

PPSP-CEIR-2

POWER PLANT CUMULATIVE
ENVIRONMENTAL IMPACT
REPORT

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IMPACT REPORT

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Maryland Department of Natural Resources

Comments and requests for additional copies should be addressed to Editor, Cumulative Environmental Impact Report, Power Plant Siting Program, Maryland Department of Natural Resources, Tawes State Office Building, Annapolis, Maryland 21401

FOREWORD

The job of compiling and editing the Cumulative Impact Report could not have been accomplished without the help and cooperation and many people and organizations.

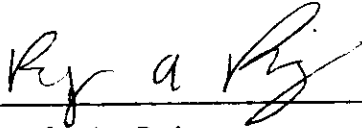
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Editor

SUMMARY

Chapter I - Energy

During the five years prior to 1973, Maryland electric energy peak demand grew by an annual average rate of 8.3%, and consumption grew by 8.6%. During the 1973-1975 period, those rates dropped to 0.0% and -0.3%, respectively. In the 1975-1977 period, growth in both peak demand and consumption resumed, to 5.0% and 7.4%/year. Forecasts prepared by the Power Plant Siting Program and the Maryland utilities project growth in peak demand over the next ten years to average 4.0%/year for the utility systems serving Maryland (3.4%/year for the portion of their service territories within Maryland).

The total time required for the construction of large-scale electric generating plants ranges up to 8-10 years for coal plants and up to 15 years for nuclear plants. Utilities plan for new capacity requirements ten or more years in advance. Maryland utility systems plan to add 3,024 megawatts of generating capacity by 1987 within Maryland. An additional 4,245 megawatts of capacity within Maryland is tentatively projected for the period 1987 to 1997. The projected increase in load factors will result in the addition of relatively more baseload capacity by these systems.

Comparison of capacity from existing and proposed plants with demand projections for the utility systems serving Maryland indicate that adequate electric power will be available over the next ten years. Based on Power Plant Siting Program demand projections and completion of planned generation additions, utility capacity plans will result in reserve margins above 25% for most of the period, with reserve margins reaching 30% by 1980, and dropping to the 25-27% range for the remainder of the period. As a result of reported financial and licensing difficulties, the Allegheny Power System (which includes Potomac Edison) may be unable to construct two generating stations planned to come online in the years 1983-1987. Based on the utility's demand projections, this contingency could cause available capacity over those years to fall as low as 10.9% below peak demand.

Chapter II - Air Impact

Of the five major pollutants emitted by all sources in Maryland, power plants contribute negligible amounts of carbon monoxide and hydrocarbons, about 30% of the NO_x , 32% of the particulates and 69% of the sulfur oxides.

For the three main power plant pollutants (NO_x , particulates and SO_x), the air quality is as follows: For particulates, the general areas of Baltimore City and the Potomac River valley near Bloomington are in violation of Federal Ambient Air Quality Standards. All areas are in compliance with standards for sulfur and nitrogen oxides. However, for photochemical oxidants (for which NO_x is a precursor), the areas near Baltimore and Washington have been declared non-attainment areas.

Various methods of sulfur oxide emission control have been analyzed for availability and cost. Comparative costs indicate no major difference (for a new plant) between the use of flue gas desulfurization, starting with high sulfur coal, physical coal cleaning and the use of low-sulfur coal. The use of scrubbers can also generate substantial amounts of waste, (for example, 200 tons/hour for a 1000 MW plant burning 3.5% sulfur coal using a lime scrubber).

The Gaussian plume model, in view of its central role in the prediction of air quality, has been tested using measurements at Maryland power plants. The model has been found to be generally accurate to a factor of two, given flat terrain, low to moderate distance extrapolations, and moderate winds. The limitations on model accuracy in conditions other than these are discussed.

The implications of the Clean Air Act Amendments of 1977 upon the siting of power plants are discussed. Because of provisions related to the Prevention of Significant Deterioration (PSD) and non-attainment areas, the size and potential locations of new coal-fired power plants may be limited. In particular, the designation of a Class I area in or near Maryland could severely limit the potential for siting a 1000 MW coal-fired plant by creating a 40-80 mile "exclusion" zone surrounding the area. Because of the large area of influence of coal-fired plants, the implications of PSD-related growth limitations will lead to competition for use of the available increments within the State. Similarly, the interstate nature of air pollutant transport may lead to competition and dispute between states.

Chapter III - Aquatic Impact

Power plants can cause aquatic impact in several ways: (1) by entraining fish eggs, larvae or prey organisms into a cooling system where they are subjected to thermal, mechanical and chemical stresses; (2) by impinging adult and juvenile fish and crabs on intake screens; and (3) by discharging heat and chemicals into receiving waters.

Cumulative impact has been examined by salinity/habitat zone. Dividing the aquatic habitat into three general areas, we can draw the following conclusions:

Mesohaline (5-19 ppt)

Because of the high reproduction rates of the plankton and good tidal mixing at existing plants, depletion of plankton populations has not occurred. Spawning occurs throughout the Bay for the species of fish present here, so local depletions are insufficient to decrease Bay populations. Impingement totals are small compared to mortality due to other sources. In addition, efforts to reduce these totals are now underway at all three existing plants, Calvert Cliffs, Morgantown, and Chalk Point. Habitat modification effects, usually more subtle in nature, have minor, localized impacts as described in this chapter. Coupled together, the power plant monitoring studies show a low cumulative impact on the mesohaline environment.

Tidal Fresh/Oligohaline (0-5 ppt)

The major area of concern within this region is the impact of cooling water withdrawals upon the nursery and spawning areas of striped bass and other anadromous species. Possum Point and Vienna have the highest potential for impact. New facilities planned for this region (Douglas Point, Summit and Vienna) would increase withdrawals. The overall impact upon striped bass due to entrainment drops from an estimated 6.6 percent entrainment (upper bound) of the eggs and larvae spawned in the Maryland portion of the Bay at present to an estimated 3.4 percent (upper bound) after 1987. The addition of Douglas Point and Summit is more than off-set by the retirements of the once-through cooling units at Vienna. No impingement data is available at any of the present plants; however, degraded water quality at the Baltimore and Washington plants appears to have severely restricted fish populations in these waters. Similarly, habitat modification effects or depletion of plankton would be difficult to detect. Ongoing studies should help to quantify these effects at the existing Maryland plants. The proposed plants are expected to have no major impacts in the areas of impingement or habitat modification due to the small amount of water withdrawn.

Riverine

No impact is expected from entrainment and impingement. Studies of possible habitat modification due to the discharge of heated effluent are now underway at both of the existing plants in this region. These studies are expected to be completed during 1979.

Chapter IV - Radiological Effects

The Calvert Cliffs Nuclear Power Plant, owned by Baltimore Gas and Electric Company, is the only operating nuclear power plant in Maryland. No other nuclear generating stations are scheduled to begin operations within the next ten years.

Spent reactor fuel is accumulating at Calvert Cliffs because the Federal government has halted commercial reprocessing, and has not yet developed its own plans for taking over the job of disposal. By the end of 1978, there will be a total of 216 spent fuel assemblies stored at the plant. BG&E has received permission from the Nuclear Regulatory Commission to expand the capacity of their spent fuel storage pool to 1056 assemblies. This will provide sufficient storage to continue plant operations through 1984, by which time it is hoped that the Federal government can begin accepting spent fuel from commercial reactors.

Discharges of radioactivity from the power plant have been small fractions of the quantities and concentrations allowed, never reaching 10% of any of the various limitations imposed by the Operating License.

Environmental monitoring in the vicinity of the plant has shown the radiation dose to the public from plant operation to be quite small. Calculations from the reported release rates yield 0.2 mrem whole body dose and 0.6 mrem skin dose for the calendar quarter of maximum release.

Radioactivity discharges to the Chesapeake Bay have resulted in detectable concentrations of Ag-110m, Co-58, and Co-60 in sediments and shellfish. The area yielding samples with detectable concentrations of plant effluents extends for roughly six miles up and down the western shore, with maximum values found at the plant discharge area. The radiation dose to an individual eating 29 dozen oysters and 15 dozen crabs (5 kg of each) taken from the plant discharge area would be about 4/1000 mrem whole body dose and 0.2 mrem gastrointestinal tract dose (about 0.007% and 0.5% of the applicable guidelines, respectively.)

Comparison of these power plant-induced doses with the fluctuations in natural radiation dose already experienced by the public indicates that the power plant effects are insignificant. For instance, detected variations in the natural radioactivity of the soils from place to place in Calvert County can create differences in annual radiation dose of 30 mrem, and different construction materials have been shown to cause changes of 14 mrem/year in the interior dose rates of buildings. These natural variations are tens of times greater than the maximum doses resulting from Calvert Cliffs Power Plant.

Although operations to date provide an insufficient basis to predict radiological impact of the Calvert Cliffs Plant over its operational lifetime, available data indicate that the plant should continue to operate with insignificant radiological impact, well within all applicable guidelines.

Chapter V - Socio-Economic Impacts

The construction of an electric generating station may have socio-economic effects upon the community in which it is located. Among the possible effects during construction are changes in population leading to strains in housing, schools, employment, transportation, and increased demands on local government services. The scale of the effects vary according to the population base of the county in which the plant is located and the distance of the site from major metropolitan areas.

Increased demands for county and municipal public services also varies during the construction period. In some instances the increased cost of public services can result in large budget deficits at both the county and municipal level as construction period revenue increases fail to keep pace with service costs. In the study case of potential Eastern Shore power plant sites, annual municipal budget deficits were estimated to range from 3% to 21% for nuclear plant construction. The same study projected the largest county deficit at 4%, with other counties experiencing revenues and expenditures which were essentially in balance.

After a new plant starts operation, the tax revenues to county governments are on the order of several million dollars per year or greater depending on plant size and local tax rates, and the service costs are small.

Chapter VI - Other Impacts

Cooling towers can be an environmentally-acceptable alternative to once-through cooling. Basically, a cooling tower exchanges consumptive water use and possible terrestrial effects for effects in the aquatic environment. There also is a loss in energy production. Because the balance of these effects is site-specific, each plant location should be examined to determine the appropriate cooling system.

Studies at Chalk Point indicate that salt deposition from the natural draft cooling tower would not exceed 8 kg/ha/month (7 lb/acre/month) at the maximum point. Experiments to determine the sensitivity of corn, soybeans, or tobacco indicated that no significant effects occurred at deposition rates below 20 kg/ha/month (18 lb/acre/month).

The routing of transmission lines deals with effects that may have aesthetic, ecological, health and physical implications. The aesthetic effects generally include trade-offs between visibility and environmental protection. Ecological effects can be both positive and negative and must be evaluated on a case-by-case basis. The electrical effects are now well understood and are potentially significant only for locations within, or extremely close to the right of way. The health effects remain an area of controversy, mainly due to differing medical results from U.S. and Soviet studies.

Although the withdrawal of groundwater is relatively high at power plants compared to most other industrial sources, due to the relatively sparse usage of the deep aquifers they have tapped and the large area occupied by the power plant sites, there has been no significant impact upon present wells near these plants. However, if a major increase in withdrawals from the Magothy aquifer were to occur in the neighborhood of Chalk Point, there could be significant impact upon users of the Magothy aquifer in that area.

RECOMMENDATIONS

1. It is recommended that the present requirement in law for a 10-year plan from each electric utility be extended to 15 years. Present trends indicate that 8-10 years are required to locate, license, and construct a fossil-fueled plant and 10-15 years are required for a nuclear plant.
2. Although studies to date indicate that there have been no significant cumulative impacts on the aquatic environment due to power plants, studies of long duration are needed to validate that initial conclusion. Cumulative impact assessment by salinity habitat zone should continue for the purpose of finding any cumulative impact thresholds that might impose limits on the siting, design or operation of future power plants.
3. Issues arising under the Federal Clean Air Act Amendments will seriously impact the State's ability to carry out orderly planning for the siting and construction of new fossil-fueled power plants. These issues include the allocation of "Prevention of Significant Deterioration" (PSD) increments among all emitting facilities, the requirement for emissions offsets for new sources locating in or near non-attainment areas; and the interstate nature of air pollutant transport and resulting regulatory issues. Since all emitting facilities are affected, not just power plants, the resolution of these issues must be achieved on a comprehensive basis. As initial steps the following actions are recommended:
 - a. A policy board should be convened to devise alternative strategies for allocating PSD increments among new sources. This board would be composed of representatives of the Departments of Economic and Community Development, Health and Mental Hygiene, State Planning, and Natural Resources.
 - b. An offset bank exchange center should be established that would facilitate the purchase of emissions offsets for new sources wishing to locate near non-attainment areas or near areas where the PSD increment has been fully utilized.
 - c. The State should pursue the creation of a multistate planning council, for example, through the National Governor's Association, whose purpose will be to:
 - (i) provide a clearinghouse for information on all sources likely to contribute significantly to pollution levels across State boundaries as well as regulatory actions related to those sources.

(ii) provide a forum for the resolution of disputes between states on consumption of PSD increments by interstate transport of pollutants.

4. Current State law prohibits storage of spent fuel in Maryland for longer than two years. As amended during the 1978 General Assembly Session, this effectively prohibits storage of spent fuel at Calvert Cliffs beyond January, 1980. In view of the lack of facilities to accept this spent fuel anywhere in the nation, legislation to resolve this dilemma must be considered.

Since the findings of Chapter 4 indicate no environmental impact from the additional storage, it is recommended that legislation to allow continued storage at Calvert Cliffs be enacted during the 1979 session pending action of the Federal government to provide permanent storage.

5. Although available data indicate that the Calvert Cliffs plant should be able to continue to operate with insignificant radiological impact, operations to date provide an insufficient basis to predict radiological impact of the plant over its operational lifetime. Therefore the State should continue its program of data collection to provide for continuing cumulative impact assessment.

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CHAPTER I

ENERGY AND ELECTRIC POWER

Since the publication of the first Cumulative Environmental Impact Report in 1975, a number of major changes have occurred which will affect the generating requirements and plans of Maryland's electric utilities. The recession and steep rise in fuel prices which occurred after the oil embargo caused a decline in the use of electric power in 1974. The use of electric power leveled off as Maryland's economy recovered and fuel price moderated. Growth in the use of electricity has resumed, but at a lower rate than before. In consideration of the earlier decline in usage and the current lower average annual rates of growth, Maryland utilities have delayed or postponed the addition of some generating units, and have rearranged the construction schedule of others.

This chapter reviews the status of electric utilities in Maryland. The purpose of the chapter is to provide an analysis of future electric generating requirements. Because the demand for electric power in Maryland and the types of generating capacity selected by Maryland utilities are strongly influenced by national economic and energy trends and policies, the chapter begins with a description of the organization of the electric utilities in Maryland. Next national energy trends and projections are discussed, followed by the current projections of electric power demand for the Maryland electric utilities, and analyzes their plans for new generating capacity over the next twenty years. This analysis includes a discussion of likely trends in both plant types and siting. The chapter concludes with a discussion of the adequacy of the future supply of electricity in Maryland.

A second function of this chapter is to make available a compendium of information on historic and projected electric power use and generation in Maryland.

The analysis of electric power supply in Maryland is based on traditional central generating station systems. Energy conservation and decentralized alternative energy systems are not discussed explicitly, but are to some extent implicit in the Power Plant Siting Programs independent demand forecasts. Maryland's energy conservation and alternative energy programs are managed by another unit of the Maryland Energy and Coastal Zone Administration of which the Power Plant Siting Program is a part.

A. Electric Utilities in Maryland

Most of Maryland's electrical customers receive power generated by one of five major electric utilities. All except Conowingo have power plants in Maryland.* These utilities are:

* Two utilities, Susquehanna Power Company (a subsidiary of Philadelphia Electric) and Pennsylvania Electric Company have hydroelectric facilities in Maryland at Conowingo Dam and Deep Creek Lake, respectively. Neither utility has customers in Maryland.

- Baltimore Gas and Electric Company, serves 714,633 residential customers, with 1977 peak load of 3,588 MW and total megawatt hour sales of 15,462,000 MW.
- Conowingo Power Company, a non-generating subsidiary of the Philadelphia Electric Company, serves 20,982 residential customers, with 1977 peak load of 85 MW and total megawatt hour sales of 419,926 MWh.
- Delmarva of Maryland, a subsidiary of Delmarva Power and Light Company, serves Delaware and portions of Maryland and Virginia. Delmarva of Maryland serves 68,816 residential customers with a 1977 peak load of 400 MW and total megawatt hour sales of 1,726,551 MWh. Delmarva also provides generation for municipals and cooperatives located in its service territory.
- Potomac Electric Power Company, serves portions of Maryland, Virginia and the District of Columbia. PEPCO serves 249,384 Maryland residential customers with a 1977 system peak load of 3,857 MW and total megawatt hour sales of 8,342,247 MWh in Maryland, including wholesale sales to the Southern Maryland Electric Cooperative.
- Potomac Edison serves customers in Western Maryland, eastern West Virginia, and northern Virginia. A subsidiary of the Allegheny Power System, Potomac Edison had a 1977 Maryland peak load of 1,018 MW and total sales of 5,604,079 MWh, and serves 107,682 residential customers in Maryland. The Potomac Edison 1977 system peak was 1,486 MW, with system sales of 8,349,010 MWh.

In addition to the major utilities, Maryland is served by a number of municipally-owned utilities ("municipals"), most of which purchase power from the generating companies at wholesale rates and distribute that electricity within their service areas, and by rural electric cooperatives ("cooperatives") which are owned by their customers and most of which also purchase their power from the generating companies. The municipals and cooperatives operating in Maryland are:

Municipals

Berlin
 Centreville
 Easton
 Hagerstown
 St. Michaels
 Thurmont
 Williamsport

Cooperatives

Accomack - Northampton
 Electric Cooperative

 Choptank Electric
 Cooperative

 Somerset Rural Electric
 Cooperative

 Southern Maryland Electric
 Cooperative

Of the municipals, only Easton has generating capability. Easton currently has 32.6 MW capacity, and is included in this chapter as part of the Delmarva Group, consisting of the Delmarva Power and Light Company system, Dover, Delaware (a municipal system), and Easton.

The service territories of the Maryland utilities are shown in Figure I-1.

In addition to generating their own power, utilities may arrange for purchases of power from plants owned by other utilities to which they are connected by a transmission system. Such purchase may be made on a "firm power" basis as a substitute for a utility's own capacity, or may be made either on an emergency basis (such as the temporary failure of one of its own units or a level of demand larger than anticipated) or on an "economy" basis. Economy sales and purchases are exchanges between utilities which permit the utility to select the least expensive electricity available at a given moment either from its own generating units or from units owned by another company. Utilities can function as a power "pool," in which all of the plants of the member companies are treated as belonging to a single entity -- the "pool" -- and power is sent out to a given utility from the most efficient unit (i.e., the unit with the lowest cost of generation) available at that moment, regardless of ownership or location.*

Four of the five Maryland electric companies belong to the PJM Interconnection, a power pool made up of 11 utilities in Maryland, Pennsylvania, New Jersey and Delaware.** (Potomac Edison, the fifth major utility is a subsidiary of the Allegheny Power System, which operates its three subsidiary companies as a fully integrated system in a manner analogous to a power pool.) These utilities interchange electricity between each other on an economy basis. As a result, the extent to which each utility generates its own electricity is largely a function of the availability of less expensive generation elsewhere in the system at a given moment in time. This, in turn, depends on the efficiency of the plants owned by each utility and on the pattern of demand experienced by each company at a given moment.

Figure I-2 illustrates sales and purchases to other utilities for BG&E and PEPCO (1), for the calendar years 1976 and 1977. The Figure shows the change in the relative amounts of purchases and sales of power from other utilities (mostly within the PJM power pool) which occurs over an annual demand cycle, particularly the shift towards purchases of power during the summer months during which these two utilities experience their highest level of demand. The figure also shows the shift towards deliveries of power to the pool as a large amount of capacity becomes available from new units with lower capital costs, as when the second BG&E Calvert Cliffs nuclear unit came on-line

* Transmission costs are incorporated into the send-out decisions.

** The PJM members are: Atlantic City Electric Company, Baltimore Gas and Electric Company, Delmarva Power & Light Company, Jersey Central Power & Light Company, Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power & Light Company, Philadelphia Electric Company (of which Conowingo is a subsidiary), Potomac Electric Power Company, Public Service Electric and Gas Company, UGI Corporation

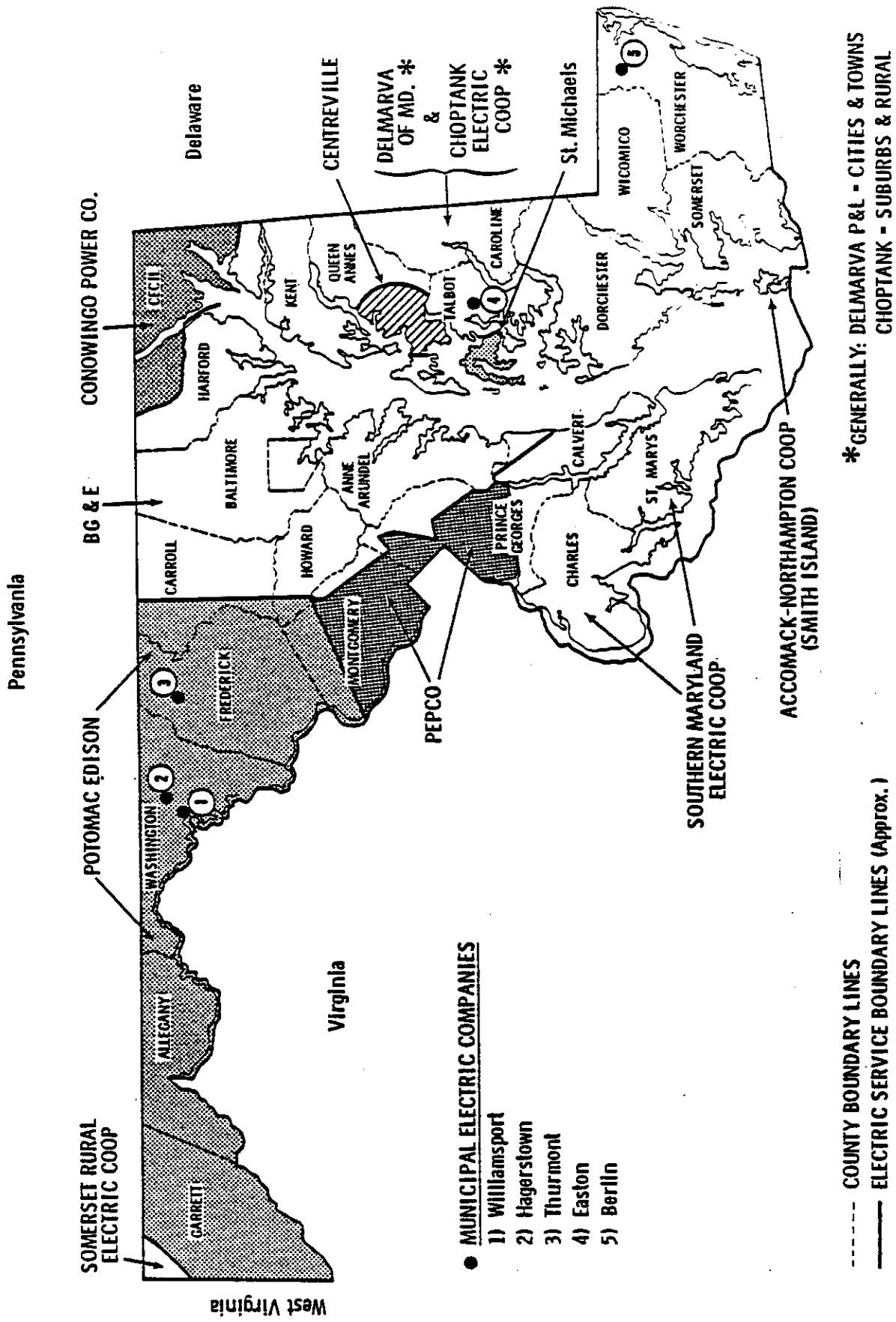


Figure I-1. Service territories of Maryland electric utilities

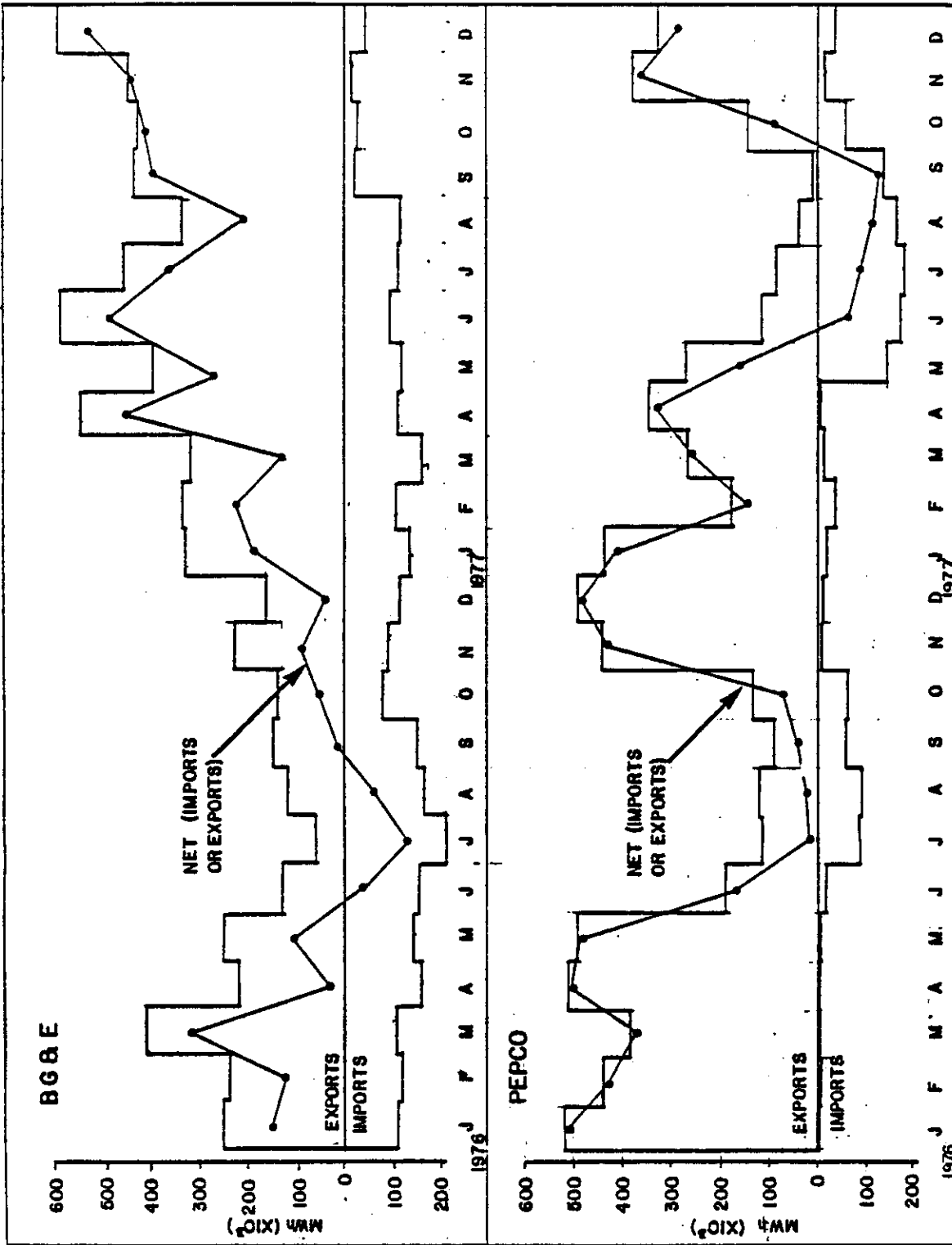


Figure I-2. Imports and exports of electric power by BG&E and PEPCO, 1976-1977

in April of 1977, or during winter months during which these utilities experience lower levels of energy use by their own customers.

Historically, Maryland has been a net importer of electric power. In recent years, imports have ranged from a low of 1.2% of total electric power use in 1977 to a high of 13.9% in 1975. BG&E, Potomac Edison, Delmarva of Maryland, and Conowingo have historically been net importers of power, while PEPCO, Pennsylvania Electric (owner of hydroelectric capacity at Deep Creek Lake), and Susquehanna Electric (owner of hydroelectric capacity at Conowingo Dam) have been net exporters. Table I-1 gives the net imports and exports of power for Maryland by utility from 1967 to 1977 (2).

In addition to whatever pool arrangements they may make, U.S. utilities were required by the Federal Power Commission* to form regional Electric Reliability Councils. Formed as a consequence of the 1965 Northeastern power blackout, the purpose of the councils was to develop a level of utility interconnection and system reliability adequate to reduce the likelihood of large-scale power blackouts. These reliability councils serve as planning bodies to coordinate utility generation and transmission planning. They do not serve the economy send-out function of power pools. However, the councils do monitor the availability of plants in their own and neighboring territories, they make that information available to member utilities hourly, and they coordinate emergency interchanges.

BG&E, Delmarva, Conowingo (through its parent company, Philadelphia Electric Co.), and PEPCO are members of the Mid-Atlantic Area Council (MAAC), which covers all or parts of Maryland, the District of Columbia, Pennsylvania, New Jersey, Delaware, and the Eastern Shore portion of Virginia. Potomac Edison is a member of the East Central Area Reliability Coordination Agreement (ECAR), which covers the western portion of Maryland, Pennsylvania, and Virginia, all of West Virginia, Ohio, and Indiana, and most of Michigan and Kentucky.

Utility interconnections, either in power pools or in the reliability system grid, raise the question of whether or not a utility generation construction program is required for the utility's own customers or for sales to another utility located elsewhere. The regional reliability council agreements are intended to foster a high level of total system reliability by requiring that each member utility have a level of capacity adequate to serve its own needs, and by providing a level of interconnection of utilities that is capable of transferring power from other utilities into a particular service area in emergencies.** The PJM Power Pool agreement, which is designed to provide its members access to the least expensive electricity at any point in time, has a similar clause requiring that its members own enough generating capacity to maintain a given level of reliability, and includes a surcharge for continuing purchases necessitated by factors such as inadequate generation capacity.

* Now the Federal Energy Regulatory Commission (FERC) of the U.S. Department of Energy.

** This ability to obtain power from other companies actually reduces the amount of capacity a utility must own in order to achieve a given level of reliability.

Table I-1. Imports and exports of electricity to and from Maryland by utility, 1967-1977, millions of MWh(a)

Year	Baltimore Gas & Elec.	Conowingo	Delmarva Power & Light (b)	Pennsylvania Electric	Potomac Edison (c)	PEPCO (d)	Susquehanna Electric	Total State of Md.
1967	-1,251,673	-184,240	-407,715	27,988	-974,259	3,725,179	1,811,472	2,746,762
1968	-463,019	-205,142	-484,876	22,850	-1,137,495	2,536,890	1,506,695	1,776,916
1969	-984,212	-250,341	-516,592	16,425	-1,372,891	1,058,753	1,265,288	783,555
1970	-1,146,112	-259,983	-680,646	29,655	-2,407,265	1,515,313	1,790,275	-1,158,749
1971	-1,881,874	-281,841	-751,188	34,652	-3,180,728	2,254,070	1,663,910	-2,142,985
1972	-3,145,610	-300,186	-503,684	39,733	-3,422,097	4,885,510	2,163,320	-283,000
1973	-4,286,781	-319,786	-340,331	32,860	-3,802,468	4,161,602	2,038,271	-2,516,621
1974	-3,617,297	-326,553	-472,106	31,420	-3,683,085	5,677,575	1,848,381	-591,778
1975	-5,711,684	-332,967	-1,095,230	35,868	-3,630,108	5,047,380	2,185,789	-3,605,478
1976	-3,479,120	-374,773	-885,152	23,059	-4,964,629	6,175,803	1,971,017	-1,608,762
1977	850,077	-391,677	-1,414,885	20,862	-5,236,555	3,893,618	1,899,644	-370,679

(a) Data indicates net exports; negative figure indicates imports.

(b) Includes only DP&L of Maryland and Easton.

(c) Includes imports and exports from Maryland portion of service territory only.

(d) Includes PEPCO sales to PEPCO service territory in Virginia and the District of Columbia as exports.

In reviewing certificate applications for Maryland's utilities, it has been the policy of the Maryland Public Service Commission to evaluate the need to expand capacity to meet projected future demand on the basis of the anticipated requirements of the utility's own service territory. The interconnections and power pools to which Maryland utilities belong can assist in improving utility performance and reliability. Ultimately, however, generation plans are developed by an individual utility on the basis of the requirements of its own service territory, and are judged by regulatory authorities on the same basis.

The next section of this chapter evaluates national and regional trends in total energy and electricity. In that framework, the final sections describe electrical generation trends and plans for each of the Maryland utilities at the service territory level.

B. National Energy Trends

Prices and supplies of competing sources of energy are determined within the framework of national and regional markets. Policy decisions made at a national or even an international level influence those markets, and as a consequence they shape energy options available in Maryland. It is helpful, therefore, to begin the discussion of Maryland's energy situation by describing the national energy framework within which Maryland functions.

The major primary sources of energy in the United States are petroleum, natural gas, coal, hydroelectric power and nuclear power. Figure I-3 shows the changes that have taken place in the consumption of these primary sources of energy since 1960. Table I-2 presents similar data in tabular form, with energy sources shown as a percentage of U.S. energy use for each year (3).

Two major trends in the table and figure are worth noting. First, total domestic energy use has grown almost without interruption, increasing by 70% over the past 17 years. However, during the recession which followed the dramatic oil price increases after the oil embargo of 1973, total U.S. energy consumption fell for the first time since the recession of 1958-1959. But as the data in Table I-2 show, growth in energy use resumed in 1976, coinciding with the end of the 1974-75 recession.

The second point to note in Table I-2 is the two major changes that have taken place in the composition of the U.S. energy mix. The first major change is the longterm replacement of coal by oil and, until recently, by gas. The energy share coming from coal has been taken up by the growth in the use of gas, especially for home heating purposes, and by the growth in the use of oil, especially for home heating, and for industrial and electric utility fuel use. Figure I-4 shows clearly the extent to which coal has been replaced by oil and natural gas over the past 75 years (4). The data in Table I-2 and Table I-3 suggest that in the post-embargo years since 1973 the role of coal nationally may be reversing again, particularly for electric power generation purposes (3).

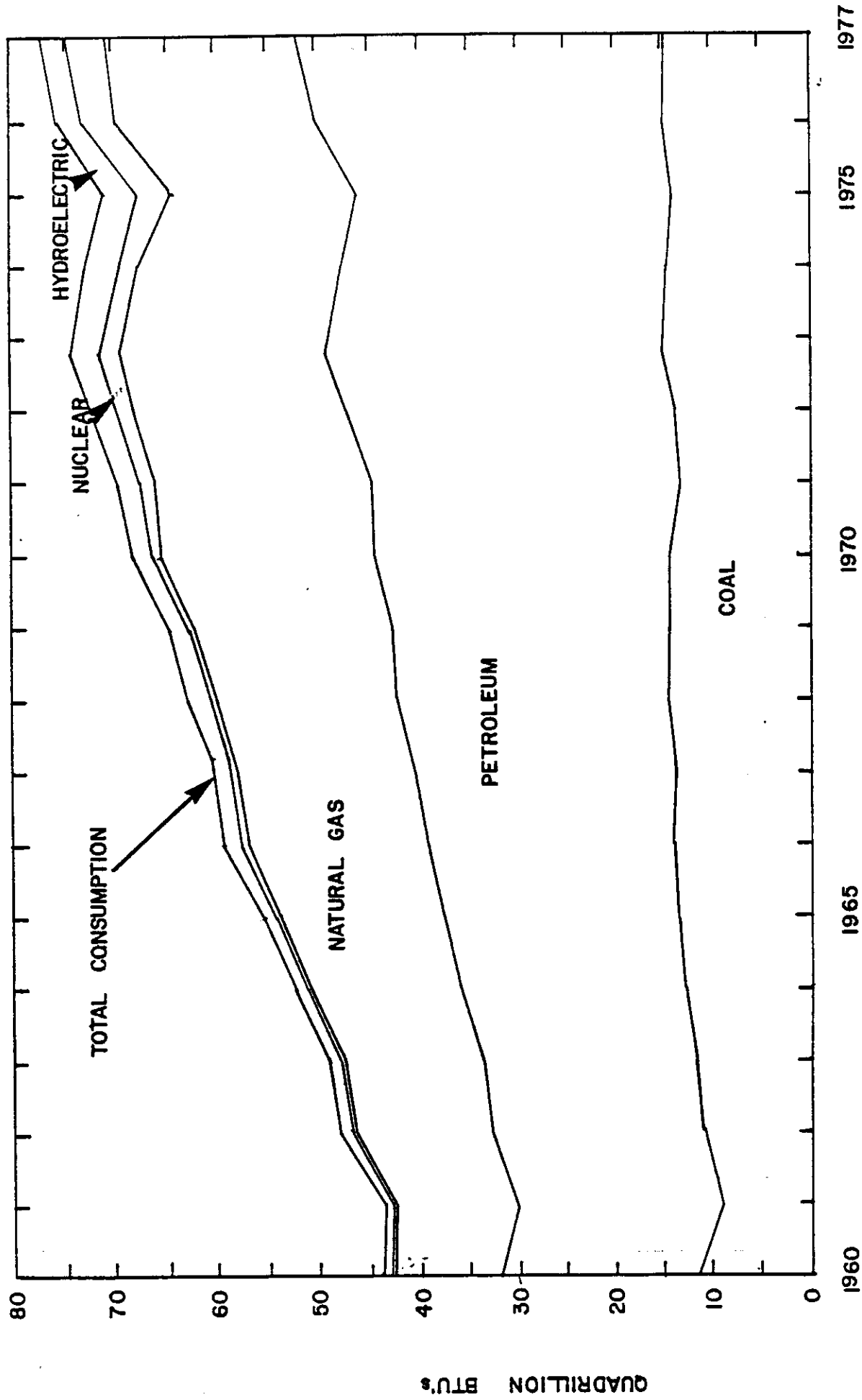


Figure I-3. U.S. total energy consumption by primary source, 1960-1977

Table I-2. U.S. energy consumption by primary energy type, 1960-1977

Year	Total Energy Consumption		Coal		Petroleum		Natural Gas		Nuclear		Hydroelectric	
	Quads*	% Change Annual	Quads	% of Total	Quads	%	Quads	%	Quads	%	Quads	%
1960	44.5	3.3	10.1	22.7	20.0	44.9	12.7	28.5	< 0.1	< 1.0	1.6	3.6
1961	45.3	1.7	9.9	21.9	20.5	45.3	13.2	29.1	< 0.1	< 1.0	1.6	3.5
1962	47.4	4.6	10.2	21.5	21.3	44.9	14.1	29.7	< 0.1	< 1.0	1.8	3.8
1963	49.3	4.0	10.7	21.7	22.0	44.6	14.8	30.0	< 0.1	< 1.0	1.7	3.4
1964	51.2	3.9	11.3	22.0	22.4	43.8	15.6	30.5	< 0.1	< 1.0	1.9	3.7
1965	53.3	4.1	11.9	22.3	23.2	43.5	16.1	30.2	< 0.1	< 1.0	2.0	3.8
1966	56.4	5.8	12.5	22.2	24.4	43.3	17.4	30.9	0.1	< 1.0	2.0	3.5
1967	58.2	3.3	12.3	21.1	25.3	43.5	18.3	31.4	0.1	< 1.0	2.3	4.0
1968	61.7	6.0	12.7	20.6	27.1	43.9	19.6	31.8	0.1	< 1.0	2.3	3.7
1969	64.9	5.2	12.7	19.6	28.4	43.8	21.0	32.4	0.1	< 1.0	2.6	4.0
1970	67.1	3.3	12.7	18.9	29.5	44.0	22.0	32.8	0.2	< 1.0	2.6	3.9
1971	68.3	1.8	12.0	17.6	30.6	44.8	22.5	32.9	0.4	0.6	2.8	4.1
1972	71.6	4.8	12.4	17.3	33.0	46.1	22.7	31.7	0.6	0.8	2.9	4.1
1973	74.6	4.1	13.3	17.8	34.9	46.8	22.5	30.2	0.9	1.2	3.0	4.0
1974	72.6	(2.6)	12.9	17.3	33.5	44.9	21.7	29.1	1.2	1.6	3.3	4.4
1975	70.6	(2.8)	12.8	18.1	32.7	46.3	19.9	28.2	1.8	2.5	3.2	4.5
1976	74.4	5.3	13.7	18.4	35.1	47.2	20.3	27.3	2.0	2.7	3.0	4.0
1977	75.8	2.0	14.1	18.6	37.0	48.8	19.6	25.9	2.7	3.6	2.4	3.2

*Quads = quadrillion BTU's = 10¹⁵ BTU's

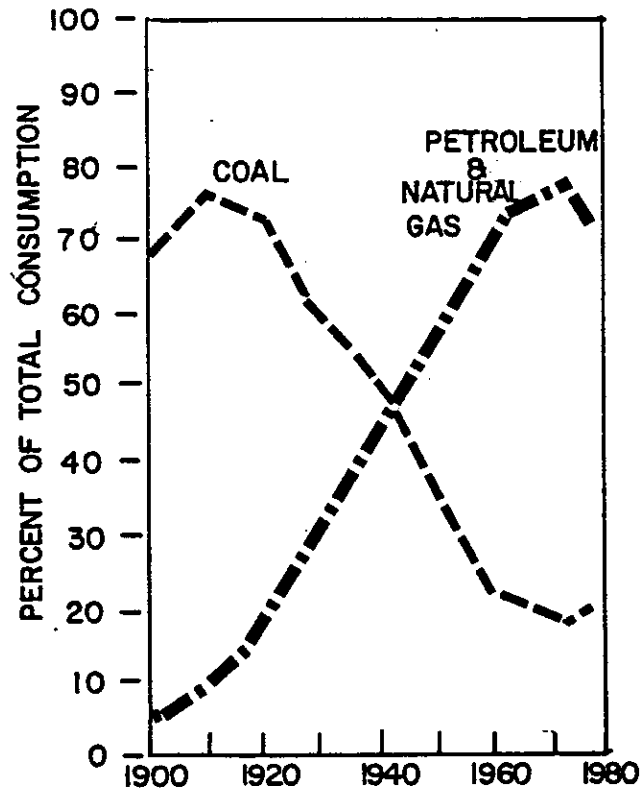


Figure I-4. Proportion of total U.S. energy supplied by coal vs oil and natural gas, 1960-1977

Table I-3. Electricity generation by fuel type - U.S. (millions of kilowatt hours and percentages of total generation)

Year	Total Net Production 10 ⁶ kWh	Coal		Petroleum		Natural Gas		Nuclear		Hydroelectric		Other	
		10 ⁶ kWh	%	10 ⁶ kWh	%	10 ⁶ kWh	%	10 ⁶ kWh	%	10 ⁶ kWh	%	10 ⁶ kWh	%
1960	753,350	403,067	53.5	46,105	6.1	157,970	21.0	518	0.1	145,516	19.3	174	0.0
1961	792,039	421,871	53.3	47,120	5.9	169,286	21.4	1,692	0.2	151,850	19.2	220	0.0
1962	852,314	450,249	52.8	46,983	5.5	184,301	21.6	2,270	0.3	168,283	19.8	228	0.0
1963	916,793	493,927	53.9	52,001	5.7	201,602	22.0	3,212	0.3	165,755	18.1	296	0.0
1964	983,990	526,230	53.5	56,954	5.8	220,038	22.4	3,343	0.3	177,073	18.0	352	0.0
1965	1,055,252	570,926	54.1	64,801	6.1	221,559	21.0	3,657	0.4	193,851	18.4	458	0.0
1966	1,144,350	613,475	53.6	78,926	6.9	251,151	21.9	5,520	0.5	194,756	17.0	522	0.1
1967	1,214,365	630,483	51.9	89,271	7.4	264,806	21.8	7,655	0.6	221,518	18.2	632	0.1
1968	1,329,443	684,904	51.5	104,276	7.9	304,433	22.9	12,528	0.9	222,491	16.7	811	0.1
1969	1,442,183	706,001	48.9	137,847	9.6	333,279	23.1	13,928	1.0	250,193	17.3	935	0.1
1970	1,492,971	675,199	45.2	179,376	12.0	366,619	24.5	21,806	1.5	249,090	16.7	881	0.1
1971	1,612,593	714,680	44.3	218,622	13.5	374,027	23.2	38,105	2.4	266,300	16.5	859	0.1
1972	1,749,629	772,857	44.1	272,550	15.6	375,735	21.5	54,091	3.1	272,613	15.6	1,783	0.1
1973	1,860,440	848,987	45.7	312,940	16.8	340,804	18.3	83,334	4.5	272,081	14.6	2,294	0.1
1974	1,867,103	829,973	44.5	299,363	16.0	320,055	17.1	113,976	6.1	301,032	16.1	2,704	0.2
1975	1,917,638	852,968	44.5	288,908	15.1	299,772	15.6	172,506	9.0	300,047	15.6	3,437	0.2
1976	2,036,487	943,879	46.3	319,518	15.7	294,419	14.5	191,108	9.4	283,680	13.9	3,883	0.2
1977	2,124,078	985,450	46.4	357,889	16.8	305,357	14.4	250,883	11.8	220,435	10.4	4,063	0.2

The second change is the more recent decline in the proportion of the energy share contributed by natural gas since 1971, when gas contributed 32.9% of the U.S energy supply. By 1976, the share had dropped to 27.3%, a decline in market share of 5.6 percentage points in only 5 years. That relative decline occurred as total U.S marketed production declined from its 1972 record production of 22.1 trillion cubic feet of gas to 19.9 trillion cubic feet in 1976 -- a 10% production decline in 4 years. The decline in gas usage has occurred as gas users, especially industrial customers subject to winter curtailments, have switched to other fuels and as new customers, such as residential customers who would have been gas users, have been forced by moratoria on new gas connections to find alternative sources of energy. In both cases customers have largely turned either to the use of oil or to the use of electricity.

Figure I-5 and Table I-3 show the changes which have occurred nationally since 1960 in the fuel mix used in generating electricity (3). The most obvious change that has occurred has been the relative increase in the role of oil, compared to the relative decline in generation by all other fuels except nuclear. This is especially true of coal, which had provided over half (51.5%) of U.S. electric energy as recently as 1968, but which provided only 44.1% by 1972, only four years later. The portion of total electricity generation which had been based on coal shifted to other fuels, principally oil: during the same period, the oil portion of this fuel mix almost doubled from 7.9% of total generation to 15.6%. The absolute amount of oil-fired generation more than doubled, growing from 104,276 million kWh in 1968 to 272,550 million kWh in 1972.

The rapid decline in the relative use of coal was the result of state and Federal air pollution legislation and regulation, principally the Clean Air Act Amendments of 1970. Utilities switched boilers from coal to oil, particularly in urban areas with poor air quality. A large percentage of the new units which were brought on line were also oil-fired. This trend was particularly marked in the heavily urbanized Northeast.

Table I-4 shows the fuel mix distribution for each region of the U.S. (5). The data in the table show fuel mixes for 1960 and 1974, and the Federal Energy Administration's (now part of the U.S. Department of Energy) projection for the 1985 fuel mix, prepared in 1976. As Table I-4 demonstrates, the fuel mix used to generate electricity varies greatly by region. Changes in state and federal energy and environmental policies, as well as in relative energy prices, can significantly affect trends in the fuel mix used by the utilities in the regions in different ways. Air pollution requirements in the urbanized and industrialized Northeast, as well as trends in operating costs, resulted in the dramatic decline in the relative share of coal in New England, which dropped from 50.3% of generation in 1960 to only 7.4% in 1974, and the more modest decline in the Middle Atlantic region, including Maryland, where the coal share dropped from 69.3% in 1960 to 42.7% in 1974.

In response to the 1973 oil embargo, the post-embargo oil price increases and national energy legislation, these trends have begun to change. Table I-3 showed what appears to be the start of an increase in the market share of coal at the national level. Recent legislation, including the Energy Supply and Environmental Coordination Act of 1974 and the Power Plant and Industrial Fuel Use Act of 1978, a portion of the Carter Administration's National Energy

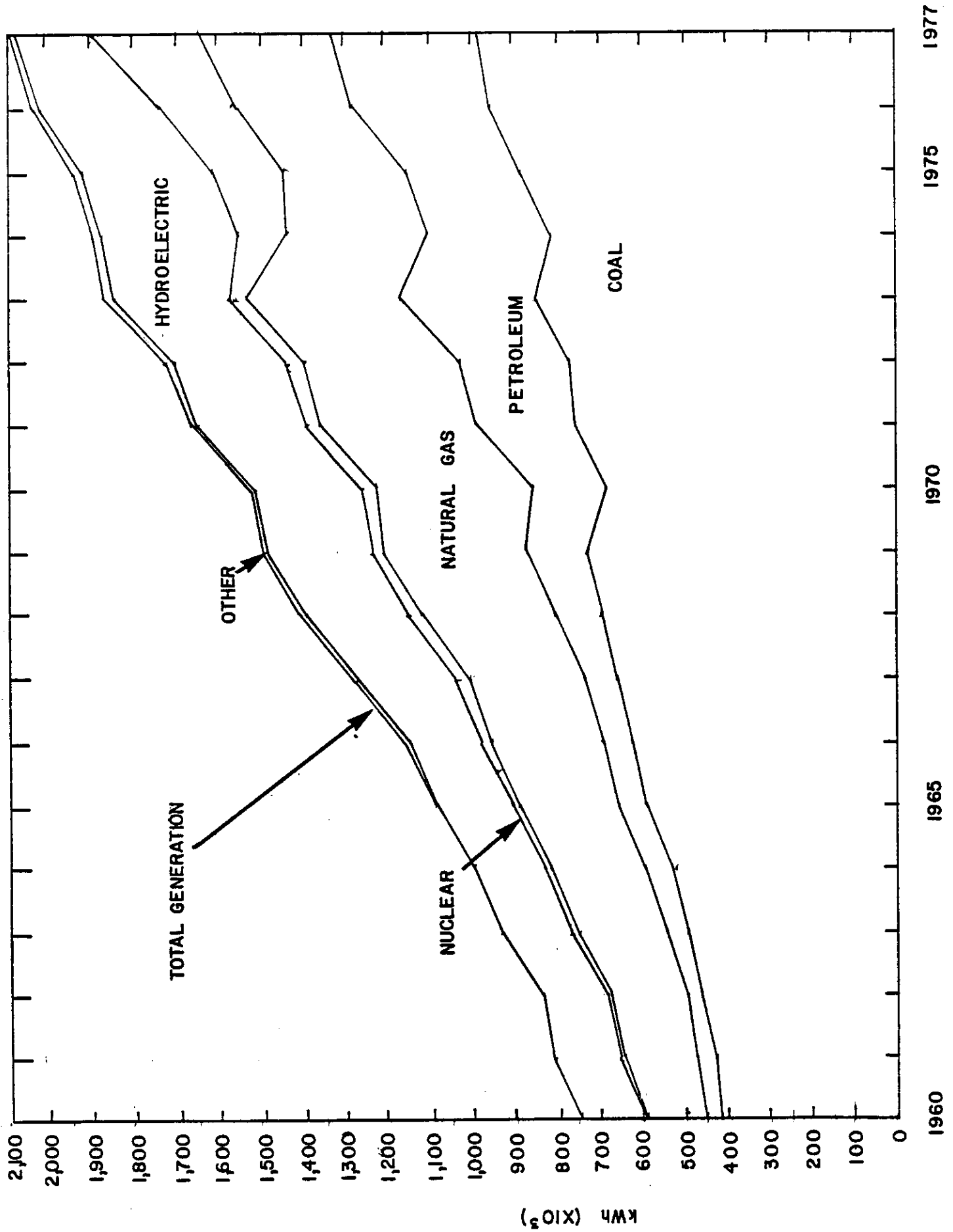


Figure I-5. U.S. electric power generation fuel mix, 1960-1977

Table I-4. Change in electric generation fuel mix, by region, 1960-1985

Region	Percentage of Total Generation for Region														
	1960				1974				1985						
	Coal	Oil/Gas	Nuclear	Hydro	Other	Coal	Oil/Gas	Nuclear	Hydro	Other	Coal	Oil/Gas	Nuclear	Hydro	Other
New England	50.3	31.7	0.1	17.9	-	7.4	61.3	24.4	6.9	-	26.8	28.4	41.0	3.9	-
Middle Atlantic	69.3	18.5	0.2	12.0	-	42.7	36.2	8.5	12.6	-	47.9	13.6	29.9	7.3	1.2
East North Central	93.5	3.8	0.2	2.5	-	82.0	8.7	8.3	1.0	-	66.4	5.8	26.3	0.6	1.0
West North Central	40.3	46.9	-	12.6	0.2	54.4	27.2	7.7	10.7	-	70.1	4.9	17.2	7.7	-
South Atlantic	66.3	20.2	-	13.5	-	54.9	32.5	7.4	5.2	-	52.6	10.3	32.0	7.3	1.2
East South Central	74.5	5.5	-	20.0	-	76.5	5.4	3.6	14.5	-	50.8	4.5	37.3	7.4	-
West South Central	-	95.7	-	4.3	-	3.0	92.6	0.2	4.2	-	20.6	55.3	22.8	1.4	-
Mountain	11.8	36.6	-	51.6	-	46.3	23.2	-	30.5	-	48.7	16.9	14.9	15.2	3.7
Pacific	-	42.0	-	58.0	-	1.7	27.8	2.8	66.7	1.0	4.7	19.9	10.2	62.2	2.5
Nation	53.5	27.1	-	19.3	-	44.5	33.2	6.0	16.1	0.1	45.4	16.1	26.1	11.5	1.0

Plan, is intended to reinforce this trend. This legislation permits the Department of Energy to require utilities and other large users to convert boilers from oil to coal, and to require that new boilers be fueled by coal. The Congressional Budget Office (CBO), in its review of President Carter's proposed energy legislation, projected that U.S. domestic use of coal would increase from 681 million tons in 1976 to 1,066 million tons in 1985 under current national policy and price estimates, and to 1,229 million tons in 1985 under the President's proposals (6). Table I-5 summarizes these projections, which are based on estimates of the growth in the demand for electricity. According to the CBO estimates, the National Energy Plan is not likely to produce major changes in 1985 coal use by electric utilities.

The data in Table I-4 also include projections of the future fuel mix used by the electric utilities in each region of the country. The projections were prepared in 1976 by the Federal Energy Administration, and are based on a complex set of assumptions concerning future fuel availability and prices, and the economic and physical ability of utilities to respond to the changing fuel conditions. Nationally, those projections indicate a large relative shift away from oil-fired generation towards nuclear, with a relatively constant coal share. For the Mid-Atlantic region (which includes Maryland), where the use of imported oil is extensive, the relative shift away from oil is anticipated to be substantial, with significant increases in the shares of coal and nuclear generation.

Table I-6 presents the additions to total generating plant projected by more recent forecast (7). The forecast is the National Electric Reliability Council's (NERC) summary of the generation expansion plans of the U.S. electric utilities for the next 10 years, summarized by electric utility region. The two NERC regions which include Maryland are MAAC and ECAR.

The projections shown in Tables I-4 and I-6 contain important policy implications. It is now national policy to encourage and require the use of coal and nuclear power to replace oil. The NERC compilation of utility expansion plans shows a shift away from oil and gas generation in favor of nuclear and coal generation. At both the national and regional levels, however, the shifts projected by the utilities in NERC (Table I-6) are not as pronounced as had been anticipated by the FEA (Table I-4). The major reason for the much smaller shift away from oil and gas projected by the NERC utilities is the smaller amount of planned new nuclear and coal generating capacity. This results in a significantly higher share of generating capacity being born by oil and gas than assumed by FEA. This difference is even greater in the NERC regions which include Maryland than they are in the country at large.

The differences between the fuel mix projected by the FEA and the fuel mix reflected in current construction plans reported by NERC can be explained to a great extent by the difficulty of altering basic plant designs for plants actually under construction or in advanced planning. However, for plants in the early planning stages, utility generating planners can respond fully to new economic and regulatory policy considerations. As will be discussed in more detail for Maryland later in this chapter, capacity additions during the 1988-1997 time period are expected to fully reflect these changes, and show very pronounced changes in the generation fuel mix.

Table I-5. Projected U.S. coal consumption

Consuming Sector	1976	Projected Use, 1985	
		Current Policy	Nat'l Energy Plan
Residential/Commercial	6	2	2
Industrial	156	206	360
Electric Utility	459	768	777
Export	60	90	90
	<hr/>	<hr/>	<hr/>
TOTAL	681	1,066	1,229

Table I-6. National and regional generation expansion plans, 1977-1987

NERC Region*	Coal		Oil		Gas		Nuclear		Hydro		Pumped Storage	
	1977	1987	1977	1987	1977	1987	1977	1987	1977	1987	1977	1987
ECAR	81.8	74.5	9.6	7.5	1.1	0.7	3.3	13.7	0.7	0.5	3.3	2.8
ERCOT	11.3	35.8	0.2	0.1	87.8	52.9	0.0	10.7	0.6	0.4	0.0	0.0
MAAC	34.2	31.8	46.3	36.4	0.5	0.4	14.0	27.0	2.1	2.0	2.9	2.2
MAIN	67.1	55.9	12.4	14.9	0.6	0.2	16.2	27.2	1.2	0.8	2.3	0.9
MARCA	52.1	65.7	15.6	11.0	1.4	0.7	17.1	14.3	13.8	8.3	0.0	0.0
NPCC	7.4	10.5	61.6	50.9	<0.1	<0.1	15.0	28.8	10.6	5.6	5.2	4.3
SERC	50.4	43.6	26.2	17.9	0.2	0.1	13.0	28.8	9.5	6.3	0.7	3.3
SPP	11.9	40.6	12.8	7.9	67.9	35.6	1.9	12.5	4.9	2.7	0.7	0.6
WSCC	18.2	23.3	32.8	23.8	2.9	2.7	2.8	15.9	41.3	30.4	1.3	2.6
NATION	39.2	42.7	25.5	18.3	13.1	7.8	8.4	20.0	11.7	8.4	1.9	2.3

* NERC regions are generally defined as follows:

- ECAR - Western Maryland, Pennsylvania, and Virginia, Ohio, West Virginia, Kentucky, Indiana, Michigan
- MAAC - Maryland, Pennsylvania, New Jersey, Delaware
- ERCOT - Central and Southern Texas
- MAIN - Missouri, Illinois, Wisconsin, Northern Michigan
- MARCA - North and South Dakota, Minnesota, Iowa, Nebraska; Manitoba
- NPCC - New York, New England; Ontario, New Brunswick
- SERC - Eastern Virginia, Tennessee, North and South Carolina, Mississippi, Alabama, Georgia, Florida
- SPP - Kansas, Oklahoma, Northern Texas, Arkansas, Louisiana, Western Mississippi
- WSCC - Montana, Wyoming, Colorado, New Mexico, and all states further West; British Columbia

The likelihood of attaining the projected shifts in production patterns shown in Table I-4 and even Table I-5 is open to some question. Utilities have postponed or cancelled many of the nuclear units assumed in the projections in Tables I-4 and I-6. The data show a drop-off in the number of new nuclear plants coming on line (Table I-7), and the number of new units ordered has shown a similar decline (3).

Part of the drop-off in new plants and new orders can be explained by the falloff in electric power demand during the 1974-1975 recession and to the subsequent rate of growth in the demand for electric power. In response to levels of demand for electricity which were lower than anticipated, many utilities slowed construction schedules or postponed the startup of new construction. In addition however, part of the drop-off in the rate of addition of new nuclear units stems from uncertainty on the part of utilities about such national policy issues as nuclear waste disposal (see Chapter IV). If the trend in Table I-7 continues, it is likely that the national share of generation coming from nuclear power in 1985 and 1990 will be lower than anticipated, and the share from coal and oil correspondingly higher. (The 1978 ten-year capacity and demand forecast prepared by *Electrical World* (8), a major trade journal, reaches a similar conclusion, and projects an even lower nuclear power share of 18% in 1987.)

It is also likely that the national share of generation coming from coal-fired generating units will be lower than anticipated. Some of the coal-fired capacity assumed in Table I-4, and even in Table I-6, has been postponed or cancelled in response to levels of demand and rates of demand growth that are lower than had been anticipated.

Projections of trends in future fuel mixes are based on projections of future growth in electric power demand, as well as of energy policy, fuel supply, and price trends. National projections of electric energy demand have been made by a number of forecasters representing government, private corporations, and independent consultants. While the estimated growth rates differ, the projections uniformly show a significant reduction in the growth rate, from the more than 7% annually that prevailed in the years from 1945 through 1973. Table I-8 show the results of a number of these forecasts, most of which were prepared in 1976 and 1977.

Projections of future demand at the national level have continued to decline as more experience with higher energy prices has accumulated. Regional electric reliability councils include ten-year forecasts in their annual submissions to the Federal Power Commission. Figure I-6 shows the declines in each successive forecast since the 1973 embargo (9). These forecasts are derived from projections made by each of the nation's utilities, and they vary significantly in the forecasting methodology used.

The changes in forecasts shown in Figure I-6 indicate the degree of uncertainty which has affected recent utility planning, making national forecasting more difficult. From these utility capacity and demand forecasts, however, it is quite clear that the demand for electric power at the national level is expected to grow, although at a slower rate than in the past, and that the generating equipment used to meet this demand is likely to rely less on oil and more on coal and nuclear power than in the past. The reduction in the

Table I-7. U.S. nuclear power capacity expansion

Year	Units Added	Capacity Added, MW
1965	1	16
1966	1	907
1967	- 1	- 35
1968	0	987
1969	3	1,310
1970	3	1,048
1971	5	3,322
1972	5	4,556
1973	9	8,121
1974	9	9,649
1975	10	8,878
1976	3	2,561
1977	8	5,884

Table I-8. Comparison of annual growth rates in U.S. electricity consumption (%/yr)*

Forecast	Demand 77	Starr	SR-37	EHI	NFP	DRI	FEA	IEA	EPP	MOPPS	NERC- FTC
1975-1980											
High	7.9	6.7	8.4	6.1	6.2	6.3	6.3	5.4	6.8	4.1	--
Medium	6.9	5.5	7.4	6.1	5.5	6.6	5.4	--	3.3	--	6.7
Low	6.9	4.7	6.1	5.5	4.5	6.1	5.2	4.4	3.0	3.2	--
1980-1985											
High	6.8	6.7	7.2	6.6	6.2	5.6	6.3	5.3	6.8	4.1	--
Medium	6.0	5.5	5.3	5.4	5.5	5.6	5.4	--	3.3	--	6.2
Low	5.5	4.7	3.2	4.3	4.5	5.6	5.2	4.4	3.0	3.2	--
1985-1990											
High	6.1	6.7	--	5.6	5.5	4.9	6.4	4.3	5.0	4.1	--
Medium	5.3	5.5	--	5.0	4.6	4.7	5.7	--	2.4	--	5.5
Low	4.5	4.7	--	2.8	3.5	4.9	5.3	2.9	1.7	3.2	--
1990-1995											
High	5.8	6.7	--	5.6	5.5	--	6.4	4.3	5.0	4.1	--
Medium	4.8	5.5	--	5.0	4.6	--	5.7	--	2.4	--	5.5
Low	4.3	4.7	--	2.8	3.5	--	5.3	2.9	1.7	3.2	--
1995-2000											
High	5.7	6.7	--	5.6	--	--	--	4.3	5.0	4.1	--
Medium	4.6	5.5	--	5.0	--	--	--	--	2.4	--	--
Low	4.1	4.7	--	2.8	--	--	--	2.9	1.7	3.2	--

Demand 77 Larry J. Williams, et al., Demand 77, EPRI Annual Energy Forecasts and Consumption Model, EA-621-SR (Palo Alto, Calif.: Electric Power Research Institute, 1978).

Starr Chauncey Starr, "Electricity Needs to the Year 2000," presented to the Subcommittee on Energy Research, Development, and Demonstration; House of Representatives Committee on Science and Technology; Washington, D.C., 1976.

SR-37 Larry J. Williams, A Preliminary Forecast of Energy Consumption Through 1985, SR-37 (Palo Alto, Calif.: Electric Power Research Institute, 1976).

EHI Edison Electric Institute, Economic Growth in the Future (New York: McGraw-Hill, 1976).

NFP Mitre Corporation, Need for Power (NFP) Study, Interim Report, prepared for U.S. Energy Research and Development Administration, Washington, D.C., 1977.

DRI Data Resources, Inc., Energy Review, Summer 1977 (Lexington, Mass.: Data Resources, Inc. 1977).

FEA Federal Energy Administration, National Energy Outlook (Washington, D.C.: U.S. Government Printing Office, February 1976).

IEA Institute for Energy Analysis, Economic and Environmental Impacts of a Nuclear Moratorium, 1985-2010 (Oak Ridge Associated Universities, September 1976).

EPP Energy Policy Project of the Ford Foundation, A Time to Choose (Cambridge, Mass.: Ballinger, 1974).

MOPPS Energy Research and Development Administration, Market Oriented Program Planning Study, Review Draft (Washington, D.C., 1977).

NERC-FTC Projections of the National Electric Reliability Council and the Federal Power Commission, as reported in NFP (see above).

*Growth rates are repeated from one five-year period to another where they have only been reported for longer

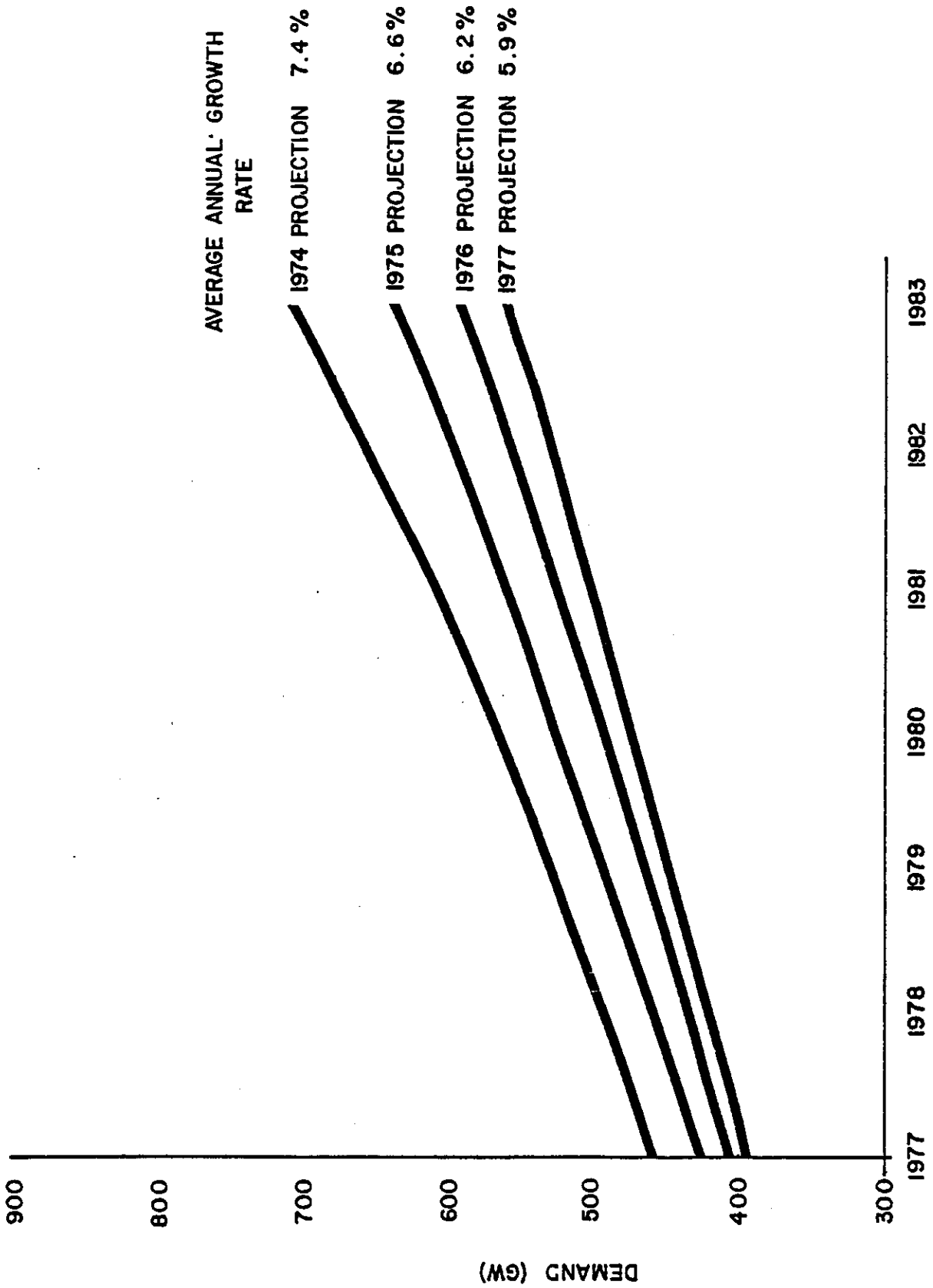


Figure I-6. 1974-1977 projections of peak demand by U.S. electric utilities

reliance on oil in favor of coal and nuclear power will be less than had been anticipated by government planners at the Federal level.

C. Maryland: Energy

The demand for and supply of energy in Maryland are driven by the same factors that affect national energy use and supply patterns. Those factors work through the set of conditions that uniquely define the State of Maryland and the Maryland economy. Factors such as the cost of transportation for alternative fuels, the composition of state industry, the age and construction of homes, and the relative level of personal income all influence the way in which Maryland consumers and industries use energy and types of fuels selected to meet those energy needs. The resulting pattern of energy demand and supply, while strongly influenced by national trends, is unique to Maryland and must be evaluated at the state level.

Table I-9 and Figure I-7 present energy flow data for the U.S. and Maryland for 1974, the most recent year for which comparable data are available (10). As can be seen from the table, there are major differences in gross energy supply and conversion between Maryland and the nation at large. The principle and most striking difference is the proportionately large share of total energy coming from oil in Maryland. The important role of oil is seen both in gross energy input for all uses and in the mix of fuels used by Maryland utilities. In both cases, Maryland oil usage is considerably higher than that of the nation as a whole: the proportion of gross oil usage is 36% higher in Maryland than in the nation, and the proportion of oil used in electric generation is almost 240% higher. The importance of oil usage in Maryland is based on the ready availability of formerly inexpensive foreign oil, the distance of population centers from large coal fields and the resulting relatively high transportation costs, and the air pollution problems that exist in Maryland's extensive urban and suburban areas.

D. Maryland Utilities: Past Trends and Future Projections

Public utilities are required by the terms of their franchise to meet customers' demand for electric power. The instantaneous demand for electric power varies by time of day, the day of the week, and by season. In addition, the demand for power exhibits a long-term trend of growth, interspersed with infrequent declines. In order to fulfill the service requirement, utilities must formulate generating expansion plans well in advance. Recent estimates indicate that it may take 8 to 10 years to bring a major coal-fired power plant on line, and up to 13 years to bring a nuclear plant on line. As a result, utilities must plan for changes in capacity over a period significantly in excess of 10 years. The Regional Electric Reliability Councils require that member utilities submit 10 and 20 year generating plans and forecasts, and the Maryland Public Service Commission requires the annual submissions of a Ten-Year Plan (see Appendix A).

There are several important concepts necessary to an understanding and evaluation of the long-range generation expansion plans of Maryland's electric utilities:

Table I-9. Energy Flows, 1974. Entries in percent of gross energy input: U.S., 72.67 x 10¹⁵ BTU; Maryland, 1.23 x 10¹⁵ BTU

U.S.

GROSS INPUTS		ELECTRIC CONVERSION		TO END USERS			
Source	Input	To Electric Generation	Electric Output	Input	To Household & Commercial	To Industry	To Transportation
Nuclear	1.7	1.7	8.8	8.8	5.1	3.7	.02
Hydro	4.5	4.5		6.1	0.4	5.7	
Coal	17.7	11.7		25.1	10.4	13.8	.9
Gas	29.9	4.8		40.9	8.4	8.1	24.4
Petroleum	46.1	4.8		81.0	24.4	31.3	25.4
TOTAL	100.0	27.5	8.8				

Unaccounted for (petroleum) = 0.4
 In industry sector 0.15 and 4.87 percentage points of coal and petroleum, respectively, go into non-fuel use (chemical feed stock)
 Electric conversion efficiency = $8.82/27.52 \times 100 = 32.1$ percent
 Electric energy is 10.9 percent of end user supply
 Totals may not check because of independent rounding

Maryland

GROSS INPUTS		ELECTRIC CONVERSION		TO END USERS			
Source	Input	To Electric Generation	Electric Output	Input	To Household & Commercial	To Industry	To Transportation
Nuclear	0	0	9.9	9.9	6.1	3.8	0.06
Hydro	1.2	1.2		10.0	0.1	9.8	0
Coal	19.1	9.1		15.7	10.4	4.1	0.20
Gas	16.8	1.1		46.5	16.0	5.1	26.40
Petroleum	62.9	16.3		82.0	32.7	22.8	26.6
TOTAL	100.0	27.6	9.9				

Unaccounted for and miscellaneous = 0.3
 Electric conversion efficiency $9.92/27.64 = 35.9$
 Electric energy is 12.1 percent of end user supply
 Totals may not check because of independent rounding

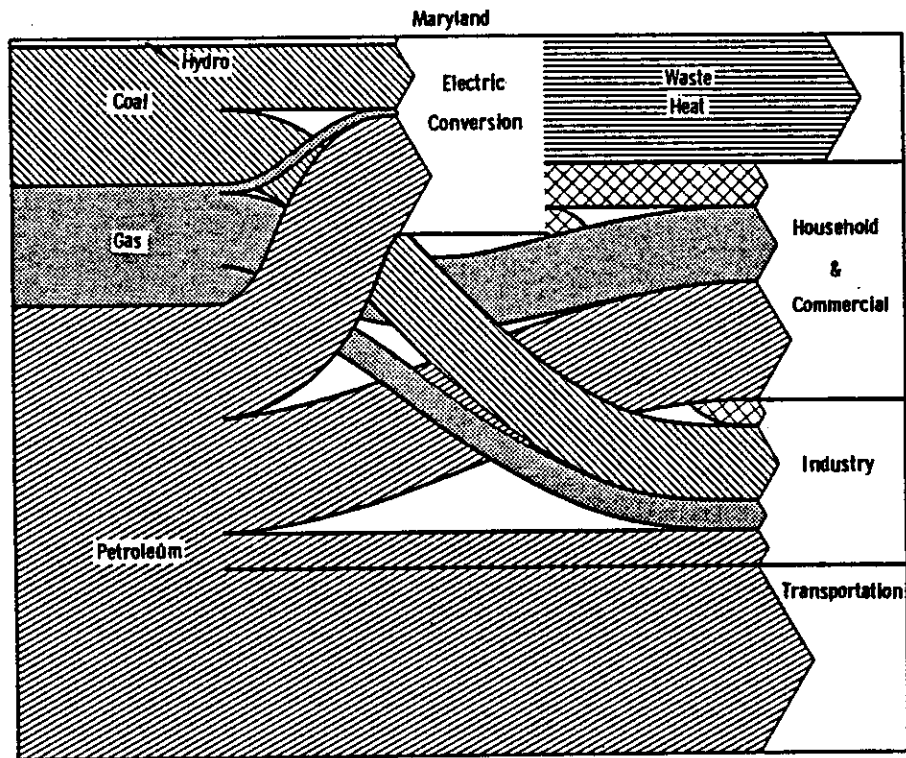
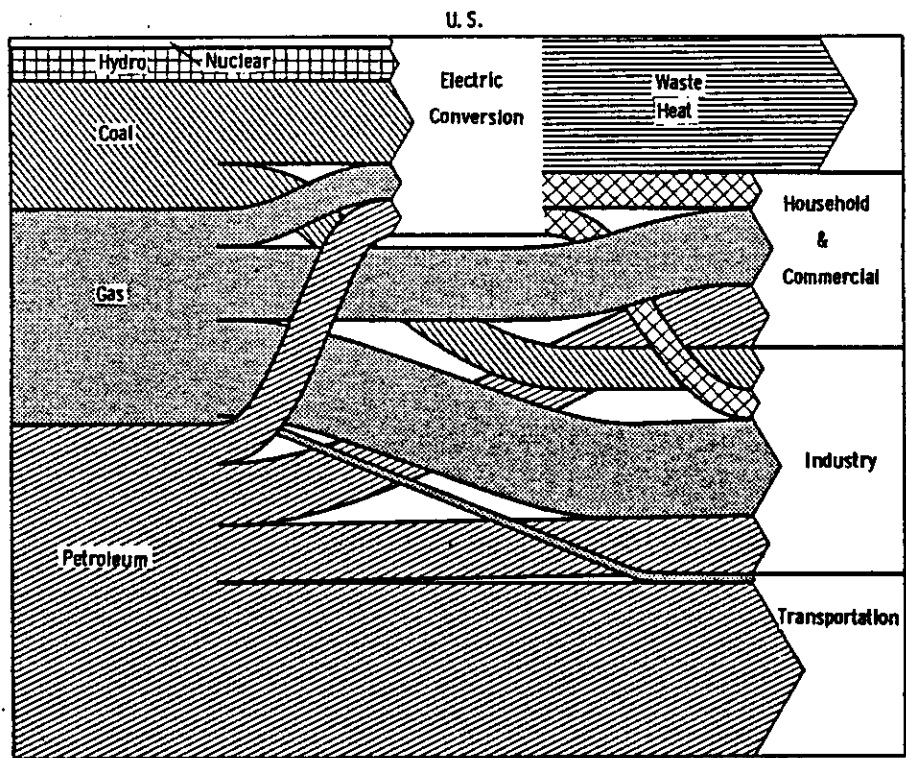


Figure I-7. Energy flows, 1974 percent distribution

- Demand is the amount of electric power required by customers at any given instant in time, usually stated in megawatts (MW) or Kilowatts (kW). One kW is the amount of power needed to light ten 100 watt light bulbs, and a megawatt is 1,000 kilowatts.
- Energy is the amount of electric power consumed over a period of time, usually stated in kilowatt-hours (kWh). One kWh is the amount of electricity required to light ten 100 watt light bulbs for one hour, and a megawatt hour (MWh) is 1,000 kilowatt-hours.
- Peak Demand is the maximum demand experienced during some time interval, such as a day or year. Peak demand in the following tables is the average power used over the 60 minute period of heaviest demand during a given year. Electric power demand varies significantly over a day, week or year, as shown in the one-day "load curve" in Figure I-8. Peak demand for that load curve is approximately 8,500 MW.
- Load Factor is the ratio of the average load (MW) to the peak load during the time period being measured. An annual system load factor, SLFa, is defined as:

$$SLFa = \frac{SEa}{SPLa \times 8760}$$

where: SLFa = annual system load factor
 SEa = annual system energy output (MWh)*
 SPLa = annual system peak load (MW), and
 8760 is the number of hours in a year (8784 in a leap year)

- Capacity Factor is the ratio of the average load (MW) on a plant or entire system to the capacity rating (maximum rated output, MW) of the plant or system for the time period being measured.
- Reserve Margin is the difference between system maximum capacity (MW) and maximum system load, divided by the maximum system load, for any given moment in time. The most commonly used reserve margin is defined at the time of the system peak demand:

$$RMp = \frac{SCp - SDp}{SDp}$$

where: RMp = system peak reserve margin
 SCp = system maximum capacity at time of peak
 SDp = system peak demand

- Base Load Plants are generating units designed to be run at high efficiency on a continuous basis over long periods of time, and are used over the period indicated by "A" in Figure I-8.

* Load factor computation is based on system energy output defined to include system losses.

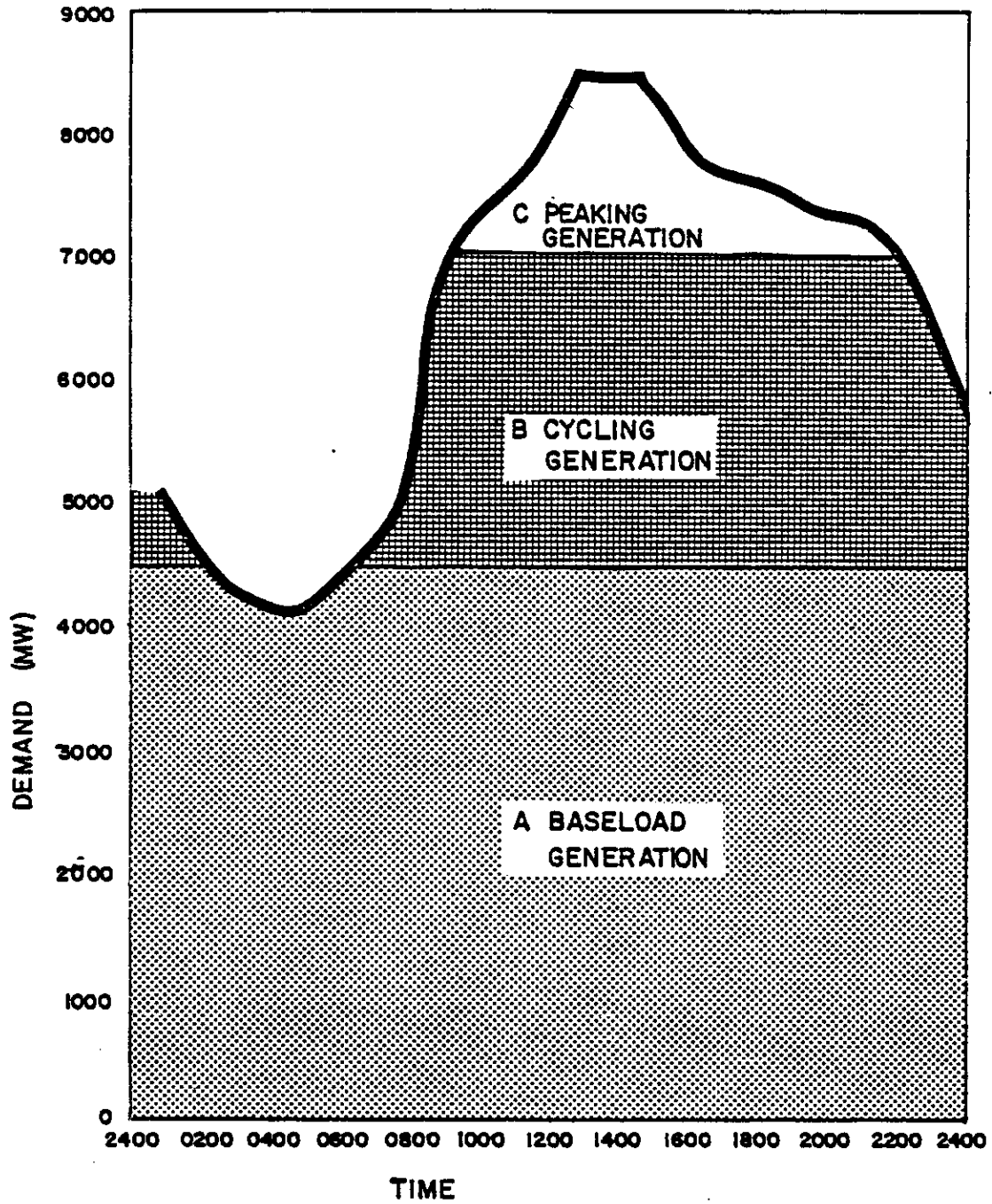


Figure I-8. Hypothetical daily load curve

- Cycling Plants are units designed to operate at relatively high efficiency, but which can be adjusted to meet changing loads and can operate well under relatively frequent on-off cycles. They are generally used in the periods indicated by "B" in Figure I-8.
- Peaking Plants are units designed to operate only for short periods of peak demand, usually for only a brief part of the day during a few months of the year. Efficiency is less important than on-off cycling ability and low capital cost because of the extensive portion of the year during which these plants are idle. They are operated during period "C" in Figure I-8.

The demand for electricity exhibited a remarkably steady growth from the period after World War II through the early 1970's, except for brief periods of slower growth or slight declines during economic recessions. During the period from 1963 to 1973, for example, the annual growth in electric energy used was 7.5% nationally, and 9.7% in Maryland. Figure I-9 shows the sudden change in this pattern of growth which followed the 1973 oil embargo and the subsequent explosive rise in energy prices (8,11).* The rapid energy price increase and the sharp recession which accompanied them produced a 0.1% decline in electric energy use nationally in 1974, and only a relatively slight 1.9% increase in 1975. In Maryland, where imported oil made up a greater share of both the total energy and the electricity utility fuel mix than in the nation generally, the change in the growth in electric energy use was even more dramatic: electric energy use declined by 2.8% in 1974, and grew by only 1.0% in 1975. Not until 1976 did electric power use in Maryland exceed what it had been in 1973. By 1976 growth in electric power use had clearly resumed. Peak demand shows a similar pattern.

Table I-10 shows the pattern of growth in electric power use in Maryland for 1963 through 1977. In the most recent period, covering the years 1976 and 1977, growth in electric power use appeared to indicate a significantly slower rate of growth than in the period prior to 1973, dropping from a 9.7% annual growth rate to 7.4%. In 1977, energy sales nationally grew by 4.3% (see Table I-3), and peak demand grew by 7.1%, very close to the long-term average. In Maryland, energy growth was 5.9%, and noncoincident peak demand grew by 11.9%.**

What is an apparent resumption of prior growth experience must be evaluated carefully, however. The 1977 growth occurred in a year in which both the national and Maryland economies were rapidly recovering from one of the longest and deepest recessions in recent history, and in which most of the contiguous United States experienced record and prolonged July heat. In the period before 1973, these conditions probably would have resulted in national peak demand growth of approximately 10%. The 1977 experience would appear to lend support

* From 1973 to 1975, the price of imported oil, adjusted for general inflation, rose by 184%, total oil prices (including both domestic and imported oil) by 111%, and coal prices by 88% (12).

** See also Table I-18, at the end of this chapter.

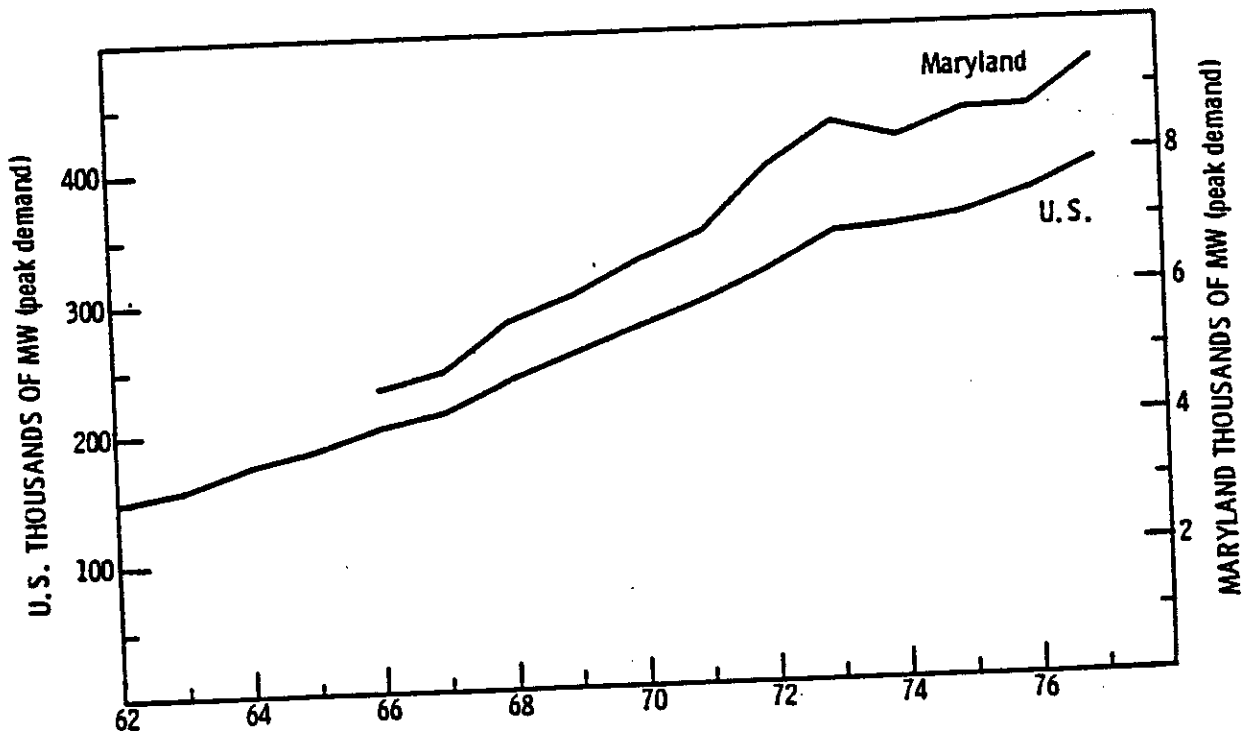
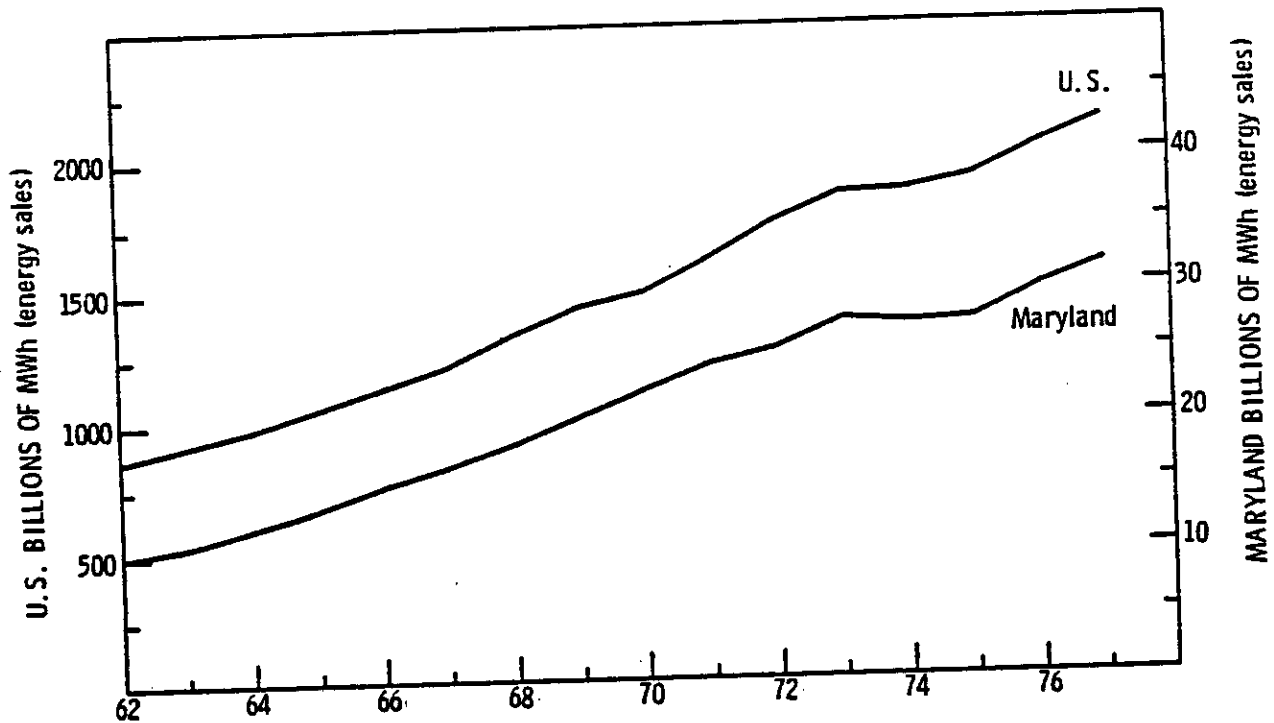


Figure I-9. Maryland and U.S. electric energy sale, 1962-1977, Maryland and U.S. electric energy peak demand, 1962-1977, respectively

Table I-10. Electric energy sales in Maryland, 1962-1977*

Year	Maryland (Millions of kWh)		Total
	Residential	Non-Residential	
1962	3,145	6,879	10,024
1963	3,425	7,491	10,916
1964	3,789	8,307	12,096
1965	4,229	9,081	13,310
1966	4,792	10,220	15,012
1967	5,196	11,209	16,405
1968	5,990	12,268	18,258
1969	6,700	13,497	20,197
1970	7,483	15,004	22,487
1971	7,919	16,311	24,230
1972	8,406	17,005	25,411
1973	9,330	18,270	27,600
1974	9,200	17,910	27,110
1975	9,598	17,859	27,457
1976	10,064	19,837	29,901
1977	10,718	20,935	31,653

* Data from Appendix B