
2024 IRP Working Group

Meeting 6: December 18-19, 2023
Franklin, TN

Welcome and Safety Moment

Jo Anne Lavender; IRP Facilitator
Hunter Reed, IRP Project Manager

Safety Moment

EMERGENCY ACTIONS

In case of Building Emergency

**Exit through the closest external doors
and gather in the parking lot**

In case of Severe Weather

**Exit the conference room, go across the
hall to our room for meals**



Agenda – December 18, 2023

Topic	Time (CT)	Presenter(s)	Notes
Lunch	11:00-12:00		
Welcome	12:00-12:15	Jo Anne Lavender; Hunter Reed	Welcome, safety moment, agenda review
Modeling Updates: 4A and 5A	12:15-1:30	Hunter Reed; Roger Pierce	Carbon Regulation and Carbon Regulation plus Growth updates
Break	1:30-1:45		
Behind the Meter Forecasting Overview	1:45-2:25	Scott Jones	
Seasonal Dispatch Profiles	2:25-3:20	Shane Downey	
Break	3:20-3:55		
Integrated Transmission Plan (ITP) Discussion	3:55-4:55	Zach Mansell and Nate Schweighart	
Wrap-up	4:55-5:00	Jo Anne Lavender	
Off-site dinner	6:00-8:00		

TVA's Integrated Resource Plan

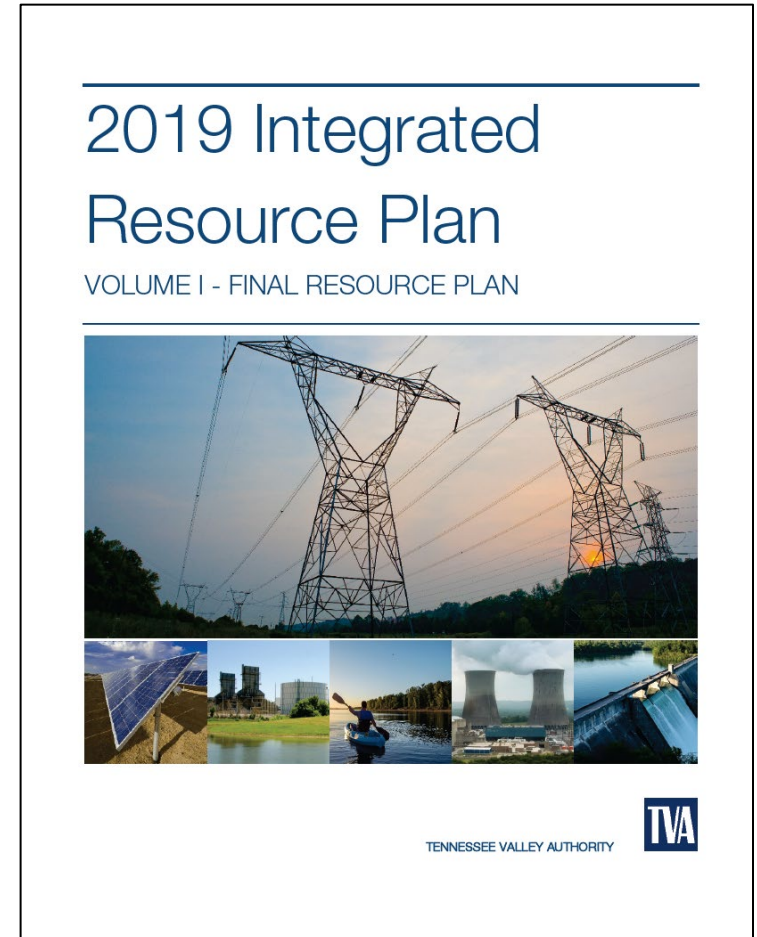
The IRP is a study of how TVA could meet customer demand for electricity between now and 2050 across a variety of possible futures.

A programmatic Environmental Impact Statement (EIS) accompanies the IRP to address 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 10 million residents of the Tennessee Valley.



Overarching Objective of the IRP-WG

To provide stakeholder input to the framing and evaluation included in TVA's next IRP, which establishes TVA's resource strategy in developing the energy system of the future.

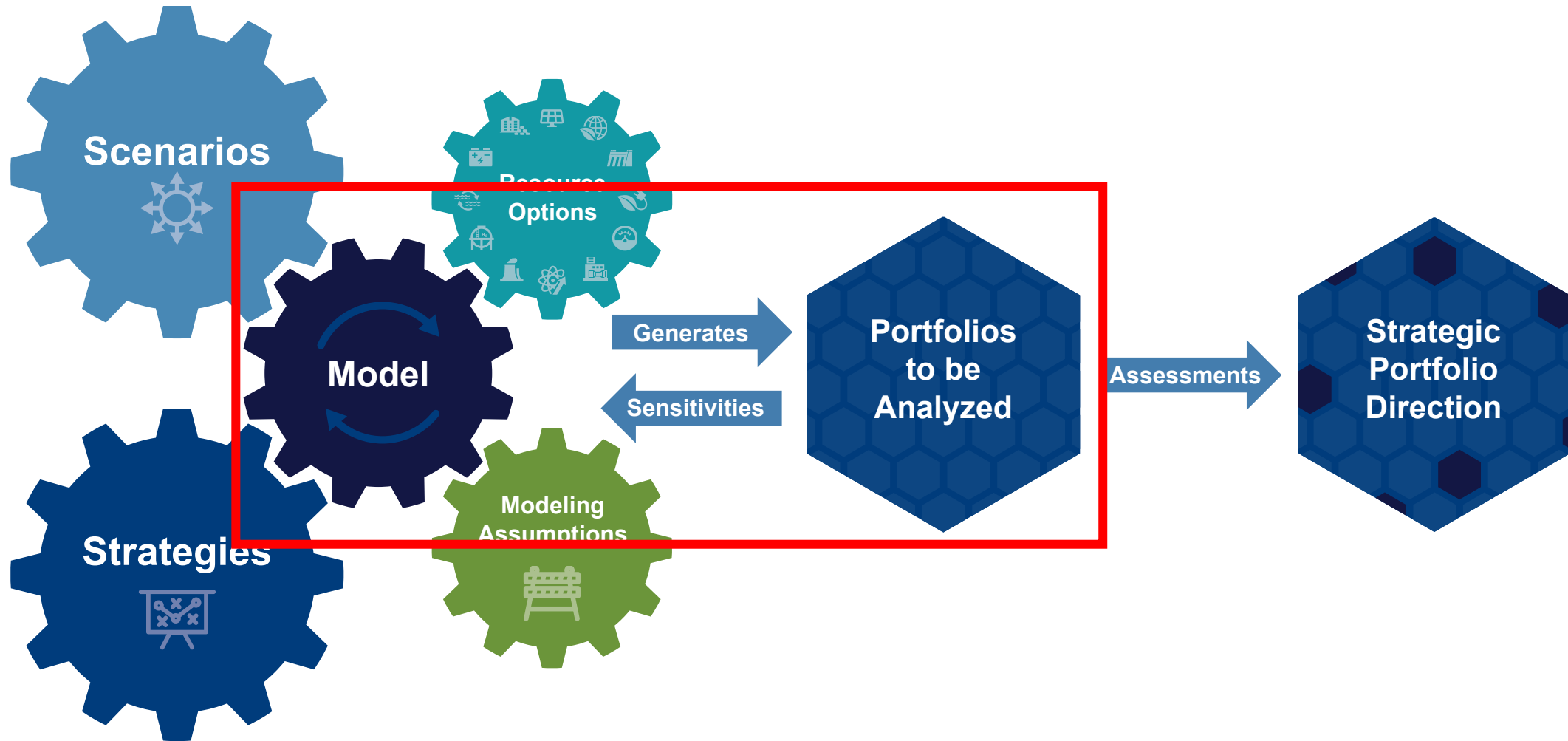
Modeling Updates: 4A/5A

Carbon Regulation and Carbon Regulation plus Growth with Baseline Utility Planning

Hunter Reed; IRP Project Manager

Roger Pierce; Sr. Specialist, Resource Strategy

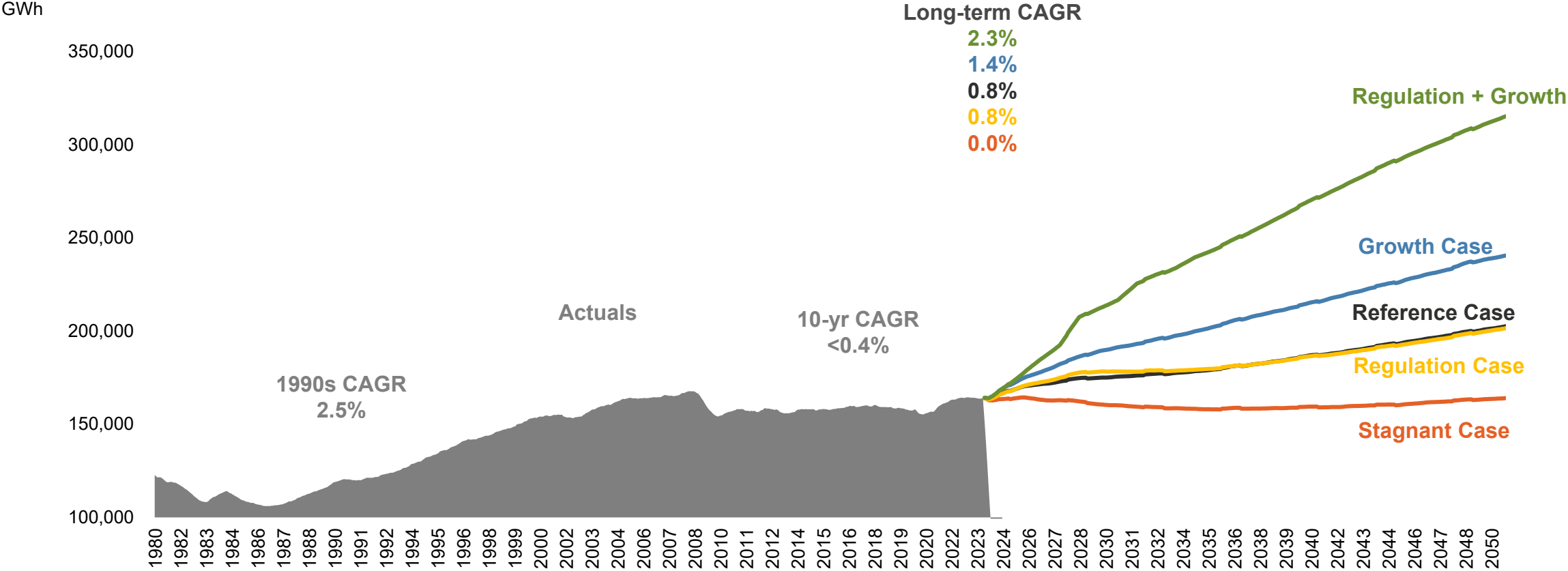
How the Integrated Resource Planning Process Works



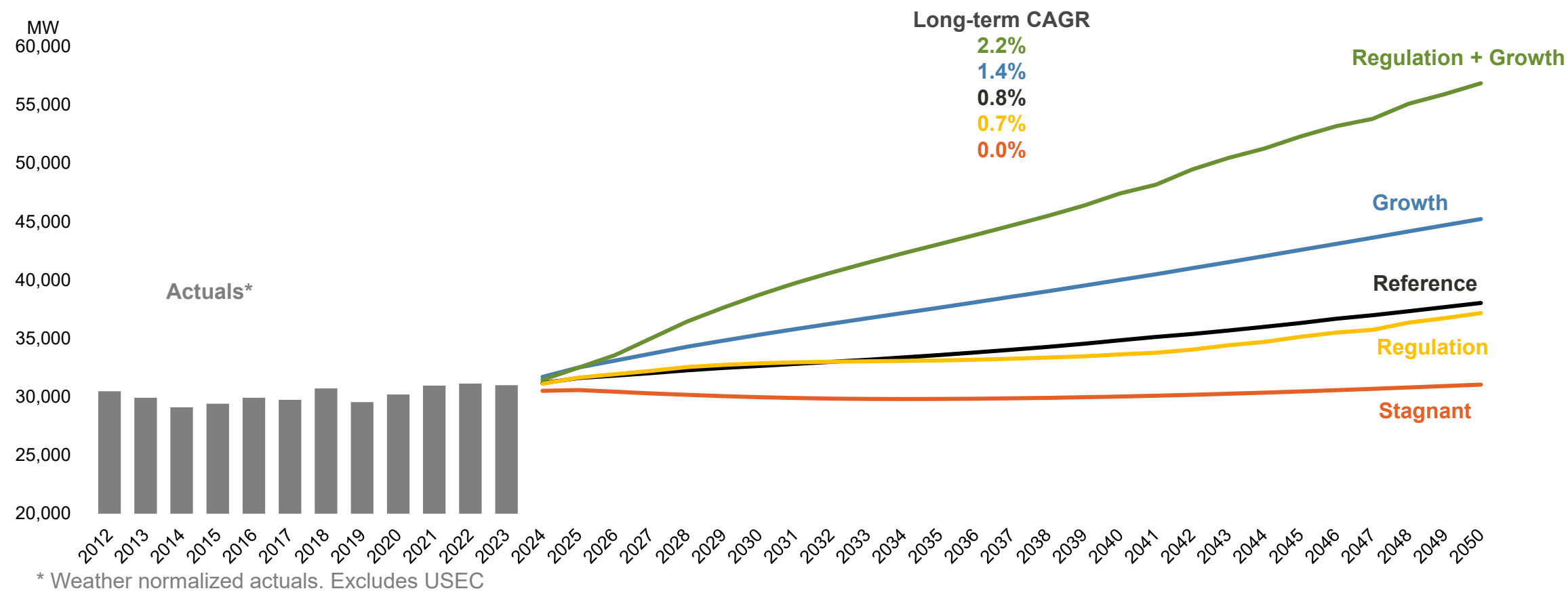
2024 IRP Scenarios

1	REFERENCE CASE Represents TVA's current forecast that reflects employment, population 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 targeting 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 the impact of proposed and potential future regulations along with substantial advancements in clean energy technologies, spurring economic growth and extensive electrification.

Total System Load Forecast



Net System Demand Forecast



2024 IRP Core Cases

2024 IRP Core Case Matrix	A. Baseline Utility Planning	B. Carbon-Free Innovation Focus	C. Carbon-Free Commercial Ready Focus	D. Distributed and Demand Side Focus	E. Resiliency Focus
1. Reference Case	1A	1B	1C	1D	1E
2. Higher Growth Economy	2A	2B	2C	2D	2E
3. Stagnant Economy	3A	3B	3C	3D	3E
4. Carbon Regulation	4A	4B	4C	4D	4E
5. Carbon Regulation plus Growth	5A	5B	5C	5D	5E



4A Updates (Carbon Regulation x Baseline Utility Planning)

Roger Pierce; Sr. Specialist, Resource Strategy



2024 IRP Scenarios

1	REFERENCE CASE Represents TVA's current forecast that reflects employment, population 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 targeting 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 the impact of proposed and potential future regulations along with substantial advancements in clean energy technologies, spurring economic growth and extensive electrification.

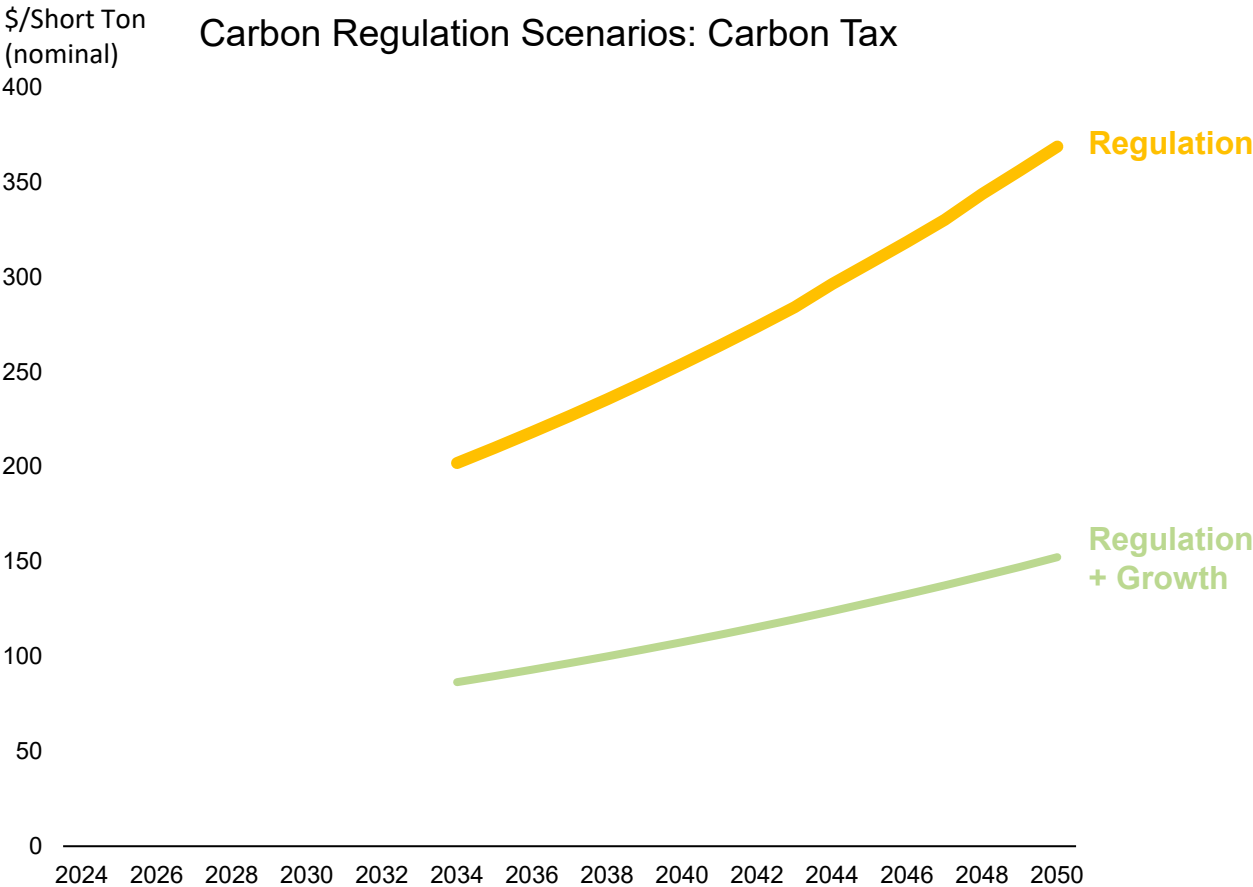
Carbon Regulation Scenario: Major Assumptions

Resource cost forecasts remain the same as the Reference Case

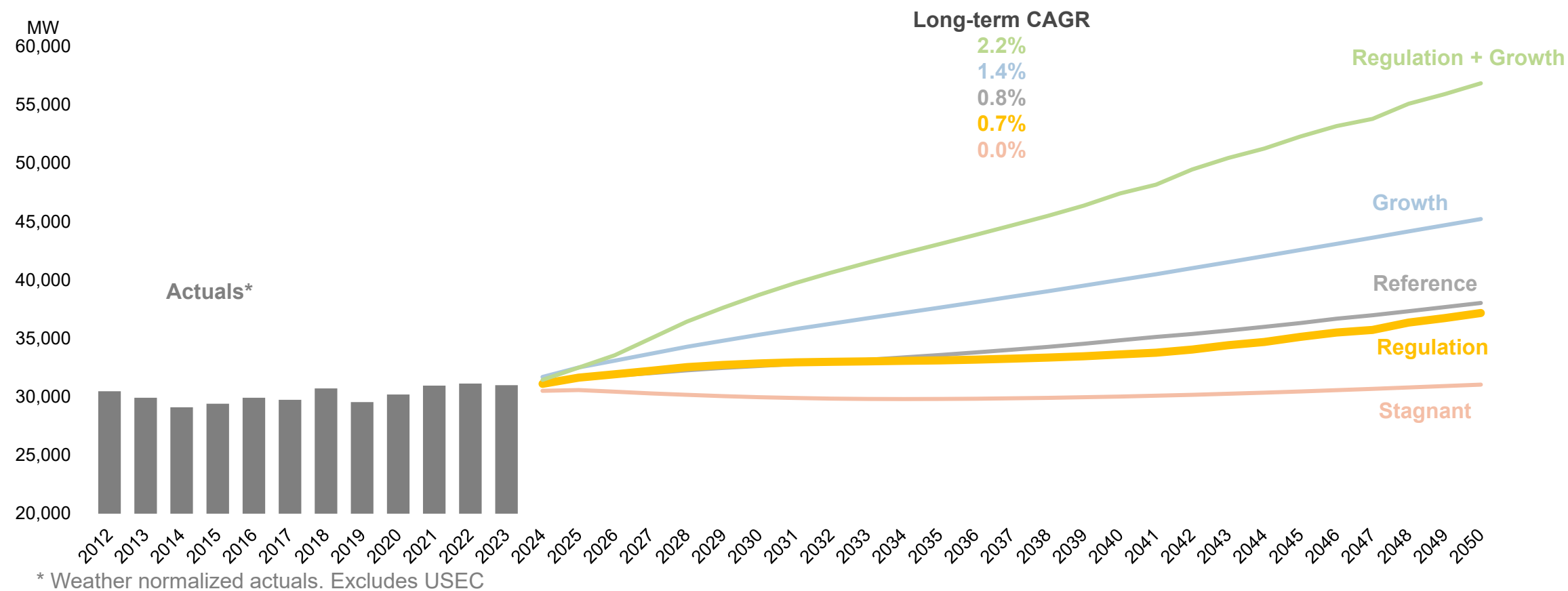
Proposed EPA Greenhouse Gas Rules are implemented, requiring major changes to the operation of fossil fuel-based resources (phased impacts between 2030 and 2040)

Starting in 2034, a Carbon Tax is applied using the draft EPA social cost of carbon at a 2.5% discount rate as a proxy (\$202/short ton in 2034)

Market-delivered hydrogen reaches \$1/kg by 2050

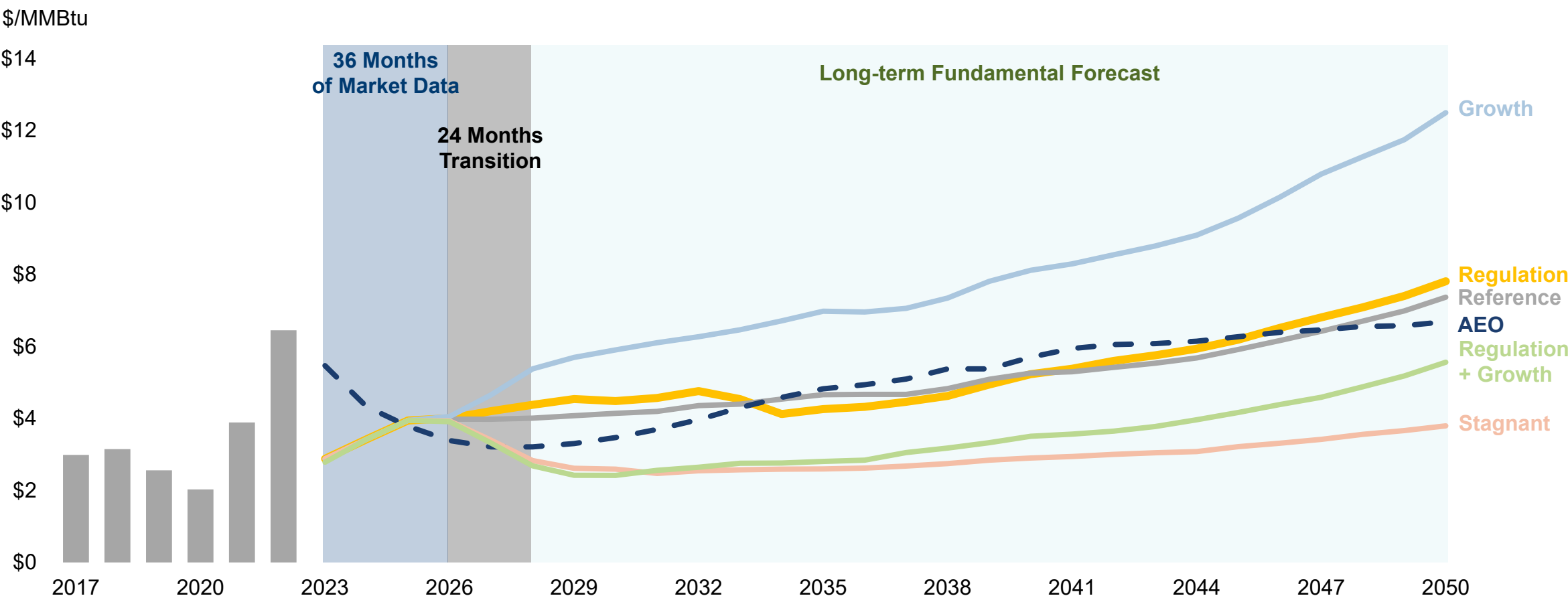


2024 IRP Scenarios: Net System Demand Forecast



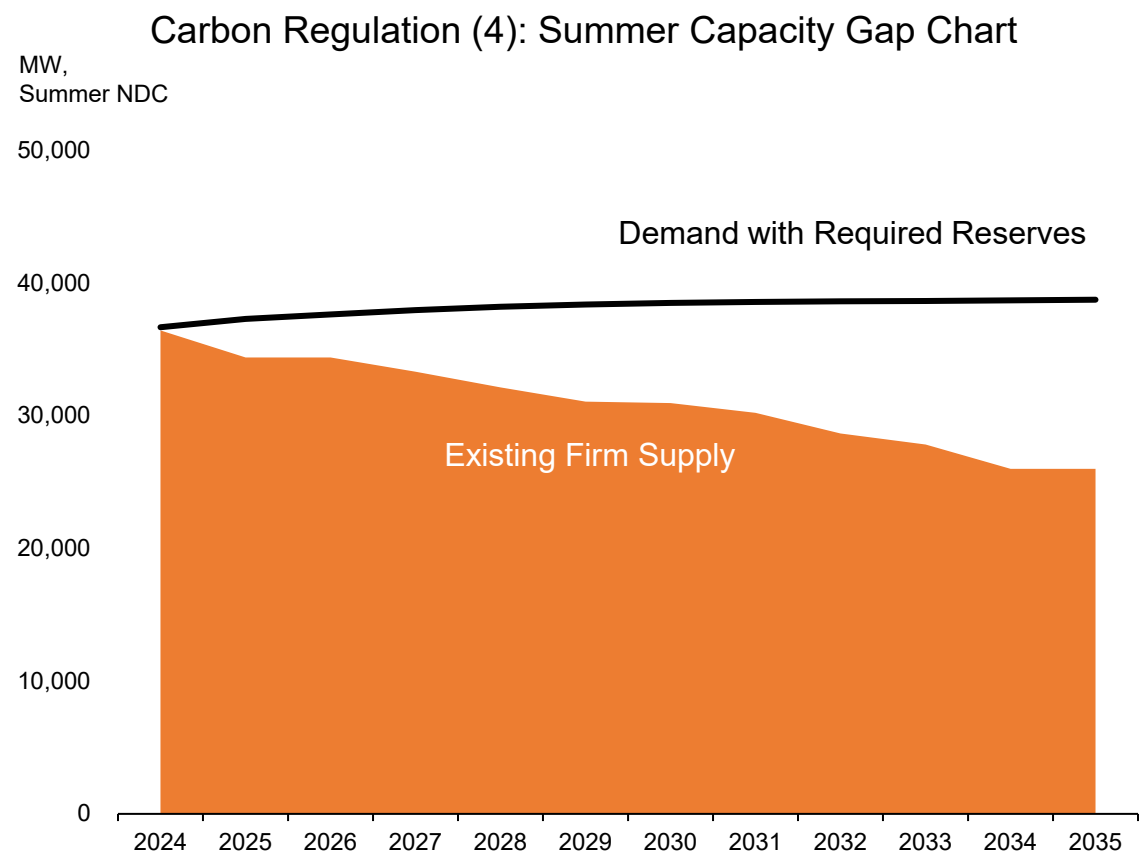
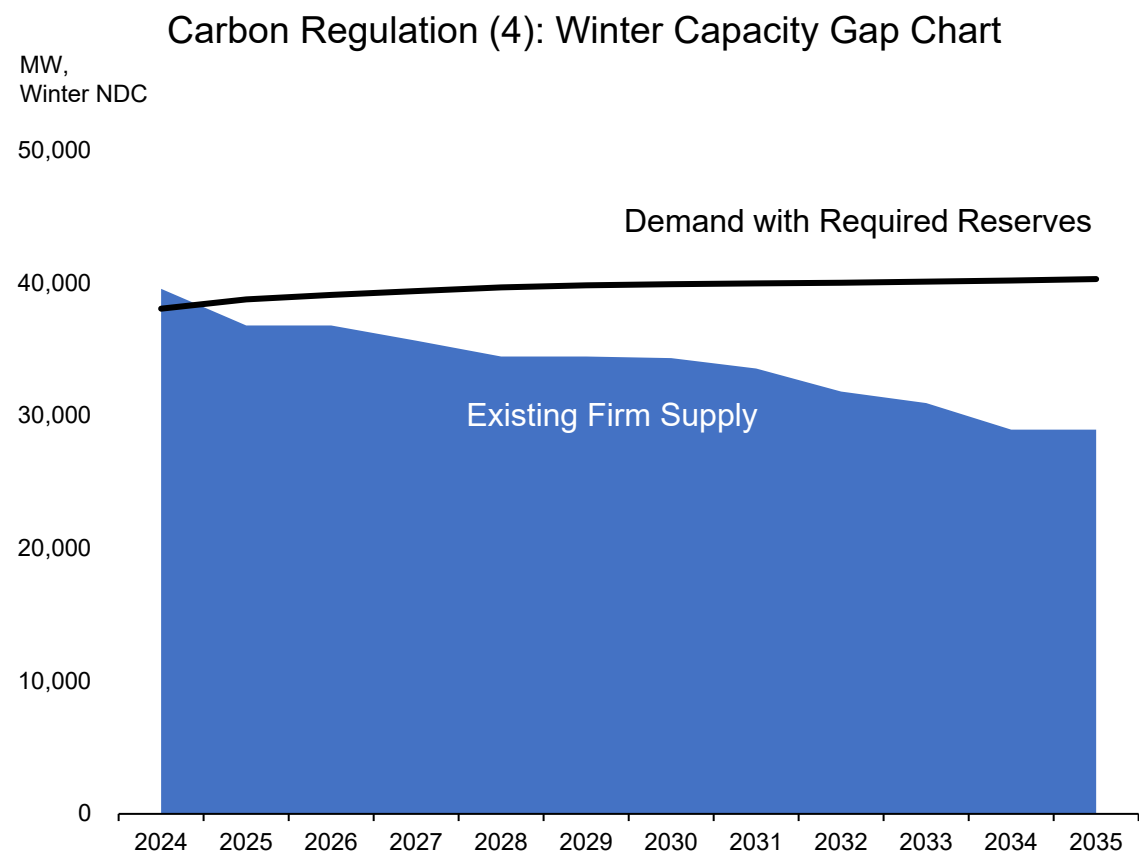
2024 IRP Scenarios: Henry Hub Forecast

2026-2050 Average Nominal Price: **\$3.00** | **\$3.52** | **\$5.14** | **\$5.28** | **\$7.85**



Carbon Regulation Capacity Gap Chart (2024 – 2035)

The IRP must account for planned retirements and expirations of over 10,000 MW of firm capacity.





5A Updates (Carbon Regulation plus Growth x Baseline Utility Planning)

Roger Pierce; Sr. Specialist, Resource Strategy



2024 IRP Scenarios

1	REFERENCE CASE Represents TVA's current forecast that reflects employment, population 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 targeting 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 the impact of proposed and potential future regulations along with substantial advancements in clean energy technologies, spurring economic growth and extensive electrification.

Carbon Regulation plus Growth Scenario: Major Assumptions

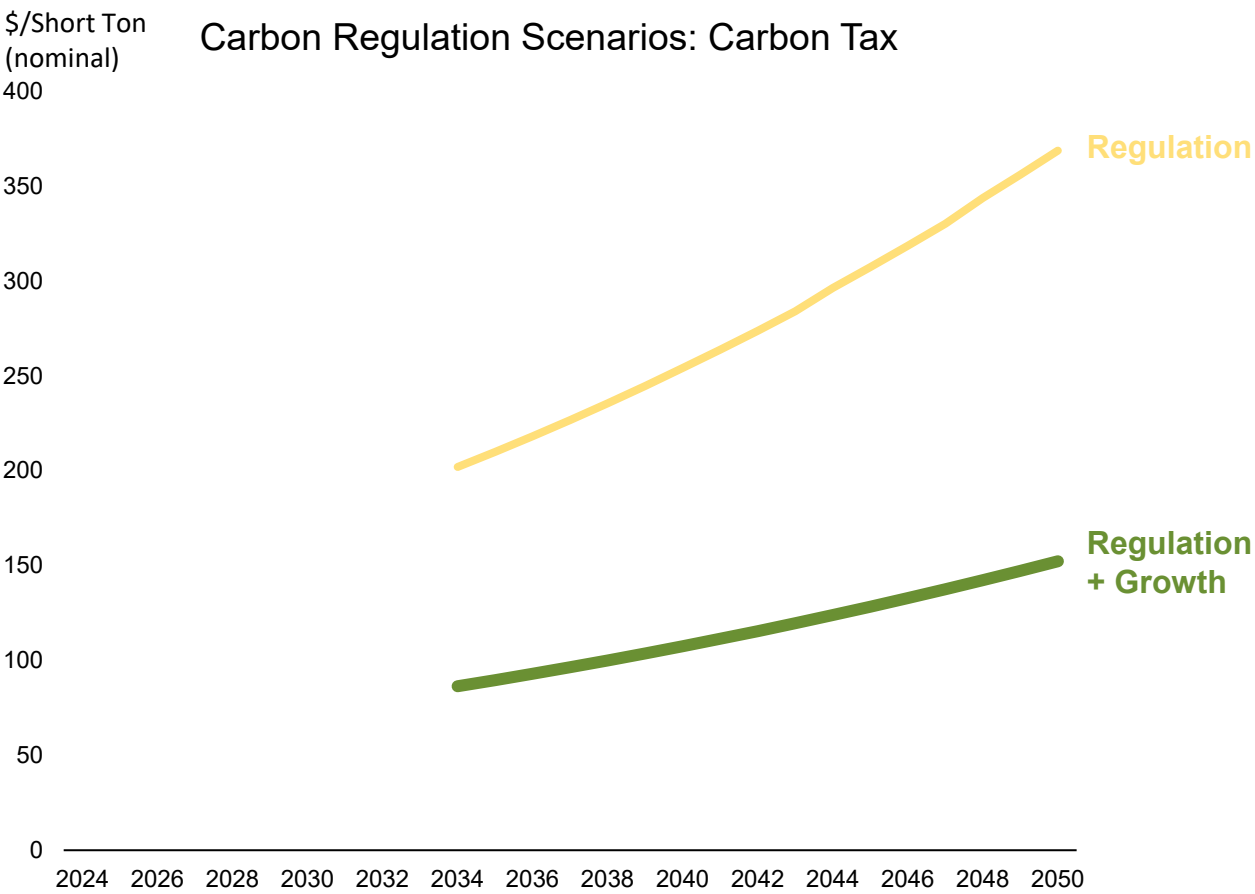
Resource cost forecasts are reduced to NREL advanced case

IRA tax credits increase to maximum value and do not expire

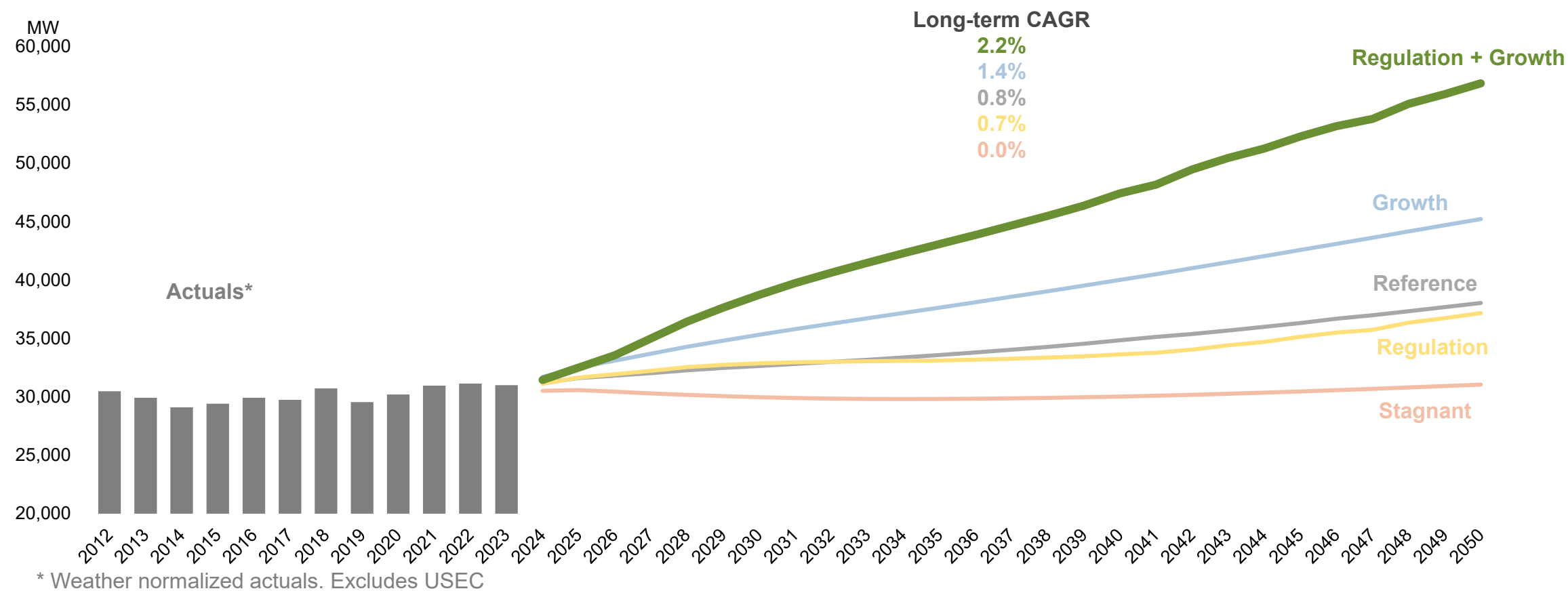
Proposed EPA Greenhouse Gas Rules are implemented, requiring major changes to the operation of fossil fuel-based resources (phased impacts between 2030 and 2040)

Starting in 2034, a Carbon Tax is applied using the 2021 White House interim social cost of carbon at a 3.0% discount rate as a proxy (\$86/short ton in 2034)

Market-delivered hydrogen costs assumed to fall from \$3.60/kg in 2023 to \$1.00/kg by 2032 (\$31.57/MMBtu to \$8.70/MMBtu)

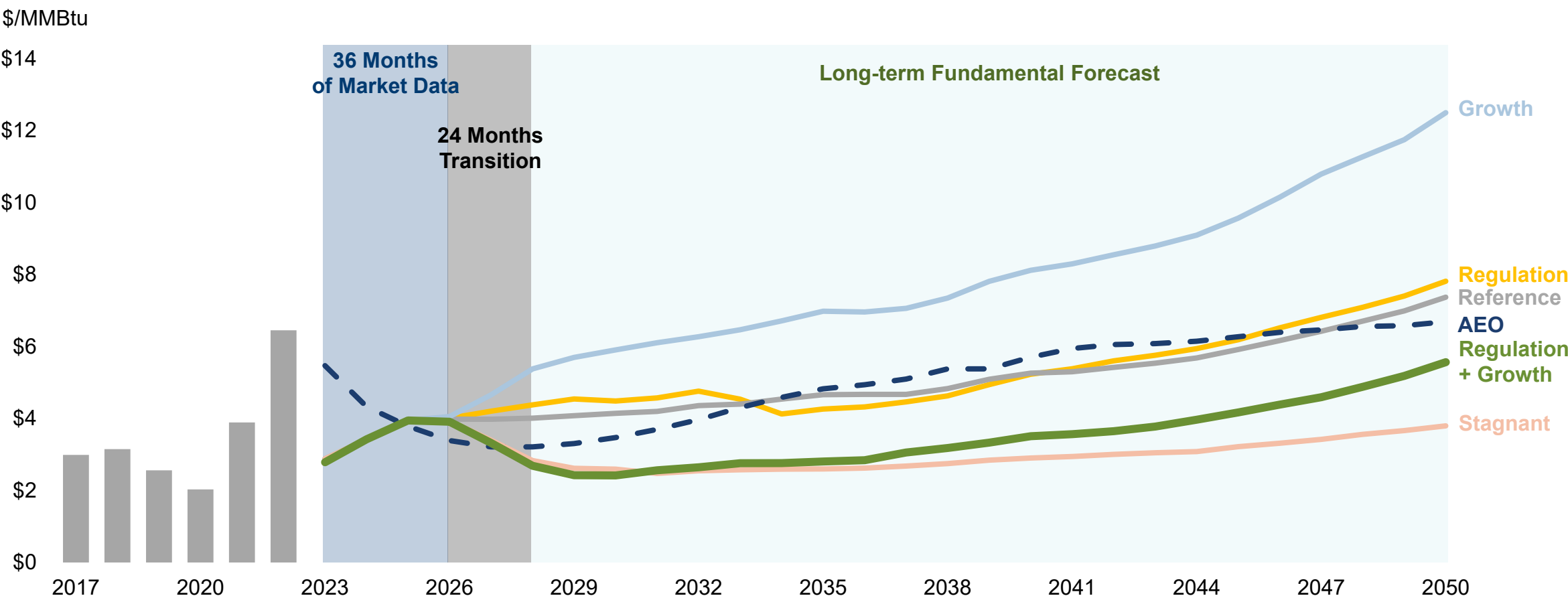


2024 IRP Scenarios: Net System Demand Forecast



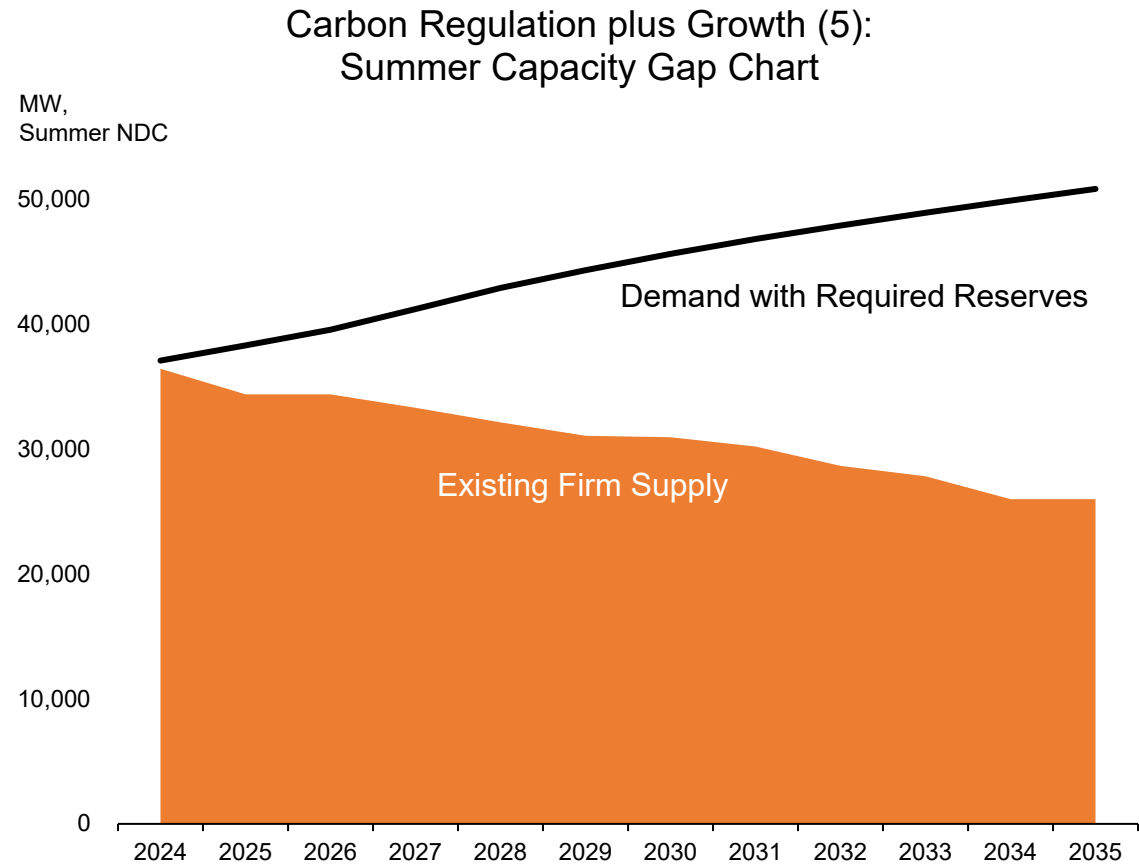
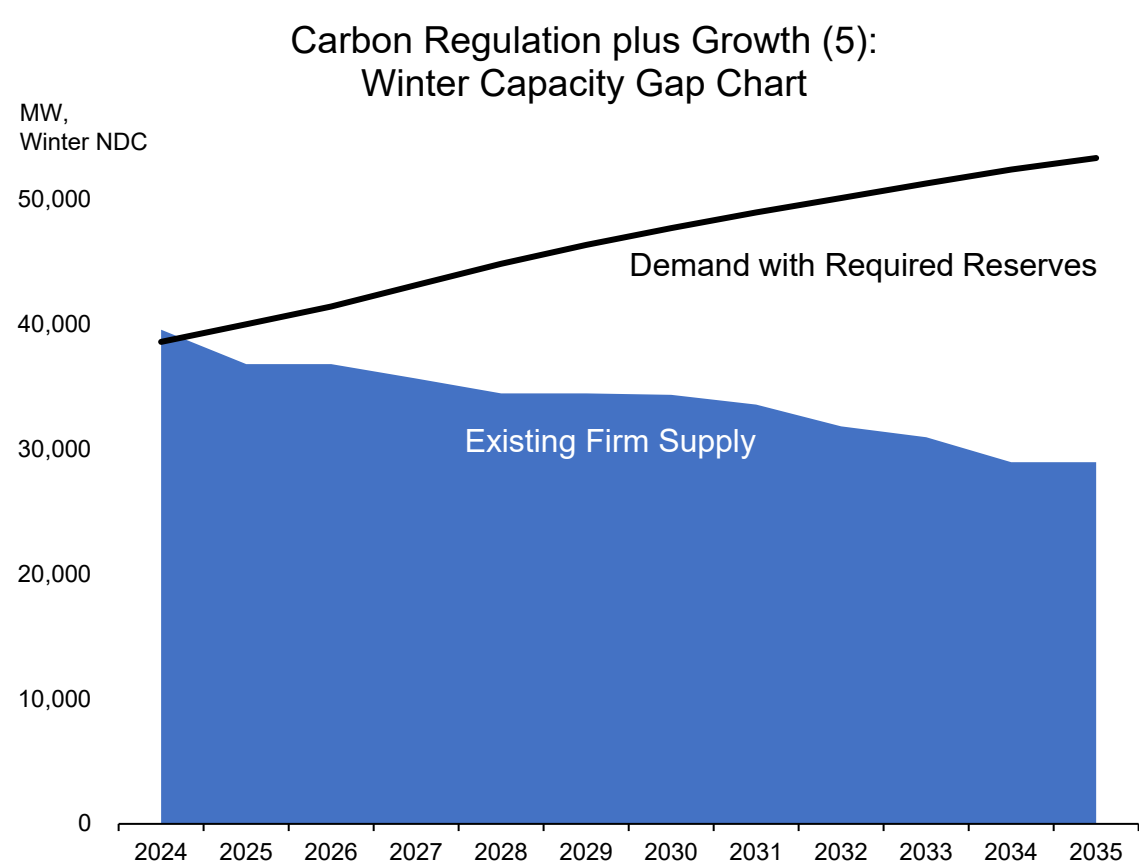
2024 IRP Scenarios: Henry Hub Forecast

2026-2050 Average Nominal Price: **\$3.00** | **\$3.52** | **\$5.14** | **\$5.28** | **\$7.85**



Carbon Regulation plus Growth Capacity Gap Chart (2024 – 2035)

The IRP must account for planned retirements and expirations of over 10,000 MW of firm capacity.



Break



Behind-the-Meter Forecasting Overview

Scott Jones; Sr. Specialist, Resource Strategy

Behind-the-Meter (BTM) Forecasting Overview

The 2024 IRP includes unique assumptions for BTM solar, storage, and 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.



Key Elements of the Adoption Model

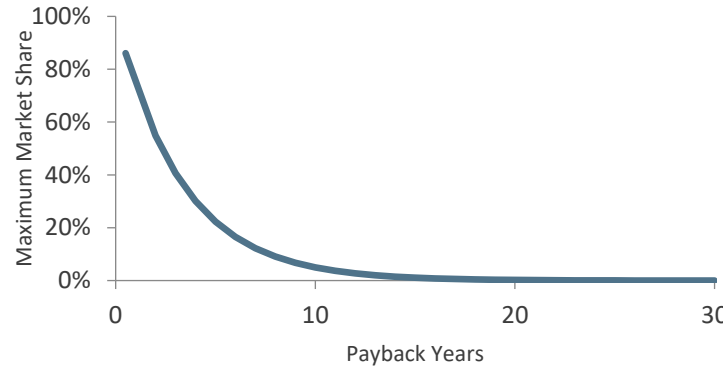
Approach is like NREL's Distributed Market Demand Model, which simulates potential adoption of a given resource as a function of payback period.

Key elements are the payback period (number of years required to recoup investment), maximum market share, and the adoption curve.

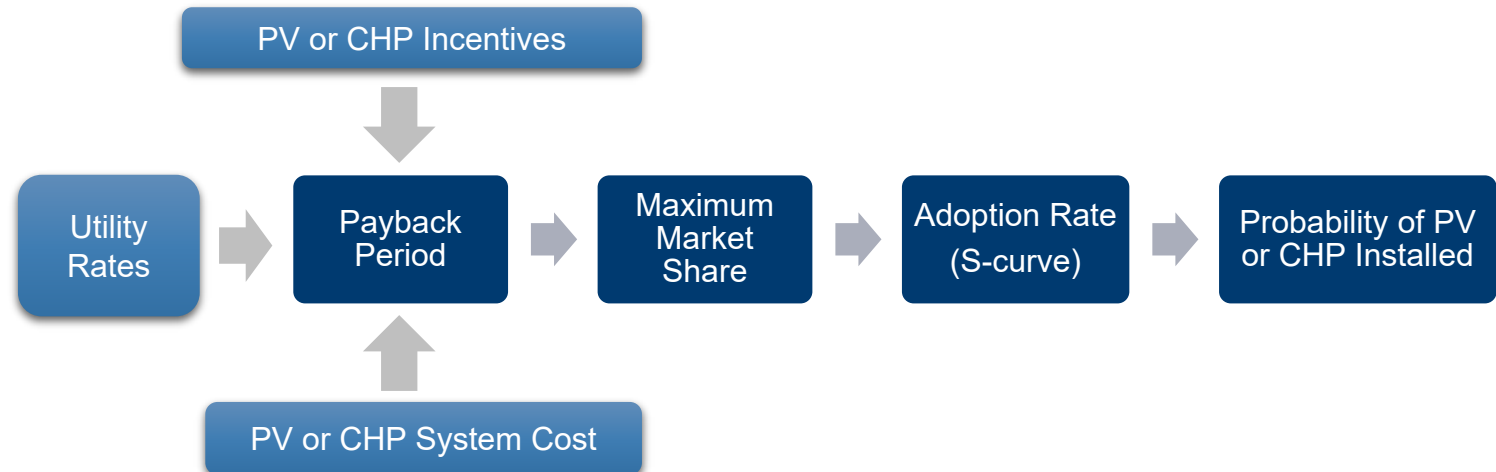
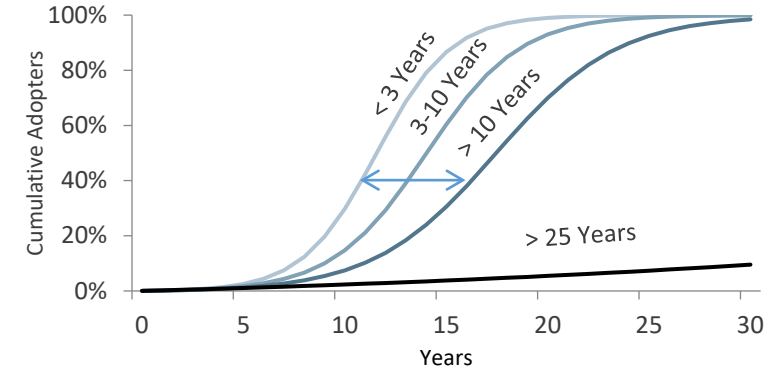
The payback period determines the maximum market share, or depth, for either BTM solar or CHP.

The payback period also determines how quickly the market will adopt a given resource type, with a faster payback resulting in faster maximum market saturation.

Maximum Market Share



Adoption Curve



Seasonal Dispatch Profiles

Shane Downey; Sr. Specialist, Resource Strategy

Break



Integrated Transmission Plan (ITP) Discussion

Nate Schweighart; General Manager, Transmission Planning

Zach Mansell; Senior Program Manager, Transmission Planning & Projects

Wrap-up and Day Two Preview

Jo Anne Lavender; IRP Facilitator

2024 IRP Working Group

Meeting 6: December 18-19, 2023
Franklin, TN

Welcome

Jo Anne Lavender; IRP Facilitator

Agenda – December 19, 2023

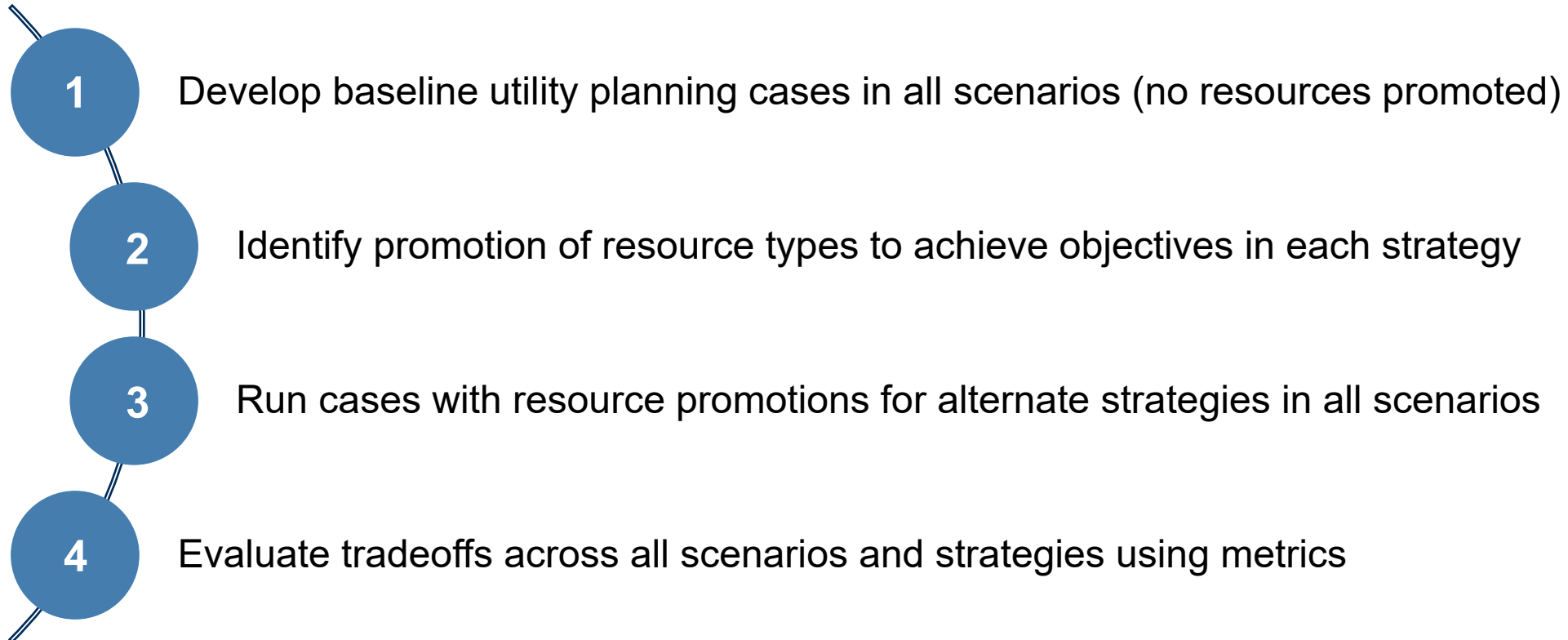
Topic	Time (CT)	Presenter(s)	Notes
Breakfast	8:00-8:45		
Agenda and welcome	8:45-9:00	Jo Anne Lavender	
Strategy review and modeling approach	9:00-9:30	Hunter Reed	
Reference Case Alternative Strategy Results	9:30-10:00	Preeth Srinivasaraghavan	
Break	10:00-10:15		
Reference Case Alternative Strategy Results (cont.)	10:15-11:30	Preeth Srinivasaraghavan	
Lunch	11:30-12:30		
IRP-WG Discussion	12:30-1:30	Jo Anne Lavender	
Wrap-up	1:30-1:45		

Strategy Review and Modeling Approach

Hunter Reed; IRP Project Manager

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.



2024 IRP Strategies

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 renewable technologies such as wind, solar, battery and long-duration 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, coupled with strategic transmission investment, to drive wider geographic distribution of resources and additional resiliency across the system.

Attributes: Strategy Decision Matrix

Strategy	Distributed and Demand Side Resources					Utility Scale Resources					
	Distributed Solar	Distributed Storage	Combined Heat and Power	Energy Efficiency	Demand Response	Solar and Wind	Battery Storage	Long-duration Storage	Aero CTs and Recip Engines	New Nuclear	Hydrogen and CCS*
Baseline Utility Planning	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base
Carbon-Free Innovation Focus	Moderate	Moderate	Base	Moderate	Moderate	Moderate	Moderate	Moderate	Base	High	High
Carbon-Free Commercial Ready Focus	Moderate	Moderate	Base	Base	Moderate	High	High	High	Base	Base	Base
Distributed and Demand Side Focus	High	High	High	High	High	Base	High	Base	High	Base	Base
Resiliency Focus	Moderate	Moderate	Moderate	Base	High	Base	High	Moderate	High	Moderate	Base

*Carbon Capture and Sequestration

Reference Case Alternative Strategy Results

Preeth Srinivasaraghavan; Specialist III, Resource Strategy

2024 IRP Core Cases

2024 IRP Core Case Matrix	A. Baseline Utility Planning	B. Carbon-Free Innovation Focus	C. Carbon-Free Commercial Ready Focus	D. Distributed and Demand Side Focus	E. Resiliency Focus
1. Reference Case	1A	1B	1C	1D	1E
2. Higher Growth Economy	2A	2B	2C	2D	2E
3. Stagnant Economy	3A	3B	3C	3D	3E
4. Carbon Regulation	4A	4B	4C	4D	4E
5. Carbon Regulation plus Growth	5A	5B	5C	5D	5E

IRP Modeling: Next Steps

Ahead of January IRP-WG meeting:

- Perform final quality reviews and refinements to existing cases.
- Produce portfolios for alternate strategies against scenarios 2 through 5.
- Calculate metrics and prepare for key tradeoffs review.

Lunch



IRP-WG Check-in

Jo Anne Lavender; IRP Facilitator

IRP Six-Months in Review

Key Accomplishments

- Designed, aligned, and finalized 5 scenarios and 5 strategies
- Developed and reviewed economic, commodity, and load forecasts for all scenarios
- Developed and reviewed all 5 scenarios against Baseline Utility Planning and all 5 strategies under the Reference Case
- Discussed metrics to be evaluated and resource costs
- Roundtable discussions with key senior leadership, including President and CEO Jeff Lyash

IRP Six-Months in Review

Stakeholder engagements to date

- IRP Public Scoping: 45-day public comment period, with 43 official comments received
- IRP Public Webinars: 4 held to-date; covered scoping, project updates, and scenarios and strategies
- Ongoing regional touchpoints with LPCs, Direct Serves, and customer associations

IRP-WG Check-in

How do you feel the process is going?

What topics would you like to see clarified at future meetings?

Any other feedback or constructive comments?

Meeting Wrap-Up

Jo Anne Lavender; IRP Facilitator