Lambertson, R. Memorandum from R. Lambertson, U.S. Fish and Wildlife Service, Hadley, MA, to W. Paul, Maryland Air and Radiation Management Administration, Baltimore, MD. 4 August 1994.

Lieberman, J.T., and P.H. Muessig. 1978. Evaluation of an air bubbler to mitigate fish impingement at an electric generating plant. *Estuaries* 1(2):129-132.

Mack, F.K. 1988. Selected geohydrologic characteristics of the Patapsco Aquifers at Chalk Point, Prince George's County, Maryland. Prepared by the Maryland Geological Survey in cooperation with the U.S. Geological Survey and the Maryland Power Plant Research Program. Open File Report No. 88-02-4.

Magnien, R.E., D.K. Austin, and B.D. Michael. 1993. Chemical/physical properties component, Level I data report (1984-1991). Volume 1. Prepared by Maryland Department of the Environment, Baltimore, MD.

MARAMA (Mid-Atlantic Regional Air Management Association). 1994. Facsimile correspondence from D. Haskins, MARAMA, Harrisburg, PA, to MARAMA States. 19 July 1994.

Marita, F. 1994. Memorandum from F. Marita, U.S. Forest Service, Milwaukee, WI, to W. Paul, Maryland Air and Radiation Management Administration, Baltimore, MD. 8 March 1994.

Marland, G. et al. 1989. Estimates of CO_2 emissions from fossil fuel burning and cement manufacturing using the U.N. energy statistics and U.S. Bureau of Mines cement manufacturing data. ORNL/CDIAC-25 NDP-030. Oak Ridge National Laboratory, Oak Ridge, TN. October 1989.

Maryland Bureau of Mines. 1992. Seventieth annual report of the Maryland Bureau of Mines. DNR Water Resources Administration, Bureau of Mines. Frostburg, Maryland.

Mason, E. 1994. Personal communication from E. Mason, Maryland Energy Administration, Annapolis, M, to A. Adams, Versar, Inc., Columbia, MD. 13 June 1994.

McGroddy, P.M., and J.A. Matousek. 1989. Intake technologies: Research status. Prepared by Lawler, Matusky & Skelly Engineers, Pearl River, NY, for the Electric Power Research Institute, Palo Alto, CA. EPRI GS-6293.

McLean, R.I., and S.L. Domotor. 1988. Environmental radionuclide concentrations in the vicinity of the Peach Bottom Atomic Power Station: 1981-1984. Maryland DNR, Power Plant Research Program, Annapolis, MD. PPRP-R-9.

McLean, R.I., J.K. Summers, S.L. Domotor, C.R. Olson, and V.A. Dickens. 1988. Radionuclide concentrations in Susquehanna River and Chesapeake Bay sediments: Implications for transport and distribution of particle-reactive pollutants. *In:* Understanding the Estuary: Advances in Chesapeake Bay Research. Chesapeake Bay Research Consortium, Gloucester Point, VA.

McLean, R.I., S.L. Domotor, A.R. Maranto, J.K. Summers, and M. Gaughan. 1992. Mass balances of radionuclides released by Calvert Cliffs Nuclear Power Plant. Maryland DNR, Power Plant Research Program, Annapolis, MD. PPRP-R-14.

MDE (Maryland Department of the Environment). 1994. Maryland air quality data report for 1993. Baltimore, MD.

Monastersky, R. 1993. Ozone layer shows record thinning. *Science News*, 143(17): 260. 24 April 1993.

Morgan, R.P., A.J. Janicki, C.K. Murray, M.A. Pawlowski, and M.J. Pinder. 1991. Western Maryland stream survey: Relationships between fish distributions, acidification, and watershed characteristics. Prepared by the University of Maryland, Appalachian Environmental Laboratory, Frostburg, MD and Coastal Environmental Services, Inc., Linthicum, MD, for the Maryland DNR, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. AD-91-1.

Morgan, R.P., II, C.K. Murray, and K.N. Eshleman. 1994. Episodic effects on water chemistry in a western Maryland watershed. Prepared for the Maryland DNR, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. CBRM-AD-94-8.

Mulchi, C.L., D.C. Wolf, J.E. Foss, and J.A. Armbruster. 1977. Chalk Point cooling tower project: Cooling tower effects on crops and soils. Post-operational Report No. 2. Prepared by the Department of Agronomy, University of Maryland, for Maryland DNR, Power Plant Siting Program, Annapolis, MD. PPSP-CTCTP-19.

Murtlow, A. 1993. Memorandum from A. Murtlow, AES Warrior Run, Inc., Arlington, VA., to W. Paul, Maryland Air and Radiation Management Administration, Baltimore, MD. 5 October 1993.

Murtlow, A. 1994a. Memorandum from A. Murtlow, AES Warrior Run, Inc., Arlington, VA, to W. Paul, Maryland Air and Radiation Management Administration, Baltimore, MD. 21 March 1994.

Murtlow, A. 1994b. Memorandum from A. Murtlow, AES Warrior Run, Inc., Arlington, VA, to W. Paul, Maryland Air and Radiation Management Administration, Baltimore, MD. 24 March 1994.

Murtlow, A. 1995. Personal communication from A. Murtlow, AES Warrior Run, Inc., Arlington, VA, to A. Adams, Versar, Inc., Columbia, MD. 3 May 1995.

NAS (National Academy of Sciences). 1991. Policy implications of greenhouse warming. National Academy of Sciences. Washington, DC: National Academy Press.

NCRPM (National Council on Radiation Protection and Measurements). 1988. Ionizing radiation exposures of the population of the United States. National Council on Radiation Protection and Measurements, Bethesda, MD.

Niemeyer, V. 1990. Measuring the Value of Improved Visibility. *EPRI Journal*, Vol. 15, No. 2: 50-53.

NPS (National Park Service). 1990. Technical support document regarding adverse impact determination for Shenandoah National Park. Air Quality Division and Shenandoah National Park, National Park Service.

NRC (National Research Council). 1991. Rethinking the ozone problem in urban and regional air pollution. National Research Council. Washington, DC: National Academy Press.

NRRI (National Regulatory Research Institute). 1993. A synopsis of the Energy Policy Act of 1992: New tasks for state public utility commissions. National Regulatory Research Institute, Columbus, OH. June 1993.

O'Dell, J. and J. Mowrer. 1984. Survey and inventory of anadromous fish spawning streams and barriers in the Patuxent River Drainage. Prepared by Maryland DNR, Tidewater Administration, Annapolis, MD. Project AGC-10. January 1984.

O'Leary. 1988. Air quality in the national parks. Energy and Resource Consultants, Inc. NPS Contract No. CX-0001-4-0054. July 1988.

Olem, H. and P. Jacobson. 1994. Recommendations for a Maryland watershed-scale acidic deposition mitigation demonstration project. Draft report submitted by Olem Associates, Inc. and Versar, Inc. to for Maryland DNR, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. April.

OTA (Office of Technology Assessment). 1990. Changing by degrees – steps to reduce greenhouse gases. Office of Technology Assessment, Congress of the United States, Washington, DC. NTIS No. PB91-163428.

Palmer, K., A. Krupnick, H. Dowlatabadi, and S. Siegel. 1994. Social Costing of Electricity in Maryland: Implications for Electricity Supply, Energy Demand and Air Emissions. Prepared for Maryland DNR, Power Plant Research Program, Annapolis, MD, by Resources for the Future, Washington, DC. PPES-94-1.

Pavol, K. 1992. Personal communication between K. Pavol, Maryland DNR, Freshwater Fisheries Division, Oakland, MD and R. Klauda, Maryland DNR, Chesapeake Bay Research and Monitoring Division, Annapolis, MD.

Pavol, K. 1993. Memorandum from K. Pavol, Maryland DNR, Freshwater Fisheries Division, Oakland, MD, to R. Klauda, Maryland DNR, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. 1 September 1993.

PECO (Philadelphia Electric Company). 1991. Peach Bottom Atomic Power Station monthly operating report for December 1991.

PECO. 1993a. Peach Bottom Atomic Power Station annual radiological environmental operating report: 1 January 1992 - 31 December 1992.

PECO. 1993b. Semi-annual effluent release reports for the Peach Bottom Atomic Power Station, units 2 and 3, January 1 - December 31, 1992.

PECO. 1994a. Peach Bottom Atomic Power Station annual radiological environmental operating report: 1 January 1993 - 31 December 1993.

PECO. 1994b. Semi-annual effluent release reports for the Peach Bottom Atomic Power Station, units 2 and 3, January 1 - December 31, 1993.

Penelec (Pennsylvania Electric Company). 1991. Deep Creek Station, FERC No. 2370-MD. Draft - Volume 1 and 2, New License

Application for Major Project - Existing Dam. Exhibits A-E, and Agency Consultation and Exhibits F-H. July 1991. Pennsylvania Electric Company, Johnstown, PA.

Perhac, R. 1989. A critical look at global climate and greenhouse gases. *Power Engineering*, 93(9). September 1989.

Pinkney, A.E. 1992. Summary of recent information on biofouling control at power plants. Prepared by Versar, Inc., Columbia, MD, for Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD. PPRP-103.

Pinkney, A.E., K. Killam, and W.H. Burton. 1991. Copper discharges from Maryland power plants: Scientific, engineering, and regulatory issues. Prepared by Versar, Inc., Columbia, MD, for Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD. PPRP-102.

Pinkney, A.E., M.A. Friday, and R.J. Hochberg. 1992. Nationwide survey of power plant aquatic toxicity issues. Prepared by Versar, Inc., Columbia, MD, for Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD. PPRP-104.

Placet, M. et al. 1990. Acidic deposition: State of Science and Technology, Report 1, Emissions involved in acidic deposition processes. National Acid Precipitation Assessment Program, Washington, D.C.

Polkowsky, B. 1994. Teleconference between B. Polkowsky, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC, and W. Jones, Versar, Inc., Columbia, MD. 19 May 1994.

Porcella, D. 1990. Mercury in the environment. EPRI Journal 15: 46-49.

Potts, J. 1995. Personal communication from J. Potts, Potomac Electric Power Company, Washington, DC, to A. Adams, Versar, Inc., Columbia, MD. 15 May 1995.

PPER (Power Plant and Environmental Review Division). 1991. Power plant cumulative environmental impact report for Maryland. Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD. PPRP-CEIR-7.

PPRP (Power Plant Research Program). 1987. Acid deposition in Maryland: A report to the governor and general assembly.

Maryland DNR, Power Plant Research Program, Annapolis, MD. AD-87-1. NTIS No. PB87-218764/AS.

PPRP. 1988. Acid deposition in Maryland: The status of knowledge in 1987. Maryland DNR, Power Plant Research Program, Annapolis, MD. AD-88-1. NTIS No. PB88-157805/AS.

PPRP. 1993. Power plant cumulative environmental impact report for Maryland. Maryland DNR, Power Plant Research Program, Annapolis, MD. PPRP-CEIR-8/2.

PPRP. 1994a (draft). Power plant contributions to environmental mercury in Maryland. Prepared by Versar, Inc., Columbia, MD, and Coastal Environmental Services, Inc., Linthicum, MD, for Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD.

PPRP. 1994b. A review of the Maryland coal industry. Prepared by Versar, Inc., Columbia, MD, for Maryland DNR, Power Plant Research Program, Annapolis, MD. PPRP-110.

PPRP. 1995 (draft). Environmental Review.

PPSP (Power Plant Siting Program). 1983. The Effect of Overhead Transmission Lines on Residential Property Values, prepared by the Johns Hopkins University, Applied Physics Laboratory, Laurel, MD, for Maryland DNR, Power Plant Siting Program, Annapolis, MD.

President's Commission on Coal. 1980. *Coal Data Book*. Washington, D.C. Government Printing Office.

Price, R.M., and R.W. Keating. 1991. Assessment of water quality impacts from the Faulkner Fly Ash Facility. Prepared by Environmental Resources Management, Inc., Annapolis, MD, for Maryland DNR, Power Plant and Environmental Review Division, Annapolis, MD. PPER-MP-59. NTIS No. PB91-169953.

Price, R.M., R.W. Keating, and R.P. Morgan II. 1993. First annual postliming monitoring report for the Western Maryland Watershed Liming Pilot Study. Prepared by Environmental Resources Management, Inc., Annapolis, MD and the University of Maryland, Appalachian Environmental Laboratory, Frostburg, MD, for Maryland DNR, Chesapeake Bay Research and Monitoring Program, Annapolis, MD. AD-93-9.

Priestley, T., and G. Evans. 1990. Perceptions of Transmission Lines in Residential Neighborhoods, Further Analysis of Data from the Vallejo Case Study. Report prepared for Southern California Edison Company.

Quinn, J. 1995. Personal communication from J. Quinn, Baltimore Gas and Electric, Baltimore, MD, to A. Adams, Versar, Inc., Columbia, MD. 17 May 1995.

Ramanathan, V. et al. 1985. Trace gas effects on climate, in atmospheric ozone 1985, Global ozone research and monitoring project no. 16, World Meteorological Organization (Washington, DC: National Aeronautics and Space Administration, 1985).

Ratchford, L. 1994. Facsimile correspondence from L. Ratchford, Delmarva Power and Light, Newark, DE to A. Adams, Versar, Inc., Columbia, MD. 7 June 1994.

Ray, S.S., R.L. Snipes, and D.A. Tomljanovich. 1976. A state-of-the-art report on intake technologies. Prepared by Tennessee Valley Authority for the U.S. Environmental Protection Agency. EPA-600/7-76-020.

Rice, K., and O.P. Bricker. 1992. Acid rain induced changes in streamwater quality during storms on Catoctin Mountain, MD. U.S. Geological Survey, Towson, MD. USGS Open-File Report 92-649.

Robl, T. 1993. Teleconference between P. Petzrick, Maryland DNR, Annapolis, MD and T. Robl, University of Kentucky Center for Applied Energy Research, Lexington, KY. November 1993.

Rose, J. 1994. HCFCs may slow ozone layer recovery. *Environmental Science & Technology*, 28(3): 111A.

Rose, K.A., J.K. Summers, R.I. McLean, and S.L. Domotor. 1988. Radiosilver (Ag-110m) concentrations in Chesapeake Bay oysters maintained near a nuclear power plant: A statistical analysis. *Journal of Environmental Monitoring and Assessment* 10:205-218.

Rose, K.A., R.I. McLean, and J.K. Summers. 1989. Development and Monte Carlo analysis of an oyster bioaccumulation model applied to biomonitoring data. *Ecological Modelling* 45:111-132.

Simek, E.M., M.A. Hewitt, and G.T. Potera. 1983. Environmental aspects of the Faulkner ash site. Prepared by Environmental Resources

Management, Inc., West Chester, PA, for the Maryland Power Plant Siting Program, Annapolis, MD. January 1983. PPSP-MP-43. NTIS No. PB83-184374.

Slemr, F., and E. Langer. 1992. Increase in global atmospheric concentrations of mercury inferred from measurements over the Atlantic Ocean. *Nature* 355:434-437.

Sorensen, J.A., G.E. Glass, K.W. Schmidt, J.K. Huber, and G.R. Rapp, Jr. 1990. Airborne mercury deposition and watershed characteristics in relation to mercury concentrations in water, sediments, plankton, and fish of eighty northern Minnesota lakes. *Environmental Science and Technology* 24: 1716-1727.

South, D. 1991. Technologies and other measures for controlling emissions, performance costs, and applicability. National Acid Precipitation Assessment Program, State of Science/Technology Report No. 25.

Spotts, D.E., and C.L. Rice. 1992. Mercury concentrations in fish from twelve Pennsylvania lakes. U.S. Fish and Wildlife Service, Pennsylvania Field Office, State College, PA. Special Project Report 92-2.

SRAFRC (Susquehanna River Anadromous Fish Restoration Committee). 1993. Restoration of American shad to the Susquehanna River: Annual progress report.

Stern, A., R. Boubel, D. Turner, and D. Fox. 1984. *Fundamentals of Air Pollution*. Academic Press.

Stultz, S.C., and J.B. Kitto, eds. 1992. *Steam: Its Generation and Use*. 40th Edition. New York: The Babcock and Wilcox Company.

Sturges, S.D. 1993. Greenhouse gas emission offsets: A global warming insurance policy. *The Electricity Journal* 6(6):70-83.

Survey of Current Business. 1992.

Sverdrup, H., P. Warfvinge, M. Rabenhorst, A. Janicki, R. Morgan, and M. Bowman. 1992. Critical loads and steady-state chemistry for streams in the state of Maryland. *Environmental Pollution* 77:195-203.

Tatham, T.R., D.L. Thomas, and G.J. Miller. 1977. Survival of fishes and macroinvertebrates impinged at Oyster Creek Generating Station.

In: Fourth National Workshop on Entrainment and Impingement, 235-243. L.D. Jensen, ed. Melville, NY: EA Communications.

Thibodeau, F.R., and N.H. Nickerson. 1986. Impact of power utility rights-of-way on wooded wetland. *Environ. Manage.* 10(6): 809-814.

Thomas, J. 1994. Personal communication from J. Thomas, National Park Services, Luray, VA, to W. Jones, Versar, Inc., Columbia, MD. 17 August 1994.

Trijonis, J. 1990. Visibility: Existing and historical conditions–causes and effects. National Acid Precipitation Assessment Program, State of Science/Technology Report No. 24.

U.S. DOE (Department of Energy). 1994. Facsimile correspondence from K. Dupree, U.S. Department of Energy's Green Room, Washington, DC, to A. Adams, Versar, Inc., Columbia, MD. 2 June 1994.

USEPA (U.S. Environmental Protection Agency). 1979. Identification of mandatory class I federal areas where visibility is an important value. Federal Register, Vol. 44, No. 232, p. 69122. 30 November 1979.

USEPA. 1989. The analysis of air toxic emissions, exposure, cancer risk and controllability in five urban areas. Volume I-Base year analysis and results. Prepared by Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA-450/2-89-012A.

USEPA. 1990. *Federal Register*, Vol. 55, No. 181. September 18, 1990. p. 38403.

USEPA. 1991. Regional ozone modeling for northeast transport (ROMNET). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC. EPA-450/4-91-002a. June 1991.

USEPA. 1992. Framework for ecological risk assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC. EPA/630/R-92/001. February 1992.

USEPA. 1993. Guidance for assessing chemical contamination data for use in fish advisories. Volume 1: Fish sampling and analysis. U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA/823/R/93/002.

USEPA. 1995. Notice of the 1995 EPA SO_2 allowance auction results. Federal Register, Vol. 60, No. 78, pp. 20086 - 20089. 24 April 1995.

USGS/MGS (U.S. Geological Survey/Maryland Geological Survey). 1981. Chemical Analysis of 45 Maryland Coal Seams. Report 81-1099.

USNRC (United States Nuclear Regulatory Commission). 1977. Calculations of annual doses to man from routine releases of reactor effluents for the purpose of evaluating compliance with 10 CFR Part 50, Appendix I. Regulatory Guide 1.109. Washington, DC: U.S. Government Printing Office.

Wark, K. and C.F. Warner. 1976. Air pollution - its origin and control. New York: Harper and Row.

Weaver, K.N., J.M. Coffroth, and J. Edwards. 1981. Coal reserves in Maryland: Potential for future development. Maryland DNR, Maryland Geological Survey.

Weil, J.C., T.E. Pierce, and L.A. Corio. 1985. Western Maryland power plant siting study: Air quality assessment of three candidate sites. Prepared by Martin Marietta Laboratories, Martin Marietta Environmental Systems, and Dam Safety Division, Water Resources Administration, Maryland DNR, Power Plant Siting Program, Annapolis, MD. PPSA-85-02.

Weisberg, S.B., W.H. Burton, E.A. Ross, and F. Jacobs. 1984a. The effects of screen slot size, screen diameter, and through-slot velocity on entrainment of estuarine ichthyoplankton through wedge-wire screens. Prepared by Martin Marietta Environmental Systems, Columbia, MD, for Maryland DNR, Power Plant Research Program, Annapolis, MD. CP-84-1.

Weisberg, S.B., C.F. Stroup, A.F. Holland, and E.A. Ross. 1984b. Biofouling potential on fine mesh wire screens and a test of some mechanisms of biofouling control. Prepared by Martin Marietta Environmental Systems, Columbia, MD, for Maryland DNR, Power Plant Research Program, Annapolis, MD. CP-84-3.

Weiss, D. 1995. Personal communication between D. Weiss, Maryland Department of the Environment, Baltimore, MD, and L. Corio, Versar, Inc., Columbia, MD. 12 May 1995.

Wheeler, T. 1994a. State begins daily smog forecasts, asks public to reduce driving. *Baltimore Sun*, 24 May 1994.

Wheeler, T. 1994b. State plans warning system for "bad air" days. *Baltimore Sun*, 26 April 1994.

WHO (World Health Organization). 1990. Environmental Health Criteria 101: Methylmercury. World Health Organization, Geneva.

Wietz, D.H. 1981. Fish impingement net test program at Morgantown Generating Station. Prepared by the Potomac Electric Power Company, Washington, DC. P8188-F8125.

Wigington, P.J, Jr., J.P. Baker, D.R. DeWalle, W.A. Kretser, P.S. Murdoch, H.A. Simonin, J. Van Sickle, M.K. McDowell, D.V. Peck, and W.R. Barchet. 1993. Episodic acidification of streams in the northeastern United States: Chemical and biological results of the episodic response project. U.S. EPA Environmental Research Laboratory, Corvallis, OR. EPA/600/R-93/190.

Wuebbles, D., and J. Edmonds. 1988. A primer on greenhouse gases. Prepared for the U.S. Department of Energy. March 1988. DOE/NBB0083.

Acid Deposition ("Acid Rain") - A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Acid Mine Drainage - Any acid water draining or flowing on an area of land affected by mining, due to leaching of oxidized pyrites; also called acid runoff.

Acid Neutralizing Capacity (ANC) - The equivalent capacity of a solution to neutralize strong acids. The components of ANC include weak bases (carbonate species, dissociated organic acids, alumino-hydroxides, borates, and silicates) and strong bases (primarily, OH^-).

Acid Precursor - Principally, sulfur dioxide (SO_2) and nitrogen oxides (NO_X) that react with water vapor, sunlight, and other compounds (particularly ozone) in the atmosphere to produce the sulfates and nitrates that acidify the environment through acid deposition.

Acidification - The decrease of ANC in water or base saturation in soil caused by natural or anthropogenic processes.

Air Monitoring - Refers to the measurement of the concentration of an air pollutant in the atmosphere, using equipment designed for detecting the presence of that pollutant.

Air Pollution - The presence in the outdoor atmosphere of any substance in such quantity and in such duration that it:

1) may be predicted with reasonable certainty to be injurious to property or to human, plant or animal life; or
2) unreasonably interferes with the proper enjoyment of the property of others because of the emission of odors, solids, vapors, liquids or gases.

Air Quality Related Value (AQRV) - Special attributes (e.g., visibility, vegetation, soil, and water) of a Class I area that may be affected by deterioration of air quality.

ALARA - Used to describe an approach to radiation exposure control or management whereby the exposures and resulting doses are maintained as far below the limits specified for the appropriate circumstances as social, economic, technical, and practical considerations merit (literally, As Low As Reasonably Achievable).

Allowance - An authorization to emit one ton of SO_2 during or after a specified year.

Ambient Air - Outside air; does not include the air that is inside of buildings or homes.

Anadromous Fish - Marine fish that migrate from high salinity areas to freshwater tributaries to spawn.

Anthropogenic - Derived from, or caused by humans or related to human activities or actions.

Ash Content - The solid residue remaining after the combustion of coal, expressed as a weight percent. The term "fixed ash content" is used to designate that portion of the ash content that is structurally part of the coal after the coal is pulverized and mechanically cleaned prior to use.

Ash Fusion Temperature - The temperature at which ash becomes a liquid.

Atmospheric Fluidized Bed Combustion (AFBC) - The process where a bed of solid coal is burned with a calcium containing substance (usually limestone), while suspended in a stream of upward-flowing air, to remove sulfur in the combustion process.

Atmospheric Loading - The net amount of a constituent, such as CO_2, in the atmosphere after accounting for all sources and sinks of the constituent.

Backhauling - Transportation of by-product materials (such as fly ash) from an electric generating facility for use elsewhere. Such materials can be transported back to where they were mined, for use in its reclamation, or they can be used in the manufacture of various products such as concrete block and road paving materials.

Biocide - A substance, such as a pesticide, weed killer, or rodenticide, that is produced and used to kill living organisms. Biocides are used in the cooling systems of power plants to reduce the growth of fouling organisms that hamper the process of generating electricity.

Biodiversity - The variety and variability among living organisms, and the ecological complexes in which they occur.

Biogenic - Resulting from natural processes.

Biomass - Land and water based vegetation and photosynthetic organisms.

Biota - The animal and plant life of a particular region considered as a total ecological entity.

Burners-Out-of-Service (BOOS) - A concept similar to overfire air, but applicable to certain boilers, whereby burners which normally supply fuel to the combustion zone are retrofitted with burners that deliver additional air to complete fuel combustion at a lower flame temperature, thus reducing NO_X formation.

Chloroflurocarbons (CFCs) - Man-made inert chemicals used primarily for refrigeration, foam production, air conditioning, and as aerosol propellants; CFCs have been linked to stratospheric ozone depletion.

Class I Area - Federally-designated areas which are afforded the greatest air quality protection; includes the following:

1) all international parks;
2) national wilderness areas and national memorial parks with an area greater than 5,000 acres; and
3) national parks with an area greater than 6,000 acres.

Closed-cycle Systems - Power plants using natural draft or mechanical cooling towers to cool the condensers.

Co-generation - An industrial process that both generates electricity and produces another product or service using the waste heat or electricity produced by the power plant.

Coastal Zone - In Maryland, includes both the Eastern and Western shores, or it may be thought of as that region east of the Fall Line. It is geologically younger than the remainder of the state.

Concentration - The amount of a substance contained in a unit volume or mass of sample.

Constructed Wetland - A mitigation measure for acidified surface waters that promises an economical means of raising pH, while at the same time contributing wildlife habitat and other benefits to the landscape.

Cosmic Radiation - High energy particulate and electromagnetic radiation originating outside the earth's atmosphere. Cosmic radiation is one source contributing to natural background radiation.

Criteria Pollutant - A pollutant for which the U.S. EPA has formally established an ambient air quality standard (carbon monoxide, sulfur dioxide, particulate matter, nitrogen oxide, ozone, and lead), supported by a background document which explains the criteria for the specific ambient standard.

Critical Load - The level of acidic deposition below which adverse impacts to sensitive biological resources would not be expected.

Curies (Ci) - A unit of radioactivity. One curie is defined as 3.7×10^{10} (37 billion) disintegrations per second. Several fractions of the curies are commonly used for quantifying levels of radioactivity in the environment. These are the millicurie (mCi), -10^{-6} Ci, and the picocurie (pCi), -10^{-12} Ci.

Deep Mining - The type of coal extraction used at depths greater than 150 feet. This method is also referred to as underground mining.

Demand-side Management (DSM) - Cost-effective measures employed by utilities to reduce the demand for electricity, usually by inducing customers to shift electricity demand to "off-peak" usage hours or by interrupting a customer's load through control of appliances such as air conditioners and hot water heaters.

Derating - A process through which the expected electrical generation rate of a unit may be modified to reflect actual generating experience. The electrical production rating of a unit should realistically reflect its capability to produce electricity under conditions normally encountered by the unit.

Diversion Well - A mitigation measure for acidified streams composed of a cylindrical concrete well with limestone on the bottom that receives acidic water diverted from a stream for neutralization before the water is returned to the stream.

DOE - U.S. Department of Energy

Dose - The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Dose Commitment - The dose that an organ or tissue would receive during a specified period of time (e.g., a 50-year period is used in dose calculations in this report) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from one year's release.

Doser - Any mechanical device designed to continuously treat acidic flowing waters by the addition of base materials such as limestone.

Ecological Risk Assessment - A process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

Effective Dose Equivalent - An estimate of the total risk of potential health effects from radiation exposure. It is the sum of the committed effective dose equivalent from internal deposition and effective dose equivalent from external penetrating radiation received during a calendar year.

Effluent - A liquid or gaseous waste discharged to the environment. Discharge from a pollution source such as the cooling water discharge from power plants or sewage treatment plant discharges.

Entrainment - The process of being pulled through the cooling system of a power plant. Occurs for small organisms such as plankton, fish eggs and larval fish small enough to pass through the traveling screens.

Entrapment - The act of attracting and trapping aquatic organisms in the forebays or intake channels of power plants. Usually results in higher impingement or entrainment of trapped organisms.

Environmental Surveillance - The collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media to determine environmental quality. It is commonly performed at sites containing nuclear facilities.

Environmentally Significant - As used in this report, refers to radionuclides that are known to be assimilated by biological organisms,

and are discharged in detectable amounts. Not included are aqueous release of noble gases, tritium, or very short-lived radionuclides.

EPCRA - Title III of the Superfund Amendments and Reauthorization Act of 1986, also known as the Emergency Planning and Community Right-to Know Act.

Episodic Acidification - The short-term decrease of ANC from a lake or stream. This process has a time scale of hours to weeks and is usually associated with hydrological events (i.e., an increase in water flow or discharge resulting from rainfall or snowmelt).

EPRI - The Electric Power Research Institute. An electric-power industry-funded organization in Palo Alto, CA that investigates problems concerning utilities.

External Radiation - Exposure to ionizing radiation when the radiation source is located outside of the body.

Fate - The deposition of a chemical in various media or locations as a result of release, ecological processes, uptake, degradation, transport, and cycling.

FDA - U.S. Food and Drug Administration

Flue Gas Desulfurization (FGD) - The process used to reduce SO_2 emissions from coal-fired boilers using postcombustion methods, such as scrubbing.

Fly Ash - Ash that would be carried up a stack and emitted to the atmosphere if there were no control measures.

Footprint - That part of a site that is to be, or has been, developed, landscaped, or otherwise permanently disturbed. The footprint of a site includes all man-made features such as buildings, structures, roads, and stormwater facilities.

Forage Finfish - Small bait-fish which form the base of the food chain and provide food for predatory fish.

Fossil Fuel - Fuel consisting of coal, oil, or natural gas formed from fossilized carbonous material.

Fuel NO_x - Nitrogen oxides resulting from the conversion of fuel-bound nitrogen during the combustion process.

Global Climate - The statistical collective of weather conditions for the entire planet during a specified interval of time (at least several decades).

Greenhouse Effect - The naturally occurring phenomenon in which clouds and certain gases found in relatively minute amounts in the atmosphere trap heat emitted by the Earth's sun-warmed surface, and warm the atmosphere near the ground.

Ground Water - Water contained beneath the surface of the Earth, underground water in a saturated zone within soil or rock.

Half-life - The time required for a radioactive substance to lose one-half of its activity by decay. Each radionuclide has a unique half-life.

Halons - A family of compounds containing bromine that are used in fighting fires, and whose breakdown in the atmosphere depletes stratospheric ozone.

Haze - A pervasive clouding of the atmosphere which occurs due to the build-up of air pollutants under hot, humid, low wind speed weather conditions.

Heat Rate - A measurement of a power plant's efficiency in converting fuel to electricity. It is determined by taking a ratio of fuel energy input (British thermal units) to electrical energy output (kilowatt-hours).

Human Health Risk Assessment - A process that evaluates the likelihood that adverse effects on human health may occur or are occurring as a result of exposure to one or more stressors.

Impingement - The process of being pinned against the traveling screens or trash rakes positioned in front of the circulation pumps of power plants.

Independent Power Producer (IPP) - A non-utility generator lacking qualifying facility status, as accorded by the Federal Energy Regulatory Commission. In theory, IPPs can be utility-owned, but normally do not provide service within the owning utility's franchise service territory.

Index of Biotic Integrity (IBI) - An integrated number combining 12 metrics of fish community structure and function that measures the extent

to which a stream fish community approximates an excellent natural community.

Integrated Resource Planning (IRP) - The process by which utilities select the best combination of options to meet anticipated load growth over a long time frame, typically fifteen to twenty years.

Ion - A atom or group of atoms carrying an electric charge.

Ionizing Radiation - Any electromagnetic or particulate radiation capable of producing ions (electrically charged atoms or atomic particles), directly or indirectly, in its passage through matter.

Juvenile Fish - Young fish that have all the adult characteristics of its species but has not reached sexual maturity.

keq/ha/yr - One thousand equivalents per hectare per year. An equivalent is a unit of ionic concentration, a mole of charge; the quantity of a substance that either gains or loses 1 mole of protons or electrons.

Larva - An early, immature state of an animal that changes structure as it becomes an adult. Plural is larvae.

Letter of Authorization (Letter of Exemption) - A type of authorization issued by the Water Resources Administration, Nontidal Wetlands Division, for minor work in nontidal wetlands. To qualify, a project must propose cumulative losses of less than 5,000 square feet of nontidal wetlands and their buffers. Many projects involving small, temporary disturbances of nontidal wetlands qualify for Letters of Authorization.

Liming - The addition of any base materials to neutralize surface water or sediment or to increase ANC.

Linear Facilities - Utility items vital for operation of power plants, such as electric transmission lines, gas pipelines, water pipelines, railroads, and coaxial cables. These items tend to follow linear paths from beginning to end on the landscape, hence the name.

Low-NO_x Burner - Commercially available combustion modification-type of emission control that minimizes NO_x formation by introducing fuel and its associated combustion air into a boiler such that initial combustion occurs in a fuel-rich (i.e., oxygen deficient) environment and is completed in a fuel-lean (i.e., oxygen rich) environment at points downstream of the initial flame.

Low-Sulfur Fuel - Fuel containing a low percentage of sulfur such that sulfur oxide emissions are minimized.

Lowest Achievable Emission Rate (LAER) - An air pollution regulatory requirement applicable to some new emissions sources in areas that have levels of air pollution exceeding the National Ambient Air Quality Standards. Specifically, it is the lowest emission rate achieved in practice by a class of similar stationary sources.

LPG - Liquefied Petroleum Gas

Maximally Exposed Individual - A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose.

Mesohaline Zone - Waters that are 5-19 parts per thousand (ppt) in salinity.

Minimum Detectable Concentration (MDC) - The smallest amount or concentration of a radionuclide that can be distinguished in a sample with a given degree of confidence (usually 95 percent). The MDC is affected by the counting, gamma-ray detector used, and amount of other radiation present.

Mitigation - The amelioration of adverse impacts caused by acidic deposition, including liming to eliminate acidic conditions in surface waters and preserve or restore aquatic communities.

Model - A computer program of mathematical algorithms used to predict the occurrence of an event (e.g., an air dispersion model predicts ambient pollutant concentrations associated with pollutant emissions to the ambient air under certain meteorological conditions).

Mrem - The dose equivalent that is one-thousandth of a rem.

National Ambient Air Quality Standard (NAAQS) - The federally-prescribed concentration of a pollutant in the ambient air that cannot be exceeded during a specified time period in a specified geographical area. The standards are selected to protect public health with a reasonable margin of safety, and public welfare.

Natural Radiation - Radiation attributable to cosmic and other naturally occurring radionuclides present in the environment.

Noble Gases - A group of elements that have an extremely limited ability to react chemically. Also known as inert gases, they include helium, neon, argon, krypton, xenon, and radon.

Nonattainment Area - A geographical area where an ambient air quality standard is not being met.

Nontidal Wetland - An area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a predominance of vegetation typically adapted for life in saturated soils conditions (hydrophytic vegetation). Nontidal wetlands are not influenced by the daily rise and fall of the tides.

Oligohaline Zones - Water that are 0.5-5 parts per thousand (ppt) in salinity.

Once-through Cooling System - A power plant cooling system where surface water is cycled through the plant to cool the condensers without the use of cooling towers.

Outfall - The end of a drain or pipe carrying effluent into a river, pond, or bay.

Overfire Air - Combustion air "staging" whereby a portion of the combustion air is introduced to the stream of pulverized coal in incremental stages thereby reducing the amount of fuel-bound nitrogen combining with oxygen to form nitrogen oxides.

Peaking Operation - Term used for a particular type of operation at hydroelectric facilities (dams) to generate electricity. Under these operations, water is stored behind a dam until it reaches a specific height, and then it is released, and passed through the turbines to generate electricity. Such operations involve rapid fluctuations of impoundment and river water levels, which can have adverse effects on vegetation and wildlife.

pH - The negative logarithm of the hydrogen ion activity. The pH scale runs from 1 (most acidic) to 14 (most alkaline); a difference of one pH unit indicates a tenfold change in hydrogen ion activity.

Photochemical - Represents the set of atmospheric chemical reactions which occur in the presence of sunlight.

Prevention of Significant Deterioration (PSD) - A federally mandated pre-construction program that is applicable in attainment areas only. Its goal is to limit the increase in concentration of criteria pollutants in the ambient air due to the construction of new or modified sources.

PSD Increment - The maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant.

Pyrites - A form of inorganic sulfur that is combined with iron as a crystalline.

Radioactive Decay - The spontaneous transformation of one nuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same nuclide.

Radioactivity - The spontaneous emission of radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope.

Radionuclide - An unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

Reasonably Available Control Technology (RACT) - An air pollution regulatory requirement applicable to some existing emissions in areas that have excessive pollution levels. Specifically, it is the lowest emission limit that a particular source is capable of meeting by applying controls that are reasonably available, considering technology and economics.

Reburning - Involves injecting fuel above the main burner zone in a boiler to destroy formed NO_X.

Receiving Water Body - The river, lake or bay from which the cooling water is discharged.

Rem - The unit dose equivalent (rad multiplied by a quality factor). Dose equivalent is frequently reported in units of millirem (mrem), which is one-thousandth of a rem.

Run-of-River Operation - Term used for a particular type of operation at hydroelectric facilities (dams) to generate electricity. Under these operations, the river outflow from the project equals its inflow. Such operations simulate natural river flow and do not involve frequent river and impoundment level fluctuations.

SARA - Superfund Amendments and Reauthorization Act of 1986.

Scrub/Shrub - Wetland or upland vegetation type where there is a predominance of a mixture of shrubs and herbaceous plants over the landscape. Trees in this vegetation type are typically small, and their abundance varies from almost nonexistent to scattered throughout.

Scrubber - A post-combustion control technology that removes sulfur impurities, such as sulfur dioxide, from exhaust gases, usually through reaction with an aqueous solution or slurry of alkaline material, such as lime and/or limestone.

Selective Catalytic Reduction (SCR) - A post-combustion control technology that converts NO_X to molecular nitrogen and water using a reducing agent (e.g., ammonia) in the presence of a catalyst.

Selective Non-catalytic Reduction (SNCR) - A post-combustion technology in which NO_X is reduced by injecting ammonia or urea/water solution into a high-temperature region of the boiler rather than under the influence of a catalyst (as is done for SCR).

Slurry - A suspension of pulverized solid in a liquid.

Smog - Type of air pollution which is formed through the interaction of sunlight with volatile organic compounds and oxides of nitrogen, under conditions of low wind speed.

Source Water Body - The river, lake or bay from which the intake water is withdrawn.

Stable - Not radioactive or not easily decomposed or otherwise modified chemically.

State Implementation Plan (SIP) - Documents prepared by states, and submitted to EPA for approval, which identify actions and programs to be undertaken by the state and its subdivisions to implement their responsibilities under the Clean Air Act.

Steady-State Model - A model (i.e., an abstraction or representation of a system) in which the variables under investigation are assumed to reach equilibrium and are independent of time.

Strip Mining - Also known as surface mining. This is a method of extracting coal at depths less than 150 feet.

Substrate - The substance, base, surface, or medium in or on which an organism lives and grows.

Surface Runoff - The amount of surface water that is not absorbed by a surface; depends on rainfall intensity and land use classification.

Surface Water - Free flowing water in rivers, lakes, and bays.

Terrestrial Ecosystem - The organisms of land habitats together with the physical environment that they live.

Thermal NO_x - Nitrogen oxides generated by a chemical reaction sequence in which the rate of NO_x generation is an exponential function of the flame temperature and also a linear function of the time that the gases remain at the flame temperature.

Thermoluminescence Dosimetry (TLD) - A technique used to measure external gamma radiation levels in the environment.

Tidal Fresh Zone - Waters that are 0-0.5 parts per thousand (ppt) in salinity.

Tidal Wetlands - In Maryland these are defined as all state and private tidal wetlands, marshes, submerged aquatic vegetation, lands, and open water affected by the daily and periodic rise and fall of the tide within the Chesapeake Bay and its tributaries, the coastal bays adjacent to Maryland's coastal barrier islands, and the Atlantic Ocean to a distance of three miles offshore of the low water mark.

Toxic Substances - Chemicals that can produce harmful effects on organisms exposed to those chemicals.

Trophic Level - A group of organisms that obtain their food from the same number of food chain steps.

U.S. EPA - United States Environmental Protection Agency

Visibility - The greatest distance at which an object can be seen or recognized.

Volatile Matter - Matter that consists of hydrocarbons and other gases that are obtained by the distillation and thermal decomposition of coal. The main constituents of volatile matter include hydrogen, oxygen, carbon

monoxide, methane, water, and hydrocarbons. Volatile matter content is one of the criteria used to establish the rank of coals.

Watershed - The geographic area from which surface water drains into a particular lake or point along a stream.

Weapons Test Fallout - Radioactive debris from atmospheric weapons tests that has been distributed and deposited on the earth's surface after being airborne.

Wedge-wire Screens - A fine mesh screen designed to reduce entrainment and impingement at water intakes. The screen is constructed of wedge-shaped wire typically positioned between 1-3 mm apart. The broader portion of the wedge-wire forms the outside surface of the screen so that particles about the size of the mesh can easily dislodge when passing through the screen.

Wet Bottom Boiler - A boiler in which the bottom ash is removed as a liquid.

Wetland - Area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence or vegetation typically adapted for life in saturated soil.

Wheeling - The transfer by direct transmission or displacement of electric power from one utility to another over the facilities of an intermediate utility.

A

Appendix A
Determinants of Electricity Demand Growth in Maryland

THE DETERMINANTS OF ELECTRICITY DEMAND GROWTH IN MARYLAND

A number of economic, demographic, and technological factors influence the demand for electricity. This appendix provides an overview of these economic and demographic factors and their historical and projected trends in Maryland.

The Power Plant Research Program (PPRP) has conducted a program of independent electric load forecasts since the mid-1970s. The forecasts developed through this program are used to help ensure that future power supplies are adequate to meet projected consumer demand, and to help minimize the costs associated with excess capacity.

The PPRP forecasts, as well as those prepared by the Maryland utilities, are based on sets of economic models of electricity demand (these models are described in the individual PPRP forecasts). The historical data required to develop the econometric models are obtained from a variety of sources including the Maryland utilities; the Maryland Office of Planning (OP); the Bureau of Economic Analysis (BEA); the National Oceanic and Atmospheric Administration (NOAA); the U.S. Department of Commerce; the Bureau of Labor Statistics (BLS); and the Maryland Department of Economic and Employment Development.

Assumptions about the future values of the explanatory variables (i.e., income, employment, population, etc.) are necessary to forecast future power demand with these models. OP prepares and publishes county-level, long-range projections of population, employment, households, household size, and income. The PPRP forecasts of power demands and energy sales incorporate these projections.

This appendix presents a description of the economic/demographic historical trends in Maryland and OP's outlook through 2010. To put these trends in perspective, Maryland data are frequently compared to the performance of 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 — Potomac Electric Power Company (PEPCO), Delmarva Power Company (Delmarva Power), and Potomac Edison Company (PE) — sell significant portions of their power outside Maryland. Thus, with the exception of Baltimore Gas and Electric Company (BGE), projections of economic and demographic trends in

Maryland are only part of the information base required for systemwide forecasting.

The following sections of this appendix examine economic and demographic trends for the U.S., Maryland, and principal Maryland regions as defined by OP (see Table A-1).

Table A-1 ***Principal Regions in Maryland***

Region	Counties	Predominant Electric Utility
(1) Baltimore	Baltimore City	Baltimore Gas and Electric Company (BGE)
	Baltimore County	
	Anne Arundel	
	Harford	
	Howard	
	Carroll	
(2) Washington Suburban	Montgomery	Potomac Electric Power Company (PEPCO)
	Prince George's	
(3) Eastern Shore	Cecil[1]	Delmarva Power Company (Delmarva Power) and Choptank Electric Cooperative
	Caroline	
	Kent	
	Queen Anne's	
	Talbot	
	Dorchester	
	Somerset	
	Wicomico	
	Worcester	
(4) Southern Maryland	Calvert	Southern Maryland Electric Cooperative (SMECO)[2]
	Charles	
	St. Mary's	
(5) Western Maryland	Allegany	Potomac Edison Company (PE)
	Frederick	
	Garrett	
	Washington	

(1) Most of Cecil County is served by Conowingo Power Company.

(2) SMECO is a wholesale customer of PEPCO.

A. *Linking Electricity Demand with Economics and Demographics*

The economic models used by PPRP are based on economic theory of the consumer and the firm (or business enterprise). Individuals are assumed to purchase the set of goods and services that maximizes their "return" given certain constraints such as income. Electricity, by itself, confers no benefits to the consumer. Rather, electricity is purchased to allow consumers to benefit from the use of electricity-consuming appliances. Thus, electricity demand is actually derived from the demand for other goods and services. This is a very important concept given the historical increases in electrification by residential customers (e.g., big-screen color televisions, VCRs, microwave ovens, heat pumps and computers). A household's demand for electricity, therefore, will be influenced by appliance holdings, weather, household size, income, and also the price of electricity. Extending this notion to a region's household demand for electricity, we can also expect that the region's number of households will affect total consumption.

Economic theory assumes that all firms are motivated to maximize profits or minimize costs for a given level of output. Like labor and machinery, electricity is considered an input to produce a firm's ultimate good or service. Electricity demand will increase as the firm increases its output — that is, machinery may be run for longer hours, or more intensely. Analogously, office space may be increased to handle additional employees, thus increasing the amount of area heated, cooled, and lighted. On a regional basis, we infer that electricity consumption increases as overall business activity increases. The price of electricity will also affect a firm's use of electricity. For instance, if price increases, the firm may look to substitute natural gas heat for electric heat.

B. *Employment Trends*

Turning back to the notion that, among other things, a business's consumption of electricity is influenced by its level of production, we start our analysis by looking at employment trends. County-level employment is used in lieu of output because output measures at the county level are not available on a consistent basis.

Table A-2 shows historical and forecasted trends in Maryland and U.S. employment between 1970 and 2010. Maryland average annual employment growth of 2.9% exceeded that of the U.S. (2.0%) during the 1980 to 1990 period. While total Maryland employment growth is expected to continue to outpace the nation's, annual growth will slow significantly, to 1.0%. This is ultimately due to slowing population growth and a leveling off of labor force participation, because the majority of gains in female labor market participation have already been realized.

Maryland's above average employment growth is largely due to the state's relative lack of dependence on manufacturing. In 1970, 16.4% of state employment was in the manufacturing sector (see Table A-3). In contrast, in 1990 only 7.8% of the state's workers were employed in manufacturing. The effect of this shift from a fairly large manufacturing base to a more service-oriented base can be seen by the fact that from 1970 to 1990, the percentage of total employment devoted to services in Maryland increased by 11.3 percentage points while the percentage for the U.S. increased by 7.5 percentage points.

Table A-2 ***Total Employment in the U.S. and Maryland, 1970-2010 (thousands)***

Year	Maryland[1]	U.S.[2]	Maryland as a Percent of U.S.
1970	1,699.7	91,093	1.9%
1980	2,069.2	113,730	1.8
1990	2,740.2	138,596	2.0
2000	3,018.6	151,450	2.0
2010	3,340.5	158,618	2.1
	Average Annual Rates of Growth (Percent)		
1970-1980	2.0%	2.2%	
1980-1990	2.9	2.0	
1990-2000	1.0	0.9	
2000-2010	1.0	0.5	

(1) OP projections, June 1994.

(2) BEA Regional Projections to 2040, Volume 1: States, U.S. Department of Commerce, Bureau of Economic Analysis, June 1990.

Table A-3 ***Structure of Nonagricultural Employment in Maryland and the U.S., 1970 and 1990 (Percent)***

	Maryland[1]		United States	
Sector	**1970**	**1990**	**1970[2]**	**1990[3]**
Mining	0.2%	0.1%	0.6%	0.7%
Construction	6.3	7.2	5.5	4.7
Manufacturing	16.4	7.8	24.8	17.5
Transportation, Communications & Utilities	5.4	4.4	6.1	5.3
Trade	20.1	21.8	21.5	23.7
FIRE[4]	6.6	8.5	5.0	6.2
Services	19.3	30.6	17.7	25.2
Civilian Government	24.8	18.7	15.8	16.8
TOTAL[5]	**100.0%**	**100.0%**	**100.0%**	**100.0%**

(1) OP projections June 1994.

(2) 1985 Statistical Abstract of the United States, 105th Edition, Bureau of the Census, U.S. Department of Commerce.

(3) 1993 Statistical Abstract of the United States, 113th Edition, Bureau of the Census, U.S. Department of Commerce.

(4) Finance, insurance and real estate.

(5) Non-farm employment, totals may not sum to 100 percent due to independent rounding and due to the exclusion of agricultural services.

Table A-4 shows the differences of regional employment growth patterns across the state. From 1970 to 1990, employment in Baltimore City and the Southern Maryland region grew at -0.2% and 4.1% rates, respectively, while employment in the state grew annually at a rate of 2.4%. In general, regions with larger proportions of manufacturing employment have exhibited relatively slower growth. OP predicts Baltimore City will continue to lag the rest of the State in employment growth through 2010. Conversely, Southern Maryland will lead the other regions with average growth in employment of 1.9% per year.

Table A-4 ***Regional Employment for Maryland and the U.S., 1970-2010(1) (thousands)***

Region	1970	1990	2010	Annual Rate of Growth 1970-1990 (%)	Annual Rate of Growth 1990-2010 (%)
Baltimore City	533	513	489	-0.2%	-0.2%
Baltimore non-City	451	879	1,083	3.4	1.0
Washington Region	467	963	1,275	3.7	1.4
Southern Maryland	41	92	133	4.1	1.9
Western Maryland	88	116	136	1.4	0.8
Eastern Shore	120	178	224	2.0	1.2
Total State	1,700	2,741	3,340	2.4%	1.0
U.S.	91,093	138,596	158,618	2.1%	0.7%

(1) Maryland data - OP projections, June 1994. U.S. Data - BEA Regional Projections to 2040, Volume 1: States, U.S., Department of Commerce, Bureau of Economic Analysis, June 1990.

Everything else remaining the same, these trends suggest that the demand for electricity by Maryland businesses will continue to grow. However, relatively slow manufacturing job growth will lead to only moderate increases in industrial electricity demand. Relatively robust demand for electricity by the commercial sector, however, is expected due to stronger growth in nonmanufacturing jobs.

Regional disparities in job growth also indicate that business demand for electricity will grow faster in Southern Maryland and the Washington suburbs than in Baltimore City.

C. *Population and Household Trends*

From a demographic perspective, residential uses of electricity will be influenced by the number of households and the number of individuals per household. Household and population growth are closely linked. Thus we start our examination by looking at trends in population.

As shown in Table A-5, Maryland's historical population growth has mirrored that of the nation. The most striking facet of Table A-5 is the great unevenness of growth across regions within the state. From 1970 to

1990, Southern Maryland's population grew 3.5% annually, while Baltimore City's declined by 1.0% annually.

Table A-5 ***Regional Population for Maryland and the U.S., 1970-2010(1) (thousands)***

Region	1970	1990	2010	Annual Rate of Growth 1970-1990 (%)	Annual Rate of Growth 1990-2010 (%)
Baltimore City	906	736	699	-1.03%	-0.26%
Baltimore non-City	1,165	1,612	1,935	1.64	0.92
Washington Region	1,269	1,637	2,069	1.28	1.18
Southern Maryland	116	229	357	3.46	2.24
Western Maryland	209	224	244	0.35	0.43
Eastern Shore	258	344	417	1.45	0.97
Total State	3,923	4,782	5,721	1.00%	0.90%
U.S.	203,302	249,466	282,050	1.03%	0.62%

(1) Maryland data - OP projections, June 1994. U.S Data - BEA Regional Projections to 2040, Volume 1: States, U.S., Department of Commerce, Bureau of Economic Analysis, June 1990.

OP expects that historical regional growth disparities will continue in the future though the magnitude of the regional growth rate differences are expected to lessen. For example, the most rapid historical growth rate of 3.46% per year (Southern Maryland) is expected to decline to an average annual rate of 2.24% in the 1990-2010 period. By contrast, the area of slowest growth historically (Baltimore City), whose population declined at an average annual rate of 1.03% between 1970 and 1990, is projected to face less of an average annual decline in the 1990-2010 period (-0.26%). However, on average, total state-wide population growth is expected to decline from the historical rate of 1.0 to 0.9% per year from 1990 to 2010.

Population growth and the rate of household formations are closely related. Generally, we find that increases in population lead to increases in the number of households. Differences are largely attributable to household formation rates, divorce rates, the age distribution of the population, and the number of people per household.

Table A-6 ***Historical and Projected Number of Households and Average Size of Households in Maryland by Region, 1970-2010***

Region	1970	1990	2010	Annual Rate of Growth 1970-1990 (%)	Annual Rate of Growth 1990-2010 (%)
	Number of Households[1] (thousands)				
Baltimore Region	624	868	1,058	1.7%	1.0%
Washington Suburban	375	593	787	2.3	1.4
Southern Maryland	30	75	130	4.7	2.8
Western Maryland	67	85	95	1.2	0.6
Eastern Shore	79	128	166	2.4	1.3
Total State[2]	**1,175**	**1,749**	**2,236**	**2.0%**	**1.2%**
	Average Household Size				
Baltimore	3.22	2.64	2.42	-1.0%	-0.4%
Washington Suburban	3.32	2.71	2.58	-1.0	-0.2
Southern Maryland	3.77	2.97	2.71	-1.32	-0.5
Western Maryland	3.05	2.52	2.37	-0.9	-0.3
Eastern Shore	3.12	2.58	2.41	-1.0	-0.3
Total State	**3.25**	**2.67**	**2.49**	**-1.20%**	**-0.7%**

(1) OP projections, June 1994.

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

Residential consumption of electricity in Maryland is influenced by the number of households and the number of individuals per household (see Table A-6). Holding the consumption of electricity per household constant, we would expect residential use of electricity to grow given OP's projections of household growth. However, future growth would appear to be less than historical growth since households will only grow by 1.2% per year in the future compared with the historical growth rate of 2.0% per year between 1970 and 1990. Another factor that will also dampen the growth in the demand for electricity by households is the declining number of persons per household. As seen in Table A-6, the number of persons per household has been declining since 1970. In fact, household

size has been declining since before 1950. While Southern Maryland (the region with the largest household size) was 0.45 person per household larger than Western Maryland (the region with the smallest household size) in 1990, is expected to be only 0.34 person per household larger in 2010. Moreover, by 2010, all regions will be closer to the average household size for the state than in 1990.

D. *Household Income Trends*

Changes in real (i.e., inflation-adjusted) household income will affect the use of electricity by residential customers. Table A-7 indicates that Maryland real household income grew 1.4% per year from 1970 to 1990. Southern Maryland and the Eastern Shore experienced 1.6% and 1.4% annual growth, respectively, while Baltimore City real household income increased at a rate of 0.9% annually. OP expects future state income growth to decline to 0.5% per year between 1990 and 2010 while historical regional disparities continue. Moreover, the Washington Region possessed 73% greater income per household than Western Maryland in 1990. This difference is expected to remain approximately constant (i.e., decline marginally to 69%) through 2010. All else remaining the same, this would suggest greater use of electricity by Washington Region households, relative to those in Western Maryland. In summary, these real income trends point to continued growth in total residential electricity uses, with other factors remaining unchanged.

Table A-7 ***Income per Household in Maryland, 1970-2010(1)***
(1987 Dollars)

Region	1970	1990	2010	Annual Rate of Growth 1970-1990	Annual Rate of Growth 1990-2010 (%)
Baltimore City	$34,621	$41,232	$43,473	0.9%	0.3%
Baltimore non-City	41,802	54,215	57,944	1.3	0.3
Washington Region	47,622	61,472	67,396	1.3	0.5
Southern Maryland	35,877	49,085	57,273	1.6	0.8
Western Maryland	27,715	35,518	39,784	1.2	0.6
Eastern Shore	31,560	42,039	47,951	1.4	0.7
Total State	$39,749	$52,602	$57,890	1.4%	0.5%

(1) OP projections, June 1994.

E. *Summary*

A number of economic, demographic, and technological factors influence the demand for electricity. This appendix focuses on providing an overview of the economic and demographic linkages to electricity demand. Additionally, a review of past and forecasted trends of these major influencing factors is provided. The linkages among the demand for electricity and the economic, demographic, and technological factors are complex and can work in opposite directions (e.g., increasing household income and decreasing household size). Furthermore, the factors that affect electricity demand are themselves interrelated. For example, employment growth affects income and population growth.

To account for the complex nature of electricity demand, PPRP forecasts use econometric models that account for major determinants of electricity demand. In general, electricity demand is expected to increase in Maryland. This is principally due to the following factors:

- growth in the number of households;
- growth in real income per household;
- increased electrification by the residential and commercial sectors, i.e., more and bigger color televisions; more VCRs, microwave ovens, heat pumps, computers, etc.; and,
- growth in the number of jobs.