THE ADEQUACY AND RELIABILITY OF ELECTRICITY IN THE NATIONAL CAPITAL AREA

INTRODUCTION

As you may recall, members of the League of Women Voters of Montgomery County, MD, are also members of the League of Women Voters of the United States, the League of Women Voters of Maryland and the League of Women Voters of the National Capital Area (LWVNCA). LWVNCA is the Inter-League Organization (ILO) that deals with issues that cross jurisdictions in the Washington D.C. metropolitan area.

At its 2009 Convention, LWVNCA adopted a study of "The Adequacy and Reliability of Electricity in the National Capital Area." Benjamin Franklin's spark has evolved into the major source of energy for lighting, heating, cooling, refrigeration, computers, banking, communications, industrial machinery and transportation. Huge amounts are necessary to serve both industrial and residential needs and demand. A study of electricity involves looking at the three elements necessary to produce and deliver electricity: Generation, Transmission and Distribution. The committee will survey the various technologies and sources, including fossil fuel, wind power, solar power and nuclear power, which generate electrical energy. Electricity transmission lines provide the transport highways to move electricity from the generation sources to concentrated areas of customers. Proposed transmission lines as well as the "Smart Grid" will be discussed. Distributors, usually investor-owned utilities, deliver electricity from the transmission lines to the end user or customer.

GENERATION

Electricity is the movement of electrons and occurs naturally. Electricity is created from the conversion of a fuel or other source of energy into moving electrons. All of the fuels and most energy sources are used to convert water into steam, which moves power turbines that generate electricity. Centralized power generation became possible when it was recognized that alternating current power lines can transport electricity at a very low cost across great distances by taking advantage of the ability to raise and lower voltage using power transformers. Electricity has been generated at central stations since 1881, initially relying upon coal or water power. Distributed generation is any electricity-generating technology that is connected at the customer side of the meter, such as photovoltaic solar energy serving an office, and that is used to displace electricity from the grid during times of peak demand.

Fossil Fuels

In the National Capital Area (NCA) the type of fuel used to generate electricity is as follows: coal – 55%, nuclear – 34%, natural gas – 8%, petroleum – 1%, hydroelectric – 2% and other, including renewable generators, 1%. Coal is the primary source of electricity in the NCA area. Coal is very abundant, easy to store and transport. Coal-power plants offer unique load-carrying flexibility useful to meet peak demand and provide a dependable base-load. Mining coal, especially mountaintop clearing, can be very destructive of the environment and hazardous to miners. Coal-powered electrical generation plants emit Nitrogen oxides (NO2), Sulfur dioxide (SO2), Mercury and greenhouse gases such as Carbon dioxide (CO2) and Methane. Coal-powered plants produce the highest emissions of CO2. Nitrogen dioxide forms ozone (smog) in the presence of heat and sunlight. Coal-powered plants also produce great quantities of fly ash and scrubber sludge. Power plants are significant users of water and the operations of plants located near the Chesapeake Bay affect aquatic ecosystems as well as the availability of water for other users. Finally, coal is an inefficient producer of electricity.

Natural gas emits only half as much CO2 as coal and is regarded as a transitional fuel toward renewable energy. Over the past decade expertise in the complex technology needed to extract gas from shale has been developed. The Marcellus Shale basin starts in New York State and runs through Pennsylvania, passes through Garret County, Maryland, into West Virginia, thus providing a source of energy closer to the NCA area. However, the hydraulic fractioning extraction method poses some environmental concerns about ground water contamination. Nevertheless, the increasing supply of natural gas may lead to natural gas being the near-term fuel of choice for cleaner electricity production and transportation. Major oil companies such as Exxon Mobile are acquiring smaller natural gas companies and their shale assets.

Nuclear Energy

The 1979 partial meltdown of the Three Mile Island nuclear plant in Pennsylvania effectively stopped the nuclear power industry in the United States. It has been 13 years since the last new nuclear power plant opened in the United States. The pressure to reduce the production of climate-warning gases has renewed interest in low emissions nuclear power overriding the dangers of radioactive waste disposal and nuclear proliferation. Newer reactor designs such as Generation 3+ reactors use standardized designs, include passive safety features and consume more nuclear fuel which lowers costs and reduces wastes. The Energy Policy Act of 2005 provides $13 billion in tax credits for new nuclear facilities (enough for two or three plants) and further tax credits have been proposed in the current session of Congress. An application, submitted by Constellation Energy, to build a new nuclear plant at Calvert Cliffs is being reviewed by the Nuclear Regulatory Commission. Virginia has two nuclear facilities, at Lake Anna and at Surry. However, the costs of building nuclear power plants are prohibitive and construction may take as long as ten years. Nuclear energy has low efficiency balanced by low operating costs. Another negative impact is the water needs of nuclear energy facilities. The Calvert Cliffs nuclear plants withdraw, daily, more than 13 times the daily municipal supply for the City of Baltimore.

Geothermal Energy

Temperatures in the interior of the planet, Earth, are incredibly high due to heat from the Earth's molten core, the breakdown of radioactive materials in the crust and the friction of the crust's plates rubbing each other. This heat is brought to the surface as hot water and gases usually in volcanic areas where it used to warm buildings and to generate electricity. All commercial geothermal plants rely upon hydrothermal reservoirs which lie close to the surface. Three geothermal power plant technologies are being used to convert hydrothermal fluids to electricity. These are dry steam, flash steam and binary cycle. Dry stream power plants use steam as it comes from the wells and route it directly through turbine/generator units to produce electricity. Steam technology was first used in Lardello, northern Italy, in 1913. Steam technology is also used at The Geysers, California, the world's largest single source of geothermal power. Flash steam plants, the most common type, use water at temperatures greater than 360 degrees Fahrenheit that is pumped under high pressure to the generation equipment at the surface. Binary cycle geothermal power is a closed loop system so that virtually nothing is emitted to the atmosphere. Making electricity with geothermal power is approximately as cheap as using fossil fuels. The Earth's magma and hot dry rock will provide cheap, clean and almost unlimited energy as soon as the technology to use them is developed with the support of the Department of Energy.

Renewable Sources of Energy

Renewable resources are those that are continually replenished and are not used faster than they can be replaced. Renewable/alternative energy resources include sunlight, wind, tides and geothermal heat.

Solar energy is clean, abundant and highly efficient. Two technologies are used to produce electricity from solar power. The first, traditional solar panels use photovoltaic cells to convert the sun's rays directly into electricity without emitting any greenhouse gases. Solar modules can be installed on roofs, in a field or in a patch of desert. In the Washington area, coops have been formed to facilitate the use of photovoltaic modules for individual residences and more than 1,000 solar panels will be installed on four Catholic University buildings. However, according to the International Energy Agency, power from solar cells costs $200 – 600 a megawatt-hour (MWh) as opposed to $50 – 70 per MWh for offshore wind power in the United States. The second technology, concentrated solar power or CSP, deploys huge banks of mirrors to focus solar radiation; the resulting intense heat drives steam turbines, producing electricity in a process similar to the one used in coal- or oil-fired plants, but without the greenhouse gas emissions. Efficient solar-thermal plants can be built in principle on the same sort of scale as gas-fired power stations. President Obama has distributed economic stimulus funds to Abengoa Solar, a leader in CSP technology, to build one of the world's largest solar plants in Arizona.

Wind power is one of the fastest-growing alternative energy sources in the world. Wind power is a low carbon, renewable source of electricity that can deliver millions of watts of relatively low cost power. Wind turbines have high capital costs and close to zero operating costs. Construction of wind turbines involves transporting and assembling very large components. Modern wind turbines weigh more than 300 tons and stand some 300 feet tall. A floating wind turbine can have a turbine tower 213 feet above the waterline and is attached to a buoy which extends about 330 feet below the waterline. However, like solar energy, wind power is intermittent, driving the growing use and development of batteries and other storage devices. A more serious obstacle is the lack of adequate transmission lines. Wind energy has bumped into the power grid's limits.

In the November 2009 issue of *Scientific American,* Mark Z. Jacobson and Mark A. Delucchi propose how 100% of the world's energy, for all purposes, could be supplied by wind, water and solar resources by 2030. The authors call for 3.8 million large wind turbines, 90,000 solar plants and numerous geothermal, tidal and rooftop photovoltaic installations worldwide. They assume that most fossil fuel heating, ovens and stoves can be replaced by electric systems and that most fossil fuel transportation can be replaced by battery and fuel cell vehicles.

TRANSMISSION

Electricity transmission lines move electricity from generation sources to concentrated areas of customers, where the distribution system moves electricity to the end user. Electricity, when transmitted, flows over all available paths, following the path of least resistance, and cannot be easily directed. The buying and selling of electricity requires direct coordination and proactive monitoring of the electrical systems. Three independent electrical systems, known as power grids, transmit electrical power in the United States. They are the Eastern Interconnect, covering the eastern two-thirds of the United States and Canada, the Texas Interconnect and the Western Interconnect, encompassing most of the rest of the two countries. Each system operates in a coordinated and unified manner within its power grid but the three grids are not linked so that power can flow between them.

The Energy Policy Act of 1992 empowered the Federal Energy Regulatory Commission (FERC) to restructure electric markets. FERC issued Order No. 888 and No. 889 in 1996. These landmark actions directed the owners of the nation's transmission lines to open their lines to third-party customers at non-discriminatory rates. "Deregulation" rapidly followed, leading to separate ownership of generation plants and distributors/electric companies. In 1999, FERC issued Order 200 which established Regional Transmission Organizations (RTO) who will operate the transmission portion of the electrical system.

RTOs are expected to reduce discriminatory transmission practices, improve power grid reliability and increase investments in transmission infrastructure. The PJM Interconnection (PJM) coordinates the flow of electricity from power plants to distribution companies over a network of transmission lines owned by its members in all or parts of Delaware, Maryland, New Jersey, Pennsylvania, Virginia and the District of Columbia. As authorized by the Energy Act of 2005, the Mid-Atlantic region from Northern Virginia to New York has been designated as an NIETC. This designation means that additional transmission capacity is so critical that FERC, under limited conditions, may overrule state utility commissions and issue permits for regional transmission line projects that are deemed to be in the nation's interest.

Two additional transmission lines, the Mid-Atlantic Power Pathway (MAPP) and the Potomac Appalachian Transmission Highline (PATH), have been proposed. PATH, like most of the transmission lines that serve the National Capital Area, would transmit power generated in the Mid-West by traditional power plants dependent upon coal. MAPP will run from Dominion Virginia Power's coal-powered Possum Point substation to the Calvert Cliffs nuclear plant, go under Chesapeake Bay to Maryland's Eastern Shore and through the Delmarva Peninsula. The major objection to both proposed lines is that since PMJ must transmit the cheapest power, electricity generated by dirty coal will have an advantage. MAPP, however, could transmit nuclear power from Calvert Cliffs and could be useful for transmitting wind energy from the Delaware shore to the Mid-Atlantic Region. The power grid is balkanized with about 200,000 miles of power lines divided among 500 owners. Big transmission upgrades involve multiple companies, many state governments, numerous permits and fights with property owners. The end result is that electrical generation is growing four times faster than transmission, according to federal figures.

DISTRIBUTION

Distribution is the process whereby electrical power is physically delivered to end-users. Because of deregulation in the District of Columbia and Maryland, determining exactly who is providing what to whom isn't as simple as it used to be. Generally, there is a major provider for each area. The various public service commissions have approved a number of other providers who sell electric services as well – some only to residential, some only to commercial users and some to both. The state of Virginia has not deregulated electricity, so that some distributors also generate electricity.

District of Columbia

Potomac Electric Power Company (Pepco) is the major provider of electricity to the District of Columbia. The DC Public Service Commission has approved 37 additional providers, of which 17 are currently providing service in the District. All 17 sell to commercial customers while only two service residential customers. According to a DC Public Service Commission report, 97.3% of DC residents get their power from Pepco and only 2.7% from other providers; 75.9% of commercial customers get their power from Pepco and 24.1% from other providers. Overall, Pepco provides service to 95% of total customers and the other providers 5%.

Maryland

Baltimore Gas and Electric (BGE) is the major provider in Anne Arundel and Howard Counties. Allegheny Power serves Frederick County and Pepco is the major provider in Montgomery and Prince George's Counties. The Maryland Public Service Commission (MPSC) approves additional providers by service area of the major providers. One additional provider has been approved for the Allegheny service area, 11 for the BGE service area, and five for the Pepco service area. The additional major provider is Delmarva which serves mostly the Eastern Shore. None of Maryland's providers own generational facilities.

A total of 4.1% of residential customers and 28.8% of commercial customers are serviced by alternate providers. The larger the commercial enterprise, the more likely it is to use an alternate provider. Not included in any of the above figures are cooperatives, municipally owned electric companies, etc. In other words, only investor-owned companies are regulated and, apparently, tracked by the Maryland PSC.

Virginia

NCA communities in Northern Virginia are served by Dominion Virginia Power (DVP) and Northern Virginia Electric Cooperative (NOVEC). On average, 80% of power used in Virginia is generated in Virginia and 20% comes from out-of-state. Virginia is projected to increase power demands 28% over the next decade, the fastest of any of the 13 states in the PJM area. Dominion Virginia Power's electricity in 2009 came 42% from coal, 40% nuclear, 11% natural gas, 6% renewables and 1% oil. Dominion owns four nuclear facilities, at Lake Anna and Surry, VA, numerous coal-fired and gas-fired facilities and a biomass facility in Hurt, VA that burns waste from logging, saw mills and paper mills. Dominion also owns a pumped-storage hydro facility in Warm Springs, VA, that uses excess energy generated during low-demand periods to pump water into large storage basins from which water is released during high-demand periods to generate electricity. This Bath County facility is actually a net consumer of electricity, but it benefits Virginia's electrical system by converting electric power from low-demand periods to electric power for high-demand periods. Dominion has two wind projects planned.

NOVEC is a member-owned distribution cooperative headquartered in Manassas that serves parts of Clark, Fairfax, Fauquier, Loudon, Prince William and Stafford Counties and the cities of Manassas, Manassas Park and Clifton. NOVEC receives power supply primarily from Old Dominion Electric Cooperative (ODEC), which purchases power through the PJM marketplace. Old Dominion co-owns base-load generating facilities with Dominion Virginia Power, including a share of the Lake Anna nuclear plant and three gas-fired facilities to meet peak load demand.

RELIABILITY

Reliability is the ability of a power company to deliver electricity to its customers in an adequate amount at the reasonable prices. While local power outages are the responsibility of the distribution companies, PJM is responsible for delivering reliable power to the distributors. The Federal Energy Policy Act authorized the North American Reliability Corporation (NERC), an independent organization, to establish mandatory and enforceable reliability standards for the interstate transmission system. Eight regional reliability councils are charged with assessing compliance with these standards. Reliability First Corporation (RFC) covers Maryland and most of the PJM service area. A total of 83 mandatory reliability standards have been approved by FERC thus far.

The absolute amount of electricity produced by power plants is one factor that affects overall reliability of the system. The other is transmission congestion, a situation occurring when lower cost power cannot reach its intended market because the transmission grid is overloaded. According to the *Electricity in Maryland Fact Book*, generators selling to zones with high congestion can receive higher prices than those who sell in zones with lower congestion.

Maryland legislation required the Maryland Public Utility Commission (PUC) to "assess the amount of electricity generated in Maryland as well as the amount of energy imported from other states in order to determine whether a sufficient supply of electricity is available to customers in the State." The 2007 report was the last of a series. Its conclusion is that the reliability of Maryland's supply is "uncertain." It found that the mid-Atlantic area is deficient in generating capacity and thus is one of the largest power-importing areas in the country. Maryland imported 25% of its power in 2006. Little in-state generating capacity is

expected to come on line in the next five years and certain fossil fueled generating plants may be retired to comply with state and federal air pollution. The state's utilities and PJM forecast that demand will continue to rise at a pace of 1 – 2% per year. As a result, Maryland is expected to have little margin for error in ensuring electric reliability. Because Maryland imports so much of its power, as do neighboring states, its ability to import power during peak periods is limited because the transmission system is working at peak capacity. In addition to the possibility of shortages, the difference in "locational marginal prices" (LMPs) between Maryland and points west has risen significantly in the past several years. The PUC recommendations include adding in-state generation, siting and improvement of new transmission facilities, energy conservation and demand management programs that will reduce the need for new electric supplies and more efficient use of both existing and planned electric infrastructure.

In a report issued in April 2009, NERC points out that integrating increasing amounts of "variable resources" such as wind, solar, ocean and some forms of hydro will require significant changes in traditional methods of planning and operation because availability of these sources cannot be adjusted to meet varying demands by consumers as opposed to traditional power plants which control the amount of power they produce. The report says that significant transmission additions and reinforcements will be needed to move these alternative forms of power from their sources to demand centers since much of the power produced by alternative sources is located in low-population areas and may be produced during times of low demand. Most of the comments of the Maryland PSC apply as well to the District of Columbia and Northern Virginia since they are all part of the same PJM system.

Preliminary data from PJM apparently indicate that at least some additional transmission lines may not be needed as soon as originally thought. PJM is in the process of preparing its 2010 Regional Transmission Expansion Plan, based on recent data.

An indication of what we might see comes from an Associated Press report from September 2009 stating that demand for electricity across the United States fell 1.6% in 2008 and was expected to fall another 2.7% in 2009. Wholesale prices for coal, natural gas and oil in the PJM market area were down 40% in 2009.

THE "SMART GRID"

The "Smart Grid" concept embodies the idea of bringing the electric grid into the computer age. Smart Grid proponents believe that the electric infrastructure will evolve over the next few decades into a highly automated and interconnected network similar to the Internet. The Smart Grid involves a network of "smart" devices (microprocessor or computer technology) that enable real-time balancing of generation and electrical delivery via information flow through intelligent systems. Currently grid operations are based on the balance of supply and demand between generators and utility customers. The current grid monitors demand and adjusts supply. The Smart Grid will be self-sustaining to ensure reliability. The Smart Grid refers to an array of switches, sensors and computer chips that will be installed at various stages in the energy-delivery process in power stations, in electricity meters (smart meters) and in clothes dryers and air-conditioning systems. The Smart Grid will provide consumers with timely information and control options to help them to reduce their electricity bill.

The American Recovery and Investment Act of 2009 earmarked $11 billion for Smart Grid technologies to modernize and enhance the nation's electric transmission infrastructure. On July 13, 2009 the Baltimore Gas and Electric Company (BGE) announced it filed with the Maryland Public Service Commission (PSC) a comprehensive and advance Smart Grid initiative, including the planned installation of two million residential and commercial smart meters, that could save BGE electric and gas customers in excess of $2.6 billion over the life of the project. A pilot program proved that customers can reduce peak electricity usage

by about a third and enjoy significant savings with the aid of smart meters and a new pricing plan. Early in 2010, Pepco announced the installation of smart meters in the District of Columbia.

REGULATION OF ELECTRICITY

Deregulation has succeeded in restructuring the electrical industry by separating the generation of electricity from the transmission and distribution of electricity. Nevertheless, the generation, transmission and distribution of electricity remains heavily regulated at the federal, state and local level.

The Federal Power Commission (FPC) was created in 1920 to coordinate hydroelectric power. Its authority was expanded by the Public Utility Regulatory Policies Act of 1935 to include regulation of all interstate electricity transmission. The Department of Energy Organization Act of 1977 created the Department of Energy. At the same time the FPC was renamed the Federal Energy Regulatory Commission (FERC), remaining a separate independent regulatory body. FERC regulates the interstate transmission of electricity, natural gas and oil. The Energy Act of 2005 gave FERC jurisdiction over interstate transmission and wholesale sales of electricity, hydroelectric licensing, some siting applications for electric transmission projects and mandatory reliability standards for high-voltage interstate transmission lines.

The Nuclear Regulatory Commission (NRC), created in 1974, focuses its regulatory activities on reactor safety oversight and reactor license renewal of existing plants, materials safety oversight and materials licensing for a variety of purposes and waste management of both high-level waste and low-level waste. In addition, the NRC evaluates new applications for nuclear plants.

The Environmental Protection Agency has jurisdiction over air quality and other environmental effects caused by the generation, transmission and distribution of electricity. The Public Service Commission of the District of Columbia regulates electrical rates of the Potomac Electric Power Company and licenses alternative electricity generator and transmission suppliers. The Maryland Public Service Commission regulates electrical rates and modifications in scope of service, maintains records and reports of electrical service and has jurisdiction over new generating plants and high-voltage transmission lines. The Virginia State Corporation Commission sets rates for electricity for retail customers and regulates new generation facilities and new transmission lines. Virginia approached deregulation gradually and in 2007 the Virginia General Assembly acted to re-regulate electricity except for users with very large energy demands. Virginia has set a voluntary goal of 12% renewable generation by 2022. Both the District of Columbia and Maryland have a very active Office of the People's Council to represent consumer interests.

The adequacy and reliability of electricity in the National Capital Area is but one aspect of the generation, transmission and distribution of electricity to the area. A study of the complexities of pricing both on a wholesale and retail level would complete the picture.

References and sources are available upon request.

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