

Welcome!

The Meeting will begin at 9:00 AM Eastern



Regional Energy Resource Council

May 18, 2021

4th Meeting – Term 4

Virtual

Welcome





Living our History of Service Every Day Since May 18, 1933





Happy Birthday TVA

RERC Virtual Meeting

- This is the 4th and last meeting of the 4th term of the RERC.
- This meeting is being recorded. A link will be provided on the TVA RERC Website (tva.gov/rerc).

• We welcome members of the public attending and who are in listen only mode. For those that pre-registered to make public comments, the meeting host will unmute your line at that time. Written comments are always welcomed (tva.gov/rerc).

• **RERC Members are able to mute and unmute their own line.** Please keep yourself on mute until you wish to speak. RERC Members may use the raise hand function to be recognized for questions or comments.



Safety First!



Rivers, Lakes and Reservoirs

- Check local conditions
- Stay away from spilling dams when boating and fishing
- Watch for people being pulled behind boats
- Have proper safety gear
- Tell someone where you will be and when to expect you back



Term 4 Issues Covered and Advice Topics Issues Advice

- Coal Ash Management
- Improving TVA's transparency
- TVA's Vonore Battery Project
- Impacts of COVID-19 on TVA's energy system (Internal and external)
- TVA's Electric Vehicle Strategy
- **TVA Valley Partner Initiative**
- Southeast Energy Exchange Market
- 2019 IRP Near-term actions
- Sustainable Carbon reduction strategy
- Innovative research initiatives
- Asset management strategy 7

- How TVA can partner with other entities to remove barriers to EV adoptions
- Gaps in TVA's EV strategy
- Improvements to TVA's Sustainability Report (Joint meeting with Regional Resource Stewardship Council)
- Preparing for the Energy System of the **Future**



Introductions

Name

Organization

Key take-away from Term 4



Term 4 RERC Members – Introductions

Name, Organization, Position What was a key take-away for you during Term 4?

Michael Butler Tennessee Wildlife Federation

Dr. Bill Carswell University of Alabama, Huntsville (ret'd)

Erin Gill City of Knoxville

Rodney Goodman Habitat for Humanity

Dana Jeanes Memphis Light, Gas, and Water

Matt Largen Williamson, Inc. **Jonathan Levenshus** Sierra Club

Peter J. Mattheis Tennessee Valley Industrial Committee

Jennifer Mundt, RERC Chair State of North Carolina

Alice Perry State of Mississippi

Doug Peters Tennessee Valley Public Power Association

Dr. Kari Babski-Reeves Mississippi State University Patrice Robinson Memphis City Council

Charles Snavely Commonwealth of Kentucky

Alexa Voytek State of Tennessee

Clay Walker NETWORKS Sullivan Partnership

John Warren Commonwealth of Virginia

Lloyd Webb Olin Chlor Alkali



May 18, 2021 RERC Meeting

All times are EDT

Agenda

9:00	Welcome – Jennifer Mundt, Althea Jones and Designated Federal Officer Melanie Farrell
	Safety, Introductions, Agenda
9:30	Public Listening Session
10:00	TVA Update
10:15	Asset Strategy
11:00	Break
11:15	Energy System of the Future
11:45	TVA's Signature Transformative Innovation Initiatives
12:15	Advice Discussion
12:45	Lunch Break
1:15	Review and Approve Advice
2:00	Closing Remarks and Adjourn



Advice Question

Having heard how TVA is preparing for the energy system of the future, are there other actions that TVA should consider to reach its goals?



Public Comment



This is a listening session; responses are typically not provided



Thank You



TVA Update

Melanie Farrell, Designated Federal Officer

- TVA Board of Directors
- TVA Safety Record Set
- Memphis Update
- FERC Filing
- Electric Vehicle Partners
- Southeast Energy Exchange Market SEEM



Southeastern Energy Exchange Market

SEEM is a group of energy companies serving electricity customers across a wide geographic region in the southeastern U.S. is exploring an integrated, automated intra-hour energy exchange with goals of lowering costs to customers, optimizing renewable energy resources and helping maintain the reliable service we provide today



Southeast Energy Exchange Market (southeastenergymarket.com)



Asset Strategy

Brian Child – Vice President, Enterprise Planning

Jacinda Woodward – Senior Vice President, Power Operations

May 18, 2021



2019 Integrated Resource Plan (IRP)

The 2019 IRP evaluated scenarios and options to meet the Valley's future electricity needs, striving to achieve six key goals based on least-cost planning principles



The IRP identified the <u>strategic direction</u> for TVA's asset plans that will continue to support affordable, reliable, and cleaner energy for the customers we serve; along with <u>near-term actions and key signposts</u> to monitor.



IRP Utilized a Rigorous Analytical Process



Stakeholder and public comments informed additional sensitivity analyses to test the impact of changes in key assumptions



The Future of Our Energy Supply



All portfolios point to a TVA power system that will be LOW-COST, RELIABLE, and CLEAN



In addition to providing the strategic direction for our future energy supply, the 2019 IRP recommended near-term actions that have been integrated into asset strategy initiatives.



Signpost Changes Since the IRP

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Demand for electricity

• Increased industrial load, partly offset by COVID-19 impacts



Natural gas prices

Lower fundamental prices over the long term



Customer expectations

· Acceleration of renewables due to customer demand

Regulatory requirements

• Biden policy shifts on climate change, pipeline challenges, Effluent Limitation Guidelines rule, etc.



Operating costs for existing units

• Better understanding of fleet investments needed, helping inform portfolio direction



Solar and wind costs

Competitive solar RFP offers, with forecasts pointing to continued decline



Emerging and developmental technologies

• Continued advancements in storage; DOE and utility interest in advancing Small Modular Reactors







Capacity aligns to 10-K Net Summer Capability, adjusted to include demand response programs and Browns Ferry Nuclear uprates. Planning capacity is lower, as it accounts for Hydro and Renewable expected generation at peak, fuel blend derates, and other factors.

Resource Planning Continuum

MORE "TACTICAL"

MORE "STRATEGIC"

2020	2025	2030	2035	2040+	
More certainty in forecasts and available technologies				Less certainty in forecasts and evolving technologies	
Activities are underway for approved actions	ROBUST	INFORMATION	A f N F a c	Analysis provides indications of future system needs and risks	
Long-lead time activities will begin to help meet system needs in 2025-2030	SUPPORT FOR A FUTURE SYSTEM	TO GUIDE ROBUST DECISIONS		Plan will evolve with signposts and as we gain experience operating a changing fleet	
More tactical plan is needed for the first 10 years, as timing is more critical				Runway to explore and develop options in the first 10 years to enable future paths	

Planning is an iterative process, evolving with tactical experience and evolving signposts



Asset Strategy

TVA's asset strategy was developed based on 2019 IRP strategic direction, near-term actions, and key signposts, grounded in least-cost planning, and includes the following initiatives:

			5	Ŧ	8	
Coal	Natural Gas	Nuclear	Hydro	Solar/Wind	Storage	EE & DR
Retire Bull Run in 2023 Align additional coal retirements with cost, condition, and environmental drivers	Continue evaluation of market options Modernize the combustion turbine fleet Use as bridging technology to integrate renewables	Improve overall fleet performance Renew nuclear fleet licenses Explore advanced technologies	Invest to recover and sustain performance Evaluate pump options Optimize flexibility	Add solar based on economics Partner with customers to meet their renewable goals Optimize location and procurement	Demonstrate battery storage use cases Research and develop emerging storage options	Continue to invest in low income programs Conduct energy program market potential study Support integrated planning efforts
Transmission						
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Asset Strategy Decision Making Process

In order to make the best possible recommendation to the Board, we start with a number of considerations, which inform the development of plans. The plans are then modeled, adjusted, and refined as new information becomes available.



Plans must go through a series of steps before recommendations are made to the Board. Decisions require Board approval.



Coal Fleet Retirement

Established planning assumptions related to the retirement of all remaining coal by 2035 Orderly workforce transition

Economic development in impacted communities

Planning for resources needed to fill the energy void that will be created



Most Coal Built in the 1950s and 1960s is Retired

TVA's coal plants are operating well beyond their original book life and are among the oldest still in operation in the nation.



Weighted Average of Operating Date; Source: EIA



Coal Fleet Performance is Challenged, Driving Cost and System Reliability Pressure



Includes Outside Management Control events. Peer data to calculate CY2020 quartile values was unavailable at the time of report generation. TVA's coal fleet availability ranks in the bottom quartile in a regional peer comparison.

Significant unplanned outages are a symptom of deteriorating material condition, with high outage rates at Cumberland, Gallatin, and Kingston and a deteriorating trend at Shawnee.



Gas Fleet

Combustion-turbine natural gas plant upgrades

Natural gas generation is also necessary to support reliability as we expand our renewable energy supply





Natural Gas as a Bridge

- Reduces energy derived from coal
- Enables solar energy expansion
- Maintains system reliability and resiliency
- Enhances decarbonization strategy





Solar Generation Expansion

Targeting **10,000 MW** by 2035 with 2,300 MW already committed

Diverse and Cleaner Energy Mix



Graph represents energy. FY30 forecast is based on current planning assumptions in the FY21 Trajectory. EE includes TVA Energy Efficiency Program impacts on a Net Cumulative Realized at System basis, 2007 base year, and excludes energy efficiency effects from external factors.



Solar and Wind Generation Profiles





Solar Introduces Operational Challenges



Gas, storage, and hydro can play a role in integrating intermittent solar generation.

Approaching 7,000 MW of solar penetration, the system will experience more rapid changes in demand net of solar generation, especially prominent in the spring

It will be important to coordinate the pace of solar additions in the 2020s with actions that enhance flexibility and enable successful integration, such as:

- Coal retirements
- Newer, more flexible gas additions
- Storage additions



Change Management and Communications Plan: Key Takeaways

An effective change management and communications plan is critical to executing TVA's Asset Strategy and Decarbonization efforts, grounded in least-cost planning and evolving signposts. Change management and communications efforts will be aligned with efforts focused on:

- Gaining stakeholder input and support on the asset strategy and carbon reduction plan
- Integrating lessons learned from past asset decisions
- Ensuring consistent messaging across stakeholder groups
- Coordinating stakeholder engagement and outreach



Key Stakeholder Analysis

Key stakeholders include employees, customers, government, interest groups, and others. Engagement plans are being developed for each stakeholder group, including a tracking mechanism to record all stakeholder interactions.

Stakeholder Group		Includes:	Stakeholder Group		Includes:	
000	Employees	 Impacted Employees Plant Leadership Corporate Support Other Employees 	interest (Associat	Groups and ions	 TVPPA TMEPA AVI TVIC Utility Assns 	 Seven States RERC RRSC SIERRA Club SACE
	TVA Board	TVA Board Members	Retail Ra	atepayers	Retail RatepayersLPCs (for regulatory of the second sec	compliance)
Ⅲ	State and Local Government	 State Governors State Legislators Local / Municipal leaders State Regulators 	Direct Se	erves •	 Large Commercial an Federal Agencies/Ins Universities 	d Industrial Customers tallations
	Federal Government	Federal LegislatorsExecutive BranchFederal Regulators	Local Po	wer Companies	Municipals and CoopLong-term Partners	eratives
, CO	Media	Local MediaNational Media	Potential	Ind. Customers	 Potential Industrial Co State / Local Economic 	ustomers ic Dev. groups
1000	Community Groups	Local OrganizationsLocal Non-profits	Business	Partners	VendorsSupply Chain Partner	S
ê Î	Bargaining Units	Trades and Labor Council	Financia	I Community	InvestorsRating Agencies	



Timeline and Future Board Engagement




Workforce Strategy | Key Elements

- Finalize the long-term asset plan
- Work toward a 5-year rolling window of certainty for staffing needs
- Understand the impact on employees caused by reduction of current and future staffing needs
- Provide opportunities for employee transition, such as training, movement to other plant or business unit positions, VRIF, and identification of external opportunities



Employee and union partner input will be critical to developing and executing this strategy









Energy System of the Future: Building a Sustainable, Clean Future

Rebecca Tolene – Vice President, Environment Chief Sustainability Officer



Why continue to drive sustainable decision making and a move to a cleaner future?

- Strengthens our ability to attract and retain major businesses that create jobs and support economic growth in the Valley
- Customer demand
- Climate requirements and policy direction
- Protects and preserves the environment and the value of public power for future generations



TVA Sustainability and Carbon Reports







tva.com/carbon



What is Sustainability at TVA?



Annual Sustainability Program Cycle

Plan is to move from only reporting on past performance to driving strong sustainability continuous improvement.





RERC Advice on TVA's Sustainability Report / Program

How could TVA improve its Sustainability Report and raise awareness of its Sustainability Program?

- Create an easily accessible and interactive Program website;
- Refer to the triple bottom line People, Prosperity, and Planet;
- Make the program and content consumable for the average person;
- Use more graphics and less verbiage in the report;
- Continue its outreach to the investor community (on ESG calls);
- Add sustainability topics to regular meetings / briefings with direct served customers, local power companies, and local governments / municipalities;
- Create special sections targeting specific audiences.

What priority areas should TVA target for improvement in its Sustainability efforts?

- Simplify the report and prepare an Executive Summary.
- Create a short report with links to more content
- Use an Appendix for providing detail
- Focus on the future and integrate with other key strategic and financial plans;
- Set out challenges and risks of short- and long-term goals;
- Define the multiple audiences;
- Compare TVA to other entities using GRI;
- Focus on TVA short and longer term priorities.

Advice summarized from December, 2020 RERC Meeting held in conjunction with the RRSC.



Sustainability Areas



Environment

- •GHG Emissions
- Air Quality
- •Water quality and availability
- •Waste Management
- •Habitat and Biodiversity Protection

Governance

- Transparency
- •Board and Executive Diversity
- •Systemic Risk Management •Ethics
- •Cyber and Physical Security

Social/Community

- •Public Health and Safety
- Environmental Justice
- •Community Vitality and Engagement
- •Reservoir and Stewardship Benefits

Economic

- Energy Affordability
- •Reliability & Resiliency
- Jobs Created/Retained
- Flood Management
- •Business Model

Employees

- Safety
- •Diversity and Inclusion
- Labor Relations
- •Recruitment, Development, and Retention
- Skilled Workforce Availability

Partnerships

- •LPC Partnership Health
- Investor Relations
- Supplier Partners
- Public Policy Relations



Leadership Today - Goals are Important, But Action is Key

TVA is an industry leader in carbon reduction – already reducing carbon emissions by 63% from 2005 levels. We aspire to achieve net-zero carbon emissions by 2050, and to support broader national efforts to decarbonize the economy.



PERCENT REDUCTION IN CO2 EMISSIONS (TONS)'

¹ Annual CO2 emissions normalized by generation. Data captures emissions only from owned or controlled generation capacity and is reported on a calendar year basis. Data Sources: U.S. Energy Information Administration, U.S. Environmental Protection Agency.



Guiding Principles

There is not a single solution to decarbonization, but we have identified guiding principles that we know will be part of any path forward. TVA will:

- Prioritize the needs of Valley stakeholders- maintain RELIABILITY AND AFFORDABILITY
- Use best available science and support RESEARCH
- PARTNER with customers and communities on economy-wide ELECTRIFICATION

- NUCLEAR and HYDRO generation and a strong TRANSMISSION GRID are crucial
- Be TRANSPARENT with STAKEHOLDERS in measuring and sharing our progress; LISTEN and work effectively
- Adapt and be willing to CHANGE as technology advances





A Framework to Evaluate Clean Energy Options



ROUTINE STRATEGIC PLANNING



TVA'S DECARBONIZATION JOURNEY





Progress We have reduced our mass carbon emissions by 63% from 2005 levels.

Plan Our current asset plan supports a 70% reduction in carbon intensity by 2030.

Path We are working on pathways, including advanced nuclear and additional renewables, that would lead us to an approximate 80% reduction by 2035.

Purpose

We are exploring new technologies and options and aspire to net zero emissions without compromising the low rates and reliability that sustain the communities we serve and while supporting the region's growing clean energy economy.







TVA's Signature Transformative Innovation Initiatives

Joe Hoagland - Vice President, Innovation and Research

Amy Henry - Director, Research & Technology Innovation

May 18, 2021



Market Changes

Market changes reflect changing stakeholder expectations.

2/3

Two-thirds of utility respondents' top driver for grid transformation is **improving reliability**, according to a 2020 survey. ~50%

Significant customer **load shifts** resulting from COVID-19 resulting in load declines and ~50% of people **working from home**. \$7T

By the end of 2020, all active BlackRock (fund manager of \$7T assets worldwide) portfolios and advisory strategies will be fully Environmental, Social and Governance **(ESG) integrated.**

\$1B

Shell plans to spend \$1 billion a year on **Clean Energy** between 2020 and 2030.



Proliferation of **plug-in Electric Vehicles** (EV) models in next two years (65 new models), an increase of 120% over current model availability. **3X**

Distributed Energy Resources

(DER) grew three times faster than central station generation between 2015-2019 in the US. 168 VERSUS 57 GW



Increasing Complexity In the System



integration with system flexibility



Provide peak winter capacity

Smart sensors and control technology

611

Reduce CO₂ emissions



Consider non-wires transmission alternatives



Integrate distributed resources



Carbon Reduction Goals

TVA aspires to achieve net-zero carbon emissions by 2050 and to support broader national efforts to decarbonize the economy.







Arrow size depicts range of carbon reduction.

TENNESSEE VALLEY

AUTHORITY

Transformation of the System



TVA and LPCs must evolve the public power model together to maintain our unique value proposition for the Valley.



Signature Transformative Innovation Initiatives





What is Regional Grid Transformation?







Elements of a Connected Community

A Connected Community uses data and technology to offer new and improved services to its people and businesses.





Working to Make Technologies Affordable

Research, development, and demonstrations are planned to both mature multiple technologies and bend down their cost curves to meet our least-cost planning mandate.





Partnering is Key for Buy-in and Success



TENNESSEE

VALLEY

Engaging Universities, Industry Groups, and Labs



Low Carbon Resources Initiatives

Partnering with LCRI and National Carbon Capture Center to accelerate the development and demonstration of low-carbon energy technologies such as hydrogen and carbon capture; this effort is on track to raise \$100M from the electricity and gas industries

PARTNERS

- Low-Carbon Resources Initiative (LCRI)
- National Carbon Capture Center

Focused Research and Development

Connecting over 100 TVA subject matter experts with EPRI researchers to solve problems throughout the TVA fleet; our participation in 86 research programs leverages outside funding 16:1

PARTNERS

Electric Power Research Institute (EPRI)

University Partnerships

Working with multiple university research partners to support the closure of identified research and technology gaps, to support improved stakeholder relations, and to enhance workforce knowledge and awareness

PARTNERS

- Mississippi State
- Tennessee Tech University
- University of Kentucky
- University of Memphis
- University of Tennessee
- University of Tennessee
 Chattanooga
- Vanderbilt

Demand Response Research

Working with DOE to develop a home energy management system that can aggregate residential demand response and distributed generation

PARTNERS

Grid Modernization Laboratory Consortium



Engaging Venture Capital



Incubatenergy Labs

Partnering with EPRI and other utilities to sponsor a wide range of demonstrations at TVA and around the world. These demonstrations put new tech through real world situations, allowing the sponsors to choose that are ready for scale up

As an example, TVA deployed the LineVision monitoring system on several transmission lines to demonstrate the capability of remote monitoring and optimization of transmission.

PARTNER

 Electric Power Research Institute (EPRI)

Knoxville Entrepreneurial Accelerator

Partnered with ORNL and UT to sponsor an assessment of the Knoxville entrepreneurial ecosystem

This collaboration is now starting to create a Knoxville entrepreneurial accelerator with TechStars, a group that has a history of jumpstarting regional innovation hubs. They surround companies with mentors and a network of corporate partners, investors, and alumni.

PARTNERS

- Oak Ridge National Laboratory (ORNL)
- Techstars
- · University of Tennessee

Strategic Investment Portfolio

Investing a portion of our Asset Retirement Trust in six different venture capital funds. These funds are targeted at early-stage companies creating products that may be of use to TVA in the future. The funds have sponsored 47 companies to date

LineVision is a company in the Clean Energy Ventures Fund.

SIX FUNDS

- Activate
- Blackhorn Ventures
- Clean Energy Venture Group
- Energy Impact Partners
- G2VP
- · The Ecosystem Integrity Fund

Innovation Crossroads

Co-sponsoring our fifth cohort of energy startups at ORNL

This program connects the nation's top innovators with experts, mentors, and networks in technology-related fields to take world-changing ideas from research and development to the marketplace.

PARTNER

 Oak Ridge National Laboratory (ORNL)



Transformative Initiatives Outcomes





Delivering the TVA Mission









Advice Discussion



Advice Question

Having heard how TVA is preparing for the energy system of the future, are there other actions that TVA should consider to reach its goals?



Lunch Break

Please be back by 1:15 p.m. EDT

Welcome Back
Term 4 RERC Members – Vote

Michael Butler Tennessee Wildlife Federation

Dr. Bill Carswell University of Alabama, Huntsville (ret'd)

Erin Gill City of Knoxville

Rodney Goodman Habitat for Humanity

Dana Jeanes Memphis Light, Gas, and Water

Matt Largen Williamson, Inc. Jonathan Levenshus Sierra Club

Peter J. Mattheis Tennessee Valley Industrial Committee

Jennifer Mundt, RERC Chair State of North Carolina

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Charles Snavely Commonwealth of Kentucky

Alexa Voytek State of Tennessee

Clay Walker NETWORKS Sullivan Partnership

John Warren Commonwealth of Virginia

Lloyd Webb Olin Chlor Alkali



Closing Remarks



Thank You

This is the last meeting of the RERC 4th Term. Members of the 5th Term will be selected this summer. The first meeting of the 5th Term will be in October. Thank you for your service to TVA and to the people and businesses in the Tennessee Valley Region.



