

Welcome!

The Meeting will begin at 8:00 AN Eastern



Regional Energy Resource Council

April 18-19, 2023

4th Meeting – Term 5

Welcome



RERC Live and Virtual Meeting

- This is the forth meeting of the 5th term of the RERC.
- We welcome members of the public attending virtually and who are in listen only mode. For those that pre-registered to make public comments, the meeting host will give you instructions for speaking to the Council at that time. Written comments are always welcomed (tva.com/rerc).
- **RERC Members who are attending virtually are able to mute and unmute their own line.** RERC Members who are attending virtually may use the raise hand function to be recognized for questions or comments.
- **RERC Members attending in person**, please turn your light bulb on and I will call on you. I will identify the person I call on so that those attending virtually will be able to identify the speaker. Please use your microphone so that those in the room and those attending virtually can hear your comments.



Safety First!

- In case of fire or other building emergency, exit the doors you entered at the back of the room. Exit the building via the front doors. Turn right and gather outside in the parking lot.
- In case of severe weather, exit the doors you entered in the back of the room.
 You will be guided to an interior room.



Introductions

Name

Position, Organization, Location

What are you looking forward to this season



RERC Term 5* Members

Mike Butler Tennessee Wildlife Federation

Erin Gill** City of Knoxville

Rebecca Goodman Commonwealth of Kentucky

Rodney Goodman Habitat for Humanity

Chrissy Heard State of Mississippi

Dana Jeanes Memphis Light, Gas, and Water

Candy Johnson Urban League of Greater Chattanooga

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Jonathan Levenshus Sierra Club

Sen. Steve Livingston State of Alabama

Pete Mattheis Tennessee Valley Industrial Committee

Dan Miller Oak Ridge National Laboratory

Doug Peters Tennessee Valley Public Power Association

Bailey Recktenwald State of North Carolina

Dr. Kari Babski-Reeves Mississippi State University

Introductions: Name Position, Organization, Location Looking forward to this season

> Patrice Robinson Memphis City Council

Alexa Voytek State of Tennessee

Clay Walker NETWORKS Sullivan Partnership

John Warren Commonwealth of Virginia

Lloyd Webb Olin Chlor Alkali

To Be Appointed State of Georgia

*August 1, 2021 – July 31, 2023 ** Council Chair



Agenda

RERC Meeting – Day 1 April 18, 2023 All times are ET

8:00 am	Welcome – Designated Federal Officer Melanie Farrell & Chair Erin Gill
	Safety, Introductions, Meeting Protocols
	Agenda
8:45	Federal Advisory Committee Act Briefing
8:55	DFO Briefing
9:20	Break
9:30	TVA New Nuclear Program
11:30	Adjourn for Lunch
12:15 pm	Welcome Back
12:20	Council Responds to Advice Questions
1:30	Adjourn Day 1 RERC Meeting



Agenda

RERC Meeting – Day 2 April 19, 2023 All times are ET

7:45 am	Welcome and Recap
8:00	Nuclear Engineering Institute Presentation
8:45	Demand Response Electric Vehicles PURPA Standards
10:15	Break
10:30	Public Listening Session
11:30	Break
11:45	Finalize Advice Statement
1:00 pm	Adjourn Meeting



FAC Meeting Requirements

Jennifer Brundige – Attorney, TVA General Counsel Office April 18, 2023



Federal Advisory Committee Act Meeting Requirements

Agenda

- Prepared and approved by the DFO, or alternate DFO, in consultation with Council Chair
- Distributed to Council and an outline is published in the Federal Register prior to each meeting
- Topics may be submitted for consideration to the DFO by any member of the Council, or non-members, including members of the public

Meeting Minutes

 DFO will ensure that minutes are prepared for each meeting, approved by the Chair, and made available to Council members and the public

Voting

- Any member of the Council may make a motion for a vote
- Quorum is a majority of the seated members of the Council as defined in the bylaws
- Advice requires an affirmative vote of majority of Council members present
- Advice may include minority or dissenting views

Membership

- Balanced Membership
- Professional or personal qualifications to achieve the mission of the Committee
- Broad range of diverse views and interests



TVA Update

Melanie Farrell, Designated Federal Officer



New TVA Board Members

Joe Ritch Wade White Michelle Moore Beth Geer William Renick Robert Klein





Significant TVA Updates

- Winter Storm Elliott After Action Review
- Building the Energy System of the Future
 - Cumberland Record of Decision
 - New Pumped Storage Exploration
 - New Nuclear Technology
 - Carbon-free RFP
- Valley Pathways Study
- TVA / DOE Hydropower Technology Development Partnership
- Diversity, Equity, Inclusion, and Accessibility (DEIA) Report



May 2022 Meeting Recap

Signature Transformative Innovation Initiatives



BREAK



Advice Questions

The New Nuclear Program established by the TVA Board in February 2022 provides a roadmap for TVA's exploration of advanced new nuclear technologies to accelerate progress toward its aspiration of a net-zero carbon future.

- 1. What other considerations should TVA take into account in implementing the New Nuclear Program?
- 2. What are the topics and methods for stakeholder engagement that TVA should consider in implementing the New Nuclear Program?



TVA Nuclear Overview: New Nuclear Program

Presented by Scott Hunnewell VP - TVA New Nuclear Program



Agenda

- TVA, Decarbonization and SMRs
- Technologies
- Workforce Development
- Future Siting
- Discussion



Tennessee Valley Authority

- TVA is a federal corporation
- Largest public utility in the US.
- TVA currently receives <u>NO</u> funding from the US Government.
- TVA created in 1933 by Congress as part of President Franklin D. Roosevelt's New Deal



TVA's Nuclear Power and Construction Experience our experience & evolution point to advanced nuclear



TVA operates the third largest nuclear reactor fleet in the U.S.

TVA's Watts Bar Unit 2, the nation's first new nuclear generation in 20 years, entered commercial operation in 2016



At any given time, TVA has around 900 active projects totaling \$12 Billion in approved funding for construction and refurbishment projects.



TVA Mission Built for the people of the valley



Since its inception, TVA has innovated to meet the needs of the Valley.

Today and in the future, the Valley needs affordable, reliable, resilient, and carbon-free energy to lead the nation in energy innovation and economic development.





Diverse and Cleaner Energy Mix



FY22 & FY30 forecasts based on the FY22 Budget Power Supply Plan and are subject to change. Please refer to TVA's most recent annual report on Form 10-K and quarterly report on Form 10-Q for a discussion of factors that could cause actual results to differ from these forecasts. TVA Energy Efficiency Program impacts are estimated to reduce total energy needs by about 1.6% in FY22 on a Net Cumulative Realized at System basis, 2007 base year. TVA sells the renewable energy certificates associated with some of its renewable energy to certain customers.



TVA's Decarbonization Journey

ENERGY TECHNOLOGY INNOVATION THAT CAN SUPPORT CARBON GOALS



Base Load Power

Base Load Generation

- Combined Cycle Gas w/ Carbon Capture*
- Current Nuclear Fleet
- Small Modular Reactors
- Hydro

Intermediate & Peak Generation

- Combined Cycle Gas
- Small Modular Reactors
- Wind with Storage**
- Solar with Storage**
- Hydro
- Pumped Storage
- * Carbon Capture under development
- ** Utility Scale Storage under development





Land use efficiency of energy for different energy sources, MWh/year per acre, direct and indirect land use



Source: DOE Pathways to Commercial Liftoff: Advanced Nuclear March 2023



Board Action Summary

- In December 2021, as announced in February 2022, the TVA Board authorized a Program to advance new nuclear considerations. Specifically, the Board authorized:
 - Funding of up to two hundred million dollars (\$200,000,000) for a program to:
 - Perform design engineering, scoping, estimating, and planning associated with potential, future deployment of an Advanced Reactor at Clinch River,
 - Develop content for potential, future license application(s) to NRC for Advanced Reactor design(s),
 - Continue to study potential, future deployment of Advanced Reactors of various designs at Clinch River, and
 - Study potential future deployment of Advanced Reactors of various designs at various sites in addition to Clinch River
- The Board *did not* authorize construction, site preparation, or procurement of long-lead components

Notes on \$200M Authorization:

• <u>Did</u> include *both* Clinch River first unit (aka "The Project") and future fleet scale optimization and planning (aka "The Program") activities

PROJECT-OWNED ACTIVITIES | PROGRAM-OWNED ACTIVITIES



Clinch River Nuclear Project & New Nuclear Program



Reaching NetZero & Fleet Concept

TVA's SMR Journey



Clinch River Nuclear Decision Gate Process PHASED DECISION APPROACH TO REDUCE RISK AND COSTS

Board Authorization required to proceed beyond Decision Gate (DG) for each phase. Enterprise evaluation criteria to support recommendation to the CEO and Board.



AUTHORITY

Criteria Assessed at Each Decision Gate

DECISION GATE CRITERIA

- **Technology Readiness**
- **Planning Readiness**
- **Cost Estimates**
- Schedule Estimates
- Partnering Status / Estimates
- Fit Within the Enterprise

- Each Decision Gate Package contains three elements:
- 1) <u>Documentation</u>: Sufficient details to support approval
- 2) <u>Concurrence</u>: Groups from
- across TVA that review and signoff on documentation
- 3) <u>Approver</u>: ELT member approves the criteria package prior to recommendation for CEO



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Clinch River Nuclear Project TVA'S FIRST ADVANCED NUCLEAR SMALL MODULAR REACTOR*



* SUBJECT TO SUPPORT, RISK SHARING, REQUIRED INTERNAL AND EXTERNAL APPROVALS, AND COMPLETION OF ALL NECESSARY ENVIRONMENTAL AND PERMITTING REVIEWS



Oak Ridge: Tennessee's Nuclear Hub

Lancing Within 15 miles of Clinch Wartburg (62) Heiskel **River Nuclear Site:** Marlov Coalfield **OAK RIDGE** National Laboratory **Bull Run Fossil** Winslow Blair Oakdale (3) (62) (10) 高 CEDAR B ISNC **Kingston Fossil** Farragut ULTRA SAFE NUCLEAR **Clinch River** Cedar Grove Nuclear Eaton **Kairos Power** 58 72 Midway Friends Binfield 323 Philadelphia ...and more. Ten Mile Greenback



Clinch River Nuclear Site History

MANHATTAN PROJECT TO TVA'S FIRST SMALL MODULAR REACTOR*





* Subject to support, risk sharing, required internal and external approvals, and completion of all necessary environmental and permitting reviews



Site Development

NRC Early Site Permit



Nation's First

Small Modular Reactor Early Site Permit Clinch River Site





Site Layout




Clinch River Nuclear Project Proposed Site Layout

Potential Future UNIT 2*

PROJECT TRAILER (TEMPORARY LOCATION)

YOU ARE HERE

Proposed UNIT 1*

FORMER BREEDER REACTOR PROJECT LOCATION

FOR ILLUSTRATIVE PURPOSES ONLY; FINAL SITE PLAN SUBJECT TO CHANGE

*subject to support, risk sharing, required internal and external approvals, and completion of all necessary environmental and permitting reviews

TVA Vision for Advanced Nuclear

STRATEGICALLY MOVING FORWARD FOR THE PEOPLE OF THE VALLEY

Leadership Experience **Approved Site** Strategic *= Approach Future-Looking ()

TVA's leadership in technology innovation provides a pathway to net-zero carbon emissions.

TVA has the nuclear and construction experience and talent to support small modular reactor (SMR) development and deployment.

TVA's Clinch River site is approved by the Nuclear Regulatory Commission for SMRs.

TVA's Decision Gates will ensure the timing of deployment is right.

TVA's Advanced Nuclear Program will inform future SMR decisions and potential deployment locations across the Tennessee Valley.



Advanced Nuclear Technology

- Power Output ~300 MWe or less, in contrast to the >1,000 MWe reactors operating today
- Two general categories of Advanced Reactors of interest for commercial power use:
 - Light water-cooled reactors, or small modular reactors (SMRs), are most like current operating reactors but simplified (Generation 3+).
 - Nonlight water-cooled reactors, sometimes called Generation 4 reactors, use alternative reactor coolants such as gas (helium), metal (sodium), or molten salt.



Source: Idaho National Laboratory Website



Emerging Technologies

Light water reactors

- SMR Pressurized Water Reactor (PWR), Lower Power Unit
- SMR Pressurized Water Reactor (PWR), Higher Power Unit
- SMR Boiling Water Reactor (BWR)

Non-light water reactors

- Thermal, Molten Salt, Graphite Moderated
- Thermal, Fluoride Salt Coolant, Graphite Moderated
- High Temperature Gas, Graphite Moderated, Helium
- Molten Chloride Fast Reactor
- Micro Reactor







GEH BWRX-300 Design FIRST-OF-A-KIND & TRADITIONAL PLANT COMPONENETS





GE-Hitachi BWRX-300

CLINCH RIVER NUCLEAR PROJECT'S SMR TECHNOLOGY

TVA identified GEH's innovative BWRX-300* reactor design as the most promising for near-term deployment.



This provides confidence the technology can be rapidly deployed on a predictable schedule with acceptable risk.

*TVA has not yet decided to deploy an SMR. Any decisions will be subject to support, risk sharing, required internal and external approvals, and completion of all necessary environmental and permitting reviews



GEH BWRX-300

Passive safety design combined with innovative features eliminates numerous systems reducing costly surveillances and maintenance.

- No Recirculation Pumps
- No Variable Frequency Drives
- No Jet Pumps
- No High Pressure Coolant Injection pump
- No Reactor Core Isolation pump
- No Emergency Core Cooling System
- No Standby Liquid Control
- No Emergency Diesels
- Control Room Not Safety Related



GEH BWRX-300

Innovative construction

- A circular slurry shoring wall is installed in the softer upper soil
- Removal of the soil within the shoring wall
- Excavation is continued through the rock down to the mud mat elevation
- Waterproofing is applied to the surface of the slurry wall and the rock face
- Build from the mud mat up with SteelBricks[™] technology (Registered trademark of Modular Walling Systems)



ELIMINATES ONE MILLION CUBIC YARDS OF EXCAVATION AND ENGINEERED BACKFILL



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HITACHI



BWRX-300 Small Modular Reactor

DOE's Nuclear Reactor Innovation Center

NRIC project objectives

Demonstrate multiple technologies used in other industries

- Vertical shaft construction, a best practice from the tunneling industry that could reduce construction schedules by more than a year
- Steel Bricks[™], modular steel-concrete composite structures, much like high-tech LEGO[®] pieces, which could significantly reduce the labor required on site
- Advanced monitoring, coupled with digital twin technology, which can create a digital replica of the nuclear power plant structure



Modular steel-composite construction system (Source: Modular Walling Systems)



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HITACHI

Technology Beyond the Plant

- Technology In Flight
 - Smart Procedures
 - 4D Modeling
 - Interconnected Electronic Design Basis Documents
 - Wi-Fi/Bluetooth Connectivity Throughout Plant
 - Integrated Camera Capabilities



Graphic Source: Georgia Power Vogtle Website



Planning/Construction Phase Workforce

- Planning Phase Workforce
 - Project Management Professionals
 - Engineers
 - Licensing Specialists
- Construction Phase Workforce (adds ~2000 craft) (notional examples only)
 - Carpenters
 - Boilermakers
 - Electricians
 - Pipefitters

A first-of-a-kind reactor project, incorporating new technologies and techniques, will require an integrated team approach across all disciplines and organizations.

TIMEFRAMES

~ 2 years to develop an NRC Construction Permit Application (CPA) and to identify / evaluate risks of deciding to proceed to a Project

~ 2 years for NRC review of the CPA and to develop plans for construction readiness

~ 5 years of construction and testing, prior to commercial operation



Operational Phase Workforce

- Similar to Current Operating Reactors
 - Operations and Maintenance Professionals
 - Chemists and Radiological Protection Specialists
 - Security Force Members
 - Managers and other professionals
- Fleet Services to Support Specialty Needs (notional examples only)
 - Refueling and Outage Workers
 - Inspection and Other Maintenance Specialists
 - Training Professionals
 - Engineers
 - Planners and Schedulers
 - Licensing Specialists







Workforce Development

- Experience and skills from a variety of sources
 - Experienced professionals from within TVA
 - Experienced professionals from within the US Nuclear Industry
 - Regional College Graduates (primarily engineers, some finance, communications, etc.)
 - Nuclear Navy and other Military Veterans
 - Local workforce
- Timing of needs
 - Identifying needs during Planning phases
 - Engaging partner organizations on training and education
 programs
 - Building TVA technology specific training programs





How is TVA Helping?

- TVA has developed a 10-year labor strategy
- Partnered with the North America's Building Trades Unions to complete a labor supply survey
- Created a 10-year labor forecast for 32 NABTU T&L categories
- Half of the categories have forecasted labor shortfalls
- TVA is partnering with the Unions to identify a diverse talent pipeline through apprenticeship volume and curriculum
- TVA is working with local universities to identify areas of need that require specialty training such as RP Techs, Chem Techs

Goal is to have a diverse, talented workforce that can support the needs of the Valley for the foreseeable future!



TVA Partnerships

- TVA has entered into a consulting and licensing support agreement with **Kairos Power** as part of Kairos Power's HERMES test reactor project, near Oak Ridge, TN
- TVA has entered into a consulting and licensing support agreement with **Synthos Green Energy**, an energy company in Poland, to advise it regarding potential, future SMR projects in Poland
- TVA has partnered with Oak Ridge National Lab
- TVA has partnered with University of TN Knoxville
- TVA and OPG have executed a collaboration agreement that facilitates exchanges of information about the respective projects at Clinch River and Darlington, Ontario
- TVA has entered into a two-party agreement with GE Hitachi to support the development of a Construction Permit Application for Clinch River-1



 TVA, OPG and Synthos are negotiating a contract to jointly fund and develop the standard design of the GEH BWRX-300



TVA's Preparation for Potential SMR Fleet





Future Siting Major Assumptions

- The specific technology for SMRs and advanced reactors is not limited to GEH BWRX-300
- Bias towards TVA existing properties
- Bias towards coal generation sites
- Bias towards sites located in Energy Communities (as defined by Inflation Reduction Act)



Future Siting Enterprise Engagement

- Early discussions and preliminary input from a few Enterprise groups
 - Enterprise Planning
 - Strategic Real Estate Group
 - Transmission Ops and Planning
 - Innovation and Research (Pumped Storage and Battery Initiatives)
- Synergies
 - SREG "Play Books"
 - Holistic Asset Strategy Core Team
 - Resource Strategy Team



Identification of Future Sites

EARLY SITE IDENTIFYCATION CAN ENABLE ACCELERATED SMR DEPLOYMENTS

Siting Study Phase 1 - March 31, 2023

- Existing TVA property (Phase 1)
- EPRI Siting Guide methodology
- Rating matrix with broad set of criteria
- Includes enterprise criteria and SME input
- Report supports NRC licensing and TVA NEPA

Site Selection - September 30, 2023

- Alignment on TVA Environmental process
- Identify top sites for further investigation/development
- FY24 Begin site data and environmental data updates





Future Site Development

REDUCE FUTURE DEPLOYMENT TIMELINES WITH "CONSTRUCTION READY" SITES

- Update site and environmental data FY 2024
 - Environmental reconnaissance and investigation
 - Site characteristics for NRC licensing (meteorology, hydrogeology, geology, seismology)
- Obtain NRC and Environmental approvals in advance - FY TBD
 - Establish "construction ready" sites to reduce risk and enable options
 - Sites ready for construction, without 4 5 year permitting delays





Closing

- We are using a methodical and risk informed approach to developing and estimate and schedule for an SMR at the Clinch River Site
- We are developing a strategic plan for a potential fleet of Small Modular Reactors to support TVA's aspirational goal of being carbon neutral by 2050
- Multiple technologies will be part of TVAs future, SMRs are one solution under consideration.



Questions?







Meeting resumes at 12:15 PM EDT



Welcome



Acvice Questions Discussion



Advice Questions

- With regards to the program established by the TVA Board to pursue New Nuclear Technology, are there additional areas or aspects that TVA should consider in the implementation of the program?
- What are the topics and methods for stakeholder engagement that TVA should consider with the implementation of TVA's New Nuclear Program?



Adjourn



Meeting begins at 7:45 am EDT tomorrow





Welcome!

The Meeting will begin at 7:45 ANN Eastern



Regional Energy Resource Council

April 18-19, 2023

4th Meeting – Term 5

Welcome



Agenda

RERC Meeting – Day 2 April 19, 2023 All times are ET

7:45 am	Welcome and Recap
8:00	Nuclear Engineering Institute Presentation
8:45	Demand Response Electric Vehicles PURPA "Shall Consider" Standards
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10:30	Public Listening Session
11:30	Break
11:45	Finalize Advice Statement
1:00 pm	Adjourn Meeting



New Nuclear Energy

TVA FACA Regional Energy Resource Council

April 19, 2023

Marc Nichol Senior Director, New Reactors





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Nuclear Provided Over 50% of Clean Electricity



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Nuclear generated 19% of electricity in the U.S.

From 92 reactors at 53 plant sites across the country

KEY

Nuclear power reactor

Voices for Nuclear



"The United States views nuclear energy as a pivotal technology in the global effort to lower emissions, expand economic opportunity, and ultimately combat climate change. We have been supporting the development of SMRs for decades."

Jennifer Granholm

Secretary U.S. Department of Energy November 4, 2021



Republicans have plans to reduce those emissions while investing in clean energy technology that will lead to less emissions, lower costs, and produce as much or more power. Chief among them is advanced nuclear technology."

Rep. Kevin McCarthy (R-CA) February 26, 2020



"If we're going to continue to move and talk about decarbonization and not going to move forward with nuclear we're [going to have] serious problems."

Sen. Joe Manchin (D-W.V.) June 4, 2020



Scan to see what everyone is saying about America's largest clean energy source.
Lowest System Cost Achieved by Enabling Large Scale New Nuclear Deployment



Lowest Cost System



Nuclear is 43% of generation (>300 GW of new nuclear)



Wind and solar are 50%

Energy System with Nuclear Constrained



Wind and Solar are 77% of generation

Nuclear is 13% (>60 GW of new nuclear)

Increased cost to customers of \$449 Billion

Both scenarios are successful in achieving 95% clean electricity grid by over 95% by 2050 and economy-wide GHG by over 60%

Recent Survey of NEI's U.S. Utilities

Nuclear power's potential role in meeting their company's decarbonization goals:



NEI utility member companies produce nearly half of all US electricity.



System Benefits of Advanced Reactors



Long term price stability	• Low fuel and operating costs	
Reliable dispatchable generation	• 24/7, 365 days per year, years between refueling (Capacity factors >92%)	
Integration with renewables and storage	 Paired with heat storage and able to quickly change power 	
Efficient use of transmission	 Land utilization <0.1 acre/TWh (Wind =1,125 acre/TWh; Solar 144 acre/TWh) 	
Environmentally friendly	 Clean energy Many SMRs are being designed with ability for dry air cooling 	
Black-start and operate independent from the grid	 Resilience for mission critical activities Protect against natural phenomena, cyber threats and EMP 	

Source: SMR Start, SMRs in Integrated Resource Planning

Advanced Reactor Developers



Expanding Versatility through Advanced Technology



LWR SMRs <300MW



Oklo (shown) Approximately a dozen in development

NuScale (shown) GEH X-300 Holtec SMR-160 High Temp Gas Reactors



X-energy (shown) Several in development

Liquid Metal Reactors



TerraPower Natrium (shown) Several in development

Molten Salt Reactors



Terrestrial (shown) Several in development

Non-Water Cooled

Most <300MW, some as large as 1,000 MW

NIA Technology Primer: https://nuclearinnovationalliance.org/sites/default/files/2022-07/ANRT-APrimer-July2022.pdf

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Advanced Nuclear Versatility



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Gateway to Heat Markets

Process Heat Temperature Needs



Strong Federal Support for Advanced Reactors

- DOE funding 12 different designs, >\$5B over 7 years
- Infrastructure Bill
 - \$2.5B funding for two demonstration projects
- Inflation Reduction Act
 - PTC: At least \$30/MWh for 10 years
 - ITC: 30% of investment
 - Both can be monetized, include 10% bonus for siting in certain energy communities
 - Loan Guarantees up to \$40B in expanded authority
 - HALEU Fuel \$700M
- CHIPS Act
 - Financial assistance to States, Tribes, local governments and Universities



September 2022

1

Current Federal Policy Tools to Support New Nuclear

The following is a sist of current policy tools that could directly support the deployment of new nuclear, could potentially indirectly support the deployment or planning for new nuclear, and that currently support the deployment of new nuclear.

Programs that Could Directly Support Deployment of New Nuclear

Clean Electricity Production Credit – 45Y

The Inflation Reduction Act created a new technology-neutral tax credit for all clean electricity technologies, including advanced nuclear and power uprates that are placed into service in 2023 or after. The bill does not change the existing Advanced Nuclear Froduction Tax. Credit but precludes credits from being claimed under both programs. The value of the credit will be at least \$30 per megawatt-hour, depending on inflation, for the first ten years of plant operation. The credit phases out when carbon emissions from electricity production are 75 percent below the 2022 level. The following is a link to the studutory language.

https://uscode.house.gov/view.xhtml?req=43y&f=treesort&fq=true&num=2&h1=true&edition=prefim& granuleId=USC-prelim-title26-section43Y

Clean Electricity Investment Credit – 48E

As an alternative to the clean electricity PTC, the inflation Reduction Act provided the option of claiming a clean electricity investment credit for zero-emissions facilities that is placed into service in 2023 or thereafter. This provides a credit of 30 percent of the investment in a new zero-carbon electricity facility, including nuclear plants. Like the other credits, this investment tax credit can be monetized. The ITC phases out under the same provisions as the clean electricity PTC.

https://uscode.house.gov/view.xhtml?req=48E+clean&f=treesort&fq=true&num=4&hl=true&edition=pr efim&granuleId=USC-prefim-title26-section48E

Both the clean electricity PTC and ITC include a 10-percentage point bonus for facilities sited in certain energy communities such as those that have hosted coal plants. The following is a link to the statutory language.

Credit for Production from Advanced Nuclear Power Facilities – 45J

The nuclear production tax credit 26 USC 43J provides a credit of 1.8 cents per kilowatt/hour up to a maximum of \$123 million per tax year for 8 years. Only the first 6000 MW of new capacity installed after 2005 for a design approved after 1993 are eligible for the tax credit. The credit does not include a direct pay provision, so the owner will need to have ordersteing taxable income to claim the credit or transfer the credit to an eligible project partner. The following is a link to the statutory language.

ittp://uscode.house.gov/view.xhtml?reg=production+tax+credit&t=&fq=true&num=1&ht=true&editio n=pretim&granuleId=USC-pretim=title26-section431

Current Federal Policies: https://www.nei.org/CorporateSite/media/filefolder/advantages/Current-Policy-Tools-to-Support-New-Nuclear.pdf



State Policy Options: https://www.nei.org/resources/reports-briefs/policy-options-for-states-to-support-new-nuclear

State Action for Advance Reactors

2022

2023



NÉI

Advanced Nuclear Deployment Plans

Projects in planning or under consideration in U.S. and Canada >20; Globally >30





QUESTIONS?

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Demand Response, Electric Vehicles, and PURPA



Overview

- Demand Response and Electric Vehicle Programs
 - Ray Knotts, Senior Manager, Energy Services and Program
- Demand Response, Electric Vehicles, and Rates
 - Mike Hynes, Director, Rate Design and Administration
- Public Utility Regulatory Policies Act (PURPA) "Shall Consider" Standards
 - Christopher Chandler, Senior Counsel





TVA Demand Response

Ray Knotts Senior Manager

TVA Restricted Information - Deliberative and Pre-Decisional Privileged

Winter Storm Elliott

- IP December events performance highlights:
 - 1612 MW @ 107% performance factor when both IP5 and IP30 called
 - 31-hour long event (12 Economic hours exhausted for IP30)
 - 93 IP participants (40 from IP30 and 53 from IP5)





Demand Response Portfolio

INTERRUPTIBLE POWER (IP)

Suspends a portion of participating customers' load, upon 5 or 30-minutes notice, during time of power system need. Total impact: 1,605 MW

PEAK POWER PARTNERS

TVA-managed program to provide economic load reduction through program delivery partners. Total impact: 55 MW

VOLTAGE OPTIMIZATION

Enables LPCs to operate distribution feeder voltages in the lower half of the standard voltage range to lower peak demand. Total impact: 75 MW







IP Goals

• New capacity: 400 MW by summer and 1,000 MW by winter

 Obtain additional hours from participants for summer 2023 (IP Special Offer 800+MW)





Interruptible Power (IP) 5



TARGET & DURATION

C&I customers with over 1 MW of load and 0.5 MW of dispatchable peak load reduction for unlimited reliability calls with 5-minute notice

COMPENSATION STRUCTURE

Participants receive capacity payments



CAPACITY PAYMENT Non-event month: average on-peak interruptible Event month: > average on-peak interruptible or event demand reduction Range: \$5.20 – \$5.65/kW



IMPACT

550 MW

CONTRACT TERM

5 years (notice period varies from 1-5 years)



Interruptible Power (IP) 30



TARGET & DURATION

C&I customers with over 5 MW of load and dispatchable peak load reduction of 0.5 MW for up to 12 economic hours and unlimited reliability calls with 30-minute notice

COMPENSATION STRUCTURE

Participants receive capacity and energy payments based on event performance



CAPACITY PAYMENT

Non-event month: average on-peak interruptible Event month: > average on-peak interruptible or event demand reduction Range: \$5.25 – \$5.75/kW

ENERGY PAYMENT

Henry Hub Natural Gas for month x 10 heat rate



IMPACT 1055 MW

CONTRACT TERM

5 years (notice period varies from 3-5 years)



Peak Power Partner: Enel X Aggregated Demand Response







TARGET & DURATION

C&I customers with dispatchable peak load reduction for economic calls and unlimited reliability calls with 30minute notice

COMPENSATION STRUCTURE

Participants receive monthly capacity payments and energy payments based on event performance

CAPACITY PAYMENT

Based on nomination

ENERGY PAYMENT

Henry Hub Natural Gas for month x 10 heat rate



IMPACT 55 MW

CONTRACT TERM 3 years initial then rolling



Dispatchable Voltage Regulation



TARGET & DURATION

Local Power Companies optimize distribution-level voltage to reduce peak demand – dispatched with day-ahead notice

COMPENSATION STRUCTURE

Participants received onetime capacity payments pending project completion milestones and energy payments for subsequent events



ENERGY PAYMENT

Henry Hub Natural Gas for previous day prompt month x 10 heat rate



IMPACT 75 MW

CONTRACT TERM 10 years





TVA EV Programs

Ray Knotts Senior Manager Energy Services and Programs

Impacts of Electric Vehicles

Electric vehicles have benefits for the environment, local economies, and residents.

	Electric Vehicle Goal	2%	200,000 EVs in the Tennessee Valley by 2028
食品	Electric Grid Ready	0.5%	Off-peak growth to TVA's Power System; GWhs of energy storage potential
	Benefits to the Environment	~1 mil	Metric tons of CO ₂ saved per year
	Benefits to Local Economies	\$120 mil	Reinvested into local economies per year
\$	Benefits to Consumers	\$200 mil	Consumer fuel savings per year

A <u>Roadmap</u> for Electric Vehicle in Tennessee

In 2019, TVA brought together a broad coalition of EV stakeholders from across the region to identify local market barriers slowing EV adoption and chart a course to remove those barriers





Market Barriers Charging Infrastructure **Vehicle Availability** Innovative & **Supportive Polices**

Consumer Awareness & Education



TVA EV Initiatives

TVA's Approach to Electric Vehicles



Charging Infrastructure Availability

- Remove "range anxiety"
- Foundational EV charging network
- Partner with Local Power Companies (LPCs)



EV Availability and Offerings

- Partner with automakers and fleets
- Support making a wide range of EVs available



Innovative and Supportive Policies

- Remove utility policy or pricing barriers
- Craft policies and pricing that encourage investment and enable a market



Consumer Awareness

- Help consumers make sound choices
- Educate, inform, and promote while lifting TVA and LPC brands

Removing market barriers in key areas

TVA is working with stakeholders to make these initiatives available throughout the Valley



Internal TVA Electrification

TVA's industry leading plans to electrify its vehicle fleet. More than 1,400 EVs will be added to fully electrify light duty vehicles by 2030.

TVA Fleet Electrification

- In 2022, TVA announced plans to electrify 100% of light duty and 50% of medium duty vehicles by 2030
- These targets put TVA among the top tier of announced utility fleet electrification plans nationally
 - Largest electric Fleet in Tennessee
- TVA currently has ~100 EVs for business use including "ValleyRide" car share for employees
 - Nissan, GM, Volkswagen, Hyundai, Mitsubishi, Kia, Ford 150 Lightning pickups
 - 200+ EV chargers installed at TVA work locations





Commercial Fleets

TVA is partnering with electrification specialists to test a consulting service for commercial customers, cities, schools and others that are considering how to electrify their Fleet of vehicles

Testing with Various Use Cases

- Light duty, medium duty, transit, school buses, trucks
- Non-profits, cities, transit, schools, utilities, federal, etc.

EV Fleet Advisor

- Meeting commercial customers where they are in their fleet electrification process (start, middle, end)
- Connecting commercial customers to third-party consulting services
 - Educational resources
 - Vehicle conversion assessment
 - Business case development
 - Deployment planning



TVA, LPC and Consumer Benefits

- Of the ~7 million vehicles on Tennessee roads, ~2 million are fleet (commercial) vehicles
- High use fleet vehicles account for 2-3x the energy use and carbon emissions per vehicle
- "Rational consumers" willing to convert based on EV Total Cost of Ownership rather than personal preferences (more rapid adoption)
- Larger O&M savings potentials can make local businesses more competitive
- More predictable and price sensitive charging behavior can lead to advantageous load shapes
- Additional touchpoint for LPCs to be viewed as trusted energy advisor by commercial customers



Innovative & Supportive Policies: Fast Charge Rates & Policies

TVA offers an energy only fast charge rate option to support investment in public charging. EV <u>rates</u> are TVA regulated to the charging station meter. Station owners set the <u>price</u> for charging services.



Consumer Awareness

EV programs including social media and community charging campaigns are designed to educate, inform and promote the many benefits of electric transportation

EV Awareness Videos

- In Charge Life with an EV video series highlights EV awareness throughout the Valley
- www.energyright.com/EV
- 8 episodes receiving millions of impressions



Nashville – A Day in the Life



Chattanooga – Adventure



Huntsville – Battery & Tech



Knoxville – Economy



Memphis – Range



Florence – Clean Energy



Bristol – Performance

Oxford – Lifestyle





Public Charging Infrastructure Availability

TVA is partnering with local power companies and regional state agencies to develop the foundational charging network with fast charging stations along interstates and major highways at least every 50 miles

Eliminate Range Anxiety

- Network of fast charging stations across seven states
- Ensure drivers can charge at least every 50 miles

LPCs will Install, Own and Operate

- LPCs will secure the charging station site, design and install the station, operate and maintain equipment
- TVA will provide technical specifications and site development guidelines

TVA and Partners Provide 80% Funding

- Programs provide 80% reimbursement of eligible costs
- LPCs will provide at least 20% share of the total project cost





Charging Infrastructure





Charging Infrastructure

Fast Charge Network Update

- 112 Local Power Companies have expressed interest in program
- Partnerships with state agencies (TDEC)
- 60 sites have been contracted or completed with
 - 51 local power companies
 - 6 states
- 4 sites opened in 2022
- Complete by 2026



Demand Response (DR), Electric Vehicles (EVs),

& Rates

Mike Hynes, Director, Rate Design and Administration



All Rate Actions Consider TVA Mission First



Energy - We deliver power at the lowest feasible cost, and we are working to make power rates better for all our customers while keeping TVA electricity safe and reliable.



Environment - TVA's mission of service includes being stewards of the region's natural resources and its public lands and waters.



Economic Development - TVA's reliable, lowcost electricity helps the region recruit industry and keeps power bills lower for the region's homes, businesses and industry.

Regional Energy Resource

TVA Provides Two Primary Electricity Products

Capacity

- To meet instantaneous demand across the valley
- Costs are largely **fixed** in nature our assets

Energy

- To meet hourly energy requirements every hour of the day
- Costs are primarily fuel, purchase power, and are variable in nature


TVA Electric Service



Interval data for Large Commercial & Industrial meter points are subtracted from interval meter reads at the wholesale LPC meter

TENNESSEE VALLEY

Regional Energy Resource Cour

DR & EV Additional Information

- 1. Electric Vehicles
 - TVA Previously offered a 3-year Pilot rate offering 2018, no subscription
 - Optional End-Use Wholesale Option introduced in October 2021
 - Additional Option to include in LPC Standard Service Dec. 2022
 - Implications for Capacity & Energy From both a Generation & Delivery Perspective
- 2. Demand Response Programs
 - Administered as overlay products to Base Rate schedules
 - Longstanding product offering at TVA (>20 years).
 - Can be viewed in a Capacity (Reliability) or Energy (Economics) Sense



The Rate Setting Process



Rates – How Do They Work?





Rate Design Guiding Principles

Rate Design







Rates should track Cost of Service



Rates must send Pricing Signals



Rates must balance precision with simplicity



Rates must be stable



Rates must be competitive & affordable

GUIDING PRINCIPLES

The guiding principles developed for the 2011 rate change (and amended to include competitive and affordability) continue to inform wholesale and retail rate changes today.



Rate Design

- According to cost causation principles
- Matching revenues with costs incurred

Cost to Achieve

Least cost objectives



Regional Energy Resource Counci

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Rate Design

Standards & Consistency with Pricing Principles

- 1. Electric Vehicles
 - " promote greater electrification of the transportation sector"
 - ".... promote affordable and equitable electric vehicle charging options"
 - Consistency with Pricing Principles Generation, Transmission, & Distribution
- 2. Demand Response Programs
 - ".... promote the use of demand response and demand flexibility practices"
 - "....timely recovery of the costs of promoting demand-response and demand flexibility practices"
 - Generally speaking, TVA would rather compensate our (LPC) customers for pledging their demand as a supply side resource.



Appendix

Rate Design Information Shared with RERC – November 2017



TVA & Rate Related Responsibilities

LPC Standards Service – 153 Local Power Companies (residential, small commercial and industrial)

Wholesale and retail rate authority established within the Power Contract



"End-Use Style Rates" - ~500 Large customers ("BCDs"). TVA also offers an optional EV wholesale rate structure

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Directly Served Customers - ~60 direct serve customers (large manufacturing, federal and commercial)

Retail Rate Regulator – according to TVA Board approved process

- Retail rate approver for 149 LPCs
- Non-discriminatory oversight for all 153 LPCs



TVA Electric Service



Interval data for Large Commercial & Industrial meter points are subtracted from interval meter reads at the wholesale LPC meter

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The Rate Setting Process



Rates – How Do They Work?





Revenue Requirements

How much money is required to run the business?



TVA has significant costs before a single kWh is sold



Revenue Requirements

COS – Determine Cost Causation

Cost of Service functionalizes, classifies, and allocates costs based on what the costs were incurred for, what caused the costs to be incurred, and who caused the costs to be incurred.

Cost of Service

Regional Energy Resource (



Multiperspective COS – FY 2021



TVA conducts a cost of service study annually to guide rate actions



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Cost of Service

Revenue Allocation

- I. Revenue Allocation
 - The process of developing targeted revenues to be collected by each rate class through rate design
 - Ideally, targeted revenues are consistent with the results of a Cost of Service study
- 2. Revenue Allocation can occur in one of two fashions:
 - Rate Adjustment
 - Rate Change

Revenue allocation is typically prepared to correct revenue to cost relationships



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Allocation

TVA can **adjust** wholesale rates if the TVA Board approves this action, and the wholesale power contract has specific provisions about how to enact this rate adjustment.

- An adjustment is an "across the board" adjustment in how much money the rates are charging/collecting
- Rates were last adjusted in October 2018



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Allocation

Rate Change

TVA can **change** wholesale rates upon TVA Board action, and subject to different contractual requirements than a rate adjustment.

- A rate **change** is when there is a fundamental change to how the rates are structured
- TVA must endeavor to reach agreement with 153 LPC's about the proposed rate structure change for 180 days before a rate change is enacted.
- Rate Changes occurred in 2011, 2015 & 2019



3

Allocation

Rate Design Guiding Principles

Rate Design







Rates should track Cost of Service



Rates must send Pricing Signals



Rates must balance precision with simplicity



Rates must be stable



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GUIDING PRINCIPLES

The guiding principles developed for the 2011 rate change (and amended to include competitive and affordability) continue to inform wholesale and retail rate changes today.



Rate Design

- According to cost causation principles
- Matching revenues with costs incurred

Cost to Achieve

Least cost objectives



Regional Energy Resource Council

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Rate Design

PURPA / IIJA "Shall Consider" Standards

Christopher Chandler, Senior Counsel, TVA



What are PURPA and the IIJA?

- The Public Utility Regulatory Policies Act of 1978 (16 USC §§ 2601-2645)
- Infrastructure Investment and Jobs Act (IIJA)
- The IIJA added two new standards under Title I of PURPA for consideration:
 - Demand-response practices
 - Electric vehicle charging programs
- Title I of PURPA requires certain state and Federal agencies and non-regulated electric utilities to consider adopting certain standards.
- PURPA requires TVA to consider standards for its wholesale power customers (the LPCs) because of its rate-making authority.
- PURPA also requires TVA to consider standards for itself as a nonregulated electric utility under PURPA.
- These standards are the so-called "shall consider" standards.



What is required?

- TVA must complete its determination of whether to adopt the standards no later than November 15, 2023
- Title I of PURPA gives TVA the flexibility to adopt standards as written, adopted a modified standard, or decline to adopt a standard
- TVA undertook this same "shall consider" process following legislation in 1978, 2005, and 2007
- TVA practice is to submit its final determinations for Board approval and publish them in the Federal Register



Overview of Standards and Staff Positions

- General notes:
 - These slides do not contain a summary of public comments, because the public comment period did not close until after the deadline for these slides. We will provide an oral summary of comments received.
 - The staff positions espoused in these slides represents the preliminary views of the TVA working group. The final determinations, and text of any standard, if adopted, is subject to the review and approval of senior TVA leadership and the Board of Directors, and is subject to change.



2021 Proposed Standard Demand-Response Practices 16 USC 2621(d)(20)

(A) In general

Each electric utility shall promote the use of demand-response and demand flexibility practices by commercial, residential, and industrial consumers to reduce electricity consumption during periods of unusually high demand.

(B) Rate recovery

(i) In general – Each State regulatory authority shall consider establishing rate mechanisms allowing an electric utility with respect to which the State regulatory authority has ratemaking authority to timely recover the costs of promoting demand-response and demand flexibility practices in accordance with subparagraph (A).

(ii) Nonregulated electric utilities – A nonregulated electric utility may establish rate mechanisms for the timely recovery of the costs of promoting demand-response and demand flexibility practices in accordance with subparagraph (A).



2021 Proposed Standard Demand-Response Practices 16 USC 2621(d)(20)

TVA Staff Views

- TVA staff's recommendation is to **adopt a modified version of the standard**
- TVA maintains programs to promote demand response, targeting LPCs, directly-served customers, and LPC end-use customers
- TVA also has a process for LPCs to request cost recovery, which could include the costs associated with promoting demand response, and TVA factors its own demand response costs into its long-term financial planning.



2021 Proposed Standard Electric Vehicle Charging Programs 16 USC 2621(d)(21)

Each State shall consider measures to promote greater electrification of the transportation sector, including the establishment of rates that —

(A) promote affordable and equitable electric vehicle charging options for residential, commercial, and public electric vehicle charging infrastructure;

(B) improve the customer experience associated with electric vehicle charging, including by reducing charging times for light-, medium-, and heavy-duty vehicles;

(C) accelerate third-party investment in electric vehicle charging for light-, medium-, and heavy-duty vehicles; and

(D) appropriately recover the marginal costs of delivering electricity to electric vehicles and electric vehicle charging infrastructure.



2021 Proposed Standard Electric Vehicle Charging Programs 16 USC 2621(d)(21)

TVA Staff Views

- TVA staff's recommendation is to **adopt a modified version of the standard**
- TVA is involved in promoting the adoption of EVs and will be for the foreseeable future. Major initiatives include developing of one of the nation's most comprehensive publicly accessible EV fast charging networks, offering affordable rate options for public EV fast charging and creation of resources to educate and support residents with their residential, commercial, and public charging needs.
- TVA will consider modifications to the proposed standard that are consistent with the requirements of the TVA Act, including regulating the disposal of TVA power through the wholesale power contract, ensuring low rates and nondiscrimination.
- Because EV charging deployment occurs at the distribution level, and these programs are executed in conjunction with and supported by LPCs, TVA will also consider whether modifications to the standard are necessary to account for the respective roles of TVA and distributors of TVA power.





Public Comment



This is a listening session; responses are typically not provided



Thank You





Finalize Advice Statement







Next RERC Meetings

September 26-27 Nashville Joint Meeting with Regional Resource Stewardship Council (RRSC) Valley Vision Recommendation - Advice

RERC Fall - date & location TBD Integrated Resource Plan (IRP) Kickoff



Adjourn


