shut off air conditioners and/or electric water heaters for short periods of time during hours of very high demand. The projected savings is 120 MW by the mid 1990's.

These programs have been approved by the Maryland PSC and have been in place for approximately one year on a non-experimental basis. Although customer interest has been strong, it is still too early to determine whether PEPCO's load savings projections will be realized. Portions of the program (time-of-day rates for WMATA and residential load control) have not yet been approved by the District of Columbia Commission.

The new EUM is currently being reserved as a resource option by PEPCO. This expansion of the current program would include time-of-day rates for new homes, small commercial programs, enhanced air conditioning cycling, and other programs. PEPCO estimates that this new set of programs, if implemented, could add another 199 MW of savings by 2002.

BG&E has had a program of curtailable rates for its large nonresidential customers for the past several years and has very recently introduced residential programs (BG&E 1988). The curtailable service program is similar to PEPCO's program. At the present time, ten customers are participating with contracted curtailable loads of 56 MW; actual curtailments amounted to about 33 MW in 1987. BG&E anticipates modest growth in this program over time. The company has also expanded its nonresidential time-of-day rates and expects load savings to increase from 21 MW in 1988 to 63 MW in 2002.

After undertaking an extensive pilot study over the past several years, in 1987 BG&E introduced its residential load management programs on a non-experimental basis. These include air conditioning control devices which shut off air conditioners for short periods of time on very hot days; storage water heaters; and time-of-day rates. All of these programs are voluntary and provide the customer with a rate incentive for participating. The air conditioner controls help reduce the system summer peak demand only, whereas the storage water heaters are able to achieve savings in both the summer and the winter. This is important because BG&E is projected to become winter-peaking by the late 1990's in both the

PPRP and BG&E forecasts. A storage water heater contains a much larger than normal storage tank to store the hot water. A timer is used to shut the appliance off during the peak usage hours, thus shifting usage to the off-peak hours. The residential programs are projected to save 94 MW in the winter and 144 MW in the summer by 2002.

DP&L has recently proposed a load management program as part of its "Challenge 2000" planning initiative, filed with the Maryland PSC in April, 1987. The current program, which estimates 225 megawatts of savings by 1996, includes nonresidential curtailable service (51 MW), residential appliance cycling (95 MW) and "small" cogeneration (79 MW). (The latter is not normally classified as load management.) The estimated 225 MW saving is nearly ten percent of DP&L's projected peak load. These programs are currently under review by the regulatory commissions in Maryland and Delaware.

The load management programs of APS are quite different than those of Maryland's other utilities. This is in part due to APS' much higher load factor (i.e., flatter loads) and its status as a winter-peaking utility. APS also has much more capacity relative to its annual peak load than do the other utilities. As a result of these differences, the APS programs tend to be "broad based," reducing demand for a large number of hours per year, rather than for just a few hours. Thus, time-of-day rates, curtailments and interruptions of service are not included (although they have been studied). Instead, APS emphasizes improved weatherization of homes and commercial buildings, water heater insulation and the installation of more efficient lighting in nonresidential buildings.

PPRP has also been conducting its own research on demand-side programs. A study of potential residential programs, using BG&E as a case study, was recently completed by Synergic Resources Corporation (McDonald *et al.*, 1987). Impacts on future power demands were estimated, and the cost-effectiveness of each program (and packages of programs) was evaluated. The study encompasses programs similar to those currently being proposed or undertaken by Maryland utilities (i.e., air conditioning and water heaters cycling, time-of-day rates, storage water heaters) and other programs not being considered (incentives to purchase high-efficiency appliances).

Table II-10 presents the peak load and energy savings attained in year 2010, assuming a 1995 program initiation date. As the table indicates, these programs are projected to achieve, potentially, nearly 400 MW of savings in BG&E's residential sector alone ("all programs"), assuming that all of the programs under consideration prove cost-effective and are implemented.

Non-Utility Generation

The passage of the Public Utility Regulatory Policies Act (PURPA) in 1978 and the FERC rules implementing Section 210 of that Act cleared the way for the development of non-utility sources of power. The legislation encourages this source by effectively deregulating "qualifying facilities" (QF's) and establishing that utilities must stand ready to purchase all such power made available to it by the QF's at the utility's "avoided cost," i.e., the cost of production the utility avoids by purchasing QF power rather than constructing and operating its own plants. The state regulatory authority has primary responsibility to determine the avoided cost purchase rates and other tariff or contact provisions.

The rates currently in effect in Maryland for each utility are summarized on Table II-11. These are standard rates for small QF's (normally less then 1 MW), with the rates for larger facilities normally established by a negotiated contract.

Nationwide, QF development has been substantial and exceeded the expectations of most observers. At the end of 1986, the FERC reported that 54,000 MW of capacity had applied for qualifying facilities status, with 19,359 MW of that total occurring in 1986 alone (FERC 1987). NERC estimates that 11 percent of electric generation capacity additions over the next ten years will be from non-utility sources (NERC 1987).

Table II-10
Estimate of peak demand and energy savings on the BG&E system in the PPRP study, 2010

Program		Peak Demand Savings (MW)	Annual Energy Savings (GWh)
(1)	TOD (Time of Day) rates w/appliance cycling	323	93
(2)	TOD rates w/storage water heaters	178	129
(3)	High efficiency appliances	148	998
(4)	TOD rates w/high efficiency appliances	137	840
(5)	TOD rates w/high efficiency appliances and storage water heaters	198	824
(6)	All programs	396	775

Source: McDonald et al. 1987.
N.B.: Programs (1), (2), and (3) are SRC's "high impact" estimates. The others are medium impacts. For comparison, BG&E's projected base case demand in 2010 is 6,582 MW and 34,240 GWh.

Table II-11
Buy-back rates currently in effect in Maryland
(in cents per kWh)

	Summer Season	Winter Season
BG&E [a]		
On Peak (weekdays, 10 AM-8 PM)	3.100¢	2.970¢
Intermediate (weekdays, 7-10 AM, 8-11 PM)	2.510	2.920
Off Peak (weekdays, holidays and weekdays, 11 PM - 7 AM)	1.460	1.790
PEPCO [a]		
On Peak (weekdays, noon-8 PM)	3.847	3.494
Intermediate (weekdays, 8 AM-noon, 8 PM-midnight)	3.217	3.117
Off Peak (weekdays, holidays and weekdays, midnight- 8 AM)	2.328	2.328
DPL [a]		
On Peak (weekdays, 8 AM-9 PM)	2.75	2.81
Off Peak (all other hours)	1.99	2.23
Potomac Edison		
On Peak (7 AM-10 PM)	1.585	1.585
Off Peak (10 PM-7 AM)	1.420	1.420
No Time of Day Metering	1.523	1.523

A 0.5¢/kWh capacity credit is available during system emergencies.

Conowingo
Energy payments shall be based on Conowingo's cost of purchase power from Philadelphia Electric and Susquehanna Electric.

	Summer Season	Winter Season
SMECO	0.7922	0.4922

Energy payments per kWh also include the FAC charge that SMECO pays to PEPCO, typically 2-3 cents per kWh.

Sources: Standard cogeneration/small power producer tariffs on file with the Maryland PSC.
[a] Capacity credits are available for customers willing to enter into long-term power supply commitments. The per-kWh credit depends on the length of the contract.

Despite this very large national trend, the development in Maryland has been fairly limited. Current non-utility generation projects located in Maryland are listed on Table II-12. These projects total to 142 MW, but much of this is industrial self-generation rather than power supplied to the utility grid. Some new capacity in Maryland has or will come from municipal solid waste-fueled systems and small scale hydroelectric. The BRESCO and Montgomery County facilities mentioned earlier are anticipated to provide about 55 MW to BG&E and 40 MW to PEPCO, respectively. A 1985 survey estimated the unexploited small-scale hydroelectric potential in Maryland at 27 MW (Weisberg *et al.* 1985). Some industrial cogeneration[5] potential has been developed but is mostly used onsite rather than being supplied to the utility grid.

As mentioned earlier in this chapter, the APS capacity plan over the next ten years is substantially based upon non-utility sources. Although the specific sources have not been identified, it is believed that little of this development will occur in Maryland; but the power will help to serve Maryland loads.

PEPCO has included very little non-utility power (except for the Montgomery County facility) in its resource plan. PEPCO has indicated, however, that it has held discussions or negotiations with developers that might supply collectively up to 500 MW. If most of this capacity emerges over the next several years, it could cause a major revision to PEPCO's capacity plan.

DP&L has included non-utility power as a major element in its Challenge 2000 plan. So far, however, little has emerged, and DP&L cannot identify at this time the specific non-utility projects that will fill this part of the plan.

Environmental Implications

The environmental implications of non-utility power and demand-side programs vary considerably depending upon the type of program or power source, the specific utility affected, and whether the focus is on the short or long run. Those demand-side programs that lead to large reductions in total energy usage (such as

5 Cogeneration is an energy production process whereby both electricity and another useful energy form (usually process steam) are produced at a single facility with the same fuel.

Table II-12
Cogeneration and renewable resource power facilities in Maryland

	Capacity (MW)
Baltimore Gas & Electric Company	
- Amstar (alternate-gas or oil)[a]	12.5
- Alternate Energy Associates (Brighton Dam)	0.4
- American Hydro Power Company (Rocky Gorge) projected	0.125
- Elvin Sprouse (small hydro)	0.008
- Baltimore Refuse Energy Systems Company (municipal solid waste)	57.0
- Union (small-scale hydro)	0.6
- Gores Mill (small-scale hydro)	0.01
Delmarva Power & Light Company	
- Copley Photovolatics	0.015
- Curtis Windmill (2 units)	0.004
- Parker Pond (small-scale hydro)	0.04
Potomac Electric Power Company	
- Gude Landfill (municipal solid waste)	2.8
- Prince George's County Detention Center (methane gas)	2.55
Potomac Edison Company	
- Bloomington Lake Dam - projected	13.8
- Savage River Dam	2.0
- Self-Use Cogenerators[a]	
Avtex Fibers	24.0
Halltown Paperboard	3.0
Kelly Springfield	2.5
Mack Truck	0.24
Westvaco	50.0
Conowingo Power Company	
- Gilpin Falls (small-scale hydro)	0.4
- Wilson Mill Dam (small-scale hydro)	0.02
TOTAL	172.0

Sources: The Ten-Year Plan filings of the Maryland utilities. Projects listed exclude utility-owned facilities. The utility-owned facilities include 22.7 megawatts of small-scale hydro. (a) These customers generate electricity principally for their own use. Westvaco occasionally sells excess power to Potomac Edison, and Amstar sells some excess to BG&E.

a high-efficiency appliance program) will reduce power plant emissions by reducing utility generation. The amount of the emissions savings for a given amount of conservation, however, may change over time. Moreover, because of power pooling and multistate system dispatching of power plants, it is very difficult to determine where (i.e., in what state(s)) the emissions reduction occurs.

The impacts of other types of demand-side programs, particularly those designed to reduce peak demand, are much more difficult to assess, even qualitatively. A program that succeeds in shifting usage from the on-peak to the off-peak period might actually lead to an increase in emissions, if the power plants that serve the off-peak load increment have higher emissions rates than those that would have served the greater on-peak load. Moreover, if the demand-side program causes the deferral of a planned baseload plant with lower emissions rates than those currently operating, planned emissions reductions will not occur. Hence, the environmental impacts are quite specific to both utilities and programs.

At present, no information has been developed on the environmental impacts of demand management other than a conceptual analysis (Kahal 1987a). PPRP plans to study this issue over the next year and develop estimates of emission impacts from various types of programs.

The impacts of non-utility power are similarly complex. Although not subject to rate-of-return regulation or certification by the Maryland PSC, all non-utility power plants are subject to prevailing environmental and emissions standards applicable to new industrial facilities. The net effect, however, depends on (a) the emissions from the non-utility facility; and (b) the emissions associated with the utility generation which will be displaced by non-utility power. To date there has been little study of this subject because only modest amounts of non-utility power are generated in Maryland.

Certain types of power, such as small-scale hydroelectric power, will unambiguously cause a reduction in emissions compared to other sources. They may, however, cause some environmental harm as well -- see Chapter IV, Aquatic Impact. Other types of non-utility power do produce emissions, but these are likely to be less than utility emissions, thus providing a net benefit. First, the majority of new cogeneration projects burn natural gas, a relatively clean fuel. Second, by making extremely efficient use of energy (by producing two kinds of usable energy from the same fuel source), cogeneration leads to an aggregate reduction in fuel burned, with a corresponding savings in emissions.

E. References

BG&E (Baltimore Gas & Electric Company). 1987. FERC Form No. 1 for 1986.

BG&E. 1988. Information submitted to the Maryland Public Service Commission, Baltimore, Maryland, for the Ten-Year Plan.

Benziger, P. H. 1987. Direct testimony of Peter H. Benziger. Submitted on behalf of Potomac Electric Power Company to the Maryland Public Service Commission, Baltimore, Maryland, Case 8063 Phase I.

DP&L (Delmarva Power & Light Company). 1987a. FERC Form No. 1 for 1986.

DP&L. 1987b. Information submitted to the Maryland Public Service Commission, Baltimore, Maryland, for the Ten-Year plan.

FERC (Federal Energy Regulatory Commission). 1987. The qualifying facilities report. Prepared by the Office of Electric Power Regulation, Federal Energy Regulatory Commission, Washington, D.C.

Estomin, S. L. and M.I. Kahal. 1986a. Updated load forecast of energy and peak demand on the Delmarva Peninsula. Prepared by Exeter Associates, Inc. for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland. PPES-86-2.

Estomin, S. L. and M.I. Kahal. 1986b. Updated load forecast of energy and peak demand for the Allegheny Power System. Technical memorandum by Exeter Associates, Inc. for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland.

Jones, K. K. 1987. Testimony of Kenneth K. Jones before the Maryland Public Service Commission, Baltimore, Maryland, concerning "Challenge 2000". Filed on behalf of Delmarva Power & Light Company, Case No. 8052.

Kahal, M. I. 1987a. The potential effects on sulfur emissions in Maryland from demand-side programs and alternative power. Technical memorandum prepared by Exeter Associates, Inc. for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland.

Kahal, M. I. 1987b. Long-range forecast of electrical energy and peak demand for Baltimore Gas & Electric Company -- 1987 update. Draft final report prepared by Exeter Associates, Inc. for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland.

MD-DNR (Maryland Department of Natural Resources). 1988. Initial brief of the State of Maryland Department of Natural Resources, Annapolis, Maryland, before the Public Service Commission, Baltimore, Maryland. Case 8063 Phase I.

MD-PPRP (Maryland Power Plant Research Program). 1986. Power plant cumulative environmental impact report. Prepared by the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland PPSP-CEIR-5.

McDonald, C., M. Ross, J. Sinha, M. Koved, R. Albert, G. Kreitler. 1987. Costs and benefits of demand-side options. Draft final report prepared for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland.

NERC (North American Electric Reliability Council). 1987. 1987 reliability assessment.

NERC. 1986. 1986 reliability review.

PE (Potomac Edison Company). 1987. Information submitted to the Maryland Public Service Commission, Baltimore, Maryland, for the Ten-Year Plan.

PEPCO (Potomac Electric Power Company). 1986. 1985 energy plan. Filed with the Maryland Public Service Commission, Baltimore, Maryland, as part of its Ten-Year Plan filing.

PEPCO. 1987a. FERC Form No. 1 for 1986.

PEPCO. 1987b. Information submitted to the Maryland Public Service Commission, Baltimore, Maryland, for the Ten-Year Plan.

PEPCO. 1987c. Application of Potomac Electric Power Company for a certificate of public convenience and necessity for Station H. Filed with the Maryland Public Service Commission, Baltimore, Maryland.

PEPCO. 1987d. 1987 Energy Plan. Filed with the Maryland Public Service Commission, Baltimore, Maryland, as part of its Ten-Year Plan filing.

SMECO (Southern Maryland Electric Cooperative). 1988. Application of the Southern Maryland Electric Cooperative for a certificate of public convenience and necessity. Submitted to the Maryland Public Service Commission, Baltimore, Maryland.

Weisberg, S. B., K.A. Rose, B.S. Clevenger and J.O. Smith. 1985. Inventory of Maryland dams and assessment of hydropower resources. Prepared by Martin Marietta Environmental Systems and The Water Resources Administration for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, Maryland.

Wittine, James R. 1987. Informational memorandum regarding Delmarva Power & Light Company's plans to install two 100 megawatt combustion turbines in New Castle County, Delaware. Memorandum to the Maryland Public Service Commission, Baltimore, Maryland.

CHAPTER III

AIR IMPACT

Sufficiently high concentrations of certain materials in the air can adversely affect human health, retard crop and forest growth, damage buildings and vehicles, and otherwise interfere with human activity. The ultimate goal of air quality control is to ensure that concentrations of pollutants in the air or deposited to the ground are maintained at levels low enough to avoid adverse impacts.

Determining the particular impact of one category of pollutant sources such as power plants on air quality in any place can be relatively complex because, in general, it is very difficult to quantitatively relate pollutant emissions from a source (or sources) to pollutant concentrations near the ground. A cubic meter of air in a specific location may contain a mixture of pollutants from many sources located in all directions and at varying distances from it, in addition to existing "background" levels of pollutant concentrations due to distant sources, that vary regionally. Since many industrial sources burn the same types of fuels, no particular parcel of air bears an easily detectable "label" identifying the source of its pollution. One common method of assessing the effects of particular sources on air quality, rather than trying to directly relate emissions to monitored ambient pollutant concentrations, is by the use of predictive atmospheric dispersion modeling -- "air quality modeling."

Modeling uses information on the amounts of pollutants emitted by a source or sources and takes into account other factors such as source location, stack height, wind direction and speed, and geographic conditions. It predicts the concentrations of pollutants at ground level in different locations that are due to pollutant emissions from these sources under the conditions specified. Working backwards, the same kind of modeling can give estimates of the maximum emissions that can be allowed from a source if air quality must be kept within specific limits. Hence the discussion of the air quality impact of power plant operations examines their emission levels. It also reviews any available air quality modeling results as well as overall information on ambient air quality.

This chapter examines the air quality impact of Maryland power plant operations, particularly plant pollutant emissions. It first examines recent trends in power plant emissions of the principal pollutants regulated under federal and state law. It then discusses overall air quality monitoring data for the state and the impact of power plants on air quality as projected by dispersion modeling. Since changes in power plant emissions have been largely determined by air quality, energy and fuel use legislation, a section is devoted to the regulatory framework. A final section discusses possible future changes in regulations and pollutant control technology that could affect power plant emissions.

A. Trends in Overall Emissions and Power Plant Emissions in Maryland

Power plants emit a number of pollutants that can affect ambient air quality and thus human health and welfare. Of those, the U.S. EPA has performed comprehensive health effects assessments and subsequently established air quality standards for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter with a diameter less than 10 um (PM_{10}), ozone (O_3), lead (Pb), and carbon monoxide (CO). Prior to July 31, 1987, the ambient air quality standard for particulate matter (PM) was expressed in terms of total suspended particulates (TSP); currently they are expressed in terms of particulate matter with an aerodynamic diameter less the 10 um (PM_{10}). Because regulatory criteria have been established for them, these substances are referred to as "criteria pollutants." For emissions measurement purposes all oxides of nitrogen (NO_x) are considered together and expressed as NO_x; air quality measurements and the air quality standard focus on nitrogen dioxide (NO_2). Emissions of volatile organic compounds (VOC's) are regulated because they are precursor pollutants for ozone. This section emphasizes emissions of SO_2, NO_x, and PM because power plants emit them in relatively large amounts.

Table III-1 presents estimated annual statewide total stationary (excluding mobile sources) and power plant emissions of SO_2, NO_x, PM, hydrocarbons, VOC's, and CO for 1976 through 1985. Figure III-1 depicts the estimated power plant emissions data for SO_2, NO_x, and PM for the same years.

Table III-1

Total annual emissions of SO_2, NO_x, PM, HC, VOC's, CO, from power plants and other stationary sources in Maryland, 1976-1985

Pollutant	Total Emissions (ton/yr)									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Sulfur Dioxide (SO_2)										
Stationary source totals	274,100	522,105	346,736	319,756	297,588	271,442	266,046	268,744	285,219	250,146
Power plant totals	180,906	238,726	228,099	200,031	227,199	202,503	211,453	215,623	243,625	214,181
Power plant % of total [a]	66	46	66	65	76	75	79	85	85	85
Nitrogen Oxides (NO_x)										
Stationary source totals	138,900	150,737	189,374	157,791	151,130	107,369	94,293	103,779	127,827	102,393
Power plant totals	75,006	88,514	135,012	82,470	98,103	86,195	60,228	68,655	85,163	69,362
Power plant % of total [a]	54	59	71	52	65	64	64	66	67	68
Particulate Matter (PM) [b]										
Stationary source totals	55,400	51,250	73,462	82,349	44,186	35,287	26,869	23,846	21,932	18,442
Power plant totals	21,052	8,444	31,886	31,685	14,256	6,073	6,427	5,352	6,229	4,137
Power plant % of total	38	16	43	38	32	17	24	22	28	22
Hydrocarbons (HC)										
Stationary source totals	56,100	68,139	185,571	80,897	88,383	79,360				
Power plant totals	1,683	1,525	2,011	1,422	1,243	1,142				
Power plant % of total [a]	3	2	1	2	1	1				

Table III-1 (continued)

Total annual emissions of SO_2, NO_x, PM, HC, VOC's, CO, from power plants and other stationary sources in Maryland, 1976-1985

	Total Emissions (ton/yr)									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Volatile Organic Compounds (VOC's)										
Stationary source totals						31,181	29,728	17,645	14,820	14,820
Power plant totals						359	361	478	352	352
Power plant % of total						1	1	3	2	2
Carbon Monoxide (CO)										
Stationary source totals	130,700	120,215	120,726	128,607	52,067	89,202	28,151	23,799	24,714	21,399
Power plant totals	3,921	6,069	8,379	4,597	4,597	4,457	2,889	3,082	4,079	2,952
Power plant % of total [a]	3	5	7	4	9	5	10	13	16.5	14

Sources: MD-BAQNC 1976; MD-AMA 1977, 1978, 1980, 1981, 1982a, 1982b, 1983, 1984, 1985

[a] Total excludes mobile sources.
[b] Because regulations based on PM_{10} have only recently been promulgated, the only particulate emission data routinely available are those for total particulate matter (PM).

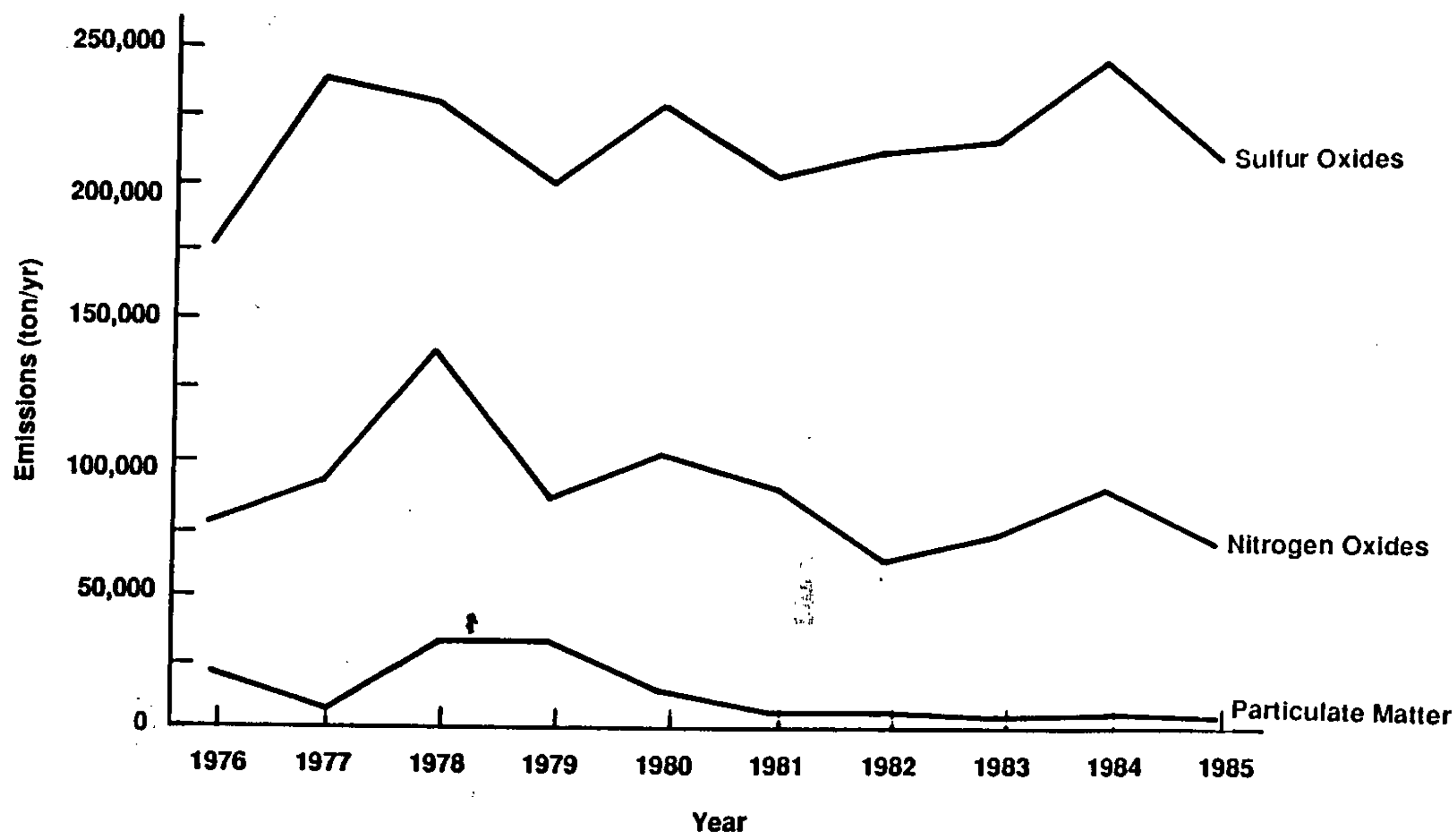

Figure III-1. Statewide total power plant emissions, 1976-1985 (See Table III-1)

As shown in Table III-1, power plant PM emissions declined from approximately 32,000 ton/yr in 1978 to only 4,100 ton/yr in 1985. Some of this reduction can be attributed to the installation of more efficient particulate control equipment at several large coal-fired power plants. In contrast, overall SO_2 and NO_x emissions show no clear trend (Figure III-1), although power plants' share of SO_2 emissions generally increased slightly over the period (Figure III-2).

Power plant emissions of CO have generally declined since 1978. Table III-1 does not include mobile source emissions. Although the table indicates that CO emissions from power plants are about 14 percent of total stationary source emissions, power plants would account for less than 0.5 percent of the total if mobile sources were included. Although VOC emissions have been compiled only since 1981, the data available indicate that a small percentage of total emissions comes from power plants. Again, if mobile sources were included, power plant VOC emissions would represent an even smaller fraction (less than 1 percent) of the total.

Increased Coal Use

The single most important factor affecting power plant SO^2 emissions in the past decade was increased reliance on coal, rather than oil, as the primary energy source. Emission limits for power plants burning coal are as high as 3.5 lb/MMBtu for SO_2, generally higher than the limits for oil-fired power plants in Maryland. The general trend in declining oil consumption is illustrated in Figure III-3, which shows oil and coal consumption for power plants in and around Maryland for 1976-1986. Fuel use data from two Washington D. C. and one Virginia power plants were examined because of the plants' size and close proximity to Maryland. Discussions of emissions, however, are restricted to Maryland power plant sources. In 1976, just over 6 million tons of coal (1.4×10^{14} Btu) were burned by Maryland's power plants. Coal consumption increased steadily to over 7 million tons (1.7×10^{14} Btu) in 1980, decreased slightly, and then reached a 10-year peak in 1984 of over 8.4 million tons (2.0×10^{14} Btu). Oil consumption, on the other hand, has decreased steadily from about 20 million

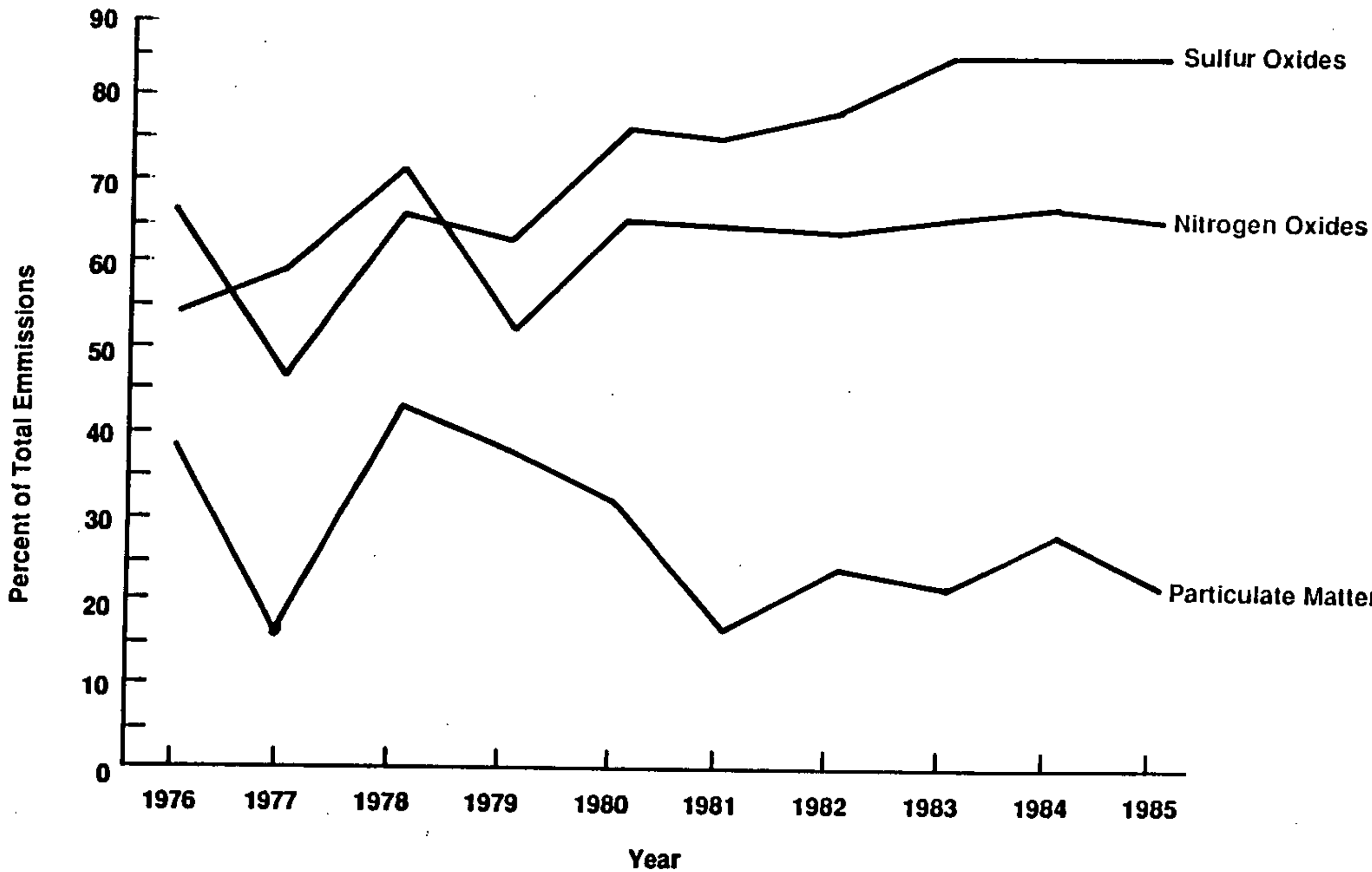

Figure III-2. Power plant emissions as a percentage of total statewide emissions (excluding mobile sources) (See Table III-1)

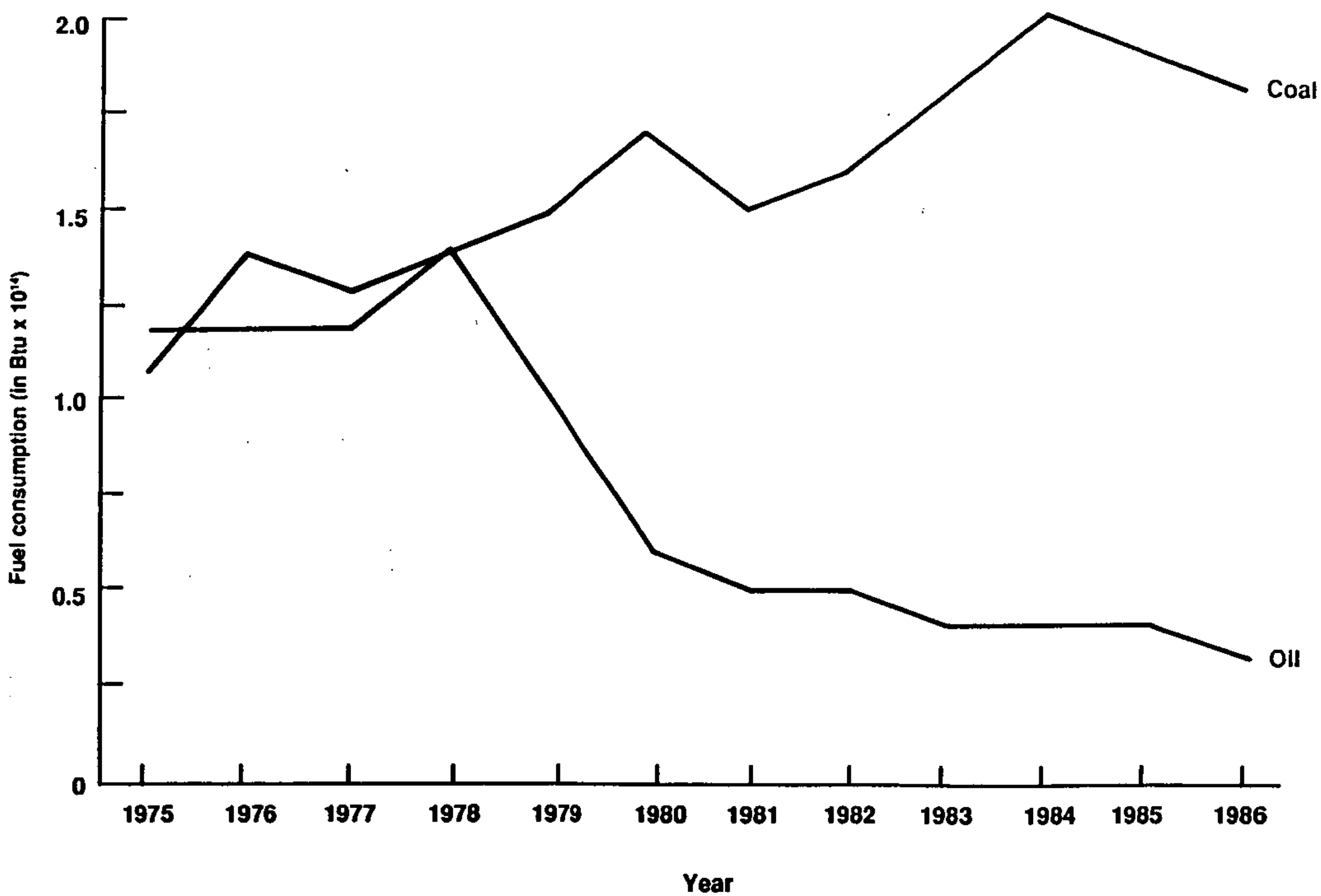

Figure III-3. Fuel consumption (in Btu x 10^{14}) for large power plants in Maryland (1983 fuel consumption data are incomplete and so are estimated)

Source: PSC 1975a-1986a, 1975b-1986b, 1975c-1986c, 1975d-1986d barrels (bbl) (1.1×10^{14} btu) per year in the late 1970's, to under 6 million bbl (0.3×10^{14} btu) in 1986.

Plant-by-Plant Emission Trends

Fourteen electric utilities serve Maryland customers. Power from the four large investor-owned systems -- Baltimore Gas and Electric Company (BG&E), Potomac Electric Power Company (PEPCO), Delmarva Power and Light Company (DP&L), Potomac Edison Company (PE) -- accounts for about 90 percent of all retail sales of electricity in Maryland (Maryland Electric Utilities Council 1982-1986). Therefore, the emissions trends discussion will focus on plants operated by these utilities. It examines emissions for three years -- 1977, 1980, and 1984 -- the three years investigated in the Model States air quality modeling analysis presented in Section B of this chapter. Annual fuel consumption rates, which influence pollutant emissions, are also evaluated. Table III-2 summarizes characteristics of the large power plants in and around Maryland. Tables III-3 and III-4 contain plant by plant SO_2 and NO_2 emissions rate data for 1980-1985.

- Baltimore Gas and Electric (BG&E)

The nine power plants in BG&E's system provided a combined generating capacity of 4,834 MW in 1986. Four of the plants are primarily oil-fired (Gould Street, Westport, Riverside, Perryman), two are coal-fired (Brandon Shores, C.P. Crane), one is coal- and oil-fired (H.A. Wagner), one is gas-fired (Notch Cliff), and one is nuclear powered (Calvert Cliffs). Emissions from the larger BG&E plants for 1977, 1980, and 1984 are presented in Figure III-4. The most significant changes in the BG&E system during the period 1977-1984 were the start-up of Brandon Shores and the conversion from oil to coal at C.P. Crane.

Brandon Shores consists of a single unit, 620 MW coal-fired generating facility located along the Patapsco River in Anne Arundel County. The plant was originally planned and licensed as an oil-burning facility. However, the Power Plant and Industrial Fuel Use Act of 1978 required Brandon Shores to "convert" to coal during construction, and it has burned coal since coming on-line in 1984. A second unit currently under construction will also burn coal. The plant's SO_2

Table III-2

Characteristics of Maryland power plants

Plant	Original Construction Date	Date Last Unit Installed	Type Of Unit	1986 Total Capacity (MW)	Number Of Units	Control Equipment in Place in 1984	Fuel	Fuel Consumption (a) 1977	1980	1984
BG&E										
Brandon Shores	1984	1984	Steam	620	1	1 Electrostatic Precipitator	Coal	--	--	809,631
Calvert Cliffs	1975	1977	Nuclear	1,650	2	Not applicable	Uranium	1,742,558	2,046,989	1,568,830
C.P. Crane	1961	1963	Steam	376	2	2 Electrostatic Precipitators 2 Baghouses	Oil Coal	2,485,447 -	1,547,710 139,093	15,296 675,631
	1967	1967	Combustion Turbine	14	1	None	Oil	7,111	3,933	2,418
Gould Street	1926	1952	Steam	103	1	1 Electrostatic Precipitator	Oil	569,552	437,587	315,700
Westport	1906	1950	Steam	126	5	1 Multiple Cyclone 2 Electrostatic Precipitators	Oil	614,194	356,301	183,567
	1969	1969	Combustion Turbine	118	1	None	Gas	474	303,394	409,422
Riverside	1942	1953	Steam	321	5	5 Electrostatic Precipitators	Oil	1,330,064	782,918	496,963
	1970	1970	Combustion Turbine	172	3	None	Oil Gas	83,547 -	20,858 1,596,117	11,939 65,276

Table III-2 (Continued)

Characteristics of Maryland power plants

Plant	Original Construction Date	Date Last Unit Installed	Type Of Unit	1986 Total Capacity (MW)	Number Of Units	Control Equipment in Place in 1984	Fuel	Fuel Consumption (a) 1977	1980	1984
Wagner	1956	1972	Steam	988	3	3 Multi Cyclone 1 Single Cyclone 1 Electrostatic Precipitator	Oil Coal	3,777,759 565,816	1,873,904 645,172	1,180,023 439,981
	1967	1967	Combustion Turbine	14	1	None	Oil	8,048	3,788	1,778
Notch Cliff	1969	1970	Combustion Turbine	128	8	None	Gas	47,569	2,881,504	256,528
Perryman	1972	1972	Combustion Turbine	204	4	None	Oil	125,484	155,442	180,380
PEPCO										
Benning	1906	1972	Steam	580	2	None	Oil	3,212,742	1,172,924	621,764
Buzzard Point	1968	1968	Steam Combustion Turbine	288 235	6 16	None	Oil Oil	125,343 417,036	77,432 299,179	(b) (c)
Potomac River	1949	1957	Steam	514	5	5 Electrostatic Precipitators	Coal	1,004,200	1,106,306	94,675
Dickerson	1959	1962	Steam	543	3	3 Electrostatic Precipitators 3 Venturi Scrubbers	Coal	1,345,715	1,175,692	1,296,941
	1967	1967	Combustion Turbine	13	1	None	Oil	14,222	2,920	2,046

Table III-2 (Continued)

Characteristics of Maryland power plants

Plant	Original Construction Date	Date Last Unit Installed	Type Of Unit	1986 Total Capacity (MW)	Number Of Units	Control Equipment in Place in 1984	Fuel	Fuel Consumption (a) 1977	1980	1984
Morgantown	1970	1971	Steam	1,164	2	2 Electrostatic Precipitators	Coal Oil	1,546,227 3,459,030	2,656,958 219,667	2,560,720 90,608
	1970	1973	Combustion Turbine	248	6	None	Oil	218,538	328,595	272,801
Chalk Point (d)	1964	1981	Steam	1,907	4	2 Electrostatic Precipitators 2 Venturi Scrubbers	2 Coal 2 Oil/Gas	551,973 2,675,071	1,080,578 2,161,596	1,465,221 1,910,065
	1967	1967	Combustion Turbine	48	2	None	Oil	254,207	236,463	10,117
DP&L										
Vienna #8	1928	1971	Steam	150	1	1 Multi Cyclone	Oil	1,065,230	861,309	734,570
PE										
R.P. Smith	1923	1958	Steam	114	2	2 Electrostatic Precipitators	Coal	371,801	317,154	224,992

Sources: Maryland Electric Utilities Council 1982-1986; PSC 1975-1986a,b,c,d.
(a) Coal in tons; oil in barrels; gas in million cubic feet; nuclear in grams
(b) Units no longer operating.
(c) Information available from emission inventory.
(d) Only oil consumption is shown.

Table III-3

Maryland power plant SO_2 emission rates

UTILITY	PLANT and UNIT(s)	FUEL	Emission Rate (lb/MMBtu) 1980	1981	1982	1983	1984	1985
BG&E	Brandon Shores 1	Coal	-	-	-	-	1.07	1.06
	Crane 1	Oil	1.07	1.07	1.08	1.08	-	-
		Coal	-	-	-	3.12	3.18	2.74
	Crane 2	Oil	1.07	1.07	1.08	1.08	-	
		Coal	2.99	-	-	3.12	3.08	2.64
	Gould	Oil	1.07	1.09	1.06	1.05	1.07	1.06
	Riverside	Oil	1.06	1.07	1.08	1.06	1.08	1.09
	Wagner 1,2,4	Oil	1.07	1.07	1.07	1.06	1.08	1.07
	Wagner 3	Coal	1.38	1.32	1.26	1.29	1.27	1.26
	Westport	Oil	1.08	1.08	1.07	1.08	1.06	1.06
PEPCO	Chalk Point 1,2	Coal	2.76	2.97	2.73	2.55	2.63	2.56
	Chalk Point 3,4	Oil/Gas	2.01	2.08	1.61	1.4	1.66	1.29
	Dickerson 1,2,3	Coal	2.37	2.88	2.53	2.54	2.35	2.19
	Morgantown 1,2	Coal/Oil	2.92	3.03	2.72	2.62	2.71	2.66
PE	R.P. Smith	Coal	1.81	1.67	1.85	1.65	1.46	1.49
DP&L	Vienna 8	Oil	2.02	1.91	1.95	1.86	1.87	1.64

Table III-4

Maryland power plant NO_2 emission rates

UTILITY	PLANT and UNIT(s)	FUEL	Emission Rate (lb/MMBtu) 1980	1981	1982	1983	1984	1985
BG&E	Brandon Shores 1	Coal	-	-	-	-	0.45	0.45
	Crane 1	Oil	0.45	0.45	0.45	0.45	-	-
		Coal	-	-	-	1.39	1.39	1.4
	Crane 2	Oil	0.45	0.45	0.45	0.45	-	-
		Coal	1.47	-	-	1.4	1.49	1.5
	Gould	Oil	0.45	0.45	0.44	0.45	0.44	0.44
	Riverside	Oil	0.45	0.45	0.44	0.45	0.45	0.45
	Wagner 1,2,4	Oil	0.45	0.45	0.44	0.45	0.45	0.45
	Wagner 3	Coal	0.8	0.8	0.8	0.8	0.8	0.8
	Westport	Oil	0.45	0.45	0.45	0.44	0.44	0.44
PEPCO	Chalk Point 1,2	Coal	0.85	0.87	0.86	0.84	0.84	0.83
	Chalk Point 3,4	Oil/Gas	0.28	0.28	0.28	0.28	0.28	0.28
	Dickerson 1,2,5	Oil	0.61	0.61	0.6	0.6	0.6	0.6
	Morgantown 1,2	Coal/Oil	0.61	0.61	0.6	0.6	0.6	0.6
PE	R.P. Smith	Coal	0.89	0.9	0.88	0.87	0.85	0.87
DP&L	Vienna 8	Oil	0.33	0.16	0.33	0.33	0.33	0.32

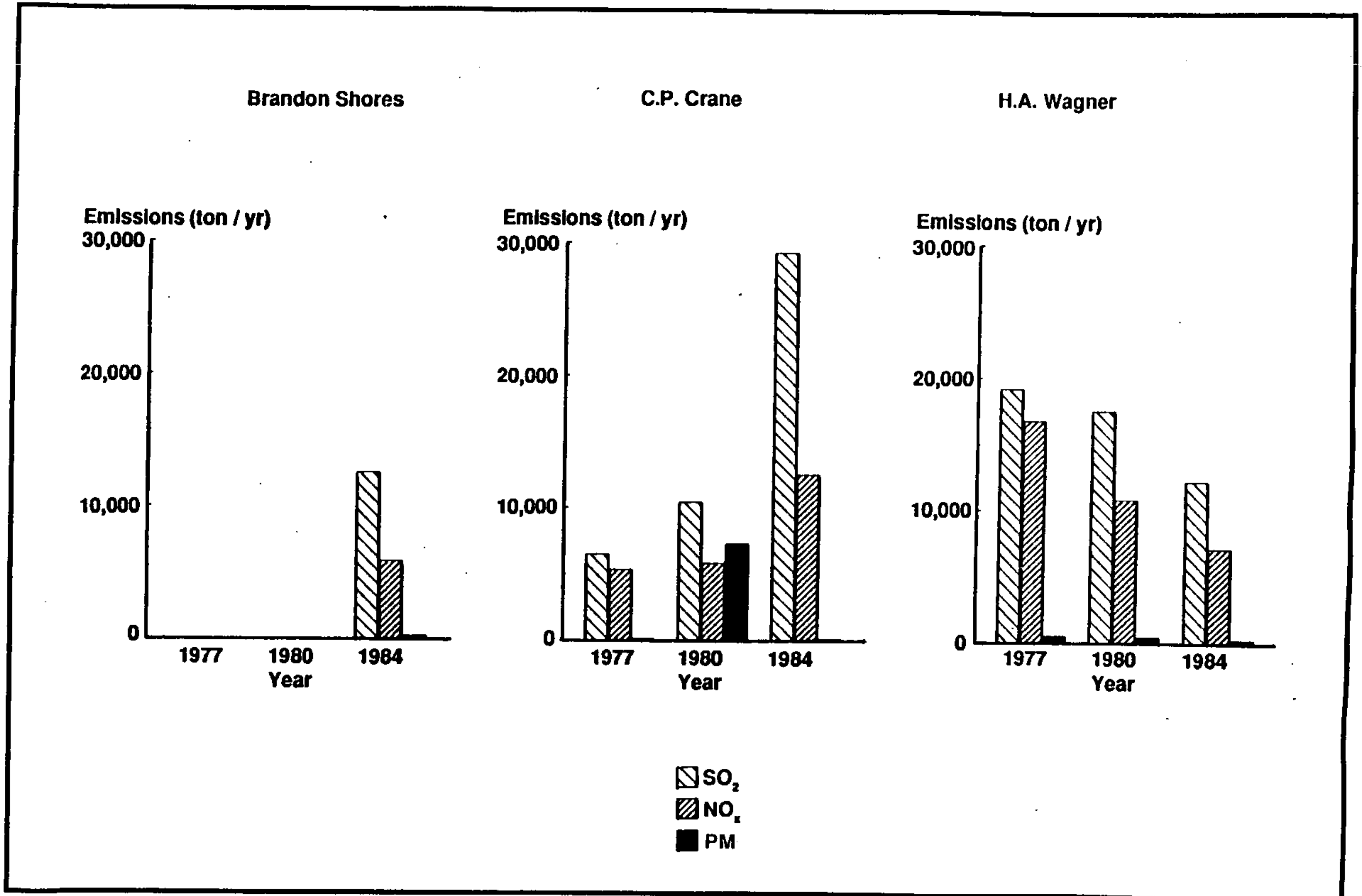

Figure III-4. Emissions of SO_2, NO_x, and PM for 3 BG&E plants for 1977, 1980, 1984

Source: MD-AMA 1977, 1980, 1984.

emissions are currently limited to 1.2 lb/MMBtu under federal New Source Performance Standards (NSPS), as compared to higher limits (some as high as 3.5 lb/MMBtu) at older power plants. NO_x emissions are limited to 0.7 lb/MMBtu, whereas most Maryland power plants have no NO_x limitations.

The Brandon Shores plant started up in mid-1984. It consumed over 800,000 tons of coal and emitted approximately 13,000 tons of SO_2, 6,000 tons of NO_x, and 300 tons of particulates in that year (Figure III-4). Coal consumption increased to over 1,400,000 tons in 1986 (MD-AMA 1984; MD-PSC 1986b).

C.P. Crane, which came on-line in 1963, has two coal-fired units with a total capacity of 376 MW and one 14 MW oil-fired combustion turbine. The two main units, which converted from coal to #6 oil in 1970, made a conversion back to coal in 1983. At that time two baghouses were installed to control particulate emissions, and several dust control devices were installed to minimize fugitive dust emissions during coal handling. Under a State Implementation Plan (SIP) revision of early 1980, SO_2 emissions are limited to 3.5 lb/MMBtu, one of the highest emissions limits for power plants in the state. At the time of the conversion, the No. 2 unit at Crane was converted to accommodate refuse derived fuel (RDF) as well as coal.

SO_2 emissions at C.P. Crane increased fourfold from 1977 (6,500 ton/yr) to 1984 (29,000 ton/yr) due to its high emissions limit and conversion to coal. NO_x emission levels doubled between 1980 and 1984, while PM levels peaked at 7,300 ton/yr in 1980 (Figure III-4). Oil consumption at C.P. Crane decreased significantly, from over 3,100,000 bbl in 1975 to under 18,000 bbl in 1984. Coal consumption, on the other hand, increased substantially to 675,600 tons in 1984 (MD-AMA 1977, 1984; MD-PSC 1975b-1985b).

- Potomac Electric Power Company (PEPCO)

PEPCO operates six power plants in and around Maryland, whose combined generating capacity in 1986 was 5,866 MW. Three of the plants are primarily coal-fired (Dickerson, Morgantown, Potomac River), and the two plants in nearby Washington, D.C. are oil-fired (Benning Road and Buzzard Point). The Chalk

Point plant has both oil- and coal-fired units. Morgantown, Chalk Point and Dickerson are the largest plants in the PEPCO system in Maryland. Figure III-5 illustrates the emissions from these plants.

Chalk Point's four units provide a total of 1,907 MW generating capacity, making it the single largest power plant in Maryland in terms of generating capacity. Two of the units are oil-fired and two are coal-fired. The plant also has two oil-fired combustion turbines, giving an additional 48 MW generating capacity. Emissions of SO_2 are limited to 3.5 lb/MMBtu from the coal-fired units, 2.2 lb/MMBtu from one oil-fired unit, and 0.08 lb/MMBtu from the other.

SO_2 emissions at Chalk Point decreased from about 71,000 ton/yr in 1977 to just over 50,000 ton/yr in 1980, and were up again in 1984 to nearly 60,000 ton/yr. NO_x and PM levels fluctuated similarly. Some of the fluctuations were due to shutdowns during equipment upgrading and the addition of a new unit. Oil consumption decreased from late 1970's levels to a 10-year low in 1980, and have increased again since then. During this period, coal consumption rose from about 600,000-900,000 tons in the late 1970's to over 1,400,000 in 1983-1986 (Table III-2) (MD-AMA 1977-1984; MD-PSC 1975c-1986c).

Morgantown has two coal-fired units with a combined generating capacity of 1,164 MW and six oil-fired combustion turbines providing 248 MW. Morgantown was designed as a dual-fuel plant, capable of burning coal or oil. Early on, Morgantown burned oil; but in the late 1970's, PEPCO converted the plant to coal. Because construction began before 1971, Morgantown was not required to meet the stricter New Source Performance Standards (NSPS) which were imposed on sources constructed after August of that year. SO_2 emissions are limited to 3.5 lb/MMBtu.

SO_2 emissions at Morgantown remained at about 90,000 ton/yr in 1977, 1980, and 1984. With the switch to coal, oil consumption decreased dramatically from late 1970's levels of just over 3,000,000 bbl/yr to just under 550,000 bbl in 1980. Coal consumption, on the other hand, more than doubled since 1975, rising to nearly 2,500,000 tons in 1986 (MD-AMA 1977-1984; MD-PSC 1975c-1986c).

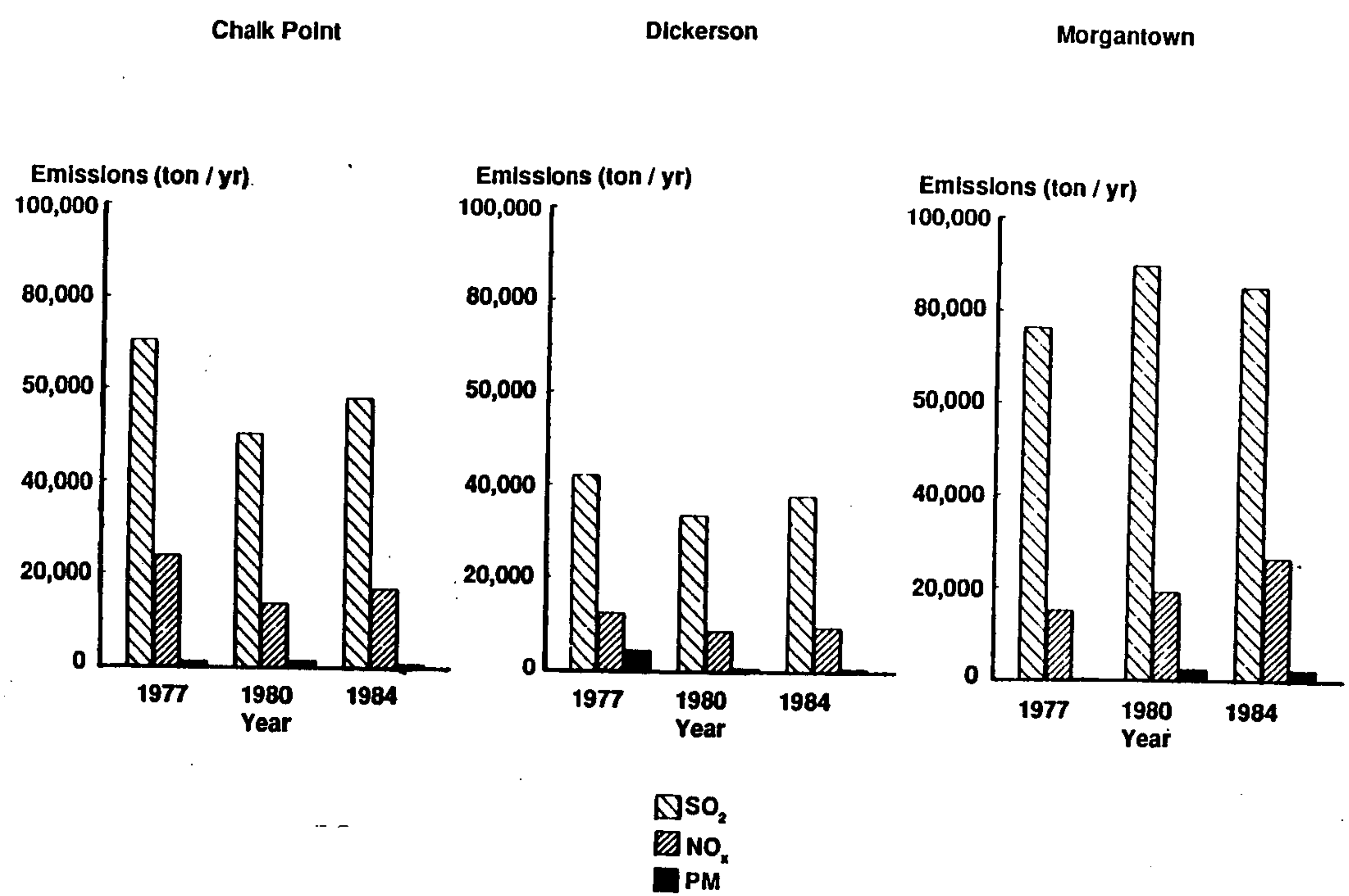

Figure III-5. **Emissions of SO_2, NO_x, and PM for three PEPCO plants for 1977, 1980, 1984**

Source: MD-AMA 1977, 1980, 1984

- Delmarva Power and Light (DP&L) and Potomac Edison Company (PE)

DP&L and Potomac Edison have one large power plant each in Maryland. DP&L operates the Vienna plant along the Nanticoke River in Dorchester County on the Eastern Shore. The main unit at Vienna is a 150 MW capacity oil-fired unit. R.P. Smith, Potomac Edison's only large power plant in Maryland, is a two-unit coal-fired facility with a generating capacity of 114 MW. Figure III-6 shows emissions from these two plants.

Coal Use and Power Plant Emissions

Coal has become a much more important source of energy for Maryland's power plants in recent years. With more plants burning coal and some large plants operating under relatively high SO_2 emission limitations, one would expect increased SO_2 emission rates from the power plants. As seen in Figure III-1, however, this was not the case. Total SO_2 emissions from power plants have remained under 250,000 ton/yr since 1976. Total NO_x emissions have varied, but have not increased since the late 1970's. Particulate emissions have also decreased steadily since 1977, despite the fact that more coal-fired plants have been operating.

Many factors contribute to the fact that SO_2 and PM emissions have not increased steadily since the coal conversion. One is that overall fuel consumption (and energy demand) has not increased significantly since 1981. Particulate emissions have been affected by improved control devices installed at most of Maryland's power plants.

SO_2 emissions remain relatively steady for a number of reasons. As a comparison of regulated emissions limits (Table III-5) with actual emission rates (Table III-3) will show, some power plants have been emitting at levels below their regulated SO_2 limits. The overall emission rate from coal-burning plants has actually decreased slightly, from about 2.9 lb/MMBtu in 1977 to 2.5 lb/MMBtu in 1984. At the same time, emission rates from oil-burning plants increased slightly (from 1.1 lb/MMBtu to 1.3 lb/MMBtu from 1977-1984). However, because such a small

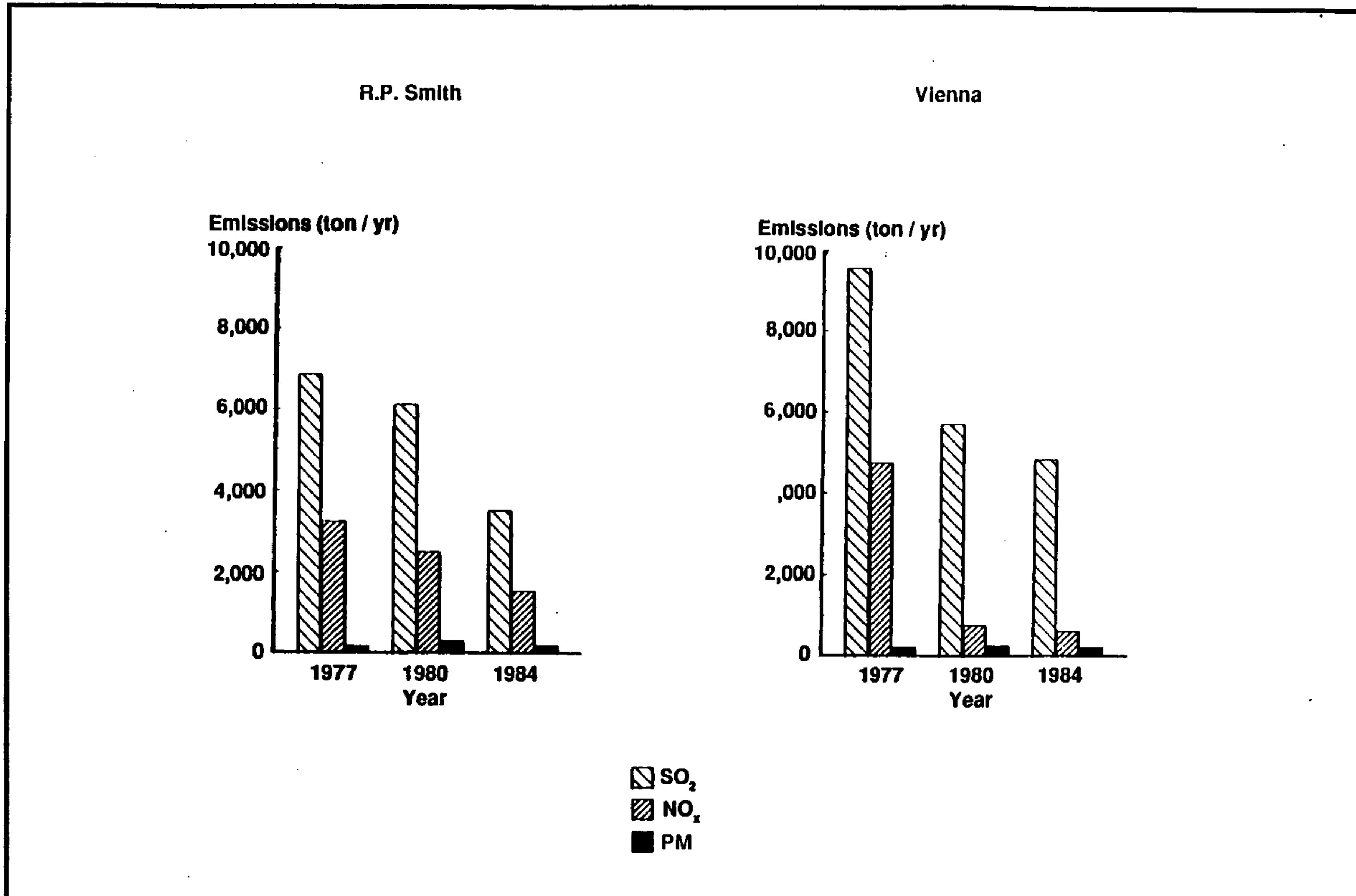

Figure III-6. Emissions of SO_2, NO_x, and PM for Potomac Edison (R.P. Smith) and DP&L (Vienna) plants for 1977, 1980, 1984

Source: MD-AMA 1977, 1980, 1984

Table III-5
Emission limits for SO_2, TSP, and NO_x for major power plants in Maryland

Source	Owner	Fuel Type	Emission Limit SO_2 (lb/MMBtu)	PM (lb/MMBtu)	NO_x (lb/MMBtu)
Brandon Shores	BG&E				
No. 1		Coal	1.20	0.06[a]	0.7
C.P. Crane	BG&E				
No. 1 & 2		Coal (with a maximum of 10% RFD)	3.50	0.06[a]	None
Gould	BG&E				
No. 3		#6 Oil (1% S)	1.10[b]	0.05[c]	None
Riverside	BG&E				
No. 1-5		#6 Oil (1% S)	1.10[b]	0.05[c]	None
Wagner	BG&E				
No. 1,2,4		#6 Oil (1% S)	1.10[b]	0.05[c]	None
No. 3		Coal (1% S)	1.66[d]	0.06[a]	None
Westport	BG&E				
No. 3&4		#6 Oil (1% S)	1.10[b]	0.05[c]	None
Chalk Point	PEPCO				
No. 1&2		Coal	3.50	0.06[a]	None
No. 3		#6 Oil (2%S)	2.20[b]	0.13[e]	None
No. 4		#6 Oil (0.7%S),	(0.8)[f]	0.05	0.3[f]
		Natural Gas	None	None	0.2[f]
Dickerson	PEPCO				
No. 1-3		Coal	2.80	0.06[a]	None
Morgantown	PEPCO				
No 1&2		Coal	3.50	0.14	None
R.P. Smith	APS				
No. 9&11		Coal	1.80	0.06[a]	None
Vienna	DP&L				
No. 8		#6 Oil (2% S)	2.20	0.18	None

Source: 40 CFR 52, Subpart V.
(a) Based on 0.03 grains per standard cubic feet (gr/scfd).
(b) Assumes a fuel heat content of 18,700 Btu/lb.
(c) Based on 0.02 grains per standard cubic feet (gr/scfd).
(d) Assumes a fuel heat content of 12,000 Btu/lb.
(e) Based on 0.05 grains per standard cubic feet (gr/scfd).
(f) New Source Performance Standard.

percentage of fuel burned (in Btu) is oil, this increase would have had little effect on overall conditions. If all plants burned fuels having the maximum allowable sulfur content, with no other changes, statewide SO_2 emissions would of course rise (see the discussion of this scenario later in this section).

Summary

Total emissions of SO_2 and NO_x from Maryland power plants remained relatively constant over the past ten years, while PM emissions decreased. Changes have occurred over the last 10 years that could have caused increases in total power plant emissions, particularly higher emission limitations and conversions to coal. However, there were also offsetting changes, such as better particulate control devices, a decrease in actual emission rates, and most importantly the fact that fuel consumption in general has not increased significantly since 1981. These have served to keep emission levels from rising significantly over the last few years.

B. Power Plant Impacts on Ambient Air Quality in Maryland

Examining available measured air quality data on pollutant concentrations in the air does not necessarily reveal the impact of power plant operations on ambient conditions. Air quality monitors are not always placed in the areas most affected by power plants. Where monitors do operate, their readings usually reflect the impact of many pollutant sources in addition to power plants. It is thus necessary to examine the results of atmospheric dispersion modeling to make some assessment of overall power plant impact on air quality in the state.

Ambient Air Quality in Maryland

The Maryland AMA has measured ambient concentrations of all criteria pollutants and of several noncriteria pollutants at various locations in the state since the early 1970's. The primary purpose of the measurement programs is to gather data to assess compliance with ambient air quality standards (Table III-6), thereby ensuring that human health and welfare are protected. Therefore, most of the monitors are located in areas where pollutant concentrations or population

Table III-6
National ambient air quality standards (NAAQS)

Pollutant	Averaging Period	Air Quality Standards (ug/m^3) Primary	Secondary
PM_{10}	Annual (Arithmetic mean)	50	50
	24-hour[a]	150	150
Sulfur Dioxide	Annual (Arithmetic mean)	80	—
	24-hour[a]	365	—
	3-hour[a]	—	1300
Nitrogen Dioxide	Annual (Arithmetic mean)	100	100
Ozone	1-hour[b]	235	235
Carbon Monoxide	8-hour[a]	10,000	10,000
	1-hour[a]	40,000	40,000
Lead	Calendar Quarter	1.5	1.5
Gaseous Fluorides[c]	24-hour	1.2	1.2
	72-hour	0.4	0.4

Source: 40 CFR 52 Subpart V.
[a]Concentration not to be exceeded more than once per year.
[b]Expected number of days in which one or more hourly ozone concentrations exceed this value must be less than or equal to 1.
[c]Applies to Maryland only.

exposures are expected to be high. In general, all of Maryland is in compliance with air quality standards for SO_2, NO_2 and Pb. Only the Baltimore metropolitan area and the Maryland portion of the Washington metropolitan area do not currently comply with ozone standards; and portions of these areas are not in compliance with CO standards. The Baltimore industrial area has been in violation of past total suspended particulate (TSP) standards. Seven years of monitoring data for SO_2, NO_2, and PM are shown in Figure III-7.

- Particulates

Total suspended particulate (TSP) levels at monitoring sites in the state have not changed appreciably in Maryland since 1982 (Figure III-7). In 1986, the composite average of 36 monitors in the state was about 50 ug/m^3. The NAAQS for TSP was eliminated on July 31, 1987, and replaced by a standard for particulate matter of less than 10 um in diameter (PM_{10}). In anticipation of the new standard, the Maryland AMA established three new monitoring stations in the Baltimore metropolitan area during 1985. The PM_{10} data collected thus far are not adequate for establishing trends. They do, however, provide some measure of PM_{10} ambient levels. The data indicate that the annual average PM_{10} standard of 50 ug/m^3 was not exceeded during the two years of monitoring. However, the 24-hr standard of 150 ug/m^3 was exceeded once in Baltimore, indicating that the area may be in violation of NAAQS.

- SO_2

Average ambient SO_2 levels have declined since 1980 for the locations monitored in Maryland, mainly the Baltimore area (Figure III-7). The 1986 value of 28 ug/m^3 is up from the previous year, but the overall trend is a decrease of several percent.

- NO_2

Ambient levels of NO_2 at the monitored locations in Maryland (Figure III-7) have increased slightly from 38 ug/m^3 in 1980 to 51 ug/m^3 in 1986. Since power plant NO_x emissions have declined over these years, it is reasonable to conclude that

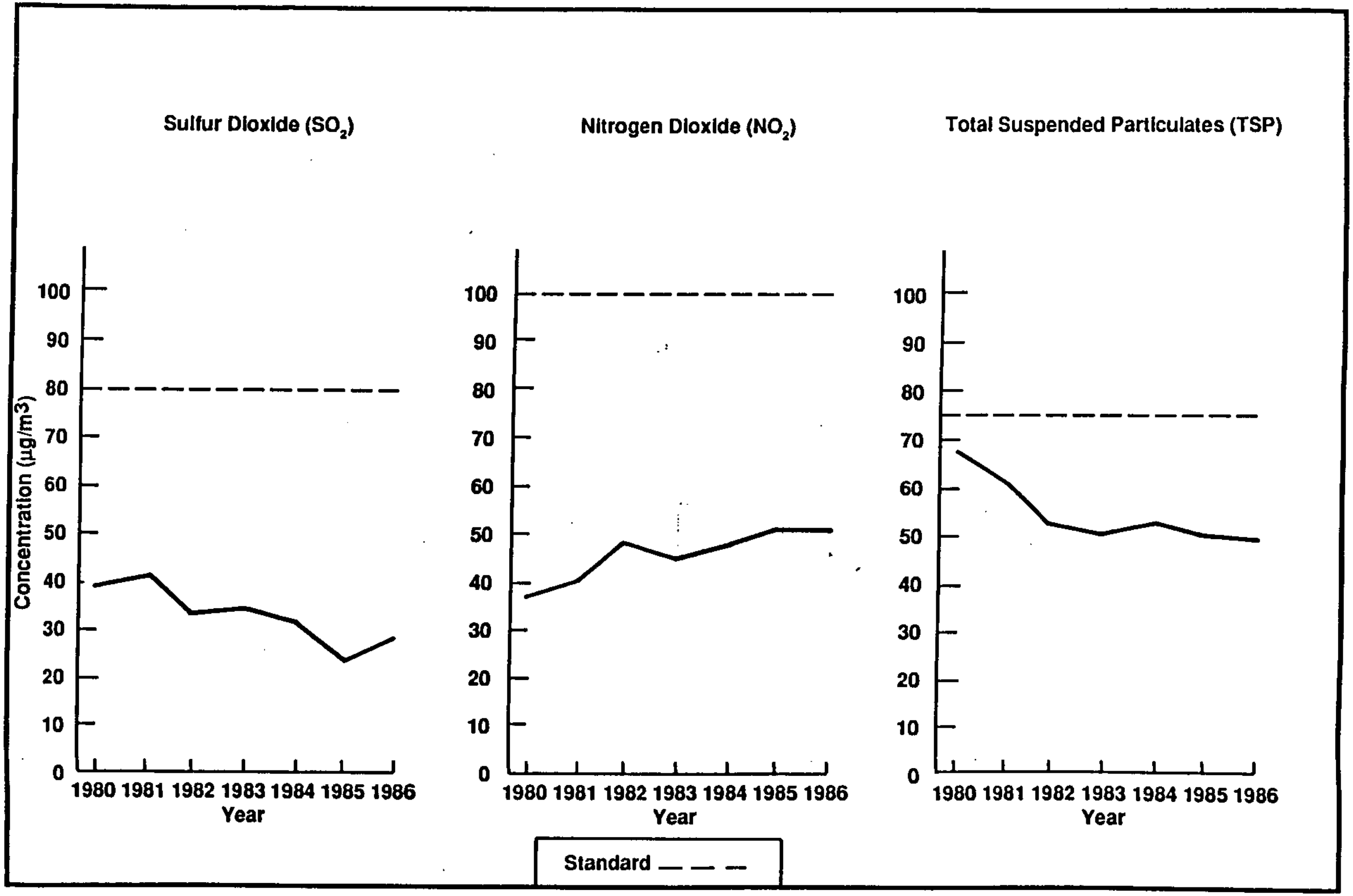

Figure III-7. Maryland monitored ambient air quality annual averages for 1980-1986 for (a) sulfur dioxide (SO_2), (b) nitrogen dioxide (NO_2), and total suspended particulates (TSP)

Source: MD-AMA 1986b, 1986c

the increase in ambient levels is due to increases from other sources, most likely mobile NO_x emissions in the state.

Modeled Impacts of Maryland Power Plants

The cumulative ground-level impact of Maryland power plants cannot be determined easily, if at all, from ambient monitoring. One way to estimate these impacts is to use predictive atmospheric dispersion models. Many air quality modeling studies have been performed to determine the current or future impact of single power plant facilities in Maryland. In fact, modeling studies have been performed for almost all existing and planned power plants in the state. Very few (Brower 1979; DOE 1981) however, have examined the combined impact of several power plants .

A particularly useful tool for this purpose is PPRP's Model States Program which uses a large database of air pollution dispersion modeling results. The Model States Program was utilized to estimate the combined annual air quality impact due solely to power plants in Maryland for three years -- 1979, 1980 and 1984 -- chosen for data availability and air quality representativeness. The program examined fourteen power plants comprising approximately 80 separate stack sources, using emission rates reported by the Maryland AMA's annual source inventories. It furnished estimates of ground-level concentrations of SO_2, NO_2, and TSP at a spatial resolution of 2.5 km. The modeling assumed: (1) flat terrain, (2) nonreactive pollutants that disperse as gases, (3) no settling or deposition, (4) uniform meteorology across the region in which the power plants are located, and (5) only stack emissions (for example, no fugitive dust emissions from coal and ash handling). Assumptions 2 and 3 are reasonable, especially for the stack pollutants considered below. Assumptions 1 and 4 also are reasonable for the majority of the power plants examined. The flat terrain assumption leads to underestimates within areas of significant terrain such as near the R.P. Smith and Dickerson plants.

Power plants themselves are the only pollutant sources examined by the Model States analysis. Plots of the modeling results show higher pollutant concentrations near the actual plants, increasingly lower concentrations away from and downwind of them, and zero concentrations in areas far from power plants. Pollutant concentrations around isolated plants in more remote areas, such as the Vienna plant in Dorchester County or R.P. Smith in Washington County, show up distinctively, and can be attributed directly to them. Concentrations around individual plants in and around Baltimore are indistinguishable, however, and represent the combined impacts of several power plants.

The following discussion examines the combined pollutant concentrations resulting from all power plants across Maryland, and from power plants in and around Baltimore in particular. The Baltimore sources are examined separately so that trends in ambient air quality, as measured by state-operated monitors, can be compared to trends in power plant impacts, as determined by Model States analyses. This comparison is more appropriate for Baltimore sources because the density of pollutant monitors is greatest in the Baltimore area, giving a more representative picture of the actual ambient air quality.

- SO_2

The predicted annual average SO_2 impacts of Maryland power plant emissions for the three years studied are shown in Figures III-8, III-9, and III-10. The highest projected impact was 5.2 ug/m^3, projected to occur in 1984, east-northeast of Baltimore in the Chesapeake Bay (Figure III-10). That concentration amounts to only about one-sixth of the average ambient SO_2 level, composed of contributions of all background, power plant, and non-power plant sources, measured at the three state SO_2 monitors east of Baltimore. This comparison suggests that, although power plants are a significant contributor to annual average SO_2 levels, they are not the major contributor.

The maximum predicted annual impact of power plant sources east of Baltimore doubled from 2.6 ug/m^3 in 1977 (Figure III-8) to 5.2 ug/m^3 in 1984 (Figure III-10) The changes were most likely due to the start-up of Brandon Shores and the conversion of C.P. Crane from oil to coal. The maximum point of impact shifted to the north, closer to the C.P. Crane power plant.

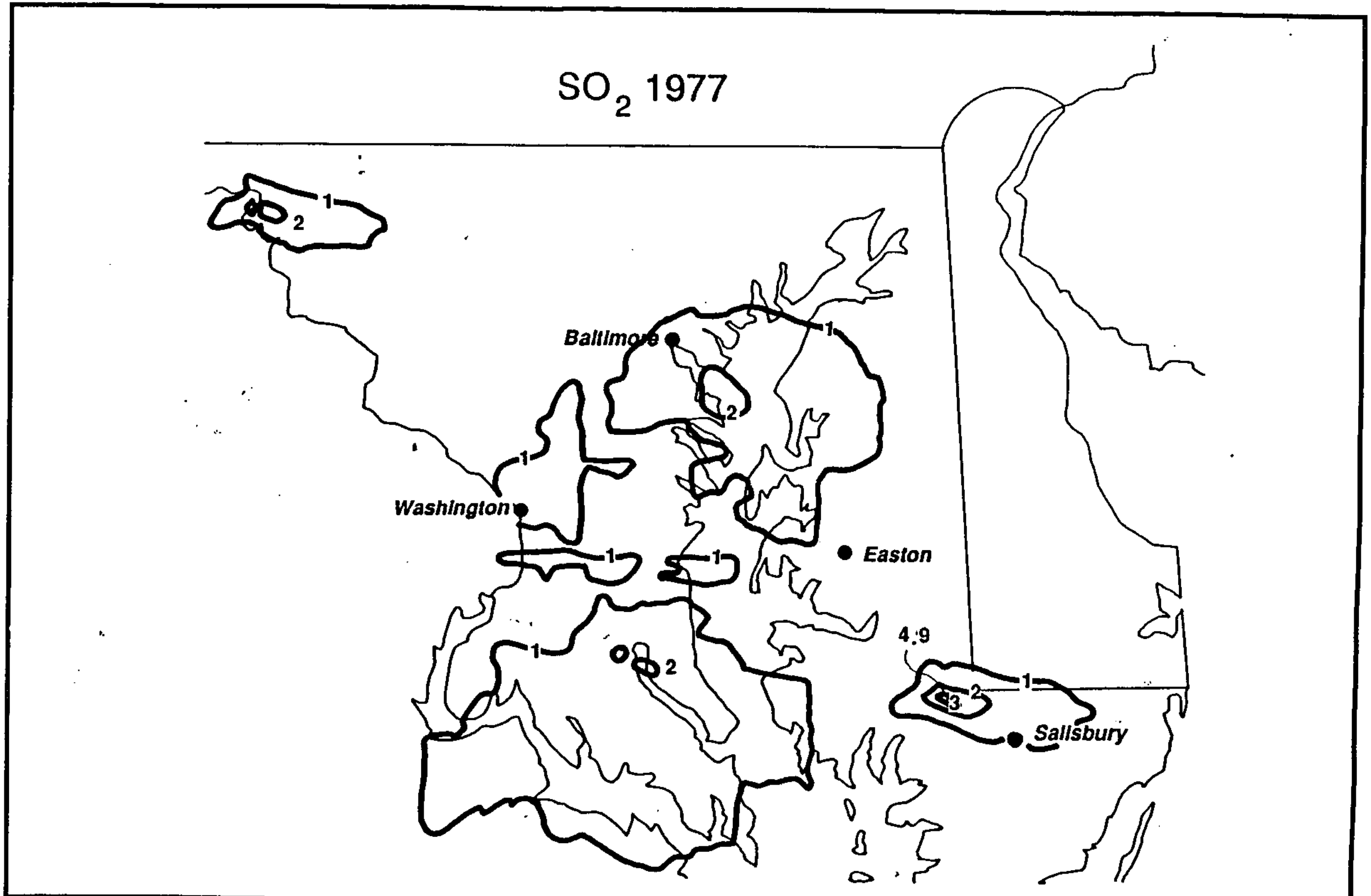

Figure III-8. Contours of model-predicted annual SO_2 ground-level concentration for 1977 due to Maryland power plants (minimum contour is 1 $\mu g/m^3$, contour interval is 1.0 $\mu g/m^3$). Maximum concentration is indicated by an arrow.

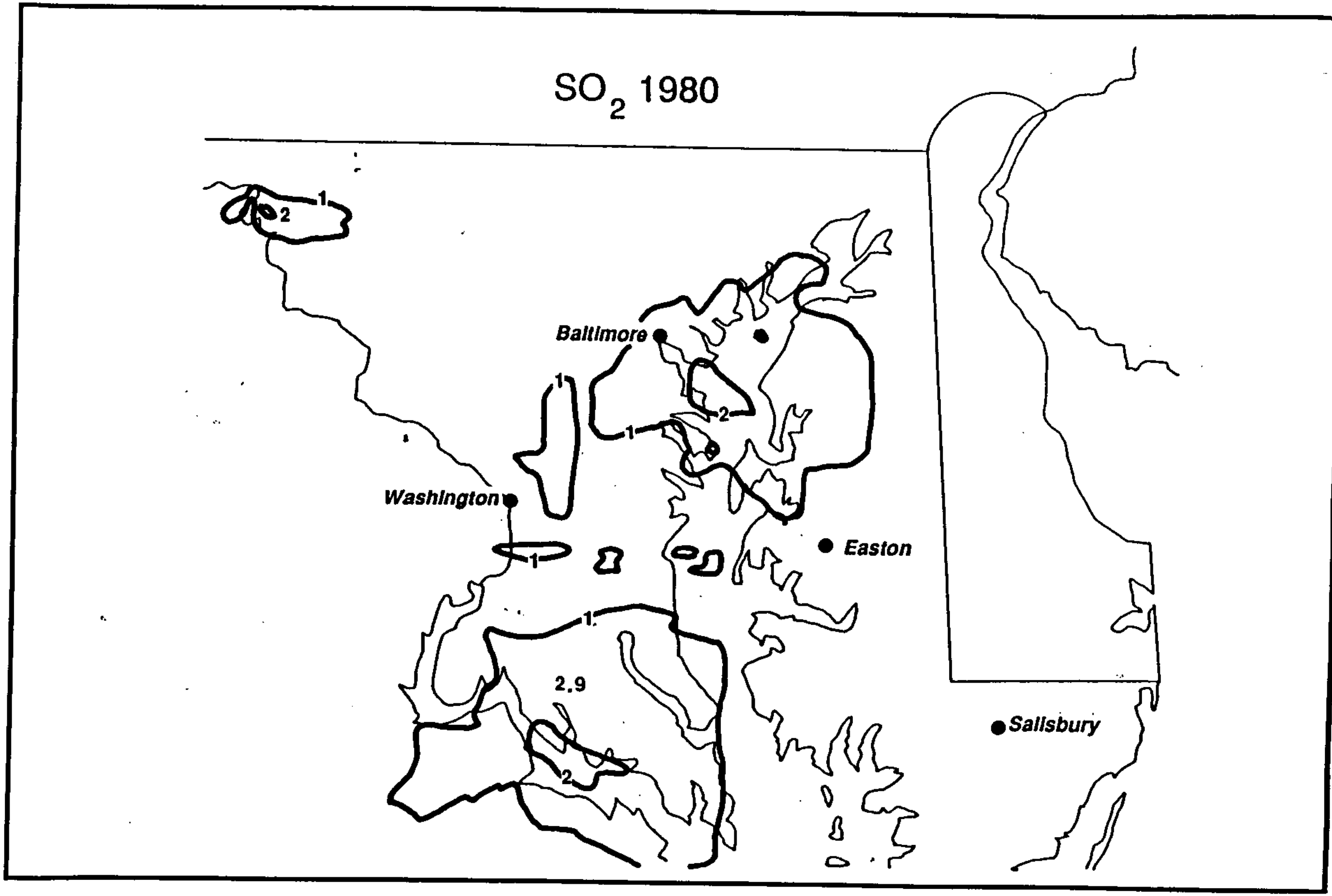

Figure III-9. Contours of model-predicted annual SO_2 ground-level concentration for 1980 due to Maryland power plants (minimum contour is 1 $\mu g/m^3$, contour interval is 1.0 $\mu g/m^3$). Maximum concentration is indicated by an arrow.

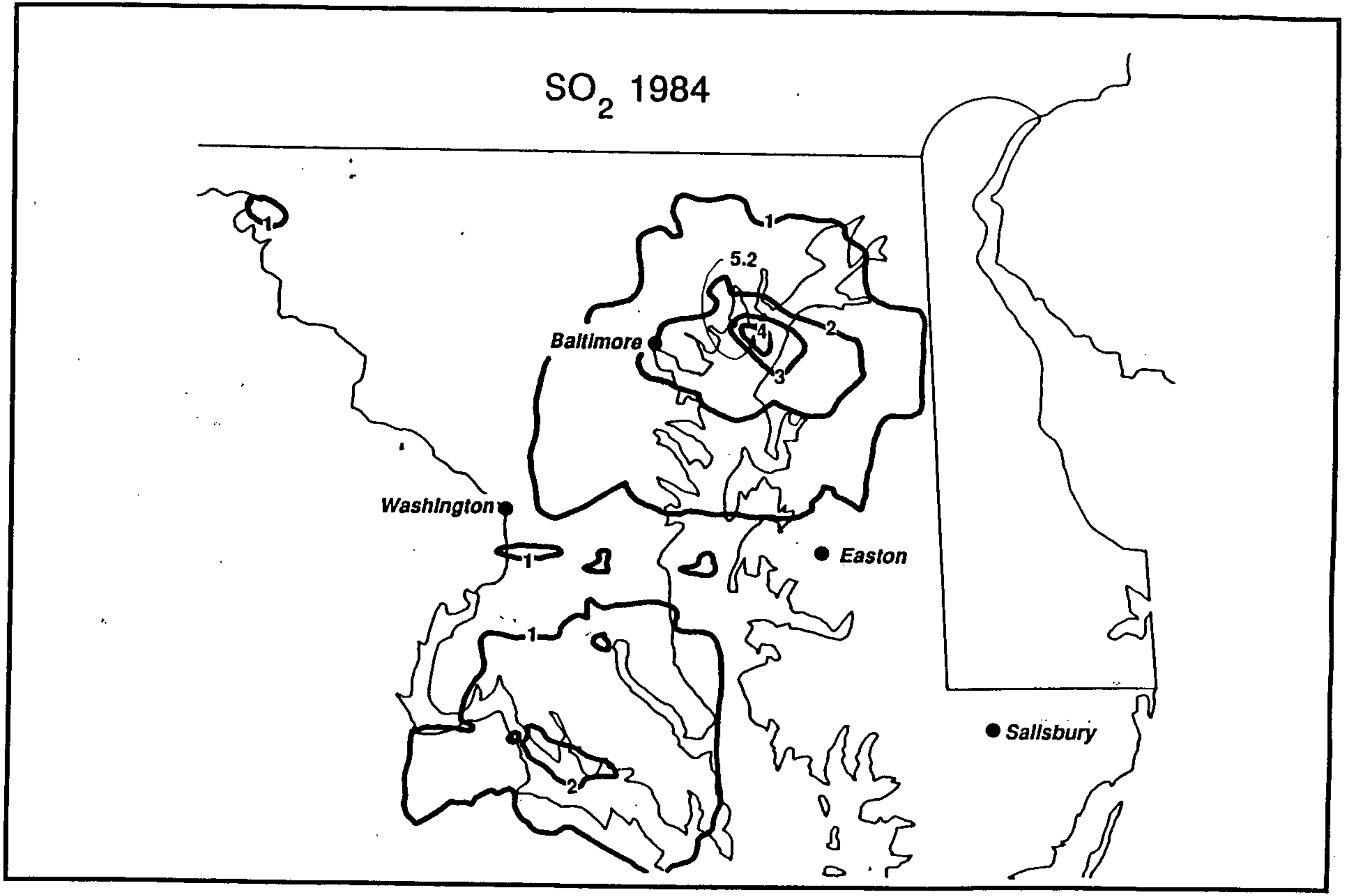

Figure III-10. Contours of model-predicted annual SO_2 ground-level concentration for 1984 due to Maryland power plants (minimum contour is 1 μg/m³, contour interval is 1.0 μg/m³). Maximum concentration is indicated by an arrow.