POWER GENERATION SYSTEM

TVA's power generation and transmissions systems are at the heart of TVA's ability to provide low cost, reliable, clean electric power to the consumer. As a result, the following criteria are integral to the accomplishment of these goals:

- The power generation system must be capable of producing power at the lowest cost achievable under a wide range of conditions.
- The transmission system must be able to deliver power to the consumer with a high degree of reliability.
- The power generation and transmission systems must be able to accommodate growth in the Valley while meeting the above requirements of low cost and reliability.
- The power generation and transmission systems must be flexible enough to accommodate the potential future addition of a significant quantity of renewable energy.
- The power generation and transmission systems must meet all state and federal environmental requirements.

TVA's power generation system employs a wide range of technologies to produce electricity and to meet the needs of the Tennessee Valley's nine million residents and its directly served industries. In 2008, approximately 55% of TVA's electricity was produced from coal and natural gas-fired plants (54% coal; 1% gas). Nuclear plants produced about 30% and hydroelectric plants produced approximately 5%. The proportion of hydroelectric generation was lower than in recent years due to severe drought conditions. Most of the remainder of the electricity was purchased from other producers and a small proportion was from renewables (wind, solar, and biomass).

Challenges and Benefits
As system needs change in the future, more generation will have to be added. All of the criteria listed above will be taken into account in the selection of technologies to expand the system's power generation capability to ensure that TVA-supplied power remains a clean, low cost, reliable asset to the consumer.

Following are additional information on the most common types of power generation:

Pulverized Coal
The majority of all electricity currently generated in the United States, including TVA, is produced by plants with pulverized coal (PC)-fired boilers and steam turbine generators.

As with any coal-fired generating option, pulverized coal plants produce sulfur dioxide (SO2), nitrogen oxides (NOx), ash (flyash and bottom ash), and carbon dioxide (CO2) as a result of burning coal. As most coal contains varying amounts of mercury (Hg), there will be some amount of mercury released. Emission control equipment is installed on some PC plants to control SO2, NOx, and flyash emissions. Coincidentally, the combination of SO2 and NOx control equipment tends to remove most of the Hg. PC plants that do not have SO2 or NOx control equipment burn coal that has a low sulfur content and have optimized combustion systems to minimize the amount of NOx produced. CO2 emissions are a function of the efficiency of the plant in converting heat from the coal burned into electricity, with the lowest CO2 emissions from the plants with highest efficiency. No control equipment to remove CO2 is currently installed on TVA PC plants.

TVA has the capacity to generate 15,056 megawatts of electricity from 11 pulverized coal plants. The relatively high capital cost, low fuel cost, and relatively high efficiency of the modern PC power plant make it a candidate for base-load capacity additions. Base-load plants typically run constantly for extended periods between planned shutdowns for maintenance.

Simple Cycle Combustion Turbine (CT)
The major emissions from combustion turbines fired with natural gas are nitrogen oxides (NOx). To reduce NOx emissions, dry, low NOx burners are typically used. Natural gas contains negligible amounts of sulfur, so sulfur dioxide (SO2) emissions are essentially zero. The higher hydrogen content of the natural gas fuel relative to coal, creates lower carbon dioxide (CO2) emissions on an energy input basis than the emissions from coal-fired power plants. Simple cycle combustion turbines typically may also be fired with fuel oil if natural gas is not available.

Several features of simple cycle CTs, including their relatively low capital cost, short construction times, low emissions, rapid start-up times, make them attractive for generating peaking power during short periods of high demand. Because of their relatively high fuel costs and relatively low efficiency, they are not as well suited for providing intermediate- and base-load power as are combined cycle CTs, pulverized coal plants, and nuclear plants.

TVA has 87 CTs at 9 power plants, with a combined generating capacity of 5,951 megawatts. One of these plants with 3 CTs is scheduled to be upgraded to a combined cycle CT plant.

Combined Cycle Combustion Turbine (CT)
The primary fuel of combined cycle plants is natural gas.

Nitrogen oxides (NOx) emissions from the combined cycle combustion turbine can be controlled, and sulfur dioxide emissions from the natural gas fuel are essentially zero. The high efficiency and natural gas fuel combine to produce relatively low carbon dioxide (CO2) emissions.

TVA presently has the capacity to generate1,640 megawatts from 2 combined cycle plants. It has also committed to add up to 1730 megawatts of combined cycle generating capacity at up to two sites to its system. Features of the combined cycle CT option, including its high efficiency, moderate capital cost, relatively high fuel cost, low emissions, and short construction time make this technology a candidate for intermediate capacity additions. Intermediate capacity is expected to operate as required to follow variations in system load. Depending on system load, intermediate capacity may shutdown at night and during weekends.

Fluidized Bed Combustion (FBC)
Fluidized bed combustion is a technology for reducing emissions from coal-fired power plants. FBC has attracted interest in the electric utility industry in recent years due to its ability to meet sulfur dioxide (SO2) and nitrogen oxides (NOx) emissions standards without the need for add-on control equipment. It is now considered a commercial technology for utility applications in unit sizes in excess of 200 megawatts up to 400 megawatts.

TVA generates 127 megawatts of electricity from a FBC unit at its Shawnee Fossil Plant in Kentucky. This unit was the first of its kind in the country. TVA also purchases 440 megawatts of electricity under a long term contract from a lignite-fueled FBC plant in Mississippi. Their relatively low combustion temperature, low nitrogen oxide emissions, relatively high capital cost, low fuel cost, and relatively high efficiency of the FBC plant make it a candidate for base-load capacity additions.

Integrated Gasification Combined Cycle (IGCC)
IGCC plants are currently considered to be in the initial stage of commercial development, and have not yet been used for TVA generation.

The conversion of coal to gas requires a gasifier and several other processing steps to make the process both environmentally safe and thermally efficient. These processing steps require specialized equipment and require considerable power to operate. Consequently an IGCC plant is relatively expensive to build and their efficiency is lower than a natural gas-fired combined cycle plant. Their fuel cost, however, is relatively low.

Sulfur dioxide emissions from the IGCC process are quite low due to the high sulfur recovery from the synthetic gas in the sulfur removal process. The low nitrogen content in the synthetic gas also limits nitrogen oxide emissions to very low levels.

The relatively high capital cost, high efficiency, low emissions, and low fuel cost of the IGCC make it a candidate for future base-load capacity additions.

Nuclear
TVA's nuclear plants contribute 6,900 megawatts of electricity to the power grid, making TVA's Nuclear Generation Group an integral part of the seven-state power system.

About 30 percent of TVA's power supply comes from its six operating nuclear units at three nuclear plant sites: three units at Browns Ferry, near Athens, Alabama; two units at Sequoyah, in Soddy-Daisy, Tennessee, and one unit Watts Bar, near Spring City, Tennessee. A second unit at Watts Bar is under construction. The operating nuclear plants alone make enough electricity to power more than three million homes in the Tennessee Valley.

As nuclear performance improves across the industry, TVA's challenge is to continue its mission of ensuring safe plant operations and achieve its vision of being the best multi-site nuclear power operator in the world.

As a non-carbon emitting power source, nuclear provides a strong alternative to other base load generating options that produce carbon dioxide and other air emissions. Nuclear power plants generate more than 70 percent of all carbon-free electricity in America and are an essential mitigation tool for reducing greenhouse gases. The costs of generating electricity with nuclear energy include fuel, operations and management, as well as used fuel management and decommissioning. Since 2001, nuclear power plants have achieved lower production costs than coal, natural gas or oil.

Nuclear requires greater up front capital costs to construct the plants but offset this cost over time with lower and more stable production costs. Used nuclear fuel is currently being safely managed at each site on an interim basis until a long-term national storage facility becomes available. In addition, industry initiatives are reviewing other long-term fuel solutions, including fuel recycling.

Hydro
Hydroelectric generation is often considered to be renewable because the fuel, water, is essentially infinite and its availability is determined by the watershed's rainfall and runoff patterns. The major impacts from hydroelectric generation result from the construction of the dam, the impoundment of the reservoir, and changes in the river downstream of the dam. Hydroelectric generation does not produce any greenhouse gases or other air pollutants, nor does it generate any waste products which might require special handling or disposal. Hydropower helps to improve air quality by making it possible to burn less coal, oil, and gas—technologies which release carbon dioxide into the air.

Unlike some other forms of renewable generation, hydroelectric generation can be dispatched, that is turned on and off as long as sufficient water is present. If there is an increased electricity demand, a hydropower plant can respond almost immediately by releasing more water. An unexpected fossil unit or nuclear unit outage can be "picked up" by hydro when water is available. And a hydro "turn down" can occur, reducing generation when it is not needed. This minimizes the need for expensive turn downs at fossil and nuclear units. The operating cost of hydroelectric generation is also very low compared to most other generation sources.

TVA operates conventional hydroelectric generating facilities at 29 of its dams. These facilities have the capacity to generate 3,538 megawatts of electricity. TVA also has a pump storage facility, Raccoon Mountain Pump Storage Plant, which has an installed capacity of 1,653 megawatts. TVA has taken many steps to improve the operation of its hydroelectric plants in recent years. These include the implementation of an aggressive Reservoir Releases Improvement program in the early 1990s, which is continuing today. As part of this program, TVA installed equipment and made operational changes to improve the quality of the water, and the associated fish and insect populations, in the tailwater river sections downstream of its dams. Additional operational changes were made in 2004 as part of the River Operations Study. TVA is also systematically updating aging turbines and other equipment in its powerhouses. The major benefit of this hydro modernization effort is the generation of more power from the same amount of water.

You can participate in TVA's integrated resource planning by submitting comments about the scope of the planning TVA should consider. You may submit comments at one of the public meetings or online at www.tva.gov/IRP.