Tennessee Valley Authority

Climate Change Adaptation Action Plan

Executive Order 13514

Federal Leadership in Environmental, Energy, and Economic Performance

Prepared by:

June 29, 2012

TVA CLIMATE CHANGE ADAPTATION ACTION PLAN

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A. TVA'S CLIMATE CHANGE ADAPTATION POLICY FRAMEWORK

The goal of TVA's adaptation planning process is to ensure that the Agency continues to achieve its mission and program goals and to operate in a secure, effective and efficient manner in a changing climate."[1] TVA has, in accordance with the requirements of E.O. 13514, adopted an internal statement on climate change adaptation to establish an adaptation planning goal and to better understand the challenges and opportunities a challenging climate may present to its mission and operations.

TVA manages the effects of climate change on its mission, programs, and operations within its environmental management processes. Its primary planning processes are its *Integrated Resource Plan (IRP)* and its *Natural Resource Plan (NRP)*. As a Federal agency, TVA must also comply with the National Environmental Policy Act (NEPA) as well as applicable Executive Orders, such as E.O. 13514, *Federal Leadership in Environmental, Energy and Economic Performance.*[2] Environmental goals are an integral part of how TVA does business and are tracked along with its other business objectives.

TVA has completed a high-level climate change vulnerability assessment as required by E.O. 13514.

TVA's adaptation planning activities and projects are summarized below.

- **Climate Sentinel Monitoring:** This project is listed in TVA's Natural Resource Plan (NRP) and focuses on collecting biological, chemical and physical data in each of the five predominant eco-regions in the Tennessee Valley.[3]

- **Strategic Partnership Planning:** This project is listed in TVA's NRP and focuses on building partnerships with state and other federal agencies, and regional organizations, to address stewardship issues of mutual importance and drive measurable improvement of health of the region's waters.

- **Water Resource Outreach Campaign:** This project is listed in TVA's NRP which focuses on increasing public awareness and involvement through the promotion of water resource protection and improvement best practices.[4]

- **Water Availability, Resource Risk Management and Ecosystem Services EPRI Program 55**: Continued funding of this EPRI program is subject to budget approval and constraints. This research program includes the development of Decision Support tools, national assessments and projections of water use and consumption, as well as water benchmarking and reporting.

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[1] *Instructions for Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514, Support Document,* CEQ, March 4, 2011, p. 8. *See* http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_support_document_3_3.pdf

[2] TVA's Sustainability OMB Scorecard is available at http://www.tva.gov/environment/sustainability/

[3] TVA Natural Resource Plan, p 16. The Draft National Ocean Plan strongly communicates the importance of observations from the Nation's protected areas, research sites, and observing systems into a coordinated network of sentinel sites, concluding that integrating observations is essential to advancing our understanding of how communities and ecosystem respond and adapt to climate change.

[4] *Id.*

- **External Coordination Efforts:** This activity focuses on the identification of an internal process to coordinate its adaptation planning with related efforts among state, local, tribal, and territorial partners. These efforts include TVA participation in the Appalachian Land Conservation Cooperative (LCC) and the Southeast Climate Science Center (CSC).

- **Dry Ash Handling and Storage:** TVA has developed plans to eliminate all wet ash and gypsum storage in the system and convert its 11 operating coal-fired power plants to dry storage. The movement away from wet fly ash systems will help to reduce the overall use of water in TVA's power generation facilities and help to meet sustainability goals as required by Executive Order 13514. The conversion plan has been developed and capital costs have been estimated.

- **Greenhouse Gas Reduction:** TVA's Environmental Policy states the environmental objective that TVA "will stop the growth of emissions and reduce the rate of carbon emissions by 2020 by supporting a full slate of reliable, affordable, lower CO_2 energy-supply opportunities and energy efficiency. In accordance with EO 13514, TVA has set additional GHG reduction targets for Scope 1, 2 and 3 activities and annually reports its progress as part of its Strategic Sustainability Performance Plan.

TVA's Senior Sustainability Officer is responsible for its annual Climate Change Adaptation Action Plan.

TVA's Senior Sustainability Officer is: Dr. Joseph J. Hoagland
Vice President, Policy and Oversight
400 West Summit Hill Drive
WT 7B-K
Knoxville, TN 37902

B. Climate Change Risks and Opportunities

1. TVA's Mission and Vision

The Tennessee Valley Authority (TVA) is a federal agency and corporation. The Agency was created in 1933 to lift the Tennessee Valley region out of the Great Depression through an integrated approach of generating and transmitting low-cost electricity, addressing environmental challenges and fostering economic development.

TVA is the nation's largest public power provider and one of the country's largest electric utilities. TVA supplies electricity to customers in most of Tennessee and parts of Alabama, Mississippi, Kentucky, Georgia, North Carolina, and Virginia--an area of about 80,000 square miles with a population of more than nine million.

Initially, all TVA operations were funded by federal appropriations. Direct appropriations for the TVA power program ended in 1959, and appropriations for TVA's land and water, stewardship, management of the Tennessee River and watershed, economic development, and multipurpose activities ended in 1999. Since 1999, TVA has funded all of its operations almost entirely from the sale of electricity and power system financings. The TVA Board also established a Regional Resource Stewardship Council under the Federal Advisory Council Act to advise TVA on its stewardship activities.

TVA's power system financings consist primarily of the sale of debt securities and secondarily of alternative financings such as lease financings. As a wholly-owned government corporation, TVA is not authorized to issue equity securities. TVA also returns funds to the U.S. Treasury. While exempt from local and state taxes, TVA makes tax equivalent payments to states and localities comparable to taxes paid by private companies. TVA's governance structure, updated by Congress in 2005, shares some similarities with that of a private corporation. Policy direction and oversight are provided by a nine-member, part-time board of directors, and ongoing operations are managed by a full-time chief executive officer. Members of the TVA Board are appointed by the President of the United States and confirmed by the United States Senate.

More detailed information about TVA's programs can be found in the annual reports (10-Ks), quarterly reports (10-Qs) and current reports (8-Ks) TVA files with the Security Exchange Commission. View TVA Securities and Exchange Commission filings.

While TVA's mission has not changed, the environment in which TVA does business continues to evolve. In August 2010, the TVA Board of Directors adopted a renewed vision to be one of the nation's leading providers of low-cost and cleaner energy by 2020.

TVA's mission continues with five key deliverables:

- Low-Cost, Reliable Power
- Environmental Stewardship
- Economic Development
- Technological Innovation
- River Management

2. TVA's Programs

a. Low Cost, Reliable Power

TVA is primarily a wholesaler of electricity. Specifically, TVA generates electricity from eleven coal-burning plants that, in an average year, produce more than half of TVA's electricity. Four of these plants and five freestanding sites also have combustion turbines, which burn natural gas or fuel oil. TVA has three nuclear plants, 29 hydroelectric dams and one pumped-storage plant. Since April 2000 it has added energy from three renewable sources--sun, wind and methane gas--to its power mix. In addition, eight Army Corps of Engineers dams and four Alcoa dams contribute to the TVA power system.[5]

The TVA transmission system is one of the largest in North America. TVA's transmission system has 62 interconnections with 14 neighboring electric systems, and delivered nearly 168 billion kWh of electricity to TVA customers in 2011. In carrying out its responsibility for grid reliability in the TVA service area, TVA has operated with 99.999 percent reliability over the last 12 years in delivering electricity to customers.

TVA, in partnership with its distributors and directly served customers, is developing a broad portfolio of energy efficiency and demand response programs designed to help reduce long-term energy supply costs in the TVA service area.

b. Environmental Stewardship

TVA's Environmental Policy provides objectives for an integrated approach related to providing cleaner, reliable, and affordable energy, supporting sustainable economic growth and engaging in proactive environmental stewardship. The Environmental Policy provides additional direction in several environmental stewardship areas, including water resource protection and improvements, sustainable land use, and natural resource management.

c. Economic Development

Since its creation in 1933, TVA has promoted the development of the Tennessee Valley. TVA works with its distributor customers, regional, state, and local agencies, and communities to showcase the advantages available to businesses locating or expanding in TVA's service area. Continued recruitment of desirable companies and retention of the current industrial and manufacturing base also continue to be critical to TVA's economic development mission.

d. Technological Innovation

TVA makes investments in science and technological innovation to help enable TVA to meet future challenges in a variety of areas. TVA leverages research and development activities through partnerships with distributors of TVA power, the Electric Power Research Institute ("EPRI"), the Department of Energy (DOE), Oak Ridge National Laboratory, the National Atmospheric Deposition Program[1], the National Park Service[2], other utilities, universities, and industry vendors. Some of these activities include: developing technologies to make electric vehicles and the charging stations that fuel

[5] More information about TVA's generation facilities can be found at: http://www.tva.com/power/index.htm

[1] TVA has participated in the National Atmospheric Deposition Program since the early 1980's to evaluate acidic deposition in precipitation.

[2] TVA has partnered with the National Park Service to better understand air quality in Great Smoky Mountains National Park.

them work together efficiently, finding ways to minimize demands on the power grid, improving the energy efficiency of the power system, and developing a better understanding of air quality in the Great Smoky Mountains National Park.

e. River Management

TVA manages the Tennessee River, its tributaries, and public lands along the shoreline to provide, among other things, year-round navigation, flood damage reduction, affordable and reliable electricity and, consistent with these primary purposes, recreational opportunities, adequate water supply, improved water quality, and natural resource protection.

TVA's integrated reservoir system provides 800 miles of commercially navigable waterways and significant flood reduction benefits both within the Tennessee River system and downstream on the lower Ohio and Mississippi Rivers. The reservoir system also provides a water supply for residential and industrial customers, as well as cooling water for some of TVA's coal-fired and nuclear power plants.

3. TVA's Adaptation Risk and Opportunities

By definition, all planning activities are always conducted under conditions of uncertainty. Adaptation planning is no different. Interagency efforts have been, and continue to be, underway to better understand the uncertainty associated with climate change. In the United States, the Global Change Research Act of 1990 mandates an assessment of the impacts of global change in the U.S. be conducted by the U.S. Global Change Research Program (USGCRP) every four years.

a. High-Level Adaptation Risk and Opportunities Analysis

In response to *Preparing Federal Agency Climate Change Adaptation Plans In Accordance with Executive Order 13514--February 29, 2012*, Table 1 summarizes the potential high-level adaptation risks and opportunities to TVA's mission, programs, and operations in the short- and long-term. The risks and opportunities analyzed are within the ranges considered by TVA's current planning and evaluation processes as discussed in Section C.

Table 1. Adaptation Risk and Opportunity Summary

Key Issue	Description	Potential Short Term and Long Term Direct and Indirect Effects
Electricity Demand	Electricity demand may increase (especially in the South and Southwest, which generally have higher per capita electricity use.)[6]	The 2009 USGCRP report concluded the demand for cooling energy generally increases from 5 to 20% per 1.8° F of warming and demand for heating energy generally drops by 3 to 15% per 1.8° F of warming.[7] The USGCRP also reported that temperature increases are "very likely to increase peak demand for electricity in most regions of the country."[8]
Reservoir Operations and Hydropower Generation	Climate change, coupled with human adaptation, will influence both the demand for and supply of water. [9]	These changes may affect hydropower generation, thermoelectric cooling, reservoir-based recreation, navigation, municipal and industrial uses, and environmental flows.
	Many U.S. Army Corps of Engineers "rule curves" that require a certain amount of space to be saved in a reservoir at certain times of the year to capture a potential flood have never been modified.[10]	A TVA Reservoir Operations Policy was developed during the Reservoir Operations Study and Environmental Impact Statement (EIS-2004). The reservoir operations include flood guides that are based upon TVA's hydrologic record and many years of operating experience. Several of these flood guides were changed as a result of the River Operations Study, and will continue to be reassessed over time.
	Evaporative losses from industrial and thermoelectric cooling may increase.	An increase in evaporative losses from industrial and thermoelectric cooling may increase reservoir losses.[11]
	Precipitation could significantly increase.	The *1988 TVA Sensitivity Study* concluded that major dams operating at or above normal maximum levels for extended periods of time may necessitate a reevaluation of dam safety at these projects.[12]
	Precipitation could significantly decrease.	Conversely, the *1988 TVA Sensitivity Study* also concluded the reduced runoff conditions may decrease the likelihood of operations at or above maximum pool levels.[13]
Effects of Changing Runoff and Water Temperatures	Runoff and water temperatures may change.[14]	The *Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region* (EPRI report) concluded that whether hydropower generation decreases or increases as a result of climate change depends on changes in runoff patterns along with any resulting changes in management priorities.[15] Specifically,

[6] *Id.*
[7] These ranges reflect different assumptions about factors such as the rate of market penetration of improved building equipment technologies. *Global Climate Change Impacts In the United States*, U.S. Global Change Research Program, 2009. *See* http://downloads.globalchange.gov/usimpacts/pdfs/health.pdf.
[8] An increase in peak demand can lead to a disproportionate increase in energy infrastructure development. *Id*.
[9] *Id.*
[10] Milly, P.C.D., J. Betancourt, M. Falkenmark, R.M. Hirsch, Z.W. Kundzewicz, D.P. Lettenmaier, and R.J. Stouffer, 2008: Stationarity is dead: Whither water management? *Science*, **319(5863)**, 573-574.
[11] *Id*.
[12] *1988 Sensitivity Study* at 64.
[13] *Id*.
[14] *1988 Sensitivity Study* at 64.
[15] *Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region,* EPRI, November 2009.

		with respect to the Tennessee Valley, the EPRI report concluded that multi-model means of climate results suggests that effects on most existing human uses of water (for example, for cooling water or hydropower) are also likely to be modest and occur within the range of existing adaptive capacity, although some adjustments in water planning will likely be necessary.[16]
Extreme Weather	Severe weather, such as ice storms, thunderstorms, tornados and hurricanes can have a negative impact on energy infrastructure.[17]	The 2009 USGCRP report concluded it is not yet possible to project climate change effects on the electricity grid because so many of the effects are more localized than current climate change models can depict, but encouraged weather-related grid disturbances be included for strategic planning and risk management.[18] In addition, the 2009 USGCRP report also encouraged the consideration of the effect of rail bed and road bed "wash out" on fuel supply chains.[19]
Heat	USGCRP analysis of nine U.S. cities[20] concluded deaths due to heat increase with rising temperature and humidity.	However, USGCRP analysis also concluded, from the 1970's to the 1990's, heat-related deaths declined, most likely from a rapid increase in the use of air conditioning.[21]
Floods	The 2009 USGCRP report concluded the amount of precipitation falling in the heaviest 1% of rain events in the U.S. increased by 20% , while total precipitation increased by 7 % over the last century. Other regions,have also seen strong increases in heavy downpours, with most of these coming in the warm season and almost all of the increase coming in the last few decades.[22]	Flooding can cause health impacts including direct injuries as well as increased incidence of waterborne diseases due to pathogens such as *Cryptosporidium* and *Giardia*. Increased flooding risk may also present a challenge to design insurance systems that properly price risks, reward loss prevention, and do not foster risk taking.[23]
Water Quality	Downpours can trigger sewage overflows and contaminated drinking water.[24]	Increases in the intensity of precipitation events, increases in water temperature, coupled with extended periods of lower stream flow may intensify pollutant concentration, increasing the number of streams EPA considers to be impaired in future years.[25]

[16] *Id.*
[17] *Global Climate Change Impacts In the United States*, U.S. Global Change Research Program, 2009. *See* http://downloads.globalchange.gov/usimpacts/pdfs/health.pdf.
[18] *Id.*
[19] *Id.*
[20] Birmingham, AL; Boston, MA; Chicago, IL; Detroit, MI; Dallas, TX; Houston, TX; Minneapolis/St.Paul, MN; Philadelphia, PA; Phoenix, AZ
[21] *Global Climate Change Impacts In the United States*, U.S. Global Change Research Program, 2009. See http://downloads.globalchange.gov/usimpacts/pdfs/health.pdf. In 1978, 44% of households were without air conditioning, whereas in 2005, only 16 percent of the U.S. population lived without it (and only 3 percent did not have it in the South). *Id.*
[22] *Global Climate Change Impacts In the United States*, U.S. Global Change Research Program, 2009. See http://downloads.globalchange.gov/usimpacts/pdfs/health.pdf.
[23] *Id.*
[24] *Id.*
[25] *Id.*

Temporal and Geographic Rainfall Variation	Climate impacts in this category are related to changes in rainfall, but also to changes in temperature, which affects evaporation and evapotranspiration (the sum of evaporation and plant transpiration from the Earth's land surface to the atmosphere).	The *EPRI Report* concluded while changes in runoff in the TVA region are likely to be modest, some impacts could result from highly localized changes in the temporal distribution of precipitation that may have major impacts on both water supply and power supply along with recreation in specific parts of the TVA region--even if the region as a whole does not experience a major impact.[26]
Prolonged Droughts	Periods of prolonged drought may increase.	The 2009 USGCRP report concluded that prolonged droughts can amplify the warming effects on water of climate change, potentially causing large fish kills or other impacts.[27] As a result of these changes, the biological composition of water bodies may change as species better adapted to warmer conditions out-compete existing species and alterations in flow regimes may provide additional entry pathways for invasive species.[28]
Decreased Dissolved Oxygen Levels	Dissolved oxygen may decrease. (dissolved oxygen is an indicator of water's suitability to support oxygen-dependent aquatic organisms.)	The *EPRI Report* observed Increased summer water temperature and no major increase in stream flow may cause the dissolved oxygen level to decrease in the region, resulting in a reduction in water quality. The condition could be worsened if summer flows are reduced.[29]
Species Diversity	Many plant and wildlife populations can be at risk from climate-related stressors.	The Tennessee Valley region supports a wide diversity of terrestrial and aquatic ecological habitats. This habitat diversity results in the area being one of the most species-diverse in North America and a center for unusually high levels of endemism (i.e. species confined to a particular geographic region). Potential climate impacts are related to changes in ecosystem type and acreage and measures of species diversity and can be attributed to changes in temperature, precipitation and atmospheric CO_2 concentrations.[30]
In-stream Habitats	Changes to in-stream flow levels may have substantial impacts on the habitats and biodiversity supported by rivers and other water bodies.	The *EPRI Report* concluded that, within the TVA region, the overall effects of climate change on in-stream flow will vary depending on run-off cycles, precipitation levels, and river characteristics. In-stream flow rates will also be indirectly affected by water management decisions between competing water uses.[31]
Habitat Migration	Climate change may have an impact on animal and plant species. The 2009 USGCRP concluded that, the United States, spring now arrives on an average of 10 days to two weeks	The growing season is lengthening over much of the continental United States.[33] The ranges of many species in the United States are shifting northward and upward in elevation.[34]

[26] *Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region,* EPRI, November 2009.
[27] *Id.*
[28] *Id.*
[29] *Id.*
[30] FWS, 2009.
[31] *Potential Impact of Climate Change on Natural Resources in the Tennessee Valley Authority Region,* EPRI, November 2009.

	earlier than it did 20 years ago.[32]	
Air Quality	Changes in meteorological conditions could affect future ozone and $PM_{2.5}$ concentrations. Climate change can also affect air quality by increasing emissions from natural sources and wildfires.	The *EPRI Report* states the TVA service territory has few metropolitan areas that currently do not meet the National Ambient Air Quality Standards (NAAQS) for ozone, small particulate matter (PM2.5), or both. Currently, "Knoxville-Sevierville-LaFollette" is in nonattainment for the 2006 PM-2.5 24-hour standard.[35] Air trends have shown dramatic improvement in ozone and pm 2.5
Natural Resource-Based Recreation	Natural resource-based recreation in the TVA service territory could be affected directly by temperature and precipitation changes, as well as indirectly through effects on water resources, forests, and unmanaged ecosystems.[36]	Warm and wet climate adaptation scenarios generally produce positive recreational impacts and warm and dry scenarios generally produce negative recreational impacts.

b. External Partnership and Stakeholder Coordination

Partnerships are a critical component of TVA's future implementation, education and operations success. TVA, along with other agencies, is tasked with finding new and creative ways to deal with funding and personnel challenges to effectively manage nonrenewable resources.

TVA is developing overarching public engagement programs to increase public awareness and promote opportunities for volunteer involvement, environmental education, financial/resource assistance and collaborative partnerships.[37] External stakeholder coordination processes are utilized in the TVA Integrated Resource Plan and the Natural Resource Plan processes.

c. Existing Cross-Cutting Planning Efforts

- ***Strategic Sustainability Performance Plan (SSPP)***

TVA's Senior Sustainability Officer (SSO) is also responsible for its Climate Change Adaptation Action Plan. TVA's Strategic Sustainability Performance Plan (SSPPP) goals and current performance can be found on its current OMB Scorecard on Sustainability/Energy.

- ***Environmental Justice Strategy***

TVA will consider environmental justice impacts in a manner appropriate for the process utilized.

- ***Applicable National Plans***

To the extent practicable, this Climate Change Adaptation Action Plan has attempted to align with existing cross-cutting planning efforts, including the:

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[33] *Global Climate Change Impacts In the United States*, U.S. Global Change Research Program, 2009. *See* http://downloads.globalchange.gov/usimpacts/pdfs/health.pdf.
[34] *Id.*
[32] *Id.*
[35] http://www.epa.gov/airquality/urbanair/sipstatus/reports/tn_areabypoll.html
[36] *Id.*
[37] TVA Natural Resource Plan, August 2012, p 19.

***National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate*,** Interagency Climate Change Adaptation Task Force, October 2011. *See*: http://www.cakex.org/sites/default/files/2011_national_action_plan.pdf

Draft National Fish, Wildlife and Plants Climate Adaptation Strategy, U.S. Fish and Wildlife Service, NOAA, AFWA, January 2012. *See* http://www.wildlifeadaptationstrategy.gov/pdf/public_review_draft.pdf

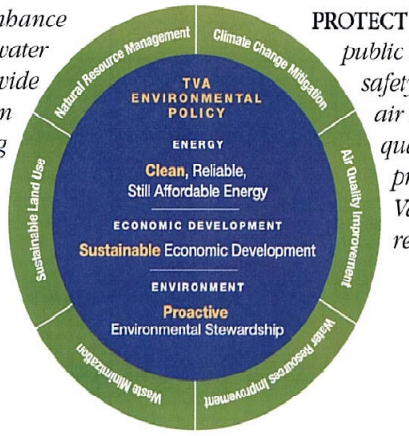
Draft National Ocean Policy Implementation Plan, National Ocean Council, January, 2012. *See* http://www.whitehouse.gov/sites/default/files/microsites/ceq/national_ocean_policy_draft_implementation_plan_01-12-12.pdf

C. TVA's Adaptation Planning and Evaluation Process

1. TVA's Environmental Policy

The focus on "Enhance, Protect and Reduce" aligns TVA's *Environmental Policy* with its *Vision*.

ENHANCE – *Enhance land and water resources to provide multiple benefits in the Valley, making it a better place to live, work and play*



PROTECT – *Foster public health and safety by improving air and water quality and protecting the Valley's natural resources*

REDUCE – *Reduce consumption of water resources and the generation of waste and by-products for a sustainable future*

2. Guiding Principles for Climate Change Adaptation[38]

The *Support Document* to the *Implementing Instructions* set out the following "Guiding Principles for Climate Change Adaptation":

- Adopt integrated approaches
- Prioritize the most vulnerable

[38] *Instructions for Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514*, *Support Document,* CEQ, March 4, 2011, p. 8. *See* http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_support_document_3_3.pdf

- Use best-available science
- Build strong partnerships
- Apply risk-management methods and tools
- Apply ecosystem-based approaches
- Maximize mutual benefits
- Continuously evaluate performance

3. TVA's Major Environmental Planning Processes

TVA 's major environmental planning processes are its *Integrated Resource Plan (IRP)* and its *Natural Resource Plan (NRP)*. Other applicable TVA planning processes include Reservoir Land Management Plans and the TVA Shoreline Management Policy.

As a Federal agency, TVA must also comply with the National Environmental Policy Act (NEPA) as well as applicable Executive Orders, such as E.O. 13514, *Federal Leadership in Environmental, Energy and Economic Performance.*[39] Environmental goals are an integral part of how TVA does business and are tracked along with its other business objectives.

a. TVA's Integrated Resource Plan (IRP)
TVA's *IRP*, adopted by TVA's Board of Directors in 2011, is a roadmap to help guide TVA in meeting the region's electricity needs through 2029. Climate change mitigation was specifically included in a majority of IRP scenarios studied. The IRP recommends a strategic direction that focuses on a diverse mix of energy sources, including alternative energy portfolios, and evaluated a broad range of potential future scenarios.

b. TVA's Natural Resource Plan (NRP)
TVA's *NRP*, was also adopted by TVA's Board of Directors in 2011. The NRP is designed to enhance stewardship of public recreation facilities, water resources, wildlife and plants and historic and cultural sites on TVA-managed reservoir lands. Implementation of the NRP is expected to be staged over a 20-year period. It is expected to be reviewed and updated at least every five years. The NRP also guides TVA in achieving the objectives of its *Environmental Policy* for a more systematic and integrated approach to natural resource stewardship.

c. TVA's Reservoir Land Management Plans
TVA develops comprehensive plans for the management of the public land around each of its lakes. Plans are developed with participation by public agencies and officials, private organizations and individuals. Many of the land plans are available online.

d. TVA's Shoreline Management Policy
In 1999, after extensive environmental review and public comment, TVA inaugurated its Shoreline Management Policy to improve the protection of shoreline and aquatic resources while continuing to allow reasonable public access to both.

[39] TVA's Sustainability OMB Scorecard is available at http://www.tva.gov/environment/sustainability/

D. Actions to Better Understand Climate Change Risks and Opportunities

Monitoring and evaluation serve a very important function in providing the scientific underpinnings *of informed po*licy. Responses to the climate change challenge will almost certainly evolve over time. Determining and refining adaptation responses will be an iterative process involving scientists, policymakers, and public and private decision makers at all levels.[40] Table 2 summarizes TVA's planned near and mid-term actions to better understand climate change risks and opportunities as reported in its 2012 SSPP. Progress is expected to continue subject to budget approval and constraints.

Table 2. TVA Actions To Better Understand Climate Change Risks and Opportunities

TVA NRP Climate Sentinel Monitoring	**Action Description**	This program is listed in TVA's NRP and focuses on collecting biological, chemical and physical data in each of the five predominant eco-regions in the Tennessee Valley.[41]
	Agency Lead	Environmental Permitting and Compliance, Senior Specialist, Water Resources-Natural Resource Planning
	Risk or Opportunity	Better understanding of potential climate change effects on streams, including water quality and their unique biodiversity within the Tennessee River watershed.
	Scale	Regional
	Timeframe	Planning during FY2012; Monitoring begins in FY2013 in the five predominant ecoregions with 10 sites a year. One of the five ecoregions (Mississippi Alluvial Plain) may be problematic for establishing a sentinel monitoring site.
	Implementation Methods	Percent samples completed; Complete and timely annual report.
	Inter-Governmental Coordination	Coordination across Federal, state, tribal, or other partners are appropriate and critical to advance this action.
	Resource Implications	We are going to integrate monitoring, modifications and additions with the existing monitoring program. TVA will be dedicating non-appropriated funds, as practicable, at its discretion.
	Challenges/Further Considerations	Continued funding. Finding reference sites that qualify for sentinel monitoring. Balancing partnerships--aligning our efforts with what others are doing while maintaining our commitments as outlined within the NRP.
	Highlights of Accomplishments to Date	Willingness of other agencies and organizations to get involved, including the potential involvement of three Federal agencies and six state agencies.
Strategic Partnership Planning	**Action Description**	This NRP program focuses on building strong partnerships with state and other federal agencies, and with regional nongovernmental organizations, to address stewardship issues of mutual importance and drive measurable improvement of health of the region's waters.[42]
	Agency Lead	Property & Natural Resource Management

[40] *Id.*

[41] TVA Natural Resource Plan, p 16. The Draft National Ocean Plan strongly communicates the importance of observations from the Nation's protected areas, research sites, and observing systems into a coordinated network of sentinel sites, concluding that integrating observations is essential to advancing our understanding of how communities and ecosystem respond and adapt to climate change. Draft National Ocean Plan, p. 58.

[42] TVA Natural Resource Plan, p 16

	Risk or Opportunity	Develop shared understanding of potential climate change effects on the Tennessee River watershed and identify opportunities to improve and/or maintain water quantity and water quality.
	Scale	Regional.
	Timeframe	Planning in 2012, Begin in 2013 and continuing through 2020.
	Implementation Methods	Establish partnerships that will collaboratively advance TVA's water resource improvements, and also serve as potential sources of shared funding.
	Inter-Governmental Coordination	Describe and reaffirm current partnerships and strengthen TVA participation with those agencies, NGOs, and other Valley and Federal Stakeholders.
	Resource Implications	Utilize existing resources to the extent possible and develop additional resources as new opportunities are identified. TVA will be dedicating non-appropriated funds, as practicable.
	Challenges/Further Considerations	Maintaining alignment with other agencies and ensuring adequate future funding.
	Highlights of Accomplishments to Date	Three projects with the Tennessee Department of Environment and Conservation addressing impaired streams and natural habitats in the Roane County area; support for State of Tennessee's lead Water Quality Improvement Initiative; and assisting the state's Green Infrastructure and Low Impact Development Grant Program. These projects are all supplemental environmental projects selected to offset $2M of the Tennessee Commissioner's Order after the Kingston ash spill.
Water Resource Outreach Campaign	**Action Description**	This NRP program focuses on increasing public awareness and involvement through the promotion of water resource protection and improvement best practices.[43]
	Agency Lead	VP, Property and Natural Resources
	Risk or Opportunity	Develop better understanding of potential climate change effects on the Tennessee River watershed and identify opportunities to increase public awareness of the issue.
	Scale	Regional
	Timeframe	Begin in 2013 and continuing through 2020
	Implementation Methods	Develop a matrix of public outreach topics, materials (existing or to be developed), and target audiences. Update existing and prepare new outreach materials and presentations. Develop and follow an integrated plan for delivering water resource outreach.
	Inter-Governmental Coordination	Ensure our efforts are coordinated with others.
	Resource Implications	Adequate funding must be procured and maintained. TVA will be dedicating non-appropriated funds, as practicable.
	Challenges/Further Considerations	Continued funding. Maintaining program focus over a long timeframe.
	Highlights of Accomplishments to Date	Initial inventory of existing materials has been initiated and historical programs are ongoing.
Water Availability and	**Action Description**	Includes the development of Decision Support tools, national assessments and projections of water use and consumption, as well

[43] TVA Natural Resource Plan, p 16

Resource Risk Management, EPRI Program 55:		as water benchmarking and reporting. EPRI is applying the model to the Green River watershed and analyzing TVA's withdrawal/consumption along with other utilities and regional sectors using water, including industry and agriculture and determining the hypothetical scenarios and strategies for model testing.
	Agency Lead	TVA Technology Innovation
	Risk or Opportunity	Water availability and use
	Scale	Regional
	Timeframe	Started in FY11 with estimated project completion FY13 for testing at the watershed level.
	Implementation Methods	Project in testing phase.
	Inter-Governmental Coordination	Partner coordination between EPRI utility members involving model scenario development.
	Resource Implications	TVA project participating will be managed using existing TA Project Manager resources. TVA will be dedicating non-appropriated funds, as practicable, at its discretion.
	Challenges/Further Considerations	Potential to conduct a feasibility study to explore the potential for the model to consider economic analysis and/or water quality analysis.
	Highlights of Accomplishments to Date	EPRI completed watershed modeling for two test areas to demonstrate tool functionality.
EPRI Ecosystem Services	**Action Description**	EPRI will be coordinating research efforts with TVA to evaluate ecosystem services models on land management programs and their general use in the electric utility industry (environmental reporting, risk management, sustainability, potential to climate change mitigation). The concept of modeling ecosystem services, while relatively new to the electric utility industry, could provide insight behind the actual value of services the environment provides.
	Agency Lead	TVA Technology Innovation
	Risk or Opportunity	Natural Resources
	Scale	National and regional
	Timeframe	Beginning FY 12-FY13.
	Implementation Methods	Project in testing phase.
	Inter-Governmental Coordination	Partner coordination between EPRI utility members involving model scenario development.
	Resource Implications	TVA project participation will be managed using existing TVA Project Manager resource. TVA will be dedicating non-appropriated funds, as practicable.
	Challenges/Further Considerations	Continued funding.
	Highlights of Accomplishments to Date	Scope of work under development.

E. Actions to *Address* Climate change Risks and Opportunities

Table 3 identifies the actions TVA will continue or initiate in FY2013 and beyond to address climate change risks and opportunities to its mission, programs, and operations. Progress is expected to continue subject to budget approval and constraints.

Table 3. TVA Actions To *Address* Climate Change Risks and Opportunities

Action Name **Internal Climate Change Adaptation Oversight Process**	**Action Description**	This action focuses on the identification of an internal process to ensure TVA has the needed capacity and organizational structures in order to effectively assess agency specific climate change risks and opportunities and implement appropriate adaptation actions.
	Agency Lead	TVA Policy and Oversight
	Risk or Opportunity	Efficient and effective oversight processes
	Scale	Regional
	Timeframe	FY2013
	Implementation Methods	Creation and maintenance of high-level process map
	Inter-Governmental Coordination	None.
	Resource Implications	TVA will be dedicating non-appropriated funds, as practicable.
	Challenges/Further Considerations	Organizational reorganization.
	Highlights of Accomplishments to Date	TBD
Action Name **External Coordination Efforts**	**Action Description**	This action focuses on the identification of an internal process to coordinate its adaptation planning with related efforts among state, local, tribal, and territorial partners. These efforts include TVA participation in the Appalachian Land Conservation Cooperative (LCC) and the Southeast Climate Science Center (CSC).
	Agency Lead	Policy and Oversight
	Risk or Opportunity	Efficient and effective oversight processes
	Scale	Regional
	Timeframe	FY2013
	Implementation Methods	Creation and maintenance of a high-level process map; Creation and maintenance of external adaptation project coordination table
	Inter-Governmental Coordination	Project Dependant
	Resource Implications	TVA will be dedicating non-appropriated funds, as practicable.
	Challenges/Further Considerations	Organizational reorganization.
	Highlights of Accomplishments to Date	TBD.
Action Name **Dry Ash Handling and Storage**	**Action Description**	TVA has developed plans to eliminate all wet ash and gypsum storage at its operating coal-fired power plants and convert the ash and gypsum systems to dry storage. The movement away from wet fly ash systems will help to reduce the overall use of water in TVA's power generation facilities and help to meet sustainability goals as required by Executive Order 13514.
	Agency Lead	TVA Policy and Oversight

	Risk or Opportunity	Water availability and use
	Scale	Regional
	Timeframe	FY2010-FY2020
	Implementation Methods	TVA is committed to better management and use of potable and non-potable water resources. For non-potable water, TVA's work to eliminate wet ash handling and storage will cut non-potable water use by 13% by FY 2012 and 11% by FY2013.
	Inter-Governmental Coordination	TVA is coordinating this work with the DOE Federal Energy Management Program (FEMP) and reporting progress through its Annual Report on Energy Management and OMB Scorecard.
	Resource Implications	TVA expects the overall program to cost $1.5 to $2 billion dollars. TVA will be dedicating non-appropriated funds, as practicable, at its discretion.
	Challenges/Further Considerations	Achievement of the goal is contingent upon TVA Board approval of individual ash/gypsum dewatering projects.
	Highlights of Accomplishments to Date	TVA has already shown a reduction of 949 million gallons of non-potable water in FY2011. The target for 2020 is 23,000 million cumulative gallons of reduced non-potable water consumption.
Action Name **Greenhouse Gas Reduction**	**Action Description**	TVA's Environmental Policy states the environmental objective that TVA "will stop the growth of emissions and reduce the rate of carbon emissions by 2020 by supporting a full slate of reliable, affordable, lower CO_2 energy-supply opportunities and energy efficiency. With EPA agreements and its own long-range plans, TVA has announced plans to retire 18 older coal-fired generation units at three power plants. The retirements, which include about 1,000 megawatts of coal-fired capacity previously slated for idling, meaning TVA will have idled or retired about 2,700 megawatts of its 17,000 megawatts of coal-fired capacity by the end of 2017. The capacity will be replaced with low-emission or zero-emission electricity sources, including renewable energy, natural gas, nuclear power and energy efficiency. In accordance with EO 13514, TVA has set additional GHG reduction targets for Scope 1, 2 and 3 activities and annually reports its progress as part of its Strategic Sustainability Performance Plan. TVA has developed plans to reduce Scopes 1 and 2 greenhouse gas (GHG) emissions through facility energy reductions, and use of renewable energy. TVA has developed plans to reduce Scope 3 Greenhouse Gas emissions through energy reductions in leased facilities (not included in Scopes 1 and 2), reduction in business travel and employee commuting, reductions in transmission and distribution losses associated with Scope 2 energy and reductions in solid/liquid waste. These actions will also help to meet sustainability goals identified by Executive Order 13514.
	Agency Lead	TVA's Internal Energy Management Program
	Risk or Opportunity	Opportunity is a reduction in GHG emissions which could reduce the impacts of climate change.
	Scale	Regional. Scope 1&2 Target is a 17% reduction. Scope 3 Target is a 20.7% reduction.
	Timeframe	FY2008 to FY 2020
	Implementation Methods	TVA is committed to reduction in energy used to power buildings and fuel vehicles. FY 2013 goals are a 9.8% reduction in Scope 1&2

		GHG emissions and 6.7% reduction in Scope 3 emissions
	Inter-Governmental Coordination	TVA is coordinating this work with the DOE Federal Energy Management Program (FEMP) and reporting progress through its Annual Report on Energy Management and OMB Scorecard.
	Resource Implications	TVA plans to spend $17 million FY 2012 – FY 2013. TVA will be dedicating non-appropriated funds, as practicable, at its discretion.
	Challenges/Further Considerations	Organizational reorganization.
	Highlights of Accomplishments to Date	TVA has been working to reduce energy use in its facilities since the late 70's. To date TVA facilities use almost half the energy of the average Federal building energy use.