Draft Energy Efficiency and Demand Response Plan

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Overview and History

Overview

This document outlines the Tennessee Valley Authority's proposed plan for short-term and long-term energy-efficiency improvements, peak electricity demand reduction, and increased end-use generation. The proposed plan, when finalized, will be the result of a collaborative effort with TVA's customers, and contains input from numerous regional and national stakeholders, including state and federal agencies, national energy efficiency experts, environmental advocacy groups, and residents of the Tennessee Valley. TVA retained the services of PA Consulting, a nationally recognized, multi-disciplinary consulting firm with expertise in energy efficiency, to conduct a detailed analysis of the region's energy-efficiency and demand-reduction potential. TVA also engaged McKinsey & Company, an international, strategic consulting firm, to prepare an analysis of the region's end-use generation potential.

The proposed plan recommends actions that TVA and its stakeholders should consider taking through 2012 to potentially reduce peak electricity demand growth on the TVA system by up to 1,400 megawatts and growth in energy consumption by up to 4.3 million megawatt-hours annually. Beyond 2012, the plan proposes a series of initiatives that will be considered to transform the market, leading to sustained energy-efficiency improvement for achieving all reasonable demand and energy reductions by 2025.

As directed by TVA's 2007 Strategic Plan, TVA will strive to be a leader in energy-efficiency improvement and peak demand reduction. Improving energy efficiency and peak demand reduction are significant actions that help slow demand growth in a cost-effective manner while addressing air pollution and global climate change. TVA believes this goal can be realized through a broad cooperative effort with strong support from TVA's customers and stakeholders.

About TVA

The Tennessee Valley Authority is the nation's largest public power provider and is wholly owned by the U.S. government. TVA was established by Congress in 1933 to manage river navigation, flood control, agricultural and industrial development, and to promote the use of electric power in the Tennessee Valley region. TVA's service territory includes most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina and Virginia. This area covers 80,000 square miles and has a population of more than 8.8 million. TVA sells electricity to 159 power distributor customers and 59 directly served industries and federal agencies.

Initially, all TVA operations were funded by federal appropriations. However, appropriations for the TVA power program ended in 1959, and those for TVA's environmental stewardship and economic-development activities were phased out in 1999. TVA now funds all its operations entirely from the sale of electricity and the proceeds from issuing debt securities.

TVA's Past Energy Efficiency Efforts

During the 1970s and 80s, TVA was a national leader in energy-efficiency improvements, conducting programs such as home energy audits and energy-efficient equipment and weatherization installations. During this period, TVA had a direct impact on the energy efficiency of more than a million homes in the Tennessee Valley.

In the 1990s, TVA's emphasis shifted toward the promotion of energy-efficient electro-technologies. TVA adopted this approach after determining that additional efforts to improve basic energy efficiency had reached a point at which they would not be cost-effective based on TVA's rates at the time. Additionally, excess generating capacity was available on the TVA system. The aim was to encourage end-users to adopt electro-technologies when it made economic sense in terms of their total energy costs.

These programs also continued to deliver demand-reduction benefits. For example, from 1996 to 2007, TVA programs, offered in partnership with distributors of TVA power, resulted in a cumulative demand reduction of more than 520 megawatts. Nearly 90 percent of this total was derived from TVA's *energy right*® residential program, which provides items such as low-interest heat pump loans and incentives for energy-efficient new home construction.

The remaining 10 to 12 percent of the reduction is attributed to residential direct load control programs for water heating, and efficiency projects with large commercial and industrial users. In addition to slowing the growth in demand on the TVA system, participating consumers, businesses and industries benefited through reduced overall energy costs.

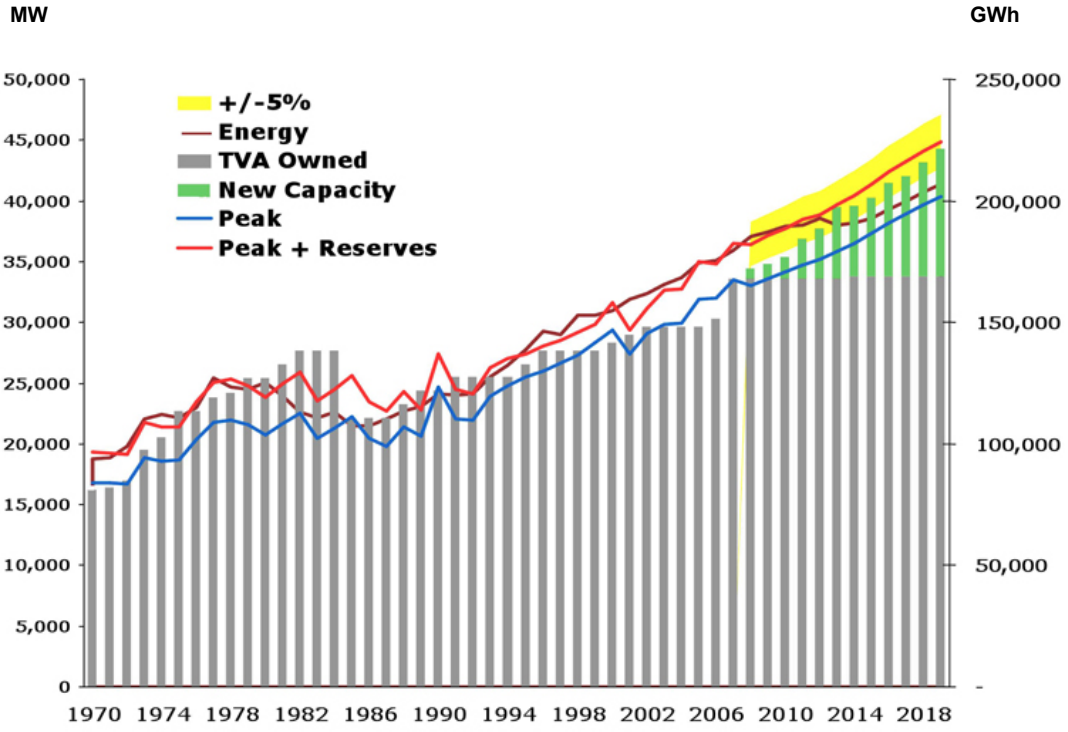
The Current Need for Energy Efficiency and Demand Response

Current State

Today, peak demand on the TVA system is growing at approximately 1.8 percent per year. Overall electricity consumption is growing at a rate of about 1.2 percent per year. This situation, with peak demand growing faster than overall electricity consumption, increases the challenge to power system operations to meet the need cost-effectively.

The chart below details historically how TVA-owned generation has matched peak demand and system reserve capacity requirements from 1971 through 2007. It also illustrates peak demand and the projected new capacity that may be needed for TVA to meet its peak load and system capacity reserve requirements through 2019, within a range of plus or minus five percent.

Historical Installed Capacity and Forecast Future Capacity vs. Both Peak Load and vs. Peak Load Plus Reserves



As the chart indicates, TVA does not have enough capacity to meet its needs. As a result, TVA is currently a net purchaser of power from external sources. In fiscal year 2007, approximately 12 percent of TVA's total system load was supplied through purchases from other power providers. In addition, during the record-breaking heat wave of summer 2007, TVA purchased as much as 20 percent of its power from other suppliers. TVA is building additional generation to meet growing demand. In order to keep costs low, TVA also must consider energy-efficiency and demand-response options.

Focus on Energy Efficiency and Demand Response

TVA's strategic plan, adopted in May 2007, recognized the continuing pressure on the TVA system. Forecasts indicated the system would need an additional 6 to 12 gigawatts of generating capacity over the next 10 to 15 years. The plan pointed out that in addition to building new capacity, energy-efficiency improvements and peak demand reduction were essential to meeting this challenge.

> *"In partnership with others, TVA will strive to be a leader in energy-efficiency improvements and peak demand reduction over the next five years. Improving energy efficiency and reducing peak demand are significant actions that help slow demand growth in a cost-effective manner while addressing air pollution and global climate change. For the purposes of this discussion, energy efficiency includes conservation (using less), efficiency (using smarter), and peak shaving (avoiding use at the most expensive times). Encouraging energy efficiency in the Valley requires the cooperative effort of TVA, power distributors and end-use consumers of electricity. TVA will work with stakeholders at the national, regional, state and local levels to encourage effective conservation, efficiency, and peak reduction initiatives. Efficiency, conservation, and peak-shaving, along with on-site generation (such as photovoltaics), are key components of TVA's energy resource mix."*
>
> *- TVA Strategic Plan*

In February 2008, the TVA Board of Directors approved a seven percent increase in firm wholesale rates to implement the recommendations of the strategic plan, including funding of new capacity additions and the renewed focus on energy efficiency.

Power distributors are vitally important to the achievement of TVA's energy-efficiency and demand-response goals outlined in this draft plan. Together with TVA, power distributors are engaged in refining the program concepts presented in this report. If implemented, these programs will help relieve some of the near-term need for power purchased from other suppliers, helping to mitigate rate pressures and providing direct benefits to the TVA system and consumers alike.

The Development Process

Energy Efficiency Plan Development

In October 2007, the TVA Board named Dr. Joseph J. Hoagland to be Vice President, Energy Efficiency and Demand Response (EEDR), and charged him with developing the long-term energy efficiency plan, and designing and implementing new programs. A core team drawn together from organizations across TVA worked with Dr. Hoagland to develop the implementation plan for EEDR.

In addition, TVA is working closely with the Tennessee Valley Public Power Association (TVPPA) and its member power distributors on the plan's development. TVA recognized from the outset that any successful energy-efficiency or demand-response initiatives would require the agreement and full support of its distributor customers. Distributors of TVA power will play a central role as work goes forward to create and bring to market the program and service offerings that may be implemented as a result of this plan.

To assist in the planning process, TVA also engaged the services of PA Consulting, a multi-national consulting firm with expertise in energy-efficiency and demand-response program development. TVA also conducted numerous outreach activities to gain additional stakeholder input into the draft plan, including a TVA Board of Directors public listening session and individual meetings with members of the environmental community, state and federal energy agencies, and regional and national organizations focused on energy-efficiency initiatives.

TVA's approach was to investigate what was theoretically possible and economically feasible by the end of TVA fiscal year 2012 and over the longer-term. As a first step, TVA assessed the technical potential within the Tennessee Valley for energy-efficiency and demand-response applications based on their technical ability to reduce peak load. The next step was to investigate how best practice programs could be tailored to meet the

Valley's specific needs and what results might be economically feasible to achieve.

Guiding Principles

TVA is actively involved with national leaders in the energy community in considering the role that energy efficiency can play within the context of the entire region and the nation. Specifically, TVA is engaged in the Leadership Group of the National Action Plan for Energy Efficiency (NAPEE), jointly facilitated by the U.S. Department of Energy (DOE) and the Environmental Protection Agency (EPA), and including more than 50 leading organizations. The effort seeks to:

> *"…create a sustainable, aggressive national commitment to energy efficiency through gas and electric utilities, utility regulators, and partner organizations."*

The NAPEE project offers the following recommendations:

- Recognize energy efficiency as a high-priority energy resource;
- Make a strong, long-term commitment to implement cost-effective energy efficiency as a resource;
- Broadly communicate the benefits of and opportunities for energy efficiency;
- Promote sufficient, timely and stable program funding to deliver energy efficiency where cost-effective; and
- Modify policies to align utility incentives with the delivery of cost-effective energy efficiency, and modify ratemaking practices to promote energy-efficiency investment.

TVA has adopted these recommendations as the guiding principles for its plan to achieve all cost-effective energy efficiency and demand reduction in the Valley.

The NAPEE project also recognized that significant barriers exist to achieving its goals, specifically:

- Market – upfront costs and split incentives;[1]
- Customer – lack of information and/or awareness;
- Public policy – prohibitive disincentives for utility support;
- Utility, state, and regional planning – cannot compete with supply-side resources; and
- Energy-efficiency programs – limited investment and effectiveness.

TVA recognizes these same constraints also must be overcome in the Tennessee Valley, in addition to the region's comparatively low energy prices; and the proposed plan seeks to address these barriers.

Reducing the Growth in Demand and Energy

The proposed TVA plan seeks to reduce the growth in peak energy demand and the growth in energy consumption in the Tennessee Valley. As the economic base of the Valley continues to grow, so will energy use. TVA's proposed approach is to do all that is economically feasible to ensure that this growth occurs in the most energy-efficient manner. Peak demand growth and increasing energy consumption are two distinctly different aspects of the Valley's overall energy use, and reducing each will require TVA to apply a combination of approaches.

TVA will target its demand-response programs toward lowering demand during the hours when it is highest, such as on summer afternoons and winter mornings. Energy-efficiency programs will reduce energy consumption over all hours of the day, but they will be targeted for maximum effect on the peak periods in the early years of the plan.

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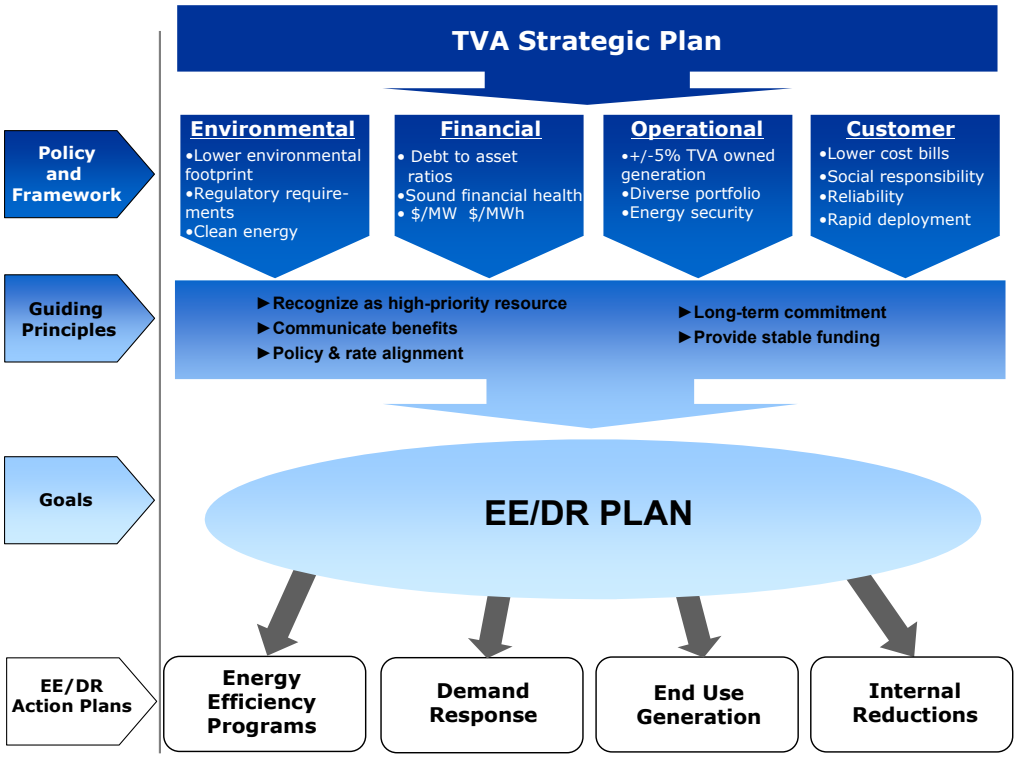
[1]As can be the case with rental property, where the tenant receives the benefit of the efficiency improvement while the owner incurs the cost, the appropriate party may not have the proper incentive to take action.

The Plan through 2012

Energy Efficiency and Demand Response Overall Goals

As noted earlier, it will not be economically feasible to capture all the technical energy savings and demand-reduction potential. This means the growth in demand and energy that does occur will require additional generating capacity to meet the requirements of Valley residents, businesses and industries. TVA is committed to ensuring these resources are constructed and operating when they are needed.

The chart below outlines TVA's energy-efficiency and demand-response planning process. TVA utilized the existing policy and framework established by its strategic plan and then developed a set of guiding principles derived from the NAPEE plan for the planning work. Those guiding principles lead to a number of goals in four action areas: energy-efficiency programs; demand response; end-use generation; and internal reductions.



This draft plan proposes nine high-level goals for achieving energy-efficiency improvement and peak demand reduction across the Tennessee Valley, specifically to:

- Achieve all reasonable demand and energy reductions by 2025;[2]
- Ensure combined program costs per kilowatt are competitive with other generating capacity options;
- Inform and educate all stakeholders;
- Stimulate and transform the marketplace;
- Facilitate the expansion of infrastructure for Advanced Metering Infrastructure (AMI) and Direct Load Control (DLC);
- Support the development of energy-efficiency standards and regulations;
- Provide incentives for demand reduction in conjunction with proper pricing signals;
- Expand and support clean end-use generation; and
- Continue the premium Green Power Switch Program.

Short-Term Plan

TVA believes there is potential to reduce the growth in peak electricity demand by up to 1,400 megawatts and the growth in energy consumption by up to 4.3 million megawatt-hours annually by the end of TVA fiscal year 2012. Achieving these targets would reduce summer peak demand by approximately 4.0 percent and annual energy consumption by approximately 2.3 percent. TVA believes these reductions could be accomplished through the development and implementation of action plans in the following four areas:

- Energy Efficiency – Capture realistic, clearly available energy savings through educational efforts with power distributors and end

[2] This goal is consistent with the vision for the National Action Plan for Energy Efficiency (NAPEE), as discussed in NAPEE *Vision for 2025: Developing a Framework for Change,* which establishes a goal of achieving all cost-effective energy efficiency by the year 2025.

users; offer incentives and training to stimulate all end-use market segments; target offerings for new markets; and develop clear procedures for measurement and verification of results.

- Demand Response – Define AMI interoperability standards between TVA and local power distributors; develop, test and implement pilot projects on all AMI technology options; and fully develop and implement economic demand-reduction tools in conjunction with distributors and TVA's directly served customers.

- End-Use Generation – Increase the Green Power Switch Program (GPS), expand the GPS Generation Partners Program, and develop and implement products that encourage installation of clean end-use generation.

- Internal Reduction – Ensure TVA continues to meet all federal requirements for energy efficiency in its buildings; work to maximize heat rate and other efficiency metrics at TVA's coal-fired power plants; take advantage of heat recovery technologies at TVA generating facilities; and implement a TVA employee initiative aimed at capturing other efficiencies throughout the agency.

Program Action Plans

TVA and PA Consulting have identified successful program designs from across the United States that TVA believes can be implemented successfully in the Tennessee Valley. Potential program concepts that are selected for further development will be refined in cooperation with distributors of TVA power. This step will ensure final program components are well suited to the TVA service territory.

Potential Residential Energy-Efficiency Program Concepts

New Homes – Modify the existing *energy right*® New Homes Program to cost-effectively increase participation and increase energy efficiency levels over standard construction. Program elements might include incentives to builders for constructing and promoting homes that meet designated Home Energy Rating System (HERS)[3] criteria to build consumer awareness about the benefits of highly efficient new home construction.

On-Line Home Energy Audit - Building on the success of TVA's existing do-it-yourself energy audit concept, a mass-market program of this type would be further enhanced to give households additional ways to develop a Home Energy Plan and immediately start becoming more energy efficient.

Comprehensive Existing Homes - Combine a comprehensive on-site energy audit with incentives to the homeowner for installing recommended measures. TVA's approach would be to develop the best options for stimulating the market to provide this service over the long-term.

Manufactured Homes - Promote the construction of ENERGY STAR® qualified manufactured homes by plants in the region through incentives to manufacturers and local dealers.

HVAC - Offer contractor training and incentives for new and replacement high- efficiency residential heating, ventilation and air-conditioning systems. Incentives might be offered in cases where customers are replacing existing central air-conditioning systems or heat pumps, for new

[3] The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home.

construction, and in situations where existing gas furnaces with central air-conditioning systems are being replaced.

Efficient Appliances and Lighting - This program would provide incentives to consumers who purchase ENERGY STAR® appliances and lights. As a secondary feature, the program could include a refrigerator/freezer pick-up and recycling service to encourage consumers to remove unused but operational refrigerators or freezer units in return for a minor incentive.

Potential Commercial and Industrial Energy-Efficiency Program Concepts

New Construction - Influence energy-efficient construction within the commercial and industrial market sectors and assess new buildings for their potential inclusion in other programs. Areas of focus would include HVAC and lighting systems in new construction and major renovations through education and incentives to local architects, building owners, operators, construction companies and others involved in the construction and renovation businesses.

Existing Commercial Building Performance - Address the unique and complicated building system situations in the commercial and industrial sectors using a whole-building approach. The objective would be to achieve electricity efficiency through prescriptive incentives, building re-commissioning and identification of demand-response opportunities.

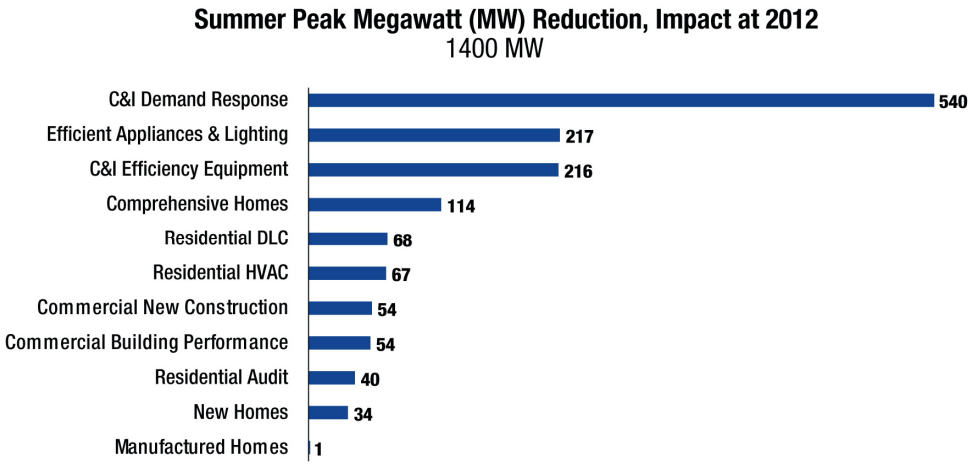
Efficient Equipment - Provide educational materials, training, and financial incentives for the replacement of individual equipment or systems with high-efficiency alternatives. The program would target equipment that contributes to the summer peak including building envelope (shell improvements), higher efficiency HVAC, water heating, lighting, commercial appliances, motors, refrigeration, plug loads, energy-management systems and industrial processes, compressed air systems, and pumping systems.

Potential Demand-Response Program Concepts

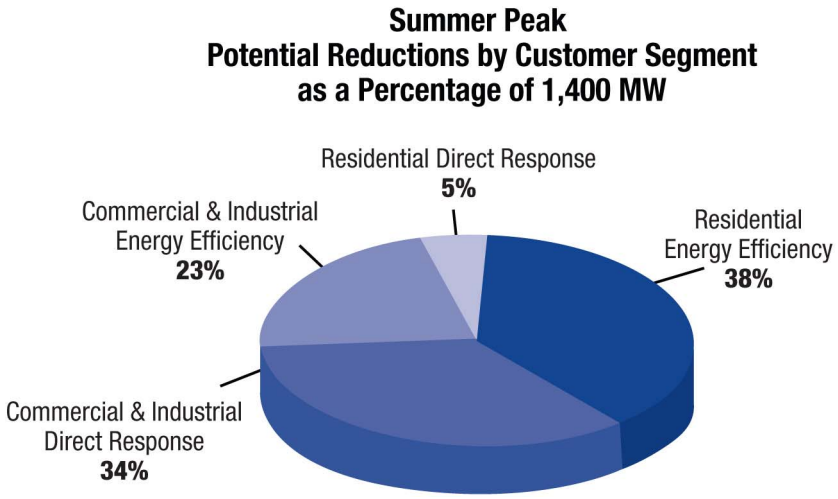
Residential Direct Load Control – Reduce load at critical peak periods by cycling off central air conditioners and electric water heaters. Participating customers would be paid an incentive for agreeing to have their central air conditioners and/or water heaters controlled.

Commercial and Small Industrial Demand Response - Provide incentives to customers for reducing their load on the TVA system when notified. This program type would target commercial and small industrial customers, including national account customers and customers with emergency or back-up generation.

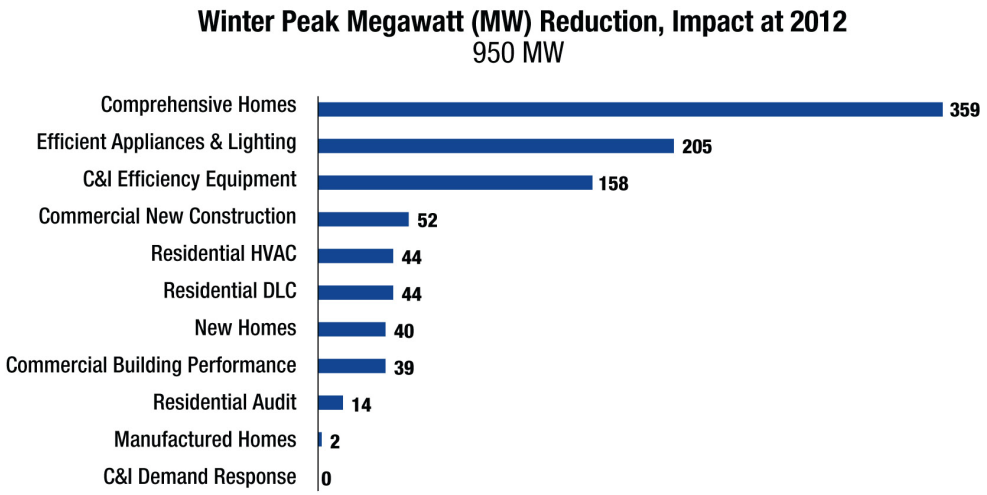
The charts below illustrate the maximum potential by program concept for reducing the growth in TVA's summer and winter peak loads by the end of fiscal year 2012. They also point out the energy efficiency and demand reduction impact by customer segment.



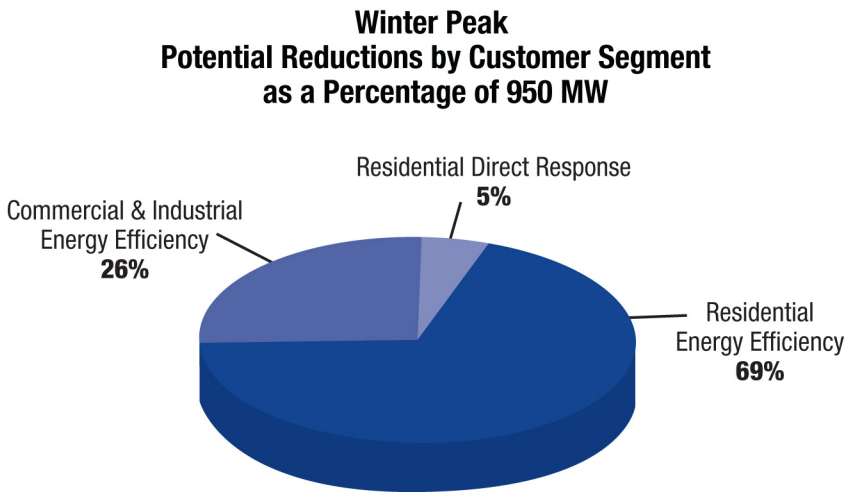
The bar chart above illustrates the maximum potential by program concept for reducing the growth in TVA's summer peak in 2012.



The pie chart above details the percentage of potential energy efficiency and demand response impact by customer segment in 2012.



The bar chart above illustrates the maximum potential by program concept for reducing the growth in TVA's winter peak in 2012.



The pie chart above details the percentage of potential energy efficiency and demand response impact by customer segment in 2012.

End-Use Generation

TVA will continue voluntary customer choice for green power through the Green Power Switch Program (GPS). TVA proposes increasing visibility of GPS and adding incremental renewable resources. Short-term implementation plans will be designed to put TVA on a path toward achieving national benchmarks for voluntary green power programs in the longer term.

In addition, TVA proposes to expand and redefine the GPS Generation Partners end-use generation program. This short-term implementation plan will be designed to increase end-use renewable resources and support clean technologies.

In a concurrent effort, McKinsey & Company, an internationally known, strategic consulting firm, is preparing an analysis of the region's end-use generation potential. In addition to reviewing traditional renewable resources, such as solar and wind generation potential, this analysis also will provide more information on the potential for applications, such as waste heat recovery and combined heat and power generation. Details of this work will be shared in a separate document.

Internal Reductions

TVA is developing action plans to minimize its internal energy use and maximize power system performance across the entire power production and delivery process. TVA will provide more information on these activities as plans are finalized.

Foundational Needs

Energy-Efficiency Education

Market research conducted by TVA indicates that end-users have relatively low levels of understanding of how they consume energy and what they can do to become more energy efficient. This trend is particularly prevalent among residential consumers and small business customers. While large

commercial and industrial consumers are more likely to have professional energy managers on staff, TVA's experience indicates that even these customers would benefit from additional education and technical assistance.

TVA's draft plan proposes to significantly ramp up communications to all target audiences focused on improving overall understanding and awareness of programs, products and services available to them. This effort will be carried out across a wide span of media channels, through stakeholder outreach efforts, and through participation in national energy-efficiency education programs.

New Rate Structures

TVA's current firm wholesale rate structure, called End-Use Wholesale Rates, charges a flat rate by customer class for each kilowatt-hour regardless of TVA's cost to produce that energy at any given time of the day. To make many of the energy-efficiency and demand-response initiatives successful, new rate structures would need to be developed to provide more appropriate price signals to end-use customers. TVA is exploring new rate structures with the active participation of TVPPA, distributors of TVA power and the Tennessee Valley Industrial Committee, which represents many of TVA's directly served customers.

Enabling Technology

For new rate structures to be effectively implemented, the broad application of enabling technologies associated with advanced metering will need to be considered. TVA understands that implementation of these technologies throughout the Valley is a multi-year endeavor. TVA will work with TVPPA to strive to implement this infrastructure.

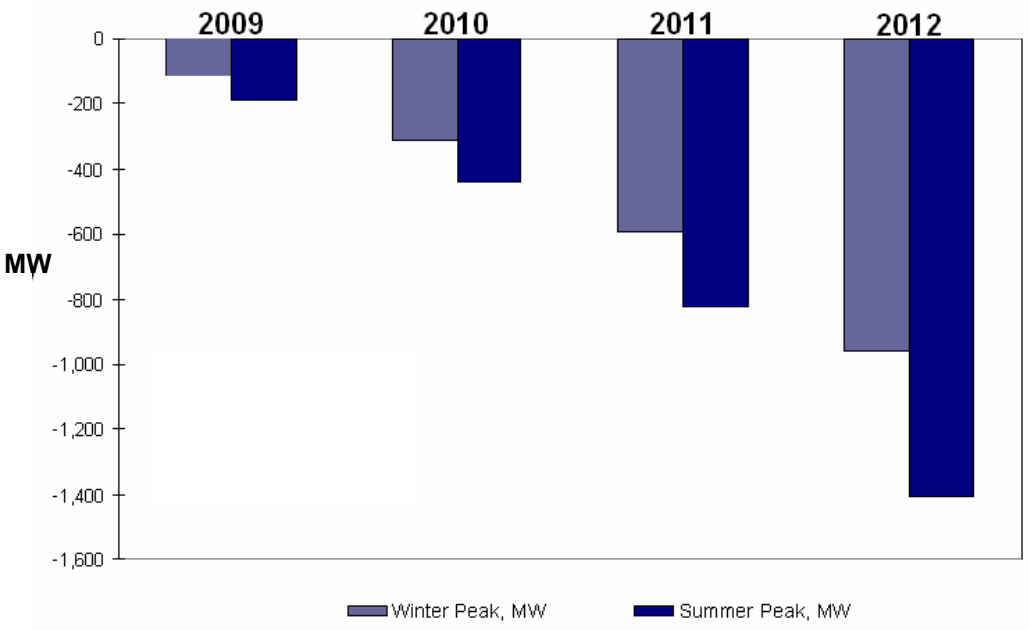
Overall Impact and Costs

TVA believes it will be possible to reduce peak demand growth by up to 1,400 megawatts by the end of TVA fiscal year 2012 at an average cost of approximately $680 per kilowatt. TVA also believes growth in energy consumption can be reduced by up to 4.3 million megawatt-hours annually.

The chart below illustrates the potentially achievable peak-demand and energy-consumption reductions by year through fiscal year 2012.

Potential Cumulative Reductions Through 2012

Cumulative Impacts



The Long View

Long-Term Plan

TVA's view is that energy-efficiency and demand-reduction improvement over the long-term ultimately must be accomplished through a transformation in the marketplace that increases consumer demand for energy-efficient products and services and provides the delivery channels to meet their needs. To accomplish this transformation, a number of underlying structural enablers may be required, including:

- An informed public able to make educated choices about their energy use and energy-related purchases;
- Electricity rates that send appropriate price signals to encourage consumers to reduce usage during periods of high demand;
- Advanced electric metering and other technologies that allow communication between end-users and their power provider;
- Uniform building codes and enforcement that require energy-efficient new construction;
- A strong, vibrant infrastructure for end-use generation technologies; and
- A robust network of commercial providers offering a wide array of energy-efficient products and services.

To hasten this market transformation, TVA proposes a five-part effort, specifically:

- Sustained education and outreach across all end-use segments;
- Development of product and service providers through continued incentive programs over the next several years;
- Expansion of advanced metering technology and communications interfaces to enable direct load control programs and time-of-use rate structures;
- Support for enhancements to existing building codes; and

- Development of new rate structures and/or other mechanisms in collaboration with TVA customers that send price signals that reflect the actual cost of power at any given time.

These activities will begin during the first five years of the plan, but, as a long-term effort, TVA expects to deliver the majority of their results from TVA fiscal year 2013 onward. TVA believes this approach could put the Tennessee Valley on course to capture all cost-effective energy efficiency and demand reduction by 2025.

Next Steps and Conclusion

Next Steps

TVA will hold a series of public briefing sessions across the Tennessee Valley to allow stakeholders the opportunity to learn more about the draft plan and offer comments. Members of the public also will be able to offer comments directly to TVA through its website at www.tva.com. Once this additional input has been received and assessed, TVA staff will present a final plan to the TVA Board of Directors for approval of the guiding principles at its May 19 meeting.

Conclusion

TVA received many highly constructive ideas and much insightful counsel and encouragement over the course of the development of this draft action plan. This input is reflected in many of the elements represented in this document. While the action plan represents a significant step forward in developing programs to achieve considerable decreases in the growth of peak demand and energy consumption, much work remains to be done. TVA pledges to continue to work with all interested stakeholders as its work continues to achieve a leadership position in energy-efficiency improvement and peak demand reduction.