cost rates. FERC has studied these developments, and in 1988 it issued three major proposed rulemakings addressing the following issues: 1) improvements to administrative avoided-cost determination procedures; 2) competitive bidding systems; and 3) independent power producers. FERC received extensive comments, but has not yet issued final rules on any of these proposals.

These proposed rulemakings appear to represent a shift in FERC policy (or at least a shift in emphasis) toward encouraging competition. The proposed rule sanctioned (and in fact endorsed) competitive bidding as a means of acquiring new power supplies (FERC 1988a). Although the FERC proposal made it clear that competitive bidding would be strictly voluntarily (i.e., at the discretion of the states and utilities), the proposed rule is an explicit attempt to encourage bidding as a substitute for the current administrative, case-by-case negotiation.

Competitive bidding has been endorsed or implemented in a number of states, including New York, New Jersey, Virginia, Colorado, Texas, California, and the New England states. Although formal competitive bidding is very new, in instances where competitive bid solicitations have occurred, a large amount of capacity has been forthcoming in response. Table 9-3 is a summary of recent bidding experience compiled by the staff of FERC. As this comparison demonstrates, competitive bid solicitations have succeeded in eliciting very large amounts of NUG capacity offers, an average of 10 MW offered for every MW sought. Of course, not all of these offers of capacity may be viable or cost-effective, but these results do appear to show considerable competitive potential.

FERC's other proposed initiative concerns IPPs. FERC has defined IPPs as:

> Wholesale producers (other than qualifying facilities under PURPA) that are unaffiliated with franchised utilities in the area in which the IPPs are selling power that lack significant market power (FERC 1988b).

Under current law, a private power producer that does not have QF status is considered a utility and subject to traditional cost-of-service regulation. FERC's proposal would substantially deregulate these entities, provided they can demonstrate that they have no market power and there is no problem of "self dealing" (e.g., a utility selling to itself at unregulated prices and passing on the cost to its retail customers).

The deregulation of IPPs, as proposed, could dramatically affect Maryland. QF development in Maryland has been limited by a lack of heavy industry suitable for cogeneration and a relative scarcity of waste or renewable resources suitable for small power production. Those "resource endowment" limitations would not stop IPPs. They are "footloose" in the sense that they can enter the market wherever they find an acceptable site and, of course, a willing utility buyer.

At the present time, the legal status of IPPs is unclear. FERC has not approved its proposed rule, and many observers believe that new federal legislation would be required to exempt IPPs from the restrictions of PUHCA (EIA 1989). It is very

Table 9-3

Comparison of capacity requested versus offered in recent capacity bid solicitations (MW)

Utility	Capacity Requested	Capacity Offered	Ratio of Bid to Requested
Central Maine Power	200	1,444	7.2:1
Sierra Pacific	125	2,800	22.4:1
New England Power	200	4,729	23.6:1
Virginia Power	1,750	14,000	8:1
Eastern Edison	30	180	6:1
Boston Edison	200	2,053	10.3:1
Green Mountain Power	114	806	7.1:1
TOTAL	2,619	26,012	
		(Average)	9.9:1

Source: FERC 1989.

unlikely that much IPP development will occur unless they are exempted from traditional regulation. At present, FERC is dealing with IPPs on a case-by-case basis, providing exemptions from strict cost-of-service regulation when warranted.

Competition has also occurred among traditional electric utility companies in bulk power wholesale markets. This trend became noticeable in the early and mid-1980s, when the prevalence of excess capacity in many regions of the country created intense competitive pressures and attractive buying opportunities. An example is PEPCO's long-term purchase of 450 MW from Ohio Edison Company.

Technically, these wholesale transactions are subject to traditional rate regulation even though they may occur in competitive markets and are based on arm's-length negotiations. However, that may be changing. In late 1989, Public Service Company of Indiana (PSI) proposed a program whereby it would sell at wholesale 450 MW of surplus generation at market-based rather than regulated prices. FERC is currently studying this proposal, and its initial response has been favorable (FERC 1990).

Increased competition in wholesale markets among both utilities and NUG suppliers may also be enhanced by new initiatives on transmission access. Many observers believe that effective competition in bulk power supply is impeded because potential suppliers do not have access to the critical transmission pathways needed to reach buyers. Certain buyers of power -- distribution-only utilities and large industrial customers -- have argued for liberalized transmission access to enable them to "shop" for the most economical supplies of power.

At the present time, there is some dispute as to authority for providing transmission access. New federal legislation may be needed to settle the jurisdictional questions and to establish national policy on this matter. In the mean time, FERC has been acting on a case-by-case basis. FERC imposed a sweeping transmission access requirement on the joint Pacific Power & Light and Utah Power & Light transmission grid as a condition for approving the proposed merger of these two companies. The PSI market pricing proposal mentioned earlier includes a voluntary "open access" transmission feature: To ensure competition, PSI will provide potential competitors in the wholesale market access to its transmission system. Transmission access conditions are also being considered as part of the proposed Northeast Utilities/Public Service Company of New Hampshire merger, which is now before FERC.

It is difficult at this juncture to determine what impact liberalized transmission access will have on Maryland. The present transmission barrier for market participants in this region appears to be more physical than institutional: Maryland utilities and the entire PJM region face transmission import limitations that will require new transmission investments and construction. If the physical barriers are overcome, however, important new power supplies outside of Maryland will become available and may provide an effective substitute for constructing power plant capacity in Maryland.

F. Changing Generation Technology

Life Extension and WEPCO

In the 1980s, the electric utility industry virtually stopped building new power plants. This was due in part to the long lead time necessary to design, permit, build, and start up a new power plant and, more importantly, to the utilities' increased reluctance to make large long-term capital investments. Now many utilities are facing the need for smaller increments of new capacity, but are running out of time to bring new units on line. As a result, older units once slated for retirement will be pressed into longer service. The expected useful lifetime of fossil fuel units traditionally had been 30 years. With active maintenance, repair, and replacement programs, some units are able to continue to generate power safely and reliably for 50 to 60 years. Life extension costs are between $125 to $625/kW compared to $1,300 to $1,900/kW for a new plant (Douglas 1987). In addition, life extension usually involves relatively short lead times and can be implemented in small increments, and supporting supply and delivery equipment is already in place.

Maryland's utilities plan to undertake measures to extend the lives of their older generating units. Allegheny Power System (the parent to Potomac Edison Company) plans to reactivate the Springdale and Mitchell oil-fired steam units currently in cold storage reserve. No unit located in Maryland is slated for retirement in this century. BG&E's Westport Units 3 and 4 had been planned for retirement in 1992, but that has been delayed until after the year 2000 (PSC 1989b).

Recent rulings by the U.S. Environmental Protection Agency (EPA) may affect these life extension reactivation and delayed retirement plans. The EPA long-term strategy for reducing air pollution had assumed that older, nonregulated stationary sources would be retired and replaced by new units with emissions controls. Many of the Maryland units planned for extended operating life are older units exempted from regulation under the Clean Air Act. In Maryland, only 1,260 MW of the nearly 7,500 MW of fossil fuel capacity is subjected to Clean Air Act regulations (CBRM 1990). EPA can, at its discretion, require new source performance standards (NSPS) to be met at previously exempted units if they have been modified or reconstructed. Although this authority is provided by the Clean Air Act, the EPA had not applied it to life extension projects.

Recently the Appeals Court, overruling the Wisconsin Public Service Commission, ruled that plans to extend the life of Wisconsin Electric Power Company's (WEPCO) Port Washington pulverized coal units trigger the application of NSPS standards. WEPCO may be required to install pollution control equipment if it proceeds with a plan to restore the plant to its *original design operating capacity, and to operate it past its original design life*.

In determining whether modifications or repairs trigger the implementation of NSPS or Prevention of Significant Deterioration (PSD) requirements, EPA evaluates the following (Hagedorn 1990):

1. Has the retirement date of the facility been extended?

2. Is there a proposed increase in facility capacity over its capacity prior to renovations, repowering, or repairs?

3. Is there a proposed increase in emission of criteria pollutants over emissions prior to proposed changes?

4. Is there a change in type of fuel utilized?

If the answer to any one of the above questions is yes, EPA may require that the facility meet stricter emission standards.

Requiring all life-extended plants to meet strict air quality regulations can undermine the economic attractiveness to the utility of life extension and could reduce the amount of capacity that is life-extended -- thus adding to the need for new capacity resources. The utility may avoid NSPS by adding control technology so that emissions are *less than or equal* to emissions prior to the outage, but there could be significant costs in doing so.

Currently EPA is reviewing 233 utility sites to determine the maintenance, operational, renovations, or other changes that have been made. Information is sought on emissions before and after changes, changes in retirement dates that have been announced to government agencies (federal, state, or local), and changes in steam or electrical capacity.

Any repowering or "life extension" project proposed by utilities must be examined on both state and national levels. As the Wisconsin experience demonstrates, projects may be approved by the state, but disapproved by EPA. The continued operation of unregulated sources will be discouraged by EPA.

New Generation Technologies Emerging in Maryland

The Ten-Year Plan Report recently prepared by the PSC (1989) documents the resource plans of Maryland's electric utilities. According to these plans, Maryland utilities intend to adopt new technologies such as advanced combustion turbines, combined cycle, integrated coal gasification combined cycle, and fluidized bed coal combustion units. As discussed in Chapter 2, utilities have selected these technologies because they can be constructed in stages; they tend to have shorter permitting, construction, and shakedown times; they have less significant adverse environmental impacts; and they provide greater fuel flexibility.

Advanced combustion turbines provide improved reliability, efficiency, and availability over conventional combustion turbines. These units have only been made commercially available within the past few years. Advanced combustion turbines proposed by PEPCO, DP&L, and BG&E will use natural gas as the primary fuel, with distillate oil as an alternate (PSC 1989). The installation of natural gas turbines reflects the need for more peaking capacity in the capacity mix. The economics are favorable, even if environmental controls must be added to the overall plant. For advanced combustion turbines operating in a simple cycle, efficiencies of approximately 35 percent are projected (Moore 1988).

As electricity demand continues to increase in the mid- to late 1990s, the utilities plan to convert much of the new combustion turbine capacity to combined cycle units. Combined cycle units generate electricity more efficiently than the simple cycle units described above by combining steam turbines and gas turbines. Heat recovery steam generators use the "waste" heat of the combustion turbine exhaust to produce steam, which is fed into a steam turbine, undergoes expansion, and produces electricity during the expansion process. Combined cycle operation is expected to have thermal efficiencies of 45 to 47 percent (Moore 1988).

PEPCO and BG&E have included phased development of integrated gasification combined cycle (IGCC) plants, which pair combined cycle units with coal gasification units. The gasification unit converts a solid fuel such as coal into a synthetic gas by reacting the fuel with oxygen or air. The synthetic gas formed can be directed through chemical scrubbers, which remove undesirable emissions such as SO_x, NO_x, and hydrogen sulfide. The clean synthetic fuel is then sent to the combined cycle unit. IGCC technology offers fuel flexibility, low air emissions, and improved efficiencies, and can be constructed in phases to meet generation requirements.

Although IGCC technology has been successfully demonstrated, PEPCO is one of the first U.S. electric utilities to propose the commercial development of an IGCC facility. PEPCO has proposed IGCC for later stages of its Station H project at the Dickerson site. The Station H project is currently undergoing licensing review with the PSC. BG&E has also recently initiated the licensing process for the first phase of a potential IGCC project at Perryman.

DP&L has considered the construction of four 150 MW coal-fired fluidized bed combustion (FBC) units, and has identified a preferred site near Vienna, Maryland. FBC facilities have also been proposed in Maryland by several non-utility generators, but to date none of those projects has been initiated. FBC technology is explained in Chapter 3, Section C. Small-scale atmospheric FBC units already are used commercially around the world.

<u>Fuel Use Implications</u>

The resource plans of Maryland utilities indicate that new capacity additions planned for the 1990s will be fueled primarily by natural gas. Many of these units proposed will have the ability to use other fuels such as distillate oil or synthetic gas produced from coal. Currently 59 percent of the installed generating capacity owned by Maryland utilities is coal-fired, while the actual generation by fuel type is more than 70 percent coal-fired. Increased use of natural gas will increase the fuel diversity for Maryland utilities.

Investments in new natural gas-fired generating capacity has been made possible by the repeal of the Fuel Use Act. On a national basis, 40 percent of the planned utility-owned capacity additions 100 MW or larger are expected to be natural gas-fired (AGA 1989). Additionally, more than half of all NUG additions are expected to be gas-fired (Smock 1989). Investment in gas-fired instead of coal-fired facilities may be strengthened in regions where natural gas resources are plentiful or low-priced gas imports are available.

To improve competitiveness, and to ensure fuel cost stability, utilities have several approaches they can use in devising their generation systems. One is to install units with alternate fuel capability, which can be switched to cheaper fuel to minimize costs and ensure plant reliability. Secondly, if the system relies on a mix of fuels, those units that use the "cheapest" fuels can bear the greatest burden in meeting generating needs.

G. Summary

Important trends have emerged in the last decade concerning the manner in which electric utilities will meet growing customer demands. These trends reflect fundamental regulatory changes, financial considerations, and concerns regarding environmental quality.

In the past, electric utilities served load growth by constructing large, central station coal and nuclear generating units to take advantage of scale economies. Today, many utilities, including those in Maryland, emphasize planning flexibility and resource diversity. In practice, this means installing smaller generating units to keep pace with load growth over time and avoiding the large-scale financial commitments. Federal legislation (i.e., PURPA) has led to a trend toward deregulation of the industry, so that non-utility generators are becoming an integral part of the supply mix. That trend is in its very early stages in Maryland, but is expected to increase in importance over time. With the PSC's interest in least-cost planning, increased attention is also being given to demand-side management programs as a resource for meeting power supply needs.

The changing regulatory environment and trends in resource planning have implications for utility power plant technology selection, fuel use, and related environmental impacts. The principal implications are as follows:

- **Plant refurbishments**. Maryland utilities have plans to extend the lives or otherwise refurbish older generating units to reduce costs and capital requirements. EPA policy may require that such life-extended plants be modified to conform to New Source Performance Standards.

- **Natural gas-fired capacity**. Generating capacity additions in Maryland during the 1990s will emphasize natural gas as a fuel source. New plants will be in the form of conventional combustion turbines, advanced design combustion turbines, and combined cycle units. These plants are relatively efficient in their use of fuel, exhibit very low emission rates for major air pollutants, and generate no significant solid wastes. One concern with this trend is its heavy reliance on natural gas supplies.

- **New coal technologies.** Maryland utilities anticipate adding new coal-fired capacity to the generation mix after the year 2000. The principal options under active consideration are coal gasification and fluidized bed combustion. Compared with the previous generation of conventional coal plants, the new coal-fired technologies emphasize flexibility with regard to fuel usage (i.e., type of fuel), can be installed in stages to meet demand, and offer favorable emission characteristics.

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I. Glossary

Combined cycle unit. An electric generating unit consisting of combustion turbine capacity combined with a steam turbine. The steam turbine is fueled by the waste exhaust heat from the combustion turbines.

Combustion turbine. A type of generating unit normally fired by oil or natural gas. The combustion of the fuel produces expanding gases, which are forced through a turbine, thereby generating electricity.

Demand-side management (DSM). Utility programs designed to modify customer electricity usage, either the overall amount or time pattern of usage. Examples of DSM programs include time-of-use rates, appliance efficiency incentives, and curtailable or interruptible rates.

Economies of scale. A production process is characterized by economies of scale when total cost (i.e., capital plus operating cost) per unit of output fall as plant size is increased.

Independent Power Producers (IPPs). Non-utility electricity suppliers not eligible for "qualifying facility" status under federal rules.

Least-cost planning. A formal planning process conducted by a utility system intended to determine the combination of electric power resource additions (or other actions) that minimizes the cost of providing electric service over a relevant long-term planning horizon. The process emphasizes evaluation and integration of a wide range of resource options including new generating units, DSM, and power purchases from non-utility generators.

Qualifying facilities. Non-utility generators meeting certain prescribed federal technical standards. Such plants may be cogenerators or operate using renewable or waste fuels.

Vertically integrated systems. Utility systems involved in all facets of the electricity business including generation, transmission, and distribution of electric power.

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APPENDIX A

Characteristics of Maryland Power Plants (1987)

Characteristics of Maryland Power Plants (1987)

UTILITY Plant (type)	FUEL TYPE	FUEL CONSUMPTION (a)	EMISSIONS CONTROL	ACTUAL EMISSIONS SO2 (T/Y)	ACTUAL EMISSIONS NOx (T/Y)	ACTUAL EMISSIONS PM (T/Y)	INITIAL OPERATION OR [EXP. START] DATE	TOTAL GENERATING NAMEPLATE CAPACITY(MW)
PEPCO								
Morgantown (steam)								
AMA Entry #1	No. 6 oil	2,354,000	ESP	41,416	8,111	401	1971	626
	Coal	1,230,739						
AMA Entry #2	No. 6 oil	2,354,000	ESP	41,416	8,111	503	1971	626
	Coal	1,230,739						
			TOTAL	82,832	16,222	904		1,252
Morgantown (turbine)								
AMA Entry #3	No. 2 Oil	484,000	None	10	5	0.5	1971	
AMA Entry #4	No. 2 Oil	484,000	None	10	5	0.5	1971	
AMA Entry #5	No. 2 Oil	484,000	None	10	5	0.5	1971	
AMA Entry #6	No. 2 Oil	484,000	None	10	5	0.5	1971	
AMA Entry #7	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
AMA Entry #8	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
AMA Entry #9	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
AMA Entry #10	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
AMA Entry #11	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
AMA Entry #12	No. 2 Oil	1,009,000	None	21	34	2.5	1973	
			TOTAL	166	224	17		296
			PLANT TOTAL	82,998	16,446	921		1,548
Dickerson (steam)								
AMA Entry #1	No. 2 Oil	326,000	ESP	12,924	3,676	195	1960	196
	Coal	450,627	Scrubber					
AMA Entry #2	No. 2 Oil	326,000	ESP	12,924	3,676	195	1960	196
	Coal	450,627	Scrubber					
AMA Entry #3	No. 2 Oil	326,000	ESP	12,924	3,676	195	1960	196
	Coal	450,627	Scrubber					
			TOTAL	38,772	11,028	585		588
Dickerson (turbine)								
AMA Entry #4	No. 2 Oil	46,000	None	1	2	0.1	1967	16
			TOTAL	1	2	0.1		16
			PLANT TOTAL	38,773	11,030	585.1		604

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UTILITY Plant (type)	FUEL TYPE	FUEL CONSUMPTION (a)	EMISSIONS CONTROL	ACTUAL EMISSIONS SO2 (T/Y)	ACTUAL EMISSIONS NOx (T/Y)	ACTUAL EMISSIONS PM (T/Y)	INITIAL OPERATION OR [EXP. START] DATE	TOTAL GENERATING NAMEPLATE CAPACITY(MW)
PEPCO (continued)								
Chalk Point (steam)								
AMA Entry #1	No. 2 Oil	1,029,000	ESP	25,242	7,860	256	1965	364
	Coal	747,589						
AMA Entry #2	No. 2 Oil	1,029,000	None	25,242	7,860	196	1965	364
	Coal	747,589						
AMA Entry #7	No. 6 Oil	30,515,000	None	3,348	630	253	1975	659
AMA Entry #8	No. 6 Oil	30,515,000	None	3,348	630	253	1982	659
			TOTAL	57,180	16,980	958		2,046
Chalk Point (turbine)								
AMA Entry #3	NA	---	None	0	0	0.0	1964	
AMA Entry #4	NA	---	None	0	0	0.0	1964	
AMA Entry #5	No. 2 Oil	824,000	None	18	8	0.8	1964	
AMA Entry #6	No. 2 Oil	172,000	None	4	6	0.4	1967	
AMA Entry #9	No. 2 Oil	172,000	None	4	6	0.4	1974	
AMA Entry #10	No. 2 Oil	824,000	None	18	8	0.8	1975	
AMA Entry #11	No. 2 Oil	824,000	None	18	8	0.8	1975	
AMA Entry #12	No. 2 Oil	824,000	None	18	8	0.8	1975	
AMA Entry #13	No. 2 Oil	824,000	None	18	8	0.8	1975	
			TOTAL	98	52	5		51
			PLANT TOTAL	57,278	17,032	963		
DELMARVA								
Vienna (steam)								
AMA Entry #2	No. 6 Oil	30,449,000	Multiple Cyclone	4,482	639	339	1972	162
AMA Entry #3	NA	---	None	0	0	0	1980	
			TOTAL	4,482	639	339		162
Vienna (turbine)								
AMA Entry #1	No. 2 Oil	82,000	None	0.48	2	0.1	1968	19
			TOTAL	0.48	2	0.1		19
			PLANT TOTAL	4,482	641	339.1		181

Characteristics of Maryland Power Plants (1987)

UTILITY Plant (type)	FUEL TYPE	FUEL CONSUMPTION (a)	EMISSIONS CONTROL	ACTUAL EMISSIONS SO2 (T/Y)	ACTUAL EMISSIONS NOx (T/Y)	ACTUAL EMISSIONS PM (T/Y)	INITIAL OPERATION OR [EXP. START] DATE	TOTAL GENERATING NAMEPLATE CAPACITY(MW)
BG&E								
Calvert Cliffs (nuclear)								
AMA Entry #1	No. 2 Oil	27,000	None	0.47	0.32	0.00	1971	
AMA Entry #2	No. 2 Oil	27,000	None	0.47	0.32	0.00	1971	
AMA Entry #3	No. 2 Oil	13,000	None	0.16	0.16	0.00	1970	
AMA Entry #4	No. 2 Oil	13,000	None	0.16	0.16	0.00	1970	
AMA Entry #5	No. 2 Oil	13,000	None	0.16	0.16	0.00	1970	
			PLANT TOTAL	1.415	1.101	0.00		1,829
Brandon Shores (steam)								
AMA Entry #1	No. 2 Oil	1,695,000	ESP	19,994	9,740	539	1984	685
	Coal	1,462,054						
			PLANT TOTAL	19,994	9,740	539		685
Riverside (steam)								
AMA Entry #3	No. 6 Oil	5,168,000	Multiple Cyclone	414	309	17	1951	
	Gas	138,080						
AMA Entry #4	No. 6 Oil	3,184,000	ESP	255	220	7	1948	
	Gas	193,084						
AMA Entry #5	No. 6 Oil	4,295,000	ESP	344	232	16	1944	
	Gas	23,205						
AMA Entry #6	No. 6 Oil	5,320,000	Multiple Cyclone	426	297	24	1953	
	Gas	66,027						
AMA Entry #7	No. 6 Oil	2,469,000	ESP	175	225	15	1944	
	Gas	40,046	TOTAL					
				1,614	1,283	79		283
Riverside (turbine)								
AMA Entry #1	No. 2 Oil	464,000	None	10	16	1	1970	
AMA Entry #2	No. 2 Oil	464,000	None	10	16	1	1970	
AMA Entry #8	Gas	362,000	None	1	81	3	1970	
			TOTAL	21	113	5		172
			PLANT TOTAL	1,635	1,396	84		455
C.P. Crane (steam)								
AMA Entry #5	No. 2 Oil	159,000	ESP	12,560	6,134	99	1961	190
	Coal	329,927	Baghouse					
AMA Entry #6	No. 2 Oil	159,000	ESP	12,738	6,496	110	1963	209
	Coal	331,125	Baghouse					
			TOTAL	25,298	12,630	209		399

Characteristics of Maryland Power Plants (1987)

UTILITY Plant (type)	FUEL TYPE	FUEL CONSUMPTION (a)	EMISSIONS CONTROL	ACTUAL EMISSIONS SO2 (T/Y)	NOx (T/Y)	PM (T/Y)	INITIAL OPERATION OR [EXP. START] DATE	TOTAL GENERATING NAMEPLATE CAPACITY(MW)
C.P. Crane (turbine)								
AMA Entry #1	No. 2 Oil	379,000	None	8	13	1	1967	
AMA Entry #2	No. 2 Oil	79,000	None	2	1	0.1	1960	
AMA Entry #3	No. 2 Oil	79,000	None	2	1	0.1	1960	
AMA Entry #4	No. 2 Oil	159,000	None	3	2	0.2	1972	
	No. 2 Oil							
			TOTAL	15	17	1.3		16
			PLANT TOTAL	25,313	12,647	209.8		415
Notch Cliff (turbine)								
AMA Entry #1	Gas	119,527	None	0.04	25	0.84	1969	
AMA Entry #2	Gas	121,365	None	0.04	25	0.84	1969	
AMA Entry #3	Gas	123,476	None	0.04	25	0.88	1969	
AMA Entry #4	Gas	118,150	None	0.04	24	0.84	1969	
AMA Entry #5	Gas	113,407	None	0.04	23	0.80	1969	
AMA Entry #6	Gas	124,200	None	0.04	26	0.88	1969	
AMA Entry #7	Gas	122,771	None	0.04	25	0.88	1969	
AMA Entry #8	Gas	121,800	None	0.04	25	0.84	1969	
			PLANT TOTAL	0.32	198	6.80		144
Westport (steam)								
AMA Entry #2	No. 6 Oil	3,272,000	ESP	262	172	5	1941	60
AMA Entry #3	No. 6 Oil	3,941,000	ESP	315	207	14	1950	69
			TOTAL	577	379	19		129
Westport (turbine)								
AMA Entry #1	No. 2 Oil	819,000	None	18	8	1	1970	
AMA Entry #4	Gas	802,464	None	0.25	166	6	1969	
			TOTAL	18.25	174	7		122
			PLANT TOTAL	595	553	26		251
Gould Street (steam)								
AMA Entry #1	No. 6 Oil	10,661,000	ESP	853	560	22	1952	104
			PLANT TOTAL					104

Characteristics of Maryland Power Plants (1987)

UTILITY Plant (type)	FUEL TYPE	FUEL CONSUMPTION (a)	EMISSIONS CONTROL	ACTUAL EMISSIONS SO2 (T/Y)	NOx (T/Y)	PM (T/Y)	INITIAL OPERATION OR [EXP. START] DATE	TOTAL GENERATING NAMEPLATE CAPACITY(MW)
BG&E (continued)								
Wagner (steam)								
AMA Entry #1	No. 2 Oil	4,000	ESP	9,659	5,906	449	1966	359
	Gas	226,000						
	Coal	556,529						
AMA Entry #3	No. 2 Oil	2,528,000	Simple Cyclone	2,023	1,358	49	1972	415
	Gas	111,588	Multiple Cyclone					
AMA Entry #4	No. 2 Oil	7,933,000	Multiple Cyclone	635	870	1	1959	136
	Gas	1,648,810						
AMA Entry #5	No. 2 Oil	15,944,000	Multiple Cyclone	1,357	890	1	1959	133
			TOTAL	13,674	9,024	500		1,043
Wagner (turbine)								
AMA Entry #2	No. 2 Oil	248,000	None	5	8	1	1967	16
			TOTAL	5	8	1		16
			PLANT TOTAL	13,679	9,032	501		1,059
Philadelphia Road (turbine)								
AMA Entry #1	No. 2 Oil	76,000	None	2	3	0.2	1970	
AMA Entry #2	No. 2 Oil	76,000	None	2	3	0.2	1970	
AMA Entry #3	No. 2 Oil	76,000	None	2	3	0.2	1970	
AMA Entry #4	No. 2 Oil	76,000	None	2	3	0.2	1970	
			PLANT TOTAL	8	12	1		83
Perryman (turbine)								
AMA Entry #1	No. 2 Oil	621,000	None	6	21	2	1971	
AMA Entry #2	No. 2 Oil	621,000	None	6	21	2	1971	
AMA Entry #3	No. 2 Oil	621,000	None	6	21	2	1971	
AMA Entry #4	No. 2 Oil	621,000	None	6	21	2	1971	
			PLANT TOTAL	24	84	8		213
POTOMAC EDISON								
R.P. Smith (steam)								
AMA Entry #1	No. 2 Oil	21,000	ESP	436	239	71	1947	75
	Coal	227,660						
AMA Entry #2	No. 2 Oil	175,000	ESP	4,105	2,255	162	1958	75
	Coal	2,145,960						
			PLANT TOTAL	4,541	2,494	233		150

(a) Coal in tons/year, oil in gallons/year, and gas in thousand cubic feet/year.

APPENDIX B

Economic and Demographic Growth in Maryland

APPENDIX B
ECONOMIC AND DEMOGRAPHIC GROWTH IN MARYLAND

This Appendix provides a discussion of the historical and projected trends in economic and demographic growth in Maryland, with emphasis on those characteristics that influence the demand for electricity. The Power Plant and Environmental Review Division (PPER) has conducted a program of independent load forecasts since the mid-1970s. The electric load forecasts developed through this program are used to help ensure that future power supplies are adequate to meet projected consumer demand, and to help mitigate the costs associated with excess capacity.

The PPER forecasts, as well as those prepared by the Maryland utilities, are based on sets of economic models of electricity demand. These models (described in the 1982 CEIR) quantify the historical influence of such factors as employment, income, weather, number of households, and the price of electricity and other fuels on electricity demand. The historical data required to develop the econometric models are obtained from a variety of sources, including the Maryland utilities; the Maryland Office of State Planning (OSP); the Bureau of Economic Analysis (BEA) and the National Oceanic and Atmospheric Administration; both of the U.S. Department of Commerce; the Bureau of Labor Statistics of the U.S. Department of Labor; and the Maryland Office of Employment Security.

Assumptions about the future values of the explanatory variables (i.e., income, employment, population, etc.) are necessary in order to forecast future power demands with these models. OSP periodically prepares and publishes long-range projections of population and employment, but it does not currently prepare projections of income. The PPER forecasts of power demands for the major electric utilities serving Maryland have incorporated these OSP projections, which are prepared for each of the Maryland counties and for Baltimore City. OSP also provides data and projections of household size and household numbers, which assist in forecasting the future numbers of residential customers.

OSP develops its projections of Maryland employment and demographic variables at the county level. This is particularly useful for utility planners because investments in distribution plant (such as substations) and certain kinds of transmission capacity are based on small-area growth prospects.

This Appendix presents a description of the economic/demographic historical trends in Maryland and OSP's outlook through the year 2005. To put these historical trends and projections in perspective, Maryland data are then compared to the performance and projected outlook for the U.S. as a whole.

It is important to understand that the Maryland utilities plan all generating capacity additions on the basis of total system load growth, including the non-Maryland portions of their service areas. Three of the four major electric utilities in the state (PEPCO, DP&L, and Potomac Edison) sell significant portions of their power outside Maryland. However, BG&E, the state's largest electric utility, serves only territory within Maryland. PEPCO is the second largest electric utility in Maryland, with approximately 60 percent of its generation sold in the state (including Southern Maryland, which it serves at wholesale). Only approximately 20 percent of the Allegheny Power System (the holding company that owns Potomac Edison) and 25 percent of DP&L are in Maryland. Thus, with the exception of BG&E, projections of economic/demographic trends in Maryland are only part of the information base needed for systemwide forecasting.

The sections that follow examine the aggregate historical and projected trends in employment, population, and income for the State and break those trends down for the principal regions within the State. This Appendix identifies five distinct regions within Maryland, as indicated on Table 1, rather than the seven regions used by OSP. Whereas OSP includes Frederick County in the Suburban Maryland region, here it is included as part of Western Maryland. Also, the Eastern Shore is a single region here, rather than the "Upper" and "Lower" Eastern Shore regions the OSP uses. These changes have been made for simplicity and to make the regional definitions conform more closely to the Maryland electric utility service territories.

A. Employment Trends

Table 2 shows the trends in total civilian employment in Maryland and the U.S. between 1970 and 1987. Maryland employment growth averaged 2.4 percent per year between 1970 and 1987. Employment growth in Maryland has been particularly strong during the recent economic expansion, growing at a 4.1 percent annual average rate between 1982 and 1987. Maryland employment growth was slightly above the national average employment growth rate of 2.2 percent per year during the 1970 to 1987 time period, and it was significantly above the national 2.8 percent annual average employment growth between 1982 and 1987.

Maryland's above average employment growth is due, in part, to the state's relative lack of dependence on manufacturing, and to the relatively high proportion of government and service sector employment in the state. The state has been insulated from the slower growth trends experienced in the manufacturing sector.

Table 3 outlines the structure of nonagricultural employment in Maryland and the U.S. in 1970 and 1987. Between 1970 and 1987, both Maryland and the U.S. experienced a downward trend in the proportion of employment in the manufacturing and civilian government sectors. An increase in the proportion of Maryland nonagricultural employment in the service and trade sectors, from 40 percent in 1970 to 52 percent in 1987, accounted for most of the decline in the proportion of government and manufacturing employment in the state during the period.

Table 1
Principal regions in Maryland

Region	Counties	Predominant Electric Utility
(1) Baltimore	Baltimore City Baltimore County Anne Arundel Harford Howard Carroll	BG&E
(2) Washington Suburban	Montgomery Prince Georges	PEPCO
(3) Eastern Shore	Cecil[a] Caroline Kent Queen Anne's Talbot Dorchester Somerset Wicomico Worcester	DP&L (and Choptank)
(4) Southern Maryland	Calvert Charles St. Mary's	SMECO (and PEPCO)
(5) Western Maryland	Allegany Frederick Garrett Washington	PE

[a] Most of Cecil County is served by Conowingo Power Company.

Table 2

Total employment in the U.S. and Maryland 1970-1987 (thousands)

Year	Maryland	U.S.	Maryland as a % of U.S.
1970	1,678.1	89,753	1.87
1975	1,818.7	97,177	1.87
1976	1,841.7	99,860	1.84
1977	1,898.4	103,324	1.84
1978	1,985.8	108,092	1.84
1979	2,043.1	111,632	1.83
1980	2,050.9	112,257	1.83
1981	2,080.7	113,313	1.84
1982	2,070.7	112,565	1.84
1983	2,138.5	114,147	1.87
1984	2,238.1	119,485	1.87
1985	2,341.4	123,176	1.89
1986	2,426.5	125,823	1.91
1987	2,526.2	129,423	1.95
	Annual Rates of Growth %		
1970-1987	2.4	2.2	
1977-1987	2.9	2.3	
1982-1987	4.1	2.8	

Sources: BEA 1989a, 1989b.

Table 3

Structure of nonagricultural employment in Maryland and the U.S., 1970 and 1987

Sector	Maryland 1970	Maryland 1987	United States 1970	United States 1987
	%		%	
Mining	0.1	0.1	0.8	0.9
Construction	6.4	7.1	5.2	5.5
Manufacturing	16.7	8.4	23.1	16.0
Transportation, Communications & Utilities	5.5	4.4	5.7	4.9
Trade	20.9	23.0	20.9	22.1
FIRE[a]	6.8	7.5	5.8	7.9
Services	19.5	29.4	19.5	26.5
Civilian Government	25.3	20.0	19.2	16.1
TOTAL[b]	100.0%	100.0%	100.0%	100.0%

Sources: BEA 1989a and 1989b.

(a) Finance, insurance and real estate.
(b) Totals may not sum to 100% due to independent rounding.

Manufacturing employment continues to play a diminishing role in the Maryland economy. Manufacturing employment has fallen to just 8.4 percent of Maryland nonagricultural employment in 1987, down from 16.7 percent in 1970. The proportion of Maryland employment in manufacturing is well below the nationwide average of 16 percent.

Table 4 shows Maryland regional employment in 1970 and 1987. Employment grew at above average rates in the service oriented regions, while regions with a relatively high proportion of employment in manufacturing showed only modest employment gains during this period.

Employment in the Washington Suburban and Southern Maryland regions grew at annual average rates of 3.9 and 3.6 percent, respectively, between 1970 and 1987. Both the Southern Maryland and Washington Suburban economies are service and government sector oriented, with manufacturing employment accounting for less than five percent of total employment in these regions during the historical period. In contrast, manufacturing employment exceeded 20 percent of total employment in the Baltimore, Western Maryland, and Eastern Shore regions in 1970. From 1970 to 1987, manufacturing employment in these three regions declined an average of 0.5 to 2.2 percent per year, contributing to the below average growth in total employment in these regions during this period. The ratio of manufacturing to total nonagricultural employment has declined significantly in these three regions since 1970, but it is still well above the proportion of manufacturing employment in the Washington Suburban and Southern Maryland regions.

Table 5 shows OSP projections of Maryland and U.S. employment through 2005. National and statewide employment growth is expected to slow considerably during the 1990 to 2005 period. U.S. and Maryland employment growth is expected to be only 1.0 and 1.1 percent per year, respectively, through 2005, compared with state and national annual average employment growth rates in excess of 2.2 percent per year between 1970 and 1987. Slower growth in the working age population and in the percentage of the population participating in the work force are the primary factors affecting future employment growth.

B. Population and Household Trends

Historical population data for Maryland and the U.S. are shown in Table 6. Maryland population growth averaged 1.4 percent per year between 1960 and 1988, slightly above the national average growth of 1.1 percent per year. After very strong population growth in the 1960s, statewide population growth has slowed to an average of 0.9 percent per year since 1970, just below the national average rate of population growth.

Table 4
Employment and employment shares by region

Region	1970 Number (thousands)	1970 % of Region	1987 Number (thousands)	1987 % of Region	Annual Rate of Growth In Number Employed 1970-1987
Baltimore					
Total	983.3	-	1,322.6	-	1.8%
Manufacturing	197.0	20.0%	135.4	10.2%	-2.2
Nonmanufacturing	786.3	80.0	1,187.2	89.8	2.5
Washington Suburban					
Total	416.9	-	796.2	-	3.9
Manufacturing	16.2	3.9	29.7	3.7	3.6
Nonmanufacturing	400.7	96.1	766.5	96.3	3.9
Western Maryland					
Total	119.2	-	168.4	-	2.1
Manufacturing	31.9	26.8	22.5	13.4	-2.0
Nonmanufacturing	87.3	73.2	145.9	86.6	3.1
Southern Maryland					
Total	40.5	-	73.5	-	3.6
Manufacturing	1.1	2.7	1.4	1.9	1.4
Nonmanufacturing	39.4	97.3	72.1	98.1	3.6
Eastern Shore					
Total	118.1	-	165.3	-	2.0
Manufacturing	26.9	22.8	24.9	15.1	-0.5
Nonmanufacturing	91.2	77.2	140.4	84.9	2.6
Maryland					
Total	1,678.1	-	2,526.2	-	2.4
Manufacturing	273.3	16.3	212.6	8.4	-1.5
Nonmanufacturing	1,404.8	83.7	2,313.6	91.6	3.0

Source: BEA 1989a and 1989b.

Table 5

Employment projections for Maryland and the U.S. (thousands)

Region	1990	1995	2005	Average Annual Rate of Growth (1990-2005) %
Baltimore	1,367	1,425	1,517	0.7
Washington Suburban	860	944	1,095	1.6
Southern Maryland	77	86	98	1.6
Western Maryland	171	182	203	1.2
Eastern Shore	177	190	213	1.2
Total State[a]	2,651	2,828	3,125	1.1
United States	135,200	143,600	157,700	1.0

Source: MD-OSP 1990.

[a] Totals may not sum due to independent rounding.

Table 6

Maryland and U.S. population, 1960-1988
(thousands)

Year	Maryland	U.S.	Maryland as a % of U.S.
1960	3,101	180,671	1.72
1970	3,924	205,052	1.91
1980	4,217	227,757	1.85
1985	4,393	238,279	1.84
1986	4,461	241,613	1.85
1987	4,535	243,915	1.86
1988	4,600*	246,113	1.86
		Annual Rates of Growth %	
1960-1988	1.4	1.1	-
1970-1988	0.9	1.0	-
1980-1988	1.1	1.0	-

*Estimate

Source: BEA 1989c

The rates of population growth in different regions of the state varied widely during the 1970 to 1987 period as shown on Table 7. Over this period, the rural regions of Southern Maryland and the Eastern Shore have posted the largest percentage population gains, while the metropolitan regions of Suburban Maryland and Baltimore experienced the slowest rates of population growth. Despite higher rural population growth rates, the Washington Suburbs and Baltimore Metropolitan Region still accounted for 80 percent of Maryland's population in 1987. This 80 percent share of population in 1987 is down slightly from the 83 percent share in 1970.

Table 8 shows OSP Maryland regional and BEA U.S. population projections through the year 2005. OSP projects a slowdown in population growth rates for Maryland and for the Southern Maryland and Eastern Shore regions. Population growth in the Washington Suburban, Baltimore, and Western Maryland regions during the 1990 to 2005 period is expected to be more rapid than during the 1970 to 1987 period. The U.S. as a whole is expected to see slower population growth rates compared to those of the 1970s and 1980s. OSP expects the Maryland population to reach 5.4 million people in 2005, as compared to 4.5 million in 1987.

Relatively modest and stable trends in aggregate state and regional population growth mask the more extreme population trends occurring at the county and city level. The "suburbanization" of the Baltimore Region is a perfect example. The population growth rate for the region as a whole was very low, at 0.5 percent between 1970 and 1987. However, three counties in the region experienced annual population growth rates of 2 percent or more, while the Baltimore City population actually declined 1.1 percent per year during the same period.

The county-by-county annual average population growth rates for the Baltimore region during the 1970 to 1987 period were as follows:

Baltimore City	-1.1%
Anne Arundel County	1.9
Baltimore County	0.5
Carroll County	3.1
Harford County	2.0
Howard County	5.5
Baltimore Region	0.5%

Table 9 shows OSP projections of household numbers and household size through the year 2000. Household numbers grew more rapidly than population between 1970 and 1985. OSP expects this trend to continue through the year 2000, as it expects the average household size to continue to decline. The number of households in the State is expected to grow at approximately two times the rate of growth in population between 1985 and 2000. The number of households in Maryland is expected to reach 2.0 million by the year 2000, compared to 1.6 million

Table 7

Population in Maryland by region, 1970-1987 (thousands)

Year	Baltimore	Washington Suburban	Southern Maryland	Western Maryland	Eastern Shore
1970	2,071	1,185	116	294	258
1980	2,178	1,244	167	335	297
1981	2,187	1,260	172	336	299
1982	2,190	1,263	175	336	301
1983	2,198	1,278	179	339	304
1984	2,210	1,301	185	341	308
1985	2,223	1,320	191	343	314
1986	2,248	1,344	198	349	321
1987	2,272	1,372	210	354	327
% of 1987 Total Maryland Population	50.1	30.3	4.6	7.8	7.2
		Annual Rates of Growth %			
1970-1987	0.5	0.7	3.2	1.0	1.2
1980-1987	0.5	1.0	2.5	0.5	1.0

Source: BEA 1989c.

Table 8

Projections of total population for Maryland regions and the U.S., 2000-2005 (thousands)

	1990	1995	2000	2005	Rate of Growth 1990-2005 (%)
Baltimore	2,354	2,443	2,514	2,579	0.6
Washington Suburban	1,439	1,527	1,580	1,633	0.8
Southern Maryland	225	254	279	300	1.9
Western Maryland	374	397	417	434	1.0
Eastern Shore	351	374	392	407	1.0
Total State[a]	4,743	4,994	5,181	5,353	0.8
United States	250,410	260,138	268,266	275,604	0.6

Source: BEA 1989c. OSP 1990.

[a] Totals may not sum due to independent rounding.

Table 9

Historical and projected number of households and average size of households in Maryland by region, 1970-2000

Region	Households (thousands) 1970	1985	1990	2000	Annual Rate of Growth 1970-1985	1985-2000
Baltimore	624	809	886	996	1.6	1.4
Washington Suburban	350	477	543	634	2.0	1.9
Southern Maryland	30	61	76	100	4.5	3.4
Western Maryland	92	123	138	159	1.8	1.7
Eastern Shore	80	115	133	154	2.4	2.0
Total State[a]	1,175	1,586	1,776	2,043	2.0	1.7
			Average Household Size			
Baltimore	3.22	2.68	2.59	2.46	-1.2	-0.6
Washington Suburban	3.32	2.71	2.61	2.46	-1.3	-0.6
Southern Maryland	3.77	3.08	2.93	2.77	-1.3	-0.7
Western Maryland	3.16	2.67	2.61	2.52	-1.1	-0.4
Eastern Shore	3.12	2.65	2.57	2.46	-1.1	-0.5
Total State	3.25	2.70	2.61	2.48	-1.2	-0.6

Source: OSP 1990.

(a) Totals may not sum due to independent rounding.

in 1985, and 1.2 million in 1970. Statewide average household size is expected to decline to 2.5 persons by the year 2000, down from 2.7 persons in 1985 and 3.25 persons in 1970.

C. Population and Employment Interactions

Forecasting changes in population and employment is crucial to electricity load forecasts. Population, through its effect on the number of households and hence residential customers, directly affects electricity demand, as does employment, which reflects the level of business activity. Understanding the relationship between population and employment will help improve the accuracy of the demographic forecasts and therefore electricity load forecasts.

Population and employment interact in complex ways. Population increases tend to increase the labor supply, and in the long run increase employment, as businesses employ the larger pool of available labor. Higher population will also tend to increase the demand for local goods and services. This increase in local business activity will similarly stimulate higher employment. Alternatively, abundant employment opportunities in a region, due to increased capital investment or other reasons, may lead to increased population in that region as job seekers from outside the region move into the region.

Since 1970, total employment has grown more than twice as rapidly in percentage terms as the population in both Maryland and the U.S. Two factors are primarily responsible for this accelerated employment growth rate. First, the coming of age of the "baby boom generation" beginning in the early 1970s has resulted in proportionately large increases in the working age population (i.e., 16 years of age or older). The second factor is the large increase in work force participation by women. The proportion of total population that was of working age rose from 60 percent in 1970 to 77 percent in 1987. In 1970, women accounted for 37.7 percent of total civilian employment in the U.S. compared to 44.8 percent in 1987.

Table 10 shows the historical and projected trends in the ratio of employment to population by Maryland region and in the U.S. Substantial increases in the ratio have occurred throughout the state, with the exception of Southern Maryland. The statewide ratio of employment to population increased from 42.8 percent in 1970 to 55.7 percent in 1987. The ratio is expected to rise more slowly in the future as additions to the working age population slow and increases in the labor force participation rate by women also diminish (i.e., the rate will tend to level off). OSP projects an increase in the Maryland employment to population ratio of only 2.5 percentage points between 1990 and 2005. A pronounced slowdown in the rate of Maryland and U.S. employment growth between 1990 and 2005 is expected to result from slower increases in population growth and the ratio of employment to population.

Table 10

Historical and projected employment/population ratios for the U.S. and Maryland, 1970-2005 (percentages)

Region	1970	1980	% 1990	2000	2005
Baltimore	47.0	52.2	58.1	58.5	58.8
Washington Suburban	35.2	47.6	59.8	64.5	67.1
Southern Maryland	34.9	29.9	34.2	33.3	32.7
Western Maryland	40.5	41.9	45.7	46.3	46.8
Eastern Shore	45.8	45.2	50.4	51.8	52.3
Total State[a]	42.8	48.6	55.9	57.5	58.4
United States	44.1	49.6	54.3	56.7	57.3

Sources: BEA 1989a, 1989b, and 1989c. OSP 1990.

(a) Totals may not sum due to independent rounding.

D. Personal Income Growth

Personal income is an important factor affecting electricity demand. Increases in personal income induce consumers to purchase more electric appliances and to use electric appliances more intensively. Rising incomes also tend to increase consumption of local goods and services, which leads to increased business activity and increased electricity demand from the commercial sector.

OSP does not publish personal income forecasts. In 1985, BEA projected Maryland average annual per capita personal income growth of 1.7 percent per year. This compares with the historical rate of personal income growth of 1.7 percent per year in Maryland between 1969 and 1983. U.S. per capita personal income growth is projected to be 1.7 percent per year from 1990 to 2000, compared with growth of 1.8 percent per year between 1969 and 1983. BEA expects to publish revised projections of personal income later in 1990.

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