Resource Planning Advisory Group Meeting

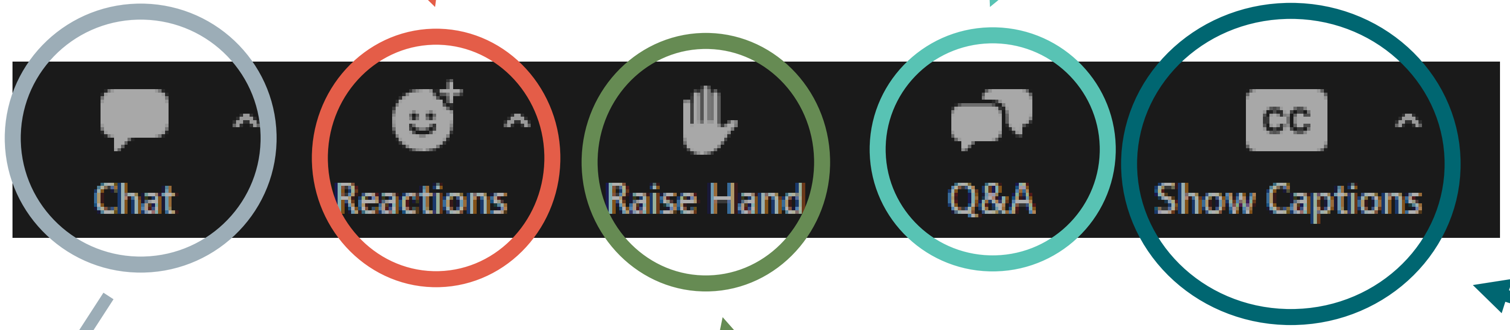
2027 Integrated System Plan

May 15, 2025

Welcome to the webinar!

Use the **Reactions** feature to respond to content with emojis

The **Q&A** tool will be turned off during the meeting



RPAG members and PSE staff are welcome to use the **Chat** feature

Use **Raise Hand** feature if you'd like to provide a comment or ask a question

Click **Show Captions** to see real-time closed captioning

Facilitator requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- Avoid use of acronyms and explain technical questions
- Use the feedback form or email isp@pse.com for additional input to PSE
- Aim to focus on the webinar topic
- Public comments will occur after PSE's presentations

Safety moment

Memorial Day Weekend safety tips

- Even in warm weather, lakes, rivers, and the ocean may still be very cold; swim accordingly and always supervise children
- Do not swim or operate a watercraft while intoxicated
- Always wear a Coast Guard approved life jacket when boating
- Supervise a BBQ grill at all times when in use
- The sun may be strong even during cloudy weather – wear sunscreen or protective clothing from 11 a.m. to 5 p.m.

Today's speakers

Annie Kilburg Smith

Facilitator, Triangle Associates

Elizabeth Hossner

Manager, Resource Planning and Analysis, PSE

Michaela Levine

Energy and Environmental Economics (E3)

Steve Schueneman

Manager, Development, Strategic Energy Initiatives, PSE

Kaitryn Olson

Associate Energy Resource Planning Analyst, PSE

Agenda

Time*	Agenda Item	Presenter / Facilitator
1:00 p.m. – 1:05 p.m.	Introduction and agenda review	Annie Kilburg Smith, Triangle Associates
1:05 p.m. – 1:15 p.m.	Overview of electric modeling	Elizabeth Hossner, PSE
1:15 p.m. – 2:00 p.m.	Resource adequacy methodology overview	Michaela Levine, E3
2:00 p.m. – 2:15 p.m.	Hydroelectric modeling update, resource alternatives, and alternative fuels	Elizabeth Hossner, PSE
2:15 p.m. – 2:30 p.m.	Emerging resources and geothermal modeling	Steve Schueneman, PSE
2:30 p.m. – 2:45 p.m.	Generic resource costs	Kaitryn Olson, PSE
2:45 p.m. – 2:50 p.m.	RPAG charter adoption	Annie Kilburg Smith, Triangle Associates
2:50 p.m. – 3:00 p.m.	Next steps and public comment opportunity	Annie Kilburg Smith, Triangle Associates
3:00 p.m.	Adjourn	All

*Times are subject to change during the meeting. Any agenda topic, including the public comment opportunity, may begin earlier or later than anticipated.

PSE PUGET SOUND ENERGY

Meeting purpose

- Provide an overview of and discuss the electric modeling process and assumptions for the 2027 ISP
- Provide a high-level overview of E3's resource adequacy methodology for the 2027 ISP
- Receive feedback from RPAG members on electric modeling
- Adopt the updated RPAG charter in principle

What we need from you

- **Share your questions, reflections, and advice on today's topics**
- **Let us know if anything is missing or unclear**
- **Flag areas where deeper discussion is needed**
- **Help us identify risks, tensions, or points of misalignment early**

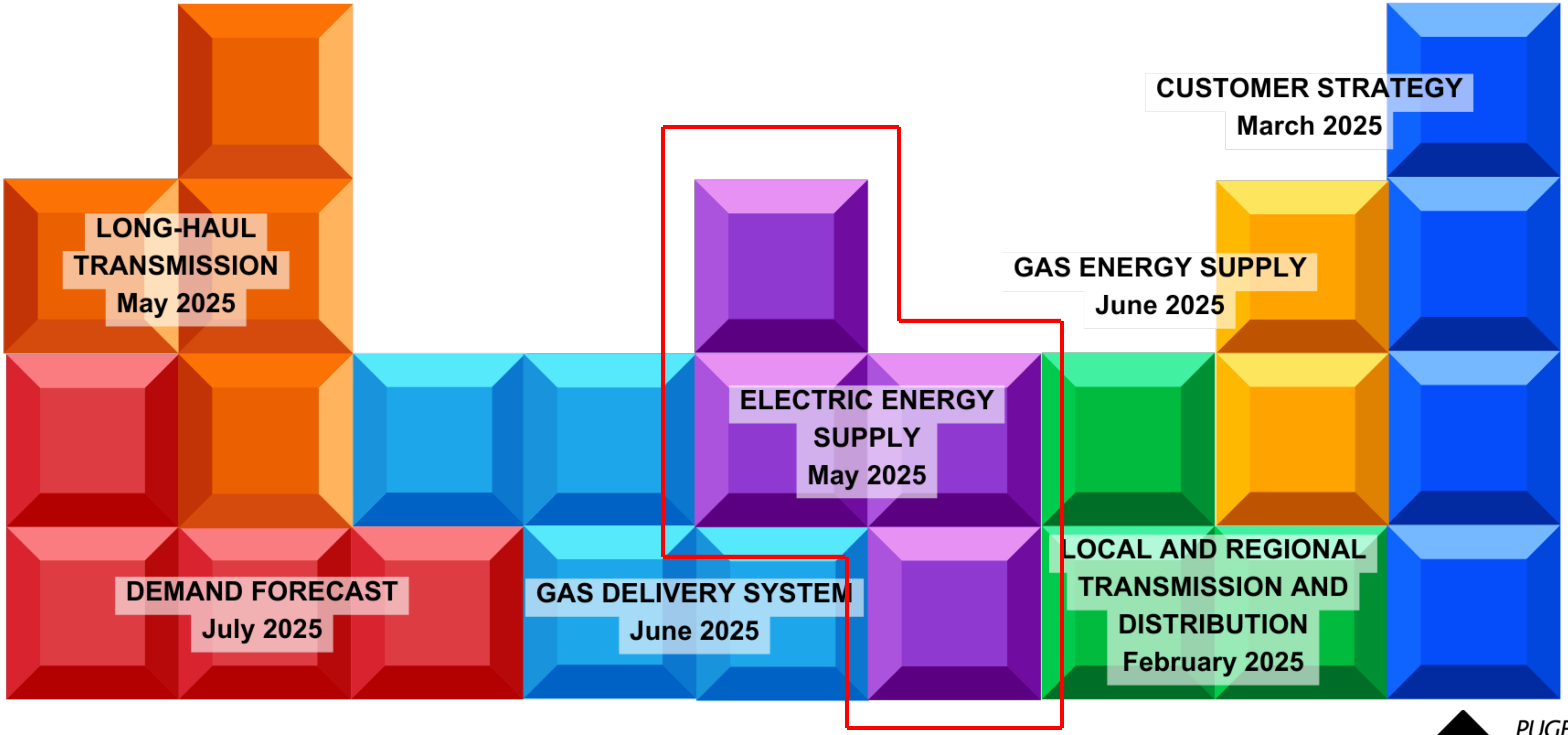
PUGET SOUND ENERGY

Electric modeling overview

Elizabeth Hossner, PSE

May 15, 2025

Today's discussion



PUGET SOUND ENERGY

Upcoming engagement topics

- **February 27, 2025** — Electric system planning modeling and assumptions
- **March 25, 2025** — Customer Strategy inputs and assumptions
- **May 15, 2025** — Resource adequacy methodology and electric utility modeling, inputs, and assumptions
- **June 18, 2025** — Electric vehicle forecast
- **June 24, 2025** — Gas utility modeling, inputs, and assumptions
- **July 29, 2025** — Demand forecast after conservation
- **September** — Equity considerations in ISP planning
- **October** — Final resource adequacy results (electric)
- **November** — Iterative analysis overview

No meetings planned for April, August, or December

Purpose

- **Discuss electric modeling feedback from the 2025 resource planning analysis (May 31, 2024 RPAG meeting) and how PSE is addressing that in the 2027 ISP**

Today's topics:

- **Present high-level overview of electric modeling**
- **Discuss resource adequacy analysis and methodology**
- **Discuss supply-side resource alternatives**

Topics for September and October meetings:

- **Equity considerations in ISP planning**
- **Resource adequacy results and resource requirements**

Electric supply in integrated system planning

<u>Inputs</u>

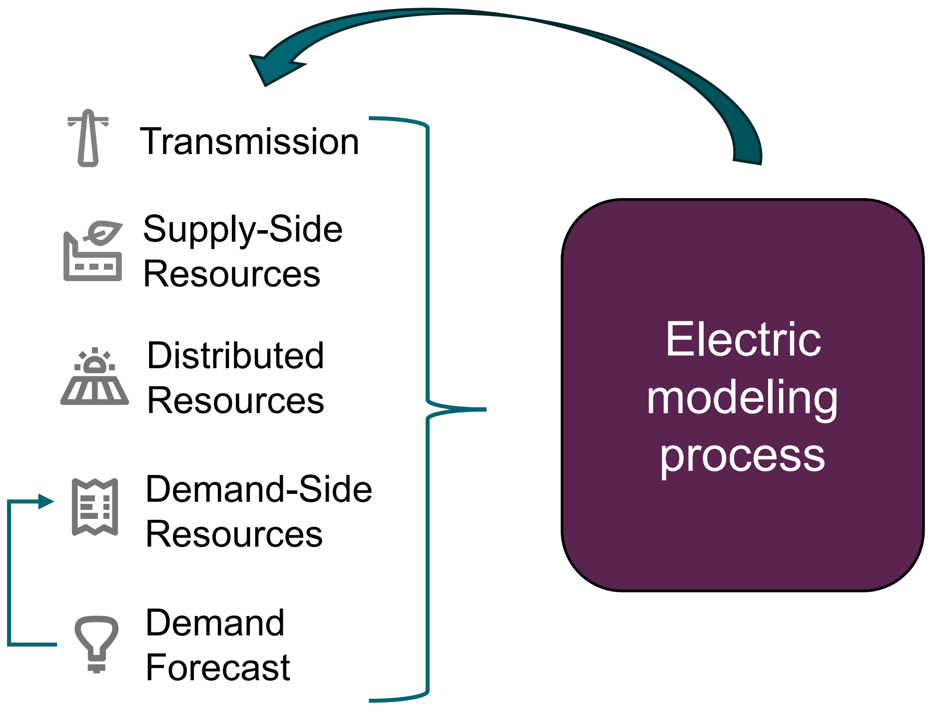
- Transmission constraints - presented Feb 27, 2025
- Distributed resources and customer programs – presented March 25, 2025
- Demand forecast – will be presented in July
- **Supply-side resource alternatives**

<u>Modeling</u>

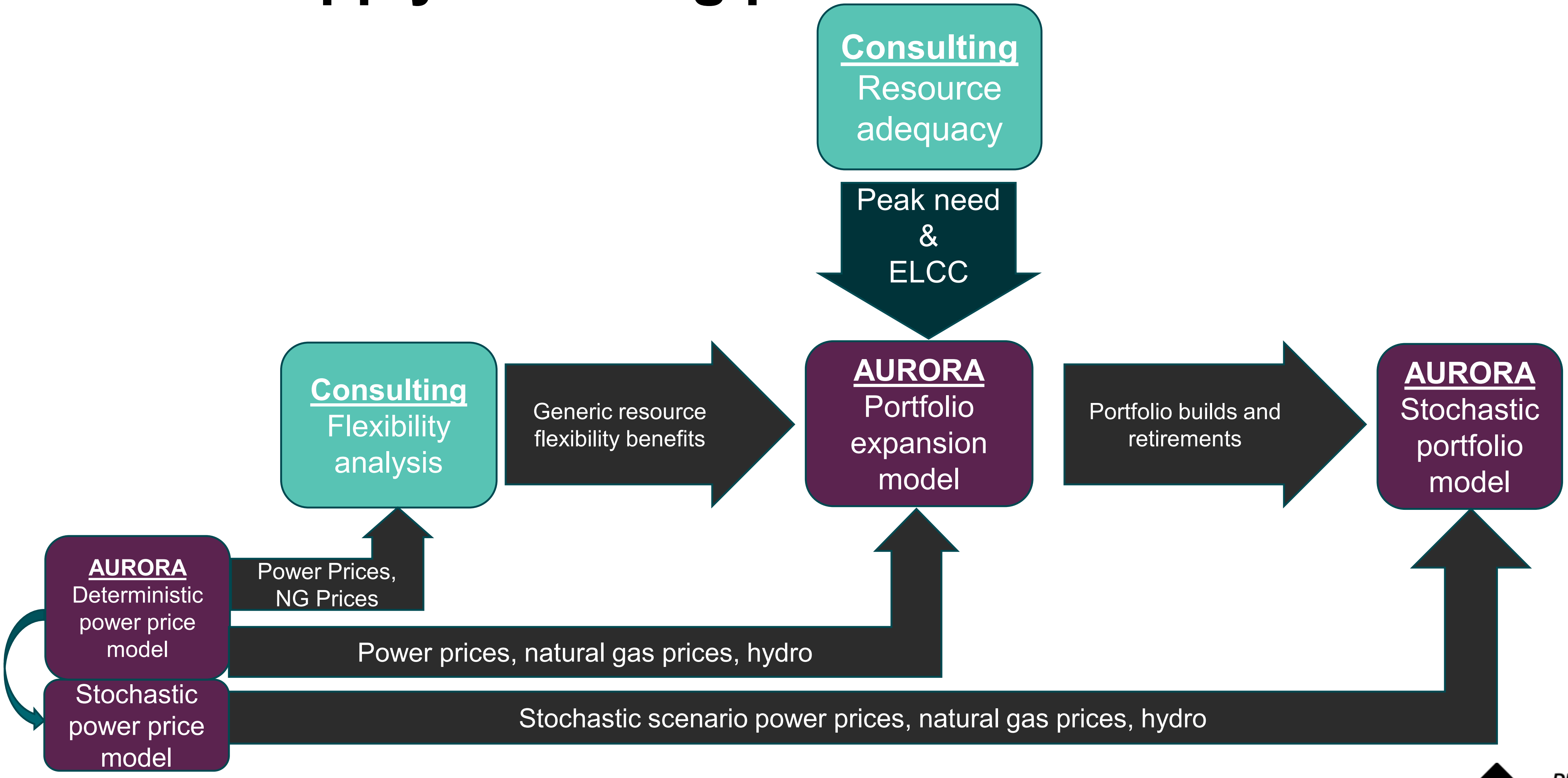
- Portfolio optimization model to iterate on different assumptions and constraints

<u>Outputs</u>

- Draft plan that optimizes supply-side resources, demand-side resources, customer programs, and transmission



Electric supply modeling process



Resource adequacy analysis updates since 2021*

LOLP Approach	2021 IRP
Mid-C Market Availability	2025 Analysis
Generic Battery Storage Characteristics	2023 Progress Report
Resource Correlations	2027 ISP
Temperature Data	2023 Progress Report
Hydro Operations	2023 Progress Report
Battery Storage Dispatch	2023 Progress Report

In 2021, PSE hired E3 to do a review of the resource adequacy analysis for the 2021 IRP.

Questions?

PUGET SOUND ENERGY

Resource Adequacy Methodology Overview

Michaela Levine, E3

May 15, 2025

PUGET SOUND ENERGY

E3 Resource Adequacy Modeling

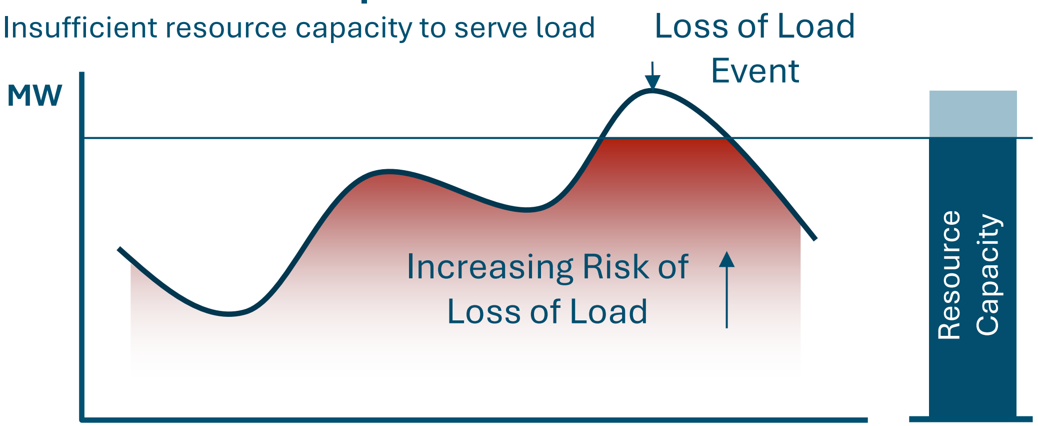
Energy+Environmental Economics

What is resource adequacy?

- **<u>Resource adequacy</u> is a measure of the ability of a portfolio of supply and demand-side resources to meet load across a wide range of system conditions, accounting for supply & demand variability**
- **No system is planned to achieve a perfect level of adequacy**
  - The most common standard used throughout North America is a “one-day-in-ten-year” standard
  - For the PSE’s 2027 ISP, E3 will perform modeling a 0.1 LOLE (loss of load expectation) standard (up to 1 day with loss of load event every 10 years), the standard also used by the Western Resource Adequacy Program (WRAP)

Loss of Load Example

Insufficient resource capacity to serve load



<u>NERC Definition of Resource Adequacy:</u>

“The ability of the electric system to supply the aggregate electrical demand and energy requirements of the end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.”

Source: *NERC Glossary of Terms*

Planning Reserve Margin and Effective Load Carrying Capability

Planning Reserve Margin (PRM)

The PRM is the total amount of capacity needed to satisfy the reliability target.

"How many MW needed in total"

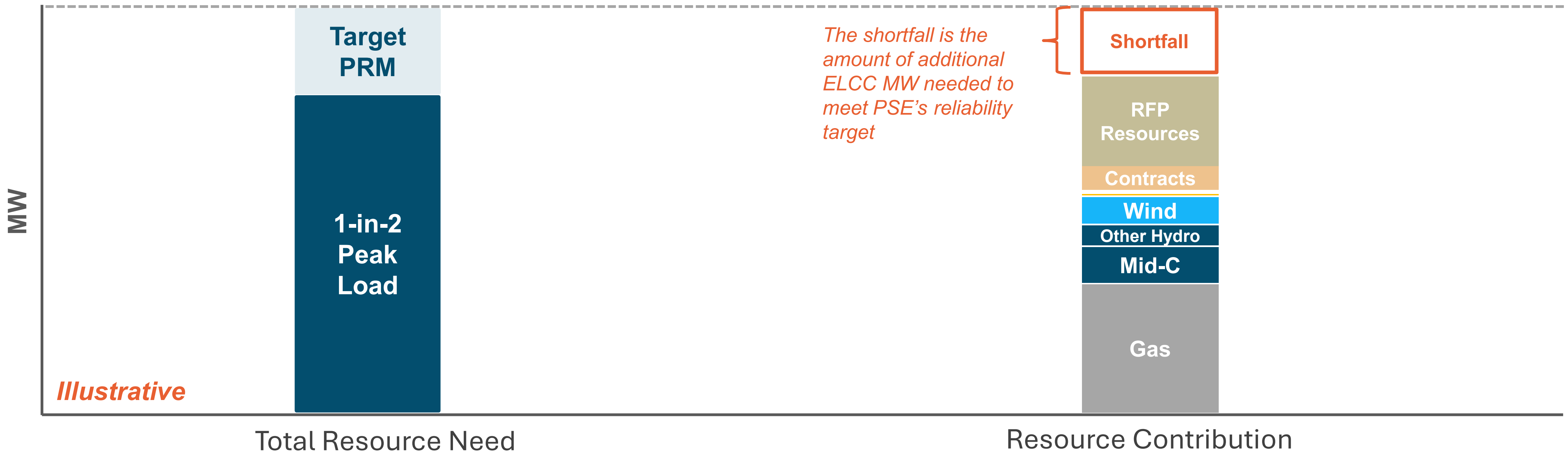
Measured as % above PSE's expected peak load

Effective Load Carrying Capability (ELCC)

The ELCC is the equivalent "perfect" capacity that a resource provides in meeting PSE's reliability target

"How many MW provided by each resource"

Measured as % of nameplate capacity

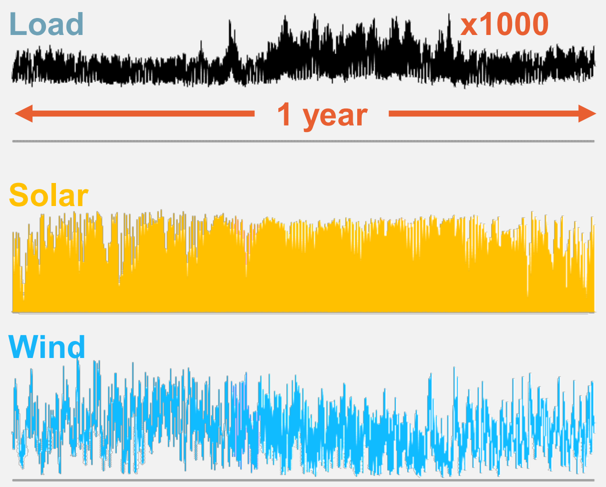


Key Steps for a Reliability Planning Framework

Part 1: Model + Data Development

Develop a robust dataset of the loads and resources, typically in a loss of load probability (LOLP) model

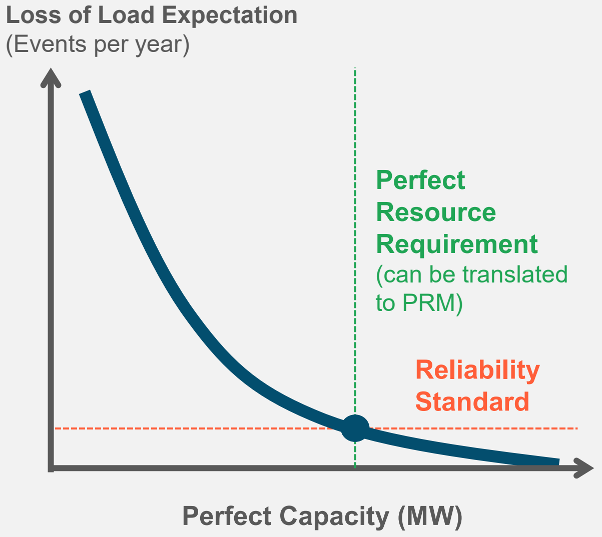
LOLP modeling evaluates resource adequacy across all hours of the year under a broad range of weather conditions



Part 2: Need Determination

Identify the Total Resource Need to achieve the desired level of reliability

Factors that impact the amount of effective capacity needed include load & weather variability, operating reserve needs

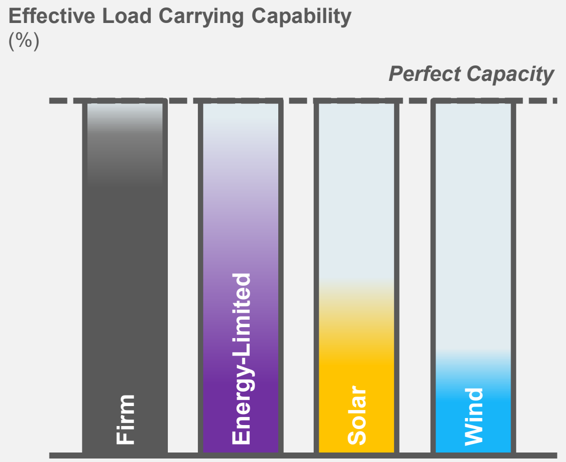


Outputs:
- Total Resource Need (TRN), in MW
- Planning Reserve Margin (PRM) = (TRN ÷ 1-in-2 peak load) - 1

Part 3: Resource Accreditation

Calculate capacity contributions of different resources using effective load carrying capability

ELCC measures a resource's contribution to the system's needs relative to perfect capacity, accounting for its limitations and constraints



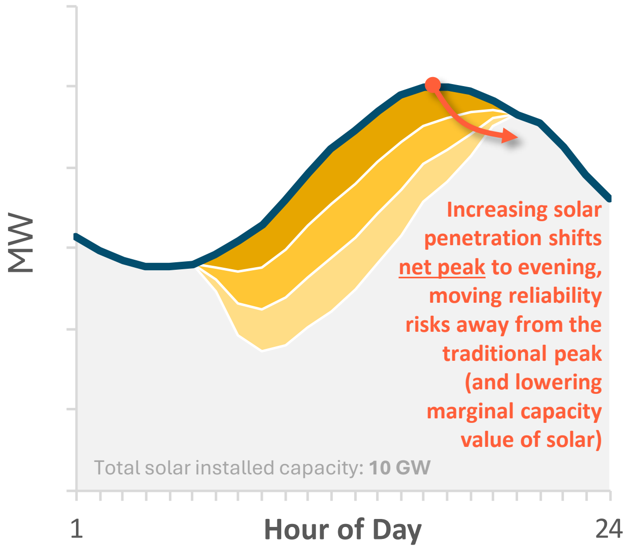
Outputs:
- Individual resource Effective Load-Carrying Capacity (ELCC), in MW and % of nameplate

ELCC captures complex dynamics resulting from increasing penetrations of variable & energy limited resources

Saturation and interactive effects are captured in the development of ELCCs to reflect how resources contribute to PSE's total resource need as the portfolio evolves

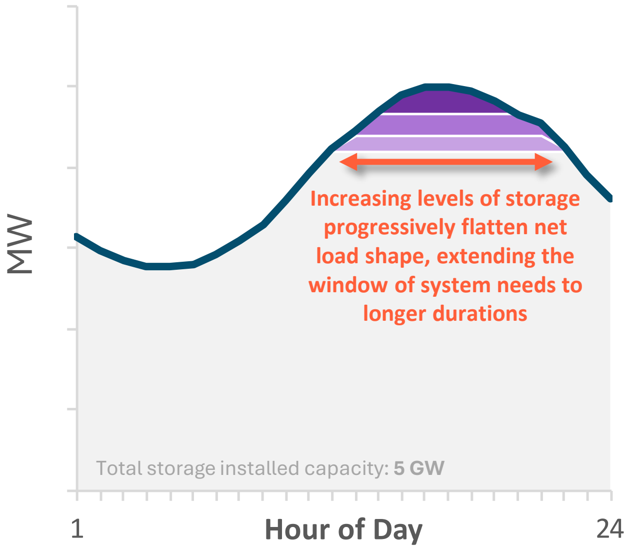
Variable resources shift reliability risks to different times of day

Solar Impact on Summer Net Load



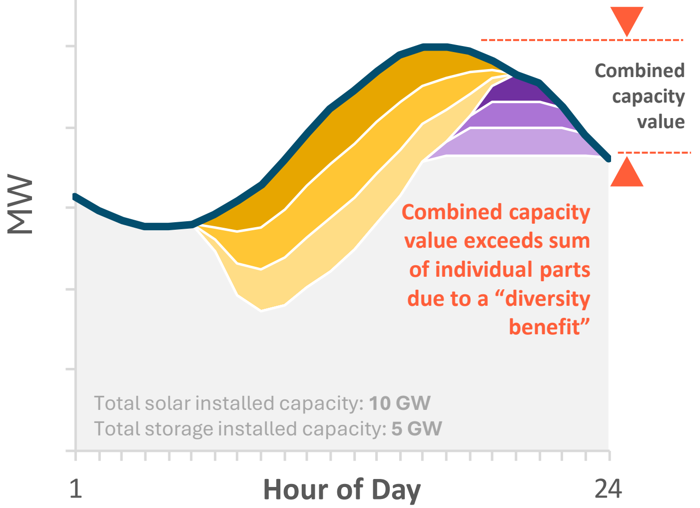
Energy-limited resources spread reliability risks across longer periods

Storage Impact on Summer Net Load



A portfolio of resources exhibits complex interactive effects, where the whole may exceed the sum of its parts

Combined Solar & Storage Impact on Summer Net Load



The ELCC approach inherently captures both **capacity** & **energy** adequacy

2027 ISP Electric Portfolio Development: Iterative Process

The ISP modeling approach pairs detailed loss-of-load-probability modeling (RECAP) with portfolio expansion models (AURORA) to provide a robust perspective on system reliability, operations, and cost under clean energy targets

1 **Quantify the capability of variable & dispatch-limited resources to contribute to resource adequacy requirements**

Reliability Modeling

RECAP as loss of load probability model

Planning reserve margin →

Technology ELCC curves →

← *Optimized portfolios*

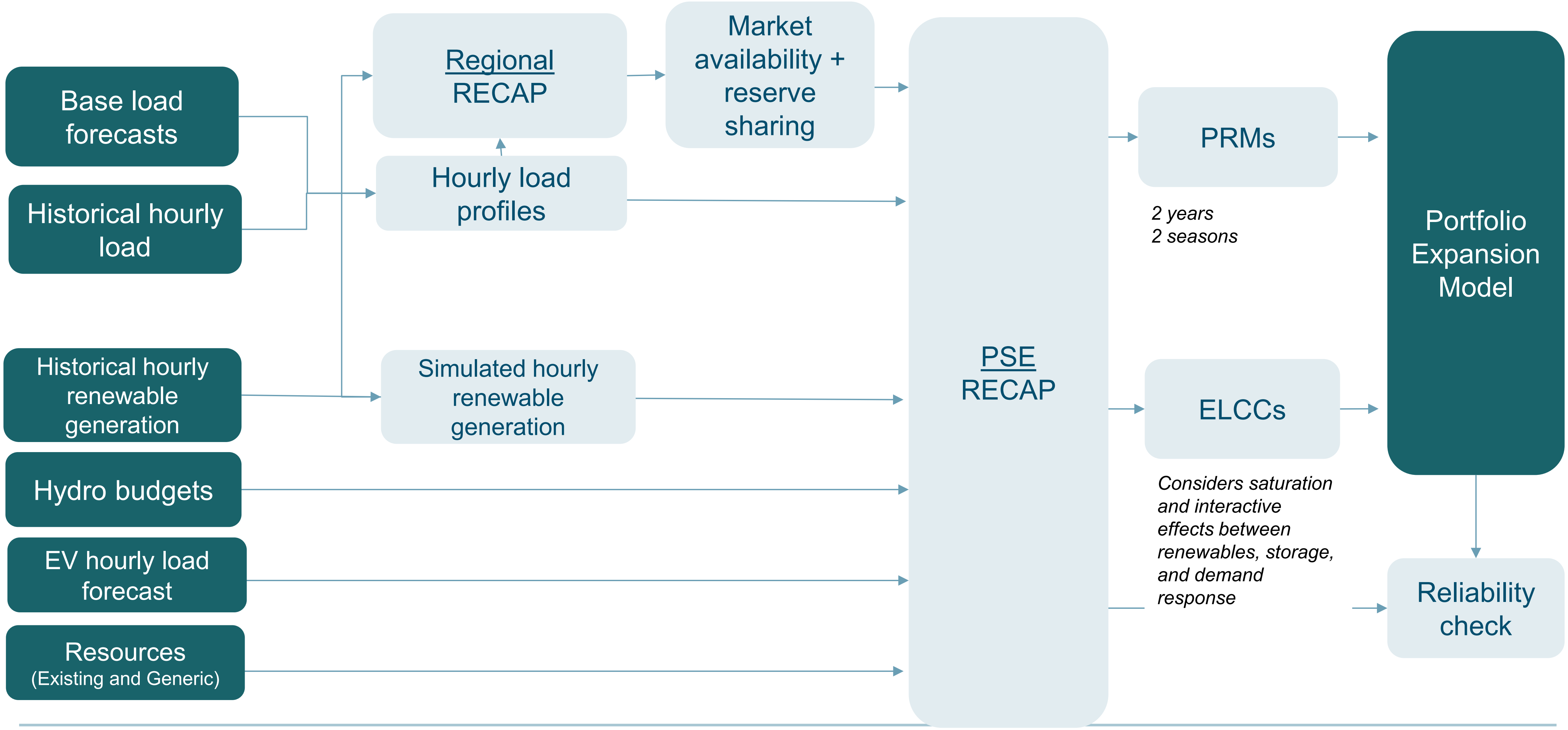
Portfolio Expansion Model

AURORA as capacity expansion model

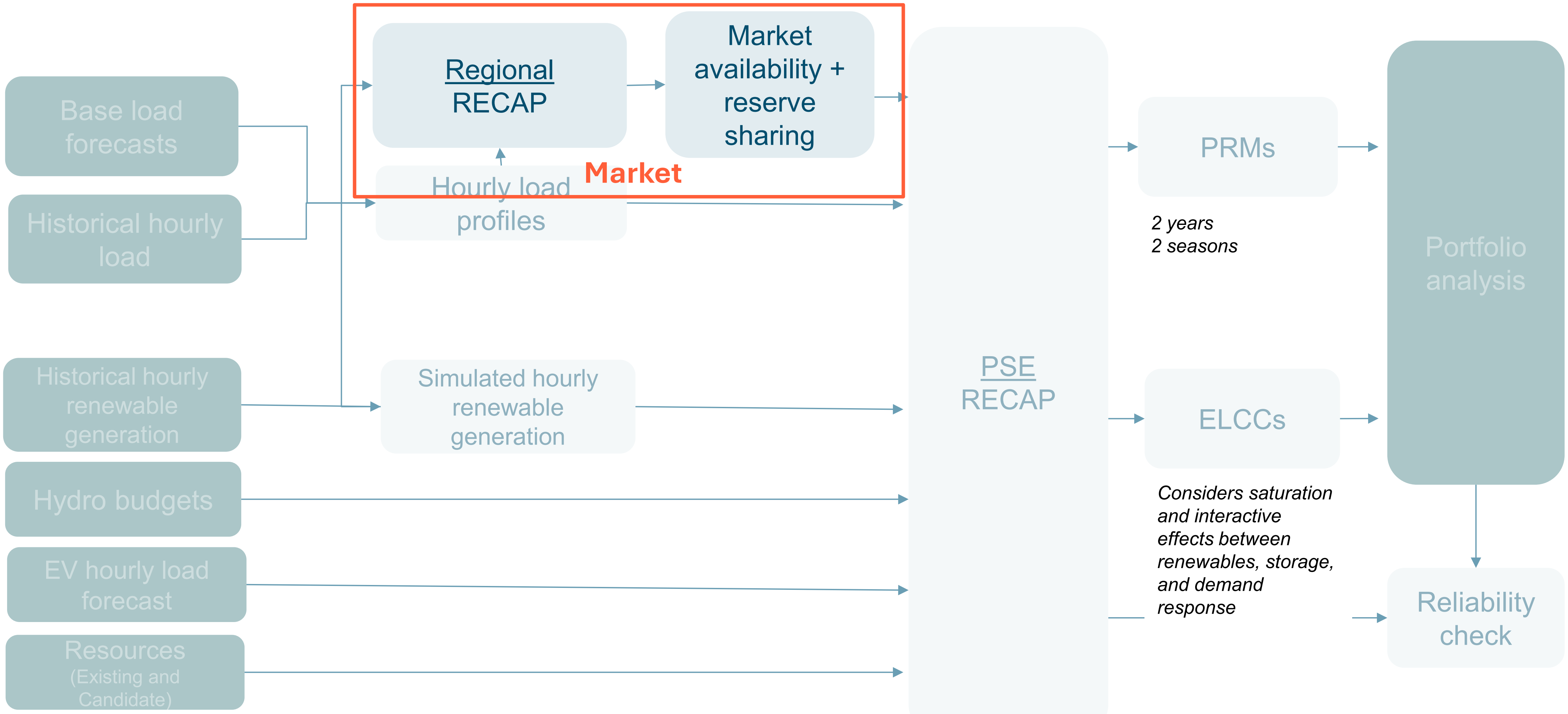
3 **Perform detailed reliability modeling to check that the optimized portfolios meet the reliability target**

2 **Optimize future resource portfolios to meet reliability and clean energy targets while minimizing cost to customers**

Overview of modeling workflow



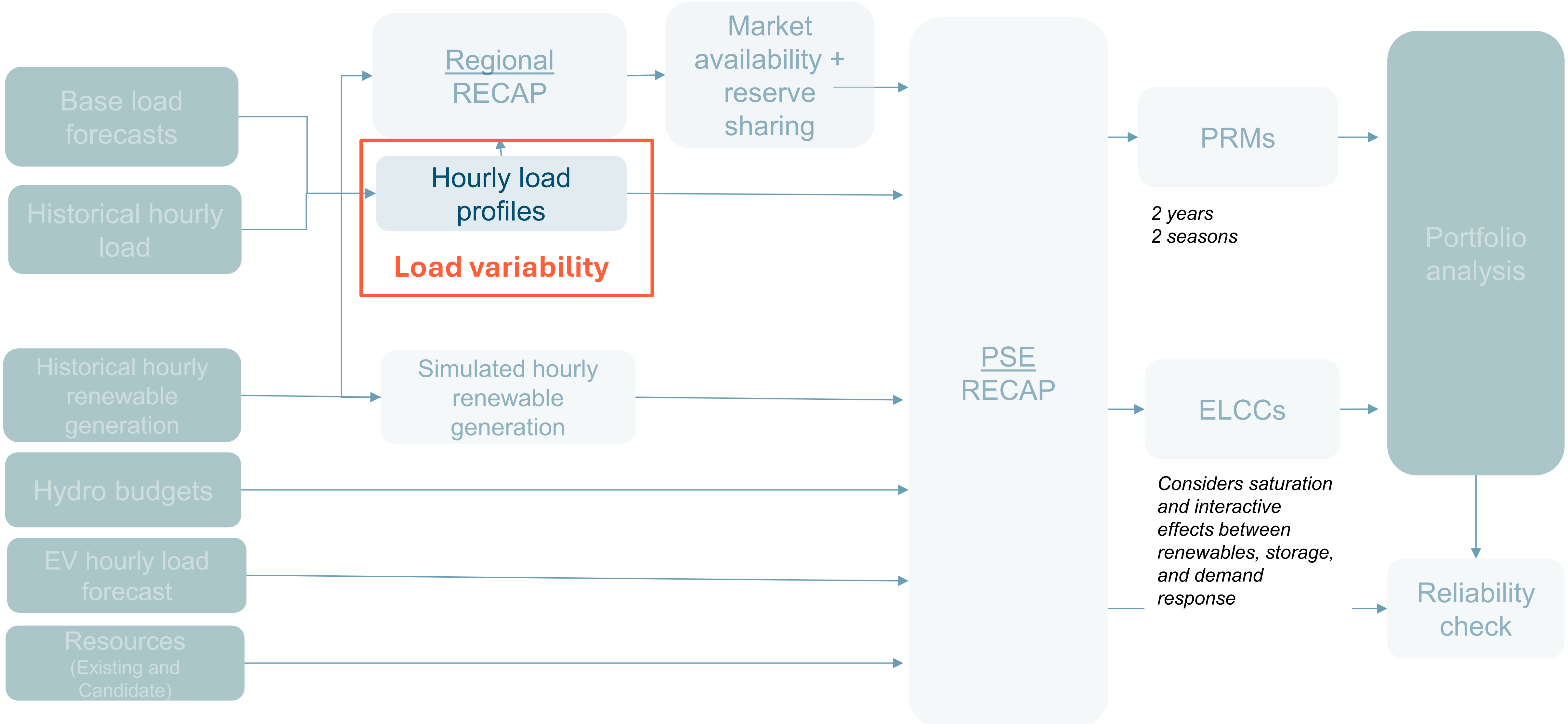
Overview of modeling workflow



Overview of modeling workflow

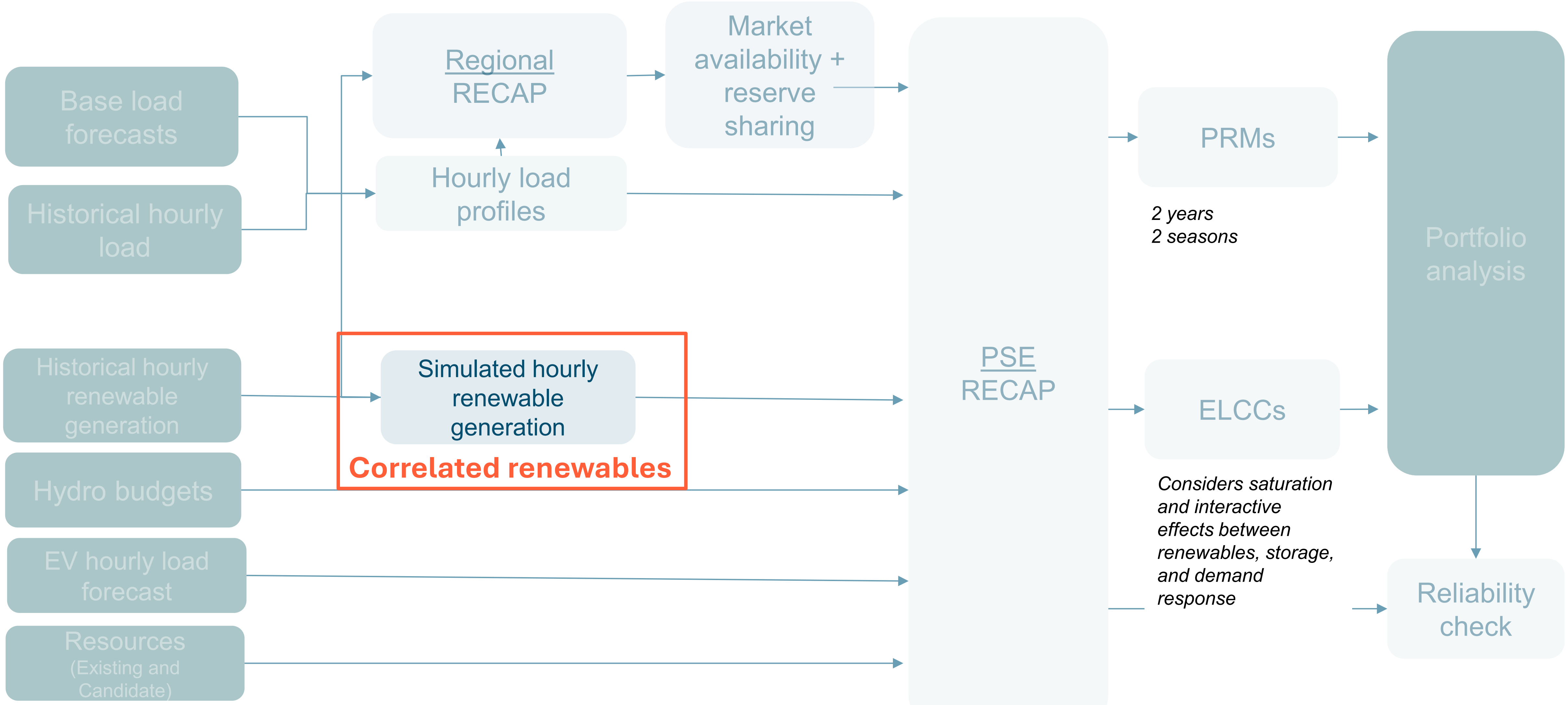
PSE

E3



Overview of modeling workflow

PSE
E3



Modeled Resources

+ E3 will evaluate the contribution of PSE's existing resources to meeting the PRM and identify reliability shortfall versus PSE's reliability standard.
+ E3 will develop ELCCs for new generic resources that can fill in the shortfall.
+ For renewable technologies, E3 will evaluate several locations where these technologies could be developed.

Generic Candidate Resources

Renewable Technologies
- Offshore wind
- Land-based Wind
- Solar
- DER Solar

Storage
- 4-hr storage
- 8-hr storage
- 100-hour storage
- DER storage

Hybrids
- Wind + Storage
- Solar + Storage
- Wind + Solar + Storage

Thermal Technologies
- Combustion turbine (peaker)
- Combined cycle combustion turbine

Other Technologies
- Advanced Nuclear / Small Modular Reactors

Demand side resources including demand response, managed EV charging, and energy efficiency will be treated as "existing" resources.

Questions?

Hydroelectric modeling update

Elizabeth Hossner, PSE

May 15, 2025

Hydro assumptions approach

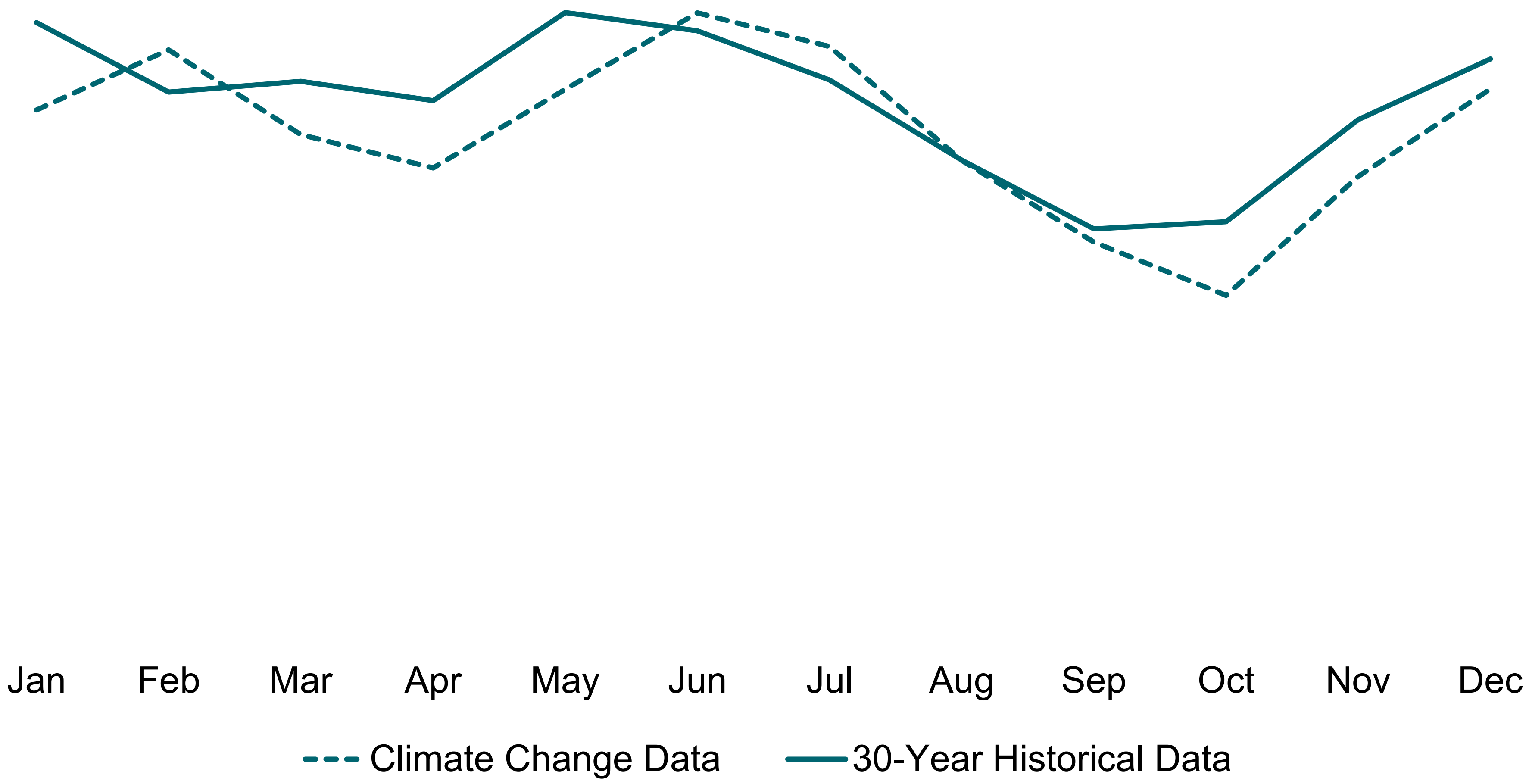
2027 ISP

- 30-year historical generation
  - Used in first 10 years of planning period
  - Years 2027-2036
- 30-year historical + climate change
  - 30-year rolling average
  - Years 2037-2050
- Benefits to this approach
  - Captures lower than predicted stream flows in recent history
  - Aligns with other PSE processes
  - Captures increasing variability due to climate change
  - Responsive to RPAG and public feedback

2025 analysis & 2023 Electric Progress Report

- Climate change data
- Aligned with NPCC's 2021 Power Plan assumptions
- Average of 3 RMJOC II models:
  - **A**: CanESM2_RCP85_BCSD_VIC_P1
  - **C**: CCSM4_RCP85_BCSD_VIC_P1
  - **G**: CNRM-CM5_RCP85_MACA_VIC_P3

PNW regional hydro shapes



Resource alternatives

Elizabeth Hossner, PSE

May 15, 2025

Electric resource alternatives

- Resources identified are generic
- Separate acquisition and evaluation processes are used to acquire resources

What is a generic resource?

- A resource used for modeling to help with evaluations, sizing, location, and creating a plan to meet future requirements

What is an emerging resource?

- Technology that appears likely to be viable in the timeline required in the ISP

Objective:

- Feedback regarding resource alternatives and location
- How to handle uncertainty and costs around alternative fuels

PSE PUGET SOUND ENERGY

Emerging technology feedback from the 2025 resource planning analysis

- Consider the full cost and environmental impacts of resource alternatives
- Model enhanced geothermal technology
- Concerns about the fuel cost, environmental impact, and availability of small modular reactor (SMR) technology
- Support for modeling offshore wind, compressed air energy storage (CAES), and iron-air batteries
- Mixed support for exploring hydrogen

Supply-side resource alternatives for the 2027 ISP

Energy Storage

- Short duration (Lithium-Ion 4 hour)
- **Medium duration (CAES 8-hour) - Emerging**
- **Long duration (Iron-Air 100-hour) - Emerging**

Wind

- Onshore wind
- **Offshore wind - Emerging**
- Hybrid and co-located with energy storage and solar

Solar Photovoltaic (PV)

- Utility scale
- Hybrid and co-located with energy storage and wind

Baseload

- **Small Modular Reactor (SMR) – Emerging**
- Combined Cycle Combustion Turbine (CCCT)
- **Enhanced Geothermal - Emerging**

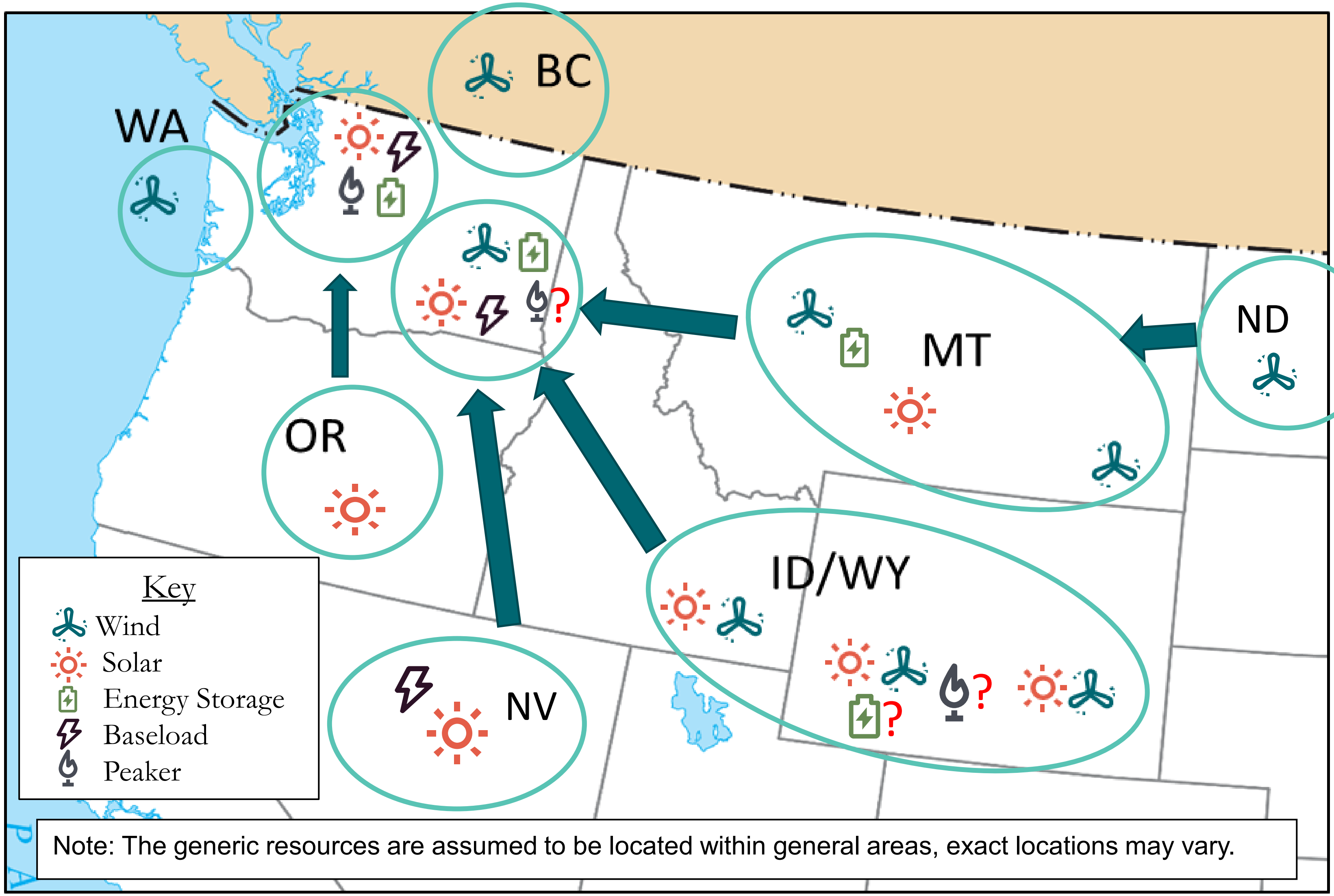
Peaker

- Natural Gas with oil backup – converts to alternative fuel in 2045
- **Hydrogen/NG blend with backup fuel - Emerging**

Distributed Energy Resources

- Solar
- Energy storage

Resource alternatives by transmission zone



- Resources will be organized into 'Transmission regions' described in the February 27 presentation.
- Allows different resources to be aggregated into unique transmission regions sharing a fixed transmission capacity.
- Feedback needed

PSE PUGET SOUND ENERGY

Alternative fuels

Given the uncertainty of fuel availability and emerging resources, we propose to take an average of several CETA-compliant fuel options to create a generic fuel alternative for the ISP.
This will be used to switch fuels on the thermal resources in 2045.

Type	Cost in 2025 dollars / MMBTU	Source
Renewable diesel	$38	Clean Cities and Community Alternative Fuel Price Report (Jan. 2025)
Sustainable aviation fuel (SAF)	$43	NREL ATB 2024, BloombergNEF 2022
Bio-based diesel	$31	Average of NREL ATB 2024, Alternative Fuels Data Center
Methanol	$28	Average of Methanex historical (2020- May 2025), Methanol Institute historical (Dec. 2021-Dec. 2024)
Generic Alternative Fuel	**$35**	**Average**

Input on inflation:

- Increase costs by inflation
- Use curve from Diesel Price forecast

PUGET SOUND ENERGY

Questions?

Emerging resources & geothermal modeling

Steve Schueneman, PSE

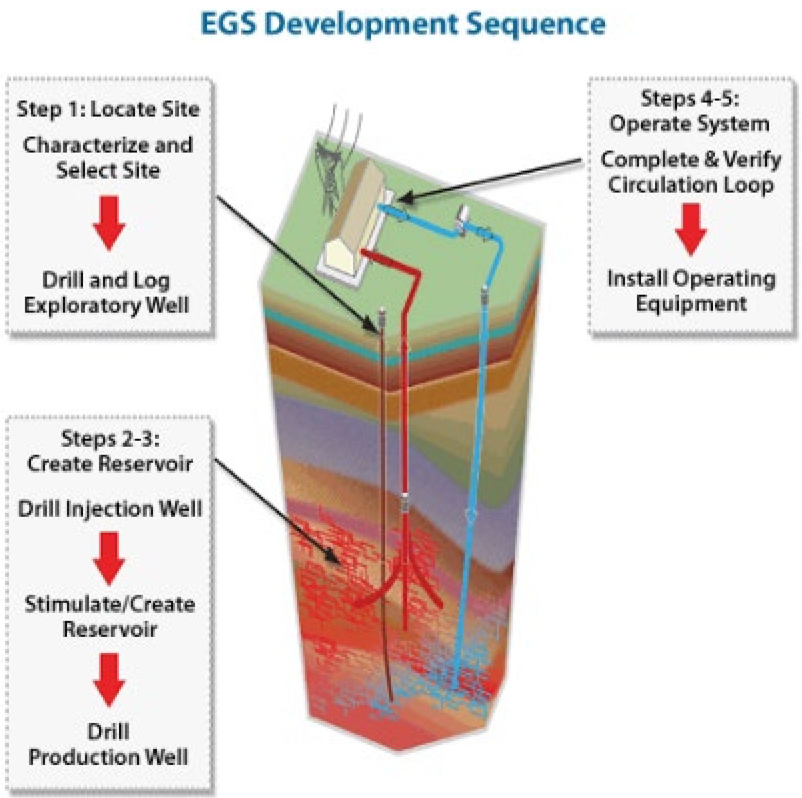
May 15, 2025

Geothermal energy harnesses heat in the earth

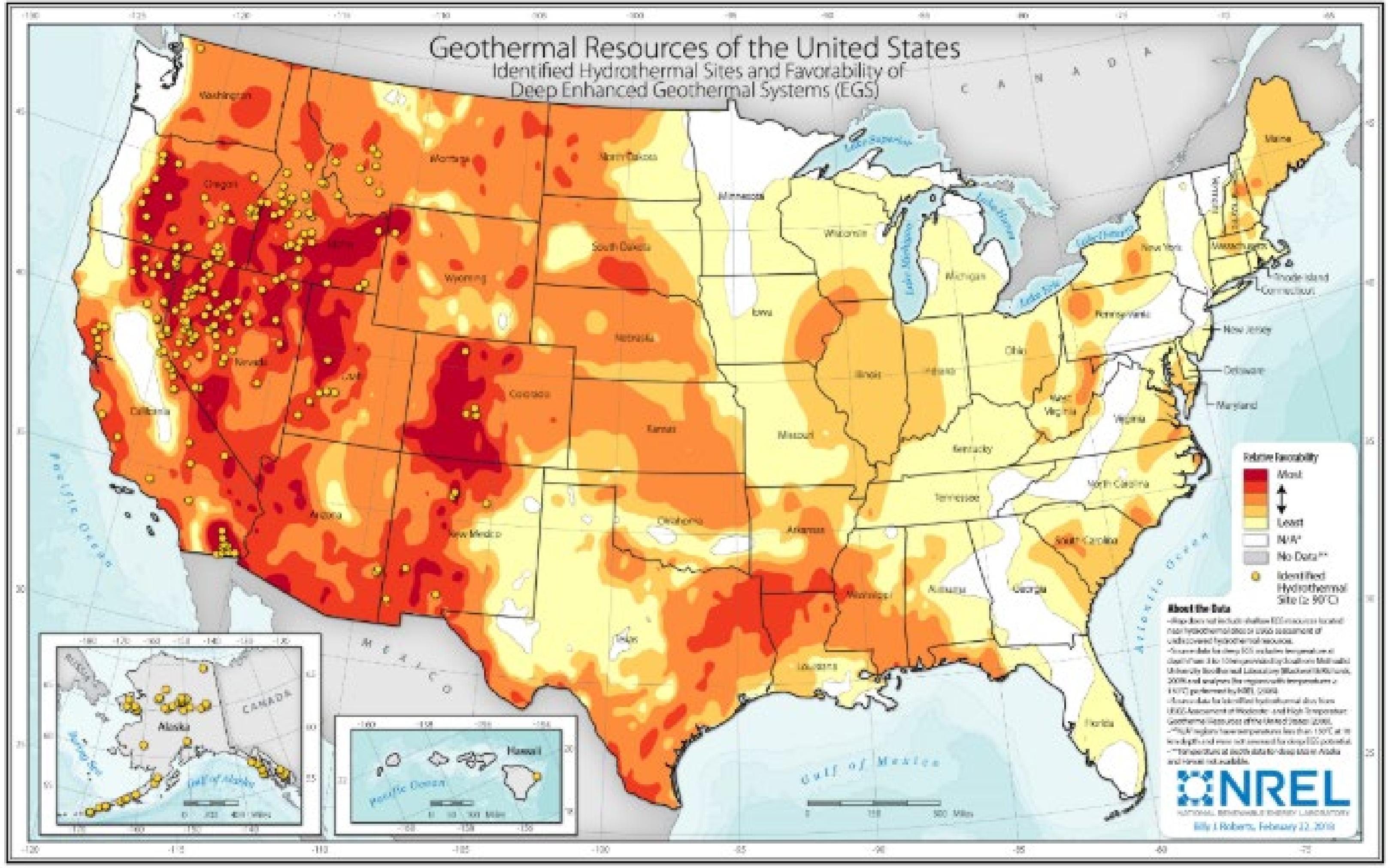
- Harnessing geothermal energy utilizes two existing technologies: horizontal drilling with hydraulic stimulation, and closed loop steam turbines

- Other drilling methods are under investigation that allow drilling to deeper depths using sub-millimeter wave technology

- Any technology will require detailed knowledge and characterization of geologic forces and heat capacity



Enhanced geothermal energy holds vast potential



- US DOE has identified approximately 100 GW of EGS capacity, primarily in the western US.
- US currently produces about 0.4% of national energy from conventional geothermal energy systems
- Widespread availability of hot rock may allow for installation of EGS systems adjacent to existing electric transmission corridors

PSE PUGET SOUND ENERGY

EGS expansion will require on-going support

Hot rock may be abundant, but ideal conditions are difficult to know for sure, and expensive to find out.

Public support to characterize temperature and geology will be essential to support early adoption.

- Most EGS systems are expected to operate at depth of 3 km to 5 km
- Geologic and temperature data largely rely on legacy oil and gas data
- Exploratory wells can cost $10M to $20M each
- Heat recovery based on estimates and modeling for now

EGS energy holds promise, but is not without risks

The case for

- Clean, flexible 24/7 dispatchable energy
- Ability to integrate with other clean energy technologies
- Lower technology risk than competing alternatives
- Energy expansion from existing footprint

The risks

- Lack of data about geology and temperature at depth
- Seismic and water quality concerns
- Lifespan of wells and costs of re-stimulation
- High capital costs and potentially high O&M

Questions?

PUGET SOUND ENERGY

Generic Resource Costs

Kaitryn Olson, PSE

May 15th, 2025

PUGET SOUND ENERGY

Discussion

- **How should we handle uncertainty around tariffs?**
- **How should we handle changes in policy surrounding investment tax credit (ITC) and production tax credits (PTC)?**
- **How should we handle uncertainty in emerging resource technology timing and costs?**

Generic Resources Capital Costs

Generic resource technologies – presented by Black and Veatch RPAG meeting [March 25, 2024]

❖ All costs are in 2022 dollars and vintage year 2025 unless otherwise stated
❖ All 2024 NREL ATB Costs are on the conservative cost curve

Draft costs include:

- EPC (Engineer, Procure, Construct)
- Owner's Costs

Not included in draft costs, but will be added later:

- Investment Tax Credit (ITC)
- Production Tax Credit (PTC)
- Interconnection costs
- Lease fees

PSE PUGET SOUND ENERGY

Emerging Resources Capital Costs

Type	Size	2025 Modeling Black & Veatch Costs	Draft 2027 ISP/ 2024 NREL ATB $/kw	Uncertainty/ Risk Percentage Adder
Nuclear SMR	600 MW	10,627	*12,681	20%?, 50%?
Offshore Wind (Floating Foundation) Class 12	100 MW	6,439	*14,694	20%?, 50%?
Enhanced Geothermal	100 MW	---	11,057	20%?, 50%?

*Vintage year 2030

PSE PUGET SOUND ENERGY

Storage Resources Capital Costs

Type	Size	2024 NREL ATB $/kw	Draft 2027 ISP $/kw	Uncertainty/risk percentage adder
Short-Duration 4-Hr Li-Ion	100 MW	2,160	2,079	10%?, 20%?
Mid-Duration Advanced Compressed Air	100 MW	*Pumped Storage: 4,270 8-Hr Li-Ion Battery: 3,828	2,439	10%?, 20%?
Long Duration Iron Air	100 MW	---	2,389	10%?, 20%?

*24 NREL ATB Class 7

PUGET SOUND ENERGY

Thermal Resources Capital Costs

Type	Size	2024 NREL ATB	Draft 2027 PSE ISP
NG Peaker[1]	120 MW	1,319	1,729
H2 Peaker	104 MW	---	2,028
Combined Cycle[2]	336 MW	1,730	1,730

1. 2024 and 2023 NREL ATB uses a F Class gas turbine (200+ MW) for its analysis. The smaller turbine results in differences in costs and performance numbers from the Black & Veatch estimates. NREL assumptions on the operating profile of the peaker may be different from Black & Veatch assumptions used in thermal modeling resulting in differences in variable O&M costs.
2. NREL ATB Combined Cycle – NG 1-on-1 (H Frame)

Renewable & Co-located Capital Costs

Technology/Size	Cost Category	2024 NREL ATB $/kw	Draft 2027 PSE ISP $/kw	Uncertainty percentage adder
PV Solar Solar Class 8 Single Axis Tracking Utility Scale	100 MW	1,541	2,169	10%?, 20%?
Wind Wind Class 6 On-Shore	100 MW	1,633	1,790	10%?, 20%?
PV Solar + BESS+ Co-Located Hybrid	100MW + 50 MW	2,569	2,139	10%?, 20%?
Wind + BESS Co-Located Hybrid	100MW + 50 MW	---	1,886	10%?, 20%?
PV Solar + Wind + BESS Co-Located Hybrid	100MW + 100MW + 50MW	---	1,999	10%?, 20%?

*Draft 2027 ISP Wind and Solar Capital Costs are informed by Black and Veatch and PSE's 2024 RFP
*All Co-Located Resources are paired with a 4hr Li-Ion BESS
+For the PV Solar + BESS in 24 NREL ATB modeled a DC coupled system with 134MWdc solar and 78MW dc battery for their analysis

PUGET SOUND ENERGY

Discussion

- How should we handle uncertainty around tariffs?
- How should we handle changes in policy surrounding investment tax credit (ITC) and production tax credits (PTC)?
- How should we handle uncertainty in emerging resource technology timing and costs?

Questions?

PUGET SOUND ENERGY

RPAG charter adoption

Annie Kilburg Smith, Triangle Associates

May 15, 2025

PUGET SOUND ENERGY

RPAG charter: adoption in principle

What we're asking today

We're inviting RPAG members to adopt the revised Charter *in principle*.

This means:

- You **generally support** the updated Charter language
- You believe it reflects RPAG's purpose, structure, and process
- You are **comfortable moving forward** with the Charter as the foundation for ongoing work

PSE PUGET SOUND ENERGY

Next steps

Feedback process

01

One week prior to meeting

The feedback window for the upcoming meeting opens.

02

3-5 business days prior to meeting

PSE posts the meeting agenda and slide deck on the Clean Energy website.

03

Day of meeting

PSE engages RPAG for feedback and facilitates a public comment opportunity.

04

One week post meeting

Feedback window for the latest RPAG meeting closes. Feedback received outside this window will go into the subsequent feedback report.

05

Four weeks post meeting

PSE posts the meeting summary and feedback report from the latest RPAG meeting on the Clean Energy website.

Upcoming activities

Date	Activity
May 22, 2025	Feedback form from this meeting closes
June 18, 2025	RPAG electric vehicle forecast info session
June 24, 2025	RPAG meeting
July 29, 2025	RPAG meeting
August 2025	No RPAG meeting this month

Contact us

- Via email at isp@pse.com
- Via feedback form at: https://www.cleanenergyplan.pse.com/contact
- Leave us a voicemail at 425-818-2051
- Subscribe to our email list
- Visit our website: cleanenergyplan.pse.com

PUGET SOUND ENERGY

Public comment opportunity

PUGET SOUND ENERGY

Public comment update

- Increasing public comment time from 2 minutes to **3 minutes** per person
- If an RPAG meeting ends substantially ahead of schedule the facilitator will have discretion to equitably extend public comments as time allows
- Reminder that commenters may not “donate” their time to other commenters
- Reminder that public comments are not meant to substitute for thoughtful written feedback
- PSE will endeavor to expedite feedback reports to complete them prior to the following RPAG meeting

How to participate in the public comment opportunity

- Please use the “raise hand” if you would like to provide comment
- Each speaker will have up to **3 minutes** to give comments
- Comments should relate to **today’s meeting topics**
- Please keep remarks respectful – no personal attacks
- Comments and questions will be included in the feedback report
- You are welcome and encouraged to send written feedback to isp@pse.com

Thanks for joining us!

Appendix

Acronyms

Acronym	Meaning
BDR	Bill discount rate
CBI	Customer benefit indicator
CCA	Climate Commitment Act
CEIP	Clean Energy Implementation Plan
CETA	Clean Energy Transformation Act
DER	Distributed Energy Resources
EAG	Equity Advisory Group
EPR	PSE’s 2023 Electric Progress Report
HELP	Home Energy Lifeline Program
IAP2	International Association of Public Participation
IRA	Inflation Reduction Act
IRP	Integrated Resource Plan
NG	Natural gas
MW	Megawatt
MWh	Megawatt hour

PUGET SOUND ENERGY

COMPARISON TO 2024 NREL ATB SUMMARY

Technology/Size	Cost Category	2024 NREL ATB	Draft 2027 PSE ISP Input
AA-CAES 100 MW	CAPEX ($/KW)	---	2439
	Fixed O&M ($/KW-yr)	---	18
	Variable O&M ($/MWh)	---	---
LDES Iron-Air Battery 100 MW 100-HR	CAPEX ($/KW)	---	2389
	Fixed O&M ($/KW-yr)	---	43
	Variable O&M ($/MWh)	---	--
Nuclear SMR 600 MW	CAPEX ($/KW)	12681	12681
	Fixed O&M ($/KW-yr)	216	102
	Variable O&M ($/MWh)	3.00	3.14
Off-Shore Wind 100 MW, Wind Class 12 Floating Foundation	CAPEX ($/KW)	14694	14694
	Fixed O&M ($/KW-yr)	80	123
	Variable O&M ($/MWh)	---	---
Enhanced Geothermal 100MW	CAPEX ($/KW)	11057	11057
	Fixed O&M ($/KW-yr)	147	147
	Variable O&M ($/MWh)	---	---

EMERGING TECHNOLOGIES

COMPARISON TO 2024 NREL ATB SUMMARY

Technology/Size	Cost Category	2024 NREL ATB	Draft 2027 PSE ISP Input
Thermal Peaker NG (vs NG) 100 MW	CAPEX ($/KW)	1319	1729
	Fixed O&M ($/KW-yr)	26	14
	Variable O&M ($/MWh)	6.94	36
Thermal Peaker 100% H_2 Fuel (vs NG) 100 MW	CAPEX ($/KW)	1319	2028
	Fixed O&M ($/KW-yr)	26	14
	Variable O&M ($/MWh)	6.94	36
Thermal Baseload Combined Cycle (NG) 336 MW	CAPEX ($/KW)	1730	1730
	Fixed O&M ($/KW-yr)	39	39
	Variable O&M ($/MWh)	2.5	2.5
PV Solar 100 MW, Single Axis Tracking Utility Scale	CAPEX ($/KW)	1541	2169
	Fixed O&M ($/KW-yr)	22	22
	Variable O&M ($/MWh)	---	---
BESS 100 MW, 4-hr Li-Ion (LFP), Utility Scale	CAPEX ($/KW)	2160	2079
	Fixed O&M ($/KW-yr)	50	48
	Variable O&M ($/MWh)	---	---
Wind 100 MW, Wind Class 6 On-Shore	CAPEX ($/KW)	1633	1790
	Fixed O&M ($/KW-yr)	32	29
	Variable O&M ($/MWh)	---	---
PV Solar + BESS 100 MW + 50 MW, 4-hr Co-Located Hybrid	CAPEX ($/KW)	2569	2139
	Fixed O&M ($/KW-yr)	72	43
	Variable O&M ($/MWh)	---	---
Wind + BESS 100 MW + 50 MW, 4-hr Co-Located Hybrid	CAPEX ($/KW)	---	1886
	Fixed O&M ($/KW-yr)	---	48
	Variable O&M ($/MWh)	---	---
PV Solar + Wind + BESS 100MW+100MW+50MW, 4-hr Co-Located Hybrid	CAPEX ($/KW)	---	1999
	Fixed O&M ($/KW-yr)	---	42
	Variable O&M ($/MWh)	---	---

CURRENT TECHNOLOGIES