TENNESSEE VALLEY AUTHORITY

Regional Energy Resource Council

July 16, 2024

4th Meeting – Term 6

TVA TENNESSEE VALLEY AUTHORITY

Welcome!

The Meeting will begin at 8:30 AM Eastern

Welcome

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RERC Live and Virtual Meeting

- **This is the fourth meeting of the 6th term of the RERC.**
- **We welcome members of the public attending virtually and 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).
- For those wishing to ask questions, there will be a **public IRP webinar** on Thursday, **July 18** from 7 PM-8 PM EDT. You can register at https://forms.office.com/g/XEGHbA8PLg or tva.com/irp
- **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 conference room doors you entered. Exit the building via back doors to World's Fair Park. Gather outside across the street in the grass.

- **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,
A Favorite Summer Activity

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RERC Term 6* Members

Introductions:
Name
Position, Organization, Location
Favorite summer activity

Jan Berry
Citizens Climate Education

Marquita Bradshaw
Sowing Justice

Ron Bunch
Bowling Green Chamber of Commerce

Monte Cooper
Jackson Energy Authority

Erin Gill, RERC Chair
Knoxville Utilities Board

Rebecca Goodman
Commonwealth of Kentucky

Rodney Goodman
Habitat for Humanity

Chassen Haynes
Ford Motor Company

Chrissy Heard
State of Mississippi

Chelsea Jenkins
Commonwealth of Virginia

Candy Johnson
Urban League of Greater Chattanooga

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

Boyd Pettit
State of Georgia

Erik Schmidt
City of Chattanooga

Patricia Sims
Drake State Community & Technical College

Alexa Voytek
State of Tennessee

Julie Woosley
State of North Carolina

*Aug 1, 2023 – July 28, 2025

RERC Meeting
July 16, 2024

Agenda

8:30 am EDT	**Welcome – Designated Federal Officer Melanie Farrell & Chair Erin Gill**
8:40	**Introductions and Agenda Review**
9:00	**DFO Briefing**
9:15	Break
9:30	**TVA's Integrated Resource Plan Updates** • IRP Overview • Scenario and Strategy Updates • Resource Costs • Stakeholder Engagement Updates
11:00	**Advice Question Discussion**
12:00 pm	Lunch
1:30	**Public Listening Session**
2:30	Break
2:45	**Finalize Advice Statements**
3:45	**Wrap up Meeting**
5:00	**Adjourn RERC Meeting**

TVA Update

Melanie Farrell, Designated Federal Officer

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Need for Energy

Tennessee counties in 2023 had most growth since mid-1990s

Region Growth

3X

the National Average

Valley Pathways Study Predicts

22%

Population increase

Capacity & Transmission Planning

Investing $15 billion over the next three years

Strategic capital investment over the next three years – approximately $11 billion - includes new construction, environmental projects and strategic transmission projects.

- **New Generation Now Online**
  - Colbert and Paradise combustion turbine gas units – 1,500 MW (nameplate)
- **New Generation Under Construction**
  - Vonore Battery project
  - Cumberland Energy Solution
  - Johnsonville Aeroderivative gas units
  - Lawrence County Solar
  - Kingston Energy Complex - battery storage, solar and natural gas
- **Pending Environmental Reviews and/or Preliminary Planning Work**
  - Shawnee Solar pilot
  - Allen aeroderivative gas units
  - New Caledonia gas units
  - Cheatham County gas units and battery

Johnsonville Aeroderivative Combustion Turbine Project

Installing 10 aeroderivative units of highly flexible, peaking generation capacity.

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Energy Efficiency & Demand Response Programs

•TVA plans to invest $1.5 billion from FY24 to FY28 to bring energy efficiency and demand management opportunities to our region's residents and businesses.

•Amid remarkable economic and population growth in our region, a robust portfolio of energy management programs are expected to **offset nearly 30% of anticipated load growth** and peak demand spikes through FY33 (FY24-FY33).

•TVA EnergyRight has home energy rebates available in addition to incentives for business and industrial customers.

Over five years (FY24-28)

$1.5 Billion
invested in demand management

2,200 MW
of carbon-free peak reduction capacity

2,200 GWh
of annual energy savings

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Role of the RERC

Provide TVA advice on its energy resource activities and the priorities among competing objectives and values. The advice of the Council is reported to TVA Board's External Stakeholders and Regulation Committee.

Federal Advisory Committees

Regional Resource Stewardship Council (RRSC) est. 1999	Regional Energy Resource Council (RERC) est. 2013

Objective

- Statutory advisory councils established to gain collective advice from a balanced stakeholder group on TVA stewardship and energy activities
- Charter approved by the Board
- Public meetings; agendas posted to the Federal Register
- **Receives collective advice on behalf of the Council and provides formal advice to the Board**

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BREAK

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Integrated Resource Plan (IRP) Update

Regional Energy Resource Council (RERC)
July 16, 2024

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IRP Update Agenda

IRP Overview

IRP Process

IRP Scenarios and Strategies Update

IRP Resource Assumptions

Stakeholder Engagement Update

Requested Advice on the IRP

IRP Overview

Clifton Lowry; Director, Resource Planning & Strategy

TVA's Integrated Resource Plan

The IRP is a study of how TVA could meet customer demand for electricity between now and 2050 across a variety of futures.

A programmatic Environmental Impact Statement (EIS) accompanies the IRP to evaluate its environmental effects.

An updated IRP is needed to:

- Proactively establish a strong planning foundation for the 2030s and beyond
- Inform TVA's next long-range financial plan

The IRP provides strategic direction on how TVA will continue to provide low-cost, reliable, and increasingly cleaner electricity to the residents and businesses across the Valley region.

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Planning is Grounded in Least-cost Principles

In resource planning, TVA applies fundamental least-cost planning principles*:

- Low Cost
- Risk Informed
- Environmentally Responsible
- Reliable and Resilient
- Diverse
- Flexible

*In alignment with the Energy Policy Act of 1992

TVA Least-cost Planning Requirements

Section 113 of the Energy Policy Act of 1992 requires TVA to employ and implement a “least-cost planning program” for its electrical system to provide “adequate and reliable service at the lowest system cost.”

Under this program, TVA is directed to:

- Evaluate all demand and supply side resources, including energy conservation, efficiency, and renewable energy
- Take into account a variety of factors related to system operations, including diversity of resources to meet operating conditions, reliability, compliance costs, and other relevant risk factors

Key takeaways for resource planning:

- TVA is not permitted to direct a specific resource mix or adopt firm policy decisions regarding what resources are to be included in or excluded from that mix.
- TVA must strive for a balance of providing electrical service that it determines is “adequate” and “reliable,” consistent with the needs of the system, with the obligation to provide that service at the lowest system cost.

What TVA's IRP Does

The IRP will:

- Use least-cost planning criteria
- Incorporate resource capital, operating, fuel, and environmental compliance costs
- Evaluate strategies using metrics based on least-cost planning principles
- Assess socioeconomic and climate impacts of alternative strategies in the associated EIS

The IRP will not:

- Establish wholesale or retail electricity rates
- Identify specific sites for new resources
- Be a Distribution Integrated Resource Plan (DIRP)

Key Integrated Resource Plan (IRP) Milestones

The IRP study approach is intended to enable stakeholder involvement and ensure transparency

- Spring 2023 – Published Notice of Intent (NOI) and initiated public scoping
- Summer 2023 – IRP Working Group commenced
- Fall 2023 – Public scoping report published
- Modeling and environmental study
- Publish Draft IRP and EIS, public comment period begins
- Respond to Draft comments and develop Final documents
- Publication and TVA Board adoption of Final IRP and EIS

PREVIEW: RERC Formal Advice Questions

IRP Scenarios, Strategies and Resource Options

The key objective of the IRP process is to establish a strong resource planning foundation.

This is accomplished by exploring a broad range of future scenarios and evaluating strategies designed to construct differentiated portfolios leveraging an appropriate range of resource options.

The IRP resource options include a range of cost and characteristic assumptions based on benchmark data, recent experience, and applicable policy and regulations.

The result will be a strategic portfolio direction which guides TVA's future asset decisions under a least cost planning framework.

How well do the IRP scenarios and strategies and resource assumptions meet this objective?

IRP Stakeholder Engagement

A key element of TVA's IRP process is to ensure public involvement and direct engagement with a diverse group of stakeholders.

Has the approach taken to public and stakeholder engagement supporting the IRP been effective thus far? Are there suggestions for enhancing the approach, particularly for plans on communication and engagement following release of the draft IRP?

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IRP Process

Candy Kelly; Sr. Manager, Resource Strategy

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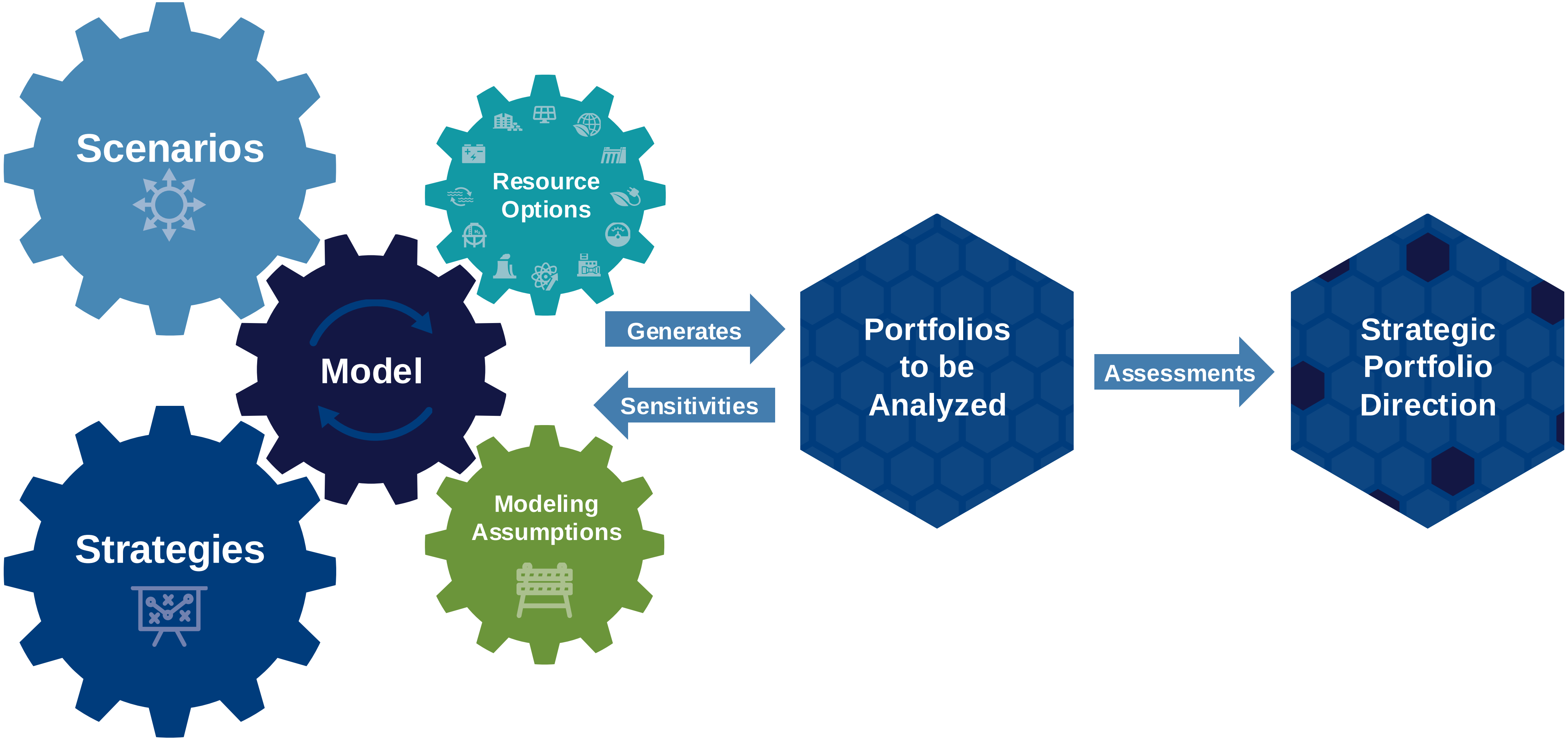
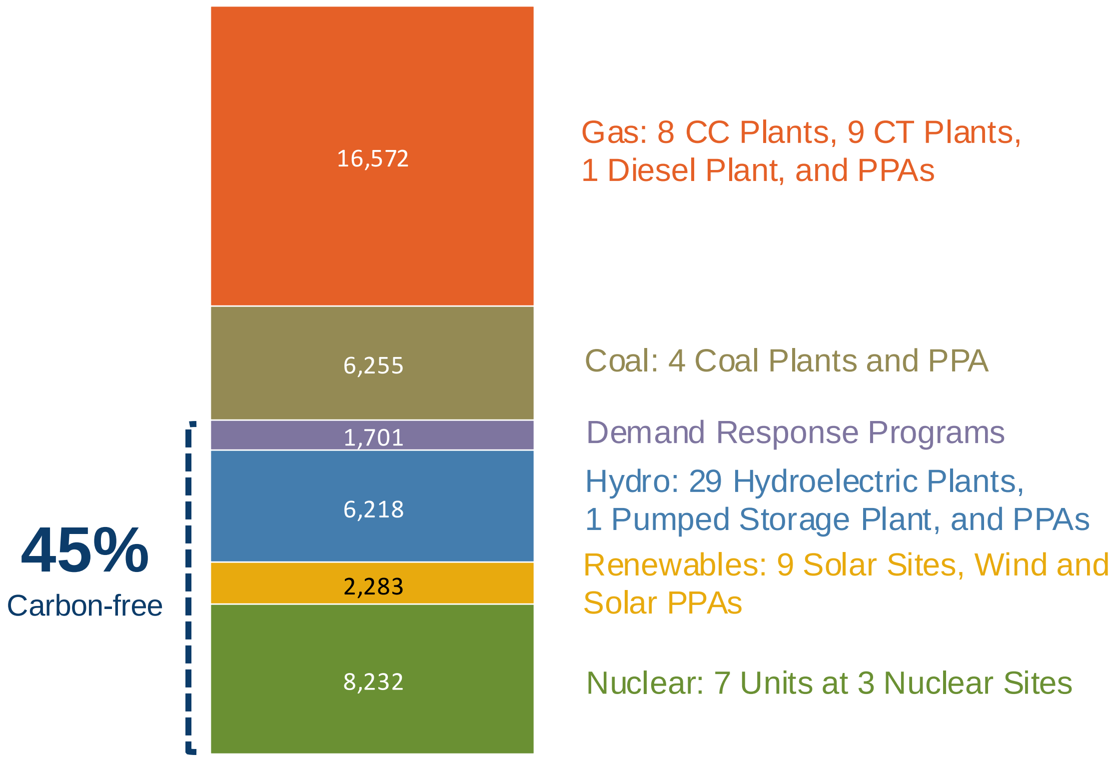
How the Integrated Resource Planning Process Works



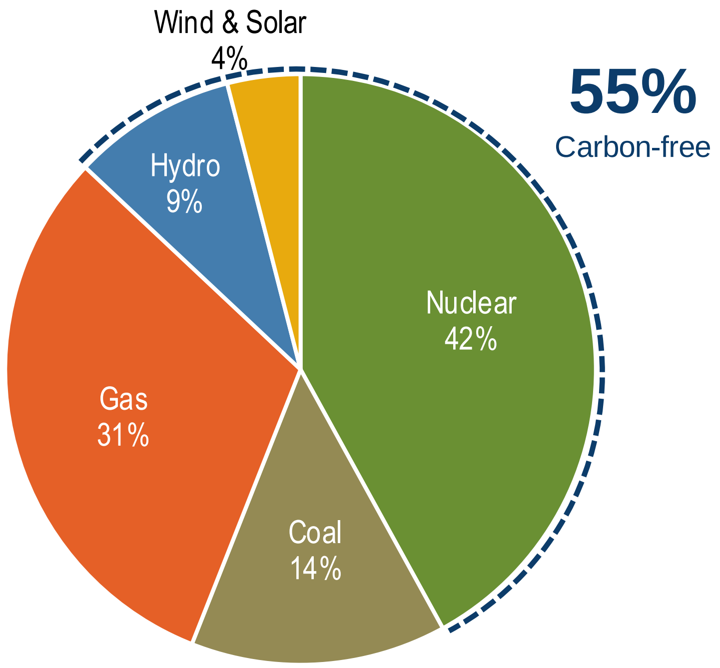
Stakeholder feedback is a key component in the development of all model inputs.

Today’s Resource Portfolio

FY23 Capacity
41,261 MW



FY23 Energy
160 TWh



Capacity aligns to FY23 10-K Net Summer Capability and Power Purchase Agreements tables, adjusted to include demand response programs and exclude delivered energy. Planning capacity is lower, as it accounts for Hydro and Renewable expected generation at peak, fuel blend derates, and other factors.

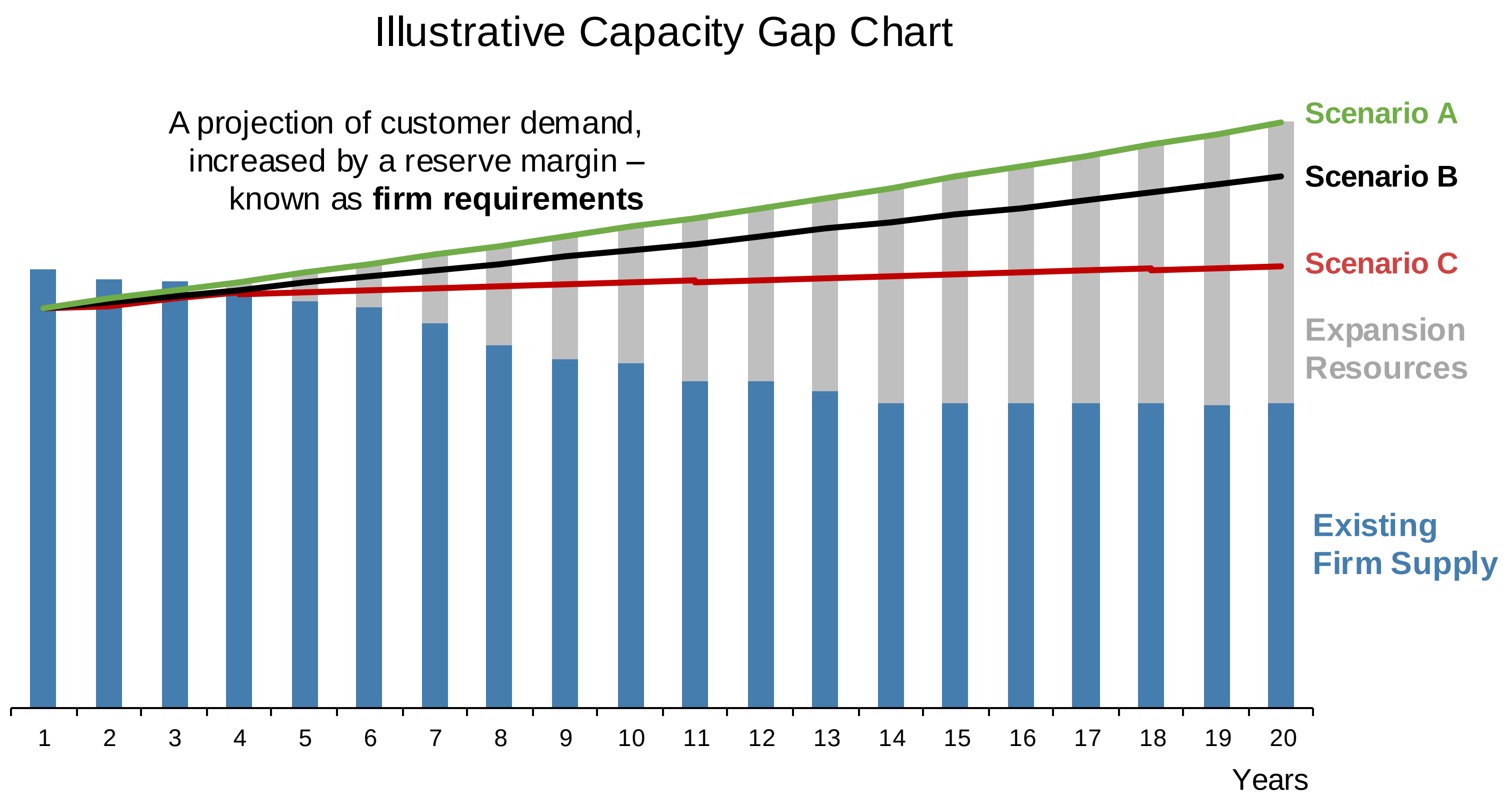
In addition to power supply sources included here, TVA offers energy efficiency programs that effectively reduced 2023 energy needs by about 2,100 GWh or 1.3% (Net Cumulative Realized at System basis, 2007 base year).

Resource Planning for Future Capacity Needs

Resource planning is about optimizing the mix of future capacity.

Projections of capacity needed are filled by the most cost-effective resources.

Multiple scenarios will be explored, reflecting different levels of forecasted demand.



Recommended path provides low cost, reliability, diversity and flexibility

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Scenarios and Strategies Establish a Framework

A well-designed strategy will perform well in many possible scenarios

Scenarios are outside TVA's control

- Describe potential outcomes of factors (uncertainties) outside of TVA's control
- Represent possible conditions and are not predictions of the future
- Include uncertainties that could significantly impact operations, such as:
  - Load forecasts
  - Commodity prices
  - Environmental regulations
- Lends insight to riskiness of portfolio choices

Strategies are within TVA's control

- Test various business options within TVA's control
- Defined by a combination of resource assumptions, such as:
  - Distributed energy resources portfolio
  - Carbon-free resource expansion
  - Resiliency focus
- Consider multiple viewpoints
  - Public scoping period comments
  - Assumptions that would have the greatest impact on TVA long term

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TVA Operates in Multidirectional Environment

Capacity (kW) and Energy (kWh)

Demand Side

Supply Side

Load Management Demand Reduction and Generation

Supply Side Resources

Nuclear

Coal

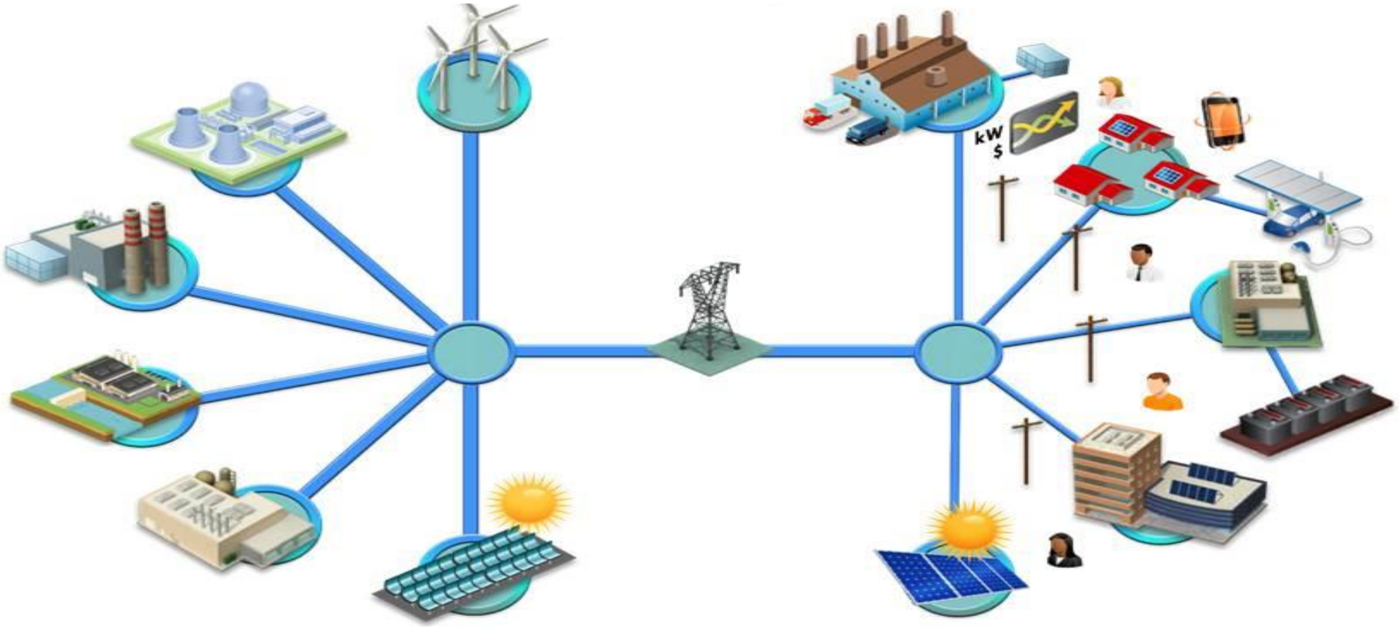
Combustion Turbine

Combined Cycle

Renewables

Hydro

Storage



Demand Side Resources

Energy Efficiency

Demand Response

Energy Services

Distributed Generation

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IRP Scenarios and Strategies

Candy Kelly; Sr. Manager, Resource Strategy

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IRP Scenario Development Process

TVA collaborated with the IRP Working Group to develop scenarios for the IRP analysis, beginning in the summer of 2023.

Scenario development involves three primary steps:

1. Scenario design brainstorming, focusing on how the future might be shaped by changes in key uncertainties, such as economic cycles, electricity demand, consumer preferences, regulation, and technology
2. Scenario theme development, leading to potential scenarios that combine key uncertainties and correlated impacts while ensuring adequate diversity and robustness
3. Scenario forecast creation, resulting in correlated forecasts for inflation, electric load, fuel, and market purchases of power

IRP Scenarios (Future Conditions)

1
Reference Case
Represents TVA's current forecast that reflects moderate population, employment, and industrial growth, weather-normal trends, growing electric vehicle use, and increasing efficiencies

2
Higher Growth Economy
Reflects a technology-driven increase in U.S. productivity growth that stimulates the national and regional economies, resulting in substantially higher demand for electricity

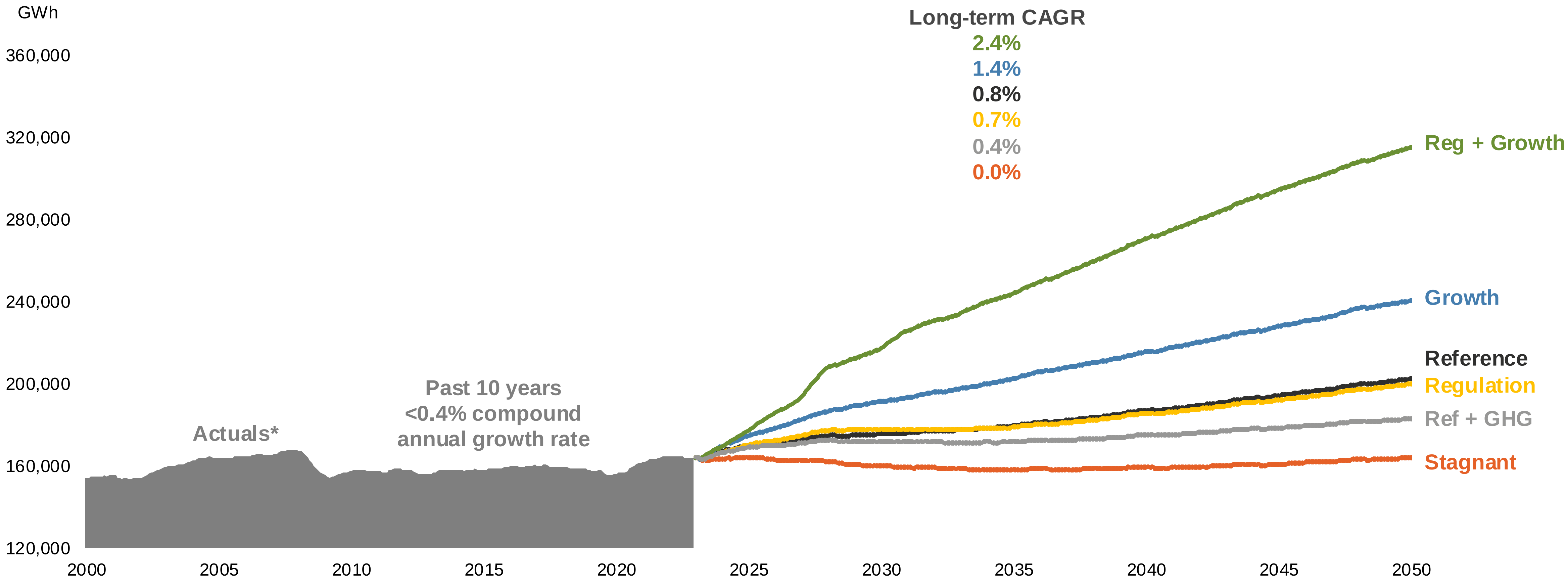
3
Stagnant Economy
Reflects rising debt and inflation that stifle consumer demand and business investment, resulting in weaker than expected economic growth and essentially flat electricity demand

4
Carbon Regulation
Reflects the impact of proposed greenhouse gas rules that target significant reductions in electric utility CO_2 emissions beginning in 2030 and potential future regulations striving for net zero by 2050

5
Carbon Regulation Plus Growth
Reflects impact of proposed and potential future regulations along with substantial advancements in clean energy technologies, spurring economic growth and extensive electrification

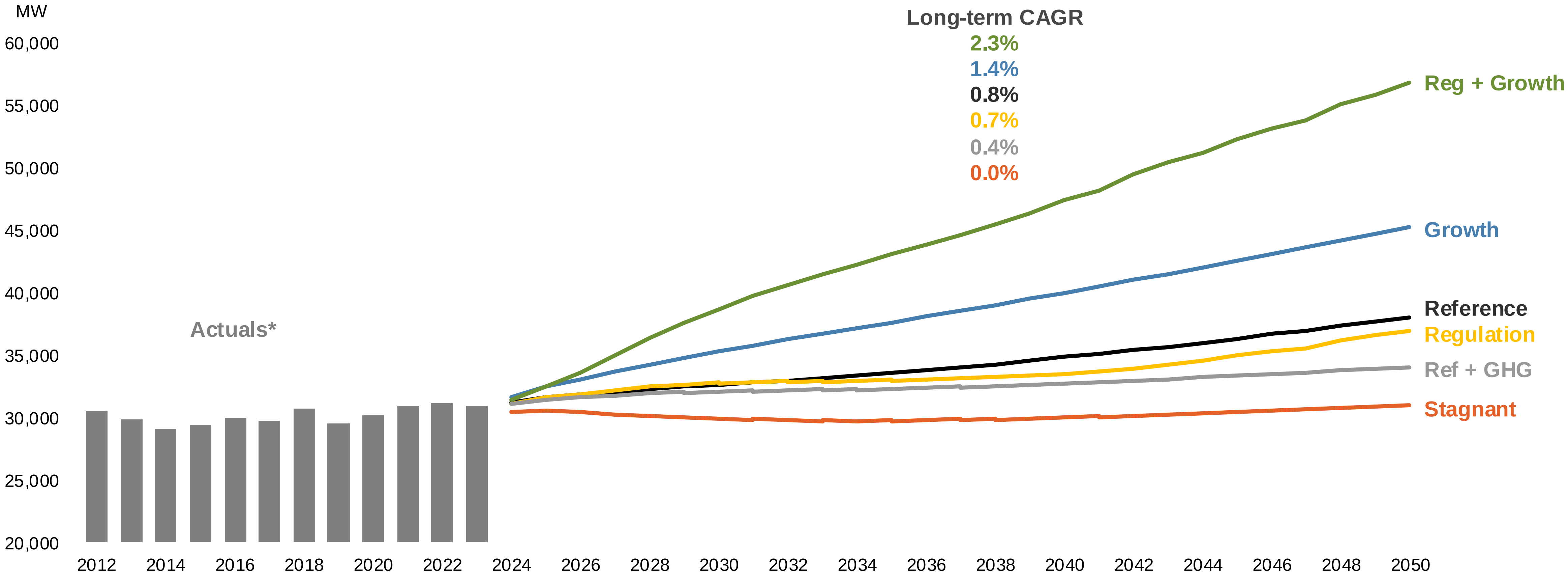
6
Reference Case with Greenhouse Gas Rule
Reflects TVA's current forecast and incorporates the impact of greenhouse gas rules finalized in May 2024 that target significant reductions in electric utility CO2 emissions beginning in 2030

IRP Energy Demand Forecasts



* Weather normalized actuals. Excludes USEC

IRP Peak Demand Forecasts



* Weather normalized actuals. Excludes USEC

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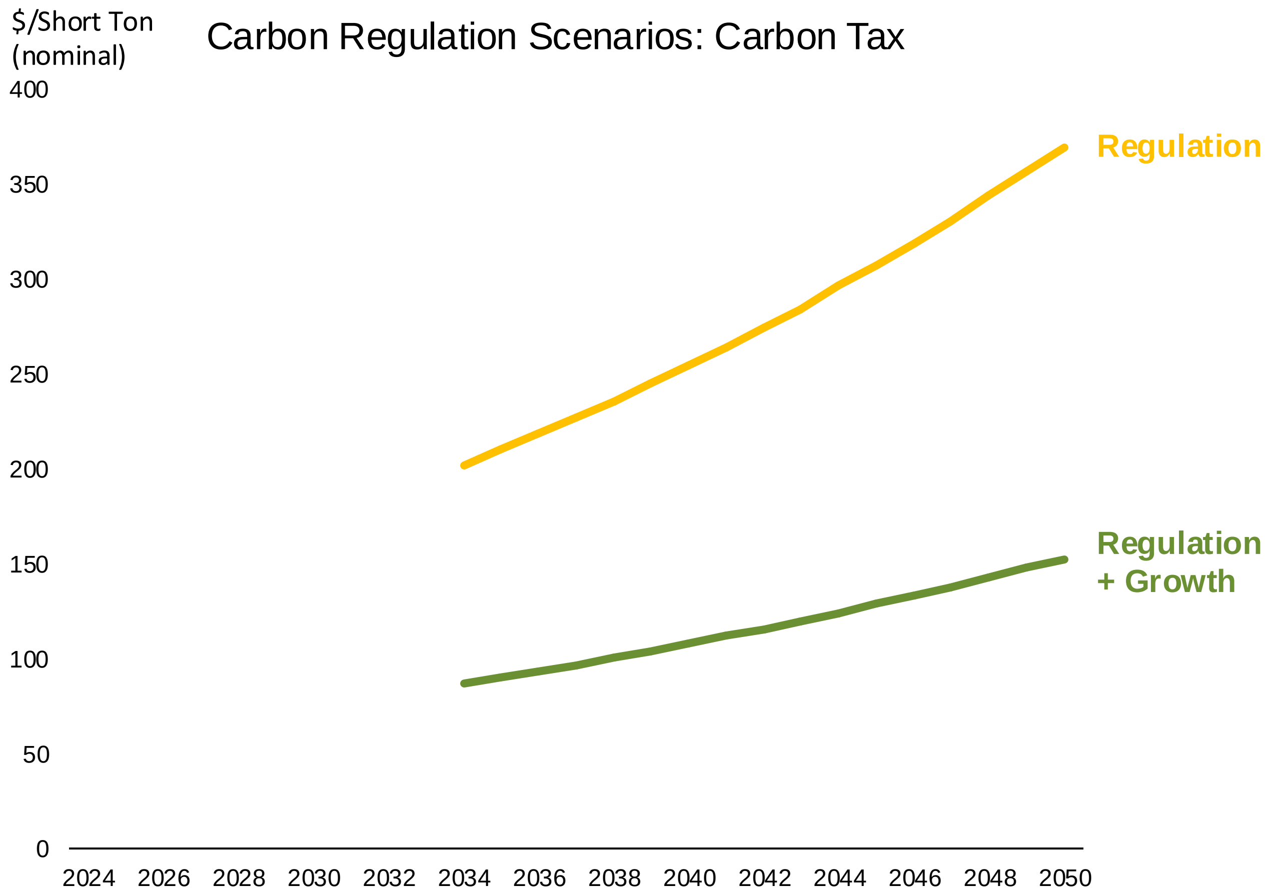
Carbon Regulation Scenarios: Major Assumptions

Proposed EPA Greenhouse Gas (GHG) Rules are implemented, requiring major changes to the operation of fossil fuel-based resources (phased impacts between 2030 and 2040).

Starting in 2034, a carbon tax is applied as a proxy for future carbon regulations beyond the GHG Rules.*

Changes specific to (5) Carbon Regulation plus Growth:

- Resource cost forecasts are reduced to NREL advanced case
- IRA tax credits increase to maximum value



*Carbon Regulation scenario uses the 2023 EPA social cost of carbon at a 2.5% discount rate as a proxy while the Carbon Regulation plus Growth scenario uses the 2021 White House interim social cost of carbon at a 3.0% discount rate.

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Strategy Design and Evaluation

The IRP will compare baseline-utility planning with alternate strategies that promote certain resource types to evaluate tradeoffs across least-cost planning principles – low cost, risk informed, environmentally responsible, reliable and resilient, diverse and flexible.

1. Develop baseline utility planning cases in all scenarios (no resources promoted)
2. Identify promotion of resource types to achieve objectives in each strategy
3. Run cases with resource promotions for alternate strategies in all scenarios
4. Evaluate tradeoffs across all scenarios and strategies using metrics

IRP Strategies (Business Approaches)

A

Baseline Utility Planning

Represents TVA's current outlook based on least-cost planning, incorporating existing programs and a planning reserve margin target. This reserve margin target applies in all strategies

B

Carbon-free Innovation Focus

Emphasizes and promotes emerging, firm and dispatchable carbon-free technologies through innovation, continued research and development, and strategic partnerships

C

Carbon-free Commercial Ready Focus

Emphasizes proven carbon-free technologies like wind, solar, and storage, at both utility-scale and through customer partnerships, along with strategic transmission investment

D

Distributed and Demand-side Focus

Emphasizes existing and potentially expanded customer partnerships and programmatic solutions to reduce reliance on central station generation and promote virtual power plants

E

Resiliency Focus

Emphasizes smaller units and the promotion of storage, along with strategic transmission investment, to drive wider geographic resource distribution and additional resiliency across the system

IRP Strategy Design Matrix

The Strategy Design Matrix provides the roadmap for how resource promotions are applied in the strategies

STRATEGY		UTILITY SCALE RESOURCES						DISTRIBUTED AND DEMAND-SIDE RESOURCES				
		Solar and Wind	Battery Storage	Long-duration Storage	Aero CTs and Recip Engines	Nuclear	CCS*	Distributed Solar	Distributed Storage	Combined Heat and Power	Energy Efficiency	Demand Response
A	Baseline Utility Planning	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base
B	Carbon-free Innovation Focus	Moderate	Moderate	Moderate	Base	High	High	Moderate	Moderate	Base	Moderate	Moderate
C	Carbon-free Commercial Ready Focus	High	High	High	Base	Base	Base	Moderate	Moderate	Base	Base	Moderate
D	Distributed and Demand-side Focus	Base	High	Base	High	Base	Base	High	High	High	High	High
E	Resiliency Focus	Base	High	Moderate	High	Moderate	Base	Moderate	Moderate	Moderate	Base	High

*Carbon capture and sequestration

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IRP Metrics Development

Metrics are used to evaluate the key tradeoffs among the IRP portfolios.

TVA's least-cost planning program evaluates cost, operational, environmental, and risk factors to support providing reliable service at the lowest system cost.

Reflecting these planning principles and with input from the IRP Working Group, TVA developed a set of metrics to assess the performance of the different strategies across the scenarios.

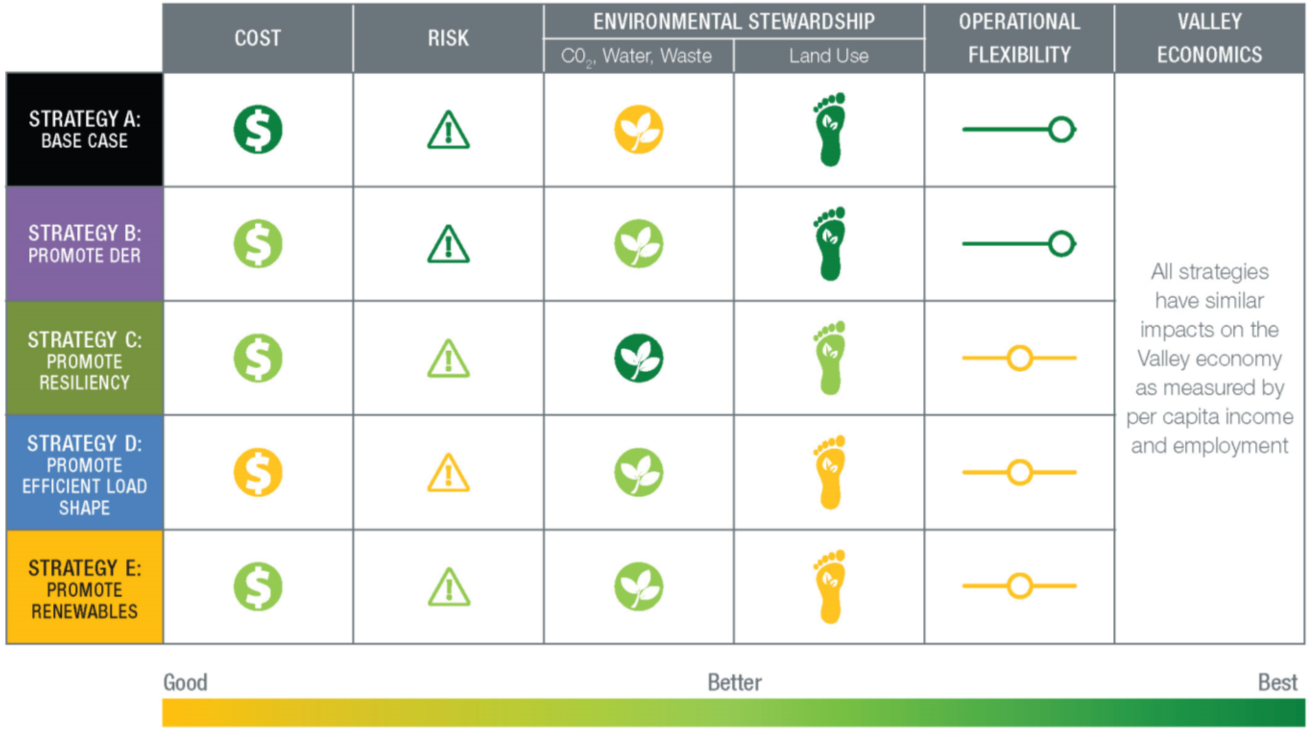
<u>Metrics Scorecard</u>

	Strategy	Low Cost	Risk Informed	Environmentally Responsible	Diverse, Reliable, and Flexible
A	Baseline Utility Planning				
B	Carbon-free Innovation Focus				
C	Carbon-free Commercial Ready Focus				
D	Distributed and Demand-side Focus				
E	Resiliency Focus				

2019 IRP Metrics

For the 2019 IRP, TVA identified 14 metrics that reflected tradeoffs related to cost, risk, environmental stewardship, operational flexibility, and Valley economics.

2019 IRP Strategy Performance



IRP Metrics and Definitions

These metrics will be used to evaluate performance of the IRP core portfolios and associated tradeoffs.

Metric Category	Metric	Definition
Low Cost	Present Value of Revenue Requirements (PVRR) ($B)	Total plan cost (capital and operating) expressed as expected present value of revenue requirements
	System Average Cost ($/MWh)	Average system cost expressed as levelized average annual revenue requirements divided by average annual sales
	Total Resource Cost ($B)	Total plan cost (capital and operating) expressed as PVRR plus participant costs net of bill savings and tax credits
Risk Informed	Risk / Benefit Ratio	PVRR above expected value divided by PVRR below expected value based on stochastic analysis
	Risk Exposure ($B)	PVRR above expected value based on stochastic analysis
Environmentally Responsible	CO_2 Direct Emissions (Million Tons)	Average annual tons of CO_2 emitted
	CO_2 Intensity (lbs/MWh)	Average annual CO_2 emissions divided by average annual energy generated and purchased
	Water Consumption Intensity (Million Gallons/MWh)	Average annual gallons of water consumed divided by average annual energy generated and purchased
	Waste Intensity (Million Tons/MWh)	Average annual quantity of coal ash and gypsum produced divided by average annual energy generated and purchased
	Land Use Intensity (Acres/MWh)	Acreage needed for expansion units divided by energy generated and purchased in 2050
Diverse, Reliable, and Flexible	Operating Cost Stability (%)	Stochastic volatility of operating cost ($/MWh) expressed as a percentage
	Flexible Resource Coverage Ratio	Flexible capacity available to meet maximum three-hour ramp divided by flexible capacity requirement in 2050
	Energy Curtailment Ratio (%)	Expected average annual curtailed energy divided by average annual energy generated and purchased

IRP Resource Assumptions

Hunter Reed; IRP Project Manager

IRP Resource Options

Nuclear

- Advanced pressurized water reactor
- Light water small modular reactor
- Gen IV small modular reactor

Hydro

- Hydro uprates

Coal

- Supercritical pulverized coal
- Supercritical pulverized coal w/carbon capture

Gas

- Combined cycle
- Combined cycle w/carbon capture
- Combustion turbine
- Aeroderivative
- Reciprocating engine
- Hydrogen blending
- Combined heat and power

Renewables

- Utility scale solar
- Distributed solar
- Midwest wind
- Southeast high-hub wind
- High Voltage Direct Current wind

Storage

- Pumped storage
- Lithium-ion battery
- Advanced chemistry battery
- Distributed storage

EE and DR

- Energy efficiency
- Demand response

Resource Assumptions Overview

The IRP considers a full range of supply-side and demand-side resource options.

Resource costs incorporate the impacts of applicable tax credits, inflation assumptions, and technology maturity over time, which vary by scenario.

Overnight capital cost trends in this presentation summarize the Reference Case scenario assumptions and are provided in nominal dollars.

The primary source for utility-scale resource costs was the moderate case from NREL's Annual Technology Baseline (ATB), except for the Carbon Regulation Plus Growth scenario that assumed the advanced case.

Small modular reactor (SMR) costs are informed by direct experience exploring designs for the Clinch River Nuclear Site; TVA used refined SMR cost estimates that are higher than NREL moderate estimates.

Solar and wind costs reflect recent proposals in the short-term, then blend into NREL moderate case costs.

Hydro expansion costs are based on internal estimates specific to opportunities on the TVA system.

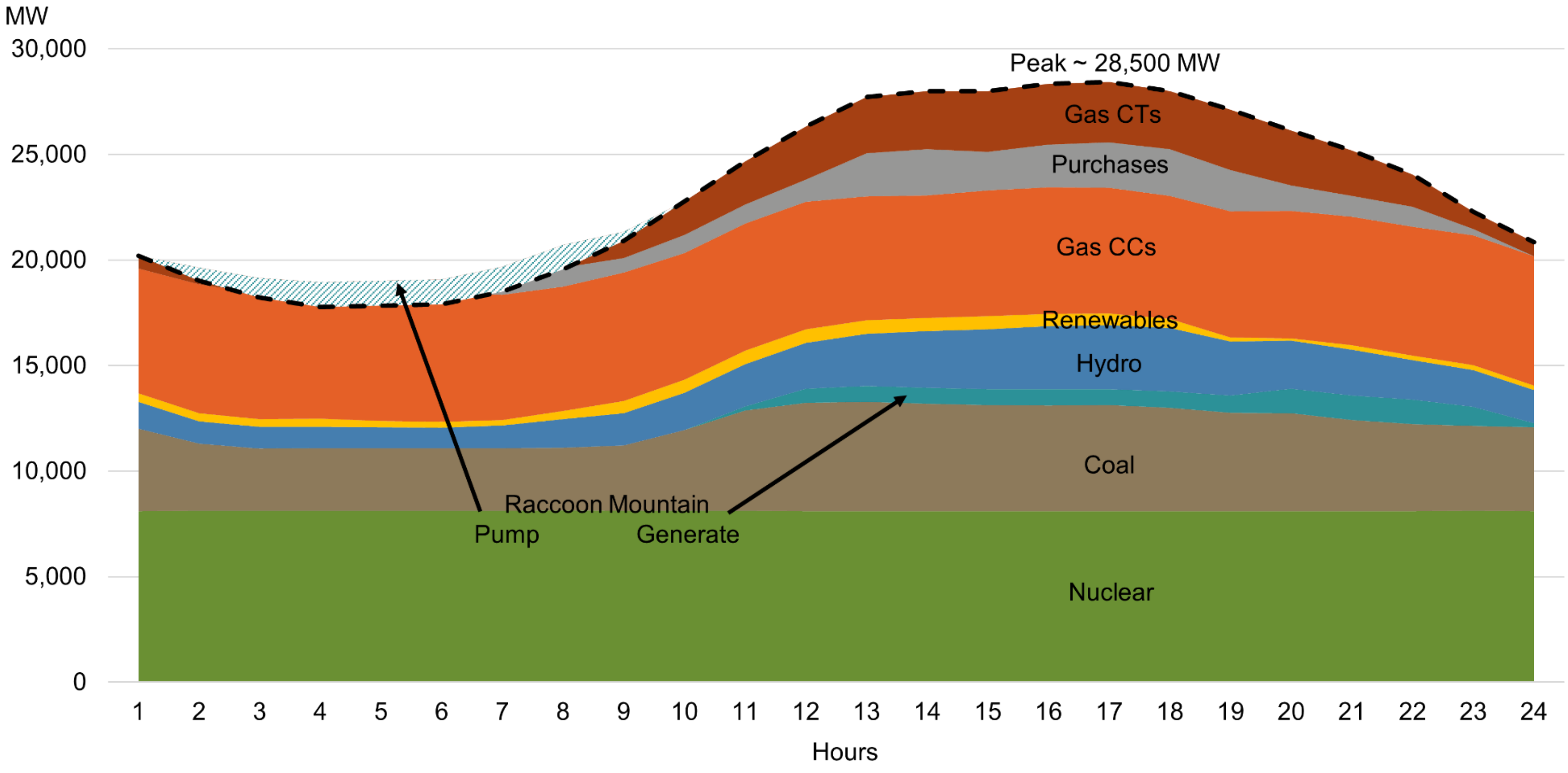
Distributed generation adoption was modeled based on consumer payback, and demand-side EE and DR resources were modeled based on TVA program experience and the recent potential study.

Resource Type Missions

Generating resources work together to reliably meet electricity demands at the lowest cost.

Most resources can be thought of in terms of their operational mission: baseload, variable, intermediate, or peaking

TVA Dispatch – Typical Summer Day (2020)



Inflation Reduction Act (IRA) Tax Credits

All IRP scenarios incorporate tax credits available through the IRA.

Section 45Q credits are available for sequestered CO_2 at CCS plants under construction before 2033.

Most scenarios assume a 40% investment tax credit (ITC) for all eligible resources.

Carbon Regulation scenario (4) assumes power sector emission declines trigger the IRA phase-out in 2034.

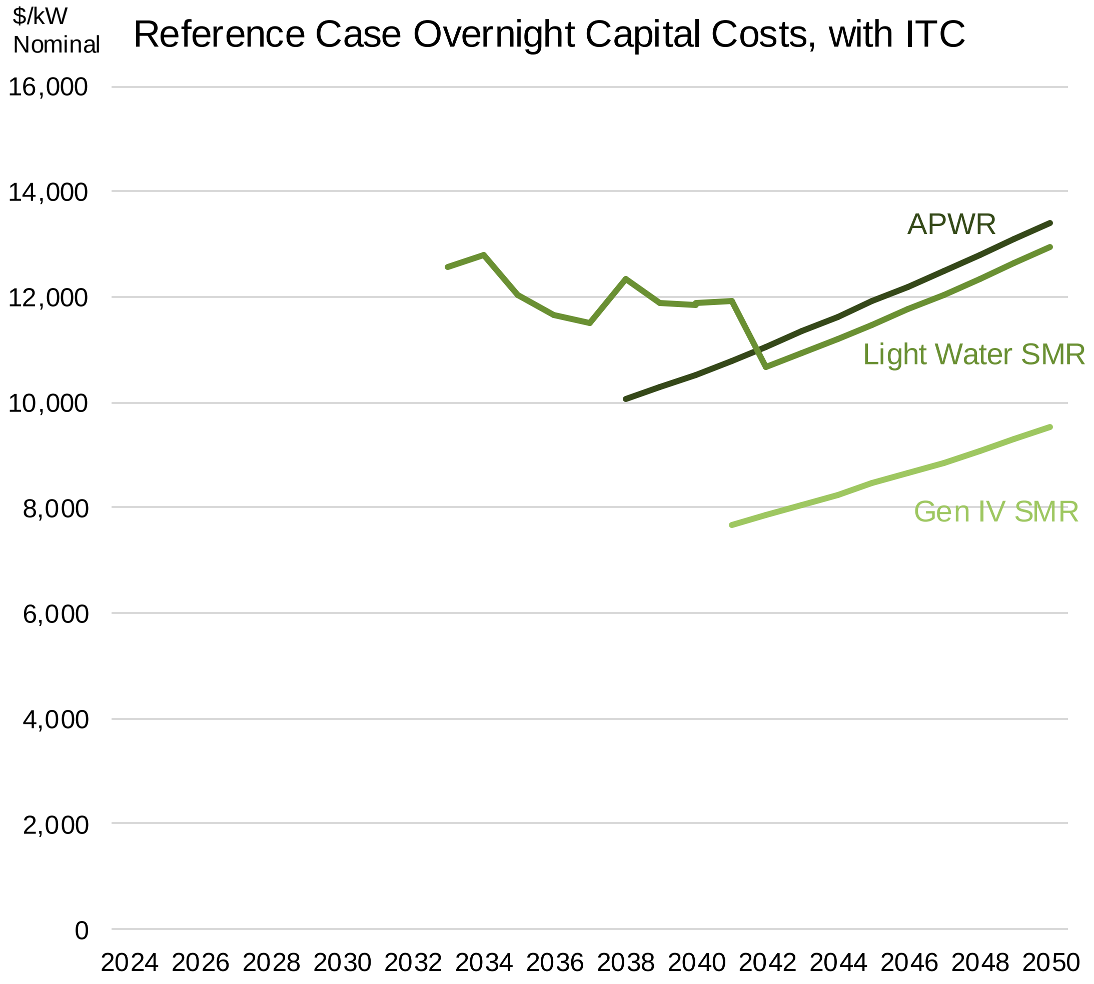
Carbon Regulation Plus Growth scenario (5) assumes the maximum amount of the ITC (50%) is achievable for all eligible resources, and the ITC and Section 45Q credit availability are extended through the full study period.

Nuclear Resources

- Advanced Pressurized Water Reactor (APWR) – Conventional reactor with advanced passive safety systems and modular design
- Light Water SMR – Light water-cooled SMR that leverages proven technology and is furthest along from a licensing perspective
- Gen IV SMR – Non-water-cooled (e.g., liquid sodium, molten salt) SMR with an integrated thermal energy storage system

Resource Option*	APWR	Light Water SMR	Gen IV SMR
Summer Net Dependable Capacity (MW)	1,150	285	345 500 with storage
Unit Availability (First Year)	2038	2033	2041
Annual Build Limit (Units)	1	1	1
Book Life (Years)	60	60	60
Overnight Capital Cost ($/kW)	12,928	17,949 (12,471^)	9,175
Summer Full-load Heat Rate (Btu/kWh)	10,132	10,713	8,308
Annual Outage Rate (%)	8	5	10
Variable O&M ($/MWh)	1.35	1.10	4.22
Fixed O&M ($/kW-year)	127.90	147.73	272.64

* Cost information is shown in 2024$ before tax credits.
^ Cost reduction with nth-of-a-kind units

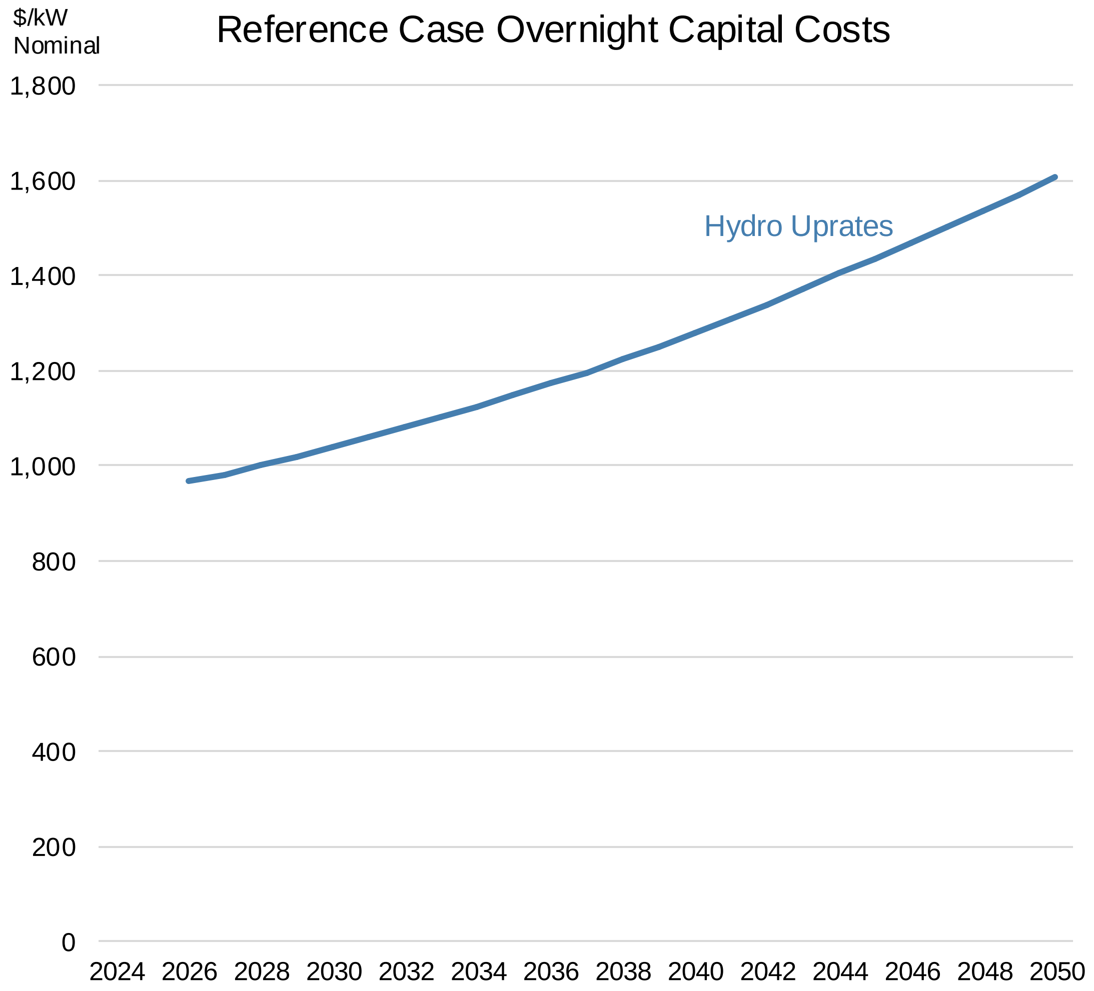


Hydro Resources

- Hydro Uprates – Improvements to existing design capabilities with incremental investment at existing TVA hydroelectric dams
  - Potential hydro uprates were identified based on TVA's Hydro Life Extension program assessments and are specific to opportunities across the TVA system
  - Based on a model that simulates river system and hydro unit operations, about 70% of the combined hydro capability is anticipated to be available at the summer peak

Resource Option*	Hydro Uprates
Summer Net Dependable Capacity (MW)	200
Unit Availability (First Year)	2026
Book Life (Years)	30
Overnight Capital Cost ($/kW)	942
Variable Operating and Maintenance ($/MWh)	2.61
Fixed Operating and Maintenance ($/kW-year)	N/A

* Cost information is shown in 2024$ before tax credits.



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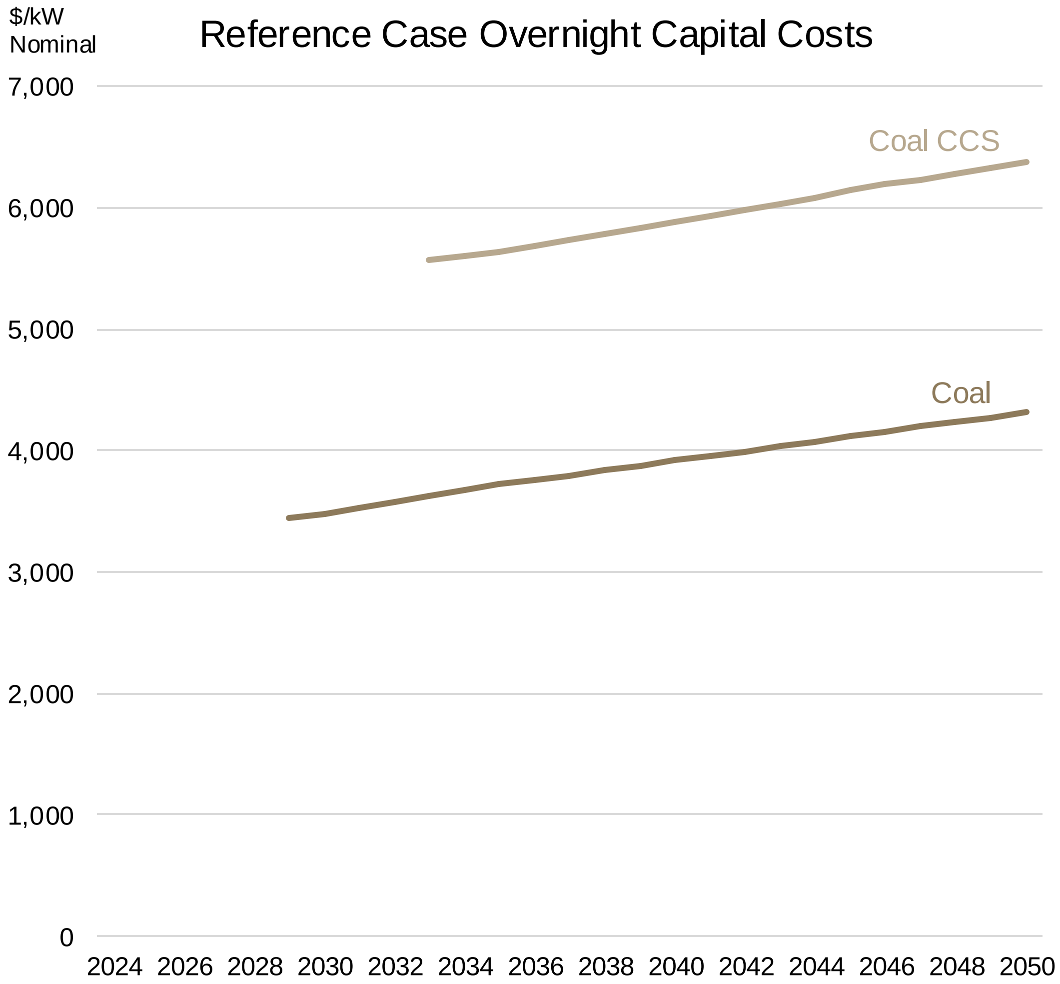
Coal Resources

- Supercritical Pulverized Coal – Coal-fired plant using pulverized coal and supercritical fluid water to generate steam at high temperatures and pressures
- Supercritical Pulverized Coal (SPC) with CCS – SPC plant fitted with carbon capture technology to capture 90% of CO_2 emissions

Resource Option*	Supercritical Pulverized Coal	Supercritical Pulverized Coal w/CCS
Summer Net Dependable Capacity (MW)	650	650
Unit Availability (First Year)	2029	2033
Annual / Cumulative Build Limit (Units)	2	1 / 11
Book Life (Years)	30	30
Overnight Capital Cost ($/kW)	3,176	4,762
Summer Full-load Heat Rate (Btu/kWh)	10,548	10,548
Annual Outage Rate (%)	25	25
Variable Operating and Maintenance ($/MWh)	2.12	19.39
Fixed Operating and Maintenance ($/kW-year)	103.56	162.74

* Cost information is shown in 2024$ before tax credits.



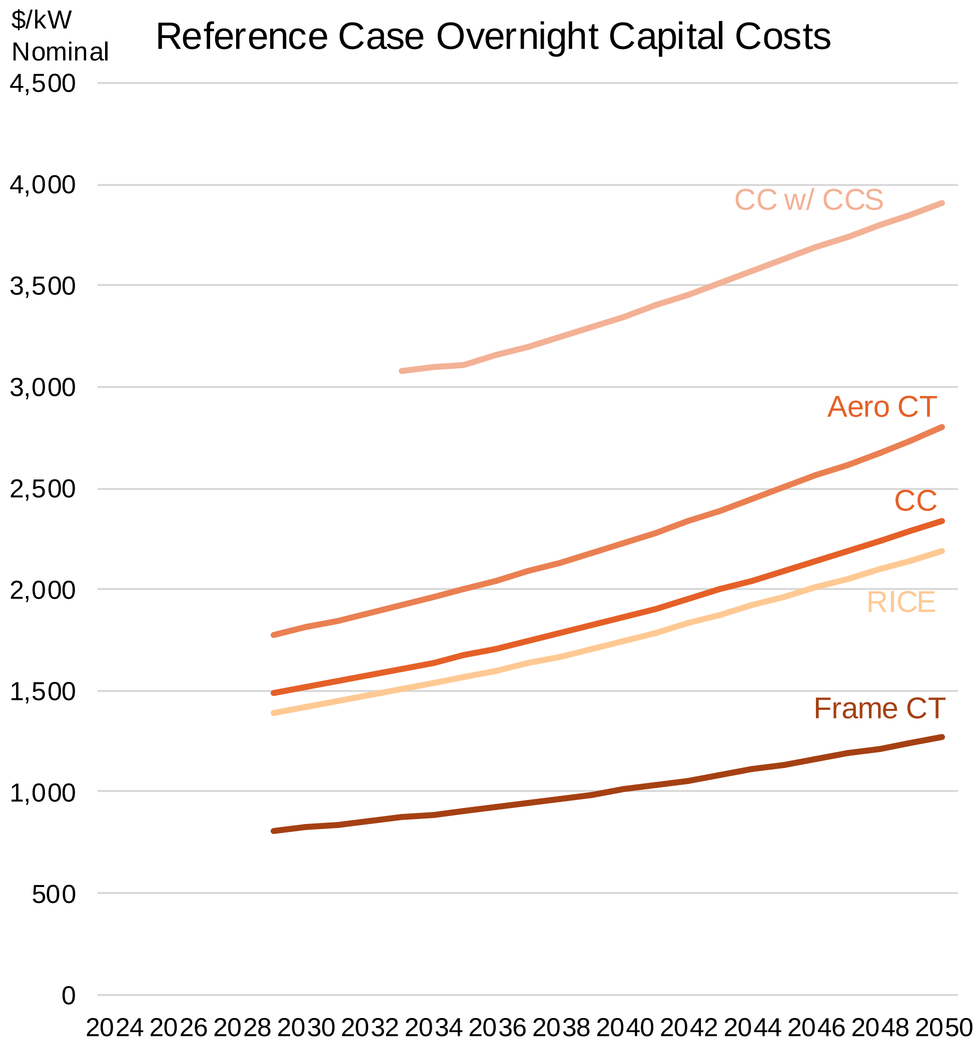
Gas Resources

- Combined Cycle (CC), 2x1x1 – Two sets of one gas turbine and one steam generator featuring higher fuel efficiency and increased power output
- CC with CCS – CC fitted with carbon capture technology to capture 90% of CO_2 emissions (CCS is eligible for Section 45Q carbon sequestration credit)
- Frame Combustion Turbine (CT) – Simple cycle gas turbine, typically used in peaking operations (3x and 4x)
- Aero CT – Smaller gas turbines derived from jet engines (2x, 4x, 10x, 20x)
- RICE – Reciprocating internal combustion engines (1x, 2x, 6x, 12x, 24x)

Resource Option*	CC	CC w/CCS	Frame CT^	Aero CT	RICE
Summer Net Dependable Capacity (MW)	1,430	1,430	884	1,060	426
Unit Availability (First Year)	2029	2033	2029	2029	2029
Annual / Cumulative Build Limit (Units)	2	1 / 11	2	2	1
Book Life (Years)	30	30	30	30	30
Overnight Capital Cost ($/kW)	1,372	3,017	744	1,642	1,287
Summer Full-load Heat Rate (Btu/kWh)	6,665	7,832	10,087	9,392	8,607
Annual Outage Rate (%)	9	9	9	9	9
Variable Operating and Maintenance ($/MWh)	0.90	5.00	0.00	8.12	6.67
Fixed Operating and Maintenance ($/kW-year)	42.24	94.01	5.50	21.93	41.22

* Cost information is shown in 2024$ before tax credits. New gas units would be capable of burning natural gas or hydrogen. Table shows assumptions for the largest configuration of each resource type, which is the most cost-effective.

^Based on typical operating conditions, Frame CTs do not include a variable O&M charge, rather they incur a larger per start cost to account for ongoing maintenance needs

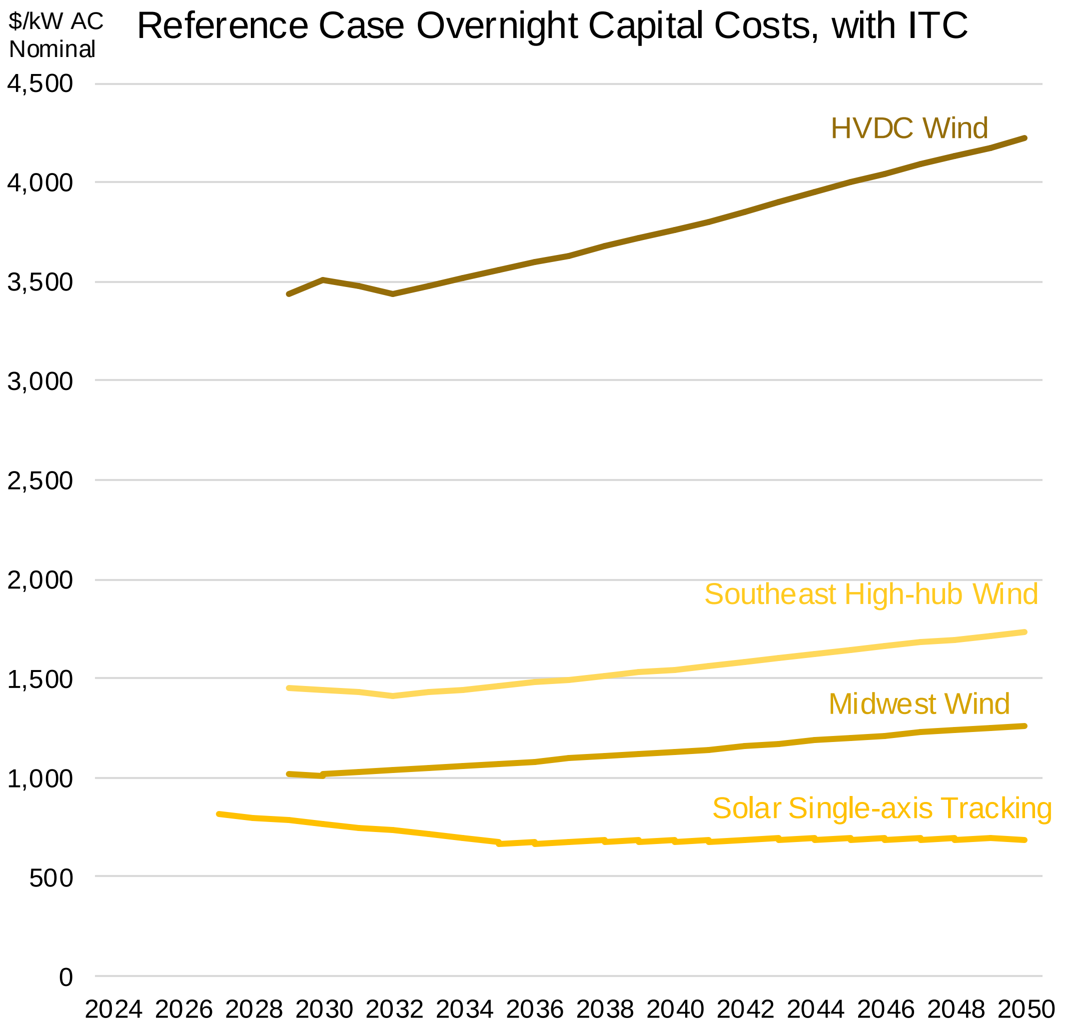


Renewable Resources

- Single-axis Tracking Solar – Large solar farms with panels that follow the path of the sun
- Midwest Wind – Midcontinent Independent System Operator (MISO) wind primarily from large wind farms in the Midwest
- Southeast High-hub Wind – Regional wind farms with higher hub heights due to the relatively lower wind speeds in the Southeast
- High Voltage Direct Current Wind (HVDC) – Wind option that requires a third party to permit and build a direct current bulk transmission line that reduces power losses

Resource Option*	Single-axis Tracking Solar	Midwest Wind	Southeast High-hub Wind	HVDC Wind
Nameplate Capacity (MW)	50	200	200	200
Summer Net Dependable Capacity (MW)	25	28	28	28
Winter Net Dependable Capacity (MW)	0	62	62	62
Capacity Factor (%)	25	40	30	55
Unit Availability (First Year)	2027	2029	2029	2029
Annual / Cumulative Build Limit (MW)	1,000	1,000	1,000	3,000/3,000
Book Life (Years)	20	20	20	20
Overnight Capital Cost ($/kW)	1,300	1,625	2,358	3,171

* Net dependable capacity information is shown in 2024 MW. Solar annual limit is increased to 1,850 MW in the highest promotion cases. Cost information is shown in 2024$ before tax credits and operating/maintenance is included in PPA cost.



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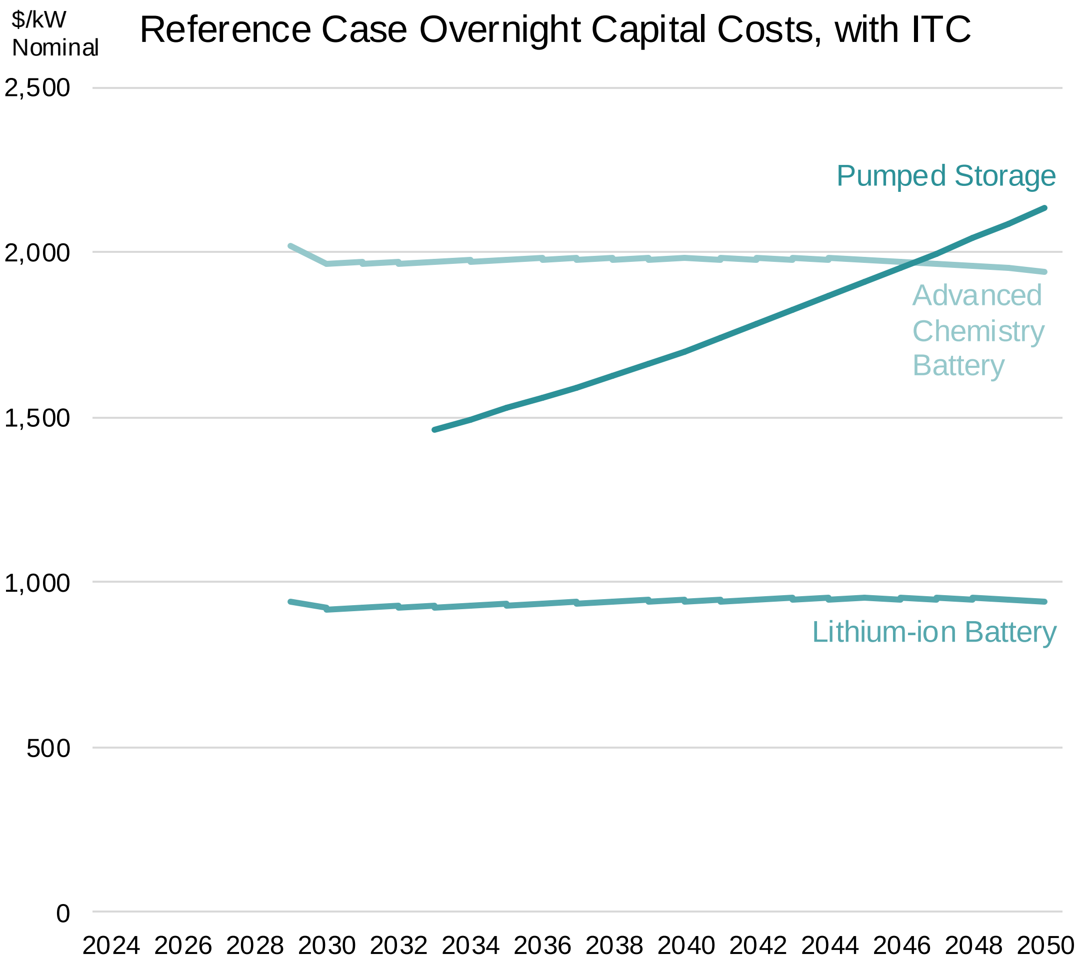
Storage Resources

- Pumped Storage – Reversible turbine generators pump water up to an upper reservoir during periods of excess power and use water flowing down to a lower reservoir to power the turbines when energy is needed
- Lithium-ion Battery (4-hour) – Prevalent battery technology today, best suited for shorter durations
- Advanced Chemistry Battery (10-hour) – Developing battery technology that would allow for longer durations of storage

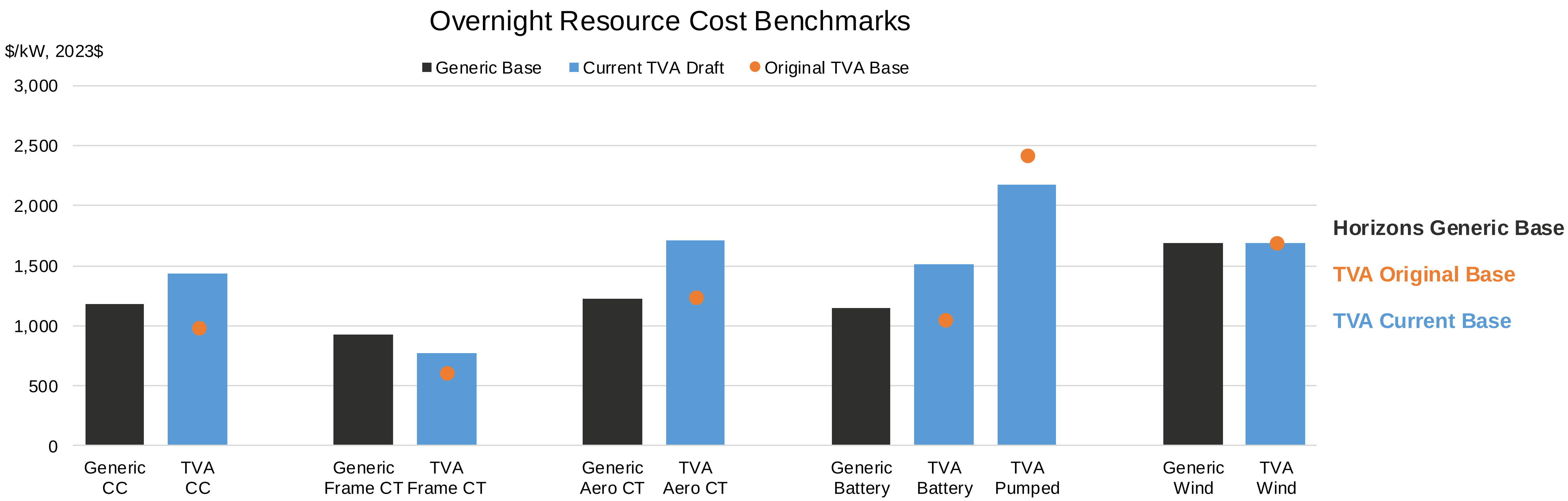
Resource Option	Pumped Storage	Lithium-Ion Battery (4-hour)	Advanced Chemistry Battery (10-hour)
Nameplate Capacity (MW)	1,600	50	50
Unit Availability (First Year)	2033	2029	2029
Annual / Cumulative Build Limit (MW)	1,600/1,600	500	500
Book Life (Years)	40	20	20
Overnight Capital Cost ($/kW)	2,088	1,445	3,106
Storage Efficiency (%)	81	85	85
Annual Outage Rate (%)	7	5	5
Variable Operating and Maintenance ($/MWh)	2.80	0.00	0.00
Fixed Operating and Maintenance ($/kW-year)	8.13	35.30	35.30

* Storage annual limit is increased to 650 MW in the highest promotion cases. Cost information is shown in 2024$ before tax credits.



Benchmarking Comparison

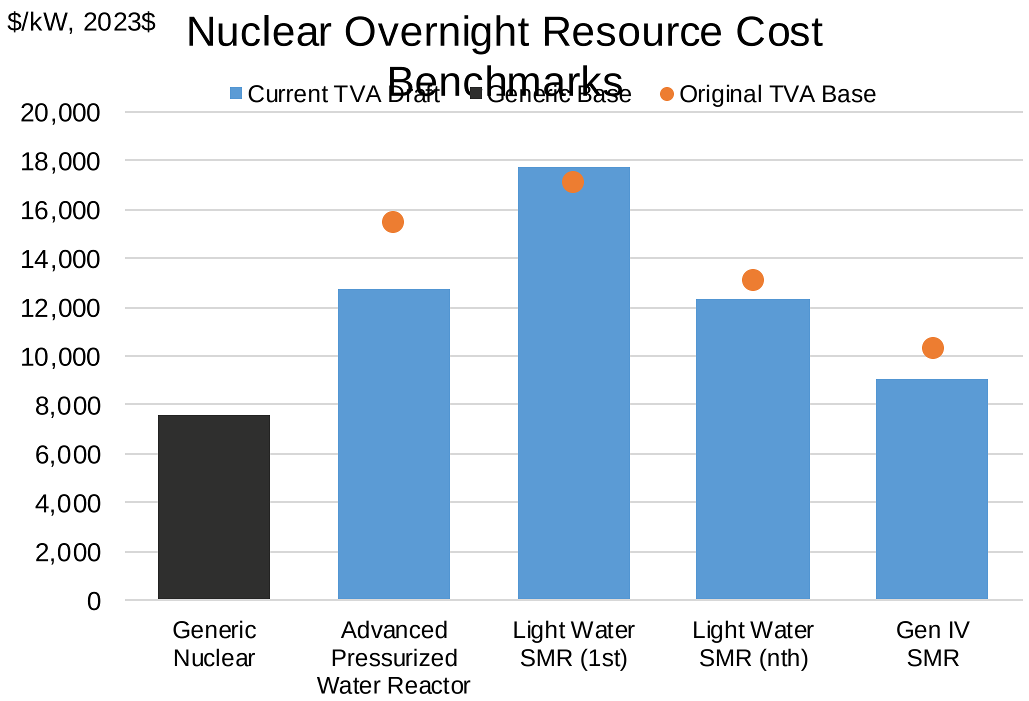
Horizons Energy developed benchmark comparisons for the resource options in the IRP, as shown below for gas, storage, and wind technologies. Horizons found that, in general, TVA's modeling of potential resource options was reasonable for a long-term resource planning model and sufficient to provide actionable results.

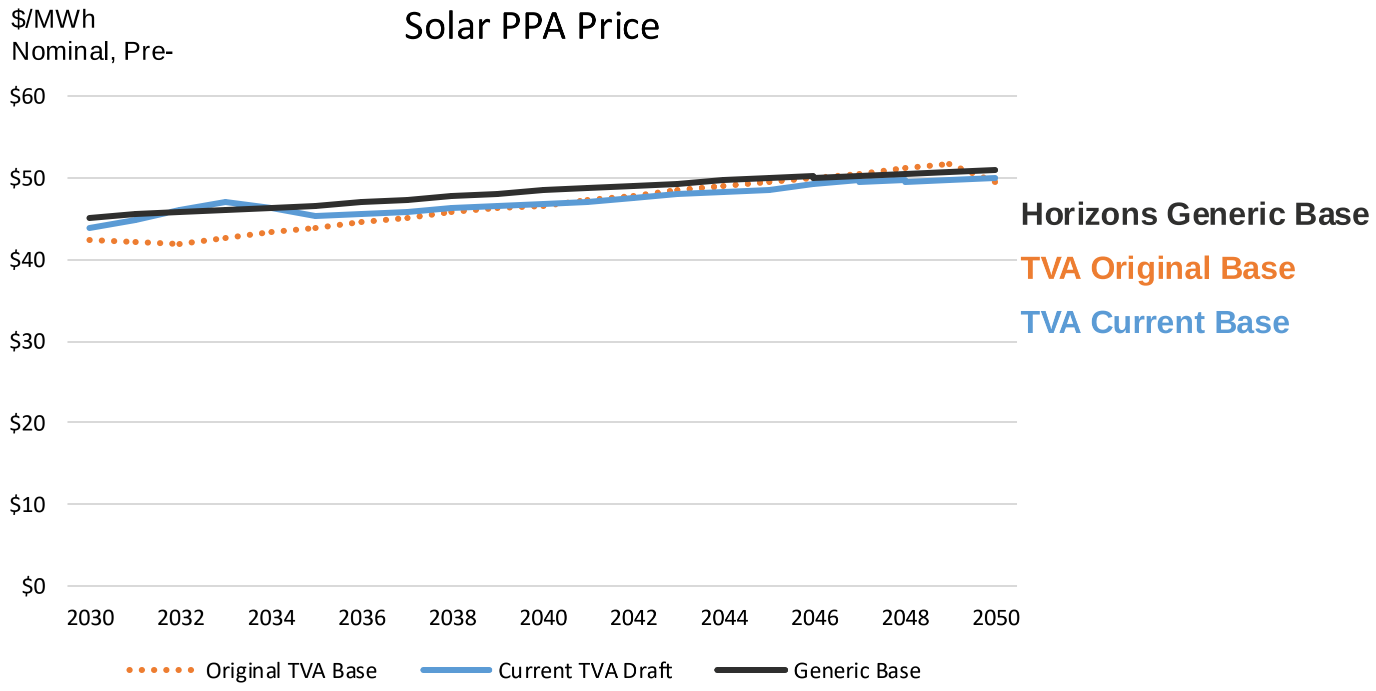


*Orange dots represent TVA costs originally reviewed by Horizons Energy in Summer 2023; blue bars represent current estimates as of Summer 2024

Benchmarking Comparison

Horizons Energy developed benchmark comparisons for the resource options in the IRP, as shown below for nuclear and solar technologies. Horizons found that, in general, TVA's modeling of potential resource options was reasonable for a long-term resource planning model and sufficient to provide actionable results.





*Orange dots represent TVA costs originally reviewed by Horizons Energy in Summer 2023; blue bars represent current estimates as of Summer 2024

Distributed Generation Resources Methodology

The IRP includes unique assumptions for behind-the-meter (BTM) distributed solar, storage, and Combined Heat and Power (CHP) adoption in each scenario and strategy portfolio.

BTM adoption forecasts are developed using an internal process based on NREL's Distributed Market Demand Model.

Key input assumptions include the forecasted price of electricity in each scenario, the forecasted installation cost of the distributed generation resource, and any incentives offered in each strategy.

Key inputs are run through the model and adoption uptake is driven by the number of years it would take a participant would see a payback on their investment.

Step 1
Model Base Level of Adoption in Each Scenario

→

Step 2
Determine Incentive Level to Apply in a Strategy

→

Step 3
Develop New Adoption Level based on Economics

→

Step 4
Enforce New Adoption Level in Expansion Model

→

Step 5
Optimize Balance of Resources for the Portfolio

Demand-side Programs Modeled in the IRP

Energy Efficiency (EE)

Residential EE

- New Homes
- Residential Services

Commercial EE

- Custom Commercial
- Standard Rebate Commercial

Industrial EE

- Custom Industrial
- Standard Rebate Industrial

Local Power Company EE

- Conservation Voltage Regulation

Demand Response (DR)

Residential DR

- Smart Thermostat

Commercial DR

- Aggregated Commercial

Industrial DR

- Aggregated Industrial

Local Power Company DR

- Dispatchable Voltage Regulation

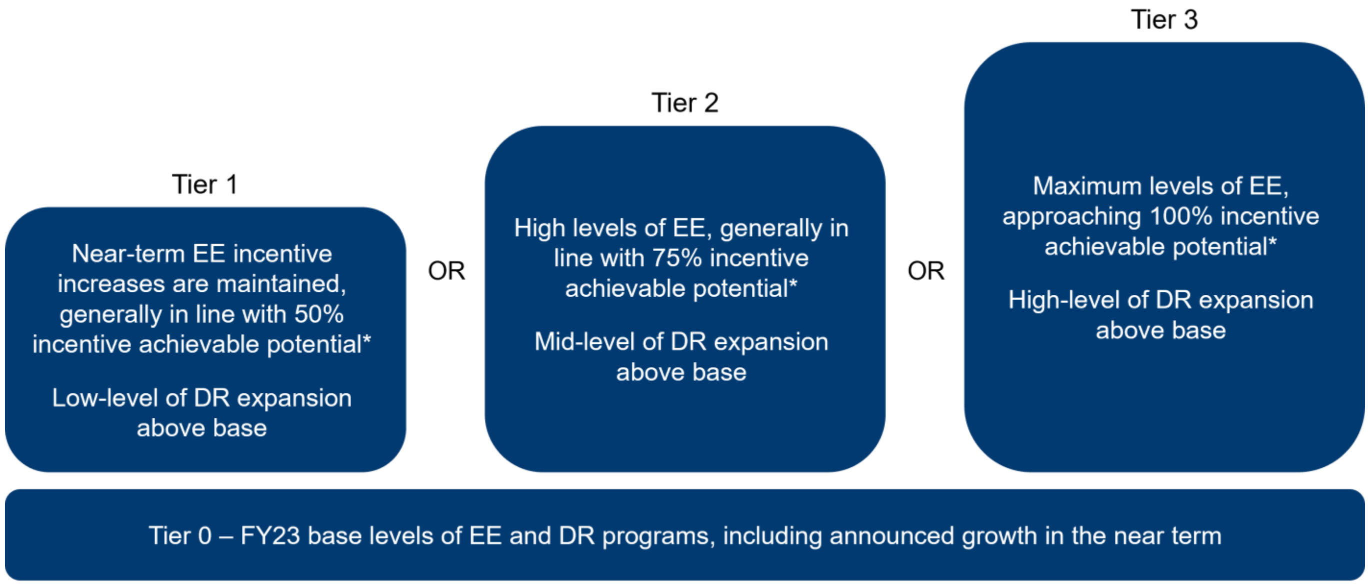
Demand-side Resources Methodology

TVA leveraged an updated potential study and historical experience to estimate load changes and costs of potential EE and DR programs.

A key driver of energy program adoption by customers is the level of financial incentive offered.

To simulate this effect in modeling, TVA created several tiers of EE and DR program levels that included increasing numbers of participants along with increasing incentives required to achieve higher participation.

In each year, the model could select a level of program participation above Tier 0, or base level, based on TVA system needs.



* Based on 2022 Energy Programs Potential Study

Resource Assumptions Summary

The IRP considers a full range of supply-side and demand-side resource options.

The combination of IRP scenarios, strategies, and resource options will help TVA and stakeholders evaluate a broad range of potential future conditions, business strategies, and portfolios.

Metrics will be used to assess the performance of the different strategies across the scenarios.

Additionally, sensitivities can stress key assumptions to evaluate impacts of changes in those assumptions.

Appendix – Resource Assumptions

Energy Efficiency (EE) Costs and Characteristics

IRP Modeling considers seven EE programs across four customer segments

Segment	Program Name	Tier	Life Span (years)*	Summer Firm Capacity (MW)	Winter Firm Capacity (MW)	Program Costs and Incentives ($000)	Energy (MWh)	$/Levelized MWh (2023$)
Residential EE	New Homes	Tier 1	20	3.8	3.5	4,497	8,670	49
		Tier 2		6.8	6.2	10,092	15,574	61
		Tier 3		13.5	12.3	34,307	30,676	106
	Residential Services	Tier 1	7-20	12.7	13.5	31,233	44,686	82
		Tier 2		49.6	52.7	107,327	174,203	72
		Tier 3		127.0	135.0	459,471	446,542	120
Commercial EE	Custom Commercial	Tier 1	10-15	4.8	3.6	5,290	31,204	20
		Tier 2		5.0	3.8	5,954	33,071	21
		Tier 3		5.3	4.0	6,669	34,938	23
	Standard Rebate Commercial	Tier 1	12-15	13.4	9.2	7,771	121,726	7
		Tier 2		14.3	9.8	8,315	129,829	7
		Tier 3		15.2	10.4	8,909	137,932	7
Industrial EE	Custom Industrial	Tier 1-3	12-15	2.0	1.7	3,819	15,874	28
	Standard Rebate Industrial	Tier 1-3	12-15	7.6	5.2	11,883	70,449	19
Local Power Company EE	Conservation Voltage Regulation	Tier 1	10	1.7	0.6	7,095	21,484	47
		Tier 2		2.6	0.9	10,860	32,225	48
		Tier 3		4.3	1.4	19,230	53,709	51

* Range reflects lifespans of the shortest and longest individual measures included within the program

Demand Response (DR) Costs and Characteristics

IRP Modeling considers four DR programs across four customer segments

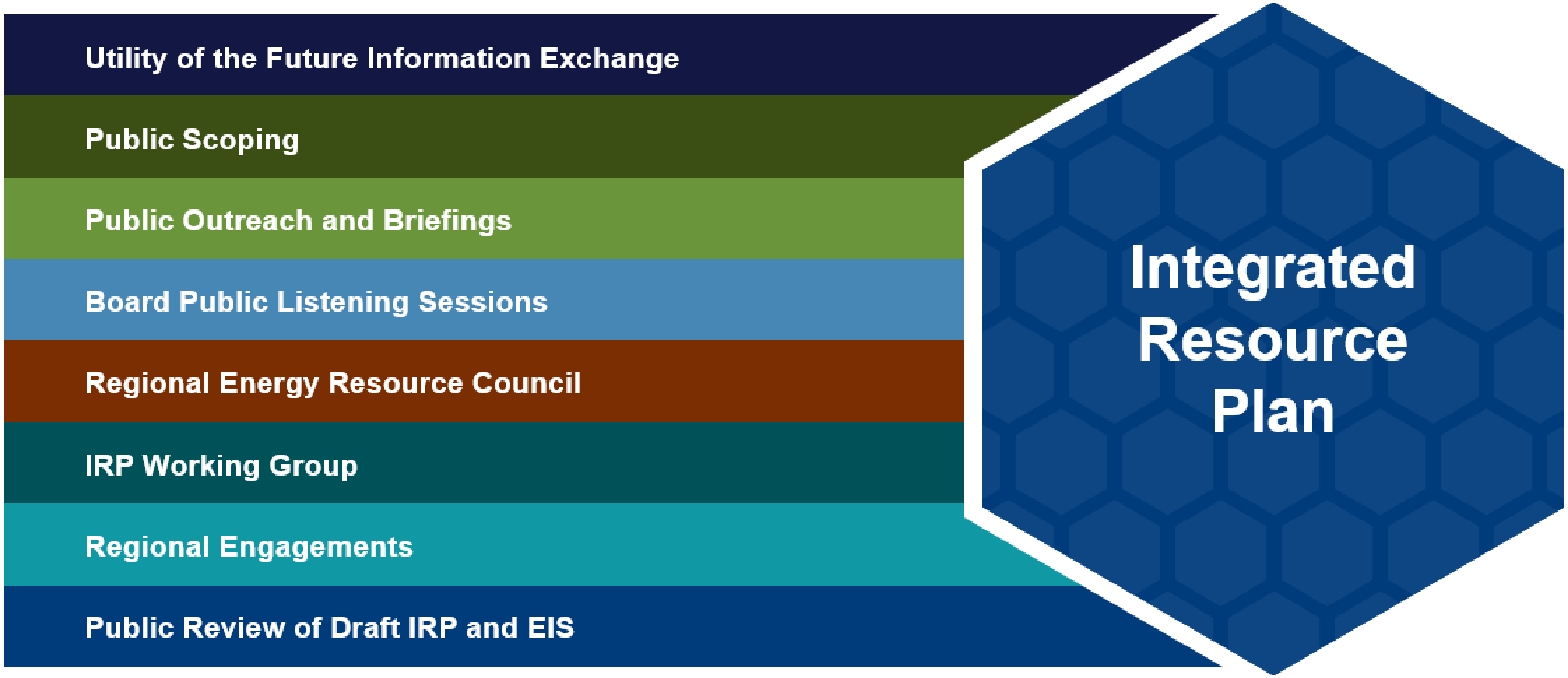
Segment	Program Name	Tier	Contract Length	Capacity (MW)	Annual Energy (MWh)	One-Time Cost (2023$)	Annual Fixed Cost ($/kW-year, 2023$)	Energy Cost ($/MWh, 2023$)
Residential DR	Smart Thermostat	Tier 1	5	20	1,600	1,460,000	77	0
		Tier 2		40	3,200	2,860,000	81	0
		Tier 3		60	4,800	5,190,000	88	0
Commercial DR	Aggregated Commercial	Tier 1	1	30	960	0	78	37
		Tier 2		60	1,920	0	78	37
		Tier 3		90	2,880	0	96	39
Industrial DR	Aggregated Industrial	Tier 1	5	30	720	4,800	123	60
		Tier 2		170	4,080	27,200	144	60
		Tier 3		300	7,200	48,000	180	60
Local Power Company DR	Dispatchable Voltage Regulation	Tier 1	5	30	4,800	45,000	55	37
		Tier 2		60	14,400	315,000	58	37
		Tier 3		120	28,800	720,000	60	37

Stakeholder Engagement Opportunities

Amy Edge; Director, External Relations

IRP Public Engagement Opportunities

A key element of TVA's IRP process is to ensure public involvement and direct engagement with a diverse group of stakeholders. The IRP process is utilizing past effective engagement venues as well as leveraging several new dynamics and initiatives.



IRP Working Group

Diverse representation creates support and credibility for TVA's long-term resource plans

Eight customer representatives, including:

- Three from Local Power Companies (LPCs)
- Five from customer associations

16 stakeholder representatives, including:

- Three from research or academic institutions
- Three from energy or environmental non-governmental organizations
- Four from state or federal government
- Six from community, sustainability, or other special interests

IRP Public Open Houses

TVA will host 12 open houses across the service territory once the draft IRP and EIS are published. The 10 in-person open houses will be held in the cities listed below with two virtual options also being offered.

Virtual Meetings

1. After Business Hours
2. During Lunch Hour

Unable to make it to a virtual or in-person meeting?

- Visit TVA's IRP website at: www.tva.com/irp for registration information.
- Taped webinars will be available as well.

In-Person Meetings *at 6 PM Local Time*

NC Murphy, NC	KY Hopkinsville, KY
TN Oak Ridge, TN	TN Nashville, TN
VA Bristol, VA	AL Huntsville, AL
TN Chattanooga, TN	MS Starkville, MS
GA Rossville, GA	TN Memphis, TN

Opportunities to Stay Involved

TVA Website www.tva.gov/IRP.

Attend future periodic public educational webinars – **next webinar July 18th at 6:00 p.m. Central (7:00 p.m. Eastern)**.

Add your name to the IRP mailing list at www.tva.gov/IRP to be notified when documents are released.

Submit comments on the Draft IRP/EIS Report, expected to be available later this year.

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RERC Advice Questions

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RERC Formal Advice Questions

IRP Scenarios, Strategies and Resource Options

The key objective of the IRP process is to establish a strong resource planning foundation.

This is accomplished by exploring a broad range of future scenarios and evaluating strategies designed to construct differentiated portfolios leveraging an appropriate range of resource options.

The IRP resource options include a range of cost and characteristic assumptions based on benchmark data, recent experience, and applicable policy and regulations.

The result will be a strategic portfolio direction which guides TVA's future asset decisions under a least cost planning framework.

How well do the IRP scenarios and strategies and resource assumptions meet this objective?

IRP Stakeholder Engagement

A key element of TVA's IRP process is to ensure public involvement and direct engagement with a diverse group of stakeholders.

Has the approach taken to public and stakeholder engagement supporting the IRP been effective thus far? Are there suggestions for enhancing the approach, particularly for plans on communication and engagement following release of the draft IRP?

Advice Questions Discussion

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Lunch Break

Meeting resumes at
1:30 PM EDT

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Public Listening Session

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Public Comment

This is a listening session; responses are typically not provided

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BREAK

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Finalize Advice Statement

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Closing Remarks

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Next IRP Public Webinar

Thursday, July 18, 2024
7PM to 8PM EDT

Please Register at
tva,govvttps://forms.office.com/g/XEGHbA8PLg

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Adjourn

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