservation, which primarily involves increasing the efficiency of our energy use, represents, in many applications, the least expensive, quickest, environmentally safest and most economically beneficial method for reducing New York's dependence upon petroleum. Estimates of the costs of various conservation actions range from one-half to one-tenth of the cost of adding an equivalent amount of energy from new sources. Moreover, conservation can make a positive impact upon New York's economy by reducing the drain of wealth from, and creating jobs in, New York State. For example, the SEO has estimated that nearly 29,000 jobs would be created by the conservation actions endorsed in this Plan for the residential and commercial sectors. Reducing fuel use, transport and production will also have a positive environmental impact, an especially important value in an urban state like New York.

Development of renewable resources indigenous to New York means that jobs will be created within New York instead of elsewhere. For example, the SEO estimates that the wood and solar initiatives endorsed in this Plan would result in 11,000 additional jobs in New York State by 1994.

3. The State of New York and its agencies should encourage the increased efficient use of natural gas and stimulate efforts to secure additional supplies of natural gas from sources that are economic, and compatible with environmental, public health, and safety standards in order to reduce New York's dependence on oil. Natural gas is and will likely remain an economic and environmentally compatible alternative to oil. This policy will help insure that supply and demand remain balanced throughout the planning period.

New York's consumption of natural gas is relatively low (14% of our total energy consumption vs. 26% for U.S.). There are strong economic and environmental reasons for increasing the use of gas in New York. Natural gas is currently less expensive than oil ($4.41/MBTU vs. $6.07/MBTU) for space heating. And, the cost of gas is likely to remain below the cost of oil for equivalent uses during the planning period. (The real prices of gas and oil are likely to increase at the same annual rate (4.4%) during the planning period.) Also, combustion of natural gas results, on the average, in 1/50 and 1/1500th the SO_x emissions of fuel oil and coal, respectively, and 1/2 to 1/100th the particulates, CO, hydrocarbons and NO_x emissions.

Currently, there is excess capacity in much of the intrastate distribution network. Thus, more gas can be sold in many parts of the State without incurring significant additional distribution capacity costs. The system is underground and nearly fully automated. Additional gas mains can be installed with a minimum of environmental impact.

We believe it is likely that interstate natural gas supplies will increase over the planning period, due to increased gas production, additional sales to the interstate market resulting from the gradual deregulation of producer prices under the Natural Gas Policy Act of 1978, and increased imports. Also, a diverse set of supplemental sources is likely to begin to make a contribution in the planning period. In addition, significant conservation by customers and conversions to other fuels by major boiler installations will help to bring demand into balance with available supplies. Competition among the states for available gas supplies will, of course, continue. New York should have a set of policies which allow its citizens and businesses to compete vigorously for those supplies.

4. The increased use of coal must be promoted where economically feasible and consistent with applicable environmental standards. Compared to continued use of oil, particularly in the utility sector, use of coal will probably result in economic advantages, given current and forecast cost differentials between coal and oil, and significant improvement in certainty of supply over the forecast period. Increased utilization of eastern coal is likely to stabilize regional energy costs and will stimulate regional

economic development. A regional energy development entity like the Energy Corporation of the Northeast (ENCONO) can provide a vehicle for maximizing the region's existing and planned production and use of coal and other energy forms.

New York's consumption of coal is also relatively low compared to the national average (9% vs 20%). Use of coal, while attractive because its price is much lower than oil, includes a significant environmental cost. Although the record supports increased reliance upon coal, site by site analysis of economic benefits, pollution control options and environmental impacts must be carried out before any major electric generating facility can be permitted to use coal.

The greatest opportunity for increased use of coal in New York State in the near-term is in electric generating facilities. Currently, State power plants burn 89 million barrels of residual oil per year. Many oil-fired facilities burned coal in the past. Other oil-fired facilities, while they have never burned coal, were designed to burn coal. As discussed later in this Opinion, conversion from oil to coal for many of these facilities appears to be technically and economically feasible. Electric customers, over time, are likely to pay less for electricity if conversion take place. Currently, Eastern coal (1 percent sulfur) used in utility boilers costs $1.56 per MBTU; residual oil for similar boilers costs $4.84 per MBTU. If cost differentials of this magnitude continue, many conversions will clearly prove to be economically desirable.

The Board is concerned, however, with regard to the cumulative environmental, social and health impacts which would result should the targets for coal conversion and new coal construction contained in the Plan both be realized. Although the Final Environmental Impact Statement associated with this Plan and related testimony on the record provide important information and guidance concerning these impacts, and were sufficient to allow the Board to endorse the above energy policy and coal conversion plan set forth herein, a more detailed and comprehensive study of the cumulative impacts of this coal conversion and construction program should be undertaken. In this connection, the Board accepts the offer to assign principal responsibility for preparation of this study to the Department of Environmental Conservation, who will work in consultation with the Department of Public Service and the State Energy Office. We ask the Department of Transportation to participate as well. Upon completion of this study, which should be submitted as soon as possible, consistent with the necessity to coordinate fully with related Federal studies, the Board will review its approval of the coal conversion targets recommended in the plan.

5. Regional cooperation, coordination, and action must be promoted to enhance the region's energy supply prospects. Interconnection of New York's electric system with neighboring systems should be pursued as a vehicle for reducing costs and oil dependence to the extent economic and feasible. Interconnection may also lessen the adverse impacts on the State's environment from construction and operation of new generation facilities.

We have a strong interest in the role that increased economic regional power sales might play in meeting capacity requirements at lowest possible costs of service, reducing New York's oil dependence, and minimizing environmental injuries to the State from power generation. Therefore, we urge the increased economic interconnection of New York's electric system with neighboring and distant systems and all other necessary arrangements to increase purchases of non oil-fired capacity and urge Congress and the relevant Federal agencies to reduce constraints that may exist on economic power sales between regions. Further, the Board accepts the offer to assign to the Department of Public Service principal responsibility for preparation of a study of the potential for economic interconnection and the institutional and transmission system changes that may be necessary to increase economic power transactions. The Energy Office and the New York Power Pool should provide DPS their full support and cooperation. This study should be completed within six months, and each Board member is to be kept informed periodically of the progress of the study. The Planning Board also calls upon the State Siting Boards in their review of new applications for construction of facilities, to evaluate fully the potential for capacity contributions which might result from improved economic regional interconnection.

6. New nuclear power plants should not be included in the State's electricity supply plan at this time. There is first a need to develop a fully adequate national nuclear waste disposal program, and a need to clarify substantial uncertainties associated with economic, safety and regulatory issues associated with the nuclear option.

The approved electric generation plan does not depend on any additional nuclear capacity during the fifteen year Plan period. It does, however, project the successful completion and operation of two plants currently under construction at Nine Mile Point Two and Shoreham.

A majority of the Board believes that current uncertainties surrounding this fuel form, particularly the Nuclear Regulatory Commission's current policy regarding the licensing of new plants and the probability of significant changes in safety requirements, as well as Federal failure to establish firm policy and programs to solve the waste problem, make it inappropriate to rely on additional nuclear capacity in the Plan. At the same time, the Board recognizes that nuclear power may offer economic advantages in the face of the deepening crisis associated with foreign oil. The Board, therefore, recommends that there be created by the Governor and Legislature a panel to evaluate fully and comprehensively the status of nuclear power development in the State of New York. This panel should review all pertinent information, including the reports of all Federal, State and local government entities which have examined issues associated with nuclear power and which reports can aid the work of the panel. Every effort should be made to obtain federal funds for this project.

The panel should consist of distinguished scientists, engineers, business persons, labor leaders, environmentalists and citizens. Upon its creation and funding, the panel should consider the following, insofar as New York State is concerned, and report to the Board, the Governor and the Legislature:

—Within six months, with respect to:
- Impacts of phase-down or elimination of existing plants and contingency plans to assure adequate electric supplies in case of federally mandated nuclear plant shutdowns;
- Adequacy of emergency evacuation programs; and
- Adequacy of arrangements for secure transportation of nuclear materials.

—Within twelve months, with respect to:
- Feasibility of Federal or other government responsibility for operation of existing nuclear power plants;
- Feasibility of Federal or other government responsibility for construction and operation of new nuclear power plants;

- Adequacy of current and proposed Federal nuclear waste management programs.

7. All consuming sectors must be given increased choice among competing energy forms, including conventional fuels, conservation and renewable resources. Increased choice will benefit consumers by increasing price competition among energy forms and will benefit the State by stimulating innovation and efficiency improvements.

The lack of an array of competing choices among fuels for energy consumers will prevent the reduction in petroleum use that should occur in light of the steep increase in petroleum prices relative to other fuels. For example, where natural gas service is not available, residential space heating choices are limited in several areas to either oil-fired electricity or heating oil.

Accordingly, every reasonable effort should be made to stimulate conditions that allow all economic energy choices, including conservation and renewable resource technologies, to compete in the market.

8. Government must act to remove any existing legislative and administrative barriers inhibiting the development of energy sources, competition among fuel forms and energy conservation, except where such action would clearly compromise public health or safety or environmental quality. Justification for any such institutional barriers must now be reexamined in light of compelling State energy needs.

The era of cheap energy ended in 1973. However, most of the laws, rules and regulations developed during that era and which well-served the public interest as long as the cost of energy remained low, still exist. These laws, rules and regulations must be reexamined and, as appropriate, modified so the government does not unduly impede changes that would increase energy efficiency or contribute to the development of new energy sources.

9. The State's electric and gas utilities, as well as PASNY, should encourage and stimulate conservation and efficient use of energy by their customers. Consideration should also be given to inducing utilities to becoming active purveyors of conservation and renewable resource technologies.

The investor-owned utilities and PASNY must increase efforts to achieve, through rate design and other economic means, further conservation and efficient use of electric energy in order to minimize energy use and particularly oil use in electric generation. In addition, consideration should be given to encouraging the utilities to become purveyors of conservation and renewable resource technologies on a broad scale to achieve our goal. A task force from SEO, DPS and DEC should be formed to assess the utility programs instituted elsewhere which broaden the service utilities have provided historically and, if a broader utility role appears advisable, the study should assess the proper institutional arrangements to best effect that new role. The task force should report the results of its study to the Board within twelve months.

10. No person should be without adequate heat or should be forced to forego conservation improvements by reason of inability to pay. A commitment to protect public health and safety requires no less.

Since energy is a necessity of life, rising costs may force many low income households into the intolerable choice of staying warm or buying food. This presents for all levels of government a very serious energy and social problem which must be solved.

11. The State's energy research, development and demonstration programs must continue to emphasize the development and demonstration of those technologies particularly suited for near and mid-term commercialization and implementation in New York State. Coordinated efforts in advancing such technologies should be consistent with other State energy policies.

Research, development and demonstation (RD&D) in New York should focus on technologies that are most suitable to New York's particular needs, and research efforts must recognize the need to adapt the technologies and solutions being developed by industry and the federal government to New York's problems. The particular weather conditions, environmental restrictions, intra-state energy supply and distribution systems, and patterns of energy demand are some of the factors which require consideration in developing technologies to suit New York's needs.

Therefore, there must be a close relationship between energy policy and RD&D. Energy policy must guide RD&D priorities and new technologies emerging from RD&D efforts must guide policy development.

12. In view of the extensive reliance on oil in the transportation sector, more comprehensive consideration of possible State actions in that sector should be undertaken as part of the Board's future review of the Plan.

Improving energy efficiency in the State's transportation sector is vital to reducing the State's dependence on petrolemm products. Energy use for transportation in New York State accounts for almost one-third of total end-use energy requirements. More significantly—since petroleum products account for virtually all of that energy—the transportation sector accounts for over one half of the total end-use petroleum product consumption.

While the Board recognizes that the State is limited in its ability to take conserving actions in the transportation sector—passenger auto efficiencies are within federal purview, many freight actions are constrained by inter-state commerce considerations, and the investments required to improve or expand transit sytems are considerable—the Board believes that far more comprehensive consideration needs to be given to possible State action in this sector.

The Board therefore recommends that SEO, in cooperation with the Department of Transportation and other appropriate agencies, develop a comprehensive list of legislative and administrative actions in the transportation sector that may be worthy of further consideration and study. This list of actions should be presented to the Board within three months.

Introduction

The future demand for energy will be dependent upon a host of such complex factors as economic activity, population growth and consumption patterns, the price of competing energy sources, including energy conservation, the market penetration of energy efficient devices and the relationship of energy growth to economic growth.

There are uncertainties associated with each of those factors. Nonetheless, we believe that it is possible to evaluate these and the other factors likely to affect future energy demand and reach an informed judgment. We note that the planning legislation accommodates these inherent uncertainties by requiring the Board, at least on a biennial basis, to update the electric and gas demand forecasts and to review other energy forecasts (as well as other energy planning matters). The legislation also provides for more frequent amendments, if necessary.

TOTAL END-USE ENERGY REQUIREMENTS[6]

Background

The long-range forecasts submitted in this proceeding consist of two types: integrated forecasts of energy requirements for all major primary fuels and electricity, and forecasts of a single energy form, such as electricity or natural gas. We will proceed first with a consideration of the forecasts of total end-use energy requirements and then turn to the forecasts of electricity and natural gas.

Draft Plan Forecast

The Draft Plan contains forcasts of end-use energy requirements by demand sector (residential, commercial, industrial and transportation), by end-use (space heating, hot water heating, and other end-uses) and by fuel type (petroleum products, natural gas, electricity, coal and renewables).

Figure 1 summarizes the forecasts of average annual growth rates for end-use energy requirements by demand sector and fuel type.

The Draft Plan forecasts have been developed through the use of econometric and engineering end-use methodolgies; provide a systematic and consistent measure of the impact of price-induced and mandated conservation measures; assume a growing State economy; account for the effect of the 1979 OPEC price increases upon the attractiveness of competing fuels, upon electricity prices (which is important in a statewide generation system heavily dependent upon residual oil) and upon energy conservation and efficiency; and are capable of being readily updated on a continuing basis as significant events or actions dictate.

The assumptions underlying these forecasts are set forth in detail below under the discussion of the electricity forecast.

NYPIRG, et al. Cornell Group Forecast

In addition to the Energy Office, NYPIRG, *et al.*, submitted an integrated forecast of statewide energy requirements for all fuel forms by demand sector and by fuel type. The NYPIRG, *et al.* forecasts were prepared by the "Cornell Group". The Cornell Group forecast growth of end-use energy requirements at 0.4 percent per year.

The Cornell Group demand model employed an econometric approach. The assumptions underlying the Cornell Group forecast appear under the discussion of the electricity forecast.

For the reasons described above, we have concluded that the forecast of end-use energy requirements in the Draft Plan is reasonable. We have decided not to adopt the Cornell Group forecast, in large part, because it is based on pre-1977 data and contained no end-use and no substate detail. But the Cornell Group forecast has served as a valuable check on the forecast contained in the Draft Plan.

Background

Six long-range electricity forecasts were submitted in the proceeding. Figure 2 compares the respective approaches and methodologies. The forecasts discussed below were prepared by National Economic Research Associates, Inc. (NERA), the New York Power pool (NYPP), the State Energy Office (SEO), the Cornell Group on behalf of NYPIRG, *et al.*, the Energy Systems Research Group (ESRG) on behalf of the Sierra Club[8] and the Department of Public Service/Consumer Protection Board.

FIGURE 1
DRAFT PLAN FORECAST OF END-USE ENERGY REQUIREMENTS 1978-94

Sector of Use	Average Annual Growth Rates
Residential	0.3
Commercial	1.0
Industrial	0.8
Transportation	0.4
TOTAL END-USE ENERGY REQUIREMENTS	0.5
Fuel Type	
Petroleum Products	−0.1
Natural Gas	1.4
Coal	0.7
Renewables	3.7
Electricity	2.1
TOTAL NET ENERGY REQUIREMENTS	0.5*

* The 0.5 percent per year rate of growth of end-use energy requirements forecast by SEO is higher than the −0.5 percent per year rate of growth from 1973-1978 and lower than the 2.5 percent per year rate of growth in the pre-1973 embargo period.

[6] "End-use energy requirements" refers to the energy consumed directly by the demand sectors and differs from total primary consumption of energy by excluding losses occurring in connection with the generation and transmission of electricity.

[8] An earlier version of the ESRG forecast was presented in the Public Service Commission 1978 149-b proceeding by the Department of Environmental Conservation, which continues to support ESRG's findings.

Electricity (KWH Sales)

The base case forecasts of electricity sales range from a low of 1.1 percent average annual growth to a high of 3.0 percent for the next 15 years. At the high end, the NERA and NYPP forecasted a 3.0 percent and a 2.6 percent annual growth in electricity sales, respectively. At the low end, ESRG and Cornell forecast a base case of 1.1 percent and 1.4 percent annual growth in electricity sales, respectively. Figure 3 presents a comparision of the various forecasts of electricity sales and peak demand (MW) growth rates over the forecast period.

The base case forecasts represent the forecasts of electricity sales and peak demand the parties consider the most probable.

Draft Plan Forecast

The Draft Plan forecast of elecricity sales projects a 2.1 percent statewide average annual increase in total electricity sales. Forecasted sectoral growth rates are:

Residential	1.6
Commercial	2.1
Industrial	2.5
Transportation	3.2
TOTAL	2.1

The Draft Plan residential forecast employed an econometric approach, accounted for the impact of mandated efficiency improvements for the major end-uses, and was developed at the utility service area level. In the commercial sector, an adaption of an econometric-engineering and end-use model developed by Oak Ridge National Laboratory was employed. The commercial sector forecasts were developed at a substate regional level and were then broken down by utility service areas. The SEO industrial sector model employed an econometric approach to forecast industrial energy requirements for industry groupings. The statewide industrial sector forecasts were then broken down by utility service areas.

The following key assumptions underlie the forecasts of electricity sales developed by SEO.

Economic Activity	Average Annual Percent Change, 1978-1994
Gross State Product	2.2
Personal Income	2.5
Manufacturing Output	3.0
Commercial Employment	1.3

Real Fuel Prices	Average Annual Percent Change, 1978-1995
Petroleum Products	4.4
Natural Gas	4.4
Electricity	1.8

Conservation

All existing major State and federal conservation legislation and programs including the National Energy Act of 1978 and the State Energy Conservation Construction Code.

FIGURE 2
COMPARISON OF NEW YORK STATE ENRGY MASTER PLANNING PROCEEDING END-USE ENERGY REQUIREMENTS FORECASTS

		Fuel Type				Approach/ Methodology					
Forecast	Year	Electricity	Natural Gas	Oil	Coal	Econometric	Engineering End Use	Price Sensitivity	July OPEC Price Increase Incorporated	End Use Specific Forecast	Conservation Impact by End Use
State Energy Office	1979	X	X	X	X	X	X	Yes	Yes	Yes	Yes
National Economic Research Associates	1979	X				X	To some extent	Yes	No	To some extent	To some extent
New York Power Pool	1979	X				X		Yes	No	"	"
Public Service Commission (PSC)/ Consumer Protection Board (CPB)	1978	X				X		Yes	No	No	"
Cornell Group/New York Public Interest Research Group, Inc., et al	1979	X	X	X	X	X		Yes	No	No	No
Energy Systems Research Group/ Sierra Club, et al	1979	X					X	To some extent	No	Yes	Yes
New York Gas Group	1979		X				X	"	No	No	No

FIGURE 3

COMPARISON OF ELECTRIC ENERGY SALES AND PEAK DEMAND (MW) GROWTH RATES 1978-1994

	Statewide Average Annual Growth Rate (Percent)	
	Electricity Sales	Peak Demand
NERA	3.0	2.8
NYPP	2.6	2.5
DPS	2.3	2.1
SEO	2.1	2.1
NYPIRG et al/Cornell*	L-0.8; M-1.4; H-2.4	1.1**
Sierra et al/ESRG	L-0.4; M-1.1*** H-1.7	1.1

* 1980-1994

** Base case scenario, with time-of-day rates.

*** Simple average of low and high forecasts.

Figure 4 presents the forecast of electricity sales by electric utility service area.

During the course of the hearings, SEO recommended that its forecast of electricity sales in the Draft Plan be revised as a result of two recent events—increased world oil prices and passage of legislation extending the scope of the State's Lighting Standards to all non-residential buildings over a specified minimum size.

FIGURE 4

ELECTRICITY SALES BY UTILITY 1978 and 1994

	Sales (Billion KWH)		
	1978	1994	Average Annual Growth Rate (%)
Central Hudson	3.3	4.8	2.4
Con Edison	26.6	31.2	1.0
Long Island Lighting Company	12.4	17.5	2.1
NYS Electric and Gas	10.5	16.8	3.0
Niagara Mohawk	29.3	39.6	1.9
Orange and Rockland	2.9	4.6	3.0
Rochester Gas and Electric	5.1	7.8	2.7
PASNY	15.4	24.4	2.9
New York Power Pool	105.5	146.7	2.1

Updating the world oil price assumption (and the resulting impact on petroleum product prices) would, according to SEO, result in both a significant reduction in petroleum product consumption and an increase in electricity use. The growth in electric energy use would increase by approximately 0.1 percent per year, and electricity peak demand growth would increase by approximately 0.1 percent per year, with a resulting increase in 1994 peak demand of approximately 400 MW. Implementation of the recently enacted State lighting standards legislation will reduce growth in electric energy use by approximately 0.1 percent per year. The impact on electricity peak demand would be a reduction in 1994 peak demand of approximately 425 MW. These two effects thus approximately counter-balance one another with respect to the overall impact on electric energy (KWH) and peak demand (MW) growth rates.

NERA Forecast

National Economic Research Associates (NERA) presented forecasts of electric sales and peak for the New York State Power Pool.

NERA forecasts an increase in electricity sales of 3.0 percent per year. NERA used an econometric forecasting methodology. The NERA residential model consists of econometric end-use analyses; the NERA commercial model employs a single equation econometric formulation; and the NERA industrial model employs an econometric approach to forecast energy use on an industry by industry basis.

The assumptions utilized by NERA include:

	Average Annual Percent Change
GNP	N.A.
Real Electricity Price	0.8%
Real Fuel Oil	1.5%

NYPP Forecast

The NYPP statewide forecast is the sum of the forecasts prepared by the various member systems of the NYPP.

The NYPP forecast a 2.6 percent annual increase in electricity sales. The various member systems develop their forecasts from different methodologies utilizing different assumptions. Most utility forecasts are based upon a combination of judgmental and econometric methods. Most utility residential sector forecasts include end-use analyses. In addition, most NYPP members have attempted to include the future impact of appliance and equipment efficiency standards in their forecasts. In the commercial sector, some utilities rely upon NERA's single equation econometric model for forecasting commercial sector electricity sales, while others have developed their own models or rely on other approaches. No member of NYPP has forecast commercial sales on an end-use basis. A similar range of methodologies are used to forecast industrial sales.

The composite NYPP electricity real price assumption over the forecast period is for an average increase of 0.8 percent annually. The individual member companies generally make independent economic activity assumptions in deriving their forecasts. Some, particularly RG&E and LILCO, however, do not appear to have made specific long-term economic activity assumptions in deriving their sales forecasts. With respect to the residential sector, each member company made an independent assessment of the probable growth in residential customers over the forecast period.

NYPP presented several important arguments with respect to the forecasts of other parties. First, NYPP asserted that the primary reason for the differences among the forecasts of the member systems, the Draft Plan and the Cornell Group was the range of future electricity price assumptions. Second, NYPP claimed that the implicit Draft Plan electricity/gross state product (GSP) relationship during the forecast period was unreasonable. Third, NYPP stated that the mem-

ber company non-price conservation assumptions were not the principal cause of the difference between its forecast and those of the Draft Plan. Finally, NYPP stated that the SEO, Cornell Group and ESRG sectoral forecast models, particularly the residential and industrial models, contained certain methodological weaknesses.

While the NYPP forecast represents a summation of forecasts prepared by each of the member companies for their individual service areas, NYSEG and Con Edison were the only member companies to submit testimony challenging the SEO forecast for their particular service areas. Figure 5 presents a comparison of the Draft Plan and the NYPP electricity sales forecast by utility service area.

FIGURE 5

COMPARISON OF DRAFT PLAN AND NYPP ELECTRICITY SALES FORECAST BY UTILITY 1978-94

	Average Annual Growth Rate (%) 1978-1994	
Utility	DRAFT PLAN	NYPP
Central Hudson	2.4	3.3
Con Edison	1.0	1.7
Long Island Lighting Company	2.1	2.7
NYS Electric & Gas	3.0	4.4
Niagara Mohawk	1.9	2.2
Orange & Rockland	3.0	3.0
Rochester Gas & Electric	2.7	3.3
PASNY	2.9	2.9
New York Power Pool	2.1	2.6

NYSEG submitted testimony arguing that the Draft Plan's forecast of electricity sales for NYSEG was unreasonable in light of past experience. First, NYSEG claimed the SEO data base on gas customers was inaccurate and, as a result, the Draft Plan's forecast of gas customers was too large. NYSEG argued that this biased the Draft Plan's forecast of residential electric space heating customers and sales. However, it appears that the SEO and NYSEG forecasts of electric space heating customers are generally similar.

NYSEG also argued that the Draft Plan's forecast of industrial sector electricity growth was too low, because SEO did not adequately recognize the unique characteristics of the NYSEG service territory, and particularly its potential for industrial growth. The Draft Plan did account for a substantial increase in the rate of growth of NYSEG's industrial sales, consistent with substantially higher rates of economic growth. The economic assumptions in the Draft Plan that underlie its NYSEG forecast indicate that that area will experience a substantially higher rate of economic growth, greater than other areas of the State and higher than that experienced in the past decade. NYSEG's forecast of its industrial sales last year in the PSC 1978 149-b proceeding was the same as the Draft Plan forecast of industrial sales.

Con Edison Forecast

Con-Edison contends that the Draft Plan forecast, which separated the State into 3 regions (New York City—Region 1; New York City suburbs, including Westchester, Nassau, Suffolk, Rockland and Putnam Counties—Region 2; and Upstate—Region 3), failed to account properly for Westchester's Region 2 designation in forecasting Con Edison commercial sales. Westchester does lie within Region 2; however, SEO estimated a growth rate more similar to the rest of Con Edison's commercial sales. Con Edison did not present any data showing that Westchester County commercial sales grew at a rate dissimilar to the rest of its service territory.

Con Edison correctly argued that SEO understated the 1978 base year level of commercial sales, to the extent that a small component of commercial sales was not included. However, upon reviewing all elements of the SEO New York City commercial sales forecast, we have concluded that the projected growth is nonetheless reasonable. The SEO commercial model contains factors which may well slightly overstate future demand and thus fully offset this minor omission.

Finally, Con Edison argued that its rates will not increase more than the rate of general inflation over the planning period and are thus overstated in the Draft Plan forecast. However, the company's price assumption fails to account for the 1979 OPEC price increases, and the company's generating capacity is still mostly oil-fired. While coal conversions and purchases of more economic power would help Con Edison achieve a constant real price for electricity during the planning period, we do not believe that the company has supported its argument strongly enough.

Cornell Group Forecast

The Cornell Group presented forecasts of electric sales and peak demand growth on behalf of NYPIRG and several other consumer interest groups. Results for three different scenarios, with and without time of day (TOD) rates, were presented and are contained in Figure 6. The Cornell Group projects electricity sales to grow at a rate of 1.4 percent annually in its base forecast and 2.4 and 0.8 percent in its optimistic and pessimistic scenaries, respectively.

The Cornell Group's energy forecasting methodology consists of four sets of equations derived from an econometric model known as a multinomial logit specification. This approach yields integrated forecasts of all major primary fuels and electricity within each sector. In addition, the Cornell Group energy model is partially integrated with a model of the State's economy which, in turn, is fully integrated with a State demographic model.

Cornell employed different underlying economic activity and fuel price assumptions for each of the scenarios, as shown in Figure 6.

The lower set of fuel price assumptions are generally consistent with the Draft Plan fuel price assumptions; the high price scenario is based on the assumption that growth of real prices will not slow during the latter part of the forecast period. The various economic scenarios each have elements similar to the Draft Plan economic forecast. For example, the optimistic projection for population and industrial employment correspond closely to those elements in the Draft Plan forecast, while the pessimistic forecast of household growth, per capita income and commercial employment growth more closely parallel those elements in the Draft Plan economic projections.

NYPIRG, *et al.*, in conjunction with Sierra Club, *et al.*, presented several major arguments on the record with respect to the forecasts of other parties in the proceeding.

First, NYPIRG stated that the Plan should account for the contribution of renewable resources as a reduction in

FIGURE 6
CORNELL GROUP ENERGY DEMAND SCENARIOS

Scenario	Economic Activity	Fuel Prices	Electric Energy Forecast	1980-1994 Peak Demand Forecast (w/o TOD Rates)	1980-1994 Peak Demand Forecast* (with TOD Rates)
Optimistic	Optimistic	SEO	2.4	2.4	2.1
Base	Base	High	1.4	1.4	1.1**
Pessimistic	Pessimistic	High	0.8	0.8	0.5

* Assuming a ratio of three between on-peak and off-peak prices.

** Note: This is the forecast set forth in NYPIRG's Brief.

CORNELL GROUP FORECAST
ELECTRICITY GROWTH
BY SECTOR
1980-94

	Base	Optimistic	Pessimistic
Residential	0.6	1.4	0.1
Commercial	2.4	3.2	2.1
Industrial	0.9	2.4	—0.4
Total	1.4	2.4	0.8

demand for energy from central utility systems. Second, NYPIRG stated that the Draft plan's PASNY forcast is inaccurate and that the Board should accept the PASNY forecast developed by ESRG. Thirdly, NYPIRG stated that the Draft Plan's assumption of floorspace per employee in the commercial sector is unrealistically high and leads to an overstatement of electricity requirements in the Draft Plan forecast.[9]

ESRG Forecast

The Energy Systems Research Group (ESRG) presented forecasts of electric sales and peak demand growth on behalf of the Sierra Club and several other consumer interest groups.

ESRG developed low and high case forecasts and then, by averaging the two, obtained its base forecast.

ESRG projects electricity sales to grow 1.1 percent annually in its base forecast; whereas, the low and high case forecasts indicate increase of 0.4 and 1.7 percent, respectively, as shown in Figure 7. The sectoral forecasts for each of these cases are also shown in Figure 7.

The residential and commercial sector forecasts of ESRG are based on engineering and end-use analyses. The industrial sector electricity forecast is a trending of statewide energy intensity by major industry groupings.

ESRG's year by year forecasts of residential appliance saturation rates or the resulting long-term saturation levels. Year-by-year unit consumptions for the various residential end-uses are based on assumptions regarding efficiency increases, new technology market penetration, energy conservation practices, and other factors.

[9]Finally, NYPIRG also asserted that the NERA and NYPP forecasts should be totally disregarded because they are based on flawed methodologies.

for the various residential end-uses are based on assumptions regarding efficiency increases, new technology market penetration, energy conservation practices, and other factors.

FIGURE 7
ESRG ELECTRIC ENERGY
GROWTH RATE PROJECTIONS
BY SECTOR
1978-94

	Base	High	Low
Residential	1.4	1.9	0.8
Commercial	0.6	1.2	(0.1)
Industrial	1.3	1.9	0.6
TOTAL	1.1	1.7	0.4

The ESRG commercial sector model is quite similar to the SEO methodology used in the Draft Plan, except that it does not incorporate the econometric capability to assess important factors such as fuel choice and equipment utilization rates.

For the industrial sector, ESRG trends electricity use per unit of output for two-digit SIC codes. Thus, changing electricity and other energy prices have no explicit effect on ESRG's projections of industrial electricity demand.

Because of the lack of fuel price variables in any of ESRG's forecasting equations, ESRG makes no explicit assumptions regarding future fuel prices. Similarly, ESRG makes no explicit assumptions about income growth or aggregate economic activity. However, ESRG presents a disaggregated set of high and low-commercial employment forecasts which it uses to

forecast commercial floorspace; and a disaggregated set of high and low industrial output forecasts which it uses to forecast industrial electricity sales.

Sierra Club, *et al.*, presented the same major arguments regarding the forecasts of the other parties in the proceeding as NYPIRG, *et al.*

Basic Assumptions Underlying Forecasts

Our review of the basic assumptions underlying the forecasts indicate that, to a great extent, the differences among the forecasts tend to diminish as adjustments are made for a common set of assumptions.

Economic Activity

The record contains a general consensus, with one exception, ESRG, regarding the probable economic activity in the State over the forecast period. That consensus is fully supportive of significant further economic recovery and continuing economic growth over the forecast period, as typified by the Draft Plan's assumption of a gross state product growth rate of 2.2 percent per year (equivalent to 80 percent that of the projected GNP) over the forecast period.

The record indicates that the Draft Plan, NERA, NYPP, DPS and Cornell forecasts generally concur in this respect. The New York State Commerce Department also agrees with the reasonableness of the Draft Plan's economic activity projections for the State.

Although ESRG has not assumed an aggregate economic activity growth rate in deriving its forecasts, it did make separate economic activity projections in deriving its forecasts of commercial and industrial sales. Many of these projections for its low case are significantly below those of other parties. These lower economic projections, in large measure, account for not only the unusually low ESRG low case forecast, but also the comparatively low mid-range forecast, since the mid-range forecast is an average of the low and high case forecasts.

We believe that the economic activity projections underlying the forecasts of the Draft Plan and the parties other than ESRG reflect a more likely and realistic view of the future State economy.

Electricity Prices

The record contains substantial differences of opinion with respect to energy prices generally and electricity prices, specifically. The Draft Plan estimates that real electricity prices will increase at an average rate of 1.8 percent per year over the next 15 years. This estimate is based on the NYPP electricity price estimate for the next 10 years, adjusted to reflect the 1979 OPEC price increases.

The NYPP, reflecting the price estimates of the individual NYPP members, as noted, estimates that real electricity prices will increase at an average rate of 1.3 percent per year over the next ten years and 0.8 percent per year over the next 15 years. The NYPP estimate is based on its estimate of fuel prices, which do not take into account the 1979 OPEC price increases (there has been a 70 percent increase in residual oil costs over the last twelve months), and its estimate of the cost of its proposed electric supply plan.

NERA presented a composite statewide real electricity price estimate of 0.8 percent average growth per year over the next 15 years. The NERA forecast also does not take into account the impact of 1979 OPEC price increases.

The Board concludes that the Draft Plan real price estimate of an average 1.8 percent increase annually over the next 15 years is reasonable and should be assumed in forecasting electricity demand.

Although an estimate of the impact of the Draft Plan electricity prices on the NYPP forecast is not possible, in view of the disparate NYPP member methodologies, the NYPP forecast of electricity requirements would be significantly lower if the impact of the higher electricity prices projected in the Draft Plan were reflected. We also note that the NERA forecast, if modified only to reflect the SEO electricity price estimate, would be adjusted downward by 0.65 percentage points, or more than one half the difference between the SEO and NERA forecasts.

Conservation

The NYPP asserted that the difference in the SEO and NYPP forecasts is not attributable to differences in the amount of mandatory energy conservation taken into account, but rather is based on differences in real electricity price assumptions. SEO argued that NYPP arrived at this conclusion by using NERA's price elasticity response of minus 0.65, rather than SEO's price elasticity of minus 0.2. SEO maintains that the primary reason for its lower price elasticity is that, much of the price induced conservation in the residential and commercial sectors is accomplished by legislated energy conservation in the SEO model. SEO has also shown that a 1 percentage point decrease (from the SEO projection of 1.8% to the NYPP projection of 0.8%) in the growth of electricity prices would increase the overall SEO electricity growth rate from 2.1% annually to 2.3% rather than to 2.6%, as NYPP claimed.

Our review of the record leads us to believe that mandatory energy conservation is a major reason for the difference in the SEO and NYPP forecasts.

The NERA residential and commercial forecasts do not account for mandated conservation in a complete and consistent manner. While the NERA residential model contains non-price conservation adjustments reflecting DOE appliance efficiency targets, it contains no explicit adjustment for such important mandatory conservation measures as the State Energy Conservation Construction Code. The NERA commercial forecast also contains no explicit adjustments for the State Energy Conservation Construction Code. NERA's failure to account explicitly for all existing legislation significantly affecting energy conservation is a major reason for the difference between the SEO and NERA forecasts.

The Cornell Group econometric forecasting methodology, as previously noted, makes no explicit allowances for the impact of mandatory State and federal conservation measures. The Board believes that such an accounting is necessary for a reliable forecast.

The ESRG engineering end-use residential and commercial models contain the most detailed set of assumptions with respect to mandated conservation measures. While the Board believes that this is a particular strength of the ESRG model, the Board concludes that ESRG's unrealistic assumption of 100 percent market penetration of cost-effective conservation measures improperly inflates the impact of conservation.

Other Concerns

In addition to basic assumptions underlying the forecasts, there are a number of other important forecasting issues: the electricity/GSP relationship; the PASNY forecast; residential space heating saturation; the proposed case conservation forecast; the treatment of renewables; and the concern over a point or range forecast.

Energy GSP Relationship

The NYPP, while not directly questioning the Draft Plan's economic activity assumption, questioned the reasonableness of the relationship between the SEO forecasted electricity and economic activity growth rates. We consider the Draft Plan's forecasted relationship of a slight decline in the electricity/GSP ratio over the forecast period to be reasonable. We can find no persuasive reason to assume there will be a fixed relationship between economic activity and electricity growth in a period when energy prices, public policy and institutions are changing significantly.

The long-term historical relationship between energy, electricity and economic growth has shown variation. There have been several studies disputing the notion that there is an immutable relationship between the growth of GNP and growth in energy use. We believe that a given level of economic activity could be consistent with different energy growth rates and, even more surely, different relationships among the growth rates of specific fuel forms. A primary reason for change in the relationship is rising real energy prices and substitution of capital for energy-based on relative costs, e.g., capital investments in insulation and more efficient appliances substituted for energy consumption. As was noted, even with falling real energy prices, the efficiency of energy utilization improved steadily during the last 20-30 years. With real energy prices (including electricity prices) now rising, the incentive for conservation is greatly increased, and thus we would expect energy efficiency to improve to an even greater extent than it has in the past.

SEO reviewed NERA's analysis of recent energy/economic growth trends for the nation and extended it to New York State. For the nation, the ratio of electricity/GNP has increased, albeit at a steadily declining rate since the 1960's and, in fact, has remained virtually unchanged since 1976 during a period of rapid national economic expansion. New York State data show a similar trend, with the electricity/GSP ratio during 1976-1978 even decreasing slightly despite restrictions on natural gas in New York State.

The record indicates that various national forecasts prepared in recent years (DOE[10], EPRI[10], Exxon, among others) have projected successive declines in both the demand for electricity and the electricity/GNP ratio. The Electric Power Research Institute, a widely recognized industry source, in its Demand '79 forecast, reported in the May, 1979 EPRI Journal, indicates a significant reduction in the long-term forecast of national electric growth rate to about 3.5 percent annually. Since GNP is forecast to grow at approximately 3 percent annually, the EPRI forecast results in a ratio of electricity and GNP growth rates approaching 1.0, similar to the Draft Plan forecast.

In summary, review of both past trends and forecasts prepared by others indicates that there is no reason to expect in a period of rising energy prices a reversal of recent trends in the electricity/GSP ratio. We, therefore, conclude that the Draft Plan forecast of electricity sales relative to its economic growth assumption is reasonable.

PASNY

Several parties in the proceeding, notably Sierra Club et al., NYPIRG et al., and DEC, assert that ESRG's rather than the Draft Plan's forecast of PASNY's electric sales and peak load should be approved. ESRG's mid-range forecast of PASNY's electric sales and peak load is 6,241 GWH and 837 MW, respectively, lower than the Draft Plan's forecast. These parties noted that the Draft Plan forecasts are based on PASNY's own forecasts, which are largely based on a judgmental analysis of information supplied by its customers.

PASNY and other parties counter that ESRG's forecast for municipal and cooperative customers ignores the electricity price advantage enjoyed by PASNY's customers by assuming that growth of per capita energy consumption will be the same in both the municipal territories and the surrounding service areas. PASNY points out that municipal energy growth from 1972 to 1977 ranged from 1.8 to 5.4 times higher than the rate for the surrounding service area, and that these energy growth rates for the first nine months of 1979 continued to be substantially higher than those for the surrounding private utility service areas.

In support of its forecast, SEO indicates that, prior to adopting PASNY's forecast, it reviewed the relationship between PASNY's sectoral forecasts and its own, and concluded that the relationship was reasonable in view of information available with respect to PASNY's electricity price differentials and historical trends.

The Board recognizes that forecasting PASNY loads presents a unique set of problems, because of its relatively few customers, because most of PASNY's customers are large volume users and because they are geographically dispersed throughout the State. The latter circumstances, in particular, hinder the development of methodologies based on econometric and end-use analyses which require considerable amounts of economic data.

Although we fully recognize the subjective nature of PASNY's forecast, ESRG's forecast is also subjective: for instance, it utilizes PASNY's forecast of industrial sales and sales for some of its large volume governmental customers in its high scenario forecast while assuming virtually no growth for the governmental customers in its low scenario forecast. In addition, we believe that by applying ESRG's forecast growth rates for surrounding service areas to per capita energy consumption in PASNY's municipal and cooperative service areas, ESRG has not properly reflected the electricity price advantage enjoyed by PASNY customers in its forecast.

On balance, we believe that PASNY's forecast is more reasonable. Nevertheless, we believe that there is substantial room for improvement. We suggest that PASNY examine in as systematic and explicit a manner as possible recent trends and prospects for each of PASNY's major loads. This should include an assessment of the impact of such major factors as economic activity, electricity price and conservation on its electric demand.

Residential Electric Space Heating Saturation Levels

The Cornell Group, unlike any other party in the proceeding, forecasts a decline in residential electric space heating. It supports that conclusion by noting that the elimination of promotional prices which existed during the sixties and early seventies to encourage electric space heating and the renewed availability of natural gas will act to limit the expansion of electric space heating and, indeed, result in gradual declines during the latter part of the forecast period. SEO and NYPP argue that this factor alone accounts for the principal differences between the Cornell Group's and the Draft Plan's residential sector forecast.

The Board can not determine from the record the specific methodological reasons for the Cornell Group's atypical space heating projections. In view of the current and forecast price advantage of electricity and gas relative to oil, the Board concludes that the other parties' forecast of increasing electric and gas space heating saturations during the fore-

[10]Department of Energy, Electric Power Research Institute.

cast period are more realistic. We note that adoption of the Draft Plan residential space heating saturation levels would increase the Cornell Group's electricity requirements forecast by approximately 25 trillion BTU's (approximately 7300 GWH @ 3412 BTU/KWH), and increase the electricity requirements growth rate from 1.4 percent per year to 1.8 percent.

Commercial Sector Floor Space per Employee Assumption

The Sierra Club, *et al.*, also supported by NYPIRG, contended that a second basic reason for the differences between the Draft Plan and the lower ESRG forecast concerned the specific assumption for commercial floor space per employee for certain commercial sector building types.

We find that, in view of the unavailability of suitable generally accepted data sources, there is no basis for a direct assessment of the reliability of the Draft Plan commercial floor space-per-employee assumption. Nonetheless, the Draft Plan forecast is in the low end of the range of those forecasts that were derived without explicity incorporating an assumption for commercial floor space per employee. The ESRG forecast, however, is well below this range. The Board concludes that the Draft Plan forecast assumption is reasonable and does not appear to lead to an overestimation of commercial sector electric sales.

Proposed Case Conservation

Several parties have contended that the forecast should be based not on the Draft Plan base case, but on the proposed conservation and renewable cases. These parties include Ecology Action of Oswego, the National Consumer Law Center, and the Rochester Safe Energy Alliance. These parties argue that adoption of a lower forecast, reflecting proposed conservation and renewables contributions, would eliminate all or part of the need to approve construction of new power plants and hence provide a less costly energy future for New York State. The Energy Office has opposed this position, arguing that it is unreasonable to rely on the passage of proposed legislation.

Although there is some merit to the position of Ecology Action of Oswego, the National Consumer Law Center, and the Rochester Safe Energy Alliance, we would prefer to amend the Plan and Report to account for significant developments as they occur.

Treatment of Renewables

There has been considerable discussion on the record concerning the appropriate method of accounting for renewable resources. The Draft Plan treated those renewable resources which produce electricity that either will or could conceivably enter the utility grid as electric supply additions. These include small hydro, cogeneration, and resource recovery. All other base case renewable resources, including solar and wood, were treated as reductions in the demand for various fuels.

The Sierra Club, *et al.*, argue that the forecast of renewables that produce electricity should be removed from the electric demand forecast and that the Board should make a finding with respect to the need for additional central power plants.

Our review of the Energy Law, Section 5-112, convinces us that the specific finding of electric demand referred to therein relates to the demand for electricity regardless of its source, whether central station or, for instance, small hydro or cogeneration.

Point or Range Forecast

Several of the parties, notably the Department of Public Service and the NYPP, have argued that the Board should adopt a forecast range, in view of inherent forecasting uncertainties. DPS maintained that the Siting Boards could then decide on a specific forecast figure within the range at the time of a particular siting decision.

Legislation establishing the planning process recognized that there are inherent uncertainties in energy planning and, to account for this, included a provision for periodic (at least every two years) updating of the electricity forecast in the Report, and more frequently, if circumstances warrant (Energy Law, Section 5-112). Further, the legislation, Section 5-112, requires that the Board make "specific findings of projected electric and gas demand." Therefore, we believe that we should make a specific forecast within only a very narrow range.

Conclusion

Our best estimate is that statewide electricity sales will increase at a 2.1 percent average annual growth rate over the 15-year forecast period and we hereby approve that forecast of the Draft Plan. Further, we conclude that forecasts of individual utility company and PASNY growth, set forth in Figure 4 above and contained in the Draft Plan, are reasonable and are hereby approved.

Electricity Peak Demand

The record contains a variety of methodologies used to calculate peak demand requirements based upon forecasted annual energy requirements. The methodologies range from the use of gross load factors, to customer class load factors, to approaches recognizing disaggregated end-uses, particularly those which are weather sensitive. In addition, many methodologies incorporated explicit allowances for marginal cost pricing, load management, and time differentiated rates. Figure 8 presents a comparison of the resultant projections of 1994 Statewide load factors.

FIGURE 8
COMPARISON OF LOAD FACTOR* PROJECTIONS

FORECAST	Actual 1978	Forecast 1979	Forecast 1994
Cornell (Base with TOD Rates)		63.1**	65.5
NERA		63.9**	65.2
DPS		N.A.	64.9
NYPP		62.9	64.5
SEO (Base)	64.9	63	62.9
ESRG (Base)		62.3	62.0
Cornell (Base without TOD Rates)		63.1**	61.6

* Load factor is the ratio of average demand to peak demand on an electric system during a given period of time.
** Applicable to 1980

Several parties, notably the DPS and CPB, have challenged SEO's assumption that, based on its forecast of electricity end-use requirements (and offsetting effects due to specific utility load management programs), the Statewide load factor will remain constant. The DPS maintains that the SEO assumption overstates growth in peak demand and is unsupported by the SEO's forecast of end-use requirements. DPS maintains that rapid growth in industrial sales (traditionally high load factor load) should more than offset the effect of above average rates of growth of air-conditioning. In addition, DPS maintains that a percentage adjustment for losses for each utility, rather than the absolute difference used by SEO, should be used in order to account for SEO's generally lower energy forecast.

Our review of the record convinces us that the statewide load factor will improve in the future. And, in view of the inherent limitations in the SEO load factor assumption detailed by the DPS, the Board concludes that the SEO projection of a constant load factor should be modified to reflect a moderate improvement.

The Board considers a projected increase in statewide load factor from 62.9 to 64.5 (similar to that forecast by NYPP) to be reasonable. This would result in a reduction in the 1994 peak demand projected by SEO in the Draft Plan of approximately 717 MW.

In addition, the Board concludes that the SEO peak load projection should be revised using the appropriate percentage allowance for transmission losses and company use rather than the absolute amounts contained in the utilities' forecasts. This revision results in an additional reduction of statewide peak demand of 180 MW.

Conclusion

These revisions result in a peak demand forecast of 1.8-1.9 percent, which is adopted by the Board. Figure 9 indicates the derivation of that forecast from the forecast of peak demand in the Draft Plan.

A peak demand forecast of each utility company has also been derived by the Board, by taking the individual company sales forecasts approved herein and applying the individual load factors projected by the NYPP member companies. These load factors were used since they are consistent with the load factor we selected in connection with our statewide peak demand determination, result in the combined statewide peak of 1.8-1.9 percent annually we found likely and reasonably represent the company specific load factor improvements which should be achievable. The resultant peak demand forecasts for the individual NYPP members, presented in Figure 10, are adopted.

NATURAL GAS

Background

The record contains three forecasts of natural gas demand developed by SEO (in the Draft Plan), NYGAS and the Cornell Group.

Draft Plan Forecast

The Draft Plan forecast of natural gas requirements was developed as an integrated part of the forecast of end-use energy requirgments. The Draft Plan statewide forecast of 1.4 percent average annual growth is higher than either the NYGAS or Cornell forecasts. On a sectoral basis, there exists reasonable agreement among the parties on commercial and industrial growth forecasts. The Draft Plan forecasts substantially higher growth in the residential sector. The Cornell Group's commercial and industrial forecasts are substantially below both the Draft Plan and NYGAS's but its residential forecast is in general agreement with NYGAS. Figure 11 presents a comparison of the natural gas forecasts by demand sector.

The Draft Plan's natural gas forecast took into account the impact of 1979 OPEC price increases and was developed within a total energy framework employing both econometric and engineering end-use methodologies. The economic activity and fuel price estimates in its natural gas forecast are equivalent to those used to develop the Draft Plan's electric energy forecast.

The Draft Plan estimated that the real price of natural gas would increase, on the average, by 4.4 percent per year over the 15 year forecast period, taking into account the effect of deregulation of well-head prices after 1985. This compares to 1.8 percent per year for electricity and 4.4 percent per year for petroleum products. These natural gas price estimates are based on full implementation of the Natural Gas Policy Act of 1978, but assume that implementation of decontrol of well-head prices in 1985 will not result in immediate de-control of *all* domestically produced natural gas becavse NGPA provides that certain categories of natural gas will remain under control beyond 1985.

We note that the relationship in the Draft Plan between natural gas and petroleum product price estimates are consistent with those developed by DOE and published in the *Annual Report to Congress*: 1978, Volume III (August, 1979). The natural gas price estimates are also consistent with those prepared by DPS staff for use in its long-range forecasts.

Finally, SEO considered in preparing the Draft Plan a range of factors which will affect natural gas prices, including

FIGURE 9
ELECTRICITY PEAK DEMAND

SEO Forecast (Draft Plan)	Impact (MW)	1994 Summer Peak (MW)	Incremental Impact on Growth Rate (%)	Average Annual Growth Rate (%) (1979-1994)*
Board Adjustments		29336		2.09
• Impact of Higher Oil Prices	+400	29736	+.09	2.18
• Impact of Lighting Standards	−425	29311	−.10	2.08
• Revision of Energy to Peak Methodology	−180	29131	−.04	2.04
• Impact of Improving Load Factor	−717	28414	−.16	1.88

* Growth rate resulting from cumulative changes.

FIGURE 10
ELECTRIC PEAK DEMANDS AND GROWTH RATES
BY UTILITY, 1978 and 1994

	Summer Peak (MW)			Winter Peak (MW)		
	1978	1994	Growth Rate (%)* (79-94)	1978	1994	Growth Rate (%)* (79-94)
CHE&G	614	964	2.47	623	964	2.61
CE	6714	7710	0.54	4862	5313	0.40
LILCO	2997	4203	1.83	2456	3749	2.39
NYSEG	1729	2742	2.78	2138	3413	2.69
NMPC	5002	6890	2.11	5500	7558	2.05
O&R	662	1088	2.80	515	839	2.88
RGE	983	1531	2.71	941	1514	2.87
PASNY	2348	3854	3.35	2500	4180	3.17
TOTAL	21049	28982		19535	27530	
Coincident Peak	20418	28414	1.88	18939	27257	2.10

* These growth rates are based upon weather normalized 1979-1994 peak demand projections.

FIGURE 11
FORECASTS OF NYS NATURAL GAS
DEMAND BY SECTOR
1978-1994

Sector	Actual 1978*	SEO	NYGAS**	Cornell
Residential	334.2	2.0	0.4	0.1
Commercial	131.7	0.9	0.9	—3.5
Industrial	105.0	0.1	1.0	—7.2
TOTAL	570.9	1.4	0.6	—1.5

* Weather-Normalized, in trillion BTU's.

** Calculated from 1979 to 1994.

availability of supplies (conventional and non-conventional sources), federal regulatory policy with respect to use of gas under boilers, and transmission and distribution constraints.

NYGAS

The New York State Gas Group submitted a forecast of natural gas requirements which is a summation of the fourteen individual NYGAS member forecasts.

Each gas distribution company has its own forecasting methodology and assumptions. In general, the forecasting methodologies are comprised of marketing studies, linear extrapolations, assumptions of growth rates (often no growth), and some regression analyses.

Because of the nature and variety of the methodologies employed, it is difficult to assess the underlying economic estimates of the NYGAS forecast.

With respect to the natural gas prices, NYGAS appears to have estimated that the composite statewide price of natural gas will increase by 2.2 percent annually over the forecast period. The NYGAS price estimate, however, was prepared prior to the 1979 OPEC price increases.

Cornell Group

The Cornell Group's natural gas demand forecasting methodology is also analagous to its electric energy forecasting methodology. It consists of four sets of equations derived from an econometric model known as a multinomial logit specification. Within each sector, a forecast of total energy demand and each fuel's share is developed. The various equations were estimated from observations of 10 northern states over the 1966-1976 time period.

The underlying economic estimates are generally consistent with those of the Draft Plan. And the Cornell Group incorporated a set of natural gas price estimates that were generally similar to the Draft Plan's prices.

Conclusion

The Draft Plan natural gas demand forecast is based upon a substantial number of residential customers converting from oil to gas space heating, particularly in the downstate region. This factor alone appears to account for the difference between the SEO and NYGAS forecasts.

In light of the current price differential between oil and natural gas, the current number of conversion requests already received by the downstate gas companies, and the enormous potential for conversions downstate (since approximately 80 percent of residential gas customers use oil for space-heating), we conclude that the conversion potential embodied in the Draft Plan forecast of residential natural gas demand is reasonable and supported by recent and anticipated events in the residential heating markets. We further believe that the projection of an average 4.4 percent natural gas real price increase over the 15-year forecast period is reasonable and should be assumed in forecasting natural gas demand.

The Cornell Group's forecasts of commercial and industrial natural gas demands are substantially lower than those of SEO and NYGAS. Because of the similarity between SEO and the Cornell Group's input assumptions and the complexity of the multinomial logit specification, the Board is unable to identify specifically the reasons for the Cornell Group's forecast of significant declines in commercial and

industrial natural gas demand. The Board does note, however, that the Cornell Group's forecasting mode equations were estimated from data for several other states as well as New York State and only included consumption data through 1976. For these reasons, the Board concludes that the Draft Plan forecasts of commercial and industrial sector natural gas demand, which are similar to the respective NYGAS forecasts, are the most reliable.

The Board, therefore, adopts a forecast of natural gas demand growth of 1.4 percent per year over the 15-year forecast period.

CONSERVATION

Introduction

Conservation should be pursued as the cornerstone of the State's energy planning strategy. Energy conservation is, in many applications, the least expensive, environmentally safest, and most economically beneficial supply option available. The lead times necessary to develop renewable resources, synthetic fuels, and other supply options limit their usefulness in the next few years. In contrast, substantial energy use reductions can be achieved relatively quickly through conservation.

Further, conservation efforts can create jobs within the State, as opposed to elsewhere. Consuming oil produced in foreign countries tends to draw capital out of the State. Conservation activities create jobs locally, especially in the construction and services industries for the on-site installation of energy conserving materials and devices.

Finally, a dollar spent in cost-effective conservation tends to achieve more than a dollar spent in many types of energy production investments. Many residential energy conservation measures cost less per megawatt than the power produced by a new generating plant that might have to be built if the conservation did not occur.

Energy conservation is also beneficial to the environment. As discussed in the Final Environmental Impact Statement, a reduction in the use of fossil fuel results in a nearly one-to-one reduction in direct air emissions, both particulates and gases.

New York State's energy conservation effort is well underway in both the public and private sector. Energy prices, Federal programs and State initiatives have already resulted in significant energy savings.

Indeed, even since issuance of the Draft Plan, several of the conservation legislative initiatives recommended therein have been enacted into law, including:

- Chapter 743 of the Laws of 1979, amending the State Lighting Efficiency for Existing Public Buildings Act of 1978, to extend the mandatory lighting efficiency standard to existing non-residential buildings, using the State Energy Office, local agencies, and self-certification procedures as enforcement mechanisms.
- Chapter 741 of the Laws of 1979, amending the Home Insulation and Energy Conservation Act of 1977 to:
  - •• include as eligible measures furnace and boiler retrofits, furnace and boiler replacements, regardless of the fuel used, and heat pumps;
  - •• extend the program to four-family housing; and
  - •• increase the maximum loan amounts available.
- Chapter 740 of the Laws of 1979, amending the Vehicle and Traffic Law to exempt van pool drivers of non-profit vans from the special licensing requirements needed for bus drivers.
- Enactment through popular referendum in November of the Energy Conservation Through Improved Transportation Bond Issue.

Additional energy conservation, however, can and should be achieved within New York State over the next fifteen years. A part of this effort will require additional legislative and administrative action.

Discussion

The Draft Plan recommends a series of actions designed to achieve regulated conservation and to enhance price-induced conservation. Price-induced conservation results from actions taken because a direct economic benefit will be derived. The magnitude of the savings resulting from price-induced conservation will be increased by public education and technical assistance programs which improve the operation of normal market forces. Regulated conservation refers to those actions taken because of a law or regulation—although such legal requirements are usually based on anticipated favorable economic effects.

Proposals contained in the Draft Plan are discussed below. Following the discussion of these proposals, we discuss additional proposals recommended by various parties to the proceeding and conclude with a discussion of two new proposals which are adopted as part of the final Plan.

State Actions

> Amend the Energy Conservation Construction Code to reflect improvements in energy conservation, design and construction practices, and equipment effectiveness.

The Draft Plan proposed to amend the Energy Law to allow the Energy Commissioner to amend the code by regulation. This proposal was modified by SEO during the proceedings. The proposal now specifies code amendments, which would be subject to legislative approval, pursuant to Sections 11-104(2) and (3) of the Energy Law. These code amendments have been based on analyses showing that they present attractive payback potential, are consistent with current technology and design practices, and/or better reflect feasible industry compliance; we support their adoption. Moreover, we believe that the Energy Commissioner should be authorized to amend the code by regulation to assure that the code is amended promptly.

> A task force should be established to investigate requiring regulated electric utilities to invest in end-user installation of conservation and renewable resource devices as an alternative to investments in new electric capacity.

The investment necessary to realize the full benefit of the proposed conservation measures are substantial; the investment in the residential sector alone likely exceeds one billion dollars over the forecast period. But the installed cost of these recommended energy conserving building envelope and device retrofits may be lower than the future cost of providing equivalent energy supplies, including addition to electric capacity. The economic analysis contained in Appendix E to the Draft Plan suggests that conservation investments in New York are now lower than the costs for investments in equivalent electric capacity. If the analysis is correct, a cost savings would accrue to consumers by electric utility investments in conservation rather than additional production facilities. Also, investments in conservation in place of production facilities may reduce the financial strain on utilities which now accompanies their large capital construction program.

The task force should study the feasibility of New York's electric utilities investing in end-use conservation in their service territories. This study should analyze the economics of such investments vis-a-vis investments in new generating facilities, and should consider the equity of such a program for all ratepayers, including those who have already invested in conservation. The possibility of investments in renewable resource equipment (such as solar-hot water or passive solar heating systems) should also be analyzed.

Enact a "Cost-of-Energy" disclosure act to require disclosure of a record of energy bills for existing homes at the time of sale.

The essence of the proposal is to provide for disclosure of information that will be useful to the consumer in making a choice among homes on the basis of likely energy costs. Prospective purchasers of one and two family residential buildings would be informed of the history of energy costs for the dwelling being considered for purchase by requiring sellers to provide summaries or copies of energy bills. We believe the requirement may stimulate the home or building owner to invest in conservation to improve the marketability of the home.

Since home energy use varies substantially with occupant behavior and habits, information disclosed pursuant to such legislation would have to be used with care by the prospective buyer. But we believe the information would be at least as useful as the EPA auto efficiency ratings are when consumers make automobile purchasing decisions. And we believe the cost of providing the information is likely to be minimal.

Amend the New York State Multiple Dwelling Law and Multiple Residence Law to establish a minimum temperature for hot water in multifamily housing at 110°F.

This proposed legislation would assure that owners of multiple dwelling units will be in compliance with legal requirements to supply hot water to such dwelling units if the water has a minimum temperature of 110°F, and all other relevant requirements of the Multiple Dwelling and Multiple Residence Laws are met. In particular, overriding health and safety requirements are preserved. The Multiple Dwelling Law applies to all multiple dwellings in cities with a population of 400,000 or more and to any other city, town, or village that has adopted its provisions. The Multiple Residence Law applies to cities, towns, and villages of less than 900,000. These amendments would supersede all local laws, ordinances, resolutions, or regulations which require a minimum temperature for hot water higher than 110°F. It would not, however, preclude a building owner from providing hot water at a higher temperature.

The impact of the legislation will be twofold: (1) in New York City the minimum temperature standard for multiple dwellings as contained in the New York City Housing Maintenance Code will be reduced from 120°F to 110°F (the amended Multiple Dwelling Law would supersede less restrictive local codes); and (2) in areas of the State that are governed solely by the Multiple Dwelling Law or the Multiple Residence Law, and where, therefore, no minimum temperature standard exists, a minimum of 110°F would be established. This standard would give building owners a minimum temperature against which to compare and adjust their current practices.

Establishing a uniform standard could result in annual savings of as much as 570,000 equivalent barrels of oil, according to State Energy Office estimates. The proposal appears to entail minimal costs of implementation.

Amend Section 79 of the New York State Multiple Dwelling Law-and Section 173 of the New York State Multiple Residence Law to establish a minimum space temperature requirement of 68°F between 6:00 a.m. and 10:00 p.m.[11]

Section 79 of the Multiple Dwelling Law provides that facilities be maintained in all multiple dwellings to meet the minimum temperatures required by local law, ordinance, rule, or regulation in all parts of a dwelling that are used or occupied for living purposes. That minimum is 68°F between the hours of 6:00 a.m. and 10:00 p.m. whenever the outdoor temperature falls below 55°F. It is 55°F between the hours of 10:00 p.m. and 6:00 a.m. whenever the temperature falls below 40°F. At present, local law, ordinance, rule, or regulation can establish higher minimum temperatures than those given above.

Section 173 of the Multiple Residence Law requires that every new dwelling be capable of heating all living rooms sufficiently to maintain minimum temperatures required by local law, ordinance, rule, or regulation, or by local public health officer. It does not establish specific minimum temperatures.

These laws have fostered a wide range of minimum temperature standards varying by locality.

This proposed legislation, superseding existing locally adopted standards, would prevent local governments from adopting codes that establish higher minimum temperature standards between 6:00 a.m. and 10:00 p.m. than those contained in the Multiple Dwelling,Law (unless those temperatures address specific health conditions) and would establish a statewide minimum temperature requirement for space heating.

Compliance with this legislation could save up to 540,000 equivalent barrels of oil annually, according to SEO estimates. The cost of implementation appears minimal.

Expand State public education/technical assistance programs with respect to energy conservation in, among others, the following areas:

—oil and gas burner retrofits,

—water heater insulation and temperature reductions, and the use of flow restrictors,

—purchase and use of energy-efficient appliances and automobiles,

—the value of ridesharing (car and van pools),

—increased use of mass transit (buses and railroads),

—energy-efficient lighting and heating practices in residential and commercial settings, and

—programs to help industry and agri-businesses implement energy-conserving processes and technologies.

Burner retrofits and general furnace maintenance can often increase furnace efficiencies from typical levels of perhaps 60-65% to over 75 percent at a cost of $200-$300. In contrast, a new efficient furnace could well cost $1500 to $2000. Water heater adjustments and retrofits can inexpensively reduce energy used to heat water by as much as 35-90 percent. Appliance efficiency and automotive mileage standards result in the manufacture of machines that use energy more efficiently. But the full potential of those standards can be achieved only by consumer purchases of the most efficient available models at any point in time, and by

[11]The original proposal in the Draft Plan recommended that minimum nighttime temperatures also be established. This part of the proposal was dropped by SEO during the proceeding.

maintaining these appliances and automobiles in good working order.

Better public education is the key to fulfilling that potential. Similarly, public education is an important factor in establishing successful ridesharing programs and maximum use of mass transit. And mandatory programs such as the Energy Conservation Construction Code and Lighting Standards are more effective in achieving maximum potential savings if the building owners and/or inhabitants take advantage of opportunities to conserve.

We endorse and encourage institution and expansion of programs designed to enhance dissemination of conservation information, and programs that provide technical assistance to end-users, such as the SEO programs to aid industry and agriculture. These could be expanded through an agricultural information dissemination service and a personnel increase for the Energy Advisory Service to Industry (EASI) Program.

Federal Actions

Increase funding-to the DOE weatherization program for low income dwellings from the current annual level of about $200 million to at least $1 billion.

As of March, 1979, more than $14 million (including administrative costs) had been spent in New York State, creating over 500 jobs and weatherizing an estimated 13,000 houses. Weatherization cost per unit has averaged approximately $369 in the past due to an expenditure limit per unit of $400. As of July 1, 1979, the limit has been increased to $800 per unit ($1000 where a contractor must be used to complete the work). The actual expenditure level per unit may be expected to increase proportionately.

There are approximately 570,000 households in New York State which potentially qualify for this weatherization program. This year's DOE funding to New York State should reach about 30,000 of those households if the previous expenditure level is maintained; 15,000 households should be reached, if the expenditure per unit doubles. Added to the 11,000 homes already reached, over 525,000 low-income homes will still be unweatherized after this year. Assuming a constant real funding level, it would take at least 17 years to weatherize all eligible homes.

Low-income households are severly limited in their ability to conserve through non-capital conservation. This large potential savings cannot be tapped, nor the efforts of this population group rewarded, unless or until their homes are properly weatherized. A much greater effort in this area is clearly called for.

We encourage the New York State Congressional delegation to seek greatly expanded funding of the weatherization program to complete the task of weatherizing these homes in the next three to seven years.

Amend the federal tax law with respect to energy conservation investments in multifamily housing to:

—extend the general investment tax credit to multifamily housing; and

—extend the business energy credits to include conventional conservation technologies as well as the more sophisticated conservation and renewable resource items currently allowed.

Multifamily housing has, in effect, been ignored in the Federal conservation tax credits programs. Especially in New York City, this means that a large residential conservation potential is not receiving the same tax benefit stimulation as one to four family housing. The approximately 2.25 million multifamily units in New York State account for over one-third of the State's housing stock. In New York City, over 60 percent of the housing units are in buildings of five or more units. Multifamily housing accounts for approximately 8 percent of New York's total energy consumption. A 10 percent reduction in the energy New York's multifamily housing uses could save the equivalent of over five million barrels of crude oil annually.

Technologies needed to reduce energy consumption in existing multifamily housing are currently available. Retrofitting technologies, such as insulation, storm windows, weatherstripping, and caulking are often cost-effective, with typical paybacks of two to six years.

The bulk of early federal retrofit funds are being directed at units in which the government already has an investment (i.e., public and federally insured housing). Apartment owners are excluded from use of the residential energy tax credits, while the list of allowable items for the business energy tax credit ignores technological constraints in existing multifamily housing. The general investment tax credit available for employment-generating investments is not applicable to multifamily housing improvements, although it may be applied to hotel and motel accommodations.

While many investments in conservation in existing multifamily buildings appear cost-effective without tax credit stimulation, we see no reason why they should be excluded from such-benefits. Moreover, landlords may need such stimulation to make investments that primarily benefit their tenants. The proposed tax policies recommended in the Draft Plan may well supply that stimulation.

Enact federal legislation to increase the EPA automotive mileage standards by one-half mile-per-gallon in each year from 1986 through 1990.

Under the Energy Policy and Conservation Act of 1975 (EPCA), the Environmental Protection Agency (EPA) has established fleet average mileage efficiency standards for passenger automobiles sold by car manufacturers each year. Under the current law, the standards are scheduled to reach 27.5 miles-per-gallon (mpg) in 1985.

Since passage of EPCA, the mileage standard has become an important factor in conserving transportation fuels nationwide. Auto manufacturers have demonstrated their ability to meet and to surpass these standards with existing and developing technologies. The 1979 Gas Mileage Guide (U.S. EPA, January, 1979) lists 37 car lines which demonstrate city mileage ratings in excess of the 1985 mileage standard of 27.5 mpg.

We see no reason why this trend toward better fuel economy should not be extended beyond 1985 by establishing a federal goal that increases the mpg requirement by at least one-half mpg in each year from 1986 through 1990. The New York State Department of Transportation has estimated that if the standards were so extended, New York would save 194 million additional gallons annually by 1994.

Increase Federal aid for mass transit development and operation from $1.25 billion to at least $2.5 billion annually.

Federal aid for mass transit is limited relative to the need for such funding, especially if modal shifts are to occur. An existing federal authorization (Section III Capital Discretionary Fund, Urban Mass Transit Act) establishes a nationwide discretionary fund to aid state and local mass transit efforts. The annual appropriation to this fund is currently about $1.25 billion. For several years, New York State's portion of this funding has been about 20 percent, under an allocation formula which favored the large existing transit

system. Recently, however, New York's share has been falling with the development of new mass transit systems in other states. Federal money has not been increased to match this growing demand.

Thus, regardless of how much New York spends of its own money, adequate federal money is not available unless or until the federal discretionary fund is increased. Consequently, New York now faces increasing difficulties in just maintaining its present public transit system. Improving mass transit is necessary to reduce further energy consumption in the State's transportation sector; reduced availability of federal funds makes it difficult for New York State, or any other state, to develop improved mass transit systems.

We urge New York State's Congressional delegation to seek a substantial increase in authorizations and appropriations to the mass transit discretionary fund.

Enact the proposed Energy Management Partnership Act.

The Energy Management Partnership Act (EMPA; pending as H.R. 4382 and S.1280) is an Administration proposal which would combine the existing federally-funded state energy programs and assist states in the development of energy planning and management activities. EMPA would eliminate a number of programmatic and funding constraints currently imposed on state programs, but would impose new requirements in the areas of energy planning, emergency preparedness, and use of renewable resources. Furthermore, EMPA would support an expanded energy role for local governments by requiring states to pass through financial assistance to local governments for energy activities. The bill would authorize $110 million annually over five years.

Passage of EMPA would provide a framework within which state and local governments could work with each other and the federal government, while allowing each state and local government to deal with its own unique energy situation.

Discussion

Two areas of concern have been raised during the proceeding. First, DEC has suggested that indoor air quality might be adversely affected to the extent ventilation rates in buildings are reduced. Second, a number of parties have suggested that the Board adopt action proposals in addition to those put forward in the Draft Plan.

With respect to the first area of concern, it has been suggested that indoor air quality may deteriorate due to the adoption of strict conservation measures that reduce ventilation within structures. Measures such as caulking, weatherstripping, or insulation reduce air exchange with the out-of-doors and may cause indoor pollutant concentrations to rise. In addition to the potential increase in exposure to pollutants, mildew, bacteria, odors, and other irritants may accumulate and cause structural damage, disease, or create an unpleasant human environment. One potential air contaminant, radioactive radon, may also pose a health problem.

We understand that state and federal agencies are aware of these potential adverse effects. Studies have recently been initiated at both levels of government to ascertain the extent of this problem.

In New York, most conservation measures would be taken in older buildings. As discussed in the FEIS, conservation retrofits of these structures are not likely to result in dangerous air pollution concentrations, since ventilation rates are generally maintained in excess of minimum building code standards (ASHRAE 65-70). However, new construction should be monitored to insure that unsafe or unpleasant conditions are not created when efforts are made to conserve energy. We understand that ASHRAE standards are currently being revised to reflect this concern.

While we share DEC's concern about these possible risks, we have no evidence to suggest they are significant. For that reason, we encourage the Energy Office, NYSERDA, the Department of Health and other concerned agencies to determine as expeditiously as possible whether these risks are significant. Pending that investigation of the problem, we will not, at this time, qualify our endorsement of any conservation proposal. Because the risks related to retrofit measures are highly speculative on the one hand, while the potential oil savings and net environmental benefits of reducing traditional energy demand are both certain and significant on the other, we will maintain our current policy proposal.

The other major area of concern raised with respect to conservation has been that the proposals in the Draft Plan could have been more comprehensive.

The Building Trades Council and the Sierra Club, *et al.*, suggest that increased use of heat pumps be encouraged, particularly as an alternative to electric resistance heating. Since this view was expressed, the Legislature has responded, at least in part. The recent amendment to HIECA includes heat pumps as an eligible conservation measure. This action should assist in stimulating greater use of heat pumps where such an investment will pay off in a reasonable period of time.

ESRG and Ecology Action of Oswego recommend a ban on new electric resistance heating. While heat pumps—which are reliable and efficient—may well present a more attractive use of electricity for heating purposes, it may be that electric resistance heating, produced from coal-fired power plants, will be a desirable alternative to on-site use of oil for heating purposes in some cases. We are, therefore, not willing at this time to recommend such a ban.

The Sierra Club and the Cayuga Lake Conservation Association, among others, have underscored the merits of more extensive planning for the transportation sector. They have suggested that the Plan should set as a goal a decrease in the use of energy for autos in New York State and propose to increased public transportation, including utilization and expansion of railroad systems in the State.

A more comprehensive program for conservation in transportation through measures to reduce vehicle miles traveled, shift the burden of highway costs from local property taxes to an auto use tax, electrify high density rail lines, and improve the ability of rail to serve the needs of the State were all proposals of potential value made by various parties and participants.

We share the view expressed by these participants that the Draft Plan did not adequately address possible State actions which could reduce vehicle energy use. Although the Energy Conservation Through Improved Transportation Bond Issue as approved should provide some of the needed capital to accomplish at least some of the suggested mass transit improvements, far more comprehensive consideration needs to be given to possible State actions in the transportation sector, as previously discussed in this Opinion.

The Board therefore recommends that SEO, in cooperation with the Department of Transportation and other appropriate agencies, develop a comprehensive list of possible legislative and administrative actions in the transportation sector that may be worthy of further consideration. This list of actions should be presented to the Board within three months.

Sierra Club, *et al.*, urges adoption of proposals for specific

State applicance efficiency standards. There is no doubt that increasing appliance efficiencies can have an impact on future state (and national) energy consumption. However, to a large degree this area has been occupied by Federal law, in particular, the National Energy Conservation Policy Act of 1978. We see no compelling reason at this time for the State to take additional actions on its own initiative.

Sierra Club, *et al.*, further suggests inclusion of proposals for mandatory implementation of conservation measures with clearly favorable payback periods and low capital costs, such as water heater insulation jackets and water flow restrictors. Many of these measures already are reguired in new construction. Further, we are mindful of the administrative and enforcement responsibilities which accompany any mandatory programs, and which pose particularly difficult problems when made applicable to existing structures. Before recommending this course of action, we would prefer to monitor the degree of success of the recently adopted legislation which extends the mandatory lighting efficiency standards to existing non-residential buildings. We are also reluctant to embrace this proposal at this time when, as here, price signals are consistent with encouraging such conservation activity in existing structures. We have recommended tax credit changes and other measures to provide further inducements and there is no doubt that state education and assistance programs will assure increasing penetration of these measures. More mandatory proposals, then, do not seem warranted at this time.

In the course of the proceeding, two additional conservation measures have impressed us as worthy of additional action. The first area concerns the Federal Energy Conservation Program for Schools, Hospitals, and Buildings Owned by Units of Local Government and Public Care Institutions. Energy savings projected for the program in New York State have been pegged at 10.5 TBTU by 1983 at the original funding level (authorization of $965 million nationwide). This savings projection is based on—and limited by—the potential for energy savings in buildings receiving assistance under the program. The number of initial applications for program assistance and grants for schools and hospitals have far exceeded the number of buildings for which funds are available. In the first grant cycle of the program, the State has received applications for $33.8 million for actual retrofit activities. Only $6.9 million in funds is available.

In contrast, the available audit and technical assistance funds for local governments and public care institutions exceed application amounts. This appears to be a reflection of the viewpoint of building managers that it may not be worth the effort to go through an audit and receive technical assistance—only to find that they are ineligible for capital grants.

All of this suggests a need for increased program funding. Further, greater flexibility must be provided in expending the funds, so that they can be used where needed. With such increased fundlng and flexibility, energy savings in New York State from this program could increase significantly. Therefore, the Board endorses the following proposal:

> Expand federal funding for the Energy Conservation Program for Schools, Hospitals, and Buildings Owned by Units of Local Government and Public Care Institutions, and add flexibility to the State's use of such funds.

The second area concerns load management: the application of procedures to shift the production of electricity away from inefficient peaking units toward more efficient intermediate and base load units by shifting use of electricity by end-users away from peak times. Load management can effectively contribute to the conservation of scarce primary energy resources through the resulting wider use of more efficient generation and decreased use of less efficient generation.

Direct and indirect load management may be employed to alter the patterns of consumption. Direct load management may be accomplished with equipment, purchased either by the utility or by a customer, that is installed, maintained, and operated by the utility. Indirect load management is accomplished through customer control of load.

While no specific recommendations pertaining to load management are contained in the record, the SEO, DEC and DPS have each referred to the potential benefits of such activities. One potential benefit is a reduction of summer peak loads by reducing air conditioning demand.

We believe it would be desirable to provide incentives and assistance to both the utilities and end-users to maximize use of direct and indirect load management. To achieve this, we endorse the following proposals:

> Amend Title I—Federal Energy Tax Act of 1978 to include load management devices as items eligible for the residential energy conservation personal income tax credit.
>
> Amend the federal tax law to extend the general investment tax credit to investments by utilities in direct or indirect load management devices and/or equipment.
>
> Amend Section 210 of the New York State Tax Law to provide an additional four percent business tax credit for load management device investments.

Conclusion

The Board endorses the Draft Plan's energy conservation proposals, as modified herein, and adds to them the additional conservation proposals with respect to the Schools and Hospitals Program and load management incentives.

RENEWABLE ENERGY RESOURCES

Introduction

Renewable energy resources are resources capable of being continuously replaced by natural ecological cycles and sound management practices. These resources include: active and passive solar energy, hydroelectric power, biomass in all its forms (wood, refuse, agricultural waste, energy crops), wind and solar photovoltaics. Cogeneration is not a renewable energy resource technology; however, it has been included in this section of our Opinion because cogeneration facilities face many of the same problems as do renewable resources.

We favor accelerating development and use within the State of renewable energy sources, and, further efforts to foster, encourage and promote the prudent development and wise use of all indigenous State energy resources, including small head hydro, wood, solar, wind, solid waste, energy from biomass, fuel cells and cogeneration.

The State contains a vast potential supply of indigenous hydroelectric power, wood and biomass. Increased development of these and other renewables, as well as cogeneration, would have important advantages: new job opportunities would be created in the State; reliance on foreign and out-of-state conventional energy sources would be reduced; the pressing need to dispose of municipal solid waste in an acceptable manner would be eased; and the quality of the State's environment would improve, as compared to what would otherwise be the impact of conventional fuel use.

The market penetration of renewable resources to date, however, has been disappointing. Factors contributing to their present minimal use include existing legal, economic and institutional barriers, technological impediments, and the current price structure for conventional fuels.

During the course of this planning process — consistent with the planning mandate of the Energy Law — market penetration rates and projected impacts of specific renewable resource technologies have been systematically incorporated into projections of the State's future energy picture. Five technologies have been analyzed: solar, wood, resource recovery, small hydro and cogeneration.

This effort is without precedent in the State. We have before us no accepted model or technique for making these estimates. We are therefore faced with the task of evaluating: the consistency and comprehensiveness of the methodology utilized in the Draft Plan to estimate these impacts; the reasonableness of the assumptions relied upon; and the reasonableness of competing claims made by other participants. Finally, we must evaluate the desirability of various proposals designed to enhance the role of renewable resources and cogeneration in the State's future energy mix.

In general, the estimates of the contribution of renewable resources received more attention on the record than the Draft Plan proposals. We turn first to the impact estimates and conclude with a discussion of the proposals.

Estimates of Renewable Resource Contribution

The contribution of each technology was forecast under two "cases." The base case was premised on no changes in current federal and state governmental policy, no new technological developments and no new economic incentives. The proposed case accounts for enactment of the federal and State policy recommendations described below.

Figure 12 sets forth the Draft Plan's estimates of the additional energy contribution of the major renewables with and without implementation of the proposals as of 1994. For example, if the solar proposals are implemented, a total of 5.5 TBTU would be provided by solar, in addition to its base case contribution. With respect to the penetration figures of small hydro, cogeneration and resource recovery technologies, each of which results in the production of electricity, the figures are integrated into the electric supply plan. Penetration figures for solar and wood technologies, use of which reduce the demand for conventional sources of fuel, are incorporated into the forecasts of energy demands over the fifteen year forecast period.

The equivalent displacement of oil by solar and wood by 1994 is projected in the base case to be 6.3 million barrels of oil annually and an additional 6.2 million barrels of oil annually if the proposals are implemented—thereby reducing current annual consumption by the equivalent of 12.5 million barrels.

The methodology and assumptions which are the basis for these projections are found in Appendix D to the Draft Plan. In general, the future penetration of each technology was forecast using assumptions specific to the particular characteristics of the technology. All base case penetrations were made on the basis of New York State specific information.

We find that the methodology employed to forecast the contribution of solar, wood, resource recovery, small hydro and cogeneration contained in the base case is acceptable in light of the uncertainties associated with these particular resources. However, significant issues were raised with respect to many of these estimates which warrant further discussion.

FIGURE 12

ENERGY CONTRIBUTION OF RENEWABLE RESOURCES IN NEW YORK STATE (Additions by 1994)

	Base Case	Proposed Case (impact over Base Case)
Solar	.3 TBTU	5.5
Wood/Biomass	21.3 TBTU	38.3
Resource Recovery		
MWe	266 MW	292
Steam	24.0 TBTU	15.8
Small Hydro	725 MW	325
Cogeneration		
MWe	221.6 MW	336.4
Steam	15.0 TBTU	23.4

Small Hydro

The base case projection of small hydro use in 1994 is 725MW, derated in the Draft Plan's electric supply plan to 460MW of firm capacity. The New York Power Pool asserted that a figure of 213MW by 1994 was more reasonable. In effect, NYPP suggests that the Board ignore the potential of all non-electric utility hydro development over the next 15 years. We find it difficult to accept this suggestion. Federal and State regulatory trends, rising energy prices, increasing availability of government support (financial and otherwise), and projects already underway lead us to conclude that more small hydro capacity will be developed in this State during the next 15 years than the Pool suggests.

The base case forecast is derived from an inventory of 5,300 dams in New York State and their potential as small hydro sites. This procedure resulted in an estimate of 3,000MW of under-developed capacity from approximately 750 sites. Further analysis of economic, institutional, regulatory, and other constraints resulted in the 725MW figure. Furthermore, for purposes of inclusion in the electric supply plan, SEO derated this number to approximately 460MW, because the higher figure cannot be considered firm capacity. This forecast seems to us reasonably conceived and we accept it.

Resource Recovery

The base case projection for resource recovery (266 MW in 1994) is based on an evaluation of resource recovery projects which are now at least at an active planning stage and with respect to which the magnitude and type of energy output is known. The Power Pool urges the Board to discount altogether the contribution of these facilities to future base load.

The environmental impetus behind most of these projects, the funding in place and the increasing economic attractiveness of the energy to be produced by these facilities are factors which provide sufficient basis on which the Board can view the base case forecast as reasonable. While reliability of such facilities may not have been conclusively demonstrated (since few facilities are now operating in this country), as the facilities are brought on line adequate reliability to justify contribution to base load will be determined. Our view could change in the future, but for now we are satisfied that the Draft Plan's treatment of the reliability

of these facilities is sufficiently conservative to support the estimate.

Cogeneration

The NYPP and Consolidated Edison have questioned the wisdom of reliance upon cogeneration technology as a means of satisfying a portion of the State's future energy needs as proposed in the Draft Plan.

The NYPP argues that the Draft Plan fails to reflect a proper fuel use perspective with respect to cogeneration technology since the objective of the Plan is to reduce oil use.

The Draft Plan projected 222 MW of cogeneration capacity, derated to 149 MW for purposes of the electric system plan; most of this capacity is projected to be non-oil fired. These projections assume that 86 percent of this future cogeneration activity will occur in the industrial sector, fueled as current projects are fueled — using primarily coal, wood, waste, and some natural gas. The remaining 14 percent is assumed to occur in the institutional/commercial sector. Further, the forecast did not assume oil use in such facilities due to the unfavorable economics of distillate fuel and because over 67 percent of the current urban cogeneration activity in the Con Edison service area is primarily natural gas fired. In this connection, we note that national energy policy, as expressed by FERC implementation of the Natural Gas Policy Act of 1978, encourages the use of natural gas in cogeneration facilities by exempting such facilities from the incremental pricing provisions of the statute.

We are concerned about the potential environmental impact of cogeneration. Possible impacts vary dramatically as assumptions related to facility concentration (many cogeneration facilities in a small area), fuel use, facility size, background pollution levels and other factors are varied. Endorsing increased utilization of this technology, as we do, and finding the impact estimate of the contribution of cogeneration set forth in the Draft Plan to be acceptable, as we do, should not be taken to suggest that we view cogeneration as an environmentally benign energy technology. We note, however, that any cogeneration facility which may have a significant environmental impact will be reviewed by appropriate local, state, or federal authorities.

Wind

The Draft Plan estimated an insignificant contribution from wind. However, nearly all parties who commented on the renewable resource portion of the Draft Plan, which included the Department of Law, the New York Power Pool, and the Building Trades Council, agreed that New York State possesses a vast wind energy resource potential.

A base case wind forecast was not made because there was little empirical information and data upon which to base such a projection. Any base case contribution of wind would be included in the electric supply plan. As such, the base case penetrations should be premised on the best available information regarding all of the factors, particularly costs, associated with the actual development and operation of a particular technology in New York State.[12]

The Department of Environmental Conservation, the Lakeshore Alliance and the Rochester Safe Energy Alliance suggest that the Board include a base case estimate of the contribution of wind energy of 3,000MW — a number we cannot find to be justified on the record.

General Conclusions

In addition to the specific issues described above, testimony submitted on behalf of the Consumer Protection Board, the Department of Environmental Conservation, the Lakeshore Alliance, the Rochester Safe Energy Alliance, Ecology Action of Oswego, Mid-Hudson Nuclear Opponents, the Cayuga Lake Conservation Association and the St. Lawrence County Planning Board challenged the renewable resource projections on the basis that either the estimates were too low or excluded certain technologies. Ecology Action of Oswego argued that all the renewable resource estimates should be raised; the Rochester Safe Energy Alliance, the Cayuga Lake Conservation Association and the Mid-Hudson Nuclear Opponents argued that cogeneration can make a larger contribution to New York State's future energy needs; the St. Lawrence County Planning Board projected a greater use of wood as a fuel source than did the State Energy Office; the Consumer Protection Board, the Lakeshore Alliance, the Department of Environmental Conservation and the Rochester Safe Energy Alliance argued that the SEO had not adequately considered the role of wind energy as a renewable energy source; the Consumer Protection Board as well as the Rochester Safe Energy Alliance argued that solar industrial process heat, photovoltaic cells, fuel cells and biogas technologies should have been considered to have a significant contribution during the planning period.

Each of these points has some merit. However, we must base our decisions on systematic reviews of the important factors underlying the potential contribution of each of these resources. For those reviews, the Draft Plan provides the most persuasive overall analyses for the following reasons: the data base used relied on empirical information gained from New York State specific information; the methodologies employed to forecast base case renewable resource estimates are sensitive to the particular technologies discussed; appropriate economic, environmental, technological, legal and regulatory variables were accounted for in developing the estimates of the future energy contribution of renewable resources; the electric contribution of the base case small hydro, resource recovery and cogeneration estimates were appropriately derated for inclusion in the electric supply plan; and due caution was exercised in preparing the base case estimate of the future energy contribution of cogeneration technology to insure consistency with the primary planning goal of oil reduction.

The Board therefore adopts the base case estimates of the energy contribution of renewable resource technologies presented in the Draft Plan and approves the inclusion of the base case estimates of the energy contribution of additional small hydro, resource recovery and cogeneration technology prepared by the State Energy Office as elements of the electric supply plan. The Board further approves the inclusion of the base case estimate of the energy contribution of additional solar and wood technology as elements of the total energy requirements forecast.

However, we find persuasive the general comment put forth by various parties that the proposed case for the renewable resource section of the Draft Plan does not properly reflect the potential contribution of such renewable resource technologies as solar photovoltaic cells, solar industrial process heat, fuel cells, biogas and wind energy. We are confident that as greater New York State experience is gained with technologies such as wind, solar, industrial process

[12]The SEO also noted that base case forecasts of the contribution of solar industrial process heat, fuel cells, and photovoltaic systems were considered to be insignificant because of similar uncertainty surrounding the likely costs of these technologies, among other issues.

heat, photovoltaic cells, fuel cells and biogas, better estimates of the energy contribution to New York of these renewable resources can be made. we therefore ask SEO, in future revisions of the State Energy Master Plan, to provide more detailed analyses of the contribution of these technologies.

Proposals

To realize the full potential of renewable resources in the State's energy mix over the next 15 years, the Draft Plan proposes the following actions:

> Amend Section 210 of the New York State Tax Law to provide an additional four percent business tax credit for renewable resource investments.

The proposal would double the credit for business investments in eligible renewable resource technologies to a maximum of 8%. Eligible renewable resource technologies would include equipment used in active and passive solar systems, small hydroelectric projects, cogeneration systems, wood boilers, resource recovery systems, and wind turbines.

This additional tax benefit would help to equalize the tax benefits between renewable resource and conventional energy technologies.

> Amend the New York State Public Service Law to exempt certain non-utility owned energy production facilities from Public Service Commission jurisdiction.

The Public Service Law should be amended to exempt certain energy production facilities, including those using conventional energy sources more efficiently and those using renewable energy resources, as well as their owners, from the regulatory jurisdiction of the Public Service Commission. These exemptions should ease the concerns of some potential alternate energy producers, who are reluctant to enter into production activities because of the possibility of PSC regulation. Although the primary business activities of potential alternate energy producers are unrelated to the furnishing of energy supplies, the breadth of PSC authority combined with the case by case nature of the exercise of jurisdiction create uncertainty which may well inhibit investments in alternate energy production facilities. And, most important, regulation is likely to be unnecessary because these producers will not have substantial monopoly power.

> Amend the New York State Home Insulation and Energy Conservation Act of 1977 to include active and passive solar, wind, and wood systems as items eligible for utility financing.

The Home Insulation and Energy Conservation Act of 1977 currently requires regulated gas and electric utilities within New York State to conduct energy audits and provide low interest financing for energy conservation measures upon the request of residential customers. The proposed amendment in the Draft Plan would include active and passive solar systems, wind energy systems, and wood stoves and furnaces as measures to be financed by the utilities, and require that residential audits conducted by the utilities provide the cost, payback period, and energy savings of such equipment.

> Amend the New York State Tax Law to exempt active and passive solar, wood, and wind energy systems from state and local sales taxation.

All solar, wood, and wind energy equipment sold within New York State is currently subject to a 4% State sales tax. Under the New York State Tax Law, localities in the State can levy an additional sales tax of up to 4% on such systems. Therefore, up to 8% of the cost of solar, wind, and wood systems may be accounted for by sales tax. The proposed amendment would exempt active and passive solar, wood, and wind energy systems from State and local sales taxation.

> Amend Section 606 of the New York State Tax Law to provide a refundable personal income tax credit for the purchase and installation of active and passive solar energy systems for use in residences.

New York State should provide a personal income tax credit for the purchase and installation of residential active and passive solar energy systems in the amount of 25% of the first $2000 and 15% of the next $8000 expended. The proposed State credit would be refundable and thus would not unduly favor higher income groups. The proposed State tax credit would supplement the existing federal tax credit and make solar investments more attractive. A recent study conducted by the Polytechnic Institute of New York showed that the rate of return on investment in a $2400 solar hot water system installed downstate increased from 19.6% without the State tax credit to 46.1% with the credit.

> Amend the New York State Public Authorities Law to allow the Power Authority of the State of New York to finance municipal investments in resource recovery and small hydroelectric projects.

Energy development in New York must include resource recovery and hydro facilitles owned and constructed by municipalities. There is a need for a centralized finance agency to channel funds into these projects. Some municipalities will be unable to arrange financing for these investments. For others, it would be more economical to issue large amounts of bonds on a centralized basis rather than have each developer arrange its own financing.

We consider PASNY an appropriate flnance agency for this purpose. PASNY may be able to issue bonds to finance municipal energy projects. The projects could be presented to PASNY, and, if feasible, financed through a central fund. Municipalities desiring to construct waste-to-energy plants or small hydro projects would benefit from this proposal.

Changes to Article 5, Title 1 of New York's Public Authorities Law (Power Authority Act) would be required to enable PASNY to finance municipal energy investments.

> Enact State legislation to facilitate implementation of resource recovery projects.

Legislation should be enacted to remove existing impediments to implementation of resource recovery projects and to provide new incentives for such projects. Passage of such legislation would provide municipalities with the flexibility needed to utilize the emerging resource recovery technologies in the manner most appropriate to each specific situation.

The proposed legislation should include provisions to; authorize municipalities to award contracts for resource recovery facilities through the evaluation of contractor proposals based on performance criteria, rather than solely on the comparison of bid prices submitted for a pre-selected technology; exempt certain resource recovery facilities from the requirements of Article VIII of the Public Service Law; modify siting and tonnage restrictions placed on New York City by existing statutes; and give New York City the authority to pass a local law governing the disposition of certain wastes generated and disposed of within its boundaries.

To further enhance renewable resource use, the Draft Plan recommends certain actions to be taken by State agencies

within existing statutory mandates. Most important among these are:

The New York State Public Service Commission should ensure that reasonable electric back-up and purchase rates are provided to owners of renewable resource technologies.

The Department of Environmental Conservation should develop a standardized Environmental Impact Statement for cogeneration facilities under the State Environmental Quality Review Act.

The Power Authority of the State of New York should expand its small hydro programs and investigate the feasibility of owning and operating cogeneration facilities.

The New York State Office of General Services should use solar technology in all new construction, where life cycle cost comparison with conventional energy systems and practices show solar technologies to be economic and feasible.

The New York State Energy Research and Development Authority should initiate a project for the production of alcohol for use in gasohol from the cellulosic content of agricultural and municipal solid wastes, as well as the starchy by-products of food processing residues.

The Draft Plan also calls upon the Federal Government to implement the following actions concerning renewable resources.

Amend Title I, Section 44C(b)(2) of the Federal Energy Tax Act of 1978 to include all components of passive solar systems within the definition of solar energy property eligible for the Federal income tax credit.

Enact Federal legislation to require the National Bureau of Standards to establish performance standards for active and passive solar equipment.

Enact Federal legislation creating a National Solar Bank funded at an initial annual level of $150 million to provide low interest loans for owners and builders of residences and commercial structures for installation of active and passive solar systems.

Enact national legislation to provide a 20 percent tax credit for builders of new passive solar residences and commercial buildings.

Amend Title I, Section 44C(b)(1) of the Federal Energy Tax Act of 1978 to include wood stoves and furnaces as items eligible for the residential energy conservation federal income tax credit.

Create a Federal industrial wood fuel research, development, and demonstration fund of $50 million.

Enact Federal legislation to make the excise tax exemption for gasohol permanent.

Amend Title III, Section 301(a)(3) of the Federal Energy Tax Act of 1978 to include small hydro and cogeneration equipment within the definition of items eligible for an additional ten percent investment tax credit.

Enact Federal legislation to shorten tax lives on small hydro equipment to a seven-year amortization period. Extend the applicability of Federal Energy Regulatory Commission (FERC) short license form to cover small hydro facilities up to 15 MW at all existing unaltered dams or impoundments.

General Conclusions on Proposals

The record indicates general agreement among the parties with respect to most of the proposals advanced in the Draft Plan to increase the penetration of renewable resource technologies. Certain parties, however, objected to specific proposals.

The record indicates the following areas of specific disagreement. The Department of Public Service opposed the proposal to include active and passive solar, wind and wood systems as items eligible for utility financing under the New York State Home Insulation and Energy Conservation Act. DPS contends that such systems fail to meet the seven year payback criteria currently employed in administering the statute.

The Department of Agriculture and Markets (DAM) opposed the proposal to make permanent the existing federal excise tax exemption for gasohol. DAM questions the wisdom of encouraging the use of food crops for energy production. Instead, DAM urges the development of economically competitive technologies for conversion of waste products and waste agricultural products to a fuel source.

Consolidated Edison opposed including cogeneration technology within the proposals to provide an additional four percent State business tax credit for renewable resource investments, to exempt non-utility owned alternate energy production facilities from New York State Public Service Commission jurisdiction and to include cogeneration equipment within the definition of items eligible for an additional ten percent federal investment tax credit. Con Edison contended that oil and natural gas fired cogenerators within their service territory are currently favored by existing tax laws[13] and that promotion of oil or natural gas based cogeneration within urban areas could result in increased oil usage and have significant adverse environmental consequences.

The Department of Law (DOL) and the Rochester Safe Energy Alliance recommended that the suggested proposals not be limited to existing technologies but be broadened to include future technological innovations. The Department of Environmental Conservation staff and the Port Authority recommended that the Board expand proposals with respect to the development of resource recovery projects by providing greater financial incentives. DEC suggested that recycling legislation be recommended.

The Adirondack Park Agency recommended the Energy Planning Board formally declare that as a matter of State policy the areas protected by Article XIV of the State Constitution and the State Wild, Scenic and Recreational Rivers System Act will not be used for construction of small hydro projects.

The Rochester Safe Energy Alliance made a series of recommendations designed to expand the energy contribution of wood, biogas, solar industrial process heat, photovoltaic cells, and wind, and promote efficient utility operations. The Lakeshore Alliance suggested a number of actions to develop wind energy. The Consumer Protection Board recommended an expansion of programs to educate consumers with respect to renewable energy technologies. Ecology Action of Oswego suggested that the Energy Office design a program to implement wind energy and that a mechanism be developed to establish sub-state regional energy plans to maximize the use of renewable resources.

Finally, the Cayuga Lake Conservation Association suggested that the Plan should set materials recovery as a goal

[13]Con Edison may be correct in this assertion with respect to local taxes; to the extent it is, we urge local authorities to remove any taxing discrimination between alternate energy forms.

in view of the energy benefits that accrue to materials recovery from the waste stream prior to burning waste for energy.

We recognize that aggressive and increased government effort is necessary to enhance the future energy contribution of renewable resources beyond the base case estimates adopted. We adopt the proposals for legislative and administrative action recommended in the Draft Plan to increase the use of renewable resource technologies within New York State for the reasons elaborated above. However, with respect to amendments to the Home Insulation and Energy Conservation Act (HIECA), we approve as a minimum those measures necessary to bring the program into conformance with the Federal Residential Conservation Service program, while we further explore the desirability of broadening the kinds of measures eligible under the HIECA program. We further note that several of the federal legislative recommendations are currently receiving serious consideration as Congress proceeds toward passage of the Windfall Profits Tax.

We cannot at this time endorse the additional proposals for encouraging renewable resource use in New York State offered by various parties because an adequate analysis of the economic, legal and environmental implications of each specific recommendation has not yet been performed. However, we believe that specific concerns raised by parties can generally by accommodated in carrying out the recommendations as approved. we expect that further analysis of each proposal may permit the Board to include some of these recommendations in future revisions of the State Energy Master Plan and Long-Range Electric and Gas Report. We suggest that SEO make such an analysis.

With respect to the specific recommendation offered by the Adirondack Park Agency concerning maintenace of the integrity of the Adirondack Park in the face of small hydro development, we note, as also discussed in the electricity section of this Opinion, that the estimates of the energy contribution of additional small hydro development adopted by this Board are premised upon compliance with all applicable environmental laws, including Article XIV of the State Constitution and the State Wild, Scenic and Recreational Rivers System Act. This plan reaffirms as a matter of state policy that those areas protected by Article XIV of the State Constitution and the State Wild, Scenic and Recreational Rivers System Act will not be used for construction of hydro projects.

With respect to the State's wood resources, in accordance with Article XIV of the State Constitution, the State's Forest Preserve will not be used or encroached upon in any way. Moreover, as a matter of policy, any increased harvest of wood on private lands will be in accordance with sound timber practices and in full compliance will all applicable environmental laws. It is noted that the Chairman of the Adirondack Park Agency is chairing a steering committee of appropriate public and private persons to insure sound timber harvest practices for the privately owned lands of the Adirondack Park, and that the Governor has requested a $100,000 appropriation to support this effort. The result of this study will assist the Department of Environmental Conservation in its efforts to help private landowners in the Catskill Preserve better manage their lands.

ELECTRICITY

Introduction

Extensive testimony was presented on the record regarding the many matters important to the Board's determination of the proper electricity supply plan. These matters include the effect of alternative electricity supply plans on the State's economy, its environment and the health and welfare of its residents; the effect of the supply plans on statewide oil consumption; the proper mode of generation for new central power plants, i.e. coal or both nuclear and coal; the extent to which the State should plan on the conversion of existing oil-fired generating units to coal; appropriate planning projections with regard to decentralized electric facilities such as small hydro, solid waste, cogeneration and wind; and, whether and to what extent new capacity should be constructed specifically to reduce oil consumption. These issues are discussed below.

Discussion

The electricity supply plans recommended in the Draft Plan and by other parties are summarized in Figure 13. The Energy Office states that adoption of its electricity supply plan as presented in the Draft Plan, would reduce oil consumption in the electricity sector by nearly 60 percent, from approximately 89 million barrels in 1978 to slightly over 36 million barrels in 1994; would provide for adequate generation and transmission reliability to meet a 2.1 percent per year growth in both electric energy consumption and peak demand; would maximize development and use of renewable and indigenous resources; would be compatible with applicable environmental standards; and would minimize financial stress on the utilities.

The Draft Plan includes construction of new generating capacity only as necessary to provide adequate reserve margins above projected growth in peak demand and further recommends that new base load capacity, beyond that already under construction, be coal or coal and refuse-fired. In addition, the Draft Plan projects conversion of 5982 MW of existing oil-fired generation to coal; increasing imports of hydro-electric energy from Quebec (although not increasing dependence upon Canadian sources for firm, year-round capacity); and development of additional non-oil generating capacity from solid waste, small hydro and cogeneration. The Draft Plan also accounts for probable reductions in the rate of growth of electricity use as a result of conservation and direct-renewable resource use. The electric generation plan recommended in the Draft Plan is summarized in Figure 14.

The Energy Office has argued for approval of this plan, as opposed to those offered by other parties to the proceeding, because a significant reduction in oil consumption would result; new nuclear power plants need not be required; and utility capital requirements for new plants are minimized, allowing the utilities financial flexibility to pursue aggressive conservation programs and renewable resource development.

Implementation of the SEO electricity generation plan and maintenance of a reliable electric system is projected in the Draft Plan to require upgrading of the State's electric transmission system. In addition to the generator leads required to connect new plants to the grid, upgrading of the transmission system is projected to be required between Hydro Quebec and the New York interconnected system, between the Utica area and the Albany area, and in the Hudson Valley corridor between Albany and New York City.

New York Power Pool (NYPP)

The plan submitted by the Power Pool is comprehensive and integrated, including a detailed generation plan and a detailed transmission plan. The generation plan originally

FIGURE 13
SUMMARY OF ELECTRICITY SUPPLY PLANS
(Capacity Added or Converted by 1994)

	SEO Base Case	NYPP	DEC	DPS	EANY Nuclear***	EANY Coal***	Building Trades Council***
Large Plant							
Oil	850	850	850	850	850	850	850
Coal	2,750	1,550	1,550	850	1,550	7,450	6,000
Nuclear	1,900	7,850	1,900	1,900	10,150	1,900	14,500
Undetermined Baseload	—	—	1,200	4,500**	—	—	—
Pumped Storage	1,000	1,000	0	0	1,000	1,000	1,000
Renewables							
Canadian Import	800	800	800	800	800	800	—
Small Hydro	725*	210	300	—	725*	725*	210
Solid Waste	298*	32		—	298*	298	290
Cogeneration	222*	—	(300)	—	222*	222*	—
Wind	—	—	400	—	—	—	—
Conversion							
Oil to Coal	5,982	3,300	3,300	3,300	5,982	5,982	1,500

* These total capacity projections were derated to obtain capacities likely to be available at time of peak demand in the SEO electricity supply plan.

** This could include a combination of baseload coal or nuclear, small hydro, cogeneration, resource recovery, and wind. It could also include pumped storage hydro if proven to have economic and oil savings.

*** The record is not clear on the actual numbers advocated by these parties. The numbers shown are a best estimate of the alternatives presented and/or analyzed by the parties.

recommended by the Power Pool, as summarized in Figure 15, has been revised since its submission to eliminate the Greene County Facility and to include 3300 MW of oil to coal conversions, including conversion of the following specific units: Ravenswood 3, Arthur Kill 2&3, Danskammer 3&4 and Lovett 4&5. During the course of the proceeding, the Pool has argued that its plan is less costly than the SEO plan, even under SEO's original assumptions,[14] will save more oil than the SEO plan if comparable assumptions are made with regard to all major planning variables other than the amount of new capacity added, and that the financial cost differences between the plans are insignificant.

Energy Association of New York (EANY)

EANY presented an analysis of the economic and oil consumption consequences of adding additional coal or nuclear capacity to the plan presented by the Energy Office. The capacity results of this analysis are summarized in Figure 13. EANY has argued that constructing the additional capacity is more economical and saves more oil. EANY presented its plan as the most economic, but suggested also that the NYPP plan is, by its analysis, close to the economic optimum and more economic than the SEO plan.

[14]We note that SEO, during the proceeding, disavowed its original nuclear capital cost estimates on the basis that uncertainity surrounding the nuclear industry in the wake of the Three Mile Island accident renders such costs unknown and unknowable.

New York State Building and Construction Trades Council (BCTC)

BCTC called for construction of substantial additional new capacity (primarily nuclear) and significantly fewer coal conversions.

Department of Public Service (DPS)

The DPS electricity supply plan was more general than the detailed plans recommended by the NYPP and the SEO. The DPS plan recognizes the potential for 3300 MW of coal conversion and contemplates the potential need for 4500 MW of new capacity during the planning period. DPS urges greater flexibility in the electricity supply plan and greater provision for contingencies. No detailed economic, environmental, or financial impact analyses were presented.

Department of Environmental Conservation (DEC)

DEC's electricity supply plan does not recommend adding pumped storage hydro capacity; projects comparatively large contributions from wind energy facilities and from Canadian imports; and suggests several contingencies involving approximately 1200 MW of either coal or nuclear capacity located either on Lake Erie, Lake Ontario or Long Island. No detailed economic, environmental or financial impact analyses were presented.

We will now turn to a consideration of the principal electricity supply issues: coal conversion, new electric generating capacity to displace oil, and the mode of generation for new baseload units.

FIGURE 14
DRAFT STATE ENERGY MASTER PLAN
ELECTRIC GENERATION PLAN*

New Facilities	Capacity (MW)	Fuel	Date
Oswego 6	850	oil	2/80
Shoreham	820	nuclear	12/80
Nine Mile Pt. 2	1080	nuclear	11/84
Somerset	850	coal	11/84
Pumped Storage Hydro	1000	PS hydro	5/87
New York City	700	coal/RDF	5/89
Downstate Coal 1	600	coal	91
Downstate Coal 2	600	coal	93
	6500		
Conversions:			
Danskammer 3	122	oil to coal	82
Danskammer 4	220	oil to coal	82
Albany 1-4	400	oil to coal	84
Ravenswood 3	928	oil to coal	84
Arthur Kill 2	350	oil to coal	84
Arthur Kill 3	501	oil to coal	84
Port Jefferson 3&4	380	oil to coal	84
Lovett 4&5	399	oil to coal	86
Ravenswood 1&2	770	oil to coal	87
E. F. Barret 1&2	380	oil to coal	88
Northport 1-4	1532	oil to coal	89
	5982		

Other: (cumulative additions):

	1984	1989	1994
Small Hydro Total (MW)	282	402	725
Solid Waste Total (MW)	208	298	298
Cogeneration Total (MW)	42	132	222
Hydro Quebec Imports	79-83	84-87	88-94
Capacity (MW)	800	800	800
Energy (Billions of KWH per year)	8.0	12.3	6.0

* This Figure reflects two changes made by SEO after issuance of the Draft Plan: the Downstate Coal 1&2 date was changed from 1992 to 1991 and 1993, and "Prattsville" was changed to "Pumped Storage Hydro."

Coal Conversion

A reasonable coal conversion target, to be pursued within the overall strategy for oil reduction, is necessary to guide other planning decisions relating to new generating capacity.

The record indicates that there are approximately 9800 MW of oil-fired capacity in New York which was designated with coal burning capability. Over 7300 MW of this capacity has, in fact, previously burned coal. The Draft Plan recommends that coal conversion be pursued for 21 individual units at eight generating stations with a combined capacity of 5982 MW.[15] These units and the target dates for conversion are listed in Figure 16.

[15]Federal coal conversion proceedings under either the Energy Supply and Environmental Coordination Act of 1974 or the Power Plant and Industrial Fuel Use Act of 1978 are already underway for Albany 1-4, Danskammer 3&4, Port Jefferson 3&4, Ravenswood 3, Arthur Kill 2&3, Lovett 4&5, and Northport 1-4.

The Draft Plan provides support for the claim that conversion to coal of each of these units would result in life-cycle saving for ratepayers. The conversions would result in saving approximately 40 million barrels of oil per year. Further, these savings can be achieved, according to the Energy Office, with capital investments of between $420/KW (1987 dollars) and $810/KW (1989 dollars) compared to over $2000/KW for equivalent new capacity. The Consumer Protection Board, in recommending adoption of the electricity supply plan in the Draft Plan, has endorsed the recommended coal conversions.

DPS and the New York Power Pool have argued that the Plan should take into account only the first 13 units[16] listed in Figure 16, at this time, due to greater environmental, engineering and economic uncertainty associated with the conversion of Ravenswood 1 & 2, E.F. Barrett 1 & 2 and

[16]Danskammer 3-4, Albany 1-4, Ravenswood 3, Arthur Kill 2-3, Port Jefferson 3-4, and Lovett 4-5.

FIGURE 15
SUMMARY OF NYPP ELECTRICITY GENERATION PLAN

Unit Name		MW Summer Capacity	Energy Strategy Date	Capacity Reliability Date
Mitchel Gardens	1&2	32	3/79	5/79
Oswego 6	FOS	850	2/80	2/80
Shoreham	NUC	820	12/80	5/81
Nine Mile Pt. 2	NUC	1080	11/84	11/85
Somerset	FOS	850	11/84	11/85
Prattsville	PS	1000	5/87	5/89
Sterling	NUC	1150	5/88	5/90
Lake Erie 1	FOS	850	*	*
Jamesport 1	NUC	1150	5/89	5/91
700 MW Fossil	FOS	700	5/89	5/91
Greene Co.	NUC	1200	11/89	11/91
Lake Erie 2	FOS	850	*	*
Jamesport 2	NUC	1150	5/91	5/93
New Haven 1	NUC	1250	5/92	5/94
New Haven 2	NUC	1250	5/94	5/96

FOS = Fossil
NUC = Nuclear
PS = Pumped Storage Hydro

* While the Lake Erie units do not carry a specific service date, licensing and limited design activities would continue to permit installation at any time to meet company or Pool requirements beginning in 1987.

FIGURE 16
COAL CONVERSIONS RECOMMENDED IN THE DRAFT SEMP

	Capacity (MW)	Target Date
Danskammer 3	122	82
Danskammer 4	220	82
Albany 1-4	400	84
Ravenswood 3	928	84
Arthur Kill 2	350	84
Arthur Kill 3	501	84
Port Jefferson 3&4	380	84
Lovett 4&5	399	86
Ravenswood 1&2	770	87
E. F. Barrett 1&2	380	88
Northport 1-4	1532	89
	5982	

Northport 1-4. DEC staff has argued that reliance on a program of substantial conversion to coal is inadvisable until there has been a thorough evaluation of all germane issues to determine whether the plan is likely to succeed.

The New York City Department of Environmental Protection (NYCDEP) has argued that there is insufficient support for inclusion of Ravenswood 1&2 in the list of recommended coal conversions.

Consolidated Edison has argued in support of conversion of Ravenswood 3 and Arthur Kill 2 & 3, but advises against including Ravenswood 1 & 2 at this time. Orange and Rockland Utilities, Inc. has argued in support of conversion of Lovett 4 & 5 but urges the Board to make clear that SO_2 standards should be met by means other than the use of scrubbers.

The Building and Construction Trades Council has recommended only 1500 MW of coal conversion.

Numerous other parties to the proceeding including DEC, LILCO and NYCDEP, have argued that the environmental and health impacts of the recommended coal conversions are not sufficiently understood and are potentially severe. As a result, these parties have argued for either further study, or reduction of the number of coal conversions,or both.

Whatever the conversion goal, we believe that the electricity supply plan should not rely on coal conversion as the sole vehicle for reducing oil consumed in the utility sector. Construction of new, economic generating capacity for the purpose of displacing oil should also be contemplated, within the overall plan, so that substantial oil reduction can be achieved even if some conversions prove to be infeasible.

The analyses on the record of the economics of coal conversions endorsed by SEO lead us to conclude that the utilities should pursue vigorously all necessary permits for the coal conversions and that they should be included, for that purpose, in the State's plan. However, we are concerned that conversions could prove to be very costly, expecially if extensive environmental equipment additions are required. The costs of raising capital for conversions are likely to fall on consumers while they are still paying the rising cost of oil before the plants are converted. Moreover, there is some economic risk involved in conversions. In light of this, and the fact that the oil savings associated with conversions will benefit the nation's need to reduce oil imports as much as New York's, we believe it is critically important that federal legislation be enacted to provide financial support for utility oil reduction programs. We urge the New York Congressional delegation, as well as all of the State's elected leaders, to support legislation designed fairly to accomplish this objective.

We are also concerned with the cumulative environmen-

tal; social and health impacts which would result should the targets for coal conversion and new coal construction both be realized. Although the FEIS issued in connection with this Plan and the related testimony on the record provide considerable information and guidance concerning these impacts (and satisfy all legal requirements for issuance of the Plan), and although detailed site-specific licensing and permitting proceedings must follow for each coal conversion, we believe that a more detailed and comprehensive study of the cumulative impacts of this coal conversion and construction program should be undertaken. In this connection, the Board accepts the offer to assign principal responsibility for preparation of this study to the Department of Environmental Conservation, who will work in consultation with the Department of Public Service and the Energy Office. We ask the Department of Transportation to participate as well. Upon completion of this study, which should be submitted as soon as possible, consistent with the necessity to coordinate fully with related Federal studies, the Board will review its approval of the coal conversion targets recommended in the Plan.

New Electric Generating Capacity to Displace Oil

The oil reduction strategy for the electric utility sector as contained in the Draft Plan focused on conversion of oil-fired units to coal and on development of renewable energy resources such as small hydro and solid waste. Construction of new generating capacity in excess of that needed for demand growth as a strategy for displacing oil was not recommended. This position has been supported in the record by CPB, Ecology Action of Oswego, and the Rochester Safe Energy Alliance. The SEO staff did argue, however, that inclusion of additional upstate coal-fired capacity should be considered as a contingency against higher than forecast load growth, lower than planned coal conversion, and the possibility of unduly severe individual company impacts which could occur but were not studied in detail in developing the statewide Draft Plan. Both RG&E and NYSE&G have argued that implementation of SEO's statewide electricity supply plan would result in severe impacts on their companies.

The staffs of DPS and DEC as well as the NYPP have all substantially agreed with the concept of including new generating capacity to displace oil.

EANY and BCTC strongly support the view that the Plan should embody a strategy of replacing oil-fired generating facilities with non-oil-fired generating facilities, to the extent such replacements minimize the cost of electricity to consumers. The Energy Association advocates, as the mininum cost generation expansion plan, one which would add 10,150 MW of principally nuclear[17] capacity during the 1987-1995 period. This plan would result in a planning reserve margin of 45 percent, as compared to 22 percent, generally recognized to be the minimum statewide reserve margin for reliability purposes. The Association also argues that, if coal plants are determined to be the appropriate mode for new generation, the least cost plan is one which would add 7,800 MW of new coal capacity in the 1987-1995 period, equating to a planning reserve margin of 39 percent. These parties have not, however, presented any detailed analysis of the financial, environmental and social impacts of undertaking such a massive program of new construction.

In view of the uncertainty which surrounds many aspects of energy planning and the requisite need for contingencies against such uncertainties, and in view of the record in this proceeding that suggests that there are economic advantages in building new coal-fired capacity to displace oil, we believe that the addition of some limited new coal capacity beyond that recommended in the Draft Plan is reasonable and appropriate. However, since the financial risks associated with such new construction, as implied by the SEO staff testimony, are serious concerns of the Board, we believe that we should rely on only limited new construction for oil displacement, particularly without federal legislation in place to help ease the capital cost burdens and risks of an oil reduction program.

The projected growth in demand for electricity, along with the need to retire certain existing units which will complete their useful lifetime over the next 15 years, results in the need for approximately 1900 MW of new capacity beyond that already under construction, or approved for construction, to maintain adequate reserve margins over the forecast period. The Board considers it appropriate to include plans for approximately 2200-2700 MW of additional new capacity to reduce oil consumption. This amount of capacity represents a weighing of the need to displace oil, the need for planning contingencies, and the environmental, social and financial impact of building new generating facilities.

Inclusion of this capacity under these conditions should not be interpreted as an indication that we are less than enthusiastic about the coal conversions and new generating capacity included in this plan. Both strategies are critically important to the primary goal of the plan, i.e. to reduce New York's dependence on oil. Full achievement of that goal may provide over the long run economic savings to consumers of electricity, and will definitely produce increased security for both the State and the nation from the harsh consequences of oil dependence.

We also have a strong interest in the role that increased economic regional power sales might play in meeting electric capacity requirements at lowest possible costs of service, reducing New York's oil dependence, and minimizing environmental injuries to the State from power generation. Therefore, we urge the increased economic interconnection of New York's electric system with neighboring and distant U.S. systems and all other necessary arrangements to increase purchases of non oil-fired capacity. And we urge Congress and the relevant Federal agencies to reduce any constraints that may be on economic power sales between regions.

Further, the Board accepts the offer to assign to the Department of Public Service principal responsibility for preparation of a study of the potential for economic interconnection and the institutional and transmission system changes that may be necessary to increase economic power transactions. The Energy Office and the New York Power Pool should provide the DPS their full support and cooperation. This study should be completed within six months, and each Board member is to be kept informed periodically of the progress of the study. The Planning Board also calls upon the State Siting Boards,[18] in their review of new applications for construction of facilities, to evaluate fully the potential for capacity contributions which might reasonably result from improved economic regional interconnection.

Mode of Generation for New Baseload Units

Arguments on the record on this issue are both extensive and diverse.

The investor-owned electric utilities, collectively and individually, have argued strongly for generation expansion plans

[17]One 700 MW coal plant is included in the 10,150 figure.

[18]Board on Electric Generation Siting and the Environment established under Article VIII of the Public Service Law.

based principally on new nuclear units. These parties have argued that the nuclear option is less expensive than coal and represents less of an overall environmental and public health impact than coal. They have further argued that there is no valid basis for excluding nuclear plants from future electric system plans. In these arguments, the utilities have been supported in large part by the American Nuclear Society, the Building and Construction Trades Council (AFL/CIO), and Multiple Intervenors.

The Energy Office has argued that uncertainty associated with nuclear plant licensing, design, construction and operation as a result of the accident at Three Mile Island, and, in addition, the uncertainty associated with nuclear waste disposal are so great as to warrant exclusion of new nuclear facilities, beyond these currently under construction, from the electricity supply plan. The SEO position is supported, in greater or lesser degree, by the Consumer Protection Board, the Department of Law, Ecology Action, the Sierra Club, and the Cayuga Lake Conservation Assocation.

Between these two positions are several parties who, while not advocating electricity supply plans which would necessarily include new nuclear units, nontheless argue that the nuclear option should not be foreclosed. These parties include the Department of Public Service, the Department of Environmental Conservation, and the Department of Commerce.

The Board has considered all of these arguments and a majority of the Board believe that current uncertainties surrounding this fuel form, particularly the Nuclear Regulatory Commission's current policy regarding the licensing of new plants and the probability of changes in safety requirements, as well as Federal failure to establish firm policy and programs to solve the waste problem, make it inappropriate to rely on additional nuclear capacity in the Plan. At the same time, the Board recognizes that nuclear power may offer economic advantages in the face of the deepening crises associated with foreign oil. The Board, therefore, recommends that there be created by the Governor and Legislature a panel to evaluate fully and comprehensively the status of nuclear power development in the State of New York. This panel should review all pertinent information, including the reports of all Federal, State and local government entities which have examined issues associated with nuclear power and which reports can aid the work of the panel. Every effort should be made to obtain Federal funds for this project. The panel should consist of distinguished scientists, engineers, businessmen, labor leaders, environmentalists and citizens. Upon its creation and funding, the panel should consider the following, insofar as New York State is concerned, and report to the Board, the Governor and the Legislature:

—Within six months, with respect to:
- Impacts of phase-down or elimination of existing plants and contingency plans to assure adequate electric supplies in case of federally mandated nuclear plant shutdowns;
- Adequacy of emergency evacuation programs; and
- Adequacy of arrangements for secure transportation of nuclear materials.

—Within twelve months, with respect to:
- Feasibility of Federal or other government responsibility for operation of existing nuclear power plants;
- Feasibility of Federal or other government responsibility for construction and operation of new nuclear power plants; and
- Adequacy of current and proposed Federal nuclear waste management programs.

Pumped Storage Hydro

The NYPP, the Energy Office and the Consumer Protection Board have recommended electricity supply plans which include a 1000 MW pumped storage hydro facility. The SEO has argued that the addition of such a facility is the most economic alternative for new capacity (based on computer optimization anaylses, using the OGP-5 program), that peaking capacity is needed and beneficial to the New York State system, and that it would result in significant oil savings.

DEC and the Sierra Club have opposed inclusion of any additional pumped storage capacity. DPS has argued that the studies performed to date are not sufficlently detailed to warrant inclusion of additional pumped storage hydro; and that it may, depending on input assumptions, be more advantageous under certain circumstances to add additional baseload capacity rather than the recommended peaking capacity.

In view of the substantial coal additions and conversions endorsed herein, we believe that a 1000 MW pumped storage hydro plant will be an appropriate economic addition and we therefore include it in the electric supply plan.

Canadian Hydro Imports

The Draft Plan incorporates projections for 800 MW of firm capacity imports from Canadian sources and for electric energy imports which vary from 8.0 billion KWH for the 1979-1983 period, to 12.3 billion KWH for the 1984-1987 period and 6.0 billion KWH for the 1988-1994 period. According to several parties to the proceeding, the only contractual committment for firm power between New York and Canada is that between PASNY and Hydro Quebec for 800 MW.

The projections of Canadian hydropower imports contained in the Draft Plan have been approved for planning purposes by both the President of Hydro Quebec and the Chairman of PASNY.

There has been no substantive dispute among the parties regarding the Draft Plan projection of 800 MW firm capacity. However, the NYPP has suggested that the Draft Plan electric energy import projections are too high and that a planning projection of 6.0 billion KWH throughout the planning period would be more appropriate. DEC has suggested that the SEO projection is too low, and that a value of 9.0 to 10.0 billion KWH is more reasonable for the 1988-1994 period.

The Board accepts the view expressed in the Draft Plan. It is possible that agreements may be reached which would result in higher levels of imports in the 1988-1994 period. However, it would be imprudent to increase the assumption at this time in the absence of any such agreement.

Site Specific Endorsements

Several parties to the proceeding, including DPS, DEC, NYCDEP and Dutchess County, have argued that the electricity supply plan should not endorse site specific proposals, but should instead be more general. The argument of Dutchess County addresses the type and location of transmission facilities rather than generation facilities.

The Board agrees that the electricity supply plan as it relates to construction of new generating facilities, should not endorse site-specific facilities. As such, the approved

generation plan will be expressed in a more generalized manner.

At the same time, we would be remiss in failing to observe the essentiality of strengthening the reliability and economics of the downstate part of the electric system. The record amply supports the notion that there is too much uneconomic and relatively insecure oil-fired generation downstate. And there are limits to the amount of power that can be reliably imported through the narrow and already crowded transmission corridor north of New York City. Reliability downstate must therefore be improved.

Since the Board will not approve the detailed transmission plan recommended in the New York Power Pool report, the concern of Dutchess County is moot.

Establishment of a Health Monitoring System

RSEA has suggested that the Board recommend a comprehensive program for monitoring energy related health effects to the State Legislature. Although largely unopposed, the Board finds this recommendation to require further analysis within an overall health planning framework. The recommendation will be referred to the State Health Department for review.

Reduction of Hydropower Sold to Neighboring States

The recommendation in the Draft Plan was unopposed. However, in view of our concern with regard to the potential for increased economic regional interconnection, and in view of the recently signed contracts for sale of Niagara project power to neighboring states, we believe more study of this issue is required before concluding that further reduction in out-of-state sales is warranted, if legally permissible.

Banning 765 KV or Other EVH Transmission Lines From the Adirondack Park

The Adirondack Park Agency has suggested that the Board should declare that any 765 KV or other EHV transmission line to carry imported Canadian hydropower should not traverse the Adirondack Park. The Board acknowledges that the Adirondack Park has been recognized as a unique and irreplaceable asset to the state for almost a century. Thus, this Plan reaffirms as a matter of State policy that no transmission line importing power shall traverse the Adirondack Park in violation of Article 14, or any other applicable environmental laws, or in such manner as will cause degradation to the environmental quality and open space character of the Park.

The Board also considered the following recommended actions proposed in the Draft Plan.

Increase Niagara Power Project Output

Various proposals are under review which would reduce Niagara Falls flow during non-tourist sensitive periods. These proposals could, if mutally agreeable to both Canada and the U.S., increase the generation of electricity from the Niagara Power Project by as much as one billion kilowatt hours. This is approximately the equivalent of the output of a 150 MW generating plant operating at a 70 percent capacity factor.

We recommend that development of proposals by PASNY continue, as should discussion with appropriate Canadian officials,in pursuit of a mutually beneficial agreement to allow greater power production without jeopardizing the tourism value of the Falls.

The Siting Board should, by regulation, require electric utilities to submit a financial plan that includes consideration of project as well as conventional financing techniques before large construction projects are certified.

Utilities contemplating additional new generating facilities are required to file applications showing, among other things, the cost and environmental effects of the new unit under Article VIII of the Public Service Law. Part 72.4 of the PSC Rules of Procedures outlines the data that must be filed by each applicant relating to cost of the unit. The Draft Plan suggests that these rules[19] should be expanded by the Siting Board to include a company-side financial forecast extending 5 years beyond the in-service data of the project.

We agree in concept; however it would be far more appropriate for the three members of the Planning Board who also sit on the Siting Board to consider this recommendation during the course of the Siting Board's deliberations on its own regulations. Moreover, we note that the Public Service Commission has called for submittal and review of such plans in light of recent Siting Board decisions and the recommendations of this Board.

Expand NYSERDA's non-recourse tax-exempt revenue bond program to include financing oil to coal conversion projects to the extent permitted by the Internal Revenue Code.

The Authority is presently authorized to promote the construction of facilities utilizing new energy technologies and pollution-abatement on power generating facilities through the issuance of revenue bonds which are exempt from State and Federal taxes, but which are not obligatlons of the State. Under this program, the Authority has issued more than $136 million in pollution control bonds to date. This tax-exempt pollution control financing program is a form of Federal subsidy to the State, which ultimately reduces the cost of electricity and gas to consumers. This ERDA revenue bond program should be expanded (consistent with the provisions of the Internal Revenue Code) to include financing of utility oil-to coal conversions. The extension of such financing to coal conversions can provide significant savings to New York consumers.

Conclusion

In recognition and pursuit of the overall energy policy of obtaining and maintaining an adequate and continuous supply of safe, dependable, economical, and environmentally acceptable electric energy for the people of the State, specific strategies must be developed and implemented. It is clear that actions to reduce oil consumption in the electric utility sector must be pursued expeditiously. Options for reducing oil consumption in this sector are limited. The preferred options include increased conservation and the development of additional renewable resource facilities. However, it is apparant that aggressive programs in each of these areas will not achieve the major reductions in oil consumption we believe are necessary. Beyond these, the realistic options that can be relied on in the planning period are to convert existing oil-fired facilities to coal and to build new coal-fired generating capacity beyond that needed for demand growth so that existing oil-fired units may be operated less frequently.

The Board has carefully weighed the arguments on the record with respect to many factors including, among others: the need to displace oil; the need for planning contingencies; the probable economic, environmental, social, financial and public health impacts of coal conversions, new coal capacity and new nuclear capacity; the appro-

[19]These rules are now issued by the State Siting Board with respect to applications filed on or after January 1, 1980.

priate mode for new capacity; and the most reasonable projections to be used for planning purposes for Canadian imports and renewable resources. The Board has determined that the electricity supply plan depicted in Figure 17 represents the best balance of the often competing and conflicting concerns in each of these important areas and hereby approves such plan. We emphasize, however, that the timely completion of this plan, with tolerable burdens to the State during the construction period, is very much dependent on the proper federal assistance we have called for.

We also endorse the Governor's recent proposal to constitute a group of State agency heads as a coal conversion expediting group that will review any unjustified institutional barriers in the State to ensure prompt processing of permit applications for coal conversions.

The Board approves, as modified and supplemented above, the recommendations contained in the Draft Plan.

FIGURE 17
ELECTRICITY GENERATION PLAN

New Facilities:	Capacity (MW)	Fuel	Date
Under Construction			
Oswego	850	Oil	1980
Shoreham	820	Nuclear	1980
Nine Mile Pt. 2	1080	Nuclear	1984
Somerset	850	Coal	1984
Planned			
Pumped Storage Hydro	1000	PS Hydro	1987
Coal and/or Coal-RDF (5 units)	3100-3600 MW	Coal/RDF**	1986-1992
TOTAL	7700-8200		
Danskammer 3	122	oil to coal	1982
Danskammer 4	220	oil to coal	1982
Albany 1-4	400	oil to coal	1984
Ravenswood 3	928	oil to coal	1984
Arthur Kill 2	350	oil to coal	1984
Arthur Kill 3	501	oil to coal	1984
Port Jefferson 3&4	380	oil to coal	1986
Lovett 4&5	399	oil to coal	1986
Ravenswood 1&2	770	oil to coal	1987
E. F. Barrett 1&2	380	oil to coal	1988
Northport 1-4	1532	oil to coal	1989
	5982		
Other (cumulative additions)	84	89	94
Small Hydro Total (MW)	282	402	725
Solid Waste Total (MW)	208	298	298
Cogeneration Total (MW)	42	132	222
Canadian Imports Capacity (MW)	79-83 800	84-87 800	88-94 800
Energy (Billions of KWH per year)	8.0	12.3	6.0

* 600-800 per unit.

** A majority of the Board believes that current uncertainties surrounding the nuclear option, particularly the Nuclear Regulatory Commission's current policy regarding the licensing of new plants and the probability of changes in safety requirements, as well as Federal failure to establish firm policy and programs to solve the waste problem, make it inappropriate to rely on additional nuclear capacity in the Plan.

NATURAL GAS

Introduction

Gas and oil are directly substitutible fuels in many end-use applications and in many market areas. A major expansion of the State's supply of gas would help significantly to decrease the State's reliance on oil. Since natural gas is, at present, the cleanest major source of energy, the environmental result of substituting natural gas for oil would be particularly beneficial to our highly urbanized state. Moreover, since there is some excess capacity in the interstate and intrastate gas distribution networks, increased gas deliveries in the State can be made with minimal investments in new capacity. This delivery system already provides consumers with energy at significant cost savings compared to other energy delivery systems. The system is underground, out of sight and nearly fully automated. Further, additional gas mains can be installed, in most instances, with a minimum of environmental impact.

The gas industry is in a state of transition, from historic, near-total reliance on traditional domestic production, to increased reliance on diversified supply sources. In contrast to traditional sources, the development of many prospective new sources is and will be much more capital intensive and require longer lead times to bring on stream. Thus, these new sources present higher risks to potential investors. In order to assure acquisition of additional economic gas supplies, the State should price gas in a way that both stimulates investor interest and promotes efficient use of the resource.

The record in the proceeding, as it relates to natural gas, has focused on natural gas supply, pricing and load attachment policy issues. These issues are discussed below.

Natural Gas Supply

Forecasts of natural gas supply have been submitted to the Board by SEO and NYGAS. Also, DPS presented a forecast of "lower 48" State gas production in 1994. Figure 18 sets forth these forecasts.

As Figure 18 shows, the Draft Plan projects U.S, gas supply to increase over the next 15 years fron 20,600 BCF/year in 1980 to 25,570 BCF/year in 1994. This forecast reflects, according to the Draft Plan, an evaluation of the availability of gas from a variety of sources, including domestic and foreign as well as conventional and non-conventional sources.

The Draft Plan gas supply forecast exceeds its gas requirements (demand) forecast; that is, the Draft Plan indicates that gas supply will be demand constrained over the planning period as follows:

1980, supply 686 BCF, requirements 627 BCF
1984, supply 719 BCF, requirements 663 BCF
1989, supply 786 BCF, requirements 696 BCF
1994, supply 851 BCF, requirements 739 BCF

NYGAS and DPS have suggested that SEO overstates the likely contribution of gas from the "lower 48" states and supplemental sources, in effect questioning the SEO assumption that new domestic sources will compensate for a decline in conventional gas production over the next 15 years. The underlying issue is to what extent rising oil and gas prices and insecurity of petroleum supply will promote development of new domestic sources. While the DPS estimate for 1994 domestic production accounts for some supply changes as a result of the Natural Gas Policy Act of 1978 (NGPA), we believe it may be too conservative. Moreover, as implementation of the Power Plant and Industrial Fuel Use Act forces major boiler installations using interstate gas to switch off gas, more gas should become available to New York consumers in the residential and commercial markets.

Concerns have been raised by numerous parties over

FIGURE 18
GAS SUPPLY (BCF/yr)

	1980				1984			
	U.S.				U.S.			
	Lower 48	Supplementals	Total	NY	Lower 48	Supplementals	Total	NY
SEO[1]	18,200	2,400	20,600	686	17,400	5,200	21,600	719
NYGAS[2]	N/P	N/P	N/P	655	N/P	N/P	N/P	649
DPS[3]	N/P	N/P	N/P	N/P	N/P	N/P	N/P	N/P
	1989				1994			
	U.S.				U.S.			
	Lower 48	Supplementals	Total	NY	Lower 48	Supplementals	Total	NY
SEO[1]	16,500	7,100	23,600	786	15,500	10,070	25,570	851
NYGAS[2]	N/P	N/P	N/P	649	N/P	N/P	N/P	662
DPS[3]	N/P	N/P	N/P	N/P	13,500	N/P	N/P	N/P

N/P — Not Provided
[1]Includes all potential sources.
[2]Includes "Lower 48" conventional supply and Mexican imports, on a sendout basis (November 1 through October 1).
Includes "Lower 45" conventional supply *only*.

increasing gas imports, as projected in the Draft Plan. While such concerns are justified, the Board notes that the United States currently imports only about 5 percent of its gas supply, and that the bulk of future gas imports (which is estimated to total about 18 percent by 1994) will originate from Western Hemisphere sources.

The NYGAS forecast includes little gas from sources other than the "lower 48" states and Mexico. Individual gas company demand/ supply forecasts show a balancing of supply to demand, based on the assumption that efforts to obtain additional supplies will be limited to those necessary to meet their forecast demand. NYGAS's demand forecast does not account for the June, 1979 OPEC price increases which in turn provides significant additional incentive to switch to gas. For that reason, the NYGAS demand forecast may well be understated.

We conclude that the gas supply forecast recommended in the Draft Plan is reasonable for planning purposes. In this connection, we note three recent events which further support this determination. An agreement was recently signed with Mexico within the past six months for initial delivery of .11 trillion cubic feet per year, 75 percent of which will flow to the Tennessee Gas Pipeline Company, the Transcontinental Gas Pipeline Company and the Texas Eastern Transmission Corporation, which are interstate pipelines serving New York. We expect that Mexico will account for increased exports of natural gas in the future. The Canadian National Energy Board recently authorized additional gas exports increasing available supplies from Canada by 38 percent, all of which originate from conventional Canadian areas only. Recent FERC actions including approvals of the Point Conception LNG Terminal, the Great Plains Coal Gasification Project and a portion of the Foothills segment of the Alaskan Highway Project—all suggest that the supply of gas will expand in the future.

Natural Gas Pricing Policy

The Draft Plan recommended that a policy be established for rolled-in pricing of gas. Rolled-in or average cost pricing involves combining new supply and supply-related expansion costs with past costs and averaging them for cost allocation and rate-making purposes. Past costs are generally lower (in some cases much lower) than present and potential future[20] 20 costs because past costs are largely reflective of price-regulated lower-48 conventional gas production. The Draft Plan asserts that rolled-in pricing should be retained as the industry seeks to develop new, more capital intensive supply sources which are subject to greater investor uncertainty than has historically been the case.

DPS has argued vigorously that adoption of a rolled-in pricing policy would encourage the inefficient use of energy sources by masking the actual costs of supplemental supplies, would be unfair to consumers who conserve gas, and would increase overall energy costs to the State's consumers.

DPS suggests that the Board adopt the approach taken by the PSC: that marginal costs should be considered an important element of ratemaking and that the specific marginal costs for each company should be analyzed in individual rate cases. According to the DPS, this approach retains the flexibility to price supplies of gas depending on the circumstances, in the gas consumers' and State's best interest.

In general, Multiple Intervenors and NYGAS support the position of SEO. The Consumer Protection Board,the Department of Law and Cayuga Lake Conservation Association support the DPS position. LILCO and the New York City Department of Environmental Protection suggest that the details of a gas pricing policy should not be determined by the Energy Planning Board, but instead be left to the PSC.

The Board has carefully weighed the arguments on this issue and concludes that flexibility in establishing gas rates should be maintained. Adoption of a specific policy calling for rolled-in or marginal cost pricing in all cases is unwarranted. However, the Board believes that gas rates should be designed within certain guiding principles. Principally, natural gas in New York should be priced to consumers in a manner that will (1) encourage New York consumers to rely on natural gas instead of oil in markets where use of gas is an economic alternative to imported oil; (2) encourage efficient use of gas by all gas consumers; and (3) advance the policies and objectives of this plan.

Pricing policy and acquisition policy are closely related. For that reason, the Board also believes there needs to be further clarification with respect to the State's policies relating to acquisition of new gas supplies. In view of the overriding importance of reducing our reliance on imported oil, we have concluded that gas supplies should be acquired by New York Gas distribution companies or interstate pipelines serving New York: (1) whenever thay can be delivered to New York markets at a price that will be equal to or less than the delivered price of imported oil; or (2) whenever it is demonstrated that acquisitions are in the public interest. Gas rates should be designed, consistent with the pricing policy expressed above, to maximize the use of such gas.

Federal Incremental Pricing

NGPA 1975, Title II, shields residential and commercial customers from the immediate effects of higher prices allowed by NGPA by first assigning those increased costs to industrial customers until the retail price to the industrial customers reaches parity with its alternate fuel price on an equivalent BTU basis. After industrial customers reach this parity price, any remaining unassigned increased costs are rolled-in to residential and commercial customer prices. This scheme is to be implemented in two phases: During Phase I, increased costs are assigned to large volume boiler fuel customers (300 MCF/day or greater) only, effective January 1, 1980. Phase II, implementation of which is to be decided in May, 1980, expands coverage to include certain other industrial customers (accounting for approximately 75 percent of such customers).

The Draft Plan initially recommended deletion of or an exemption from the incremental provisions of NGPA. Various parties, including NYGAS, CPB and DOL, argued that if the incremental pricing provisions of NGPA were not overturned then New York State should not seek an exemption because the State would benefit from its implementation. CPB and DOL further argued against repeal of incremental pricing, claiming that New York State is a net beneficiary from implementation of incremental pricing under NGPA.

It appears to the Board that Title II incremental pricing is an unwarranted intrusion by the Federal government into retail gas utility ratemaking, something that should, in principle, be left to State regulation. We, therefore, urge the New York Congressional delegation to pursue elimination of federal incremental pricing.

[20]While virtually all new gas sources will be deregulated commencing in 1985, gas sources acquired prior to the effective date of the Natural Gas Policy Act of 1978 (gas contracted for before April 1977) will remain price-regulated after 1985. This provides a cushion, to some extent, against which new, more expensive supplies can be acquired.

Load Attachment

The Draft Plan recommends that authority for approval of gas load attachments should be transferred from PSC to SEO. The Draft Plan suggests that authority for approval of gas supply projects should also be transferred to SEO so that such acquisitions can be judged within the context of the long-term benefits to all energy users in the State.

The DPS argues that such a transfer represents a fragmented approach, in that matters of supply acquisiton, gas system expansion, and load attachments must consider rate impacts.

NYGAS did not take a position on this issue, but identified several issues related thereto, the primary one being the potential for duplicative and inconsistent regulation, particularly in rate cases.

We believe that authority for approval of gas load attachments should remain with the PSC. At the same time, we recommend that the PSC rule upon load attachments and supply projects in a manner consistent with the State policy expressed herein to expand the use of gas in New York.

Acquisition of Canadian Gas

The Draft Plan recommended that NYGAS member companies form a consortium, possibly in conbination with utilities in the greater New York-New England area, to pursue acquisiton of Canadian gas.

The Draft Plan indicates that significant new gas reserves have been found in Canada, including frontier areas such as Melville Island. In addition, a surplus of gas from conventional sources exists, according to the Draft Plan, in Canada. A major new market, it is argued, would provide Canada with the incentive to develop these sources and encourage further exploration. The northeast area represents the closest market to the proposed delivery points for LNG and already has existing supply connections to the Trans-Canadian pipeline. However, the Draft Plan indicates that if supplies are to flow by 1984, initial agreements with Canadian suppliers must be consummated by 1981.

NYGAS expressed general support for this recommendation, but indicated that there was a need for involvement of and support by gas pipeline companies.

We believe that the Draft Plan proposal is sound; however, direct competition with interstate pipelines serving New York for the same source of gas should be avoided to the extent possible and efforts should be made to secure Canadian gas at firm, long term prices to avoid some of the recent steep escalations in the price of Canadian gas we have experienced.

Additional Studies

The Draft Plan proposed a number of studies relating to natural gas supply which are listed, together with the views of various parties, below.

> NYGAS and SEO should study the potential for expanding gas facilities especially into areas not presently served with gas.

NYGAS expressed general support, but expressed concern that such expansion could subsequently be determined to the imprudent. DPS expressed concern that attachments or expansion of service cannot and should not be separated from economic considerations and rate-making authority. We believe a cooperative study would be useful and that it should be concluded within the year. DPS should join with NYGAS and SEO in this endeavor.

> An intergovernmental task force should be established under SEO leadership to coordinate government sector conversion from oil to natural gas.

NYGAS supported this study, except to the extent to which it contemplated direct field purchases of natural gas.

While it may be preferable to serve these customers directly from utilities, we would not exclude consideration of direct field purchases. Such purchases may well be advisable if: load attachment approval cannot be secured; a particular distribution company does not have adequate supply; or the facility cannot be served by the local gas utility for any other reason. We believe this study should go forward.

> NYGAS and SEO should study the feasibility of developing a strategic gas reserve in New York State and develop a proposal to DOE for funding consideration.

A strategic gas reserve could help insure against severe economic losses in the event of a crisis affecting either oil or gas.

NYGAS does not support the concept because of the economic burden it would impose upon gas utility customers.

The DPS argued that the cost of a gas reserve would be excessive for gas customers, and,if DOE established the reserve, the potential benefits to New York may well be diminished since such a reserve could be considered a national resource. NYGAS, SEO, and DPS should study the feasibility and desirability of a natlonal strategic gas reserve. If appropriate, a proposal to DOE for establishment of such a reserve should then be developed. This report should be submitted to the Board within this calendar year.

> NYGAS, through its member companies, should encourage commercialization of the pulse combustion furnace.

It appears that the pulse combustion furnace is one of the more promising concepts for improved furnace efficiency. Steady state efficiencies in the 90-95 percent range have been obtained in laboratory testing, indicating a fuel savings of up to 30 percent over the existing stock of conventional furnaces. NYGAS suggested that other options may be more appropriate objects of gas utility RD&D efforts. We believe that NYSERDA and NYGAS should study and report on research and development expenditures needed to encourage commercialization of more efficient gas technologies and appliances, including the pulse combustion furnace. This report should be submitted to the Board within six months of final approval of the Opinion.

Federal Actions

The Draft Plan included, and with some modification we approve, the following additional federal administrative and legislative recommended actions:

> New York State, through its Congressional Delegation and through agency intervention, should promote the following federal actions to improve U.S. natural gas supplies:
>
> > Expedite development of a reasonable and comprehensive North American gas policy that will facilitate additional exports of economically attractive supplies of gas from Canada and Mexico to the United States.

These countries currently have abundant supplies of natural gas for which the U.S., because of its proximity and existing trading patterns, is a natural market, Additionally, these countries are much more politically stable than the Middle East.

Discourage use of gas in boilers that can convert to coal.

The Powerplant and Industrial Fuel Use Act (PIFUA) requires reduction or elimination of gas use at electric powerplants and major fuel burning installations. Preliminary estimates are that by 1985, 1 TCF/yr could be released to new markets, and by 1990, up to 3 TCF/yr—in effect, a significant supplemental source of gas. New York State should, for that reason, encourage rapid implementation of PIFUA in those instances where conversion is economic.

Elevate R&D priorities and funding levels affecting gas supply projects.

DOE and Congress should increase funding for gas supply research projects. New York should further support firm R&D commitments by DOE and the Gas Research Institute for New York indigenous resources such as Devonian Shale.

Increase importation of LNG as a supplemental U.S. energy source.

SEO suggests that it intervene at the federal level in support of LNG imports, including short haul gas from the western Hemisphere as a long-run supplemental gas source. According to SEO, LNG supply sources could and should be diversified by increasing imports from such countries as Equador, Trinidad and Tobago.

We believe the proper policy to be advocated by the State's agencies is that imports of LNG should be increased with caution so that we do not become overly dependent on foreign gas supplies. In addition, new LNG facilities should be located in isolated areas away from population centers. Siting such new facilities and expansion of capacity at existing sites are subject to federal and state regulations for both safety and environmental compatibility.

Approve alternate funding approaches, including federal government subsidies, to develop supplemental sources such as coal gasification and the Alaskan pipeline.

The difficulties in developing sources of capital for such supplemental sources is delaying their development. This has occurred because of the substantial risks in developing new supplementals with unproven technologies.

This problem can be ameliorated if the Federal government provides price and sales volume guarantees and/or guarantees of securities issued by entities constructing facilities. Such a system could be financed in whole or in part by the federal Windfall Profits Tax on oil companies. We see no reason why the federal government should not guarantee investments or otherwise foster development through direct subsidy, as it has done for other U.S. industries in the past.

Conclusion

We believe that vigorous implementation of the gas policies and recommendations approved herein will increase the supply of gas to New York and thereby reduce our reliance on oil in an environmentaiiy attractive manner. We believe that the federal actions recommended herein are sound and are hereby approved.

PETROLEUM

Introduction

Petroleum products, which accounted for 66 percent of New York's 1978 energy use, will remain a dominant energy resource over the next 15 years.

Implementation of proposals approved by us elsewhere in this Opinion for increased conservation, industrial coal conversion, electric utility conversion of oil-fired generating plants to coal, and increased use of renewable energy resources, should reduce total statewide oil use from 66 to 47 percent over the next 15 years. This reduction of approximately 19 percentage points will represent a considerable improvement in New York's energy mix.

Because New York will, however, continue to be dependent on oil for nearly half of its energy needs by the end of the planning period, appropriate action must be taken by the nation and by the State to assure an adequate future supply of petroleum.

Discussion

The Draft Plan describes the present role of petroleum products in satisfying the energy needs of all sectors of the State's economy. It also examines the rapid escalation in prices over the past decade for these essential fuels and identifies the emerging trends.

In the long term, the State, on its own, has little ability to influence these changing conditions directly. State government can best serve the interests of its residents through active participation in the national legislative and regulatory processes.

For New York State, and the nation as a whole, to reduce dependence on oil without simultaneously disrupting the international supply and distribution systems, federal policies and programs must address two critical issues—the amount of oil imported, and reliance on OPEC nations as a source of oil. With regard to the first concern, excessive imports hurt the U.S. economy because oil imports contribute to the balance of payments deficit. This negative balance of payments in effect reduces the amount of oil and other foreign goods that can be purchased for the dollar. Therefore, greater and greater amounts of what could be domestic capital instead goes into other countries.

Concerning the second issue, federal policy has never directly addressed the need to modify our posture with respect to the OPEC cartel. Instead, federal policy appears simply to accept new and higher OPEC prices. This, in turn, has escalated consumer prices and stimulated inflation nationwide. Additionally, under the present phased decontrol policy, uncontested OPEC price increases serve to raise the cost of domestic oil which will result in even higher prices for all energy consumers.

We believe the federal government must now act to diminish the disrupting impact of current OPEC supply and price policies felt primarily by the economies of those regions dependent on oil for their energy needs. Such a national policy must rely on two factors: maximizing the oil producing and exporting potential of nearby North American nations, as a means to diversify the country's imported sources, and at the same time, increasing domestic oil production, including such fuels as heavy oil, tar sands, oil shale and oil from coal.

In furtherance of these objectives, the Board makes the following recommendations for Federal and State actions:

Federal Actions

Challenge the power of OPEC to dictate worldwide oil supply and price.

First, establish an extensive international and direct bilateral financing plan to accelerate exploration, development, and production of oil reserves in non-OPEC countries. Non-OPEC developing nations currently produce only 6 percent of world oil but contain an estimated 40 percent of total prospective oil bearing geological formations. As a group, these countries represent a major source of new crude oil supplies which could weaken OPEC's monopoly power.

Second, amend foreign income tax credit regulations to exclude OPEC production from benefit eligibility, but to allow favorable tax treatment for non-OPEC production under a new and definitive royalty payment schedule. Current taxing practices are not needed to assure oil production and exploration investment in OPEC countries. Maintaining foreign tax credit eligibility for all non-OPEC countries would create strong incentives for expanding and diversifying (among nations) worldwide crude oil supplies.

Third, expand the Strategic Petroleum Reserve (SPR) from 1.0 billion barrels to perhaps 1.5 billion barrels and expedite the purchasing schedule so that required storage levels are met. The resulting level of protection will permit the nation to deal better with the consequences of severe supply interruptions which, in turn, will discourage some nations from imposing an oil embargo against the United States.

Pursue an import policy-that provides favorable treatment for neighboring North American nations.

First, we believe efforts should be made to reach agreement with the Canadian Government to make Canadian heating oil and crude exports available at prices competitive with domestic supplies. Major discussions would need to address Canada's present 30,000 BBL/D combined surplus of distillate and residual oil refining capacity, their $5 to $6/BBL export fee on refined products and the present Canadian policy of phasing out all crude oil exports after 1981.

Second, negotiate an agreement with Mexico granting technical assistance in exchange for assurances that a large proportion of its crude oil output will go to the United States. The basic elements of such an agreement would include American dollars and technology for Mexican oil at a firm price.

Ensure that a regional petroleum product reserve for the Northeast is sited within New York State.

Such a reserve would serve the interests of New York and the Northeast. During a period of severe petroleum shortage, DOE has concluded that at least 8-16 days would pass before supplemental oil supplies from beyond nearby East Coast refineries could be delivered into the New York Metropolitan area. This region at any one time has in storage, at best, a 4-5 day supply of heating oil.

Expand domestic crude oil production and the national distribution system.

Specifically, we recommend the following program:

—ensure that more federal land becomes available for oil exploration and development through appropriate regulatory actions;

—ensure that regulatory agencies expedite the leasing and permit process associated with federal lands currently available for oil exploration and development activities;

—enact a federal program of grants, loan guarantees, preferential tax treatment and technical assistance to develop synthetic crude oil from non-traditional sources; and

—designate and expedite the siting of two distinct west-to-east pipelines to transport Alaskan oil from the West Coast to mid-continent and Gulf Coast refineries.

Numerous opportunities exist to increase production of domestic crude oil. However, in order to accelerate oil production on the Outer Continental Shelf, where 32 to 60 percent of all undiscovered domestic crude oil is believed to be located, Federal leasing and permitting processes need to be streamlined. Similarly, extending financial assistance to assist industry in satisfying front-end expenses is critical to developing environmentally acceptable synthetic fuel technologies. As these new sources, in large part, will be produced on the West Coast or in Alaska, west-to-east pipeline capacity seems necessary to transport the crude oil to existing refinery centers for processing and subsequent delivery to end-users.

State Actions

Establish a task force, consisting of the Energy Office, the Departments of Public Service, Environmental Conservation and Transportation, and a pipeline construction company representative, to evaluate the economic and environmental impacts of extending the Buckeye and Colonial Pipelines to the Albany region.

Shipment of petroleum through pipelines is usually preferred over other transportation means because pipelines are less susceptible to supply disruptions such as severe weather conditions, labor disputes, and other transportation delays. Supply is generally more secure because pipeline companies often obtain throughput guarantees from shippers before constructing a line. Finally, pipeline transportation costs are generally below those of alternative means. In view of these general factors, we believe the proposed effort should be made.

Issue State Energy Office regulations to require petroleum product suppliers to notify the Energy Commissioner prior to major market withdrawls.

Within the past two years, major suppliers, without prior notification to any State agency, have announced planned withdrawals from Northeast markets. The Draft Plan cites these marketing changes as responsible, in large part, for distributor, retailer and end-user supply problems, We adopt the proposed action as desirable in these circumstances.

Conclusion

For the reasons noted, the Board approves the recommended actions discussed above.

COAL

Introduction

The State must increase its use of coal in order to reduce its dependence upon imported petroleum. Known coal reserves can meet both State and national energy needs far into the future.

The greatest near-term opportunity for increased use of coal in New York State is in the generation of electricity: by converting existing oil-fired units that are capable of burning coal; and by the addition of coal-fired baseload units to meet future growth in demand and to back out uneconomic oil-fired capacity.

In the longer-term, coal utilization should be expanded through development of a coal-based synthetic fuels industry.

Discussion

The Draft Plan contains a series of proposed recommended actions in order to reduce oil dependence through increased coal use. As modified and supplemented below, we approve those recommendations.

> Convert existing baseload oil-fired power plants to coal, where economically and environmentally feasible.

We have addressed this issue earlier.

> A feasibility study should be undertaken immediately to investigate the potential for use of a coal-oil mixture (COM) at a large baseload oil-fired generating station as a means to reduce oil consumption.

The Draft Plan suggests Niagara Mohawk's Oswego generation station (Units #1-6) as a potential candidate for this venture. If all units at Oswego were to utilize COM there would be an estimated savings of approximately 10 million barrels of oil per year.

The technical and economic feasibility of COM is now being tested in medium scale demostration projects. NYSERDA should support such a demonstration in New York so that this technology can be used soon to reduce oil dependence.

With respect to the Draft Plan proposed action for a feasibility study, the Board modifies the recommendations as follows:

> NYSERDA, with support and cooperation from SEO and DPS, should support projects to demonstrate the potential for use of coal-oil mixtures at baseload oil-fired generating stations where conversion to direct combustion of coal is infeasible.

> Encourage development of a coal-based synthetic fuels industry in the Northeast by:
>
> . . . enacting the proposed windfall profits tax;
>
> . . . creating the proposed Energy Security Corporation; and . . . enacting the Regional Energy Development Corporation Act of 1979.

The potential for a coal-based synthetic fuels industry in the nation is quite large in terms of natural resources and technology.

Substitute supplies for petroleum and natural gas need to be developed. Because of the long lead times involved, the development of these supplies should commence immediately. Clearly, a major effort must be made at the national level. However, a regional program for commercializing a synthetic fuels industry, with existing technologies, should be considered as a means to move the Northeast region into an era of more secure, reliable, and econonic energy supplies. To carry out such a program, the Congress should enact both the proposed Windfall Profits Tax and the Regional Energy Development Act of 1979. Enactment of the latter would in turn authorize creation of the Energy Corporation of the Northeast (ENCONO).

ENCONO would design and execute a program to create synthetic fuels from coal. It would have the authority to construct facilities to produce synthetic fuels, which may then be operated by private industry under leases or management agreements. ENCONO would have maximum flexibility in the conception and implementation of this important effort.

The major coal-related issues in this proceeding arise in the context of the electricity supply plan: the oil-to-coal conversion targets and new coal-fired generating stations. Issues relating to these aspects of the Draft Plan have already been discussed. The Final Environmental Impact Statement and the previous discussion of the electricity supply plan underscore our concern about the increased potential for air, water and land pollution associated with substantially increased coal use.

Upon review of the record and the FEIS, the Board believes that increased reliance on the use of coal for reducing dependence upon oil is reasonable and justified and, further, that the Draft Plan is compatible with State and Federal environment objectives.

Conclusion

The recommended actions contained in the coal section of the Draft Plan, as modified herein, are approved.

ENERGY FINANCING

Introduction

Institutional changes in the energy finance field may be required over the next fifteen years to finance the conversion of existing oil-fired capacity to coal, the construction of new coal-fired capacity, the construction of energy production technologies including small hydro, cogeneration, resource recovery and solar, and the implementation of energy conservation activities. Although conventional securities will still be used to finance energy projects, it is clear that new financing mechanisms, as well, should be considered and utilized when appropriate.

New York State may also profit from more cooperation, coordination and action to enhance the Northeast's energy supply prospects. The Northeast with its large population is the region most dependent on imported oil and, unlike other regions, has little natural gas or crude oil production. This combination of factors makes the Northeast region the most vulnerable to energy supply disruptions and shortages. Federal and State actions in the energy finance field must assure that the economics of new energy development do not result in a negative impact for the Northeast and New York State.

Discussion

We have examined the suggestions for new financial mechanisms and institutions included in the Draft Plan which could supplement conventional security financing of energy projects. The proposed Windfall Profits Tax is one source of funding for high-risk multibillion dollar synthetic fuel projects, and, to a lesser degree, for conservation efforts. However, current proposals may harm the Northeast's regional economy by draining away funds for synthetic fuel development to the West. A more balanced Federal funding program, with funds split more evenly between an energy conservation and coal conversion and substitution program, more applicable to the Northeast region, and a synfuels program, would benefit New York State and the region as well as produce more oil savings for the nation as a whole.

New York's energy future can be improved with the creation of new types of financial institutions and programs to include a regional energy development entity such as ENCONO and a centralized finance agency—such as PASNY— to help channel funds into renewable resources and conservation investments at the local level. In addition, further consideration should be given to a national synthetic fuels industry with Federal financial assistance.

The synthetic fuels industry will probably develop over the fifteen year planning period but, as the Draft Plan notes, the cost of a production capacity of 5 million barrels per day could exceed $100 billion in today's dollars. The commercialization of this industry may be too risky to be financed privately through conventional methods. Options to provide financial assistance for the development of the synfuel industry include: a federally owned corporation financed by the proceeds from the windfall Profits Tax; a federal loan guarantee program for organizations developing synfuels; market guarantees with predetermined quantities and prices; and/or tax incentives, such as lower income tax rates on income from synfuel operations or a tax credit program.

We have also examined financing options for renewable resource installations and for conservation investments. New York State has three energy-related institutions which might assist in financing these projects.

The first is PASNY, which could finance renewable resource and conservation projects.

The second is NYSERDA, which has been directed by the Governor to foster the near-term use of renewable energy resources in New York. NYSERDA's technical staff is qualified to evaluate renewable resource and energy conservation investment options and to channel limited capital into commercialization projects with high near-term saving and/or energy production potential. This broad understanding of technologically available options should be put to use.

Finally, there is the ENCONO concept. ENCONO would be a regional public corporation charged with a mandate to plan, expedite and finance energy projects in the Northeast. Funds would be raised by equity contributions made from each member state at a rate of $1 per capita. Member states and/or private industry could make additional contributions which could also provide capital. Thus, ENCONO would be a finance vehicle for joint private, state and federal funding of energy projects. Once the capital contributions have been received, it is anticipated that bonds guaranteed by the Federal government up to 15 times the amount of the subscriptions could be issued. Thus, ENCONO could develop and fund projects on a regional basis to lessen the Northeast's dependence on foreign oil.

The Board believes that all three of these potential sources of funding renewable resource and conservation projects should be pursued by the appropriate entities.

The Board agrees that new financial mechanisms should continue to be pursued and employed where sensible. On the State level, we are most interested in the possibility of expanded NYSERDA involvement in financing coal conversions through its tax exempt bonding authority. However, the most important immediate financing initiative that is necessary is federal financing assistance, as previously discussed, for utility oil reduction initiatives. We will, therefore, include a specific recommendation to this effect in the Plan, as follows:

> Congress should enact legislation to provide financial assistance for conversion of existing oil-fired capacity to coal and for construction of new coal-fired capacity to reduce oil dependence.

This action will help ensure that New York's utility customers will not be forced to shoulder the brunt of the financial burden of helping to decrease the nation's dependence on oil. We urge New York's Congressional delegation to support such legislation.

Conclusion

The proposed energy financing recommendations,described above, are adopted by the Board.

RISING ENERGY COSTS AND LOW INCOME HOUSEHOLDS

Introduction

No person should be without adequate heat or should be forced to forego conservation improvements by reason of inability to pay. A commitment to public health and safety requires no less.

Energy expenditures for all New Yorkers have risen dramatically since 1973. Recent OPEC and national oil pricing actions will drive energy prices even higher for New York State residents.

The burden of higher energy costs falls heaviest on low income households. In 1978, the average low income household spent approximately 33 percent of its income on direct energy costs, whereas the average median income household spent about 9.6 percent of its income on direct energy costs. It has been estimated that the percentage of income spent by the average low income household on direct energy costs would increase up to 40 percent as a result of a 25 percent rise in energy prices. The same price hike would increase the amount spent on direct energy costs by the average median income household to 11.5 percent of its disposable income.

The problem of the overall effects of rising energy costs on low income households is of particular importance to the State of New York and other Northeastern states because low income households within these states are impacted more severely than similar groups nationally. Differences in climate, dependence on oil for residential heating, transportation costs, and the condition of the housing stock cause seasonal energy costs within the Northeast to exceed the national average. In New York, all households, including those classified as low income, pay about one-third more than the national average for energy.

Since energy is a necessity of life, rising costs may force many low income households into the intolerable choice of staying warm or buying food.

Discussion

Since publication of the Draft Plan, several of the recommended actions it contained have been implemented. Other State and Federal government programs—not recommended in the Draft Plan—have also been implemented.

Implemented actions contained in the Draft Plan follow:

> Home heating fuel cut-off regulations were adopted by the SEO on November 2, 1979. These regulations require distributors of heating fuels to notify a customer and a third party designated by a customer, whenever a distributor refuses, suspends or terminates deliveries; and a social services agency, whenever a distributor's refusal, suspension or termination of heating fuel (other than electricity or natural gas, which were already subject to similar requirements) may cause a severe or hazardous health situation; and Federal Low-Income Assistance Program provides the poor with added resources to help meet higher energy costs through: direct cash assistance to restore purchasing power lost because of energy price increases (Supplemental Energy Allowance Program—SEAP); and special financial assistance to meet health or life threatening energy related emergencies (Energy Crisis Assistance Program ECAP).

Other implemented actions include:

> The Emergency Energy Assitance Tax Credit (Chapter 748 of the Laws of 1979) provides a $35 income tax credit to each person, age 65 or over, who heads a household with income below $14,000 per year;
>
> Chapter 745 of the Laws of 1979 amends the Tax Law by authorizing certain cities, counties and school districts to reduce or eliminate the sales and use tax rate on residential energy sources;
>
> Chapter 747 of the Laws of 1979 eliminates the State sales tax on residential energy use, effective October 1980;
>
> Chapter 749 of the Laws of 1979 establishes a State Energy Crisis Assistance Program (SECAP) to provide assistance to those households not eligible for existing federal programs; and
>
> Chapter 728 of the Laws of 1979 establishes a program which authorizes commercial banks, savings banks and saving and loan institutions to lend money directly to individual residential customers or dealers (for customer use) for the purpose of permitting customers to belatedly enter into a budget plan.

Two parties have developed additional related points.

NYGAS contends that the Federal Crisis Intervention Program (CIP) is flawed. Since applications must be submitted each time assistance is needed and the program provides after-the-fact aid, NYGAS contends CIP is not capable of providing on-going aid in advance of a crisis. In addition, NYGAS notes that aid is provided on a per-capita basis and thus does not take into account climatological differences or variations in the costs of utility service.

The Board agrees with this contention and adopts the following action:

> New York State, through its Congressional delegation, should seek increased funding for all Federal programs, including CIP, (which is now the Federal Energy Crisis Assistance Program), which assist low-income households in meeting energy costs, through the use of revenues to be derived from the proposed Windfall Profits Tax and other sources.

Second, NYGAS contends that the current welfare system which provides, as part of an assistance package, funds to meet energy needs, results in money being diverted to other uses by clients rather than being used to pay utility bills. NYGAS recommends that payments be made directly from the assistance agency to the utility.

NYGAS proposes an "energy coupon" program which would incorporate existing structures to determine eligibility and distribute coupons. Renters would receive coupons that reflect an estimate of their portion of the bill. NYGAS proposes that this program be permanently funded by the Federal government, with interim State and local funding.

We will not, at this time, adopt the second and third recommendations of NYGAS. These matters raise serious socioeconomic questions which have not been fully developed during the course of this proceeding.

The other party recommending that further action be approved by the Board is the Energy Association of the State of New York. EANY has proposed the immediate repeal of the State and local sales, gross receipts and franchise taxes on energy.

The Energy Association contended that these taxes, which

have increased by 79 percent between 1972 and 1978, most seriously effect the poor. The Association cites a Department of Labor report for the proposition that the burden of these taxes is almost three times greater for low income elderly families than for middle income elderly families. The overall effect of the taxes, EANY claimed, is to increase the average residential customer's bill by over 12 percent. We cannot, at this time, endorse these proposals because we lack sufficient data and information on which to base such a determination.

The Board finds that recent Federal and State actions have begun to address the problems of rising energy costs of low income households. However, the level of funding from the federal assistance programs, although helpful in easing the burden of low income households, is inadequate to ensure that these households will be able to afford their essential energy requirements. The Board, therefore, recommends increased funding for these programs at the federal level from funds derived from the Windfall Profits Tax and other sources.

The Board finds that the remaining proposed actions contained in this section of the Draft Plan, as listed below, are desirable and should be implemented.

- Congress should amend the National Energy Act of 1978 to expand the weatherization program for federally assisted public housing.
- The Department of Energy should revise its weatherization program regulations to allow funds to be utilized for labor.

Conclusion

The Board approves this section of the Draft Plan, as modified to include the additional action with respect to increased funding for all federal programs, including CIP.

RESEARCH AND DEVELOPMENT

Introduction

Within New York State, a vigorous and diverse energy research and development effort is being supported and carried out for the overall purposes of:

establishing ways to use energy more efficiently while reducing waste;

producing and distributing energy less expensively; and

improving the safety or environmental compatability of energy production and use.

New York's energy research and development program is being carried out by NYSERDA, the Empire State Electric Energy Research Corporation (ESEERCO), and the individual gas and electric utilities among others. New York is unique among the States in its funding and operation of an energy research and development authority, one which already has established a credible record of achievement in this area.

This ongoing R&D effort involves private engineering and scientific firms, universities, industries, state agencies, and local government. The utility research organizations and NYSERDA also coordinate their work with the two national energy research organizations—the Gas Research Institute (GRI) and the Electric Power Research Institute (EPRI)—and also with the United States Department of Energy (DOE).

The State's energy research, development and demonstration programs have and must continue to emphasize the development of those technologies particularly suited for near and mid-term commercialization and implementation in New York State. Coordinated efforts in advancing such technologies should be consistent with other state policies.

The Board recognizes, however, that these goals are being pursued within New York with limited resources compared to the costs of creating new technological solutions to energy problems.

Discussion

Section V-H of the Draft Plan outlines the areas of highest priority for the State's research and development effort. These include:

- Conserving energy
- Developing renewable and indigenous resources
- Developing cleaner and more economic method of using coal
- Protecting health and the environment
- Developing less expensive coal-based "synthetic" fuels, such as coal gasification and liquefaction
- Demonstrating and commercializing fuel cells
- Developing unconventional gas sources
- Recovering industrial waste heat
- Transmitting DC power
- Managing peak load demand

Meeting New York's energy needs requires the development of all options open to the State. Conservation, renewable energy sources, and indigenous resources are attractive means of meeting the State's energy needs because of their relatively benign environmental impacts, and their availability within the State. However, all resources must be explored, developed and demonstrated to ensure meeting these needs in an economical, safe and environmentally sound fashion. Furthermore, a balance must be maintained in meeting short-term needs and longer-range goals.

NYGAS was the only party that specifically addressed research and development issues. While supportive in most respects, NYGAS took issue with the R&D portion of the Draft Plan for two reasons. First, NYGAS argued that the Plan should contain a more comprehensive statement of proposed research directions for the State with respect to natural gas. NYGAS contended that an overall statement of proposed research directions for the State is essential so that a comprehensive view of the State's R&D needs would be known by the gas utilities and other research groups, thereby avoiding duplication of effort.

In addition, NYGAS contended that insufficient funds are being directed by NYSERDA toward natural gas research and demonstration activities. NYGAS suggested that NYSERDA enhance its efforts and expenditures in that area.

We believe that the R&D section contained in the Draft Plan adequately sets forth a comprehensive statement of proposed energy research directions for the State, including R&D in the area of natural gas. We do not find sufficient basis on the record to express an opinion concerning the level of NYSERDA funding allocation to natural gas research and development intended to improve this effort.

Conclusion

The Board endorses and approves, as supplemented above, the energy research and development section of the Draft Plan.

FINDINGS AND DETERMINATIONS

THE ENERGY PLANNING BOARD FINDS AND DETERMINES:

1. The broad state energy policy objectives set forth in Energy Law Section 3-101 have been refined during the course of the planning process into a set of specific energy policies, as required by Energy Law Section 5-110(b)(4). These energy policies, approved herein, are the major themes from which the recommendations for legislative and administrative actions also approved herein flow. Together, these approved policies and legislative and administrative actions provide clear direction to State efforts to fashion its energy future.
2. Construction of the new electric generating capacity set forth in Figure 17 in this Opinion will assure that adequate reserve margins are met, or will allow existing oil-fired facilities to be operated less frequently.
3. Conversion to coal of the existing oil-fired electric generating facilities set forth in Figure 17 in this Opinion will substantially reduce oil consumption in the electric utility sector, may well result in substantial savings to ratepayers, and, in many cases, appear to be achievable with capital investments substantially less than such investments for new generating capacity.
4. The requirements of 6 NYCRR Part 617, State Environmental Quality Review, have in all respects been met and the Final Environmental Impact Statement provides an adequate basis to permit the Board to make the following findings:
   a. consistent with social, economic and other essential considerations, from among the reasonable alternatives, the policies, forecasts, and recommendations for legislative and administrative action contained in the Draft Plan and Report, as modified herein, minimize or avoid adverse environmental effects to the maximum extent practicable, including the effects disclosed in the Final Environmental Impact Statement; and
   b. consistent with social, economic and other essential considerations, to the maximum extent practicable, adverse environmental effects revealed in the Final Environmental Impact Statement will be minimized or avoided through adoption of mitigative measures which were identified as practicable therein and in the Plan and Report, and which will be identified as practicable in subsequent site-specific regulatory reviews conducted by the appropriate licensing or permitting agencies and incorporated as conditions to approvals issued by such agencies.
5. Statewide energy demand is likely to increase at an average rate of 0.5 percent per year over the next 15 years.
6. Statewide electricity consumption is likely to increase at an average rate of 2.1 percent per year over the next 15 years.
7. Total statewide electricity peak demand is likely to increase at an average rate of 1.8—1.9 percent per year over the next 15 years.
8. Individual electric utility and PASNY energy sales and peak demand are likely to increase over the next 15 years at the rates set forth in Figures 4 and 10, respectively, herein.
9. Real prices for electricity are likely to increase at an average rate of 1.8 percent per year, on a statewide basis, over the next 15 years.
10. Total statewide natural gas demand is likely to increase at an average rate of 1.4 percent per year over the next 15 years. Supply should be adequate to meet this increased demand.
11. Real prices for natural gas are likely to increase at an average rate of 4.4 percent per year, on a statewide basis, over the next 15 years.
12. The Board has concluded that certain additional studies should be undertaken. These studies, approved herein, will assist the Board in subsequent deliberations.

ORDER

THE ENERGY PLANNING BOARD ORDERS:

1. The Draft State Energy Master Plan and Long-Range Electric and Gas Report, as modified herein, is approved.
2. All pending motions are denied.

BY THE ENERGY PLANNING BOARD,

(SIGNED)

JAMES L. LAROCCA
CHAIRMAN

APPENDIX A

LIST OF PARTICIPANTS

1. Adirondack Park Agency
2. Cayuga Lake Conservation Association
3. City of New York
4. Consumer Action Now
5. Empire State Electric Energy Research Corporation
6. Energy Association of New York State
7. Genessee Valley Peoples Power Coalition
8. Lake Shore Alliance
9. Multiple Intervenors
10. New York Gas Group
11. New York Power Pool
12. New York Public Interest Research Group
13. New York State Association of Counties
14. New York State Building and Construction Trades Council
15. New York State Consumer Protection Board
16. New York State Department of Environmental Conservation
17. New York State Department of Law
18. New York State Department of Public Service
19. New York State Energy Office
20. New York State Jewish Labor Committee
21. New York State Municipal Electric Utilities Association
22. Northeast New York Section American Nuclear Society and Health Physics Society
23. Power Authority of the State of New York
24. Rochester Safe Energy Alliance
25. St. Lawrence County Planning Board
26. Sierra Club

APPENDIX B

SCHEDULE OF FIGURES

STATE OF NEW YORK
ENERGY PLANNING BOARD

State Energy Master Planning and Long-Range Electric and Gas System Planning Proceeding

Charles A. Zielinski, Chairman, Public Service Commission, concurring:

As the Opinion and order of the Board acknowledges (p.12), this is a "first effort" to carry out a new legislative mandate for broad state energy planning by the government, and "much more needs to be done." We also express an intention "to monitor on-going developments in the energy field and, if circumstances warrant, modify the Plan and Report accordingly." From my perspective, these are important qualifications, not only because they recognize the exceedingly difficult task the Legislature has given to this Board, but also because they preserve the flexibility to change recommended policies as the future unfolds. Given the volatile nature of the national and world energy market today, as well as the still uncertain development of several key federal energy policies—which we can hope to influence as a state, but cannot decide—it would be folly indeed to recommend, through the process we have just completed, immutable state policies to govern the next fifteen years. In short, as a first effort to fulfill what the Legislature expected of us, I believe the major thrust of our actions is acceptable; I would have difficulty concurring if this were to be a final effort.[1]

The major objective of this planning effort is to reduce New York's dependence on oil imported from the politically volatile Mid-East producing countries. No party to this proceeding disagreed with this objective. Indeed, I dare say no responsible citizen of this State would disagree with this objective. It is the goal also of the national energy planning effort because ever increasing imports of high cost oil, which we seem unable to offset effectively with American exports, worsen our balance of trade deficit, sap our economic strength and threaten our ability to protect those values that distinguish us as a society of intellectually and politically free people. The major controversy in this state proceeding, as it still is in the nation as a whole, is over the set of policies that will best achieve the agreed upon objective.

The major reason for this controversy is that there seems to be no set of *effective* policies than can be devised which are totally free of sacrifice in some aspect of the way we have become accustomed to living. The easily extractable and, therefore, relatively low cost supplies of clean oil and natural gas that exist within the nation's boundaries appear to have been found and are being exploited. New supplies of domestic oil and gas will probably come forth only if we are willing to pay a much higher cost than we became accustomed to from the early 1950's to the early 1970's. Domestic coal supplies are abundant, but their extraction and combustion involve environmental, health and safety costs that must be paid, in one form or another. The same can be said of uranium as an energy source. "Renewable" energy forms, such as wind, wood, biomass, solar and small hydroelectric facilities, are expensive in relation to what we became accustomed to paying for energy; in some cases involve significant environmental costs; and in other cases are still considered to be unproven as efficient energy forms.

In one way or another, I think the Board's Opinion and order accepts all of these realities. It recognizes that, absent some energy supply breakthrough we cannot foresee, there are only two significant ways through which New York can reduce its reliance on Mid-East oil: (1) through energy conservation or, more precisely, through more efficient use of energy, particularly of oil, than we have thus far been able to achieve; and (2) through substituting energy from other sources for that which now comes from the Middle East. The former involves changes toward a more energy efficient life style; the latter involves a willingness to accept, in one form or another, the costs of the substitute energy forms. The Opinion and order of the Board suggests that we will need to do both and I fully concur in these findings.

To achieve greater efficiency in our use of energy, and oil in particular, and to substitute other energy forms for imported oil, the Board has considered numerous policy recommendations and adopted many of them, some with substantial modification. In other cases it has called for additional study. Below, I set forth my own reasoning on some of these subjects for the purpose of clarifying my concurrence in this Opinion and order.

Coal and Nuclear Electric Generation

The Board's Opinion and order assumes a fairly modest growth in the rate of demand for electricity in the State over the next fifteen years, but recognizes that we will do nothing to reduce the significant consumption of oil by electric utilities if additional capital investments are governed solely by this projected growth rate. It therefore (1) assumes completion of the 1900 MW of new nuclear capacity under construction; (2) supports 2200-2700 of new coal-fired capacity for purposes of replacing existing oil-fired capacity; and (3) expects conversion of 5982 MW of existing oil-fired capacity to coal. Because it is possible to complete these initiatives in a relatively short period of time—say 8 to 10 years particularly with federal assistance for oil displacement activities by utilities, and because it seems to me essential to transform as quickly as possible the grossly sub-optimal electric generating system that exists in this State to one that makes more economic sense, I concur in these suggested actions. At the moment, large amounts of oil-fired generating capacity are used to meet base load demands in the State. They are grossly uneconomic for that purpose because of their very high operating costs. Completion of the suggested initiatives would put the State's utilities in a position to operate nuclear and coal plants almost exclusively for base load, saving oil plants mainly for peaking loads.

The Board's Opinion and order does not rely at this time on new nuclear generation, beyond that already under construction, to achieve its major goal of reducing the uneconomic level of oil consumption in the electric utility sector. This too seems to me sensible. It now takes somewhere between 10 to 12 years to construct a large, new light water reactor. The Nuclear Regulatory Commission's emerging new safety requirements, its slow-down in issuing con-

[1]Insofar as this process represents a change in the electric and gas sectors from private planning with government oversight to actual government planning, the wisdom of that decision is not open to debate in this proceeding. The electorate, through its elected representatives, has decided this issue and it is our function to carry out the mandate given as best we can.

struction permits and licenses, and the continuing uncertainty about the cost of and ultimate plan for permanent disposal of toxic nuclear wastes seem, if anything, likely to make that period even longer in the near term. Given the need to diversify the generating mix in the State promptly through more nuclear and coal-fired generation, the course adopted in the Opinion and order—that of completing the nuclear plants under construction while relying on coal for additional units — seems only prudent as a near-term system planning strategy.

The principal obstacle to achieving the quantity of coal-fired generation contemplated by the Board's Opinion and order is its potential impact on environmental values. Because of the Board's concern about the environment, it has called upon the Department of Environmental Conservation, with cooperation from other agencies, to do a report on the cumulative impact on the environment of the amount of coal-fired generation contemplated. If, as a result of this study, it is concluded that any significant amount of the coal-fired generation contemplated cannot be put into use at a reasonable cost, I see no alternative now to the much slower and longer course of adding more nuclear capacity if we are economically to reduce dependence on oil for electric generation in the State.

Whether new nuclear capacity is pursued in the near term or the longer term, the nuclear study panel recommended by the Board seems to me a key initiative. We cannot and should not foreclose additional nuclear generation in the State for the purpose of energy planning. Our energy choices are already too limited. Nuclear generated electricity is relatively clean compared to coal-fired generation, and the costs of the two modes seem close. If it can satisfy the doubts that have been expressed about nuclear safety, the study panel's work will make an important contribution to flexibility in energy planning in the State.

Natural Gas Supplies and Pricing

I concur with some reservations in the Board's finding of a 1.4% annual rate of growth in demand for gas in the State, and its expectations with respect to cost and supply. I believe the Board is somewhat optimistic in expecting the cost of gas to remain below the cost of oil for equivalent uses throughout the fifteen year planning period. And I think there is optimism also in the expectation that real prices of oil and gas are likely to increase at the same annual rate of 4.4% during the same period. If all gas supplies were allowed to find their market clearing price during the planning period, I believe it is likely that gas would eventually sell at a price above oil for some equivalent uses, reflecting the additional value that some consumers find in its cleanliness. And if all gas is not allowed to find its market clearing price at some point in the planning period, it seems to me less likely that all economic supplies will be produced.

But I cannot say that the Board's findings and expectations are clearly wrong. National policy with respect to energy in general, and natural gas in particular, is still in a state of flux. It is not unreasonable to be optimistic about adoption of a set of national policies in the planning period that will stimulate the production of the economic supplies of gas necessary to meet the demand forecast by the Board.[1]

[1]One such policy, in my view, would be the more liberal use of gas as a means through which electric utilitles could achieve compliance with air quality regulations. Electric utilities should be willing to pay for fairly high cost gas if it could be used instead of oil at selected point sources of pollution to offset emissions from high sulfur coal at a power plant, and thereby avoid the need for costly stack gas desulfurization equipment.

Various parties in this proceeding devoted considerable time to the question of natural gas pricing. Several parties advocated prices based on marginal costs, and others argued for prices based on "rolled-in" or average costs.[2] The Board has wisely decided against choosing between these arguments, opting instead for continuing flexibility in pricing and a set of principles that should guide pricing decisions, *viz.*, prices that encourage the efficient use of gas and its consumption, rather than oil, in markets where gas is the economic alternative.

In principle, of course, gas prices should be based on marginal costs because those are the actual costs to society of satisfying demand for additional consumption. Consumers deciding whether to take additional gas should, in principle, face a price that reflects society's actual cost of production so that they can decide whether the value of the additional gas to them is worth the cost of producing it. In the free market economy that we at least purport to have in this country, this is the way that supply and demand are supposed to be brought into balance and thereby produce the optimum consumer welfare. Prices based on rolled-in or average costs, in contrast, may artificially stimulate demand, discourage the efficient use of gas—i.e., economic conservation practices—and ultimately result in shortages.[3]

Between theory and practice, however, there is much still to be done. We do not yet know how to calculate properly marginal gas costs. The Public Service Commission has called for studies on this subject. In these circumstances, the Board's decision against endorsing any particular basis for pricing is prudent and sensible.

I also concur, again with some reservation, in the Board's call for repeal of the incremental pricing provision of the Natural Gas Policy Act. I agree that they are an unwarranted intrusion into retail gas ratemaking by state regulatory commissions. I believe the Public Service Commission in New York, as well as those in some other states, are not being helped at all by this provision in the progress they had already been making in bringing some economic sense to retail gas rate structures.

At the same time, however, the incremental pricing provisions of NGPA have pushed the Federal Energy Regulatory Commission to think more cogently about proper wholesale gas rate structures. Current wholesale rates are based on rolled-in costs, except to the extent they have been modified by the NGPA requirements. They ought to be moved toward a marginal cost basis.

Given the work that still needs to be done on natural gas pricing, I think it is sensible to favor a policy of securing supplies whose cost is at or below that of imported oil because that is probably a pretty good surrogate for what proper pricing would cause now in New York in any event. This is exactly what the Board's Opinion and order suggests, and I concur in it.

Renewable Energy Resources

I concur in the Board's estimate of the contribution that

[2]The lack of such a debate about electricity pricing is striking and suggests that one issue or the other was not analyzed by all parties solely on the basis of economic principles.

[3]It may also be lining the pockets of producers with unnecessarily high profits. Canada, Mexico and Algeria, for example, are selling gas at a price very close to OPEC oil, and gas transmission companies are rolling the cost in with that of cheaper supplies. If the foreign gas had to be sold at a price reflecting what was actually paid for it plus transportation costs, if any, there might be no market for it. This could lead to price reductions from foreign producers with no easily accessible alternative market for their gas.

various renewable energy resources will make to the State's energy supply in the planning period not so much because I am totally confident in the forecasting methodology relied upon for this purpose, but mainly because we are estimating a relatively low contribution from these sources of supply. Unduly heavy reliance on the widespread use of these resources in the State during the next fifteen years would not, in my view, be prudent.

It seems to me that the most important initiative of the Board with respect to these resources is its suggestion that various actions take place that remove any improper restrictions on the ability of renewable resources to compete fairly with conventional ones for a share of the energy market. This suggestion is embodied in several explicit recommendations:[1] (1) The Public Service Commission should set proper rates for standby electric service to, and sales to utilities by, users of these technologies so that people are not improperly discouraged from using them, a course of action the Commission is now pursuing in formal hearings; (2) the Public Service Commission should not exercise economic regulation over these technologies or their users where there is no substantial monopoly power to curb — a course of action that would be made possible by proposed legislation we have collaborated on with the State Energy Office, and that would remove unnecessary potential deterrents to this activity; (3) subsidies and tax advantages enjoyed by these technologies and conventional ones should be equalized.[1] I fully agree with all of these recommendations.

[1]One important recommendation in this area that is not explicitly embodied in the Board's Opinion and order is that prices for conventional forms of energy, including electricity and gas, be tied as closely as possible to marginal cost. Pricing conventional energy forms well below marginal costs distorts the choice that consumers should be allowed to make fairly among competing energy resources.

[1]In principle, it would probably be better to *remove* subsidies for all forms of energy, if for no other reason than that it is very difficult to make sure they are being equalized. I am not certain that all of the tax incentives and subsidies recommended in the Board's Opinion and order will, in fact, achieve equality, but cannot object to the Congress and the State legislature pursuing them for this purpose.

Renewable energy resources should obtain as much of a share of the energy market as their actual costs and value, compared to alternatives, allow them to achieve. I believe the recommendations I have cited, which the Board has endorsed, will foster that result.

Transportation

I am disappointed that we could not do more in this area, but I am satisfied with the Board's call for a list of suggestions that we will consider at a later time. Large quantities of oil are consumed in the transportation sector of the State's economy and so long as our goal is to reduce economically reliance on oil in the State, we must be fully satisfied that everything sensible is being done here.

I think it is also unfortunate, in light of the many recommendations for federal actions that were included in the proceeding, that no one chose to join the debate that is going on nationally over the relative merits of gasoline rationing and stiff gasoline taxes as a means to discourage oil consumption in transportation. This seems to me one of the most important national energy issues with which the Board could have grappled, as long as we were discussing national issues.

Miscellaneous

There are dozens of State and Federal legislative and administrative recommendations endorsed in the Board's Opinion and order. I am not familiar enough with the merits of a number of these, such as the call for increasing automobile mileage standards by one-half gallon, and the urging of an increase in federal aid for mass transportation from $1.25 billion to $2.5 billion, to have an opinion. In many instances, therefore, I would have preferred that the Board's Opinion and order urged consideration of various suggestions, particularly to the Federal government, instead of their adoption. I see no point in listing all of those instances here. My disagreement here is small enough in relation to the main thrust of the Opinion and order to allow me to conclude that I concur.

STATE OF NEW YORK
ENERGY PLANNING BOARD

State Energy Master Planning and Long-Range Electric and Gas System Planning Proceeding

Ira M. Millstein, Esq., Designee of the Speaker of the Assembly, concurring:

With its Final Opinion and Order, the State Energy Board has adopted, as modified therein, the Electric and Gas Demand Forecasts and Draft State Energy Master Plan which the State Energy Office proposed to the Board in August, 1979. This action, to which I subscribe, concludes Phase One of this state's unprecedented attempt to begin planning the wise and economical management of energy resources by and for all New Yorkers.

There is agreement among Board members that the crucial goal of our planning effort must be to reduce — and greatly reduce New York's economically debilitating dependence on costly foreign oil, the supply of which, obviously, is gravely problematic. There is also agreement that conservation is the main road for an economical and environmentally benign approach toward that goal.

If I have any disagreement with my fellow Board members on this latter point it would be my expectation that we have understated the conservation effects that higher oil prices are likely to induce. In particular, the forecast of 1.8—1.9% annual increase in peak demand for electricity may well turn out to be too high.*

I concur in the adoption of this forecast demand, however, for reasons that I believe necessary to briefly set forth separately in this concurring opinion. In addition, I have particularly emphasized to my colleagues on the Board my belief in the substanital potential contribution which greater interconnection of electric utilities and resulting increased purchases of 'firm' power from other less oil-dependent utilities in other states, can make to arriving sooner at our common goal. I particularly feel it is incumbent on me to separately explain the basis for my confidence in this potential benefit because no party developed this issue either on the record or in briefs in the Board hearing.

At the outset I wish to emphasize the quality of this 'first step' which the state has taken toward our new energy future. In particular, I note the high caliber of participation by the parties in the Board hearings and in their briefs, notwithstanding the severe time constraints which the State Energy Law imposed on our planning process. This quality performance obviously contributed to the value of Phase One by greatly aiding the Board members' review of voluminous materials and their deliberations. The State owes a large debt to the parties for helping advance us toward the future when New Yorkers —freed from the drastic economic impacts of our foreign oil dependence—will enjoy both greater economic opportunity and savings from increased energy efficiency.

It is equally important to recognize that the Board's action is *only* a 'first step', however good it appears to be. As such, it initiates a continuing process which the Board, pursuant to §5-110(4) will supervise on an on-going basis in the months and years ahead.

New York cannot 'back out' of its oil crisis in one giant step anymore than an oil tanker can turn around in the Panana Canal. It must proceed by steps and stages if it is eventually to shift course meaningfully. Moreover, despite the clarity and agreement about our problem and its solution, we know the immediate future is highly uncertain. Accordingly, we must plan—*not* for final "set-in-concrete" programs now—rather we must plan for a process of amendment and adjustment of the Forecasts and Plan we have here adopted.

The basis for this amendment, among other factors, must be vigilant monitoring of energy demand and substitution effects, energy costs and prices, and energy supplies as they become verifiably known. In this way, the state can reliably proceed with due regard for all the options practicably and safely available, which further information and inquiry may from time to time establish.

1. Conservation

While concurring in the demand forecast, I expect that this projection may prove high. The recent surge in the world prices of oil and the corresponding rise in the price of natural gas and domestic oil, are inducing a conservation and fuel substitution effect which may prove to be very dramatic indeed. Of course, the demand forecast models cannot presently capture and incorporate the full impact of these price and substitution effects, simply because the instability of the international oil situation and prospects of ever higher oil prices will continue in the future. However, it must be clear to most people that energy conservation and fuel substitution are occuring at a very rapid pace since we are all, simply as consumers, taking these very steps at home and at work as fast as possible.

It is my expectation that subsequent projections from the energy demand forecasting models will clearly reflect these adjustments by energy consumers. As the relative price of energy rises, basic economics teaches that energy consumers will both conserve energy and use energy more efficiently. It is essential to note that the conservation effort is not restricted to residential consumers. As relative energy prices rise as a factor of production, business and industry also are finding ways to reduce their overall and per unit consumption. What was once postulated as an "iron link" between energy demand and increasing economic activity, appears to have been broken. The past relationships between energy demand and economic growth cannot serve as a meaningful guide to the future. While it is clear that sufficient energy supply must be available to fuel economic growth, excessive and underutilized generating capacity can prove to be a great burden on the economy and a disincentive to economic growth. The costs of expensive underutilized capacity will have to be borne by all electricity consumers if peak demand projections prove to be too high as a result of conservation measures.

2. Renewables and Alternatives

While the Plan projects a disappointingly small amount of energy from renewable energy resources, this may well reflect the fact that in the recent past, new energy technologies have not been perceived as being able to contribute substantially to meeting our overall energy needs.

However, the Plan should not only reflect the status quo, but must also be forward looking. In today's changing energy environment, it is folly to expect that the rate of technological change and innovation will remain constant. Rather, it will quicken.

* Even allowing for a shift to electricity from oil and natural gas in response to higher prices for these two fuels.

Accordingly, the Plan can and should serve as a targeting mechanism which establishes goals that can be met through private entrepreneurs acting in response to the economic conditions, new technologies and government initiatives. In order to reduce our foreign oil dependence and meet our energy needs in environmentally benign ways, we can and should establish more ambitious goals for renewable resources and alternative energy sources. Renewable energy resources can play an important role in meeting substantial portions of the energy needs of certain parts of the State. As these efforts expand, the contribution to the State's total energy picture also expands. However, with proper governmental encouragement, a greater role can be anticipated for these alternative energy sources. Certainly, barriers to the expanded use should be eliminated.

The Plan has conservatively recognized the importance of setting goals by attempting to project both a "Base" case and a "Proposed" case. More can be done. I urge that SEO re-evaluate the potential contribution in the Proposed case by establishing reasonable goals for increasing renewable resource technology and use the Plan to accomplish such goals.

3. Oil Dependence, and the Electric Demand Forecast

The State Energy Law requires the State Energy Board to adopt electric and gas demand forecasts that are "binding" on the Siting Boards which, pursuant to Articles VII and VIII of the Public Service Law, must issue certificates of necessity before construction of electric and gas facilities in New York may begin. However, in recent years, the peak demand for electricity has dropped substantially. The historic rates of 7% annual electric growth may never reappear. Indeed, as I have already stated, our State may be on the threshhold of permanently re-configuring the ratio of its energy demand to given levels of economic activity so that we will produce more "buck for the BTU" and *vice versa*. As a result, it is questionable whether "need" as projected in the electric demand forecast will actually constitute a basis for granting a certificate of necessity in the next several years.

Nevertheless, the Board has recognized that there is no necessary link between the percentage the Board selects as the "correct" electric demand forecast and the decision by the Siting Boards to approve or disapprove a new electric generating or transmission facility during the planning period, 1980-1994. In the interests of 'backing out' oil and replacing it with alternate fuels, e.g., coal,* the Siting Boards can authorize construction of new plants that promise economies warranting installation before state utility reserve margins would otherwise indicate from demand forecasts alone.

Surprisingly, a definite consensus range of forecasts did develop in the record of the Board hearings. First, the actual aggregate range extended from 0.3% annual peak demand growth on the low end to a high side prediction of 2.7% annual increase (a difference in additional capacity requirements in 1994 of 1200 MW and 10,800 MW, respectively). Nevertheless, every party sponsoring a forecast had at least one of its predictions within a middle range of 1.4% to 2.4% annual peak growth (six of ten actual forecasts). Second, the mid-point of the adjusted aggregate forecast range (0.0% to 3.8%) is 1.9% annual growth, giving very substantial consensual record support for the 1.8—1.9% forecast the Board has adopted. Those who believe the adopted forecast is too high, and there are many who will so believe, can reasonably accept this figure in light of the evident consensus, especially in view of the inherently imprecise nature of the forecasting exercise. Similarly, those who fear that the Board's forecast is too low must recognize the flexibility the Siting Boards, as authorized by the Energy Board, enjoy in deciding purely on an economic basis how much and what kind of new construction is "needed."

Finally, the formulation of the range of electric demand forecasts and our ultimate adoption of one forecast in particular serve a valuable monitoring purpose. While deciding upon a number may not decide the fate of a new generation facility, it will provide a check on the methodologies used to arrive at the forecast and thus test their underlying assumptions, including energy/economy ratios, energy price/demand elasticities and the like. Here then is an opportunity to fine-tune the planning process even while it proceeds.

Accordingly, I emphasize the need for the State Energy Office to track and model, on an on-going basis, the effects of changing oil, gas and electricity prices, level of economic activity, and verified indicators of energy consumption. In particular, the state should carry out the intention expressed in the Board's Opinion and order to further explore the Cornell model, together with SEO's model, as these data become available. Such tracking and modeling will create a sound basis for evaluating such proposals to amend the adopted Plan as may shortly be offered as well as for generating such proposals directly. As I noted earlier, the State Energy Law expressly contemplates that our planning process is continuous and the Board is prepared to assure this procedure is observed.* In particular, far greater attention must be directed to the transportion sector. While coal conversions will help to reduce the consumption of imported oil, the largest source of demand for imported oil comes from cars, trucks and buses.

While major initiatives in this area must await Federal action, the Plan has recognized that the State must also act. This recognition is important yet at such a critical time in our energy history, the Plan's lack of specific proposals delays the ultimate implementation of any programs. The Plan does call for a "comprehensive list of legislative and administrative actions" concerning transportation to be presented to the Board in three months. We expect this list to include many specific proposals which can be readily implemented to meaningfully reduce oil consumption in the State.

4. Potential Benefits from Increased Interconnection of Utilities to the South and West

Parties in the Board hearings and the Board's Opinion and Order have importantly and wisely emphasized the great promise which conservation offers to solve our oil dilemma. An aggressive policy of conservation is the keystone of all the efforts built into the Master Plan. Conservation is not magic: it is simply cheaper, easier and minimally disruptive. These virtues derive from its logic, which implies doing more with and getting more from what we already have and do. As such, conservation is a principle of general applica-

* Our use of oil to generate electricity—which accounts for 20% of our total oil consumption—is the best and most crucial place to *begin* cutting back our dependence on oil. Ultimately, the transportation sector offers the greatest opportunity for absolute reductions but New York appears to have the most energy efficient transport sector in the country, based on the measure of per capita use of gasoline. Even so, we will soon be reviewing transport sector proposals that the State Energy Office is now preparing.

* Among the studies which the Board, in its Opinion and order, agrees must be performed, and which would help assure effective, continuous review and remodeling are: coal conversion and construction (pp. 17, 18-19), interconnection with out-of-state energy sources (pp. 19-20), nuclear power development (pp. 20-21), transportation (p. 24), and the scope of utilities' services (p. 22).

tion. Applied to the electric utility sector—the prime target of this Master Plan—conservation means better utilizing existing generating and transmission capacity for the purpose of: (1) burning less oil to produce electricity; (2) otherwise lowering unit costs of production of electricity.

The means to realizing these related purposes are the interconnections between utilities and transmission facilities which enlarge the geographic scope of their power markets and the range of economically available power purchases (economy, 'firm' wholesale, interruptible, peak, maintenance, reserve, and emergency services). In consequence, optimal utilization of *existing* power facilities—the day, month, and year—becomes a reality for all utilities economically within reach of each other. This, of course, translates into lower unit costs of production.

Further, such interconnection creates access to non-oil fired capacity and thus provides New York with the opportunity to 'back out' oil burning facilities. Particularly important to appreciating this potential benefit from increased interconnection is its potential cost advantage over building new non-oil fired generating stations. This is particularly the case where, as in New York, the main proposed alternative to oil is coal generation, which entails a costly array of environmental problems that, indeed, may actually preclude it as an option.

The advantages of interconnected and co-ordinated electric utility systems are well known in the industry. Indeed, the Federal Power Act* expressly recognizes the value of these measures for enhancing the efficiency and reliability of power production at lowest costs to consumers. Various studies to evaluate whether and how to further encourage coordination and integration of utilities on a regional and even national basis have appeared from time to time since passage of this statute. More recently, and after the Board hearing began, the Department of Energy issued the results of its investigation of these matters, *The National Power Grid Study,* in two volumes. (DOE/ERA—0056-1-2, October, 1979) In its summary of recommendations based on this inquiry, DOE declared:

> "Physical interconnection coordinated planning and development, and integrated operations yield significant benefits. Because high levels of interconnection, coordination and integration exist in some places but not in others, and because performance under these conditions is demonstrably improved, its extension should be continuously explored by the industry with Federal Government encouragement. Implementation should be undertaken where the sum of all tangible and intangible benefits exceeds total costs. While the extent of these opportunities (including transmission access options) may be debated, there is evidence that the roles and responsibilities of the utility industry, the National Electric Reliability Council and of State and Federal regulatory agencies should be appropriately augmented to complement and facilitate this recommendation."*

New York cannot afford to ignore this planning imperative. The uncertainties clouding an expanded role for nuclear power and the environmental problems of conversion to coal and construction of new coal plants require us to canvas *every* available option to shift away from oil fired electric production and to produce more power from existing facilities. Of course, the New York Power Pool is a fully interconnected, coordinated network of major utilities in the State. Ironically, it may be that this very coordination, being contained within New York, is part of the problem that interconnection in principle can solve—uneconomic isolation of a utility system.

More specifically, the time has come to look carefully at the alternative interconnection and coordination arrangements that may be economically feasible today or could be made economically feasible by acceptable investments in up-graded interconnection and transmission facilities to the South and West of New York. In particular, the supplies of coal-fired power now flowing from the American Electric Power system to the Pennsylvania-New Jersey-Maryland 'power pool' ("PJM")—but not into New York—should be considered in evaluating these possibilities. There is nothing eternal about the New York Power Pool. It may be that the down-state utilities, which are most dependent on oil as fuel, are actually disadvantaged by their coordination with the New York Power Pool. If so, they could begin to build out to adjacent and more distant systems which may have non-oil fired electricity to sell. Certainly, this state cannot prudently accept any refusal of New York utilities to reach for accessible power markets or to compete, e.g., with PJM, for these supplies.

In short, New York utilities must be encouraged to increase their economy and "firm power" purchases of non-oil fired electricity from adjacent and distant U.S. electric utility systems throughout the planning period wherever such purchases are economically feasible. This strategy should assure electricity supplies at lowest costs of service, displace oil-fired generation by New York utilities, and lessen adverse impacts on the State's environment from construction of new generation facilities. Upgrading of existing transmission facilities and construction of new facilities to permit such increased intra- and inter-regional power purchases may be necessary. However, this investment in transmission facilities may involve lower capital costs than constructing new non-oil fired generation stations in New York. Such transmission investment may permit greater utilization of the extremely capital intensive generation facilities of the electric power industry and therefore promises important economies for consumers and fewer detriments to the environment. Accordingly, these opportunities should be fully exploited and those institutional changes necessary to promote this effort must be identified and effected.

For these reasons, the Board's Opinion and Order directs the Public Service Commission to conduct an investigation that will: (1) locate "available" economical out-of-state power supplies; (2) determine the particular institutional and regulatory impediments and disincentives to obtaining these supplies; and (3) ascertain the particular investments in up-graded and new facilities necessary to support a much higher level of inter-regional power transactions and competition for valuable non-oil fired electricity technically within reach of New York utilities. The Board is to be kept informed of the on-going results of this inquiry and I urge that, upon its final report, the Board should consider what recommendations for statutory or regulatory reform are necessary and appropriate to help realize the potential benefits that I hope this investigation will demonstrate.

* * * *

In conclusion, I concur in the long range electric and gas forecasts and in the recommendations of the Plan, with the reservations stated here. The Plan can help to start New York State moving toward a more energy efficient and environmentally sound energy mix only if it does not get bogged down in seeking to apply old solutions to new problems.

* e.g. Sections 202(a) and 202(b) of the Federal Power Act. More recently, amendments to the Act by the Public Utility Regulatory Policies Act of 1978 emphasize these benefits.

* The National Power Grid Study, Vol. I (Draft), at IX-b.

The energy problems of New York State are among the most acute in the nation largely due to our dependence on expensive imported oil. Therefore, it is logical that new technologies in renewable resources, co-generation, and resource recovery will become commercially competitive here more quickly than in other parts of the country.

It is my hope that the Plan will become a more forward looking document which will recommend viable ways to reduce consumption, increase energy efficiency, and accelerate the implementation of renewable and alternative energy technologies. In this way, New York State can meet its energy needs while maintaining its economic health and the quality of its environment.

STATE OF NEW YORK
ENERGY PLANNING BOARD

ENERGY MASTER PLAN
AND LONG RANGE ELECTRIC
AND GAS REPORT PROCEEDINGS

STATEMENT OF DESIGNEE OF
TEMPORARY PRESIDENT OF THE SENATE

New York State's overwhelming reliance on oil as an energy source constitutes a serious threat to both the continued economic vitality of the State and the well-being of its citizenry. All sectors of New York's society must take expeditious and substantive actions to reduce drastically oil used for electric generation, space and hot water heating, and transportation purposes in order to reduce the multi-billion dollar drain on the State's economy. As increasing amounts of money are sent out of state to pay OPEC and southwestern United States oil producers for their products, New Yorkers are experiencing a continual erosion in their standard of living; businesses are being discouraged from expanding or locating in New York; employment opportunities are being lost; and state and local governments are being deprived of new sources of tax revenues.

The most important contributions of the Energy Master Plan process have been the identification of the oil threat and the development of an overall state policy objective of reducing oil use. That objective is supposed to be implemented by converting existing electric generating plants from oil to coal and constructing new coal plants, and by promoting natural gas as a substitute for oil in space and hot water heating. A major weakness in the Plan, however, is the absence of any proposals to reduce oil use for transportation purposes, which account for approximately 40% of total oil consumption in New York. This omission is not surprising, for neither the State Energy Office (SEO) in its draft plan, nor the parties in the planning proceedings addressed transportation sector oil usage in more than a superficial manner.

Despite the Plan's recognition of the oil threat and such overblown rhetoric as "oil reduction is the guiding principle of New York State energy policy over the next fifteen years," the actual strategies to reduce oil use are too limited and seriously flawed. In fact, the Plan projects that total State oil consumption in 1994 will be approximately what it is today, even with the recommended substitution of coal for oil in electric generation. Unfortunately, that dismal forecast prevails because the Plan concentrates on the utility sector and generally ignores the balance of the oil market, where almost 80% of the State's petroleum is consumed.

Even where the Plan focuses on oil reduction, too many issues have been left untreated to provide much confidence in the anticipated result. For example, oil reduction in electric generation, which is the centerpiece of the oil strategy, is proposed to be implemented through the massive substitution of coal. Approximately 6000 megawatts of existing oil generation will be converted to coal, and 3100 to 3600 megawatts of new coal generation will be constructed. In addition, the supply plan calls for increased imports of electricity from Hydro Quebec, improved interconnections with neighboring power regions, and extensive small hydro and cogeneration development, all for the purpose of obtaining access to additional non-oil generating capacity.

While all of these initiatives look good on paper, nearly all depend upon the willingness of state and federal agencies to expedite their normal regulatory procedures and issue the necessary approvals and permits. Government, however, may not be willing to speed up the regulatory process due to the serious environmental and health-related issues raised by the excessive dependence on coal. In addition, the electric supply plan will require substantial borrowings by both PASNY and the private utilities. The former will be constrained in its money raising ability by the willingness of the tax exempt bond market to absorb billions of dollars of new New York offerings, while the latter will be equally constrained by the effect on electric rates. Finally, the planned non-utility generation is even more doubtful. It will depend upon the willingness of countless individuals, businessmen and government officials to take the private and public actions necessary for the conservation strategies and alternative energy investments to become a reality.

The electric supply plan will not be effective unless it establishes explicit implementation roles for the responsible state regulatory agencies. Without such roles, those agencies cannot be held accountable to the public for the supply plan's success or failure. The Master Plan should have called for the following agency actions to be completed within six months.

The State Department of Transportation (DOT) should provide the SEO and Public Service Commission (PSC) with recommendations as to the movement of coal into and through the State to utility generating plants, establish routes for removing ash and scrubber sludge from plants to disposal areas, identify those improvements in the State's railroad system which are required to handle heavy coal traffic, and allocate an amount of transportation bond funds for coal-related railroad improvements.

In addition, the PSC should examine sources of funding and funding mechanisms, which would enable the utilities to finance the new construction, announce those policies it will support on an interim basis to finance the conversions and new plants, and prepare with the New York Power Pool (NYPP) a schedule for removing plants from service so conversions can take place without any disruption to the State's generating system.

Finally, the Department of Environmental Conservation (DEC) should expedite the report called for in the Plan and assure that it includes estimates of the incremental air and water pollution that will result from each plant conversion, recommendations as to whether scrubbers should be required for specific plants, and steps which must be taken to assure that the conversions take place and that overall air quality is maintained.

Beyond the issue of agency accountability, the electric supply plan should also have included an overall electric generation oil reduction target independent of the supply plan. Without such a target, there is no way to measure whether the supply plan is reducing oil use to the most economic optimum as oil supply and price circumstances

change. Instead, the Plan should have called for the elimination of oil as a fuel source for all electric generation within ten years, with possible exceptions for plants using coal-oil mixtures, or where oil remains economic for use for peaking purposes.

The electric supply plan also fails to acknowledge that the downstate area must absorb some, if not most, of the new plants. New York's dependence on oil generation is primarily a downstate problem and residents of that area cannot expect to place all of the new plants and transmission facilities upstate. The Plan should make clear that no section of the State will be an energy colony for the remainder of the State.

The weaknesses in the supply plan are disturbing, for if the Plan is not implemented, the economic consequences for New York will be severe. The State will continue to rely substantially on base load oil generating plants and gas turbines (which are fired by oil derivatives) for electricity through the end of the century. Further, the consequences could be even worse if the actual electric growth rate is higher than the Plan's modest 1.8 to 1.9% estimated rate. Since the Plan has taken a conservative approach to authorizing new generating plants, incremental amounts of electric demand resulting from higher than expected growth will be generated from oil-fired facilities.

The Plan's oil reduction strategy for hot water and space heating is not much more encouraging. Space and water heating account for the second largest oil use in New York; and, fortunately, such oil use can be replaced by alternate energy forms. The Plan's strategy in this area is to promote natural gas as an oil substitute and to propose some modest energy conservation proposals.

The specific program to promote gas use originally included favorable pricing policies, proposed actions to extend the existing gas distribution system, and recommendations to develop new sources of gas supply. However, the gas program language has been so obfuscated by compromise that it could be used to justify practically any gas regulatory policy. Thus, while short-run market forces may encourage individuals to switch from oil to gas for heating purposes, conversions will likely occur regardless of the Plan and not because of it.

The Plan's failure to establish a clear gas promotion policy does, however, reflect a serious dispute on the merits of such a policy. Based upon the record in this proceeding, there is little credible evidence from which to forecast with assurance either the long range gas supply available to New York or the likely price of that gas.

As a result of increased LNG imports and federal deregulation, natural gas is currently available to permit additional residential hook-ups. Deregulation caused the so-called "gas bubble" as large quantities of gas were transferred from the intrastate to the interstate markets. In addition, recent import agreements with Canada and Mexico have increased pipeline supplies. However, even with the increased supplies, there is still not enough gas to meet present demand, much less the increased demand that could be induced by promotional policies.

In addition to the supply issue, a gas promotion policy has other weaknesses. Increasing the use of gas from foreign sources will not cure New York's dependence on foreign energy suppliers nor end the economic devastation that results from sending billions of dollars out of state to pay for those supplies. Such a policy may also mislead potential gas consumers with respect to price. Domestic gas prices will be totally deregulated by 1985, and additional supplies from geopressurized methane, tight sands, Devonian shale, deep drilling, and from Alaska will be exceedingly expensive. Further, foreign countries will likely continue pricing their gas exports in line with OPEC oil prices. Thus, a gas promotion policy may erroneously encourage New Yorkers to switch from oil to gas for price reasons even though gas can be expected to achieve price parity with oil in the mid to late 1980's.

While natural gas is an option for reducing oil use in space and hot water heating, it is not the only option. The Plan, which does call for stricter building conservation initiatives, should also recognize that electricity is an alternative to oil for space and water heating. Electric heat pumps are presently more economic to operate than oil furnaces in most areas of the State and solar or ground water assisted heat pumps will be even more competitive.

Large scale conversion of space heating from oil to electric heat pumps may establish electricity demands that can only be met from oil-fired generating stations. While such a situation would be beneficial to consumers by shifting their demand from expensive #2 fuel oil to less expensive residual oil, it would not further an oil reduction strategy. In order to implement such a strategy by means of heat pumps, additional new non-oil generating capacity will be required beyond that listed in the electric supply plan.

Because the Board focused on gas promotion, it failed to recognize the potential electric demand that could result from an affirmative program to promote electricity as an oil substitute. As a result of this failure, the Board's forecasted growth rate is too low to permit licensing of plants that may be necessary for oil substitution purposes. (Pursuant to the Energy Law, the Board's forecast of electric demand in the Long Range Electric and Gas Report is binding on the Article VIII siting boards with respect to the question of "need" for new generating plants. Thus, the forecast effectively limits the number of plants that can be licensed under the siting process.)

The third major area of oil use beyond electric generation and space and water heating is transportation. The Plan actually projects a slight increase in oil use for this purpose over the 15 year planning period. However, the doubling of gasoline prices within the past year and the reappearance of shortages and gas lines highlight the need to develop both conservation strategies and alternatives to petroleum use in the transportation area. The Board has recognized this need and directed SEO and DOT to develop a program to reduce transportation oil use.

Electric vehicles may offer one of the best alternatives for achieving major reductions in transportation oil use, and their utilization could also reduce air pollution significantly in congested metropolitan areas. Such vehicles are currently in the developmental stage and their commercial availability is not far off. In fact, General Motors last year announced plans to sell electric vehicles in the mid 1980's. The Plan, however, has failed to consider the electricity demands that would be created if large numbers of electric vehicles were introduced into the automobile market in the latter half of the planning period.

As a complement to the strategy of fostering substantial coal use downstate, the Plan should have included targets for switching many of the commercial, mass transportation and private vehicles in the major metropolitan areas to electricity by 1994. Even without setting targets, the Board could have directed DOT and the regional transportation authorities to examine possibilities for using electric vehicles, and recommended that a portion of the transportation bond funds be made available for electric vehicle demonstration programs.

The failure to plan for reducing non-utility oil dependence is a serious Plan weakness. Two of its major policy determinations, however, may actually be detrimental to

the State's best interests and hinder efforts to reduce oil use. First, there is no basis in the record for the finding that new nuclear power plants should not be included in the electric supply plan at this time. Second, the electric demand forecast of 1.8-1.9% (which is a reduction from the draft Plan's 2.1%) is too low.

The Three Mile Island accident occurred during the planning process and brought about an intensive examination of the regulation and operation of nuclear power plants. That examination has called for institutional changes by both the regulators and the utilities, but it has not recommended that the country forego future nuclear development. In fact, the President and Congress have re-affirmed this country's commitment to nuclear power. New York should do likewise.

Support for nuclear power development should not equate with complacency on nuclear-related safety and health issues. No one can question the need for the federal government to establish final geologic storage facilities for nuclear wastes or to provide more stringent and consistent supervision over the construction and operation of nuclear plants. However, states also have a role to play and cannot escape addressing issues of local responsibility. Plant siting is one such issue. States should assure that nuclear reactors within their borders are sited in areas away from major population centers. The Plan should have recognized this responsibility and directed the SEO and PSC to work with the NYPP to identify appropriate sites.

States should also monitor the operation of existing nuclear reactors and develop workable evacuation plans for use in emergencies. The Plan could have directed that management and training programs for plant operating personnel be strengthened. Further, the PSC should review its policy with respect to allocating costs of nuclear plant shutdowns. It should determine if that policy creates economic incentives to return plants prematurely to service rather than incentives to assure that all safety requirements are met prior to placing plants back on line.

Instead of addressing the State-related issues and attempting to find solutions, the Board chose to forego the nuclear option entirely. Faced with the possibility of war in the Middle East to protect our oil supplies and the dubious privilege of paying exorbitant prices for foreign oil, I think it is quite shortsighted to reject any option which can make us less oil dependent.

The Board's decision has substantial environmental, health and economic consequences in addition to the political consequences. Initially, the nuclear moratorium leads to the Board's total reliance on coal to cut oil consumption in electric generation. This reliance occurs even though the record is clear that the operation of coal plants will be quite detrimental to health and environmental concerns. Among the consequences will be an increase in carbon dioxide in the atmosphere, which may cause long run climatic changes, and the destruction of plant and animal life from so-called "acid rain." The testimony also demonstrates that there are no air quality emission standards for the vast majority of pollutants from coal plants. Thus, New York will be taking a substantial risk in introducing into the atmosphere vast quantities of pollutants without knowing the long run health effects of such pollution.

The economic consequences of a nuclear moratorium may also be great. Reliance on coal increases the chance for strike-related economic disruption, and coal can be expected to rise in price in the absence of competition from nuclear. Price will also be affected by regulatory actions, such as the Interstate Commerce Commission's recent decision to escalate coal rail transport rates.

The rush to rely on any single energy form is surprising when one considers that less than two years ago coal strikes and cold weather forced the midwest to import oil generated electricity from the northeast to keep its homes, schools and factories running. Three years ago, natural gas was in short supply and seven years ago, we suffered through an oil embargo. The lesson that we should have learned from events of the past decade is not to place excessive reliance on any single energy form. Unfortunately, the Board has ignored this lesson by rejecting nuclear power and by relying exclusively on coal for new generating plants.

For all of the above reasons, I believe that the Board's nuclear position is not in the State's best interest. I do, however, support the recommendation for a special committee to review nuclear issues. Faced with a *de facto* nuclear moratorium, I am hopeful that the committee will be the vehicle to address State-related nuclear issues so that nuclear development can proceed in New York.

The committee should not be an excuse for further delay. At some point, government must commit itself to adopting policies and to implementing those policies. Although the committee proposal offers the chance for forward movement, there is an equal chance that it may merely continue the State's policy paralysis on the nuclear issue.

The second detrimental policy determination is the Board's long range electric demand forecast of 1.8-1.9%. I have already explained how that forecast will limit oil substitution in the heating and transportation oil use sectors. In addition, the forecast will tend to discourage economic growth. The forecast was the principal contested issue in the Board's hearings on the draft Plan. During the proceedings, the respective merits of econometric, end use and engineering models, or combinations of the three, were sharply debated. Broad claims were made for their ability to predict long run electricity demand. Having attended most of the hearings on the models and observed much of the cross-examination of their proponents, I do not find the models either persuasive or helpful in making the demand forecast.

Unfortunately for the models, most must rely on historic data. From this data and economic theory, an attempt is made to project future growth trends. Unluckily for the Board, in a time of accelerating change, there is little reason to believe that the past can accurately foretell the future. For example, SEO made fifteen year oil price projections in its draft plan of August, 1979. These projections were made at a time when oil prices were escalating quickly due to the Iranian revolution. The SEO model, however, could not take into account the upheaval in world oil prices and SEO's 1994 price projections were eclipsed by actual oil price increases within six months.

Electric demand models are also forced to aggregate data to reduce the number of variables and to make simplifying assumptions to fit the complexities of the real world into those variables. Further, they cannot predict major governmental policy initiatives which dramatically change underlying assumptions. A policy of promoting electricity as a substitute for oil is an example of one such initiative.

Since it is useless to rely on the bogus scientific certainty of the models, the Board should have decided what electric capacity is necessary to implement its oil substitution and economic development objectives. Thus, the policy determination would determine the forecast and not vice versa.

The Board's forecast is not only poorly justified from a planning perspective, but it will also have a detrimental effect on business and labor perceptions of New York's commitment to economic growth. The low growth rate presents the message that New York is prepared to forego potential industrial development, jobs and taxes. That message will be heard, and a low growth rate will become a

self-fulfilling prophecy as businesses look elsewhere to expand and locate.

The Plan should have forecasted a growth rate of at least 2.5%, which would still be below the projected national rate of 2.8%. The 2.5% rate was advocated by the State Commerce Department as necessary to support an active growth economy. In addition, such a forecast would give the siting boards the flexibility to authorize new power plants to meet oil substitution demands. Even with a rate of 2.5%, however, it would be a challenge for New York to provide electricity for both growth and oil substitution purposes without the institution of aggressive load management policies.

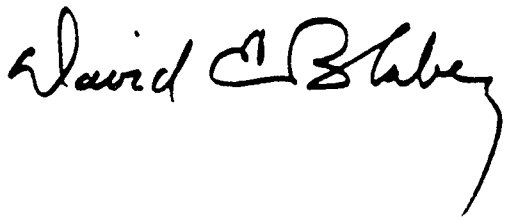
It would be difficult to finance the plants authorized by a 2.5% rate, even as it will be for those authorized by the Board's 1.8-1.9% rate. Consumers will be faced with higher electric rates, and the state and federal governments will have to provide assistance. The choice, however, is clear. Unless we are willing to bear the financial burden in the short run to end our addiction to oil, we will surely pay dearly in the long run. Oil may simply become too expensive to burn in generating plants without stringent limitations on the amount consumed. If this happens, electric consumers will be faced with both rationing and penalty rates as government attempts to restrict electricity consumption.

At several Board meetings, I publicly stated my disapproval of several minor Plan recommendations. Among the recommendations are proposals relating to ENCONO, PASNY and ERDA. All of these proposals are currently before the Legislature and will receive due consideration from the appropriate committees. Thus, the Plan's endorsement of the proposals is preemptive of the Legislature and premature.

In conclusion, I vote to approve the Plan, but only to the extent it is consistent with the provisions of this statement. The planning process has taken approximately fourteen months, and during that time oil prices have increased by more than 100%. New York needs an oil reduction strategy, and many of the Plan's provisions will help to reduce oil use. Further, the electric supply plan offers the opportunity of substantially reducing oil use in the electric utility sector. It deserves to be implemented without further delay. Finally, it is clear that the Master Plan represents an initial attempt to create a comprehensive State energy strategy. While I think more can and must be done to develop such a strategy and to free New York from oil dependence, I am persuaded that the Plan can and will be improved through the amendment process.

As more particularly explained in this Statement, I vote to disapprove the Board's forecast of electric demand for purposes of the Long Range Electric and Gas Report.

February 15, 1980



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