

CHAPTER 3

3.0 THE TVA POWER SYSTEM

3.1. Introduction

This chapter describes TVA's existing power system, including power sales and purchases, generating facilities, energy efficiency and demand response programs, and the transmission system.

As of September 30, 2010, TVA's power system had a dependable summer generating capacity of 37,177 MW. Approximately 34,000 MW of the total capacity was provided by TVA facilities and the remainder was purchased from non-TVA facilities under long-term power purchase agreements (PPAs). In fiscal year 2010, TVA sold 176 billion kilowatt-hours of electricity; 88 percent was sold to distributors and 12 percent was sold to directly-served large industries and federal installations. The total revenue from these sales was \$10.7 billion. TVA operates a network of approximately 16,000 miles of transmission lines and 498 substations, switching stations, and switchyards. This system transmits power from 51 generating facilities to 1,020 customer connections points. TVA's power system is described in more detail in the remainder of this chapter.

3.2. TVA Customers, Sales, and Power Exchanges

TVA is primarily a wholesaler of power (Table 3-1). Wholesale power is delivered to 155 local power distributors that, in turn, distribute electricity to residential, commercial, and industrial customers within their service areas. These non-profit, publicly owned distributors are diverse and include municipal systems and rural electric cooperatives. The largest, Memphis Light, Gas and Water Division, serves approximately 412,000 electric customers with annual electric sales of almost 15 billion kilowatt-hours. Some of the smallest distributors serve less than 1,500 customers. Many only provide electrical service while others provide water, wastewater, and/or natural gas service. TVA sells power directly to 57 large industries and federal installations (Table 3-1). The directly served industries include chemical, metal, paper, textile, and automotive manufacturers.

The TVA service area (Figure 1-1) is defined by the TVA Act. The TVA Act restricts TVA from entering into contracts that would make TVA or its distributors a source of power outside the area for which TVA or its distributors were the primary source of power on July 1, 1957. The Federal Power Act prevents the Federal Energy Regulatory Commission (FERC) from ordering TVA to provide access to its transmission lines to others for the purpose of using TVA's transmission lines to deliver power to customers within the TVA service area.

The TVA Act authorizes TVA to exchange, buy, or sell power, with 13 neighboring electric utilities. This arrangement gives TVA the ability to purchase power when its generating capacity cannot meet demand or when it is more economical for TVA to purchase power from a neighboring utility than to generate it. It also allows TVA to sell power to neighboring utilities when its generation exceeds its demand.

Table 3-1. TVA customers and power sales for fiscal years 2006-2010.

Type	Customers		Energy (Millions of kWh)		Sales Revenue (in millions)	
	FY 2009	FY 2006-2008 Average	FY 2009	FY 2006-2009 Average	FY 2010	
Distributor-Served		140,227	133,078	\$8,477	\$9,275	
Residential	3,840,013		59,426			
Commercial (< 1,000 kW)	705,148		39,290			
Industrial (> 1,000 kW)	2,728		33,570			
Outdoor Lighting	19,422		1,688			
Directly Served Industries and Federal Installations	57	34,268	30,726	1,390	1,436	
Other Sales and Losses			5,828	12	2	
Totals	4,567,389	174,495	176,304	\$9,854	\$10,713	

TVA conducts these exchanges through 64 transmission system interconnections. To the extent allowed by federal law, TVA offers transmission services to others to transmit or “wheel” power through the TVA service area.

In recent years TVA has purchased more power in the interchange market than it has sold. For fiscal year 2009, power exchanges with other utilities were as follows:

Sales to other utilities	0.1 billion kilowatt-hours
Purchases from other utilities	1.3 billion kilowatt-hours
Wheeling transactions	11.2 billion kilowatt-hours

3.3. TVA-Owned Generating Facilities

TVA owns approximately 34,000 MW of generating capacity (Figure 3-1). These facilities generated about 147,400 million kWh in FY 2010, a decrease from the average of the preceding four years (Table 3-2).

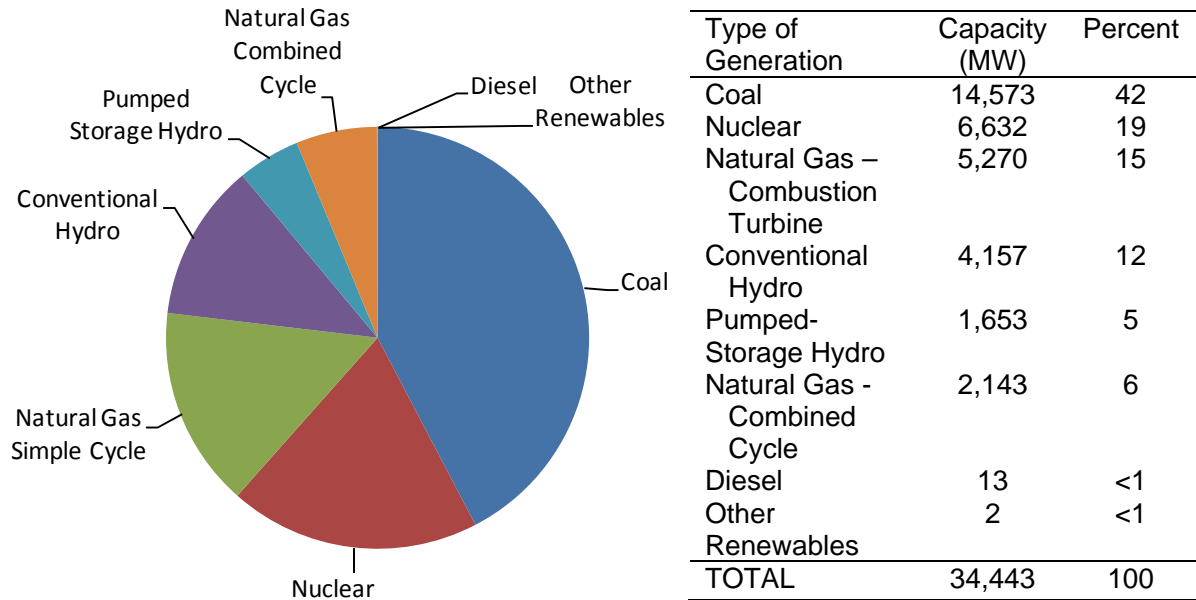


Figure 3-1. Fiscal Year 2010 TVA-Owned Summer Generating Capacity by Type of Generation.

Table 3-2. Fiscal Year 2006-2010 TVA-Owned Generation by Type.

Type of generation	Kilowatt Hours (millions)		Percent	
	FY 2006-2009 Average	FY 2010	FY 2006-2009 Average	FY 2010
Coal	93,828	74,590	54	42
Nuclear	49,043	53,339	28	30
Hydroelectric/Pumped Storage	9,278	14,013	5	8
Natural Gas	2,318	5,475	1	3
Other Renewables	33	4	<1	<1
Diesel Turbines			<1	<1
SUBTOTAL	154,500	147,421		
Purchased Power	21,034	28,782	12	16
TOTAL	175,534	176,203	100	100

Coal-Fired Generation

TVA has 59 coal-fired generating units at 11 plant sites (Figure 1-1, Table 3-3). The coal-fired units range in size from 107 MW (Johnsonville Units 1-6) to 1,239 MW (Cumberland Unit 1). The oldest unit was placed in service in 1951 at Johnsonville, and the newest is Cumberland Unit 2, which began operation in 1973.

TVA's coal-fired units have a total net summer capacity of 14,711 MW. This capacity is expected to decrease by a small amount in the next few years as TVA installs additional pollution control equipment that consumes energy when operated. All TVA coal-fired units

are equipped with mechanical precipitators, electrostatic precipitators, scrubbers, or baghouses to control emissions of particulate matter. Other controls for reducing emissions of sulfur dioxide and nitrogen oxides are listed in Table 3-3. Some units also use boiler optimization to limit nitrogen oxide emissions.

Table 3-3. Characteristics of TVA coal-fired generating facilities.

Facility	Units	2009 Summer Net Capacity (MW)	Commercial Operation Date (First and Last Unit)	Boiler Type*	Emissions Controls**
Allen	3	741	1959	CF	LSC, SCR
Bull Run	1	870	1967	SCPC	FGD, SCR
Colbert	5	1,184	1955, 1965	PC	LSC, SCR (1 unit), LNB
Cumberland	2	2,470	1973	SCPC	FGD, LNB, SCR
Gallatin	4	976	1956, 1959	PC	LSC, LNB
John Sevier	4	704	1955, 1957	PC	LSC, LNB
Johnsonville	10	1,206***	1951, 1959	PC	LSC, LNB (4 units), SNCR
Kingston	9	1,425	1954, 1955	PC	LNB (4 units), SCR, FGD
Paradise	3	2,201	1963, 1970	SCPC	FGD, SCR
Shawnee	10	1,330	1953, 1956 1988 (AFBC)	PC (9 units, AFBC (1 unit))	LSC (9 units), LNB (9 units), SNCR
Widows Creek	8	1,604	1952, 1965	PC	LSC (6 units), FGD (2 units), SCR (2 units), LNB (2 units)

*AFBC – Atmospheric circulating fluidized bed; CF – cyclone furnace; PC – pulverized coal; SCPC – supercritical pulverized coal

**FGD – Flue gas desulfurization (“scrubber”); LNB – low-NOx burner; LSC – low sulfur coal, may be blended with high sulfur coal; SCR – selective catalytic reduction; SNCR – selective non-catalytic reduction

***The output of Johnsonville Units 1-4 is reduced by about 19 MW each by the sale of steam to the adjacent DuPont facility.

In August 2010, TVA announced that nine coal-fired units totaling about 1,000 MW of capacity at three plants will be idled or indefinitely removed from service by 2015. At Widows Creek, two of the older, smaller units were idled in fall 2010 and the other four older, smaller units will be idled by 2015. Unit 10 at Shawnee was idled in fall 2010 and will

be evaluated for possible conversion to biomass fuel. John Sevier Units 1 and 2 will be idled by 2015.

Fuel Procurement - TVA is one of the largest consumers of coal in the United States and consumed a total of 36 million tons of coal in FY 2010. During the previous four years, TVA's coal consumption ranged from 37.0 to 46.5 million tons (Figure 3-2). In 2009, TVA consumed 3.8 percent of eastern U.S. coal production and 2.9 percent of western U.S. coal production. In recent years, TVA has procured coal from the Northern Appalachian, Central Appalachian, and Illinois Basin regions in the eastern U.S. and from the Powder River Basin and Uinta Basin regions in the western U.S. In FY 2010, TVA purchased 43 percent of its coal from the Illinois Basin, 28 percent from the Powder River Basin, 20 percent from the Uinta Basin, and 9 percent from the Central Appalachian regions.

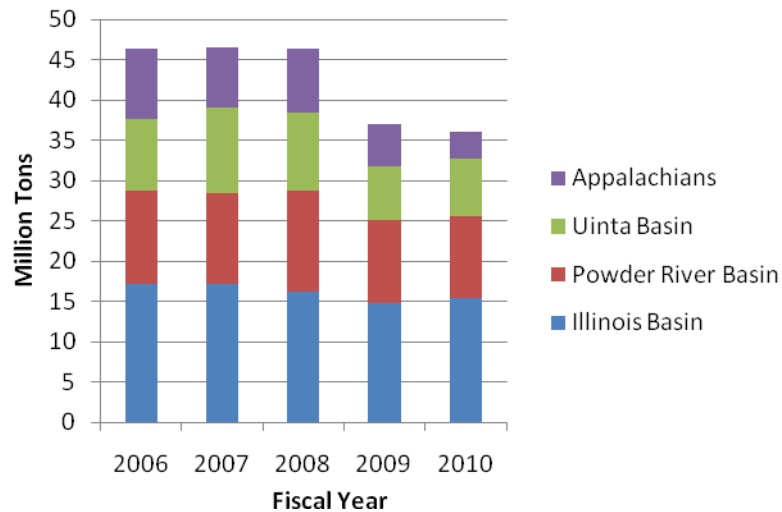


Figure 3-2. Fiscal year 2006-2010 coal purchases by mining region.

In 2011, TVA contracted to purchase 38.7 million tons of coal; 44 percent is projected to be from the Illinois Basin, 9 percent from the Central Appalachians, 21 percent from the Powder River Basin, and 26 percent from the Uinta Basin (Table 3-4). About two-thirds of this coal will be from underground mines.

TVA purchases coal under both short-term (one year or less) and long-term (more than one year) contracts; 92 percent of 2009 purchases were with long-term contracts. During 2010, 34 percent of TVA's coal supply was delivered by rail, 26 percent was delivered by barge, and 33 percent was delivered by a combination of barge and rail. The remainder was delivered by truck.

TVA uses large quantities of limestone to operate the scrubbers at five of its coal plants. This limestone is acquired from quarries in the vicinity of the plants and transported to the plants primarily by truck.

Table 3-4. TVA coal purchase contracts for 2011, in millions of tons, by mining region and mining method.

Region	Million Tons/Year by Mining Method				Totals
	Underground	Surface - Open Pit/Area	Surface - Contour/Highwall	Surface - Mountaintop Removal	
Illinois Basin	16.1	0.9	--	--	17.0 (44%)
Powder River Basin	--	8.0	--	--	8.0 (21%)
Uinta Basin	10.0	--	--	--	10.0 (26%)
Central Appalachians	2.0	0.2	0.8	0.6	3.6 (10%)
Totals	28.1 (73%)	9.2 (24%)	0.8 (2%)	0.6 (1.5%)	38.7

Nuclear Generation

TVA operates six nuclear units at three sites (Figure 1-1). These three nuclear plants have a total net summer capacity of 6,671 MW (Table 3-5). In 2007, TVA resumed construction of Watts Bar Unit 2, which had been halted in the mid-1980s. Once complete in 2013, this unit will provide an additional 1,180 MW of net summer capacity. TVA is currently undertaking an Extended Power Uprate project at Browns Ferry to add 375 MW of capacity. TVA has submitted a license amendment request for this uprate to the Nuclear Regulatory Commission (NRC) and does not presently have a firm completion date. This uprate is incorporated into the forecast of the capacity of existing generating resources used in determining the future need for power.

Table 3-5. Characteristics of TVA nuclear generating units.

Facility	Units	2009 Net Summer Capacity (MW)	Type	Commercial Operation Date (First and Last Unit)	Operating License Expiration
Browns Ferry	3	3,242	Boiling Water	1974, 1977	2033, 2034, 2036
Sequoyah	2	2,282	Pressurized Water	1981, 1982	2020, 2021
Watts Bar	1	1,100	Pressurized Water	1996	2034
Total	6	6,624			

In 2007, TVA, as a member of the NuStart Energy Development consortium, submitted a Combined Licensing Application to the NRC for the construction and operation of two Westinghouse AP1000 advanced passive pressurized light water nuclear units at its Bellefonte Nuclear Plant site. The two AP1000 units would have a total capacity of about 2,200 MW. TVA had previously begun construction of two Babcock and Wilcox 1,260 MW pressurized light water units at Bellefonte in the 1970s; their construction was halted in 1988. TVA has not proposed constructing the two AP100 units. In August 2009, TVA

issued a Notice of Intent and in May 2010 issued a Final Supplemental EIS for the completion or construction and operation of a single nuclear unit at Bellefonte, either one of the partially completed pressurized light water units or an AP1000 unit. TVA's preferred alternative is to complete the construction of a partially completed pressurized light water unit.

In August 2010, the TVA Board authorized staff to continue engineering activities and the procurement of long-lead time components of Bellefonte Unit 1, one of the partially completed units. A decision to complete construction of this unit has been deferred until the spring of 2011, after completion of this IRP.

Fuel Procurement - TVA's six nuclear units use a total of about 4 million pounds of enriched uranium (U_{238}) per year. This uranium comes from uranium producing areas around the world. TVA currently has sufficient enriched uranium under contract to provide all of its requirements through 2014. TVA has agreements with the U.S. Department of Energy (DOE) and nuclear fuel contractors to mix surplus DOE highly enriched uranium with other uranium to fabricate fuel suitable for use in nuclear power plants. TVA began using this blended nuclear fuel at Browns Ferry in 2005 and at Sequoyah in 2008, and expects to continue using it through at least 2011 at Sequoyah and 2016 at Browns Ferry.

Natural Gas-Fired Generation

TVA has 92 natural gas-fueled combustion turbine units at 10 sites (Figure 1-1, Table 3-6). The oldest turbines were completed in 1971 and the newest in 2010. Fifty-six simple cycle combustion turbine (CT) units are located at five coal-fired plant sites and 31 simple cycle units are located at five stand-alone plant sites. Five combined cycle units are located at three stand-alone plant sites; five units are owned by TVA and three units are leased by TVA. Most of the simple cycle units are capable of using fuel oil and 76 are capable of quick start-up by reaching full generation capability in about 10 minutes. The combined capacity of the combustion turbine units is approximately 5,326 MW and the capacity of all of the combined cycle units is approximately 1,377 MW.

In August 2009, TVA announced a proposal to construct and operate an 880-MW combined cycle combustion turbine plant at John Sevier Fossil Plant. Construction began in April 2010 and the plant is scheduled to begin generating at full capacity in 2012.

Fuel Procurement - In 2009, TVA used 84 trillion cubic feet of natural gas to fuel its combustion turbine and combined cycle plants and to fuel generating facilities some non-TVA plants that sell power to TVA under terms of a PPA. TVA purchases natural gas from a variety of suppliers under contracts with terms of one year or less. Most of the natural gas is from the Gulf of Mexico. TVA also contracts with its suppliers to store natural gas at a facility in southwest Virginia. This storage capacity doubled in 2008 and was scheduled to further increase in 2010.

Most of the fuel oil is purchased on the spot market for immediate delivery to the plants. TVA maintains an inventory of fuel oil at its plants with oil fueling capability to provide a short-term backup supply in the event the gas supply is disrupted.

Table 3-6. Characteristics of TVA natural gas-fueled plants.

Facility	Units	2009 Summer Net Capacity (MW)	Type	Commercial Operation Date (First and Last Unit)	Oil Fueling Capability
Allen	20	452	Simple Cycle	1971, 1972	Yes
Brownsville	4	460	Simple Cycle	1999	No
Colbert	8	384	Simple Cycle	1972	Yes
Gallatin	8	588	Simple Cycle	1975, 2000	Yes
Gleason	3	494	Simple Cycle	2007	No
Johnsonville	20	1,104	Simple Cycle	1965, 2000	Yes
Kemper	4	304	Simple Cycle	2001	Yes
Lagoon Creek	12	932	Simple Cycle	2002	Yes
Lagoon Creek	2	600*	Combined Cycle	2010	No
Marshall County	8	608	Simple Cycle	2007	Yes
Southaven	3	777	Combined Cycle	2003	No
Total	92	6,703			

*Began commercial operation in September, 2010.

Hydroelectric Generation

The TVA hydroelectric generating system consists of 109 conventional hydroelectric generating units at twenty-eight sites along the Tennessee River and its tributaries and at a single site (Great Falls) on a Cumberland River tributary (Figure 1-1). TVA also operates the four-unit Raccoon Mountain pumped storage hydroelectric facility near Chattanooga.

The total net summer capacity of the TVA hydroelectric system is 5,153 MW; this includes 3,538 MW of conventional hydroelectric generation and 1,615 MW from Raccoon Mountain. Conventional hydroelectric plants range in size from the 4-unit, 11-MW Wilbur plant to the 21-unit, 675-MW Wilson plant. The oldest of the conventional plants was completed in 1911 and the newest was completed in 1970. Since 1994, TVA has been replacing outdated turbines and other equipment in the hydroelectric plants; at the end of FY 2009, these modernization efforts had been completed for 57 hydroelectric units. These efforts resulted in a 564-MW increase in generating capacity and an average efficiency gain of 5 percent. TVA plans to update an additional 38 units by 2030. Details about the hydroelectric plants and the operation of the hydroelectric system are available in the Reservoir Operations Study (TVA 2004).

Renewable Generation

TVA owns about 2.4 MW of non-hydro renewable capacity consisting of one small windfarm with three 660-kW turbines on Buffalo Mountain near Oliver Springs, TN, and 15 photovoltaic (PV) installations throughout the TVA region (Figure 1-1). All of these were constructed since 2000. The capacity of the PV facilities ranges from 7 to 85 kW. TVA also co-fires methane from a nearby sewage treatment plant in a boiler at Allen Fossil Plant

and co-fires wood waste in a boiler at Colbert Fossil Plant. The combined output of these two co-firing projects during FY 2009 was about 29,000 MWH. Electricity generated by the windfarm, the PV facilities, and the methane co-firing is marketed through TVA's Green Power Switch program (see Section 3-5).

Diesel-Fired Generation

TVA owns two diesel generating facilities with a total net summer capacity of 13 MW. One of these facilities is located at Meridian, Mississippi and consists of 5 units completed in 1998. The other facility, at Albertville, Alabama, consists of 4 units completed in 2000.

Diesel fuel is purchased on the spot market.

3.4. Purchased Power

TVA has power purchase agreements (PPAs) for 4,495 MW of generating capacity; the major PPA contracts/facilities are listed in Table 3-7. The hydroelectric generation is from eight U.S. Army Corps of Engineers plants on the Cumberland River and its tributaries and from four Alcoa Power Generating, Inc., plants on the Little Tennessee River system. The power generated by the Corps plants is purchased through a long-term contract with the Southeastern Power Administration (SEPA), a federal power marketing agency. The power generated by the Alcoa plants is used to partially supply the energy needs of Alcoa, a directly served TVA customer. The power generated by the Invenergy windfarm is marketed through the Green Power Switch program (see Section 3-5).

Seven of the facilities listed in Table 3-7 are qualifying facilities as defined by the Public Utility Regulatory Policies Act (PURPA). Qualifying facilities are cogeneration or small power production facilities that meet certain ownership, operating, and efficiency criteria. Cogeneration (also known as combined heat and power) facilities produce electricity and another form of useful thermal energy (heat or steam) for industrial or other uses. Small power production facilities typically have a capacity of 80 MW or less whose primary energy source is renewable (hydro, wind or solar), biomass, waste, or geothermal resources. Utilities are required to purchase energy from qualifying facilities at their avoided cost of self-generating or purchasing the energy from another source.

In December 2008, TVA issued a request for proposals (RFP) for up to 2,000 MW of electricity from renewable and/or clean sources to be delivered by 2011. Qualifying sources include solar, wind, hydropower, ocean, tidal, geothermal, biomass and other biologically derived fuels, combined heat and power, waste heat recovery and other low-carbon emitting resources. TVA has subsequently signed contracts for purchasing power from seven windfarms with a combined capacity of 1,625 MW.

Two of these windfarms, the Iberdrola Streator Cayuga Ridge windfarm in Illinois and the Horizon Wind Energy Pioneer Prairie windfarm in Iowa, began delivering power in 2010 (Table 3-7). The execution of the other seven contracts (Table 3-8) is dependent on meeting applicable environmental review requirements and securing firm transmission paths for the delivery of the power to the TVA system. TVA is continuing to evaluate other responses to the RFP.

In October 2010, TVA issued the Renewable Standard Offer, which offers set prices to developers of small to mid-size renewable projects under long-term contracts of up to 20 years. The generating facilities must be between 200 KW and 20 MW in size and located

Table 3-7. Major power purchase agreement contracts/facilities.

Type of Generation	Owner/Marketer	Location	Capacity (MW) ¹
Natural Gas - Combined Cycle	Cogentrix Energy	Caledonia, MS	768
Natural Gas - Combined Cycle	Calpine - Morgan Energy Center	Decatur, AL	800 ²
Natural Gas - Combined Cycle	Calpine - Decatur Energy Center	Decatur, AL	500
Natural Gas - Combined Cycle	Suez Energy Marketing	Ackerman, MS	690
Lignite ³ (Coal) - CFBC	Choctaw Generation	Chester, MS	432
Diesel	various	various	total of 119
Wind	Invenergy TN	Oliver Springs, TN	27
Wind	Iberdrola Renewables	Livingston County, IL	300
Wind	Horizon Wind Energy	Howard, Mitchell Counties, IA	115
Industrial Gases, Chemicals	Air Products	Calvert City, KY	30 ²
Biomass - Landfill Gas		Rutherford County, TN	5.4
Biomass - Landfill Gas	WM Renewable Energy	Heiskel, TN	3.2 ²
Biomass - Landfill Gas	Cogeneration Technologies	Chattanooga, TN	2 ²
Biomass - Corn Milling Residue ⁴	Cargill	Memphis, TN	11 ²
Biomass - Wood Waste	Weyerhaeuser	Columbus, MS	70 ²
Biomass - Wood Waste	Armstrong Hardwood Flooring	Jackson, TN	3.2 ²
Hydroelectric	Alcoa Power Generating	TN, NC	347
Hydroelectric	US Army Corps of Engineers/SEPA	TN, KY	360

¹Capacity available to TVA and used in capacity planning; total facility capacity may be greater.

²Qualifying facility as defined by PURPA.

³The lignite is supplied by an adjacent surface mine.

⁴Cargill has not recently generated power from this source and is not expected to in the near future.

within the TVA region. The initiative is limited to a total of 100 MW and no single type of renewable generation can exceed half of the total 100 MW limit. Eligible types of renewable generation include wind, solar, methane recovery, biomass direct combustion and/or co-firing with greater than 50 percent biomass, and biomass gasification. Additional

Table 3-8. Pending power purchase agreements resulting from the 2008 RFP for the delivery of renewable energy.

Facility Name	Owner/Marketer	Location	Capacity (MW)	Power Delivery Date
Pioneer Prairie I Wind Farm	Horizon Wind Energy	Howard, Mitchell Counties, IA	44	1/2012
White Oak Energy Center	Invenergy Wind	McClellan County, IL	150	1/2012
Bishop Hill Wind Energy Center	Invenergy Wind	Henry County, IL	200	1/2012
Cimarron	CPV Renewable Energy	Gray County, KS	165	early 2012
Hurricane Lake Energy Center I	Invenergy Wind	Roberts County, SD	250	early 2012
Caney River Wind Project	Tradewind Energy	Elk County, KS	201	2012
Ashley	CPV Renewable Energy	McIntosh County, ND	200	2012

information on the Renewable Standard Offer is available at <http://www.tva.gov/renewablestandardoffer/index.htm>. The first contract resulting from the standard offer was signed in January 2011 for the delivery of 4.8 MW of power generated from landfill gas at Camden, Benton County, TN.

TVA also purchases renewable power through its Generation Partners Program; this power is resold through the Green Power Switch program (see Section 3-5). In early 2011, 310 facilities with a total generating capacity of about 4.8 MW were enrolled in the program and generating about 34,000 kWh per month.

3.5. Demand-Side Management Programs

TVA has had a portfolio of demand-side management programs focusing on energy efficiency and demand response for many years. Energy efficiency programs are designed to reduce the use of energy while providing the same level of energy service. Demand response programs are designed to temporarily reduce a customer's use of electricity, typically during peak periods when demand is highest. Because the energy use is typically shifted to off-peak times, demand response typically has little effect on total energy use.

The TVA energy efficiency and demand response (EEDR) portfolio is a combination of fully deployed mature programs, recently initiated programs, and programs under development.

Some of these programs have been in place for several years. Between FY 1995 and FY 2008, they resulted in an estimated cumulative demand reduction of 547 MW (Figure 3-3). The 2007 Strategic Plan (see Section 1-5) recognized the need for increased EEDR efforts and in 2008 a total of reducing the growth in peak demand by up to 1,400 MW by the end of 2012 was established. Along with the establishment of the new goal and redesign of many EEDR programs, TVA also changed the way it measured demand reduction. Progress

towards achieving the 1,400 MW demand reduction goal is shown in Figure 3-4. Anticipated FY 2010 incremental demand reductions were approximately 40 MW from residential programs, 33 MW from commercial and industrial programs, 26 MW from demand response, and 2 MW from end-use generation.

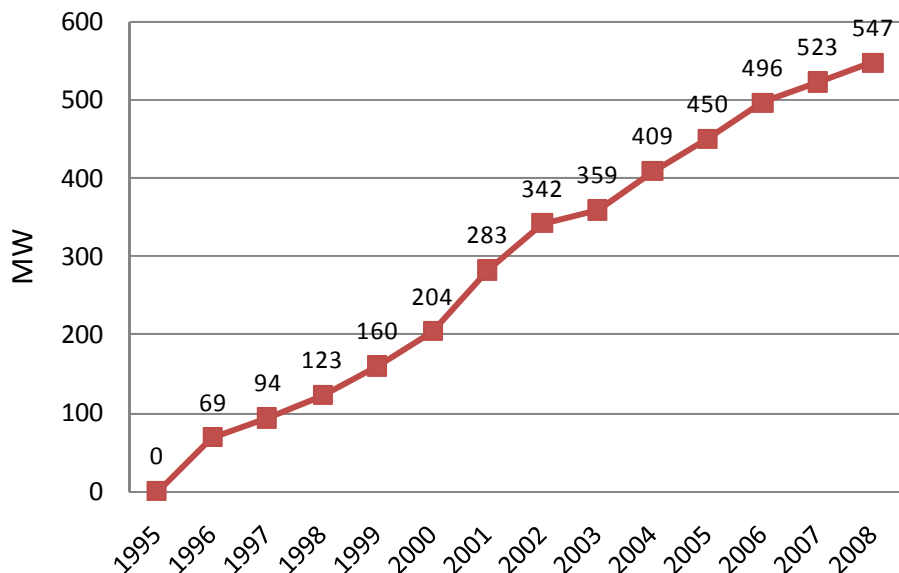


Figure 3-3. Cumulative demand reduction of TVA EEDR programs, fiscal years 1995-2008.

TVA EEDR programs are targeted at residential, commercial and industrial customers, and include a variety of energy-saving tools and incentives that help save energy and reduce power costs while providing peak reduction benefits for the power system. They are delivered through partnerships with the 155 local power distributors, however not all distributors participate in all programs. The TVA EEDR portfolio is described in more detail below; information about many programs is also available at <http://www.tva.com/ee/>.

Residential Energy Efficiency Programs

New Homes Program - This program provides incentives for builders to construct new homes with increased energy efficiency. Incentives range from \$300 to \$800 depending on the efficiency of the home. There are three levels of efficiency:

- Homes built *energy right*[®] must exceed minimum overall energy efficiency requirements by 7 percent
- Homes built at least 15 percent better than minimum requirements qualify as *energy right* Platinum
- *energy right* Platinum Certified (ENERGY STAR[®]) qualification requires additional testing at the expense of the builder or homeowner as well as being built at least 15 percent better than the minimum requirements and receives the highest incentive.

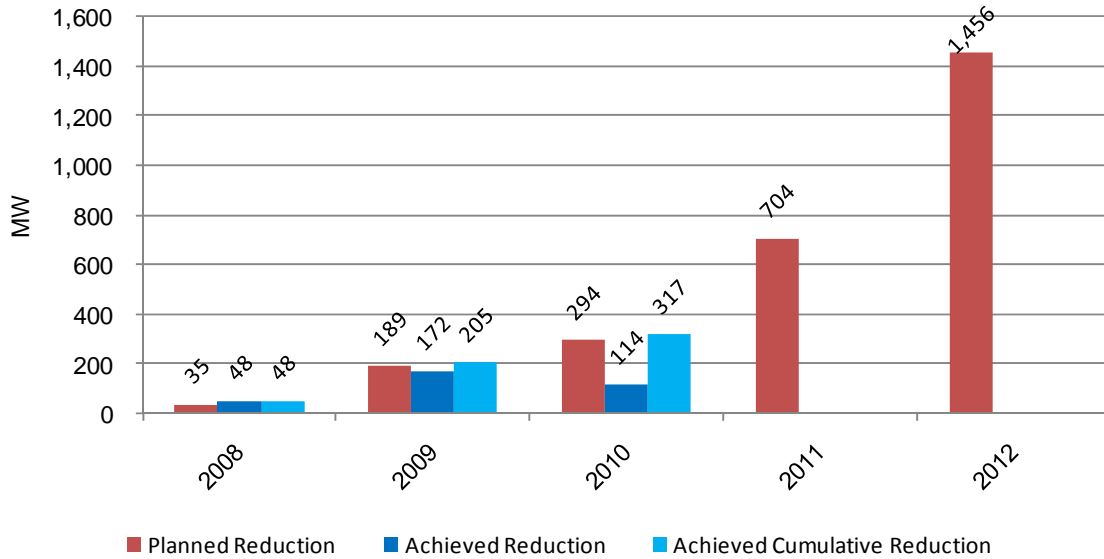


Figure 3-4. Fiscal year 2008-2012 demand reduction goals and achieved demand reduction.

Do-It-Yourself Home Energy Evaluation - Homeowners complete a home energy survey, either online or on a paper form submitted to TVA. The homeowners then receive a personalized report that breaks down their annual and monthly energy usage by category and makes recommendations for increasing energy efficiency. Participants also receive a free energy efficiency kit that may include items such as compact fluorescent light bulbs and gaskets for wall outlet and light switches.

In-Home Energy Evaluation (IHEE) - Under this program, a trained evaluator conducts a comprehensive in-home energy assessment of a participant’s home. The homeowner receives a detailed listing of potential energy-efficiency improvements and available cash incentives and financing options. The homeowner pays for the evaluation, but TVA rebates the evaluation cost to homeowners who make at least \$150 in improvements and have post-installation inspections. This program was introduced in 2009 and by August 2010 was offered through 121 distributors.

New Manufactured Homes Program - This program provides incentives for manufacturers and dealers that install high-efficiency heat pumps in new manufactured homes. Qualifying heat pumps must have a seasonal energy efficiency ratio (SEER) of at least 13 to qualify for a \$300/home incentive. TVA is also piloting an ENERGY STAR Manufactured Homes effort with the Manufactured Housing Research Alliance.

Heat Pump Program - Under this program, TVA promotes the installation of high-efficiency heat pumps in homes and small businesses by providing low-interest, fixed-rate financing for up to ten years through a third-party lender, with repayment through the consumer’s electric bill. Installation, performance, and weatherization standards ensure the comfort of the customer and the proper operation of the system. TVA has established a Quality Contractor Network of installers to maintain high installation standards. TVA reimburses local distributors for inspection and loan processing/collection.

Commercial and Industrial Energy Efficiency Programs

Major Industrial Program - This program is designed to encourage reductions in electric energy intensity in large industrial facilities that have a contract demand of 5 MW or greater. TVA provides customized technical assistance to participants taking a plant-wide, holistic assessment to finding and developing energy efficiency opportunities. Participants who implement qualified projects may be eligible for financial incentives of \$100 per kW of load reduced during TVA's critical peak period. Approximately 250 large industrial customers throughout the TVA area are eligible to participate.

Commercial Efficiency Advice and Incentives - Through this program, TVA offers various levels of technical assistance to commercial and general industrial (up to 5 MW demand) businesses to help them identify energy-saving opportunities in their facilities. Depending on the customer's size, technical assistance may include initial energy assessments, onsite energy reviews and detailed energy studies, as well as a portfolio of online business energy efficiency tools and resources. Online assistance includes an Energy Efficiency Library, a Commercial Energy Calculator, and a Preferred Partners Network list of installers and energy service companies. Eligible commercial businesses that install lighting or HVAC improvements which reduce demand during TVA's critical peak period may receive an incentive of \$200 per kW reduced. After being piloted by over 35 distributors, this program was offered throughout the TVA area in mid-2010. In 2010, TVA also began offering small business customers (up to 50 KW demand) the "Fast Cash Incentive" designed to speed their installation of efficient lighting and HVAC systems selected from a list of qualifying equipment.

Education and Outreach

National Theatre for Children - TVA and local distributors have partnered with the National Theatre for Children to conduct live theater performances in K-12 schools that promote energy efficiency. During FY 2009, performances were presented to over 250,000 students in over 700 schools and a similar number is planned for FY 2010.

Alliance to Save Energy Green Schools Program - TVA and power distributors began piloting the Alliance to Save Energy's Green Schools Program (ASE 2010) in 21 Tennessee K-12 schools in fall semester 2009. In Green Schools, teams of teachers, other staff, and students identify and implement energy-saving measures, typically resulting in school electric cost savings of 5 to 15 percent.

Trade Ally Network - This program provides local distributors with master lists, maintained by TVA, of trade allies that meet a set of criteria demonstrating commitment to the design, installation, servicing, and promotion of high quality energy efficiency and demand response technologies and equipment.

TVA Facilities

Internal Energy Management Program - This TVA program, created in 1978, is responsible for the planning, coordination of regulatory reviews, performance analysis and reporting, oversight of energy related audits, and sustainable design for TVA facilities. It has coordinated TVA compliance with energy efficiency goals and objectives for federal agencies established by the National Energy Conservation Policy Act, the subsequent Energy Policy Acts of 1992 and 2005, and several Executive Orders including the 2009 EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance. This program has resulted in significant reductions in energy use; for example, between 2003

and 2009, energy intensity in facilities was reduced by 12.6 percent. See http://www.tva.gov/abouttva/energy_management/ for more information and annual reports of accomplishments.

Demand Response Programs

Commercial and Industrial Demand Response - Under this initiative, TVA provides incentives to businesses shifting energy-intensive operations from periods of high power demand to periods of lower demand. Participants must be able to achieve a demand response reduction of at least 100 kW and be available for dispatch up to 80 hours per year. Demand reduction events are dispatched and monitored with near-real-time software. Participating customers receive capacity payments monthly and energy payments based on their performance during demand reduction events. The program was initiated in 2009 with a 160-MW peak reduction goal and had 99 distributors and 230 facilities participating. In June 2010, the TVA Board approved an expanded program with a 560-MW peak demand reduction goal by 2012.

Conservation Voltage Regulation Program - This program uses conservation voltage regulation (CVR) by power distributors to achieve capacity and energy savings through operation of distribution feeders in the lower portion of the American National Standards Institute (ANSI) service voltage requirement range, either continuously or on a dispatch-basis. The objective of CVR is to lower the voltage delivered to a customer while maintaining the proper operation of equipment within the name plate ratings and levels set by regulatory agencies. ANSI standards set the ranges for voltages at the distribution transformer secondary terminals at 120 volts +/- 5 percent or between 114 and 126 volts. Most electrical equipment, including air conditioning, refrigeration, appliances, and lighting is designed to operate most efficiently at 114 volts. If power is delivered at a voltage higher than 114 volts, energy is wasted.

5 Minute Response and 60 Minute Response Rate Products - Under these products, qualifying customers with contract demands greater than 1 MW receive credits on their power bills in exchange for TVA's right to suspend power availability during critical times. Two notification options are available to customers: 5 minute and 60 minute notice. Upon receiving notice from TVA, the customer must reduce their load to a previously determined level for the duration of the demand reduction event. Failure to reduce load can result in non-compliance charges. The credits are periodically evaluated to align with changes in valuation bases, and may not be changed more than once in a 12-month period.

Generation Partners

Under this end-use generation program, begun in 2003, TVA purchases renewable energy generated by facilities installed by residential, commercial, and industrial customers. TVA purchases this power by paying the retail rate, any fuel cost adjustment, and a premium of \$0.12/kWh for solar and \$0.03/kWh for other renewable generation. New participants also receive a \$1,000 incentive from TVA to help defray their start-up costs. Payment is in the form of a credit on the participant's monthly bill from their local distributor that shows the energy they used, which is billed at the standard rate, and the energy they generated, for which they receive credit. Power bills are reconciled either monthly or annually at the discretion of the participating distributor. The participant is guaranteed payments for 10 years from the time they signed the participation agreement.

The Generation Partners Pilot Program was expanded in 2009 and in early 2011 had 310 generating participants with a total combined capacity of 4.8 MW. Potentially qualifying

generation sources include biomass, landfill gas, solar, micro hydro, wastewater treatment biogas, and wind generating facilities up to 200 KW nameplate generating capacity. Additional information on the program is available at <http://www.tva.com/greenpowerswitch/partners/index.htm>. TVA resells the power generated by Generation Partners through the Green Power Switch program, which offers customers the opportunity to purchase blocks of renewable energy at premium prices. Other sources of energy marketed through the Green Power Switch program are described above in Sections 3.3 and 3.4.

Generation Partners continues to operate as a pilot program and is limited to a total of 200 MW of qualifying generation and a total power purchase expenditure of \$50 million. TVA is working with local power distributors and others to make Generation Partners an established program.

3.6. Transmission System

TVA operates one of the largest transmission systems in the U.S. It serves an area of 80,000 square miles through a network of approximately 16,000 miles of transmission line; 498 substations, switchyards and switching stations; and 1,240 individual customer connection points. The system connects to 52 generating facilities, where power is produced at relatively low voltages. Transformers in the generating facility switchyards boost voltage to either 161 kV or 500 kV for transmission to distributors and directly served customers. Substations at delivery points reduce the voltage for delivery through distribution lines serving end users.

The TVA transmission system operates at a range of voltages:

- 2,464 miles of 500-kV lines
- 157 miles of 345- and 230-kV lines
- 11,222 miles of 161-kV lines
- 202 miles of 138- and 115-kV lines
- 1,161 miles of 69-kV lines
- 718 miles of 46-kV lines
- 15 miles of 26- and 13-kV lines.

The TVA transmission system connects to 13 neighboring utilities with interconnection voltages ranging from 69- to 500-kV. These interconnections allow TVA and its neighboring utilities to buy and sell power from each other and to wheel power through their systems to other utilities. To the extent that federal law requires access to the TVA transmission system, the TVA transmission organization offers transmission services to others to transmit power at wholesale in a manner that is comparable to TVA's own use of the transmission system. TVA has also adopted and operates in accordance with the Standards of Conduct for Transmission Providers (FERC 2008) and appropriately separates its transmission functions from its marketing functions.

In recent years, TVA has built an average of about 150 miles of new transmission lines and several new substations and switching stations to serve new customer connection points and/or to increase the capacity and reliability of the transmission system. The majority of these new lines are 161-kV. In 2008, TVA completed a 39-mile 500-kV transmission line in Tennessee which was the first major TVA 500-kV line built since the 1980s. TVA also completed a 27-mile 500-kV transmission line in Tennessee in 2010. TVA has also upgraded many existing transmission lines in recent years to increase their capacity and

reliability by re-tensioning or replacing conductors, installing lightning arrestors, and other measures. In FY 2009, TVA spent about \$230 million on transmission system construction and over the past decade the system has operated with 99.999 percent reliability.