Resource Planning Advisory Group Meeting

2027 Integrated System Plan

September 30, 2025

PUGET SOUND ENERGY

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
- Note: This meeting is being recorded, livestreamed, and will be available on YouTube

Safety moment

- September is National Preparedness Month – Preparedness Starts at Home
  - Know your risks based on where you live
  - Make a family emergency plan
  - Build an emergency supply kit
  - Get involved in your community
  - Find out more at ready.gov

Today’s speakers

- Annie Kilburg Smith, Facilitator, Triangle Associates
- Kara Durbin, Director, Clean Energy Strategy
- Jennifer Coulson, Manager, Operations and Gas Analysis, PSE
- Ray Outlaw, Manager, Communications Initiatives, PSE
- Elizabeth Hossner, Manager, Resource Planning and Analysis, PSE
- Michaela Levine, Senior Managing Consultant, E3

Agenda

Time	Agenda Item	Presenter / Facilitator
1:00 p.m. – 1:05 p.m.	Welcome and introductions	Annie Kilburg Smith, Triangle Associates
1:05 p.m. – 1:20 p.m.	ISP development updates	Jennifer Coulson, PSE Kara Durbin, PSE
1:20 p.m. – 2:00 p.m.	Clean energy survey results	Ray Outlaw, PSE Kara Durbin, PSE
2:00 p.m. – 2:10 p.m.	Break	
2:10 p.m. – 3:45 p.m.	Resource adequacy results	Michaela Levine, E3
3:45 p.m. – 4:00 p.m.	Next steps and public comment opportunity	Annie Kilburg Smith, Triangle Associates
4:00 p.m.	Adjourn	All

Meeting purpose

- Provide ISP development updates
- Provide an overview of PSE's clean energy customer survey results
- Discuss resource adequacy results for the 2027 ISP

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

ISP development updates

Jennifer Coulson

Manager, Operations and Gas Analysis, PSE

Kara Durbin

Director, Clean Energy Strategy, PSE

September 30, 2025

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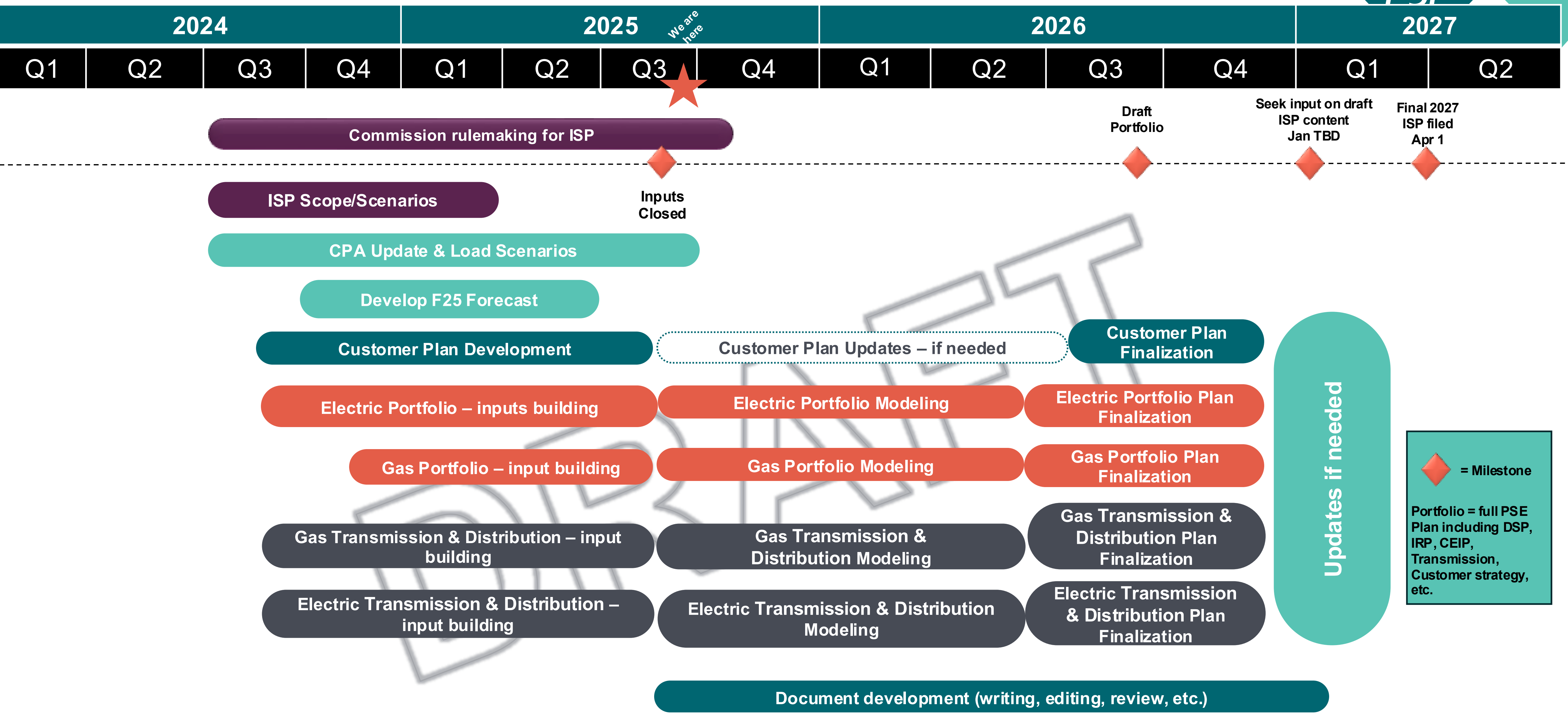
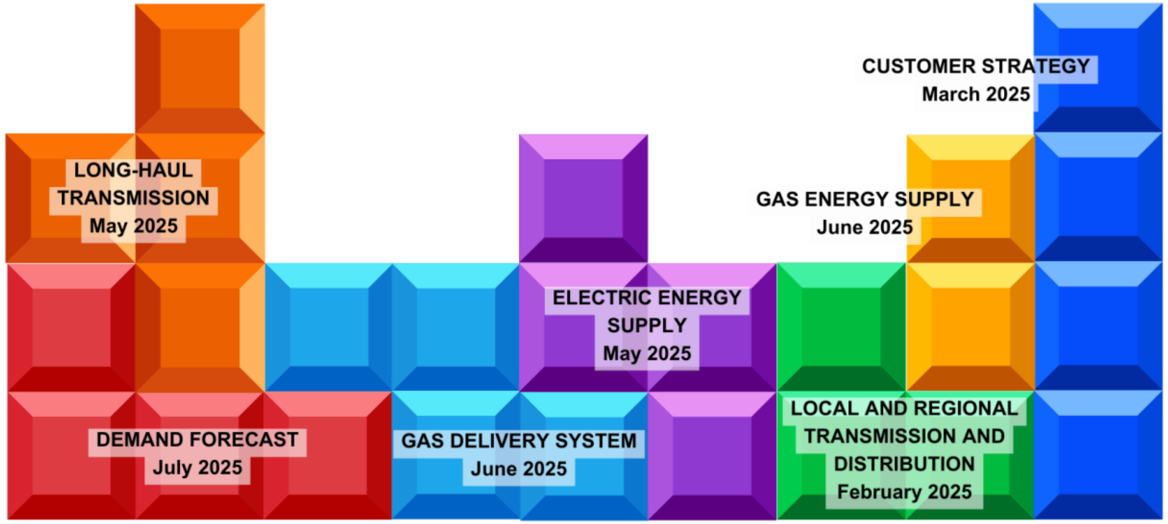
2027 ISP Schedule by Planning Area



Feedback memo

- Developing memo to document feedback received during meetings and in writing through August 2025
- Includes relevant feedback from previous IRP engagement
- Will send to RPAG members and post on clean energy website soon

Request: Review memo and let us know if any clarification is needed



Questions?

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2025 PSE Clean Energy Survey Results

Ray Outlaw

Manager, Communications Initiatives, PSE

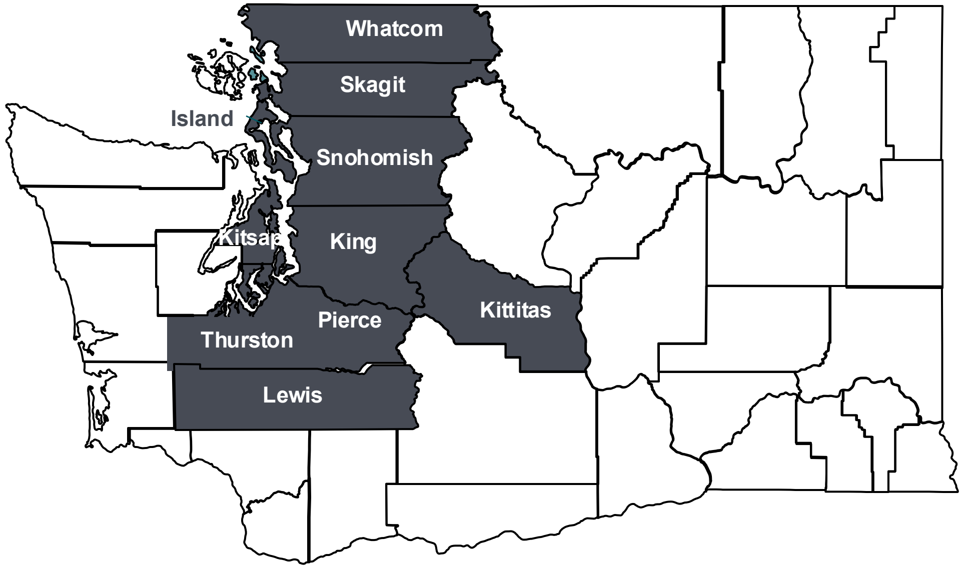
Kara Durbin

Director, Clean Energy Strategy, PSE

Edelman Data x Intelligence for Puget Sound Energy

Methodology

Washington Residents within PSE Service Areas



This survey was conducted by Edelman Data & Intelligence, an independent research firm, in partnership with PSE. The sample was fielded and collected to be representative of the Washington population across age, gender, ethnicity/race, and region.

* Denotes survey questions that were inspired by advisory group feedback.

Timing	Method
Survey fielded from: January 13, 2025 - February 7, 2025	10-minute online survey

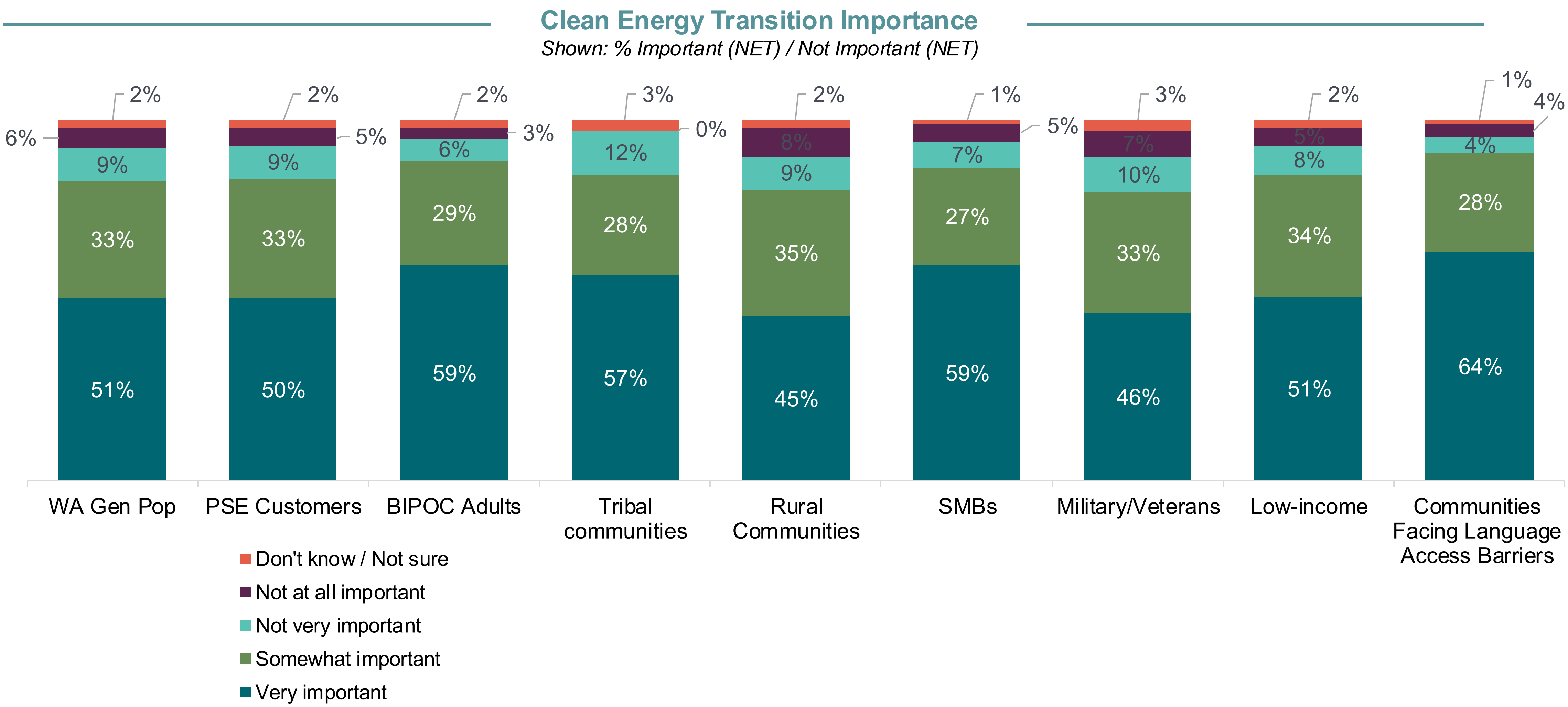
Counties	Sample Size (WA Gen Pop)
TOTAL	**n=1,501**
Whatcom	n=80
Skagit	n=35
Island	n=24
Kitsap	n=98
King	n=576
Kittitas	n=9
Pierce	n=303
Thurston	n=121
Snohomish	n=227
Lewis	n=28

Margin of error: ± 3.1% at the 95% confidence level among WA Gen Pop

Audience Name	Sample Size*
Washington Gen Pop *Adults in counties served by PSE. Quotas set on gender, age, county, race/ethnicity, and education*	n=1,501
Washington BIPOC Adults *Includes Black, American Indian/Alaskan Native, Asian, Native Hawaiian-Other Pacific Islander, Two or more races and the ethnicity grouping of Spanish/Hispanic/Latino*	n=490
Tribal Communities *Are indigenous American or Indigenous Alaskan AND identify themselves as living in tribal communities*	n=65
Rural Communities *Located in settlements with fewer than 2,500 residents*	n=339
Small/Medium Businesses (SMBs) *Owners of small/medium businesses*	n=308
Military Communities And Veterans *Have members of their household who currently or previously served in the US armed forces, reserves, or national guard*	n=374
Low Income Households *Those who are categorized as low income and fall within 80% of the Washington AMI*	n=1089
Communities Facing Language Access Barriers *Those who speak English less than "very well" (Speak English well, not well, or not at all)*	n=85

Respondents who qualified for multiple audiences were included in each applicable group's total counts. *Translations offered in Chinese, Korean, Spanish, and Vietnamese for communities facing language access barriers.*

In general, how important is transitioning to clean energy to you?*



Q1: In general, how important is transitioning to clean energy to you? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65*, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.

If you had the choice to make changes to the energy that powers your home or business, please indicate which of the following you would consider to be must-haves versus nice-to-have energy features.*

"Must-have" Energy Features

Shown: % "Must-have" NET

Option	WA Gen Pop	PSE Customers	BIPOC Adults	Tribal Communities	Rural Communities	SMBs	Military / Veterans	Low-income	Communities Facing Language Access Barriers
Highly reliable energy	75%	77%	72%	80%	75%	73%	73%	73%	65%
Lower than average energy bills	55%	54%	61%	63%	61%	56%	53%	57%	59%
Responsive customer service from energy provider	48%	49%	47%	48%	48%	51%	48%	46%	51%
Long-term energy savings / return on investment	43%	44%	50%	49%	44%	50%	43%	43%	53%
Clean, renewable energy	40%	39%	47%	48%	38%	48%	39%	44%	46%
Energy incentives and rebates	29%	31%	31%	28%	31%	31%	29%	29%	35%
Increase in property value resulting from clean energy upgrades	24%	24%	27%	31%	24%	29%	23%	24%	26%

Q3: If you had the choice to make changes to the energy that powers your home or business, please indicate which of the following you would consider to be must-haves versus nice-to-have energy features. Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.*

Methodology – Willingness to pay for clean energy

This survey question is set up using projected **annual utility bill increases through 2030** to gauge what level of rate hikes Washington adults are willing to accept in support of state-mandated clean energy goals.

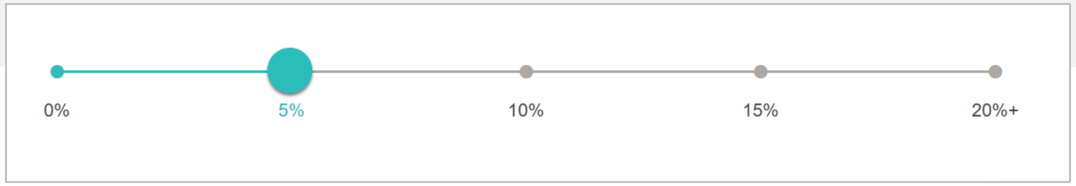
Survey Question For Reference

As Washington State transitions to cleaner energy sources, investments in utility infrastructure and projects are expected, which may affect electricity costs in the coming years.

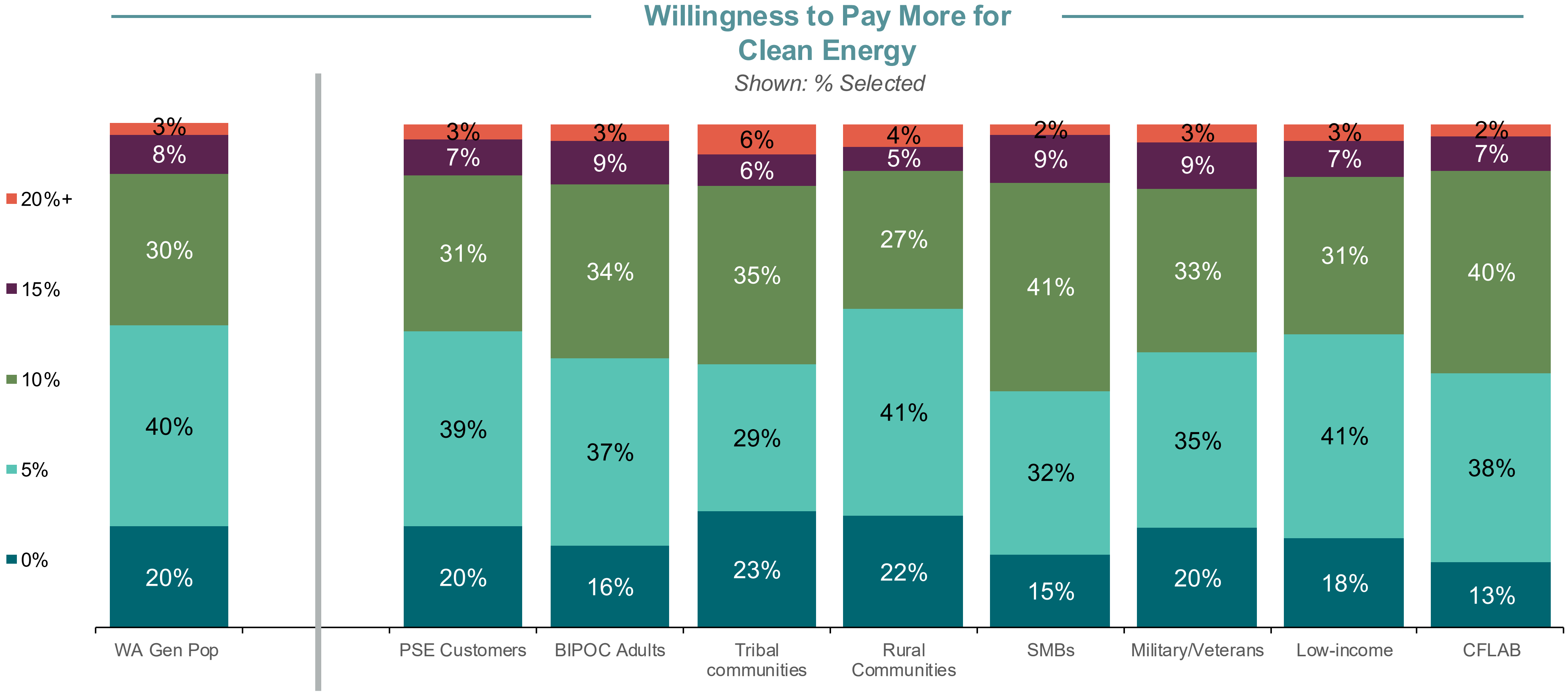
The below table shares an example of what various annual rate increases on a $100 utility bill look like through 2030. For example, a rate increase of 5% means that each year's monthly bill increases by $5.

Annual (%)	2025	2026	2027	2028	2029	2030	Total (%)
5%	100	105	110	115	120	125	25%
10%	100	110	120	130	140	150	50%
15%	100	115	130	145	160	175	75%
20%	100	120	140	160	180	200	100%

What level of annual bill increases are you willing to pay in order to meet state mandated clean energy requirements? Please use the slider below.

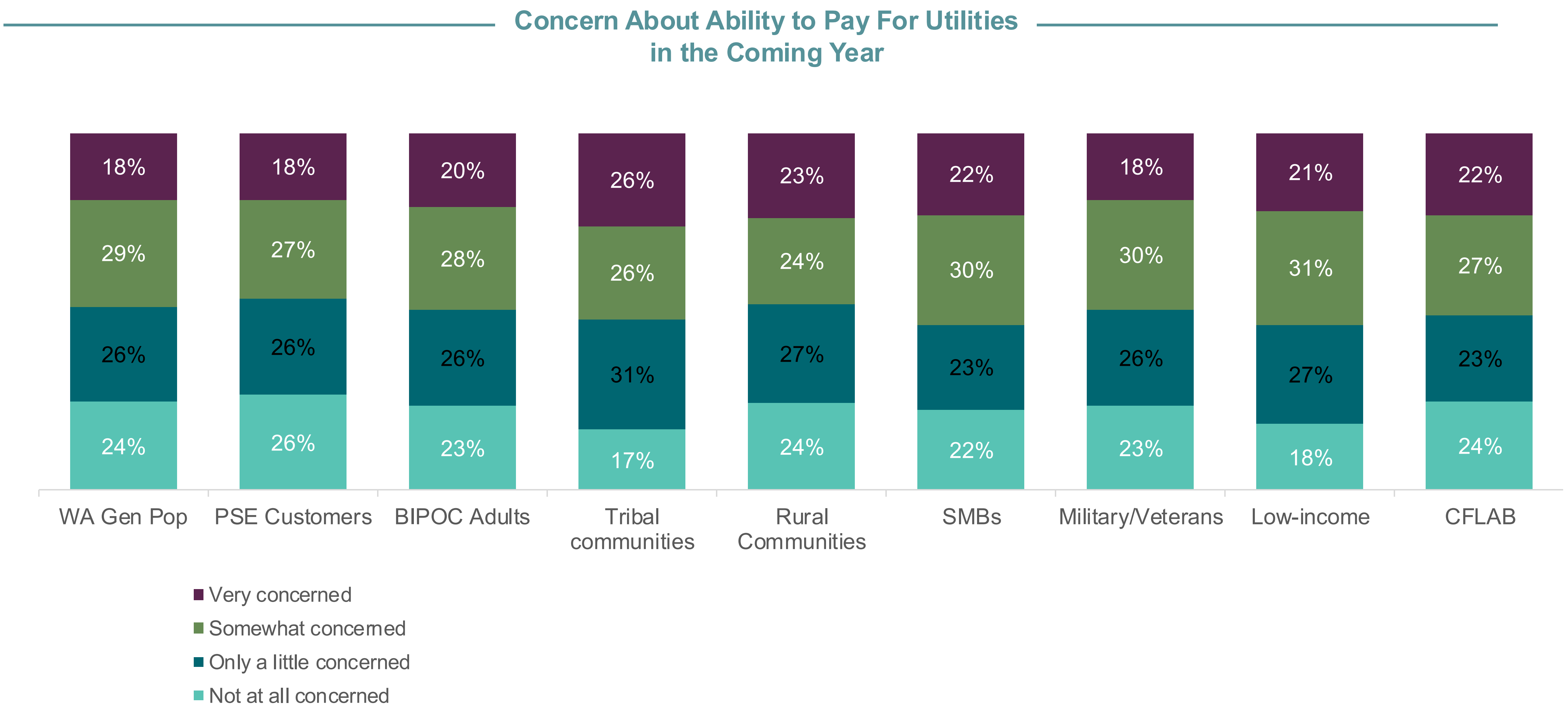


What level of annual bill increases are you willing to pay to meet state mandated clean energy requirements?



Q5:What level of annual bill increases are you willing to pay in order to meet state mandated clean energy requirements. Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65*, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.

How concerned are you about being able to pay for natural gas or electric services in the coming year?



Q7: How concerned are you about being able to pay for natural gas or electric services in the coming year? Base sizes: Gen Pop n=1372, PSE Customers n=956, BIPOC Adults n=430, Tribal Communities n=58, Rural **Communities** n=312, SMBs n=282, Military Communities and Veterans n=335, Low Income n=973, Communities Facing Language Access Barriers n=74*. *Small sample size.*

What concerns, if any, do you have regarding the transition to clean energy? Please select all that apply.*

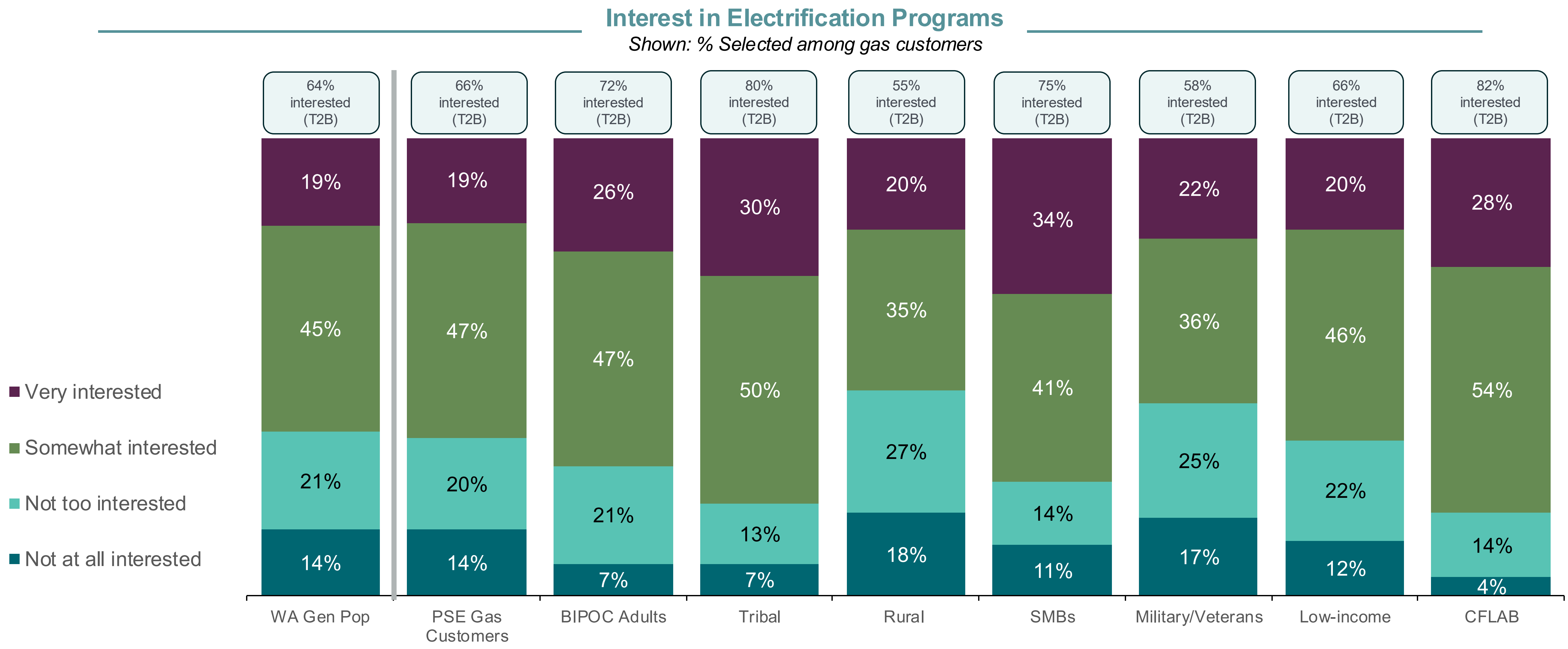
Clean Energy Transition Concerns

Shown: Top concerns by audience,
Multiple select, % Selected

Option	WA Gen Pop	PSE Customers	BIPOC Adults	Tribal Communities	Rural Communities	SMBs	Military / Veterans	Low-income	Communities Facing Language Access Barriers
Higher costs	67%	68%	64%	57%	65%	63%	68%	66%	60%
Logistical difficulties making the switch (e.g., installation challenges, cost)	45%	47%	40%	38%	47%	44%	47%	43%	39%
Long-term maintenance costs	45%	45%	42%	46%	42%	43%	50%	44%	42%
Uncertainty about reliability	44%	47%	39%	37%	47%	44%	43%	42%	35%
Lack of availability of financial incentives and rebates	34%	33%	29%	32%	37%	33%	37%	34%	29%
Lack of available options in my area	32%	31%	33%	31%	41%	34%	36%	34%	27%
Concerns about the environmental impact of new technologies	27%	26%	29%	28%	29%	26%	32%	25%	34%
Limited understanding of clean energy technologies	25%	25%	28%	28%	24%	24%	27%	26%	31%
I don't have any concerns about transitioning	7%	6%	8%	6%	9%	5%	4%	6%	4%

Q13: What concerns, if any, do you have regarding the transition to clean energy? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.*

How interested would you be in participating in an electrification program in the next 12 months?*



Q6: How interested would you be in participating in an electrification program in the next 12 months? Base sizes: Total Gas Customers n=680, PSE Gas Customers n=496, BIPOC Gas Customers n=238, Tribal Communities Gas Customers n=30, Rural Gas Customers n=130, SMB Gas Customers n=155, Military/Veteran Gas Customers n=182, Low-Income Gas Customers n=420, Communities Facing Language Access Barriers Gas Customers n=85*. *Small sample size.*

How strongly do you support or oppose each of the following resources to balance intermittent clean resources?

Supported On Demand Energy Resources

Shown: % "Support" NET

Option	WA Gen Pop	PSE Customers	BIPOC Adults	Tribal Communities	Rural Communities	SMBs	Military / Veterans	Low-income	Communities Facing Language Access Barriers
Pumped hydro storage	63%	62%	67%	62%	61%	69%	61%	64%	71%
Natural gas	61%	65%	61%	51%	56%	62%	66%	59%	62%
Renewable hydrogen	58%	59%	63%	57%	57%	67%	59%	58%	74%
Utility scale batteries	50%	51%	53%	52%	49%	55%	51%	52%	62%
Advanced nuclear	39%	41%	41%	31%	38%	44%	43%	38%	48%

Q15: How strongly do you support or oppose each of the following resources to balance intermittent clean resources? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.*

Under what conditions do you support the use of natural gas to produce electricity?

Support for Natural Gas to Produce Electricity

Shown: % Selected

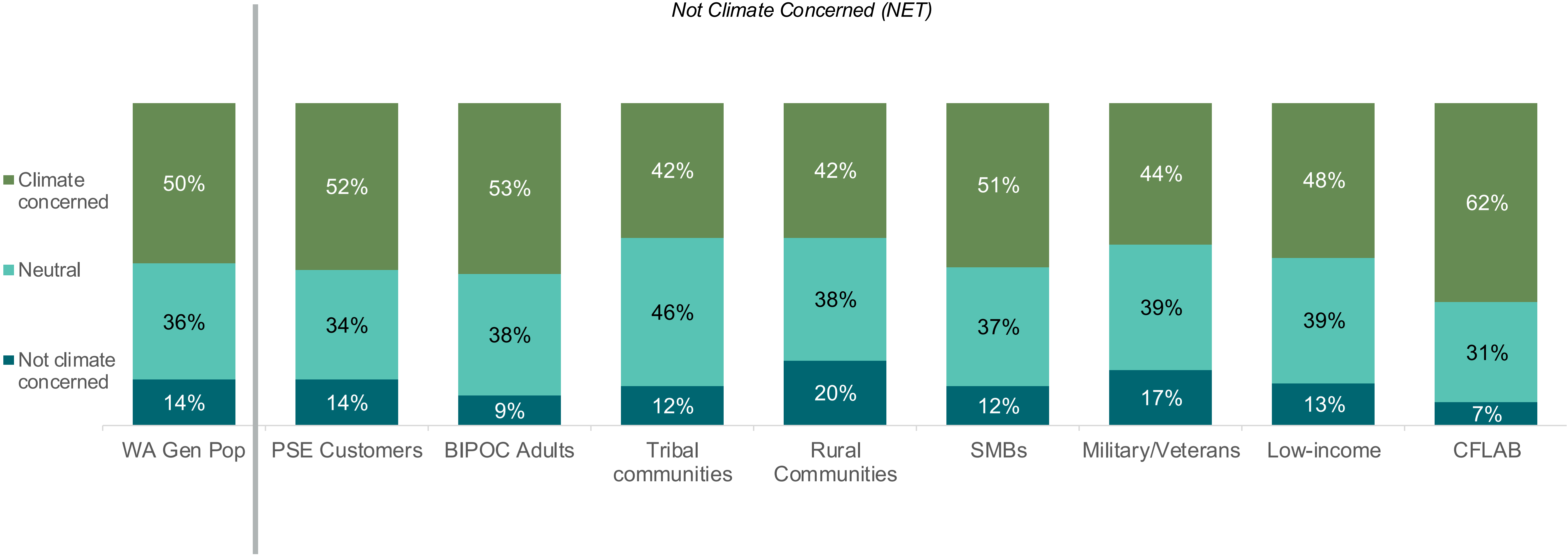
Option	WA Gen Pop	PSE Customers	BIPOC Adults	Tribal Communities	Rural Communities	SMBs	Military / Veterans	Low-income	Communities Facing Language Access Barriers
I support using natural gas if used to augment wind and solar when not those resources are less available (e.g., low wind, low sunlight)	50%	51%	48%	42%	48%	55%	55%	49%	41%
I support using natural gas if it is the cheapest option and will help keep electric bills low	48%	50%	48%	38%	46%	47%	48%	48%	48%
I support using natural gas if used to meet peak loads (for example a cold winter night or hot summer day)	45%	46%	45%	40%	43%	45%	48%	44%	46%
I support using natural gas if utilities offset greenhouse gas emissions (e.g., purchase carbon credits)	35%	36%	39%	35%	30%	37%	37%	35%	36%
N/A – None of the above	8%	7%	7%	11%	12%	4%	5%	9%	9%

Q16: Under what conditions do you support the use of natural gas to produce electricity? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.*

On a scale of 1-10, where 1 is not at all concerned and 10 is extremely concerned, how concerned or not concerned are you about climate change?*

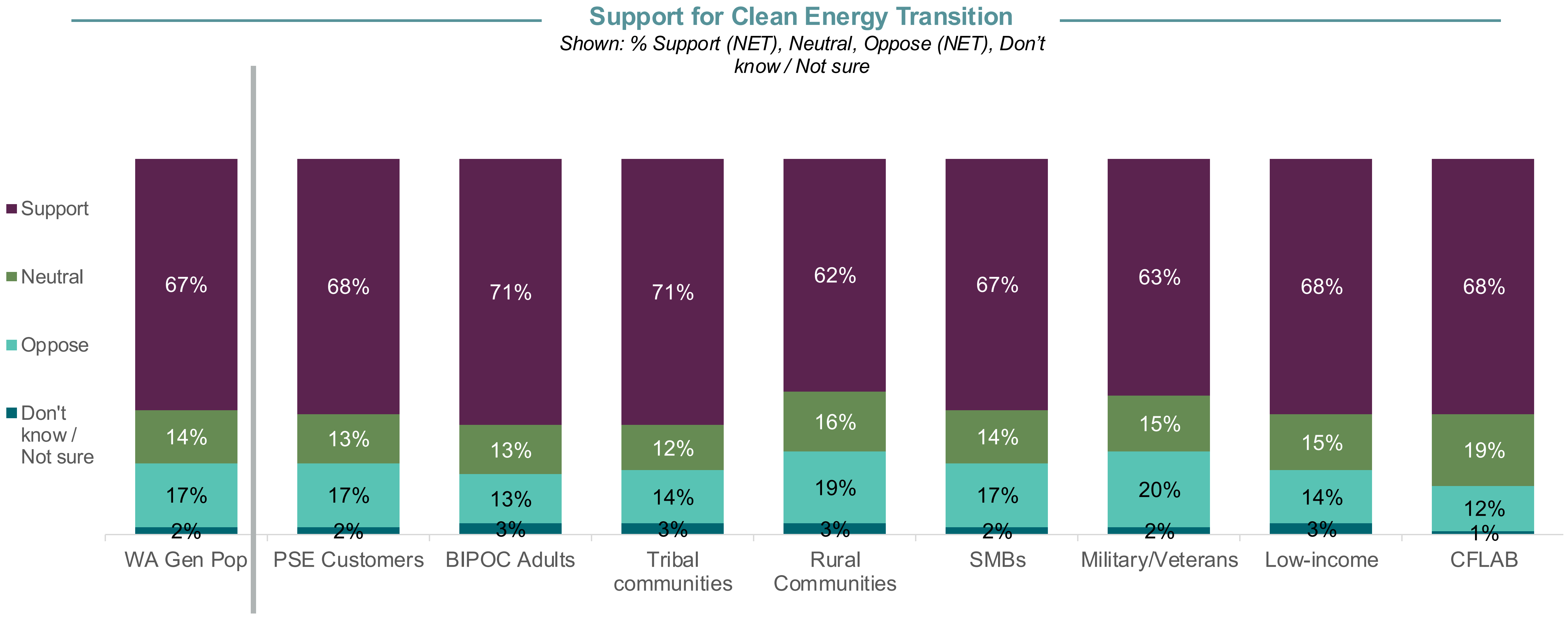
Climate Change Concern

Shown: % Climate Concerned (NET), Neutral (NET), Not Climate Concerned (NET)



Q10: On a scale of 1-10, where 1 is not at all concerned and 10 is extremely concerned, how concerned or not concerned are you about climate change? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65*, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.

Based on what you know or what you have read, do you personally support or oppose this clean energy transformation?



Q12: Based on what you know or what you have read, do you personally support or oppose this clean energy transformation? Base sizes: Gen Pop n=1501, PSE Customers n=956, BIPOC Adults n=490, Tribal Communities n=65, Rural Communities n=339, SMBs n=308, Military Communities and Veterans n=374, Low Income n=1089, Communities Facing Language Access Barriers n=85*. *Small sample size.*

Puget Sound Energy Resource Adequacy Study

RPAG Meeting

September 2025

Arne Olson, Senior Partner
Aaron Burdick, Director
Michaela Levine, Senior Managing Consultant
Ritvik Jain, Senior Consultant
Bill Wheatle, Managing Consultant

Energy+Environmental Economics

Agenda

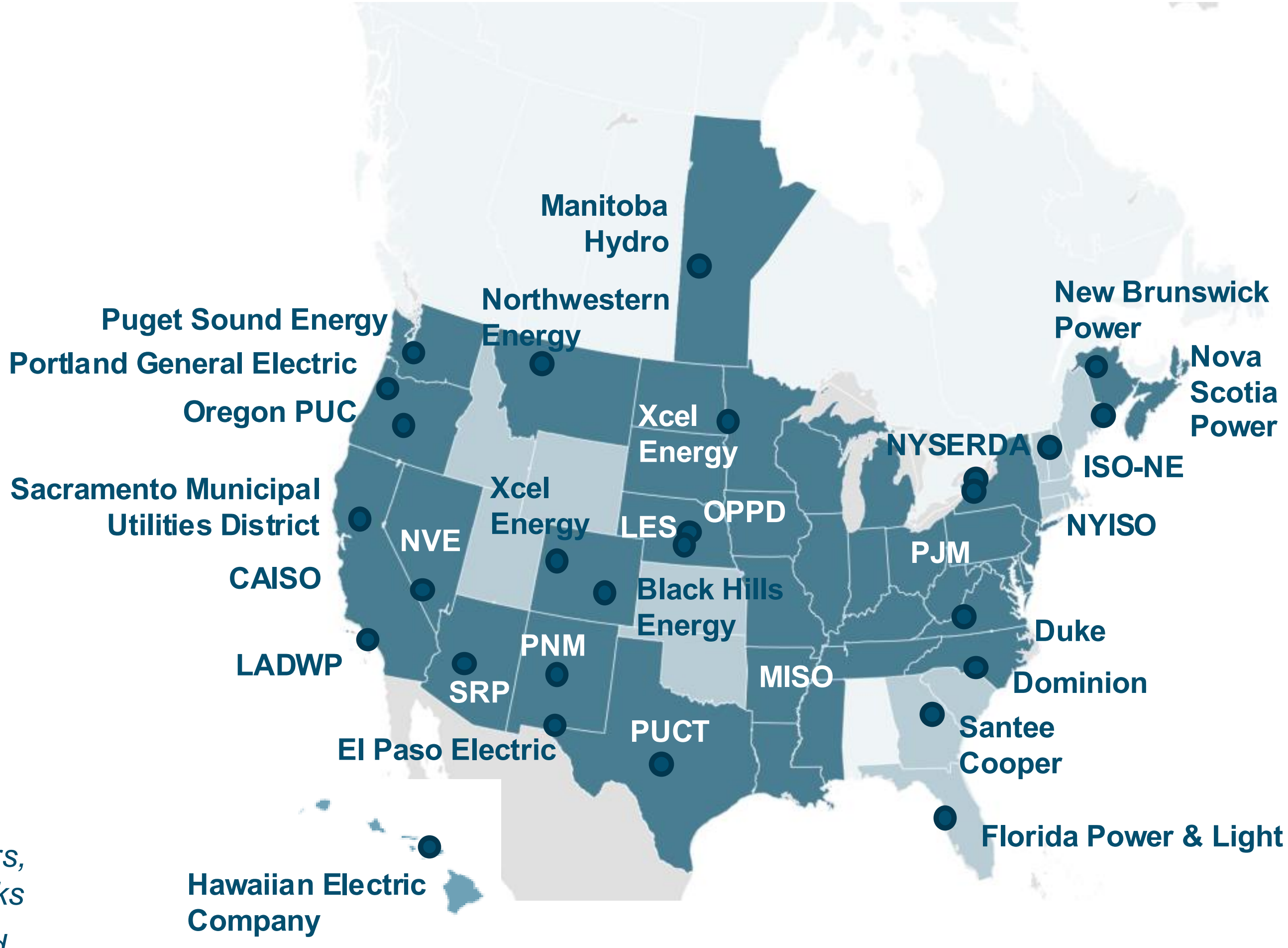
- **Background on resource adequacy**
- **Changes in the 2027 Integrated System Plan (ISP)**
- **Planning reserve margin (PRM), capacity shortfall, and effective load carrying capability (ELCC) results**
  - Comparison of 2027 ISP to 2025 Analysis

E3's Experience Performing Resource Adequacy Studies

+ E3 has performed resource adequacy studies and advised entities on resource adequacy across North America

+ E3 has developed a proprietary loss of load probability model, RECAP, to perform resource adequacy studies

+ E3 performed a resource adequacy study for PSE's 2023 Electric Progress Report (EPR) and the 2025 Analysis



States where E3 has provided direct support to utilities, market operators, and/or state agencies to perform RA modeling or develop RA frameworks

Areas where E3 has worked with other clients to examine issues related to resource adequacy

Background on Resource Adequacy

Energy+Environmental Economics

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"

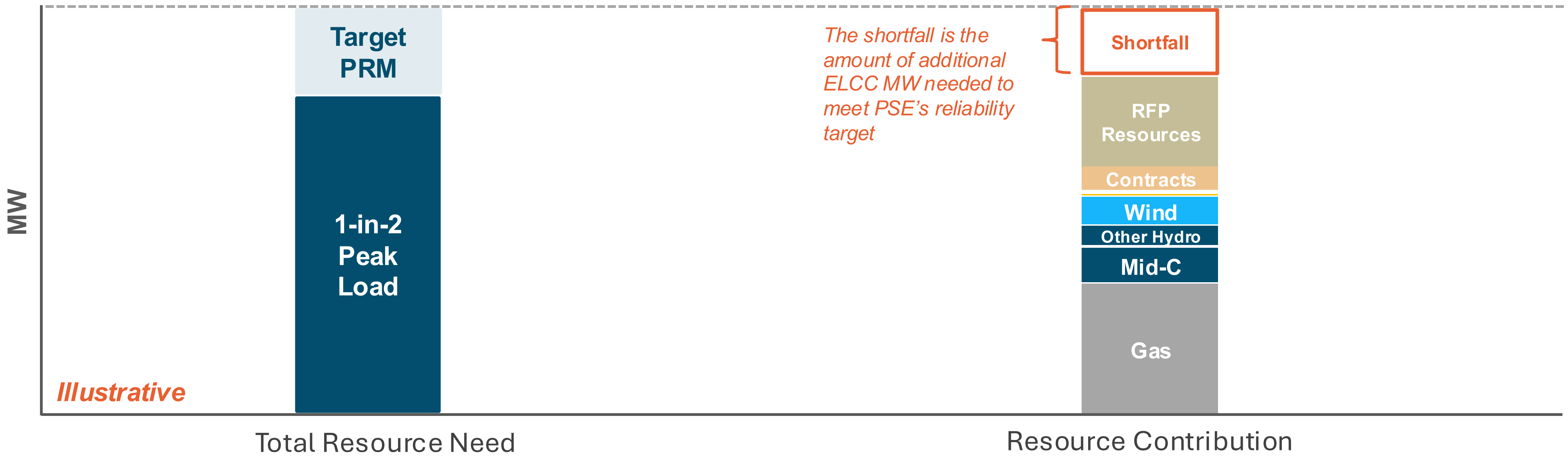
Measured as % above PSE's expected peak load

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"

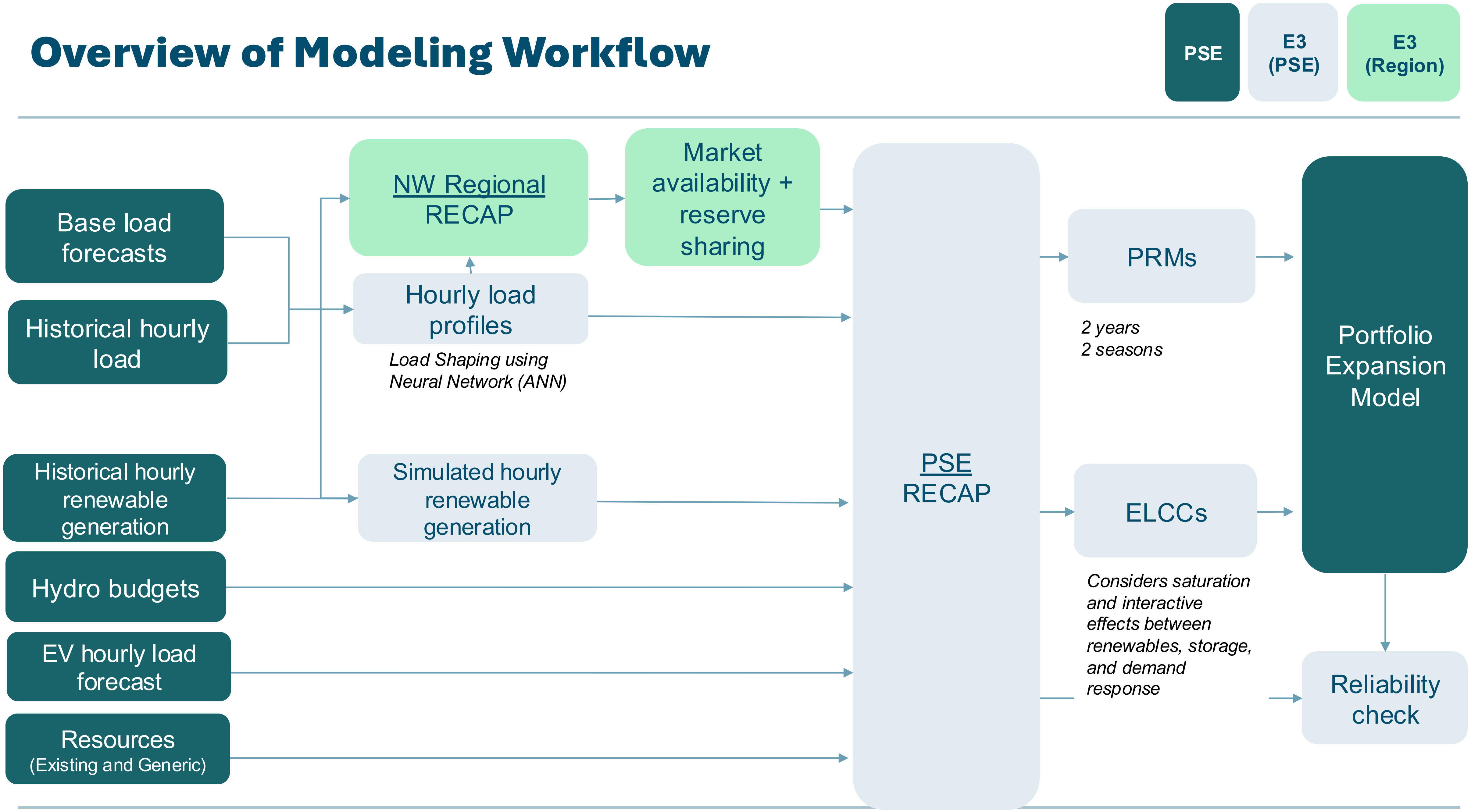
Measured as % of nameplate capacity



Changes in the 2027 ISP

Energy+Environmental Economics

Overview of Modeling Workflow

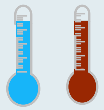


Overview of Methodology Changes from 2025 Analysis to 2027 ISP

Input / Method	2025 Analysis	2027 ISP	Significance
Hourly load profiles	PSE profiles using climate informed temperature data from NWPCC	E3 profiles using detrended historical temperature data (1979-2022)	Moderate impact Increased winter need and decreased summer need
Renewable profiles	Synthetic renewable generation profile produced by DNV	Renewable profiles generated from NREL datasets correlated with historical weather (and load) conditions	Low to moderate impact Impacts need and solar/wind ELCCs
Market availability	GENESYS and WPCM	PGP Regional RA study's RECAP model	Moderate impact Summer contribution decreases
RA Accounting Framework	Installed Capacity Mid-C and Thermal accredited at nameplate; all other resources accredited with ELCCs	Perfect Capacity All resources accredited with ELCCs	No impact on capacity shortfall. Lower PRM %.

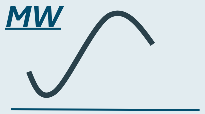
RECLAIM: Neural Net Model for Base Load Shaping

Hourly Historical Temperature

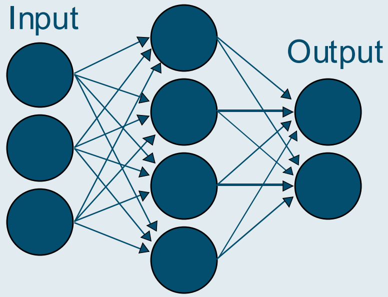


Datetime /Holiday Index

Hourly Historical Loads



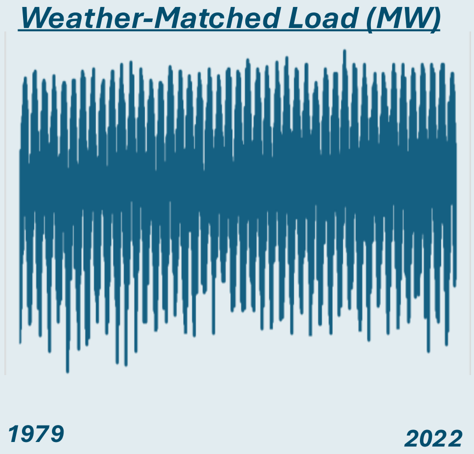
Neural Network



Hourly Climate Adjusted Temperature

Datetime / Holiday Index

Hourly Simulated Load based on adjusted weather



Training Data

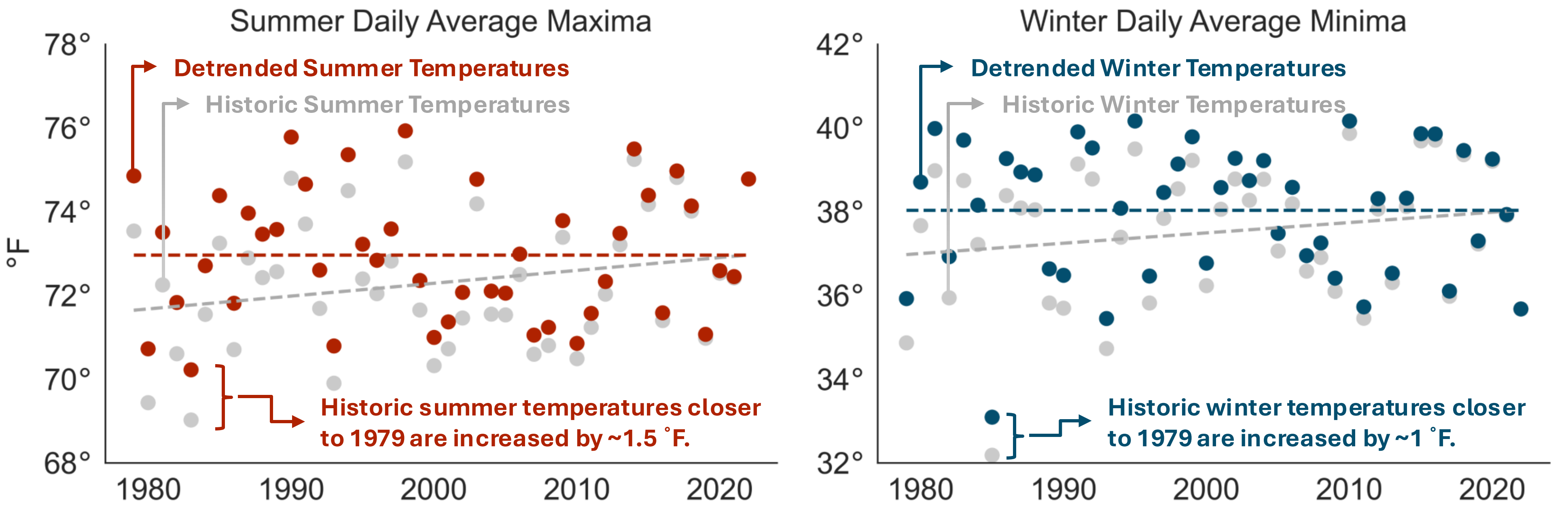
Inference Data

1979 2015 2022

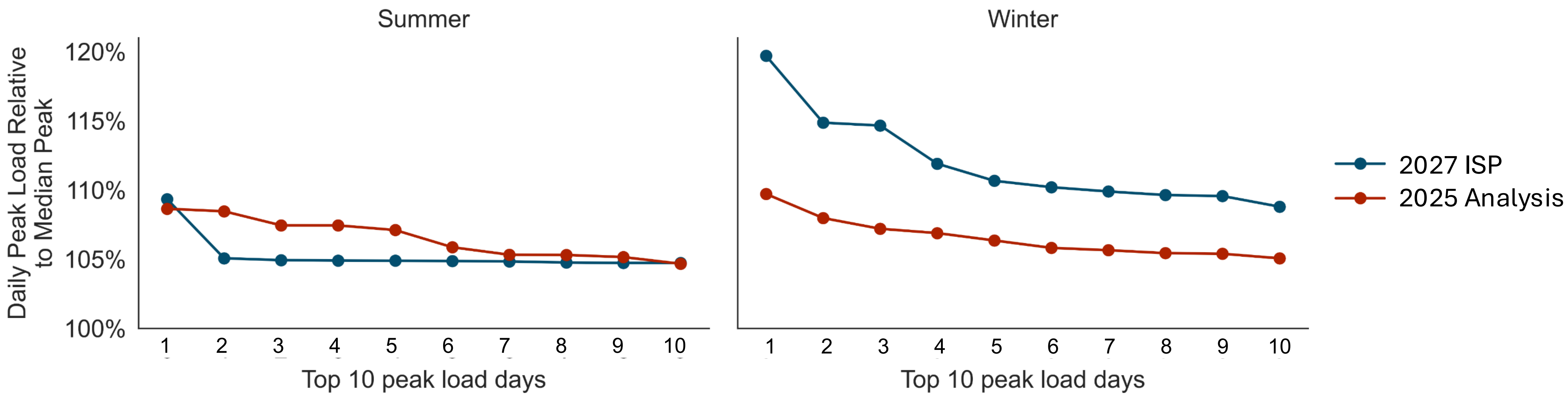
Seasonal temperature detrending

+ **Daily average summer maxima and winter minima are adjusted upwards linearly to account for the impact of climate change on each season's temperature**
  - This will generally *decrease* seasonal peak temperature variability across the entire temperature record

Impact of Seasonal Temperature Detrending on Seasonal Daily Average Extrema



Daily Peak Baseload Variability



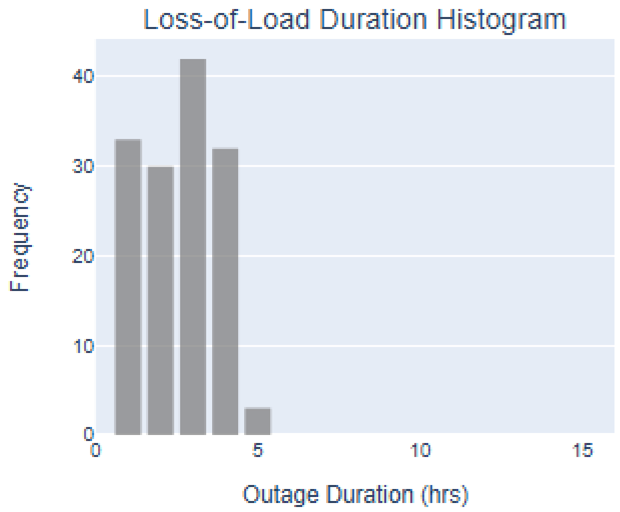
Summer peak load variability in the 2027 ISP is similar to the 2025 analysis

Winter peak load variability for the 2027 ISP is much larger than the 2025 analysis indicating a wider range of temperatures

25 Analysis vs 27 ISP Loss of Load Duration Distribution

2031 Winter

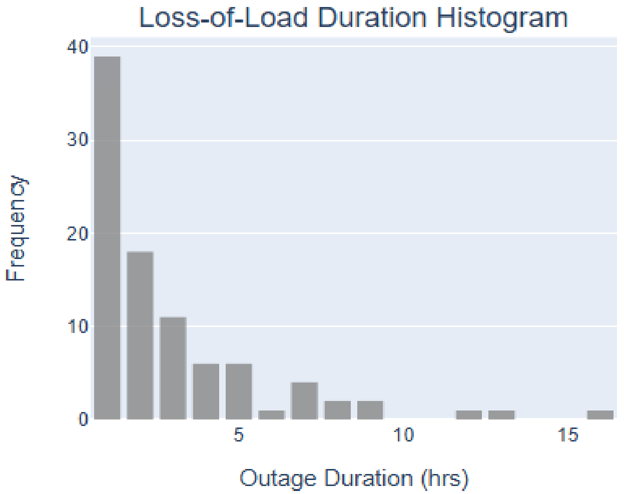
- Compared to the 25 Analysis, 27 ISP sees **much longer loss of load events**
- Early morning as well as late evening loss of load is observed in both 25 Analysis & 27 ISP
- In 27 ISP, however, the morning risk extends all the way through to the evening leading to longer durations
- Additionally, consecutive days of loss-of-load are also observed in 27 ISP



2025 Analysis, Winter

Model C

Loss of Load Events in the 2025 analysis are generally short duration (<5 hours)



2027 ISP, Winter

Increasing frequency of longer loss of load events in 2027 ISP

Total Resource Need and PRM

Energy+Environmental Economics

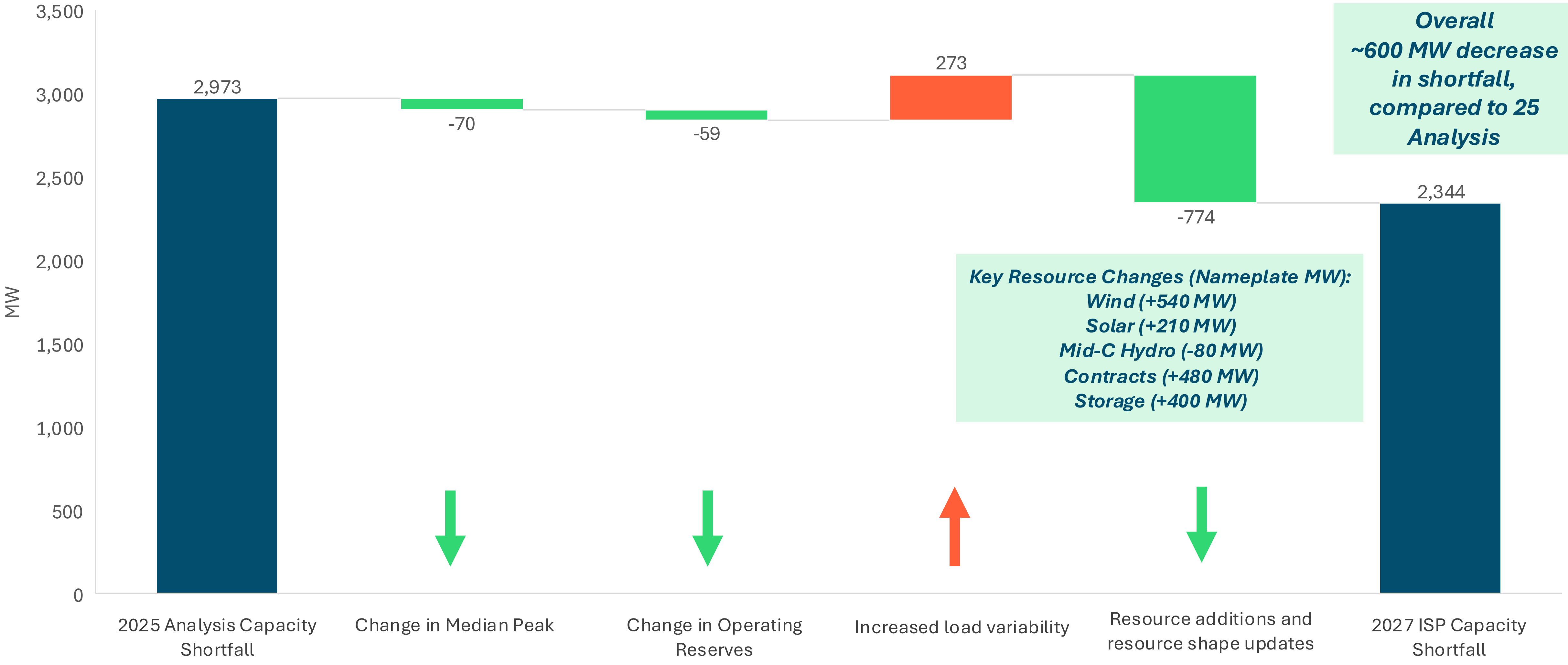
2027 ISP Input Data Change Log Preview

Components	2025 IRP Analysis	2027 ISP	Directional Impact on Capacity Shortfall
Load forecast	**5,323 MW (Winter)** **4,903 MW (Summer)**	**5,253 MW (Winter)** **4,594 MW (Summer)**	↓ Shortfall decreases both seasons
Interannual load variability (1-in-20)	**12% Summer** **9% Winter**	**6% Summer** **13% Winter**	↓Decrease in Summer, ↑ Increase in Winter
Operating Reserves	7.1%	6%	↓ Total Resource Need both seasons
Small Contracts	68 MW of Nameplate	Additional 500 MW of firm thermal + 50 MW of Brookfield Hydro	↓ Capacity shortfall decreases both seasons
New Wind and Solar Resources	1,765 MW Nameplate	2,452 MW Nameplate	↓ Capacity shortfall decreases both seasons
Mid-C & Other Hydro	~1GW Nameplate in Summer & Winter	Decrease in Nameplate by 100MW and no Wells in 2037	↑ Capacity shortfall increases both seasons
Market availability	Taken from WPCM Model	Taken from E3's PGP RA Model	↑ Generally seeing higher market curtailment

*Other data changes like improved modeling of thermal outages in RECAP 3.0, updates to renewable profiles, etc. have smaller impacts on system reliability needs, therefore are not listed here

27 ISP vs. 25 Analysis Capacity Shortfall Comparison

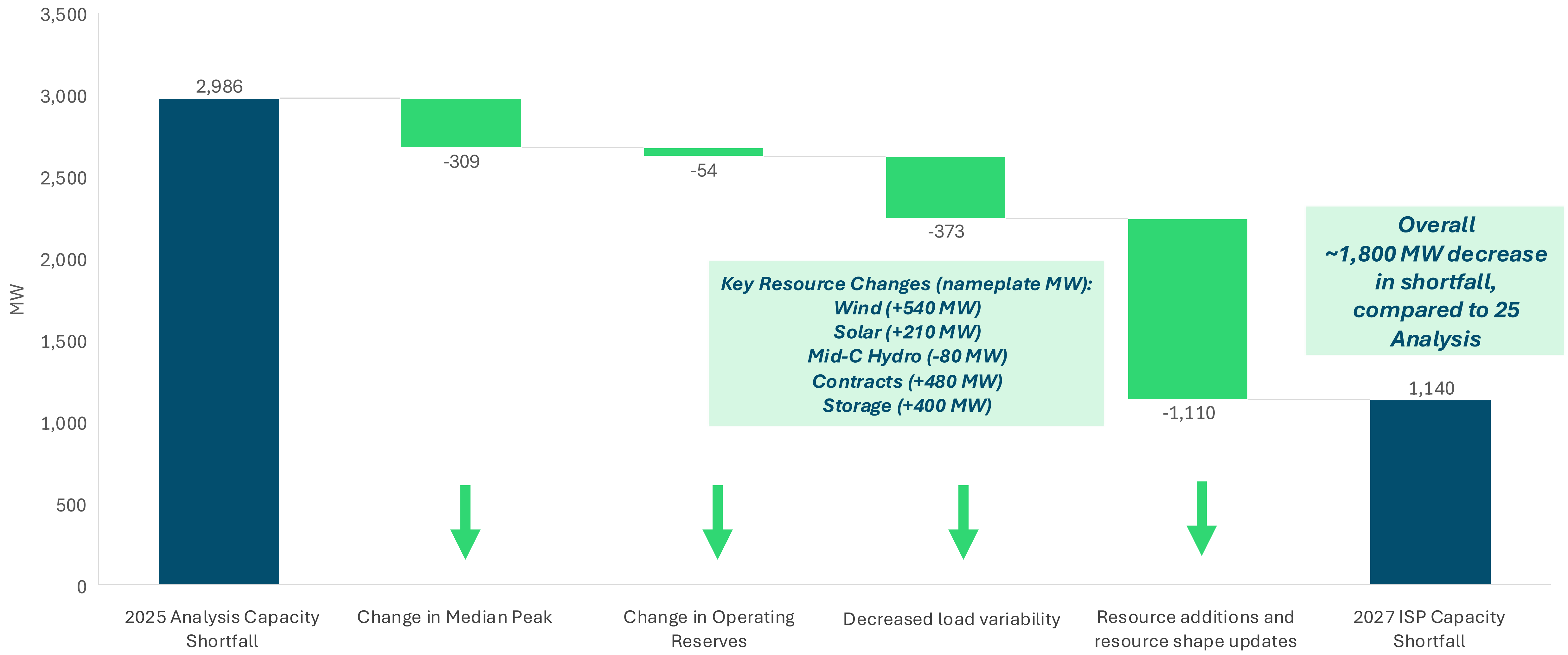
2031 Winter



Overall ~600 MW decrease in shortfall, compared to 25 Analysis

27 ISP vs. 25 Analysis Capacity Shortfall Comparison

2031 Summer



2025 Analysis and 2027 ISP Capacity Shortfall Comparison

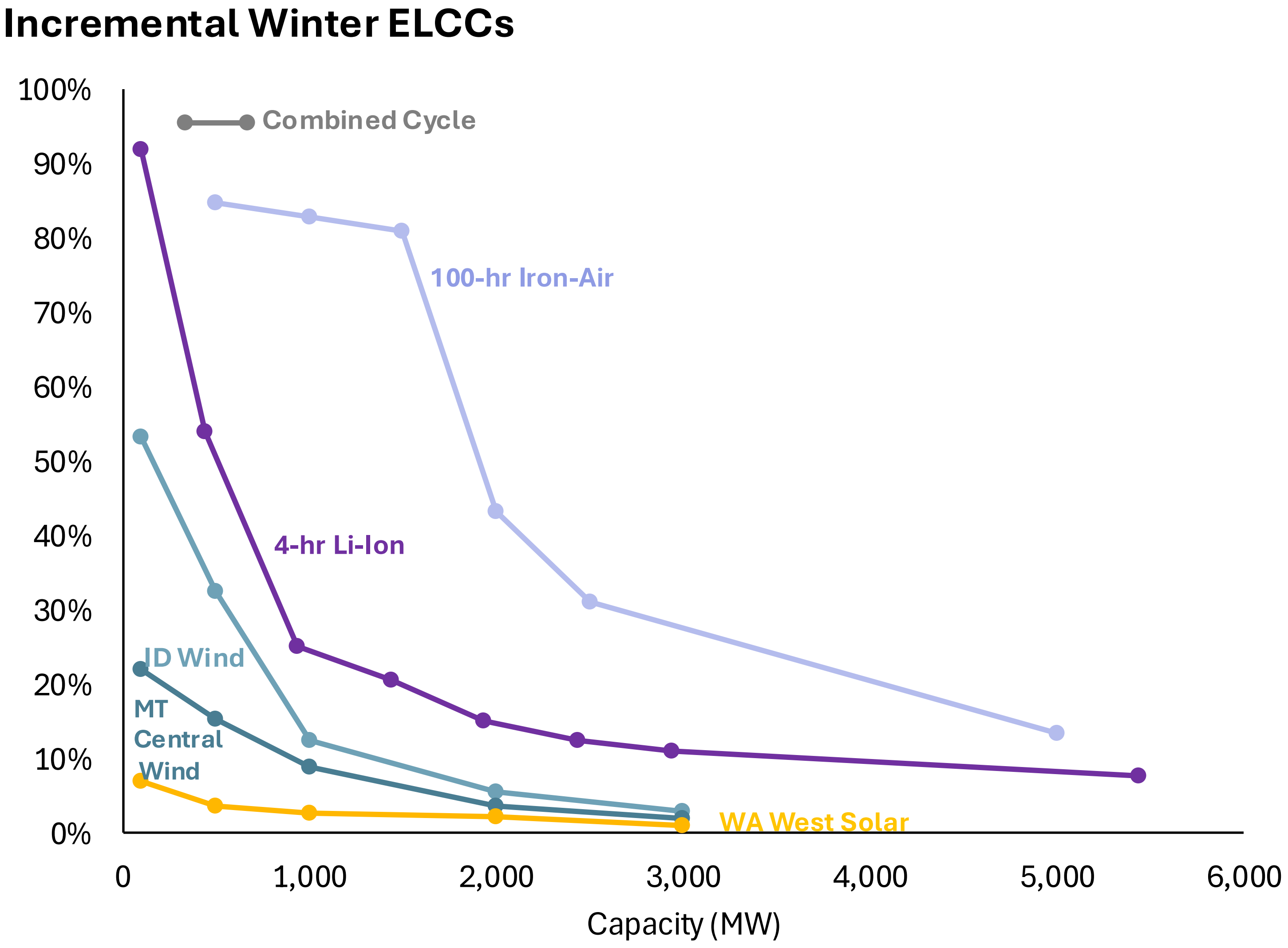
- **Major drivers of the change in <u>capacity shortfall</u> include:**
  - **Procurement** of 1.5 GW of new resources decreases shortfall
  - Increased **load variability** in winter increases shortfall; lower load variability in summer decreases shortfall
- **Minor drivers include lower peak load and lower operating reserve requirement**

	2025 Analysis		2027 ISP		
	Winter	Summer	Winter	Summer	
1-in-2 peak	5,323	4,903	5,253	4,594	*Conservation embedded in forecast*
PRM (%)	22%	24%	20%	12%	*PCAP PRMs lower than ICAP PRMs. 2027 ISP load variability increased in winter and decreased in summer*
Total Resource Need	6,487	6,095	6,327	5,133	
Capacity shortfall (MW)	**1,622**	**1,648**	**928** (↓694)	**345** (↓1,303)	*Procurement significantly reduced capacity shortfall*
Capacity short (without market) (MW)	**2,973**	**2,986**	**2,344** (↓629)	**1,140** (↓1,846)	

Generic Resource ELCCs

Energy+Environmental Economics

ELCCs: Snapshot of all Generic Resources

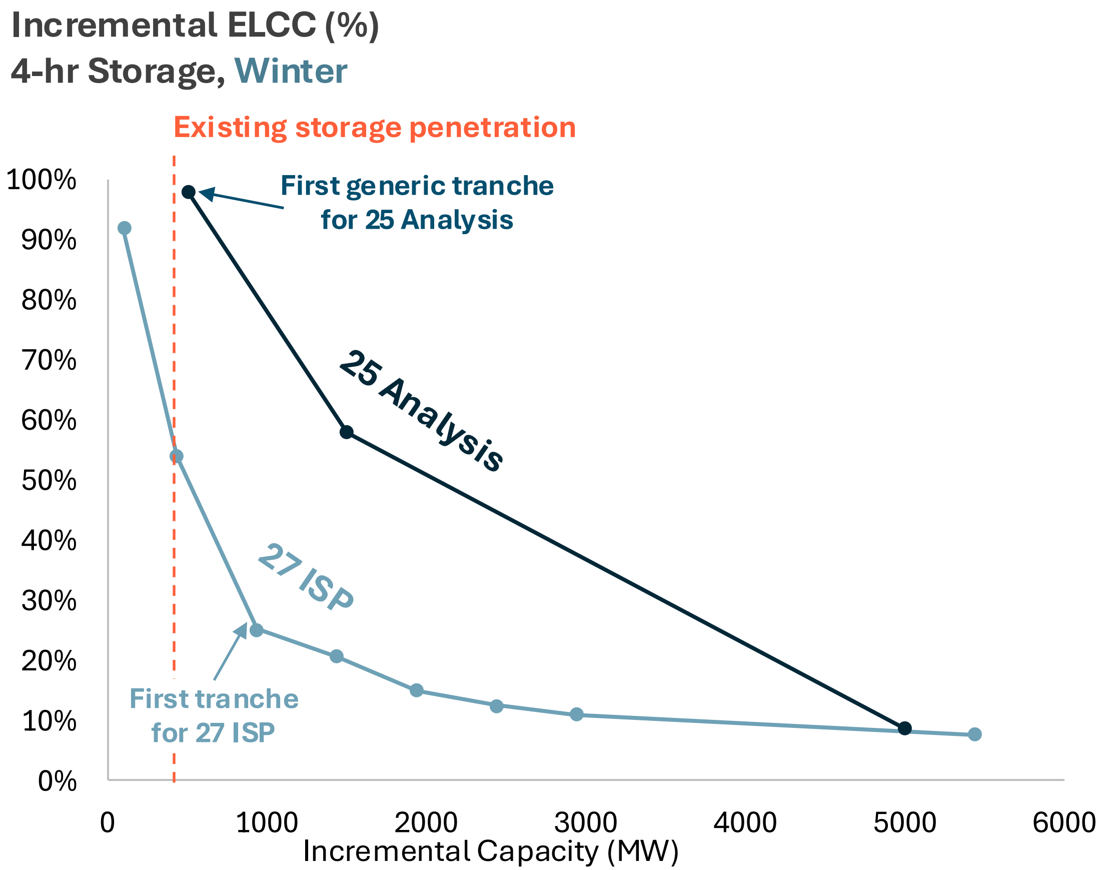


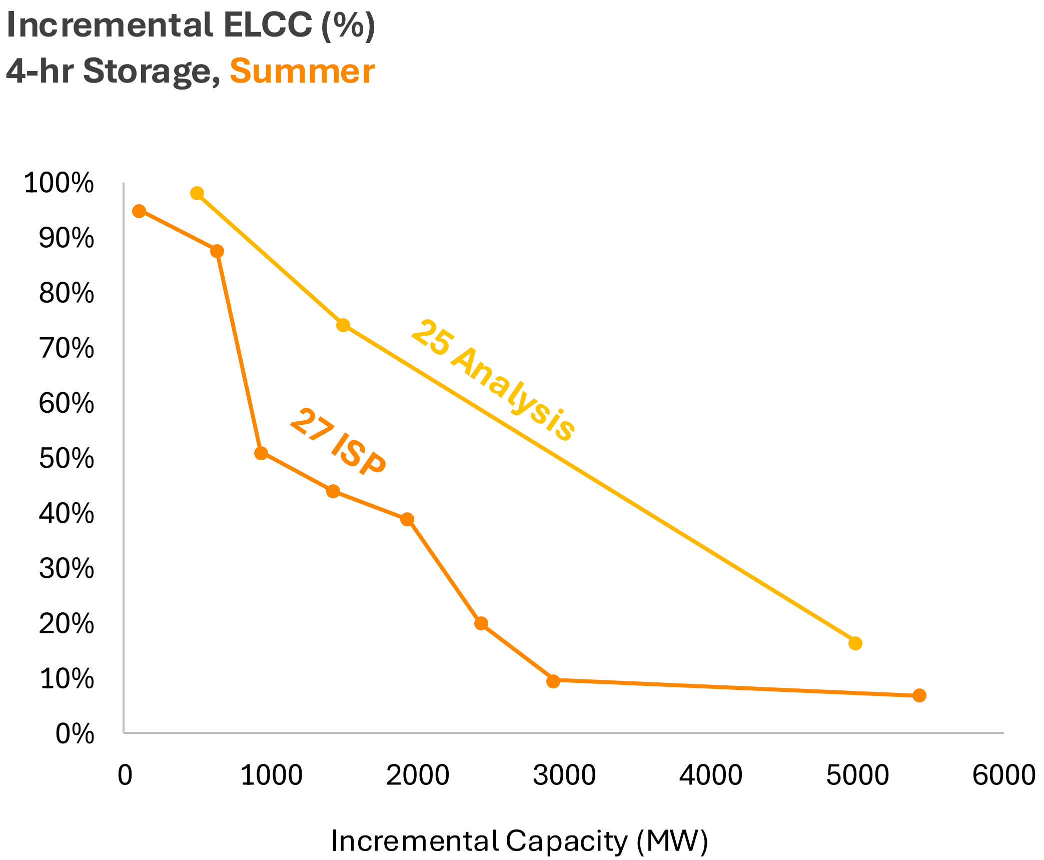
- Firm resources have high ELCCs
- Variable and energy limited resources show declining ELCCs with increasing penetration
- Wind ELCCs vary by resource type but all show steep declines in ELCC with penetrations >1,000 MW.
- Solar ELCCs generally low during winter

Note: Storage ELCC curve is incremental to 0 MW of storage in the portfolio. PSE has 437 MW of existing storage in 2031.
Winter: November - March

27 ISP vs. 25 Analysis - Incremental ELCC

4hr – Storage



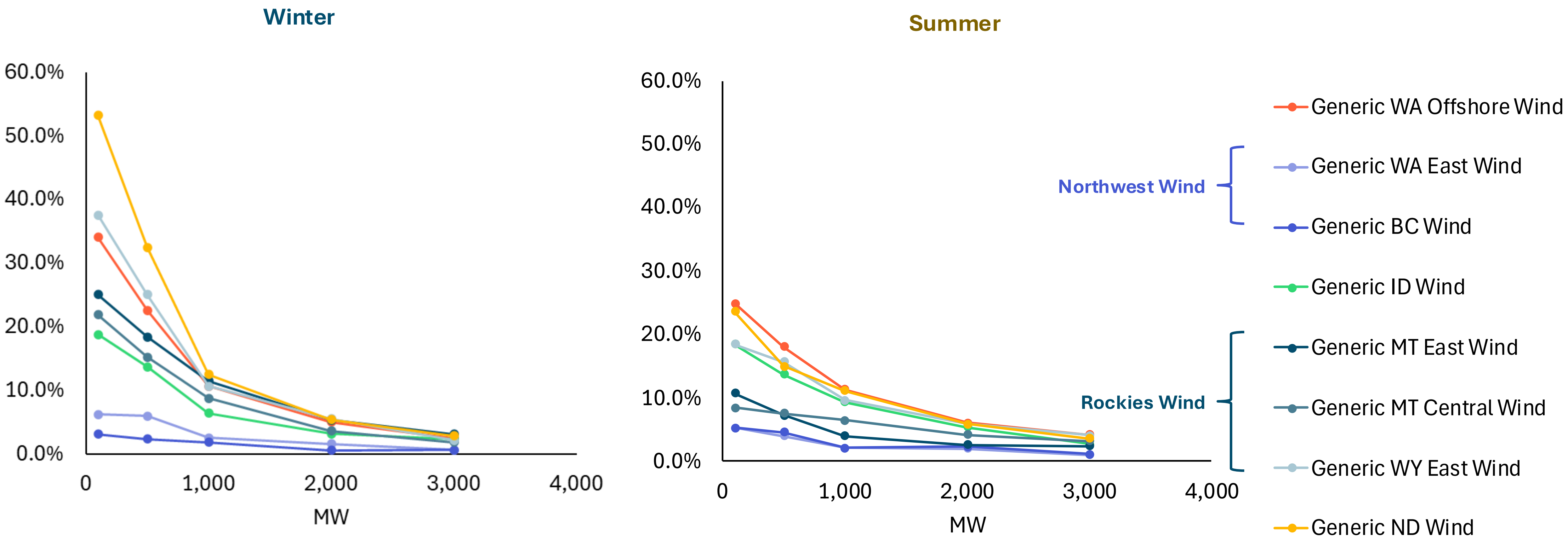


2027 ISP storage ELCCs are lower due primarily to the change in load shapes and market profiles (leading to longer loss-of-load events) and secondarily due to increased forced outage rate (2% vs. 7%)

Winter: November - March

Generic Wind ELCCs

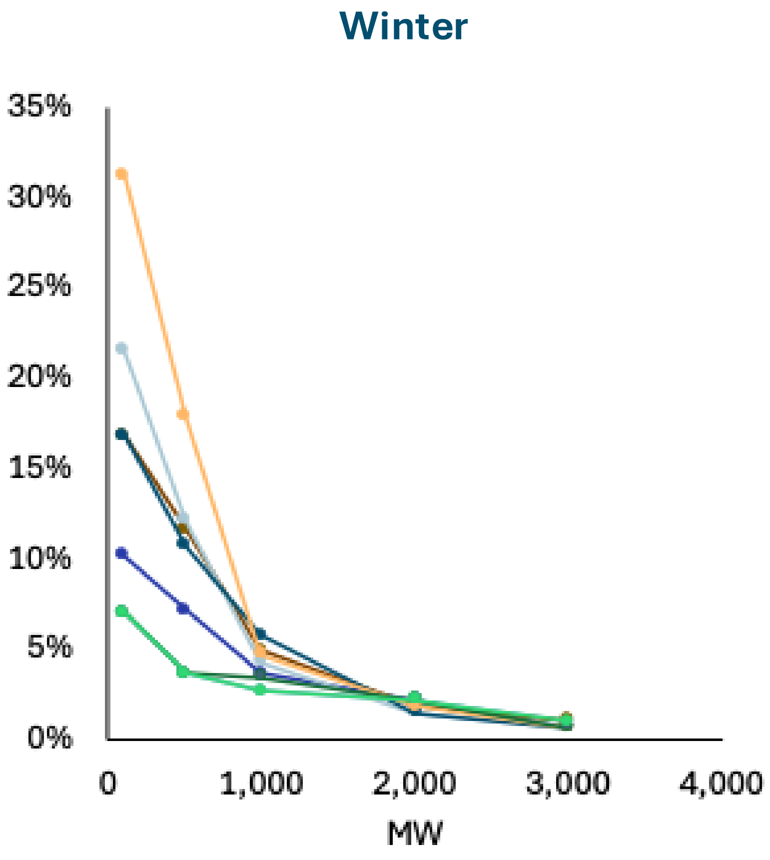
+ **Wind ELCCs decline rapidly with installed capacity, with ELCCs being lowest during the summer**

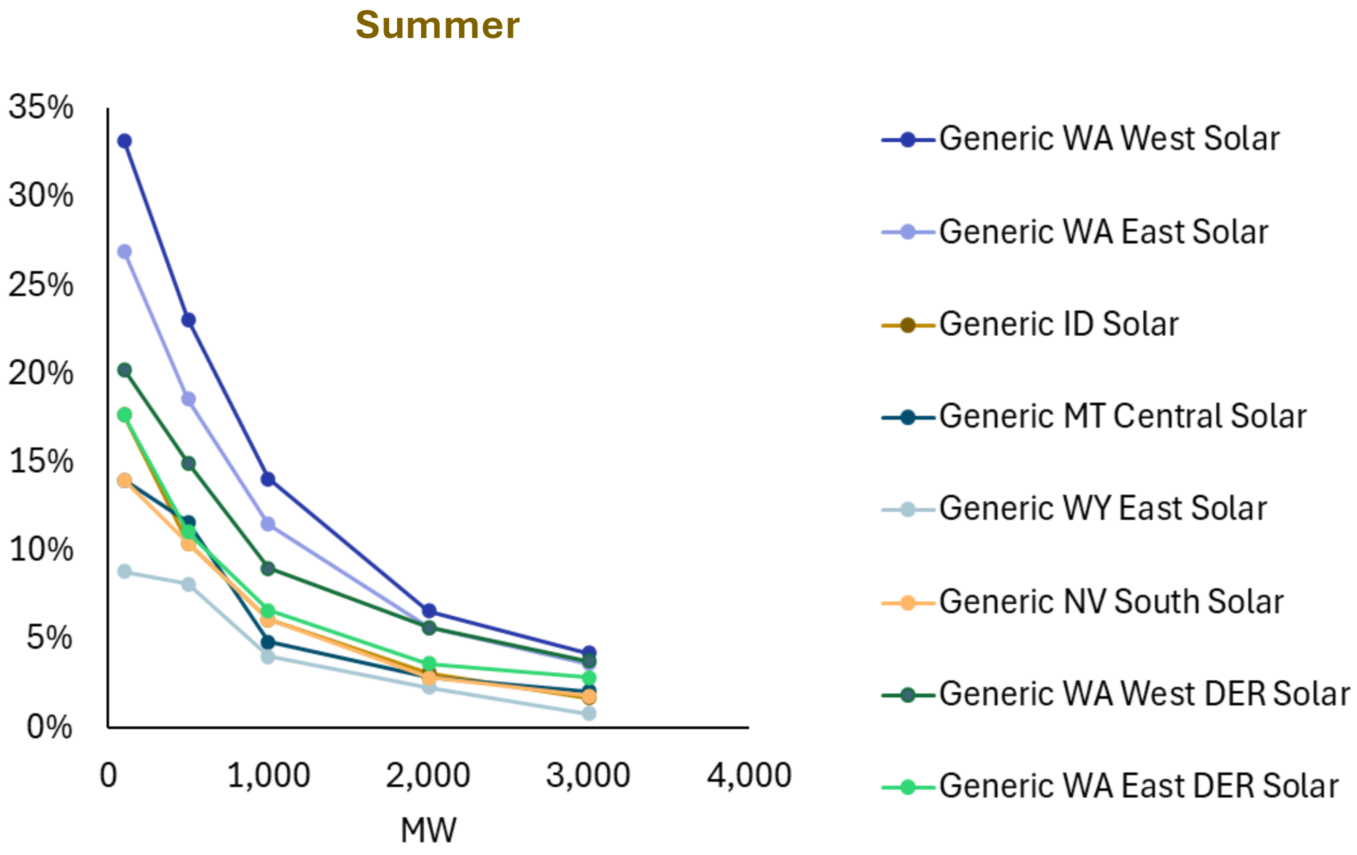


 Winter: November – March, Summer: April - October

Generic Solar ELCCs

+ Solar resources typically have better summer ELCCs compared to winter





 Winter: November – March, Summer: April - October

Change in Generic Renewable Resource ELCCs

- **Differences in renewable ELCCs are driven primarily by the update in renewable generation profiles**
  - Renewable generation profiles in the 2025 IRP Analysis synthetic profiles generated by DNV.
  - In the 2027 ISP, E3 develop renewable profiles based on historical weather conditions that are correlated with load conditions.
    - Wind profiles generated from NREL's Wind Toolkit and NOAA's Biased-Corrected High-Resolution Rapid Refresh (HRRR).
    - Solar profiles generated from NREL's SAM and NSRDB.
- **Additional solar and wind procurement since 2025 Analysis also impacts ELCC results.**

ELCC of 100 MW of Generic Resource Addition (%)

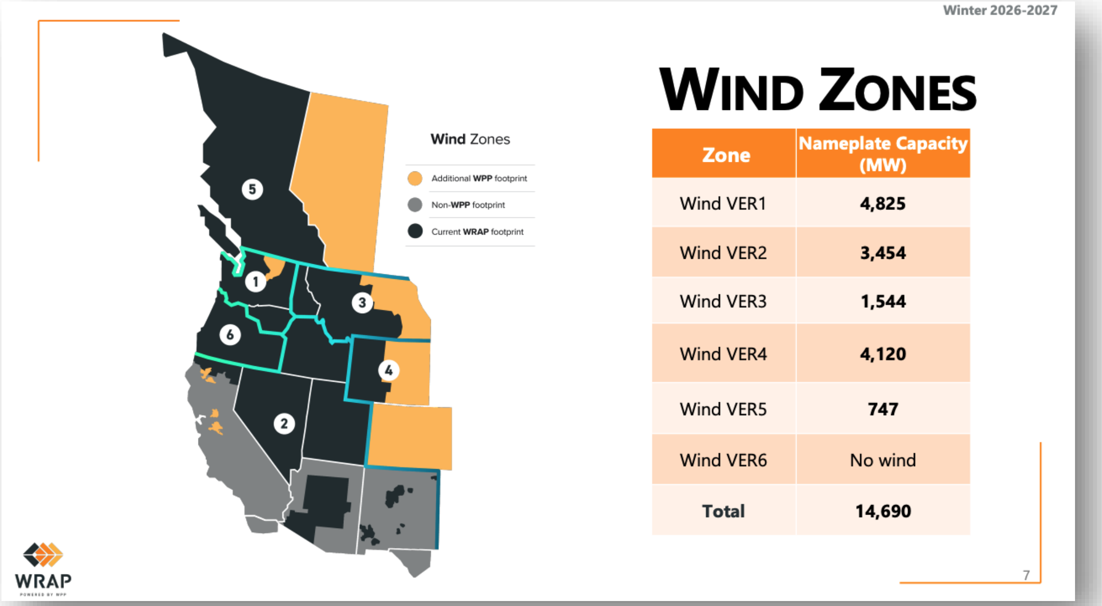
Category	Resource	Winter		Summer	
		2025 IRP	2027 ISP	2025 IRP	2027 ISP
Wind	WA Offshore Wind	35%	34%	38%	25%
	WA East Wind	14%	6%	6%	5%
	BC Wind	39%	3%	15%	5%
	ID Wind	13%	19%	19%	18%
	MT East Wind	31%	25%	21%	11%
	MT Central Wind	31%	22%	21%	8%
	WY East Wind	44%	38%	36%	18%
Solar	WA East Solar	4%	10%	51%	27%
	WA West Solar	2%	7%	48%	33%
	ID Solar	2%	17%	30%	18%
	WY East Solar	2%	21%	22%	9%
	MT Central Solar	2%	17%	22%	14%
	WA West DER Solar	2%	7%	27%	20%
	WA East DER Solar	2%	10%	27%	18%

Note: Table shows the the ELCC of 100 MW of wind or solar incremental to the existing portfolio modeled in the 25 IRP and the 27 ISP. The existing portfolios have different solar, wind, and other resource capacities leading to different saturation effects observed in the first 100 MW incremental tranche of generic resources.

Winter: November – March, Summer: April - October

WRAP Qualified Capacity Contribution Metric Forecast

- To aid in long term planning, E3 will produce a forecast of WRAP RA metrics for PSE.
- Study details:
  - Study years: 2030, 2035, 2045
  - Metrics:
    - *Seasonal* WRAP Qualified Capacity Contribution (for each zone)
    - WRAP *seasonal* PRM
    - Marginal ELCCs
  - Resources:
    - Wind for each resource zone
    - Solar for each resource zone
    - 4-hr
    - 10-hr storage
    - Hydro



Zone	Nameplate Capacity (MW)
Wind VER1	4,825
Wind VER2	3,454
Wind VER3	1,544
Wind VER4	4,120
Wind VER5	747
Wind VER6	No wind
Total	14,690

	Average ELCC	Marginal ELCC
Hydro modeled as firm	WRAP Methodology	
Hydro modeled with budgets		

Incorporating the resource adequacy study

Elizabeth Hossner

Manager, Resource Planning & Analysis, PSE

September 30, 2025

PUGET SOUND ENERGY

How is the RA study used?

- The Resource Adequacy Study produces a planning reserve margin (PRM) and effective load carrying capacity (ELCC) for all resources along with saturation curves for new resources.
- The data is input into PSE’s portfolio model to generate a portfolio that meets the capacity requirements subject to the constraint of the ELCC for each resource.

Electric modeling process

Input Database

- Demand Forecast
- PRM and ELCCs
- CETA Requirement
- Hydro Generation
- Wind and Solar Shapes
- Electric Price Forecast
- Fuel Prices Forecasts
- Transmission Constraints
- Existing and Generic Resources
- CO_2 Carbon Price Forecast

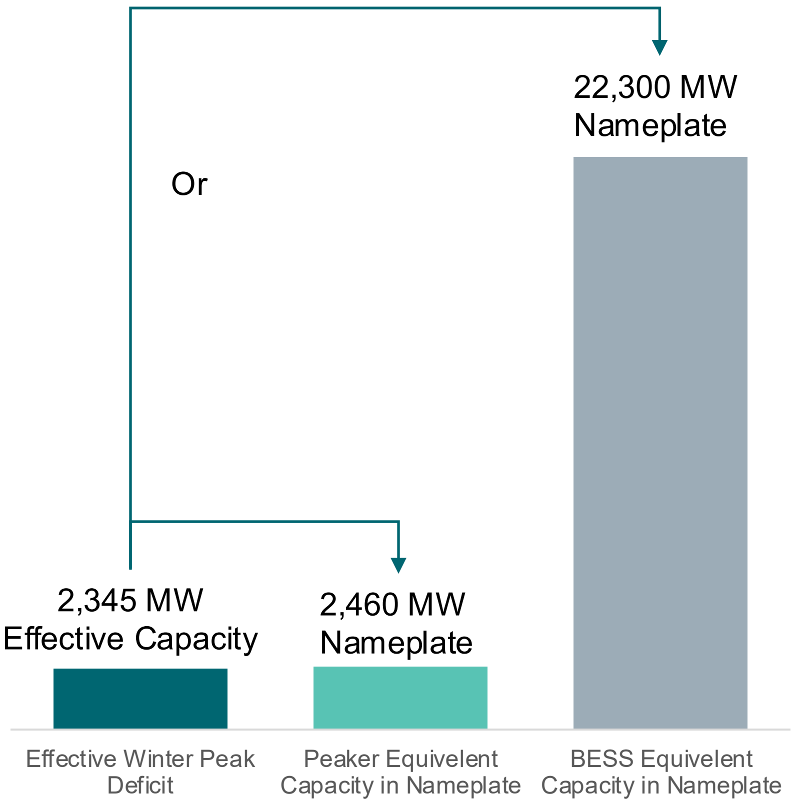
Portfolio Expansion Model

Modeling Approach:
Mixed Integer Linear Programming problem that uses a mix of continuous linear variables and discrete integer variables

Objective Function:
Minimize the total portfolio cost

Subject to constraints:
Resource Characteristics
Transmission Constraints
Hourly Energy Demand
Peak Requirements
Renewable Requirements

What would it take to meet the winter peak requirement?



<u>Effective Load Carrying Capability (ELCC)</u>

The ELCC is calculated through the resource adequacy analysis and is the probability that a resource will be available during an event.

The ELCC is calculated a percent (%) of nameplate.

<u>For Example:</u>

A peaker has an ELCC of 95%

95% * 2,460 MW Nameplate → 2,345 MW effective capacity

A Battery Energy Storage System (BESS) is more complicated since ELCC is based on saturation for limited duration. This example is based on a 4-hour battery.

1
25% = up to 100 MW nameplate

2
16% = 100 MW to 1,500 MW nameplate

3
10% = 1,500 MW +

→ 22,300 MW of 4-hr BESS = 2,345 MW effective capacity

- 100 * 25% = 25 MW effective capacity
- 1500 * 16% = 240 MW

Next steps

September 30, 2025

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.

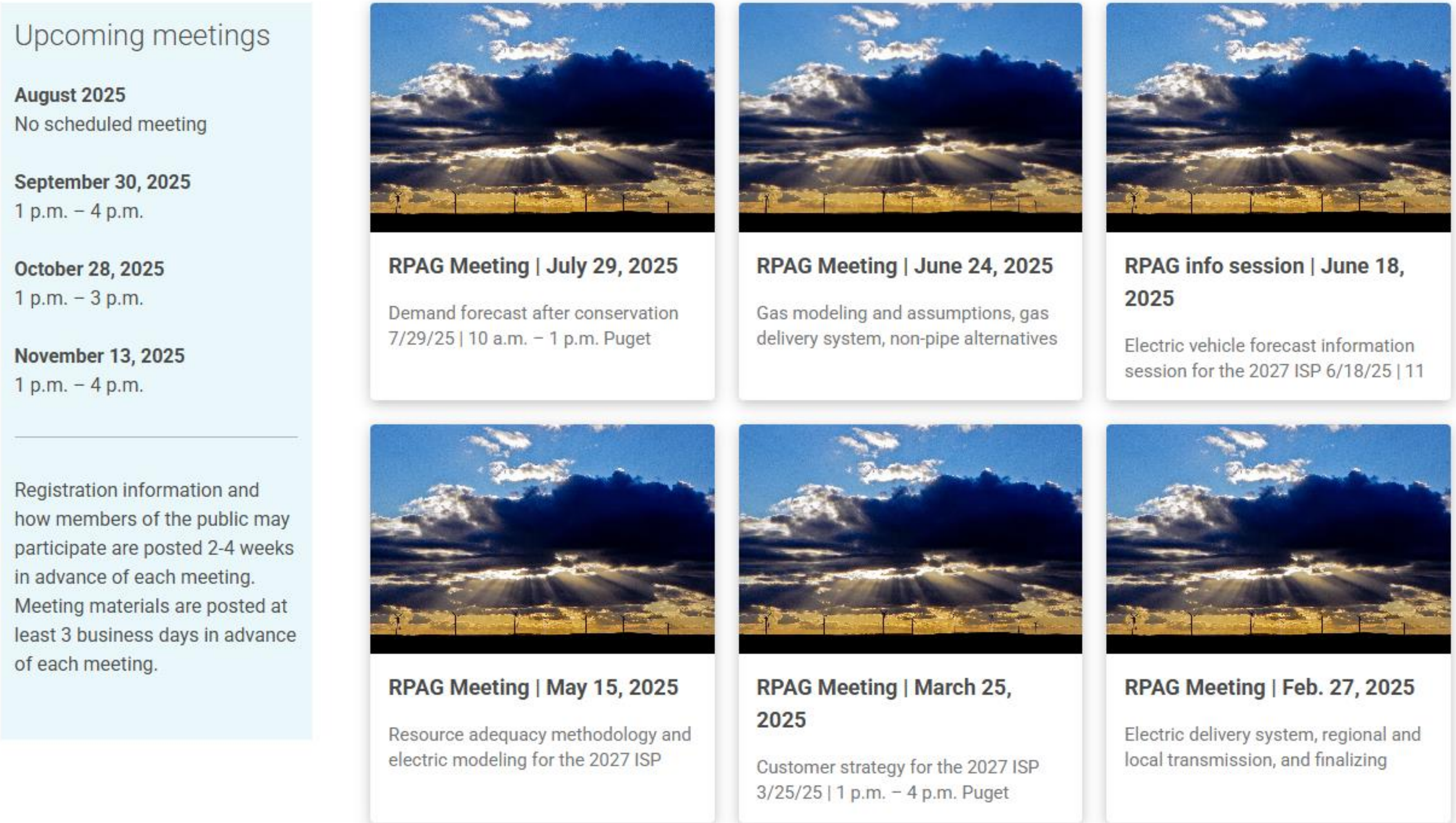
05

Four weeks post meeting

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

Visit our website

- You can find meeting materials, meeting summaries, feedback reports, and links to meeting recordings on the RPAG portion of our clean energy planning website.



Upcoming activities

Date	Activity
October 7, 2025	Feedback form for this meeting closes
October 28, 2025	RPAG meeting
November 13, 2025	RPAG meeting
November 2025 (tent.)	Public webinar
December 2025	No scheduled RPAG meeting

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 the clean energy planning website: cleanenergyplan.pse.com

Public comment opportunity

September 30, 2025

How to participate in public comment opportunity

- Please use the “raise hand” feature 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 with PSE’s response
- Note: This meeting is being recorded, livestreamed, and will be available on YouTube
- You are welcome and encouraged to send written feedback and questions to isp@pse.com

Thank you for joining us!

September 30, 2025

Appendix

Definitions and acronyms

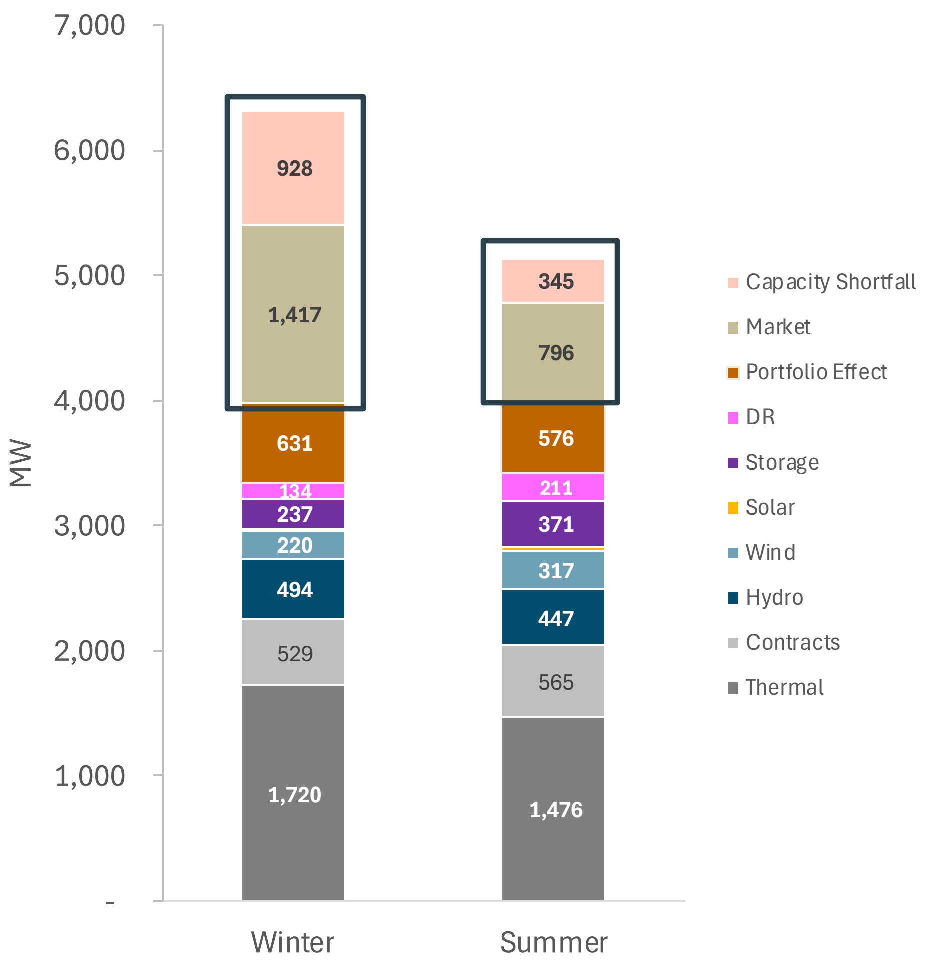
Acronym	Meaning
BIPOC	Black, indigenous, and people of color
CCA	Climate Commitment Act
CETA	Clean Energy Transformation Act
CEIP	Clean Energy Implementation Plan
CETA	Clean Energy Transformation Act
CFLAB	Communities facing language access barriers
CPA	Conservation potential assessment
DER	Distributed energy resources
DR	Demand response
DSP	Delivery system planning

Acronym	Meaning
ELCC	Effective load carrying capability
EV	Electric vehicle
IRP	Integrated Resource Plan
ISP	Integrated System Plan
MW	Megawatt
PRM	Planning reserve margin
RA	Resource adequacy
RPAG	PSE’s Resource Planning Advisory Group
SMB	Small/medium business
TOU	Time of use

Appendix

Energy+Environmental Economics

Load and Resources Table, 2031



		Winter ELCC MW	Summer ELCC MW	
1	Thermal	1,720	1,476	
2	Mid-C	385	371	
3	PSE Hydro (Baker + Snoqualmie)	109	77	
4	Wind	220	317	
5	Solar	17	29	
6	Market	1,417	796	
7	Storage	237	371	
8	DR (Events + TOU + EV)	134	211	
9	Contracts	529	565	
10	Portfolio Effects	631	576	*[11] – Sum of [1 to 9]*
11	**Portfolio ELCC**	5,399	4,788	
12	**1-in-2 Median Peak**	5,253	4,594	
13	**Total Resource Need**	**6,327**	**5,133**	
14	PCAP PRM (%)	**20%**	**12%**	
15	**Capacity Shortfall**	**928**	**345**	*[13] – [11]*
16	**Total Deficit**	**2,345**	**1,141**	*[6] + [15]*

Winter 2031: November 2031 – March 2032, Summer 2031: April 2032 – October 2032

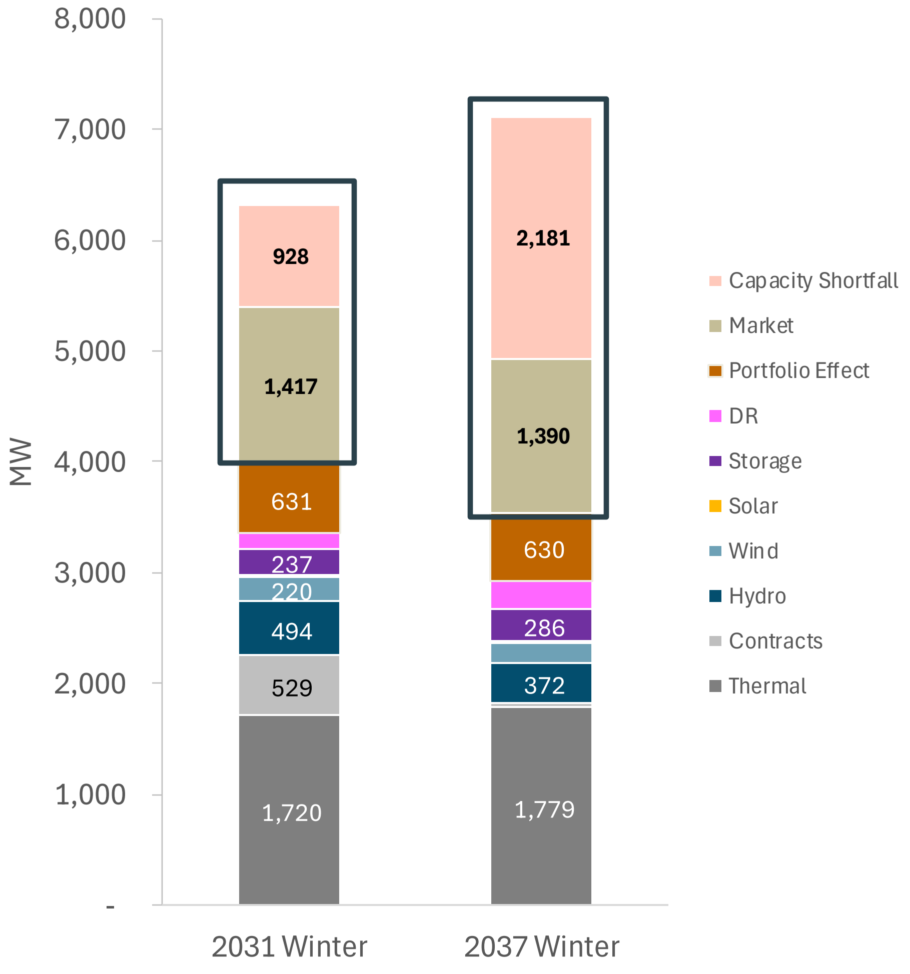
The table presents existing resources (1-9) accredited at their marginal ELCC. Portfolio effects (10) capture the impacts of saturation and diversity effects across PSE's entire portfolio. Portfolio effects is calculated as the difference between the ELCC of PSE's entire portfolio and the sum of contributions of individual resources measured at their marginal ELCCs

Load and Resources Table, 2031

		Winter (November 2031-March 2032)			Summer (April 2032-October 2032)		
		Nameplate (MW)	Marginal ELCC (MW)	ELCC (%)	Nameplate (MW)	Marginal ELCC (MW)	ELCC (%)
1	Thermal	1,976	1,720	87%	1,692	1,476	87%
2	Mid-C	607	385	64%	606	371	61%
3	PSE Hydro (Baker + Snoqualmie)	263	109	41%	263	77	29%
4	Wind	2,097	220	10%	2,097	317	15%
5	Solar	358	17	5%	358	29	8%
6	Market	2,031	1,417	70%	2,031	796	39%
7	Storage	437	237	54%	437	371	85%
8	DR (Events + TOU + EV)	307	134	44%	295	211	71%
9	Contracts	600	529	88%	600	565	94%
10	Portfolio Effects		631			576	
11	**Portfolio ELCC**		**5,399**			**4,788**	
12	**1-in-2 Median Peak**		5,253			4,594	
13	**Total Resource Need (MW)**		**6,327**			**5,133**	
14	PCAP PRM (%)		20%			12%	
15	**Capacity Shortfall (MW)**		928			345	
17	**Total Deficit**		2,345			1,141	

The table presents existing resources (1-9) accredited at their marginal ELCC. Portfolio effects (10) capture the impacts of saturation and diversity effects across PSE's entire portfolio. Portfolio effects is calculated as the difference between the ELCC of PSE's entire portfolio and the sum of contributions of individual resources measured at their marginal ELCCs

Load and Resources Table, Winter 2031 and 2037 Comparison



		Winter 2031 ELCC MW	Winter 2037 ELCC MW	
1	Thermal	1,720	1,779	
2	Mid-C Hydro	385	285	
3	PSE Hydro (Baker + Snoqualmie)	109	87	
4	Wind	220	179	
5	Solar	17	11	
6	Market	1,417	1,390	
7	Storage	237	286	
8	DR (Events + TOU + EV)	134	248	
9	Contracts	529	42	
10	Portfolio Effects	631	630	*[11] – Sum of [1 to 9]*
11	**Portfolio ELCC**	**5,399**	**4,937**	
12	**1-in-2 Median Peak**	**5,253**	**5,942**	
13	**Total Resource Need**	**6,327**	**7,119**	
14	PCAP PRM (%)	**20%**	**20%**	
15	**Capacity Shortfall**	**928**	**2,181**	*[13] – [11]*
16	**Total Deficit**	**2,345**	**3,571**	*[6] + [15]*

Winter 2031: November 2031 – March 2032, Summer 2031: April 2032 – October 2032

The table presents existing resources (1-9) accredited at their marginal ELCC. Portfolio effects (10) capture the impacts of saturation and diversity effects across PSE's entire portfolio. Portfolio effects is calculated as the difference between the ELCC of PSE's entire portfolio and the sum of contributions of individual resources measured at their marginal ELCCs