



Regional Energy Resource Council

June 26-27, 2019
Chattanooga, Tennessee



Term 3 RERC Members

Michael Butler

Tennessee Wildlife Federation

Wayne Davis*

University of Tennessee

Rodney Goodman

Habitat for Humanity

Dan Ionel

University of Kentucky

Wes Kelley

Huntsville Utilities

Doug Lawyer

Knoxville Chamber

Peter J. Mattheis

Tennessee Valley Industrial Committee

Shari Meghreblian

State of Tennessee (retired)

Jennifer Mundt

State of North Carolina

Jeremy Nails

Morgan County Economic Development
Association

Alice Perry**

State of Mississippi

Doug Peters

Tennessee Valley Public Power
Association

Derwin Sisnett

Gestalt Community Schools

Stephen Smith

Southern Alliance for Clean Energy

Charles Snavely

Commonwealth of Kentucky

John Warren

Commonwealth of Virginia

Lloyd Webb

Olin Chlor Alkali

Susan R. Williams

SRW & Associates

*RERC Chair

** Retired from the RERC June, 2018

Special Guests -- TVA Board Members

- Skip Thompson, TVA Board Chair
- Kenny Allen
- A.D. Frazier
- Richard Howorth
- Gina Lodge
- John Ryder



Introductions



- Name
- Organization and Role

Safety Moment



Building Emergency Plan



Agenda and Meeting Protocols

Agenda – June 26, 2019

12:45	Welcome and Introductions and Safety Moment
1:00	RERC Overview and Meeting Protocols
1:05	Today's Meeting Purpose
1:20	2019 IRP Overview and Development Process 2019 IRP Stakeholder Process
2:00	Break
2:15	Developing the IRP Recommendation. The IRP Recommendation
3:15	Break
3:30	Panel - Challenges and Opportunities that the 2019 IRP points out for TVA
4:45	Break and prepare for Public Listening Session
5:00	Public Listening Session (sign up ahead at the door)
6:00	Wrap Up, Conclude Session, thank all attendees

Agenda – June 27, 2019

8:30	Welcome and Recap Day 1 Summarize meeting and Board session, panels, public comments
9:00	RERC Observations from Day 1
9:45	Break
10:00	The IRP Recommendation
11:00	RERC Discussion Questions
12:00	Lunch
1:00	Form RERC Advisory Statement
2:00	Next Steps
2:30	Wrap Up and Adjourn

RERC Meeting Protocols

Agenda

- ◆ Prepared and approved by the Designated Federal Officer (DFO) in consultation with Council Chair
- ◆ Distributed to Council and published in the Federal Register prior to each meeting
- ◆ Topics may be submitted 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

Voting

- ◆ Any member of the Council may make a motion for a vote
- ◆ Recommendations to TVA Board shall require an affirmative vote of at least a simple majority of the total Council members present on that date
- ◆ Council members may include minority or dissenting views

Discussion

- ◆ DFO (or his designee) will facilitate and ensure good order during all open discussions
- ◆ Only one speaker or attendee is permitted to comment at a time
- ◆ To be recognized by the Chair (or meeting facilitator) in order to provide comment, please turn your name card on its side



Today's Meeting Purpose

Joe Hoagland, Designated Federal Officer

Recap Term 3 Meetings

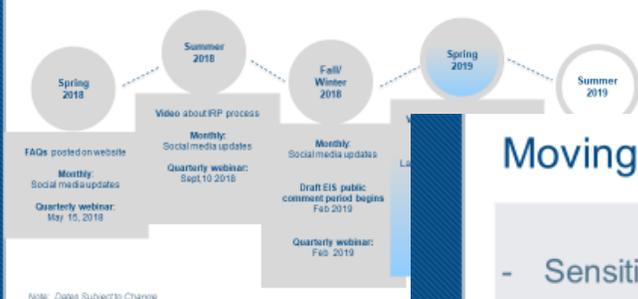
- **8 Meetings held so far in Term 3**
- **6 focused on the 2019 IRP development process:**
 - **June 14, 2018**, IRP Focus Areas and Public Engagement
 - **September 5, 2018**, IRP Scenarios and Strategies
 - **December 18, 2018**, Metrics and Scorecards; Considerations as TVA applies these metrics
 - **February 19-20, 2019**: Review Draft IRP and EIS; hosted Public Open House.
 - **April 17-18, 2019**: Moving from Draft IRP to Final
 - **June 10, 2019**: Webinar on Public Comments/Responses, and Sensitivities

Today's Meeting Purpose

- **Provide an overview on the 2019 Integrated Resource Plan**
 - Development of the IRP, including final IRP /EIS
 - Review public engagement along the way
 - Present the Recommendation
 - Host a panel of experts to gain broad understanding of challenges related to the 2019 IRP
 - Review key themes heard from public and stakeholders and how TVA addressed them
- **Host a Public Listening Session**
- **Hear RERC views:**
 - On the 2019 IRP Development Process
 - On the Scope of the Analysis
 - On the Opportunities or Focus Areas for TVA going forward

April 17-18, 2019 Meeting – Recap

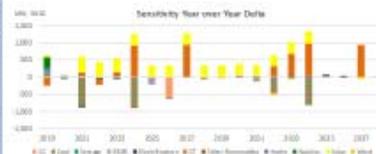
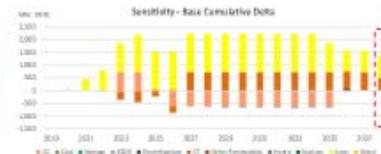
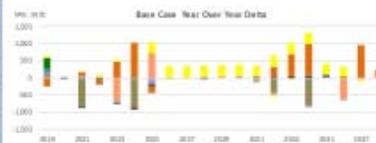
IRP Public Outreach



Moving to the Final IRP

- Sensitivities
- Forming a Recommendation
- Finalizing the IRP and EIS

Accelerated Solar



- Accelerating solar additions primarily has the effect of bringing the economic solar additions forward, resulting in an additional ~800 MW of solar by 2038 which is less than the total accelerated amounts
- Total nameplate MW of solar is below 10,000 MW in the both cases

INTEGRATED Resource Plan 2019 71





2019 IRP Overview and Development Process

Hunter Hydas and Amy Henry

TVA's Mission

Energy



Provide affordable electric power throughout the Tennessee Valley

Environment



Act as a steward of the Valley's natural resources

Economic Development



Serve as a catalyst for sustainable economic development

TVA's Integrated Resource Plan and Environmental Impact Statement

The Integrated Resource Plan (IRP) is a study of how TVA could meet customer demands across a variety of future environments.

A programmatic Environmental Impact Statement (EIS) accompanies the IRP to analyze the impacts associated with an updated IRP to the Valley.

2019 Integrated Resource Plan

VOLUME I - FINAL RESOURCE PLAN



TENNESSEE VALLEY AUTHORITY 

Why Are We Updating the IRP Now?

1

Consumer behaviors and preferences are changing

2

Companies are committing to renewables

3

Distributed energy resources introduce fundamental change

An updated Integrated Resource Plan is needed to:

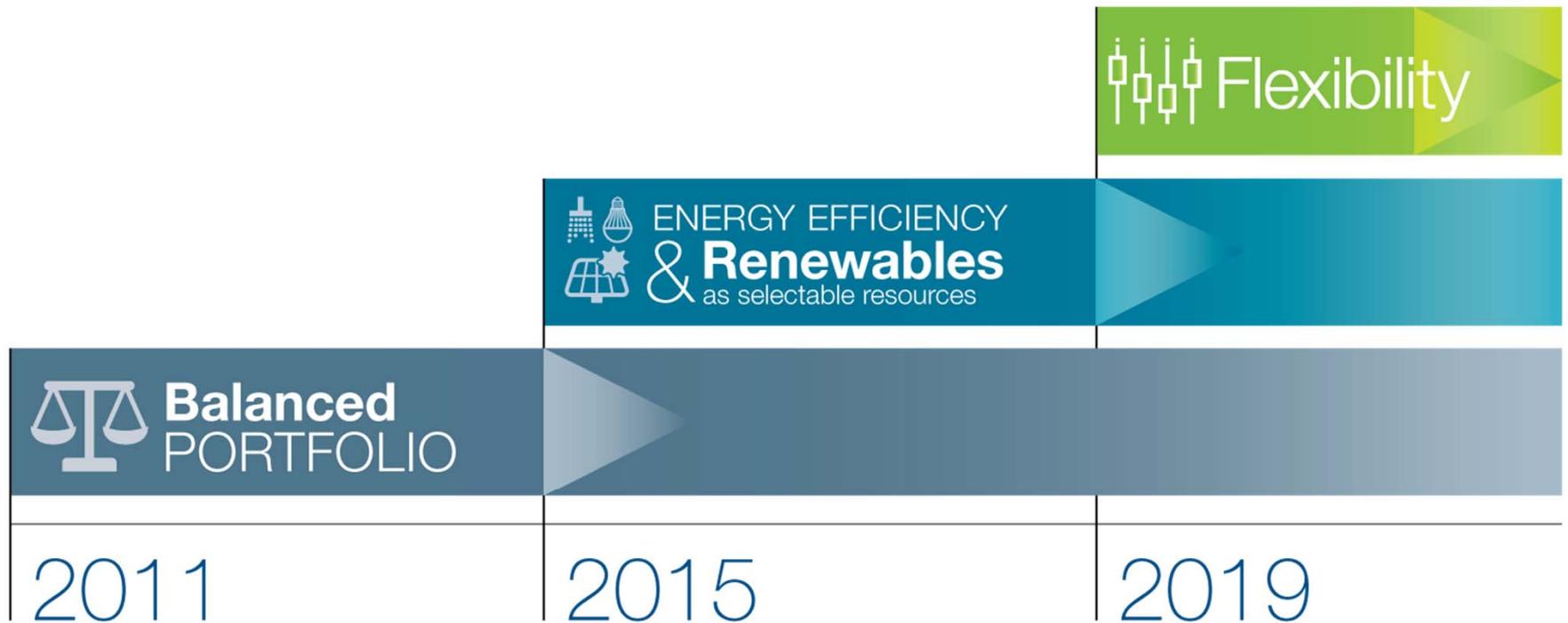
- Proactively plan for the future
- Inform next long-range financial plan
- Shape how TVA can continue to achieve the Mission



INTEGRATED Resource Plan 2019

Focus Areas:

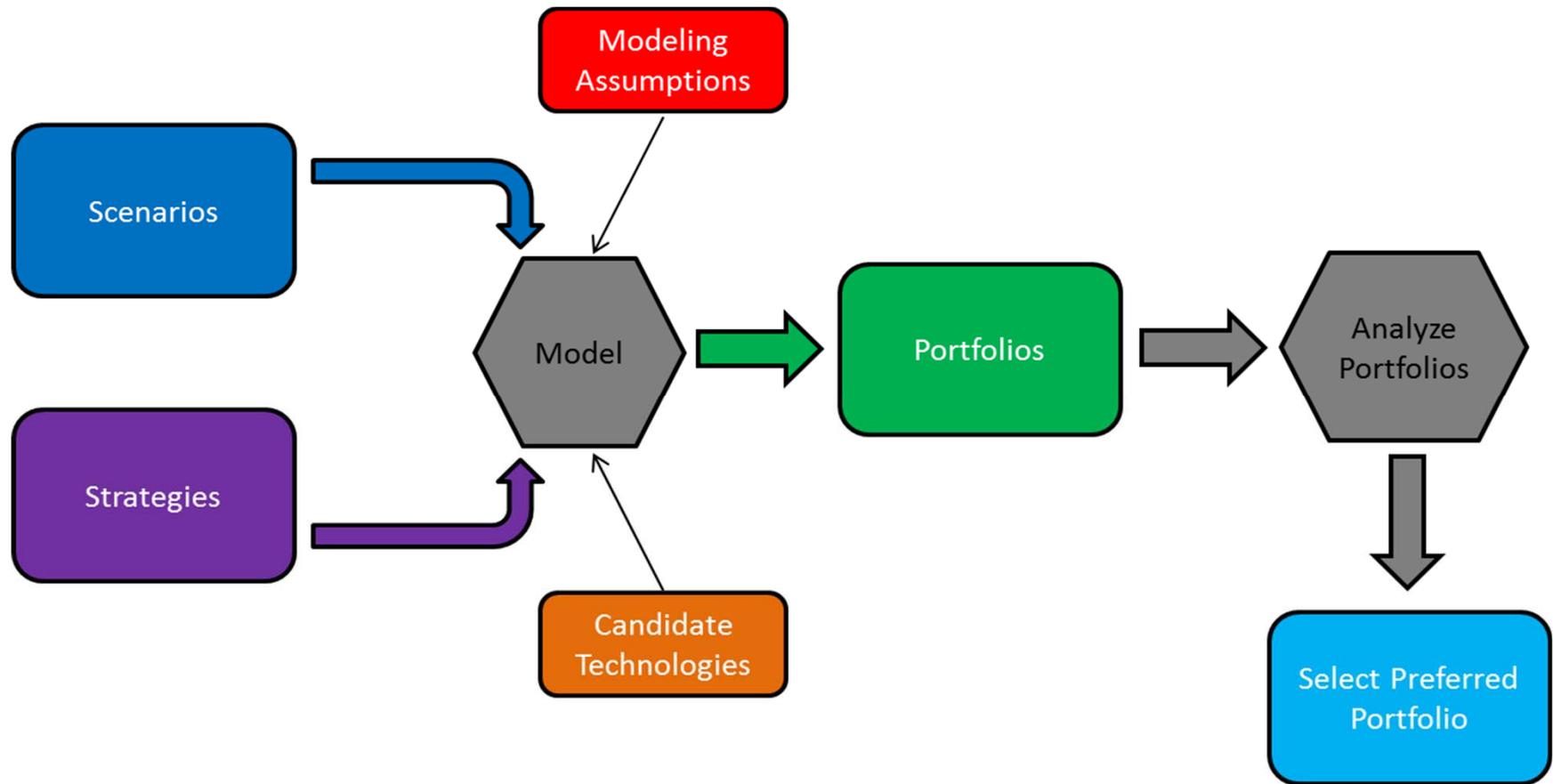
- *Distributed Energy Resources*
- *System Flexibility*
- *Portfolio Diversity*



TVA's IRP Planning Process



How the Resource Planning Process Works





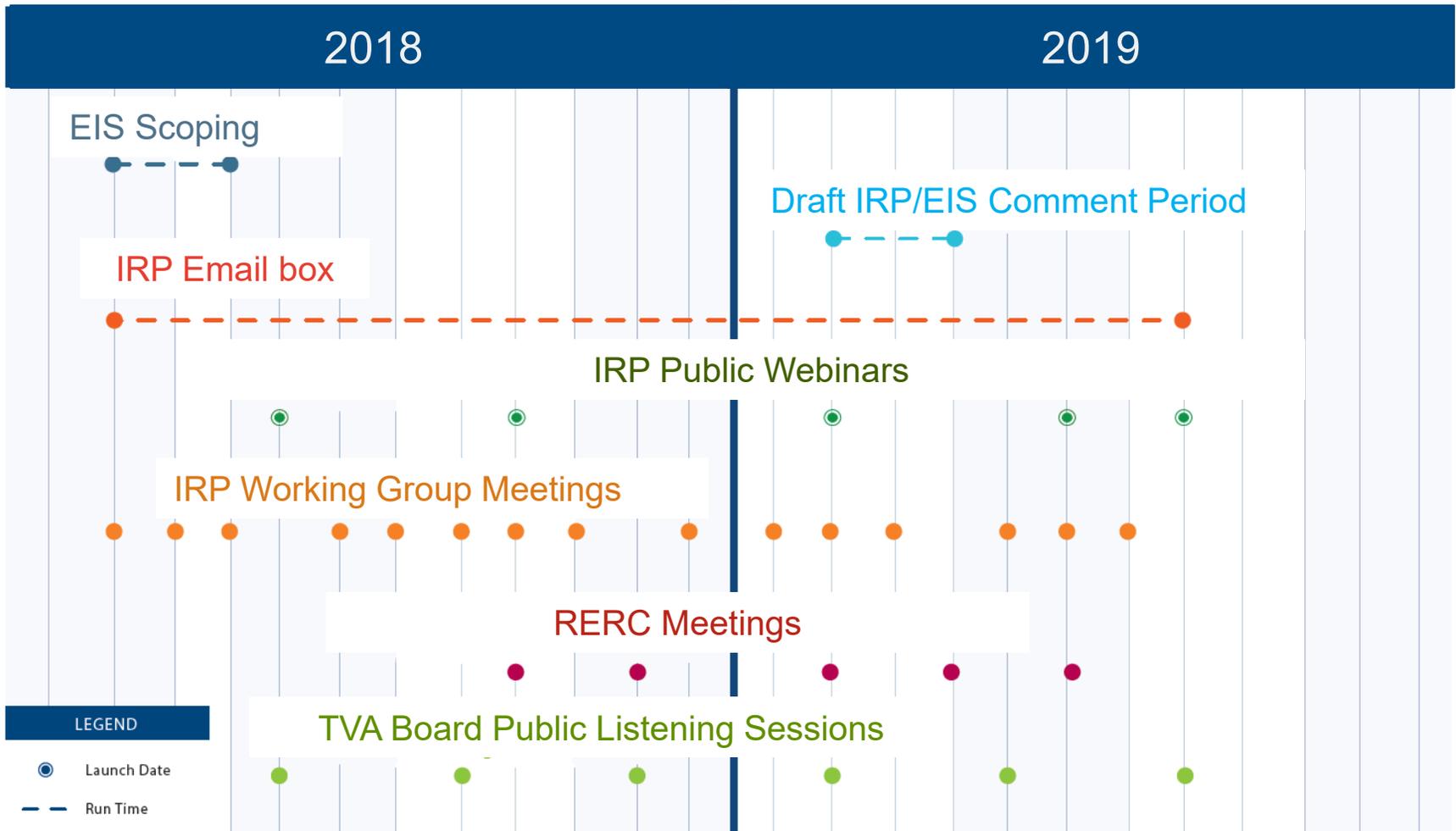
Stakeholder Engagement

Amy Henry and Matthew Higdon

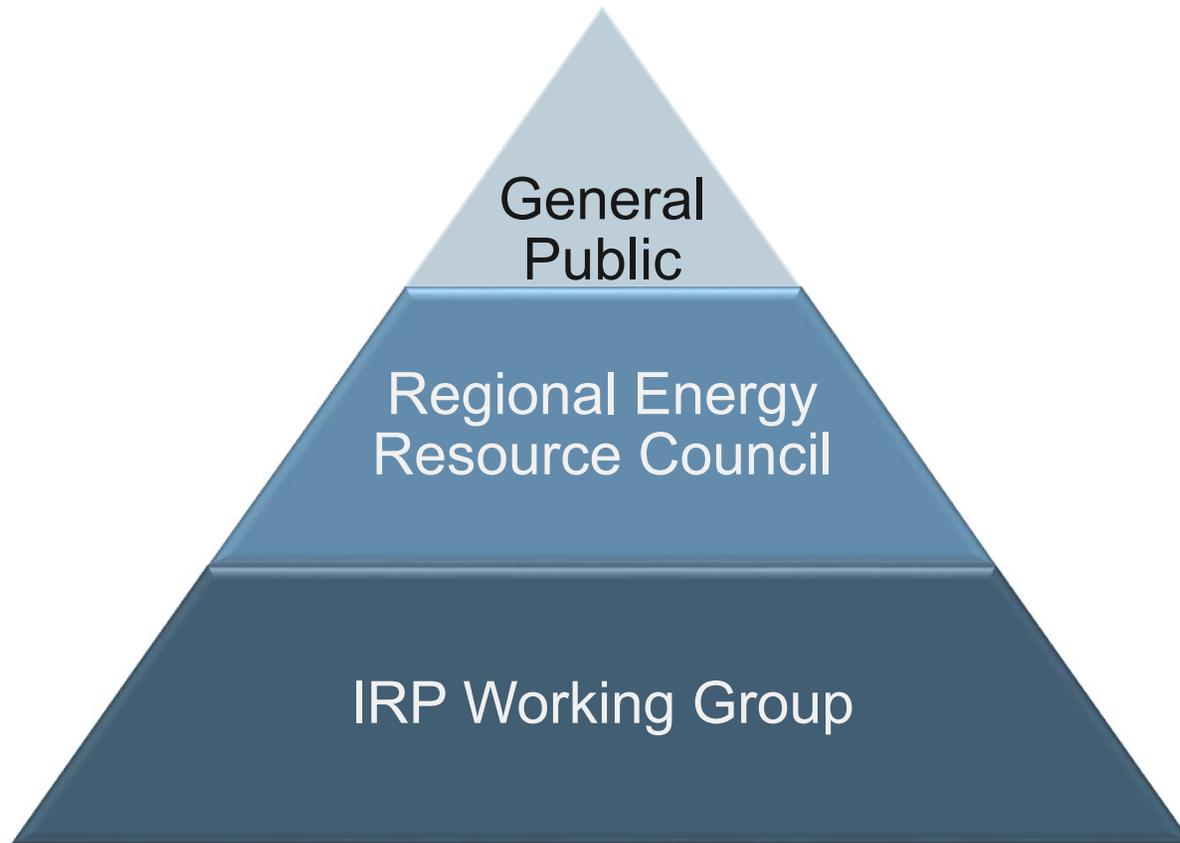
Stakeholder Engagement is a Cornerstone of TVA's IRP Process

- TVA's Integrated Resource Planning is unique
- More informed decision-making
- Better outcomes
- Incorporating TVA's responsibilities under the National Environmental Policy Act (NEPA) - enhanced environmental analysis and public outreach

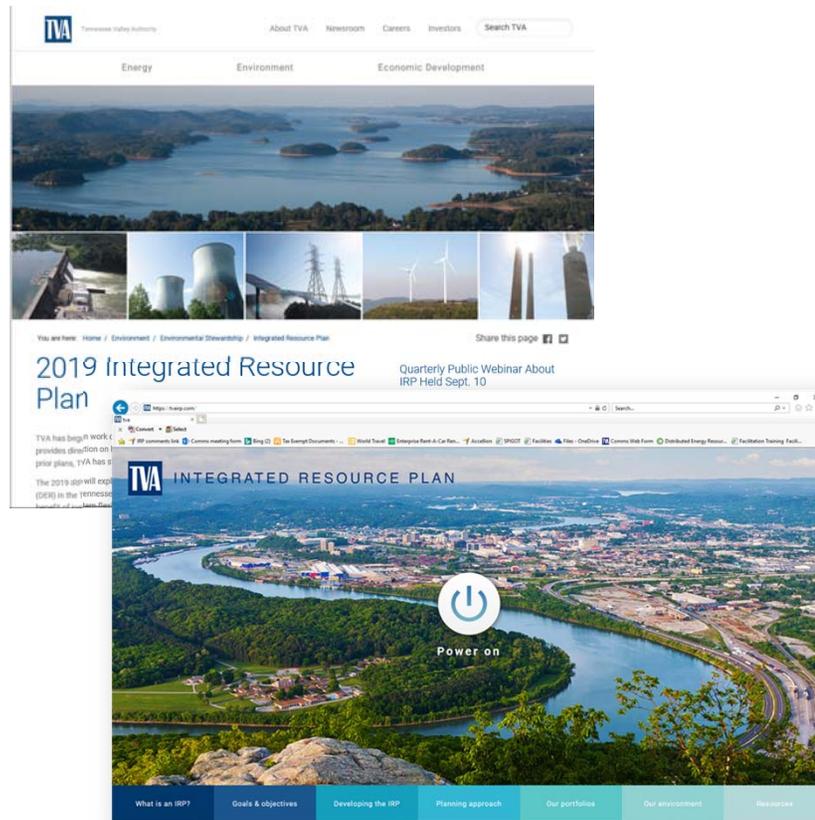
Stakeholder Input for the 2019 IRP



2019 IRP Stakeholder Engagement



General Public Outreach



- Website
- Interactive Report
- Educational Videos
- Webinars
- Social Media
- Emails to mailing list subscribers
- Public Scoping and Comment Periods
- Environmental Justice Outreach / Spanish Language version

Social Media

- Facebook
- LinkedIn
- Twitter
- Instagram
- YouTube

WHAT IS AN INTEGRATED RESOURCE PLAN (IRP)?
The IRP is a decision support tool that helps guide us on how to best meet future electricity demand.

WHAT IS THE IRP SCOPING REPORT?
Your feedback is a vital part of developing the IRP. The Scoping Report summarizes TVA's outreach and comments received in the 60-day public comment period following the launch of the IRP.

IN THE REPORT:

- View final strategies and scenarios under consideration in the IRP
- See a summary of IRP topics
- View comments received



HAVE YOUR VOICE HEARD!
Your feedback is a vital part in helping us to develop a balanced resource portfolio that meets the needs of our many diverse communities across the Valley!

NOW! VISIT "TVA.COM/IRP" TO:

- View content from public scoping meetings
- See slides from past webinars
- Join our mailing list
- Request more information on the IRP

COMING SOON!

- Webinar with update on IRP progress
- Public meetings in your area
- Online meeting with comment function



TVA TOMORROW!
Western Kentucky University
Knicely Conference Center
2355 Nashville Road
Bowling Green, KY 42101
Regency Room



VISIT TVA.COM/IRP TO LEARN MORE!



HOW WILL YOU POWER YOUR FUTURE?
Draft IRP & EIS now available.
Visit tvairp.com. Comment through April 8.



2019 IRP Working Group

- 20 representatives
 - diverse, Valley-wide perspectives
- 14 meetings
- Input on:
 - Scenarios, strategies, resource technologies, metrics, sensitivities, signposts of change and implementation



Draft IRP and EIS Public Comment Period

- Draft IRP/EIS released February 2019 for Public Comment Period
- 400+ people attended 7 public meetings and a webinar
- Interactive report online
- About 1,200+ people and organizations submitted comments

Most Frequent Comments:

- Increase the use of renewable energy
- More aggressively reduce carbon emissions
- Increase energy efficiency
- Support for and caution about coal plant retirements

Sample of the Diversity of Commenters

Tennessee Wildlife Federation
Tennessee Department of Environment and Conservation
Tennessee Solar Energy Association
Center for Biological Diversity
City of Oak Ridge
The Climate Reality Project
Tennessee Citizens for Wilderness Planning
Tennessee Interfaith Power and Light
Tennessee Valley Industrial Committee
Tennessee Valley Public Power Association
Alabama Solar Association
Senator Rand Paul
U.S. Department of the Interior

U.S. Environmental Protection Agency
Kentucky State Clearinghouse
Mississippi Department of Archives and History
Tennessee Historical Commission
Virginia Department of Historic Resources
Southern Alliance for Clean Energy
Southern Environmental Law Center
Sierra Club (includes a petition)
Southern Renewable Energy Association
Citizen's Climate Lobby, Knoxville Chapter
American Petroleum Institute
Sunrise Movement, Knoxville
NAACP
Energy Alabama

Sample of Draft IRP and EIS Comment Topics

IRP Process

Cost of Implementing a Strategy
Data Inputs and Assumptions
Scenarios
Sensitivity Testing
Strategies
Strategy Evaluation Metrics

Energy Resource Options

Clean Energy
Coal
Distributed Energy Resources (DER)
Energy Efficiency
Facility Siting
Natural Gas
Nuclear Energy
Renewable Energy
Solar Energy
Storage
Wind Energy

Environmental Impacts

Air Quality
Endangered and Threatened Species
Greenhouse Gas Emissions and Climate Change
Historic Properties
Land Use
Life Cycle Impacts
Parks, Managed Areas and Ecologically Significant Sites
Socioeconomics
Solid and Hazardous Waste
Water Resources

Impact of Public Comments

- Informed sensitivity analysis
- Considered in development of the IRP recommendation
- Revised IRP and EIS reports
- Comments and responses will be appended to Final IRP / EIS

TVA Used Input Received

RERC, IRP Working Group and Public Input received informed:

- Scenarios and strategies evaluated
- Resource options considered
- Metrics utilized
- Sensitivity analyses run
- Signposts to watch

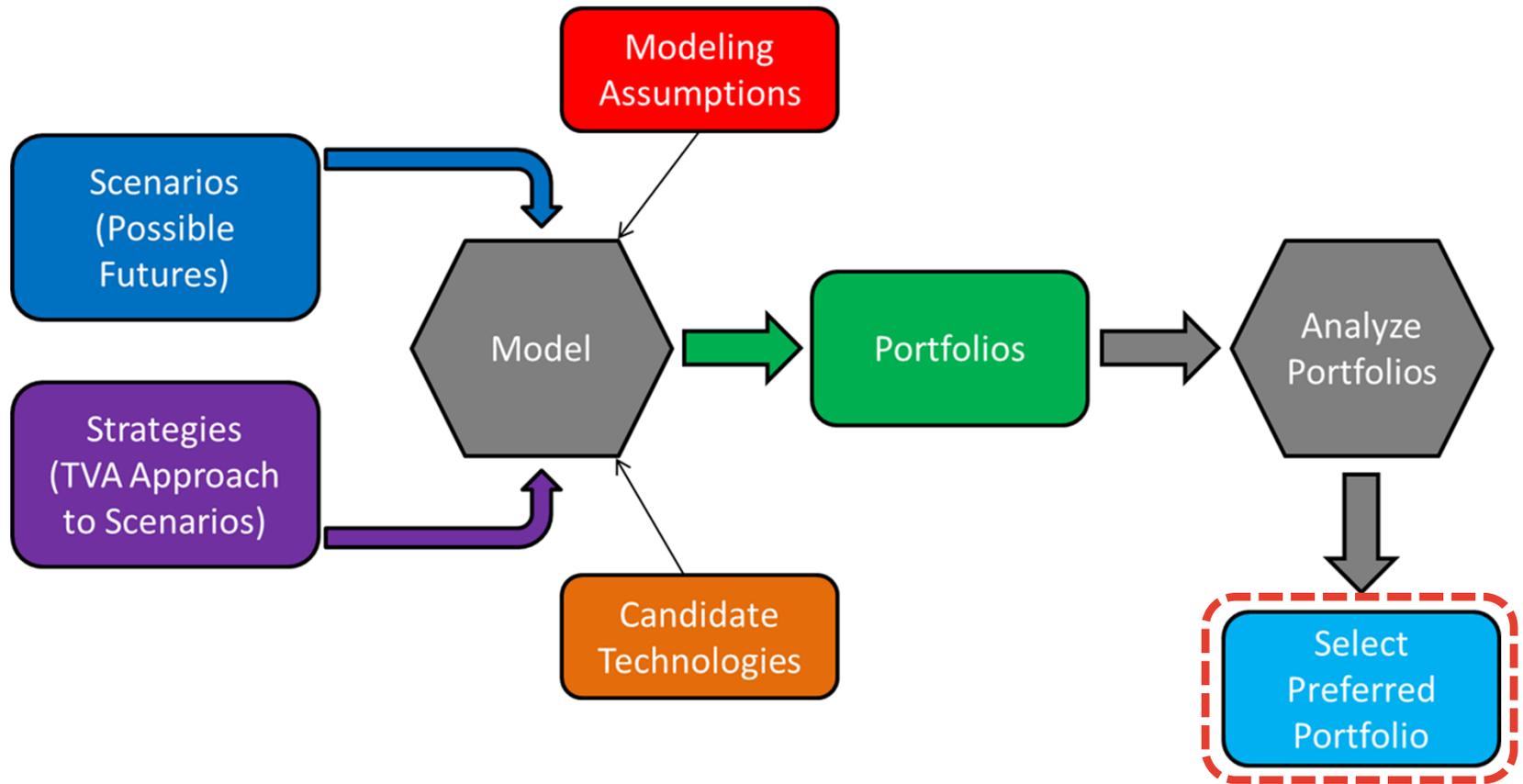




Developing the IRP Recommendation

Hunter Hydas and Jane Elliott

Integrated Resource Planning Process



2019 IRP Scenarios and Strategies

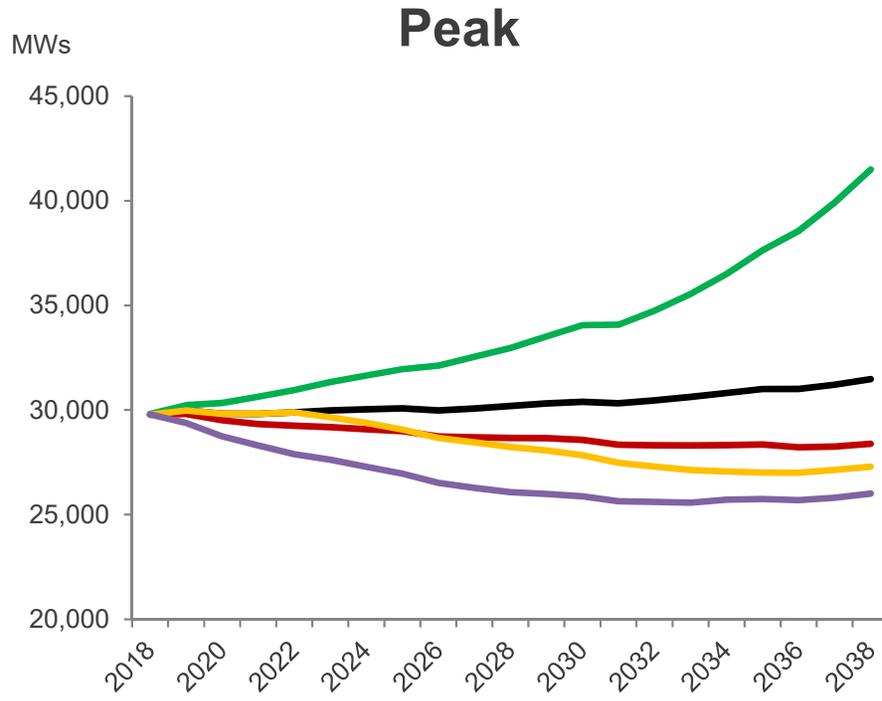
Scenarios

1. *Current Outlook*
2. *Economic Downturn*
3. *Valley Load Growth*
4. *Decarbonization*
5. *Rapid DER Adoption*
6. *No Nuclear Extensions*

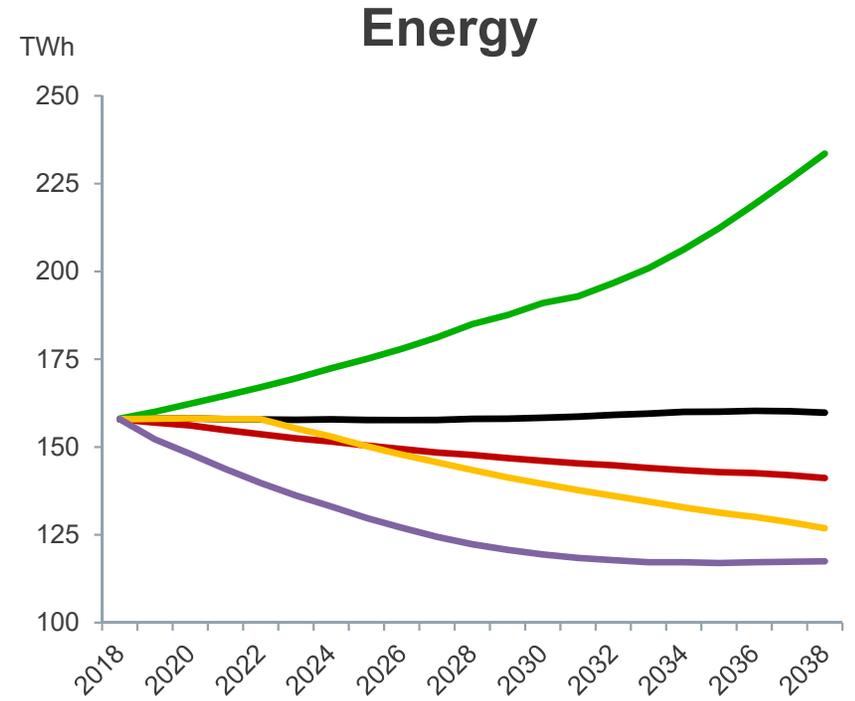
Strategies

- A. *Base Case*
- B. *Promote DER*
- C. *Promote Resiliency*
- D. *Promote Efficient Load Shape*
- E. *Promote Renewables*

Scenario Forecasts: Load Outlook



	Current	Downturn	Growth	Decarb	DER	Nuclear
CAGR	0.3%	-0.2%	1.7%	-0.4%	-0.7%	0.3%

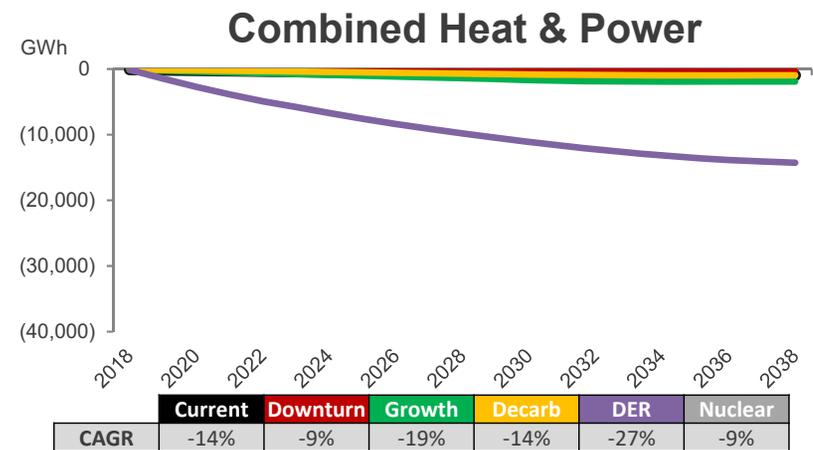
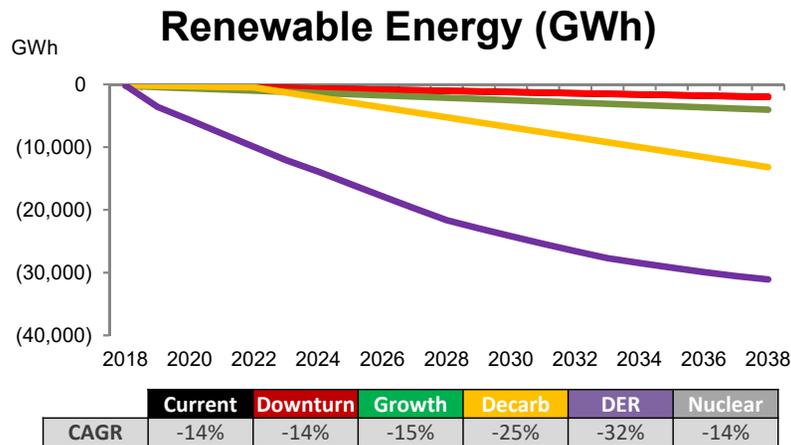
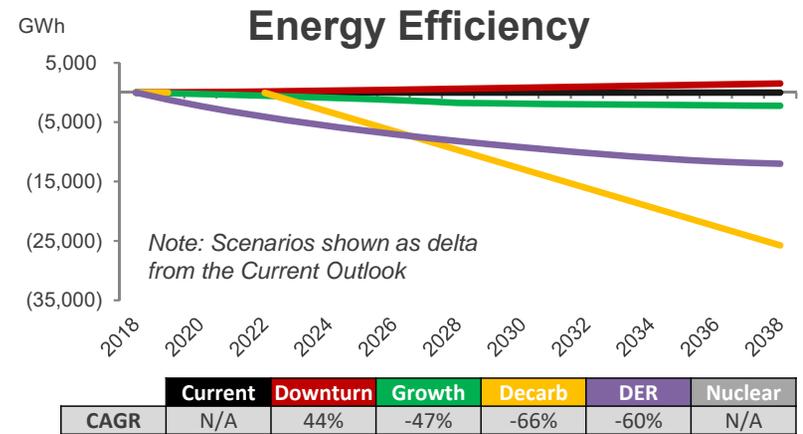
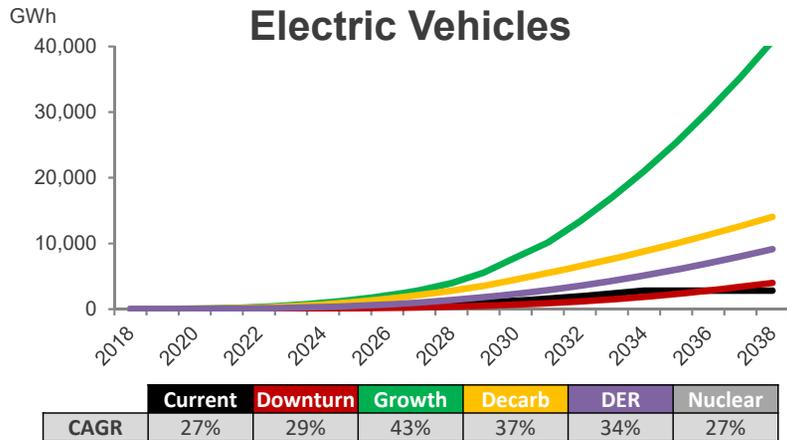


	Current	Downturn	Growth	Decarb	DER	Nuclear
CAGR	0.0%	-0.5%	2.0%	-1.1%	-1.5%	0.0%

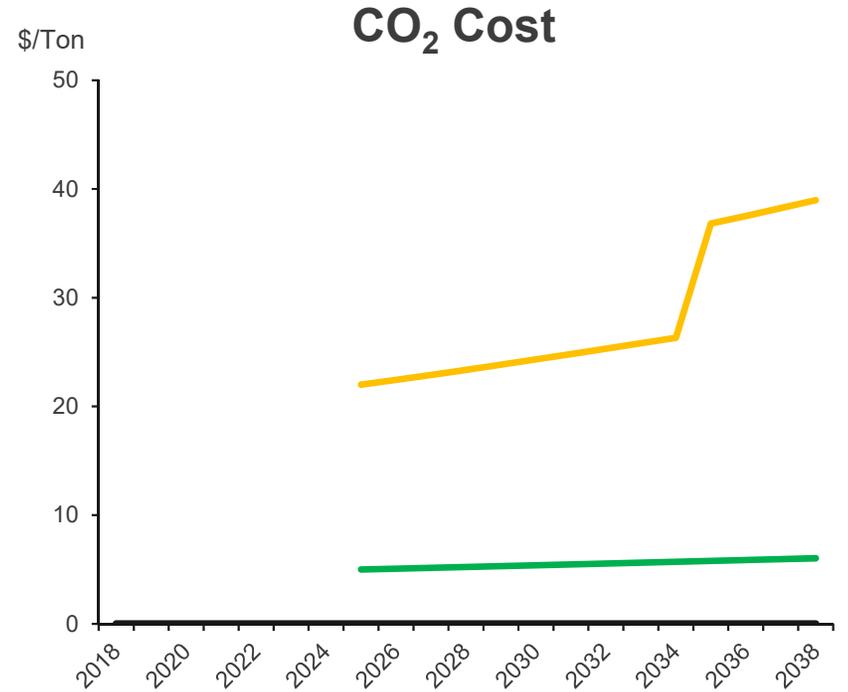
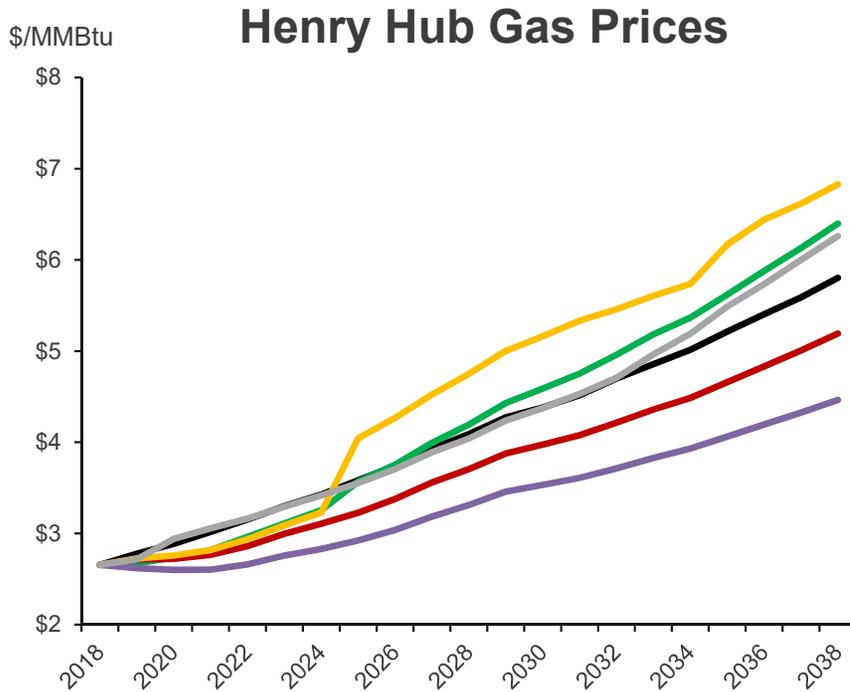
Note: Forecast for Scenario 6 Nuclear same as Scenario 1 Current Outlook



Scenario Forecasts: Behind the Meter Impacts



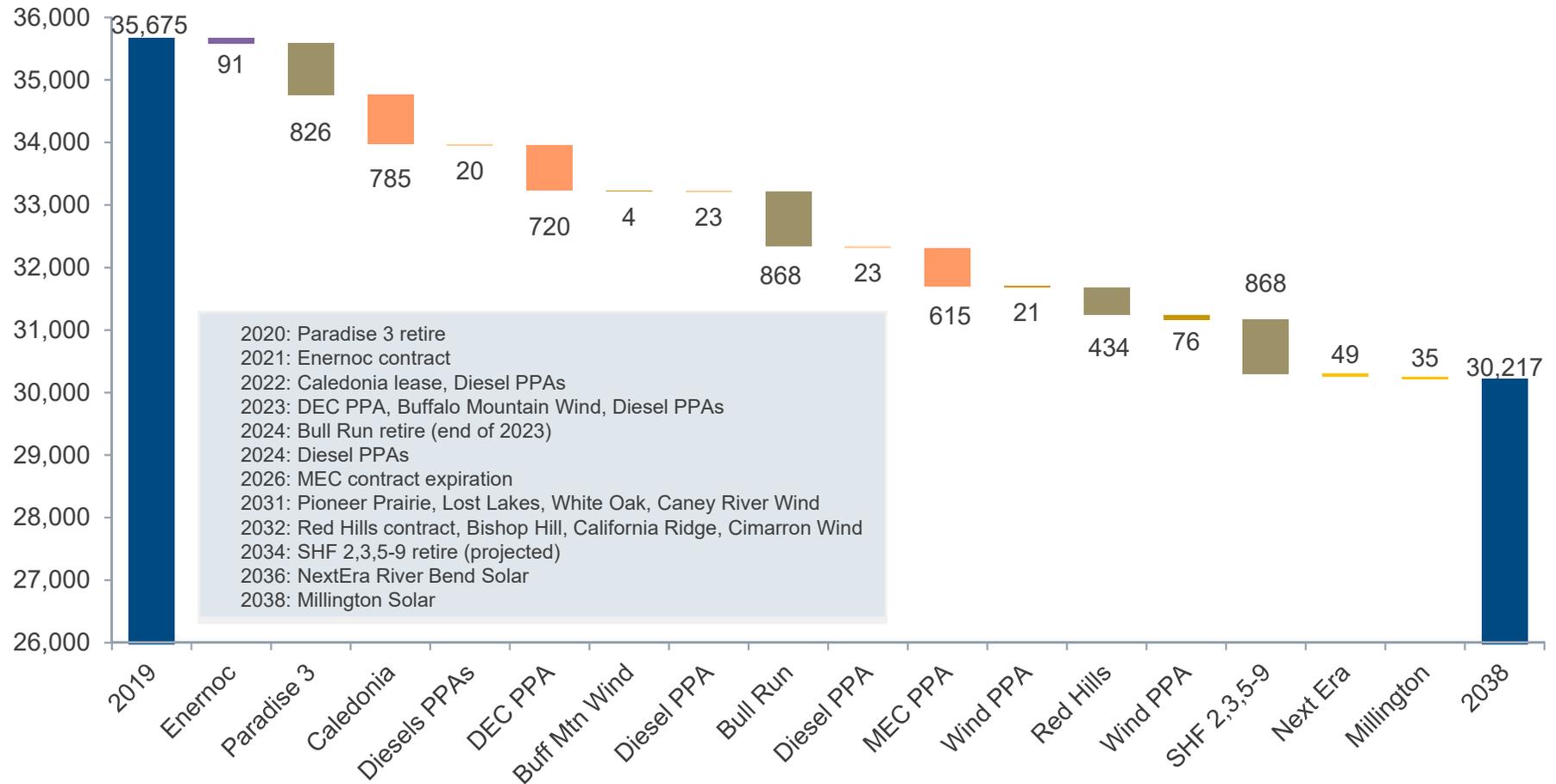
Scenario Forecasts: Gas and Carbon Prices



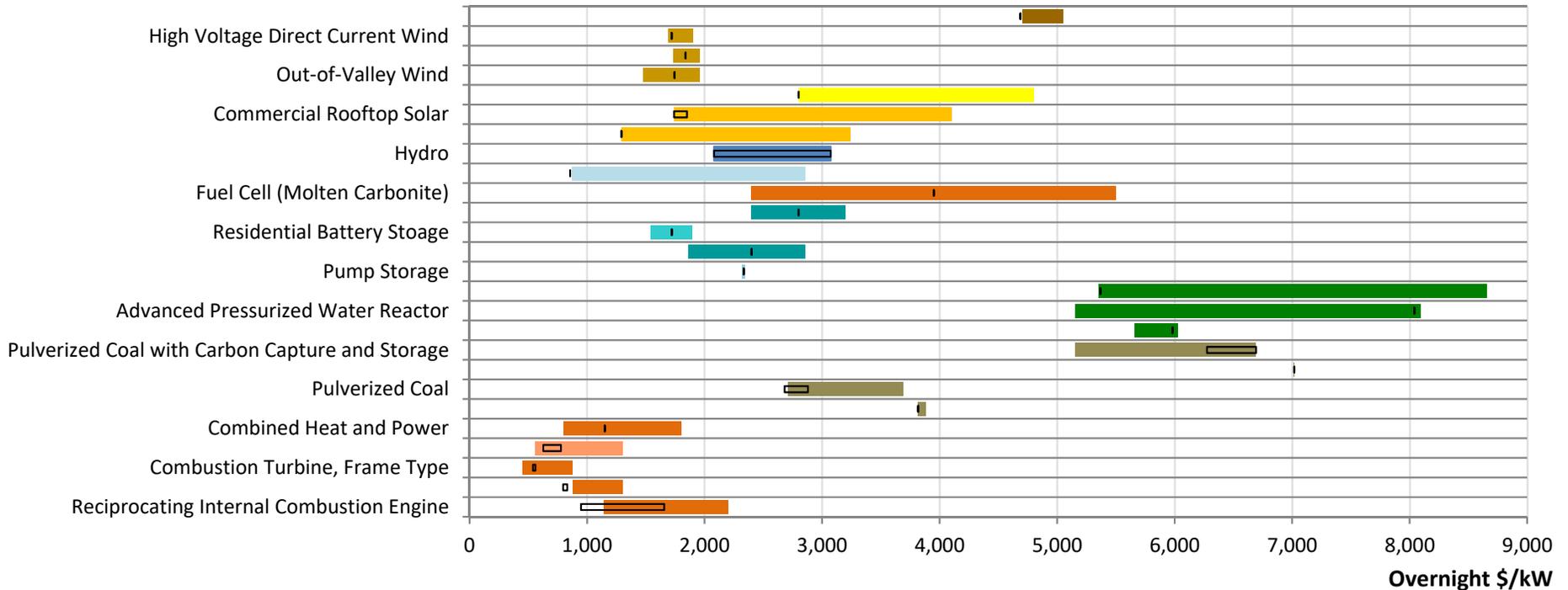
	Current	Downturn	Growth	Decarb	DER	Nuclear
CAGR	3.9%	3.4%	4.5%	4.8%	2.6%	4.4%

Note: Forecast for Scenarios 2 Downturn, 5 DER and 6 Nuclear same as Scenario 1 Current Outlook

Planned Reductions in Firm Capacity



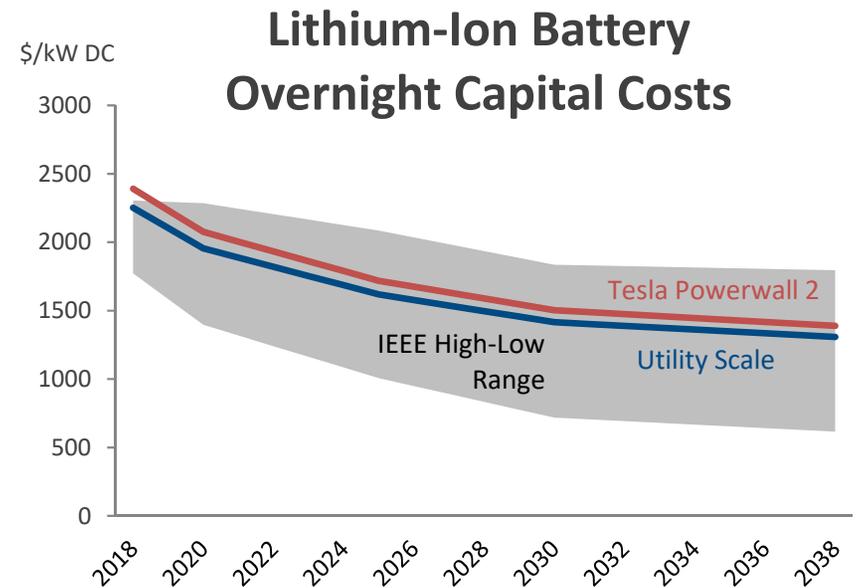
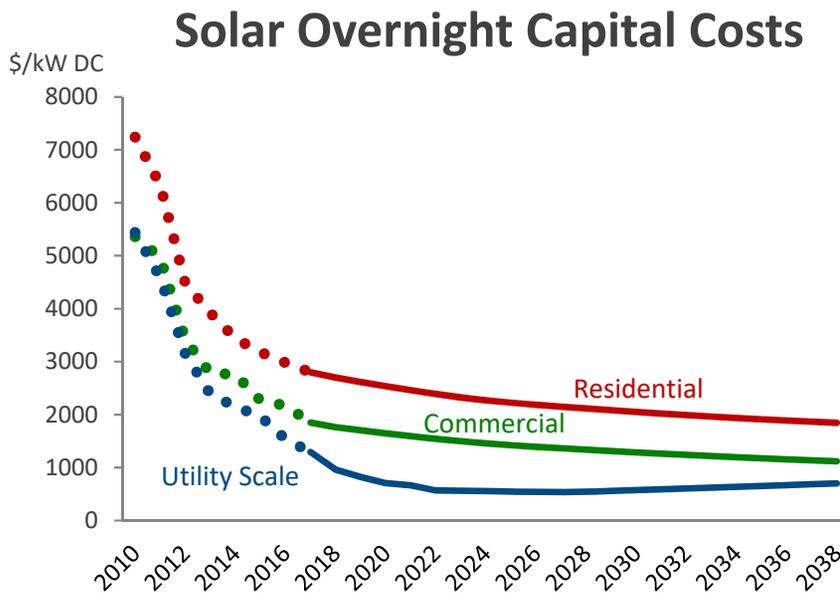
Resource Options and Cost Assumptions (\$/kW)



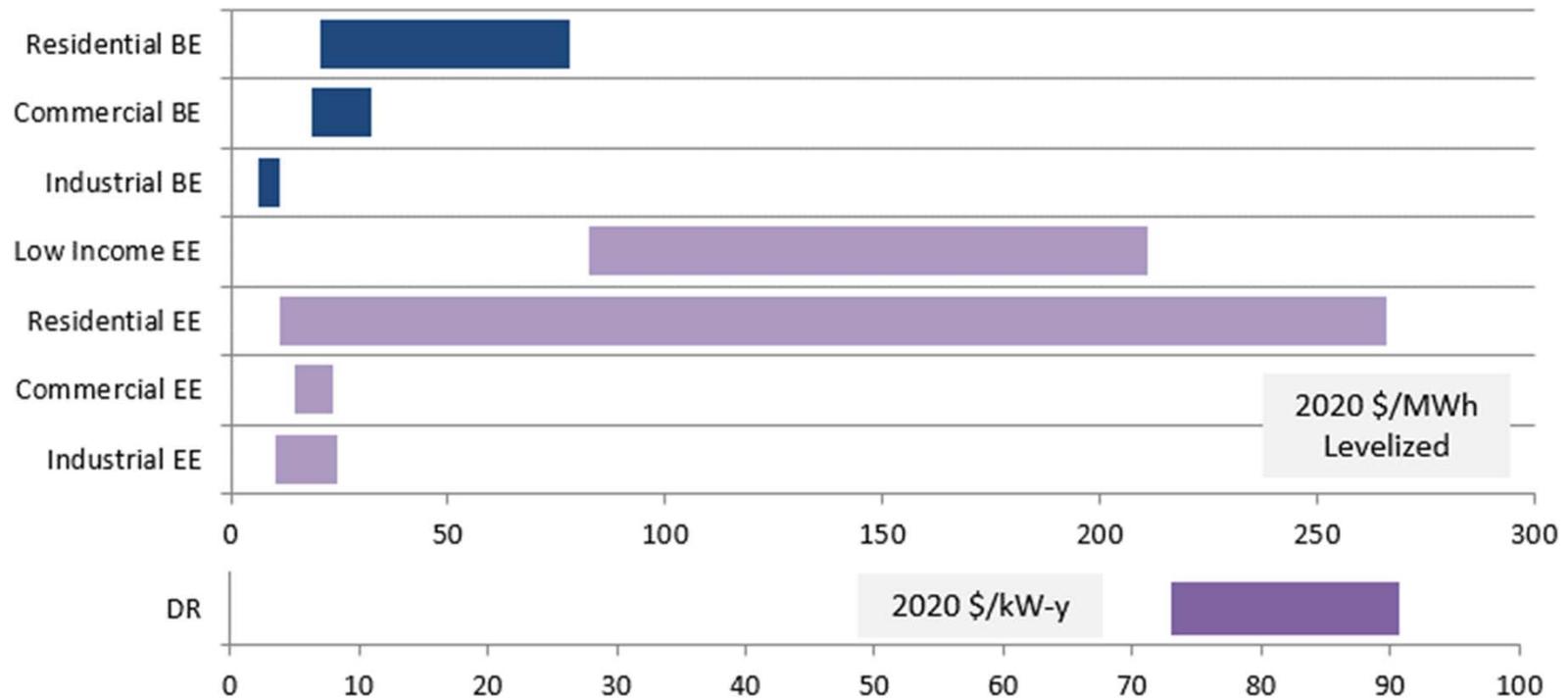
Colored bars reflect benchmark ranges and black outlines represent TVA assumptions. TVA assumptions outside of benchmark ranges are based on actual costs of TVA projects or vendor quotes. Navigant provided a third-party review of assumptions for generating resources.

Escalation Assumptions

While most resource costs will escalate with inflation, costs for resources that are still rapidly evolving may escalate differently, and escalation rates can vary by scenario.



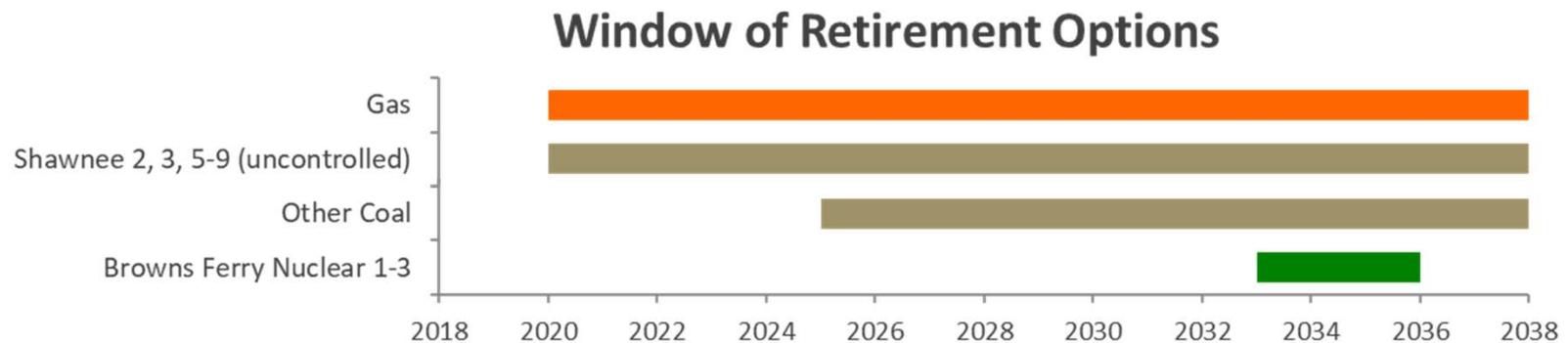
Programmatic DER Options & Cost Assumptions



BE = Beneficial Electrification
 EE = Energy Efficiency
 DR = Demand Response

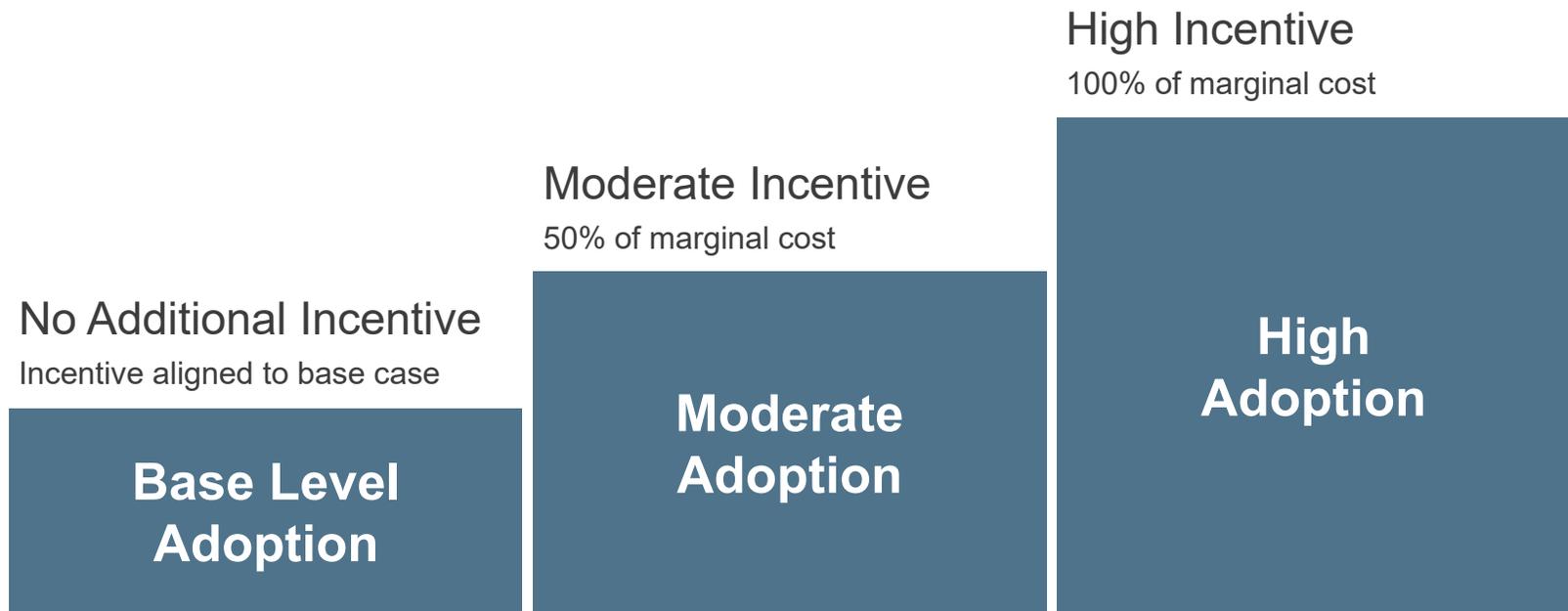
Retirement Options

Total costs can be reduced in low load scenarios or when replacement resources are more economic than the ongoing costs of existing resources. It is important that accurate ongoing costs, demolition/closure costs, and transmission upgrades required to retire resources are considered against the cost of new resources.



Strategies Promote Resources Using Incentives

Strategies provide incentives to promote adoption of certain resources, with consideration of potential, adoption curve, and reserve margin.



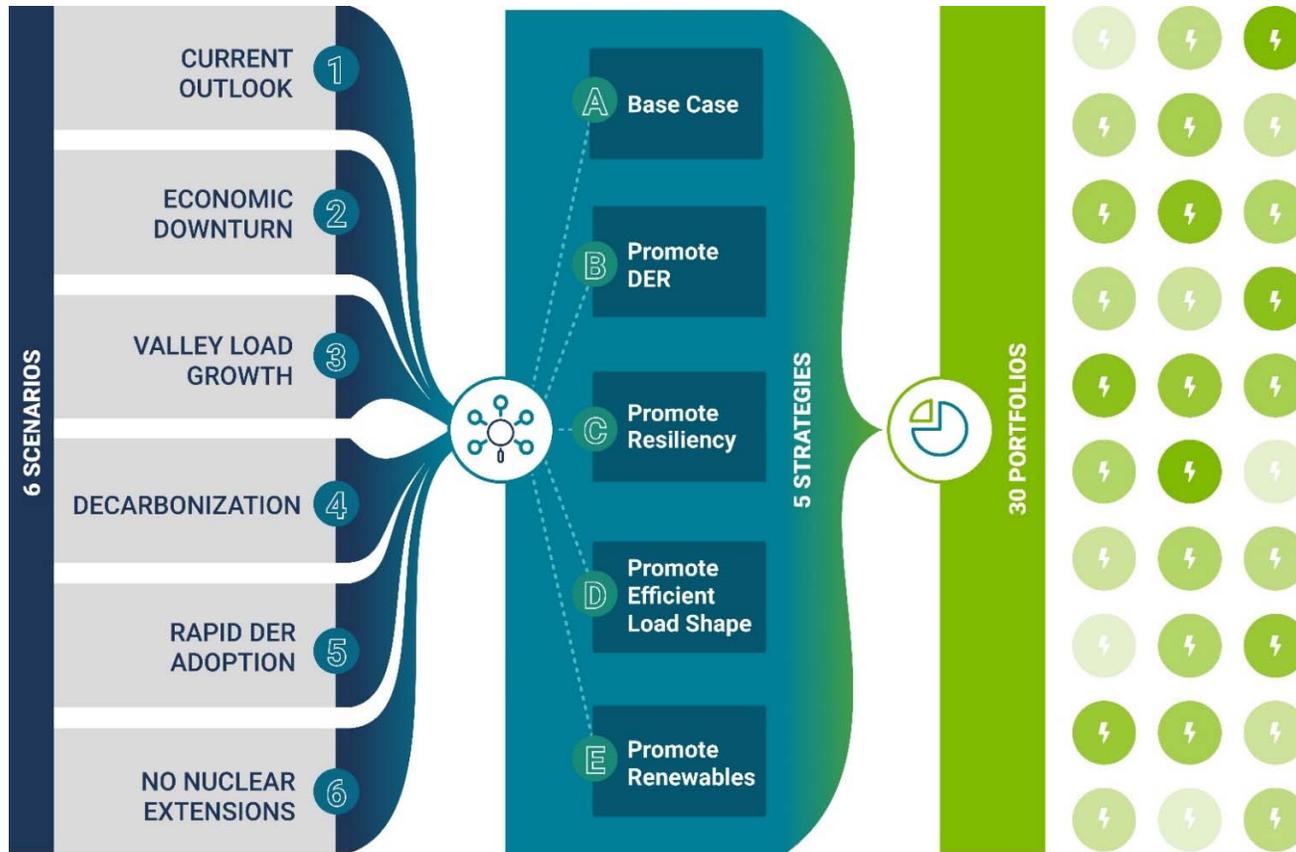
Strategy Design Matrix

Strategy	Distributed Resources & Electrification						Utility Scale Resources					
	Distributed Solar	Distributed Storage	Combined Heat & Power	Energy Efficiency	Demand Response	Beneficial Electrification	Solar	Wind	Biomass & Biogas	Storage	Aero CTs & Recip Engines	Small Modular Reactors
Base Case	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base	Base
Promote DER	High	Moderate	High	Moderate	Moderate	Base	Base	Base	Base	Base	Base	Base
Promote Resiliency	Moderate	High	Moderate	Base	Moderate	Base	Base	Base	Base	Moderate	Moderate	Moderate
Promote Efficient Load Shape	Base	Moderate	Base	High	High	Moderate	Base	Base	Base	High	Base	Base
Promote Renewables	Moderate	Moderate	Base	Base	Base	Base	Moderate	Moderate	Moderate	Moderate	Base	Base

Low Income Energy Efficiency is promoted in the following manner across the strategies:

- Pilot continuation (Base, Resiliency, Renewables)
- Pilot expanded valley-wide (DER)
- Pilot expanded valley-wide and incentives increased (Efficient Load Shape)

Robust Set of Portfolios Evaluated in the IRP



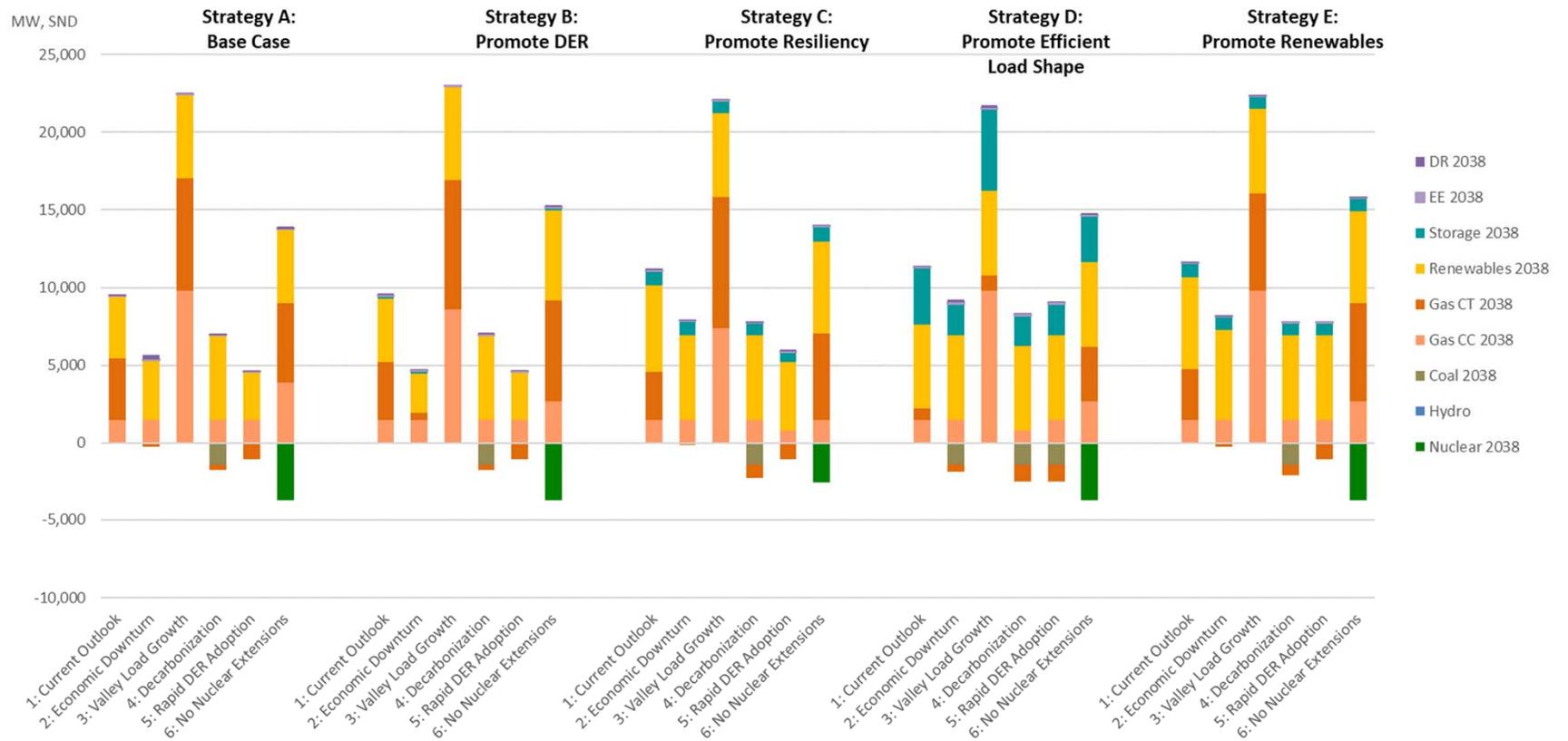
Additional sensitivity analysis was also performed to test the impact of changes in key assumptions, creating about 15 additional portfolios

Updated Base Case

- All portfolios were updated to reflect the February 2019 TVA Board decision to retire Paradise Unit 3 and Bull Run fossil plants.
- There was little to no change in capacity expansion plans for scenarios that had flat or declining electricity demand.
- In the Valley Load Growth and No Nuclear Extensions scenarios, additional solar and gas capacity expansion occurred.
- Overall, the updated base case portfolios resulted in similar costs but better environmental performance than the original cases.

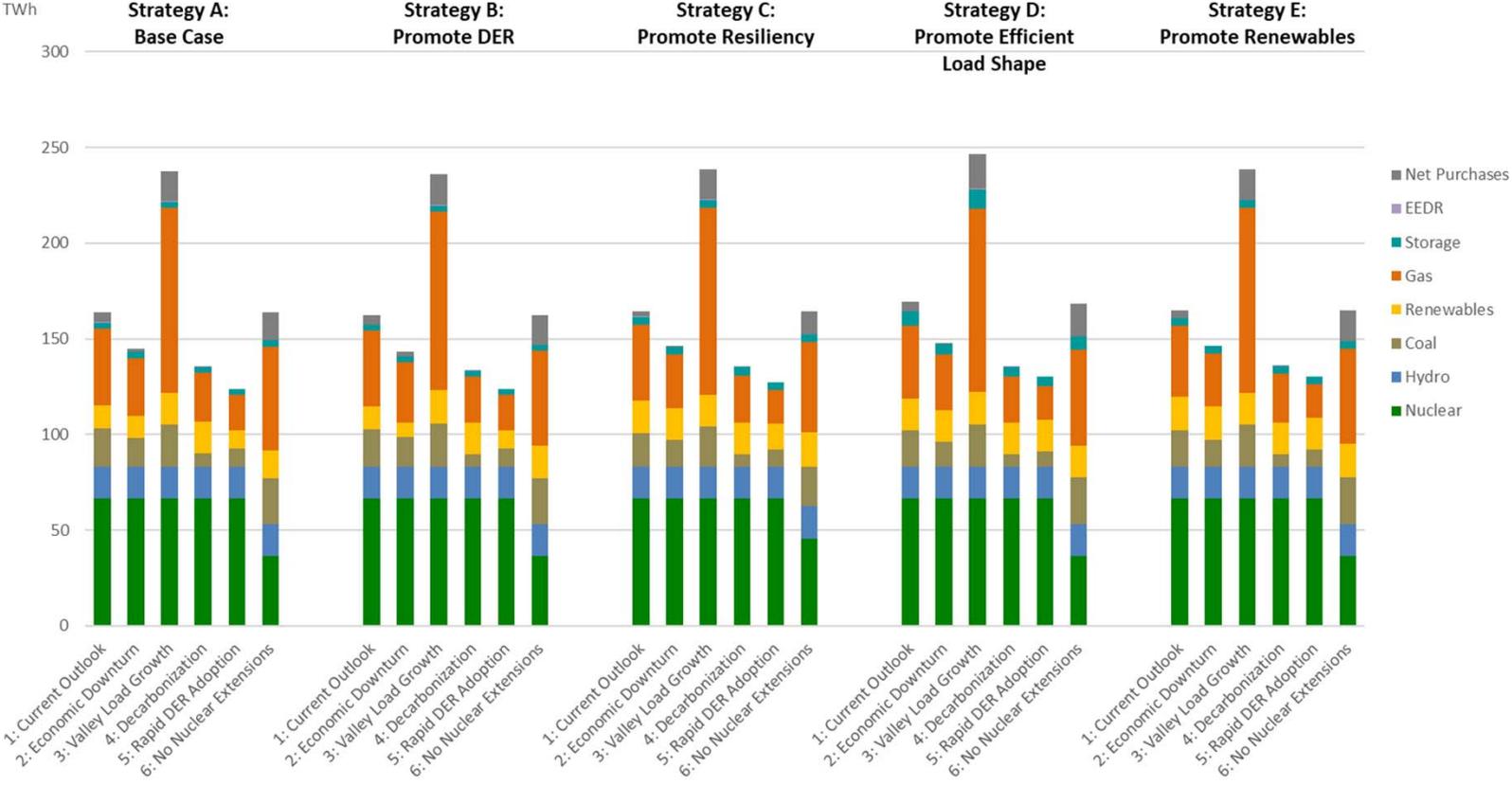
Incremental Capacity by 2038

Incremental Capacity by 2038



Total Energy in 2038

Energy in 2038



Strategy Performance

	COST	RISK	ENVIRONMENTAL STEWARDSHIP		OPERATIONAL FLEXIBILITY	VALLEY ECONOMICS
			CO ₂ , Water, Waste	Land Use		
STRATEGY A: BASE CASE						All strategies have similar impacts on the Valley economy as measured by per capita income and employment
STRATEGY B: PROMOTE DER						
STRATEGY C: PROMOTE RESILIENCY						
STRATEGY D: PROMOTE EFFICIENT LOAD SHAPE						
STRATEGY E: PROMOTE RENEWABLES						

Good
Better
Best

Summary of 2019 IRP Sensitivities

SENSITIVITY CASE <small>Base Case comparison is the Current Outlook unless otherwise noted</small>	CAPACITY EXPANSION IMPACTS BY 2038 <small>GREEN indicates increase and RED indicates decrease in resource type</small>						
	Nuclear	Coal	Gas	Hydro	Solar Nameplate	Wind Nameplate	EEDR
Higher Natural Gas Prices				+55 MW	+2,050 MW		
Lower Natural Gas Prices			2,000 MW CT replaced by CC		-5,900 MW		
Lower Wind Costs			-1,100 MW		-3,100 MW	+4,200 MW	
Greater EE and DR Market Depth			-2,000 MW		-2,200 MW		+2,100 MW
Integration Cost & Flexibility Benefit			Minor timing differences		Minor timing differences		
Pace & Magnitude of Solar Additions					+1,100 MW		
Magnitude of Solar Additions <small>(Valley Load Growth)</small>			1,000 MW CC replaced by CT		+6,000 MW		
Higher Operating Costs for Coal Plants		-2,200 MW	+1,500 MW				
More Stringent Carbon Constraints <small>(Decarbonization)</small>		-2,200 MW accelerated	CC expansion accelerated	+175 MW			
Variation in Climate	Summer derates	Summer derates	CT expansion accelerated		+2,100 MW		

2019 IRP Results Indicate:

Over the next

20



years

Up to

14  

GW solar additions (nameplate)

Up to

5 

GW storage additions

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



2 to 17

GW Natural Gas Additions

Evaluation of additional coal and gas retirements



Projected

70%  reduction in CO₂ Intensity

Average results from 2005 baseline (lbs/MWh)



IRP Recommendation

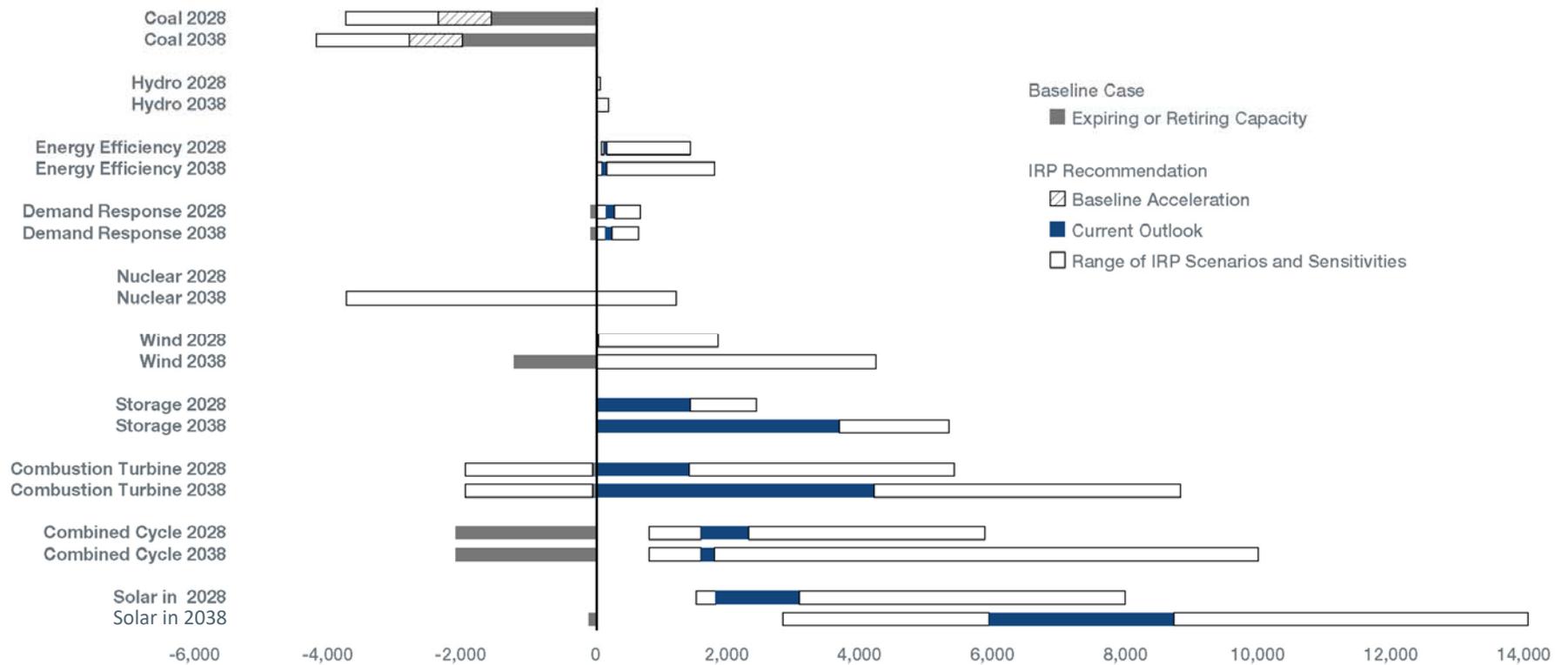
Hunter Hydas and Jane Elliott

2019 IRP Key Findings

- There is a need for new capacity in all scenarios to replace expiring or retiring capacity
- Solar expansion plays a substantial role in all futures
- Gas, storage, and demand response additions provide reliability and/or flexibility
- No baseload resources (designed to operate around the clock) are added, highlighting the need for operational flexibility in the resource portfolio
- Additional coal retirements occur in certain futures
- Energy Efficiency levels depend on market depth and cost-competitiveness
- Wind could play a role if it becomes cost-competitive
- In all cases, TVA will continue to provide for economic growth in the Tennessee Valley

2019 IRP Proposed Recommendation

Range of MW Additions and Subtractions by 2028 and 2038



- MWs are incremental changes from 2019 forward. Baseline case represents expiring and retiring capacity assumed for all cases..
- Browns Ferry Nuclear Plant license is not extended in the No Nuclear Extensions Scenario (outside of TVA control).
- Upper bounds of potential natural gas and solar additions are driven by the Valley Load Growth Scenario.
- Solar and wind are shown in nameplate capacity.
- Solar, gas, and storage ranges include utility-scale and distributed additions (where promoted in a strategy).

Near-Term Actions

Renewables & Flexibility



- Add solar based on economics and to meet customer demand
- Enhance system flexibility to integrate renewables and distributed resources
- Evaluate demonstration battery storage to gain operational experience

Existing Fleet



- Pursue option for license renewal for TVA's nuclear fleet
- Evaluate engineering end-of-life dates for aging fossil units to inform long-term planning

Energy Usage



- Conduct market potential study for energy efficiency and demand response
- Collaborate with states and local stakeholders to address low income energy efficiency
- Collaboratively deploy initiatives to stimulate the local electric vehicle market

Distribution Planning



- Support development of Distribution Resource Planning for integration into TVA's planning process

Signposts to Guide Long-Term Actions

Portfolio shifts will be driven by changing market conditions, more stringent regulations, and technology advancements.



- Demand for electricity
- Natural gas prices
- Customer expectations
- Regulatory requirements
- Operating costs for existing units
- Solar and wind costs
- Emerging and developmental technologies



Meeting will reconvene at 3:30 PM EDT



Panel Discussion

Joe Hoagland, Moderator

Panelists:

- **Al Armandariz**, Sierra Club
- **Cyrus Bhedwar**, SEEAA (Southeast Energy Efficiency Alliance)
- **Stacy Cantrell**, Huntsville Utilities
- **Gil Hough**, TenneSEIA (Tennessee Solar Industries Association)
- **Pete Mattheis**, Tennessee Valley Industrial Committee
- **Brian Solsbee**, Tennessee Municipal Electric Power Association



Meeting will reconvene at 5:00 PM EDT

Public Listening Session

- Public participation is appreciated
- This is a listening session; responses are typically not provided
- Remarks will be time limited to allow as many to speak as possible





Thank you and Travel Safely

The RERC will reconvene here tomorrow at 8:30 AM





Regional Energy Resource Council

June 26-27, 2019
Chattanooga, Tennessee



Agenda – June 27, 2019

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RERC Meeting Recap – Day 1



RERC Observations from Day 1





The IRP Recommendation

Hunter Hydas and Jane Elliott

2019 IRP Results Indicate:

Over the next

20



years

Up to

14  

GW solar additions (nameplate)

Up to

5



GW storage additions

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Projected

70%  reduction in CO₂ Intensity

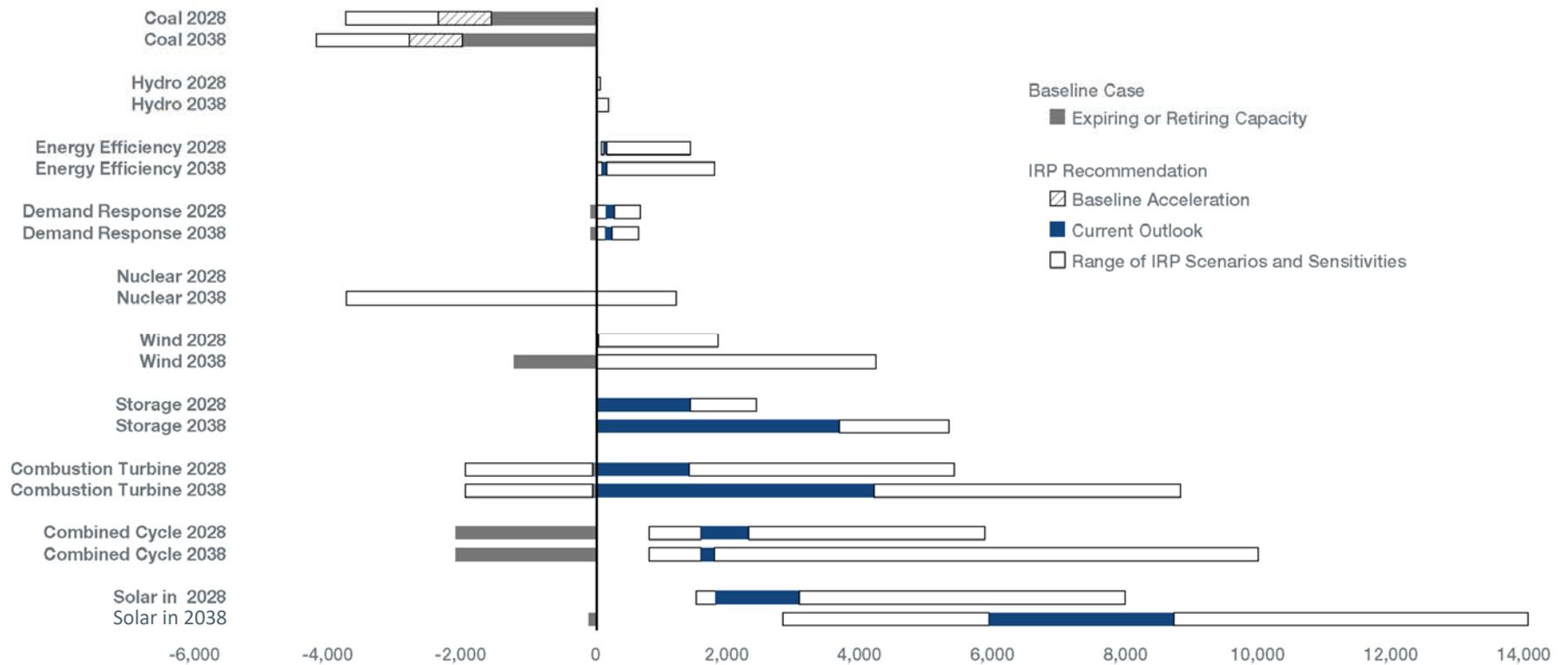
Average results from 2005 baseline (lbs/MWh)

2019 IRP Key Findings

- There is a need for new capacity in all scenarios to replace expiring or retiring capacity
- Solar expansion plays a substantial role in all futures
- Gas, storage, and demand response additions provide reliability and/or flexibility
- No baseload resources (designed to operate around the clock) are added, highlighting the need for operational flexibility in the resource portfolio
- Additional coal retirements occur in certain futures
- Energy Efficiency levels depend on market depth and cost-competitiveness
- Wind could play a role if it becomes cost-competitive
- In all cases, TVA will continue to provide for economic growth in the Tennessee Valley

2019 IRP Proposed Recommendation

Range of MW Additions and Subtractions by 2028 and 2038



- MWs are incremental changes from 2019 forward. Baseline case represents expiring and retiring capacity assumed for all cases..
- Browns Ferry Nuclear Plant license is not extended in the No Nuclear Extensions Scenario (outside of TVA control).
- Upper bounds of potential natural gas and solar additions are driven by the Valley Load Growth Scenario.
- Solar and wind are shown in nameplate capacity.
- Solar, gas, and storage ranges include utility-scale and distributed additions (where promoted in a strategy).

Near-Term Actions

Renewables & Flexibility



- Add solar based on economics and to meet customer demand
- Enhance system flexibility to integrate renewables and distributed resources
- Evaluate demonstration battery storage to gain operational experience

Existing Fleet



- Pursue option for license renewal for TVA's nuclear fleet
- Evaluate engineering end-of-life dates for aging fossil units to inform long-term planning

Energy Usage



- Conduct market potential study for energy efficiency and demand response
- Collaborate with states and local stakeholders to address low income energy efficiency
- Collaboratively deploy initiatives to stimulate the local electric vehicle market

Distribution Planning



- Support development of Distribution Resource Planning for integration into TVA's planning process

Signposts to Guide Long-Term Actions

Portfolio shifts will be driven by changing market conditions, more stringent regulations, and technology advancements.



- Demand for electricity
- Natural gas prices
- Customer expectations
- Regulatory requirements
- Operating costs for existing units
- Solar and wind costs
- Emerging and developmental technologies





Q&A / RERC Discussion

RERC Discussion Questions

1. What are your thoughts on the process?

Was the stakeholder and public engagement extensive enough to gain sufficient input?

1. Did the boundaries of 2019 IRP analysis cover what we might need to be prepared for in the future?

2. What do you see as challenges and opportunities for TVA going forward, given the near term actions identified?



Break for Lunch
Meeting will reconvene at 1:00 PM EDT



RERC Discussion (cont'd)

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IRP Next Steps

Hunter Hydas- Project Manager, 2019 IRP



Wrap Up and Adjourn



Term 3 RERC

Thank you for your Service!



Thank you and please travel safely!
