EXH. ZCY-5
DOCKET UE-23____
2022 PCA COMPLIANCE FILING
WITNESS: ZACARIAS C. YANEZ

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

In the Matter of the Petition of PUGET SOUND ENERGY For Approval of its 2022 Power Cost Adjustment Mechanism Report	DOCKET UE-23____

FOURTH EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

ZACARIAS C. YANEZ

ON BEHALF OF PUGET SOUND ENERGY

APRIL 28, 2023

RESOURCE PLAN

CHAPTER THREE - DRAFT

Contents

1. Introduction

Puget Sound Energy's (PSE) preferred portfolio is the result of robust Integrated Resource Plan (IRP) analyses developed with input from interested parties. Informed by our deterministic portfolio, risk and portfolio benefit analyses, PSE's portfolio meets the Clean Energy Transformation Act (CETA) requirements.

Puget Sound Energy (PSE) is the Pacific Northwest's largest utility producer of renewable energy. We currently own and contract over 10 million MWh of renewable and non-emitting energy, which will grow to more than 30 million MWh by 2045.

Throughout the resource planning process for the 2023 Electric Progress Report (2023 Electric Report), we focused on the following key objectives, which lay the foundation for this and all future resource plans:

- Achieve the renewable energy targets under CETA — meet at least 80 percent of PSE's demand with renewable and non-emitting energy and be carbon neutral by 2030, and meet 100 percent of PSE's demand with renewable and non-emitting resources by 2045
- Build a reliable, diversified power portfolio of renewable and non-emitting resources
- Continue to be a clean energy leader in and beyond the Pacific Northwest
- Ensure an equitable clean energy transition for all PSE customers
- Ensure resource adequacy while delivering a clean energy transition
- Ensure resource planning aligns with PSE's Clean Energy Implementation Plan (CEIP) to meet our interim targets and CETA obligations

We used three distinct types of analysis to develop, refine, and identify the preferred portfolio:

1. The deterministic portfolio analysis solves for the least-cost solution and assumes perfect foresight about the future.
2. The risk analysis examines how to diversify the portfolio to address the technology risk of future resources. Stochastic risk analysis assesses the impacts of uncertainty in hydroelectric and wind conditions, electric and natural gas prices, customer demand, and unplanned plant-forced outages.
3. The portfolio benefit analysis incorporates equity into the IRP process by measuring potential equity-related benefits to customers within a given portfolio. Because the IRP process is inherently forward-looking, this analysis seeks to identify portfolios containing a mix of electric resources that can enable more equitable customer outcomes in the future. It is important to note that the IRP process in general lacks the detail to assess existing or future programs and actions addressing equity; however, the IRP process can provide a pathway towards ensuring PSE is acquiring the electric resources necessary to implement future programs and actions that are more equitable.

2. Resource Plan

Puget Sound Energy is committed to reaching CETA goals and achieving carbon neutrality by 2030 and a carbon-free electric energy supply by 2045. The electric resource plan reflects our path to meeting our CETA commitments. Our plan prioritizes delivering cost-effective, reliable conservation and demand response and distributed and centralized renewable and non-emitting resources to our customers at the lowest reasonable cost. The plan reduces direct PSE emissions and achieves carbon neutrality by 2030 through clean energy investments.

Near-term Priorities (2024–2029):

- Add utility scale and distributed resources to achieve renewable or non-emitting energy targets specified in PSE's 2021 CEIP
- Add diverse commercially available resources to meet CETA energy and resource adequacy needs
- Begin commercial activity to acquire bulk transmission to transport renewable energy from distant renewable energy zones to our customers
- Continue to acquire conservation resources
- Continue to develop and refine methods to embed equity into resource decisions
- Lead and actively participate in developing the region's hydrogen hub infrastructure
- Explore commercial opportunities for small modular nuclear capacity and other non-emitting technologies for deployment in the early to mid-2030
- Pursue demand response programs that can effectively help lower peak demand
- Reduce reliance on short-term market purchases in response to the changing western energy market

Long-term Priorities (2030–2045):

- Complete acquisition and development of additional transmission capacity (e.g., Cross Cascades, Idaho, Wyoming, Montana, B.C.) to deliver additional clean energy to our customers
- Develop and acquire long-lead generating resources to meet CETA non-emitting generation obligations while maintaining resource adequacy and peak demand
- Explore new capacity options to drive diversity in our energy supply
- Examine repowering or upgrading existing thermal resources and existing renewable generation to better position PSE to achieve the 2045 goal of having an emission-free generation portfolio

2.1. Preferred Portfolio

The preferred resource portfolio is a portfolio of resources that can achieve our commitment to reaching CETA goals and achieving carbon neutrality by 2030 and a carbon-free electric energy supply by 2045. Figure 3.1 describes our portfolio of diverse resources; through this combination of conservation, demand response, renewable resources, energy storage and CETA compliant peaking capacity, PSE will reach carbon neutrality by 2030. However, given the large amounts of variable energy resources such as wind and solar, and energy limited resources such as energy storage, we are reliant on newer technologies such as small modular nuclear and hydrogen as a fuel to reach carbon-free energy supply by 2045 while maintaining reliability and resource adequacy.

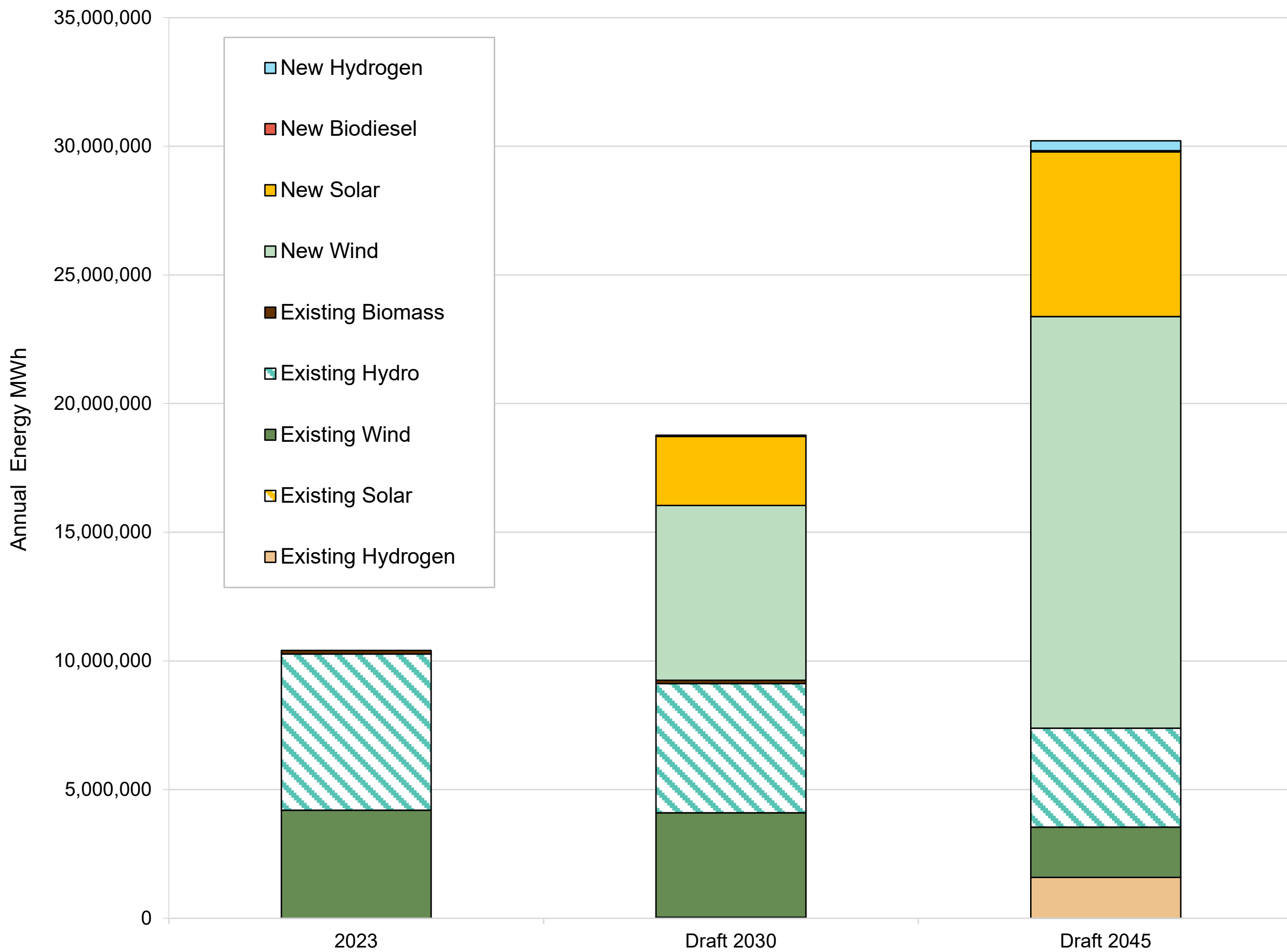
Table 3.1: Electric Preferred Portfolio, Resource Additions Incremental Nameplate Capacity

Incremental Resource Additions (MW)	2024-2025	2026-2030	2031-2045	Total
Demand Side Resources	201	417	646	1,265
Conservation[1]	65	216	537	818
Demand Response	136	201	110	446
Distributed Energy Resources	212	527	1,652	2,392
DER Solar[2]	172	380	1,572	2,124
DER Storage[3]	40	147	80	267
Supply Side Resources	1,337	4,023	5,814	11,174
CETA Compliant Peaking Capacity	237	474	877	1,588
Wind	600	800	2,250	3,650
Solar	100	600	1,590	2,290
Green Direct	-	100	-	100
Hybrid (Total Nameplate)	300	1,150	298	1,748
Hybrid Wind	100	500	200	800
Hybrid Solar	100	300	-	398
Hybrid Storage	100	350	100	550
Biomass	-	-	-	-
Nuclear	-	-	-	-
Standalone Storage	100	900	800	1,800
Total	1,750	4,967	8,112	14,830

Notes:

1. Conservation in winter peak capacity includes energy efficiency, codes and standards, and distribution efficiency.
2. Distributed Energy Resources (DER) solar includes customer solar photovoltaic (PV), Clean Energy Implementation Plan (CEIP) solar additions, non-wires alternatives, and ground and rooftop solar additions.
3. Distributed Energy Resources (DER) storage includes CEIP storage additions, non-wires alternatives, and distributed storage additions.

Figure 3.1: 100 Percent Clean Energy by 2045



2.2. Meeting Future Growth

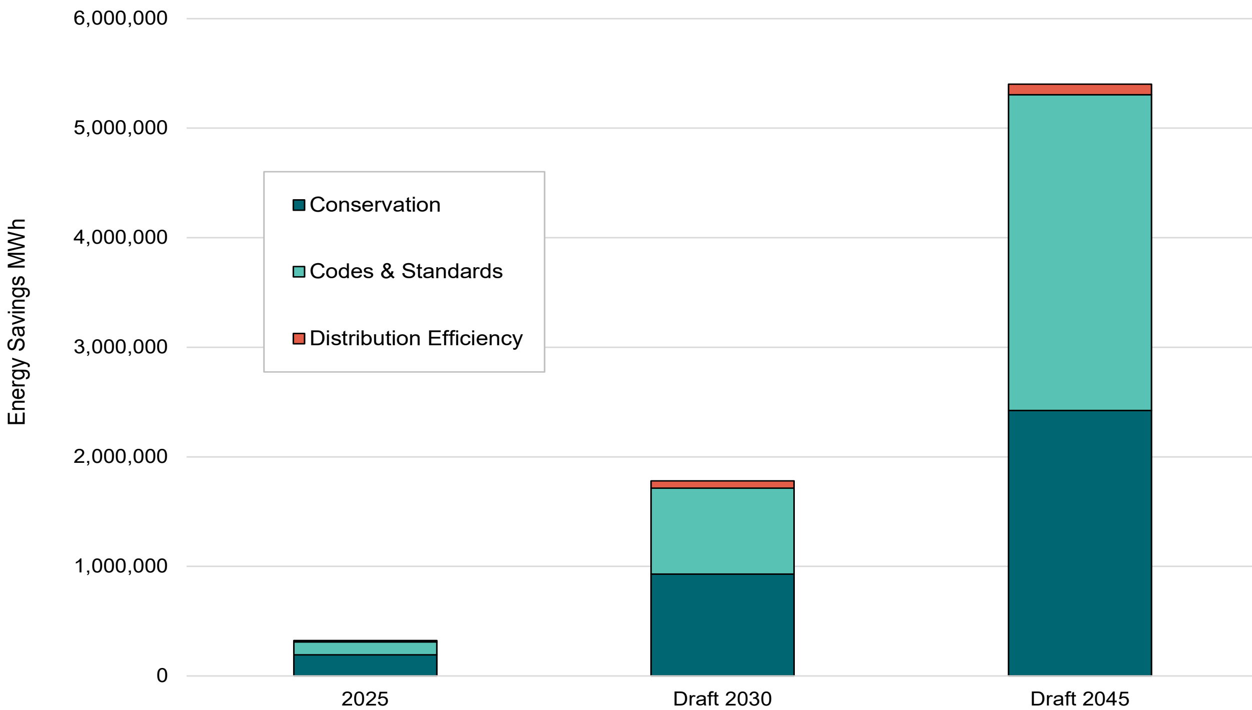
We will meet future sales growth with the combination of utility-scale resources described and shown in Figure 3.1, demand-side resources (conservation) and distributed energy resources (DERs). Distributed energy resources include storage systems, solar generation, or demand response that provides specific benefits to the transmission and distribution systems and simultaneously supports resource needs. The role of DERs in meeting system needs is changing, and the planning process is evolving to reflect that change. The DERs make lower peak capacity contributions and have higher costs. However, they are essential in balancing utility-scale renewable investments and transmission constraints and meeting local distribution system needs. These resources also provide customer benefits.

In the following section, we detail how the combination of resources in this resource plan will meet demand growth.

2.2.1. Conservation

For this analysis, conservation includes new energy efficiency measures, new codes and standards gains in efficiency, and distribution efficiency.

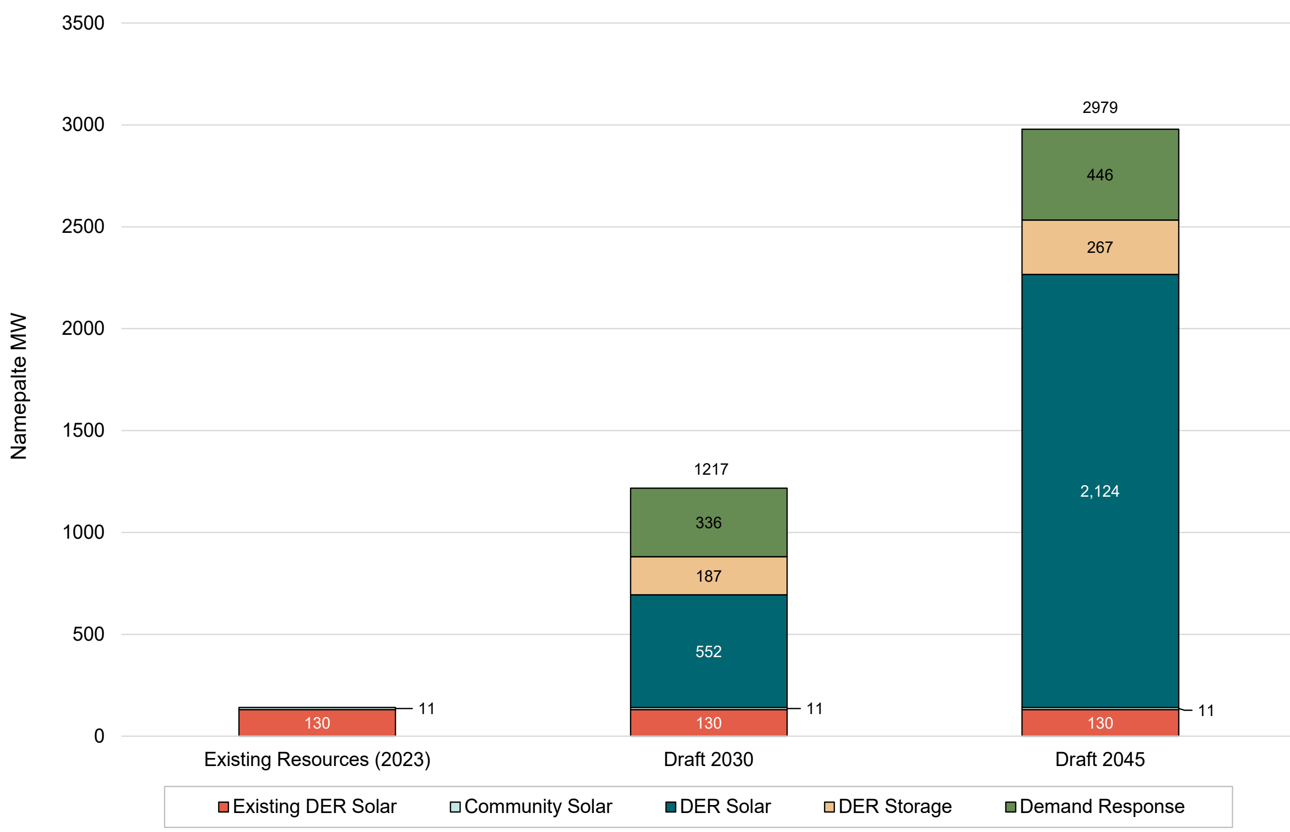
Figure 3.2: New Conservation Savings (MWh)



2.2.2. Distributed Energy Resources

Distributed energy resources are any resources located below the substation level. They can be either customer or PSE installed. For this analysis, DERs include demand response and solar and energy storage. Our system currently includes 130 MW of customer-installed rooftop solar and 11 MW of community solar. By 2030, we estimate we will add 552 MW of distributed solar and 187 MW of storage to the portfolio, growing to 2,124 MW of solar and 267 MW of energy storage by 2045. Demand response programs are peak savings options that are offered to customers and can include direct load control for indoor heating and air conditioning thermostats and water heaters and managed electric vehicle charging. Distributed resources cost more than utility scale programs, but are increased from the reference portfolio because they enable larger equity benefits than utility scale resources, described later in the chapter.

Figure 3.3: Distributed Resource Additions (nameplate MW)



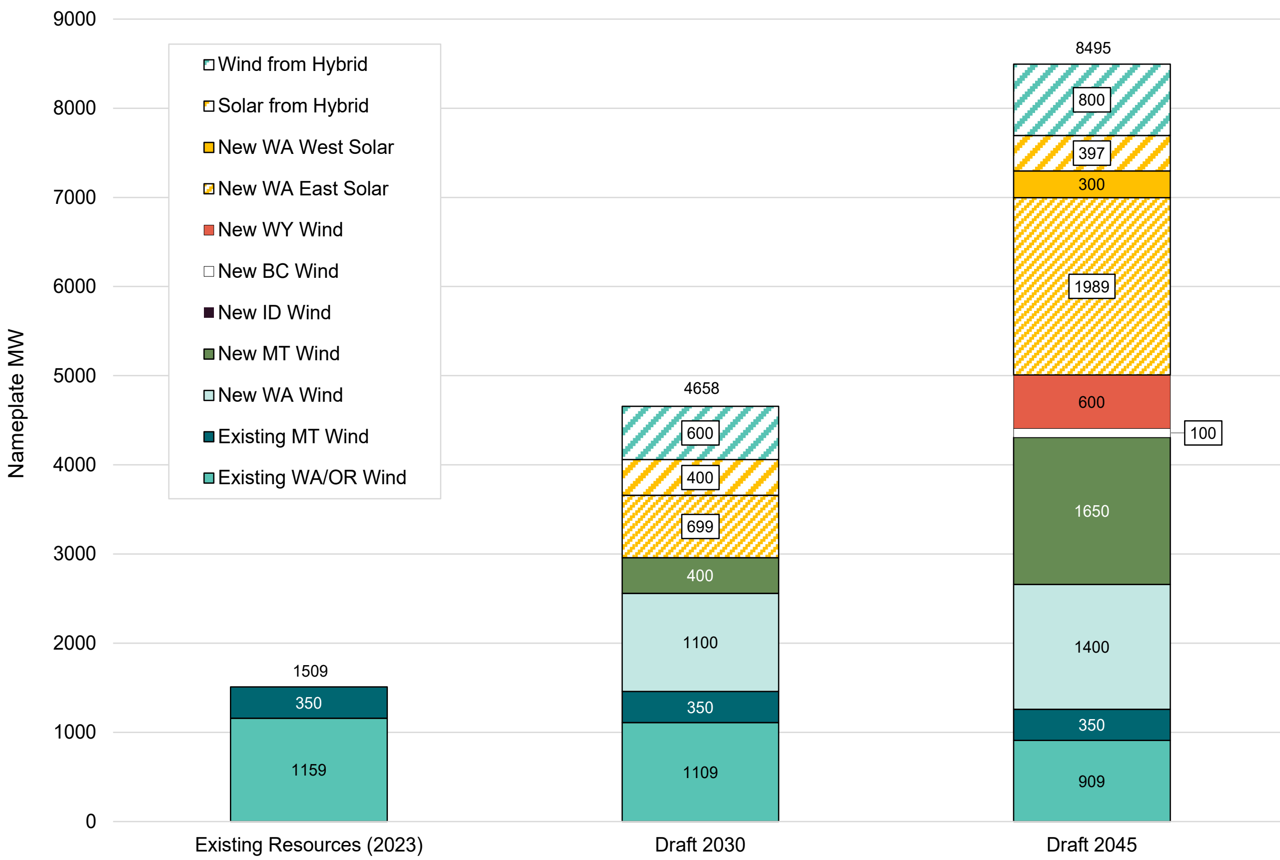
2.2.3. Clean Energy Resources

Qualifying clean energy (renewable and non-emitting) resources under CETA include wind, solar, nuclear and alternative fuels such as biodiesel and hydrogen. Along with distributed energy resources, we need to add a significant amount of large utility-scale resources to the portfolio to meet the clean energy requirements.

The scale of renewables needed will require access to renewables outside of Washington State and around the Pacific Northwest region such as Montana, Wyoming, Idaho and British Columbia. We will work to optimize the use of our existing regional transmission portfolio to meet our growing need for renewable resources in the near term. However, the Pacific Northwest transmission system likely will need to be significantly expanded, optimized, and possibly upgraded to keep pace with the growing demand for clean energy. Puget Sound Energy will have to invest in the transmission system to deliver energy to customers from the edge of our territory and support the integration of distributed energy resources and demand response within the delivery grid.

The preferred portfolio adds almost 3,200 MW of new wind and solar resources to meet the CETA clean energy requirements by 2030. Of the 3,200 MW of new wind and solar additions, 2,800 MW are resources located in Washington State that will need to utilize the cross cascades transmission. The remaining 400 MW are in Montana to that will utilize the Montana transmission.

Figure 3.4: Wind and Solar Additions (nameplate MW)



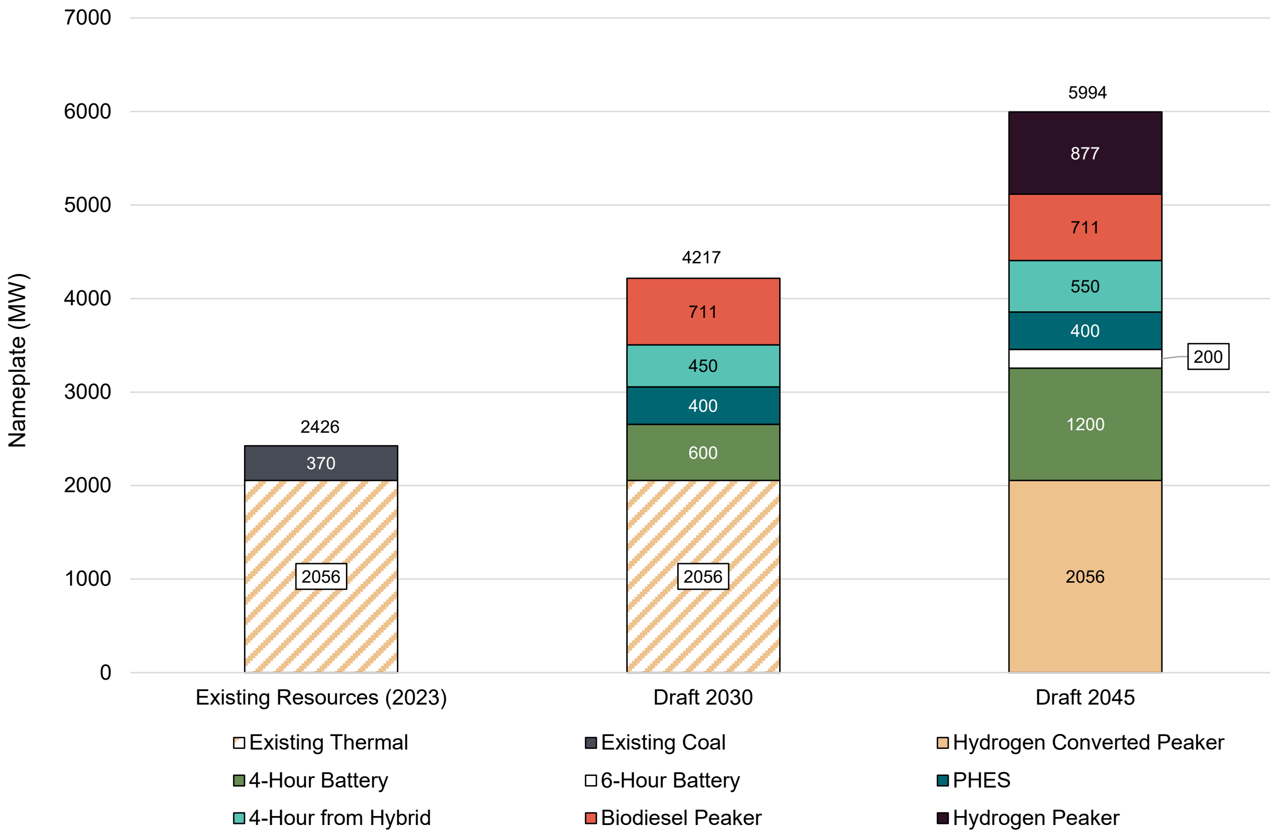
2.2.4. Capacity Resources

Qualifying resources under CETA include peaking capacity, energy storage, and nuclear. Peaking capacity modeled includes CETA-qualifying fuels such as biodiesel and hydrogen. Hydrogen fuel is assumed to be available starting in 2030. Natural gas to hydrogen blending is assumed to start at 30 percent hydrogen in 2030 and increase to 100 percent by 2045.

In order to maintain system reliability through resource adequacy, existing thermal resources, which total over 2,000 MW of capacity, remain in the portfolio and are converted to hydrogen. Existing thermal resources were modeled with an option to retire economically or convert to hydrogen starting in 2030. In Figure 3.5 below, three additional peakers are added using biodiesel as a fuel by 2030 and over 800 MW of new hydrogen peakers are added by 2045.

By 2030, 1,450 MW of new energy storage is added and this grows to 2,350 MW by 2045 to help meet resource adequacy and ancillary services. Energy storage resources are not energy producing resources, instead they store the energy produced from other resources so that it is available during peak hours.

Figure 3.5: CETA-qualifying Capacity Additions (nameplate MW)



3. Resource Adequacy

The Pacific Northwest electricity industry is transitioning as governments and system planners implement major decarbonization policies. Operators and utilities are retiring significant quantities of coal-fired capacity while adding new renewable generation resources. As a result, PSE and other utilities are rethinking how we plan our systems, especially concerning resource adequacy. As we transition to 100 percent clean energy by 2045, adequate resources are paramount. We must ensure that customers receive reliable electricity and experience a smooth transition to a decarbonized system. The resource adequacy analysis for this 2023 progress report has led to an increase in the planning reserve margin to 23.8 percent in 2029, a deficit of 2,629 MW from the 2021 IRP. Several elements contributed to the rise in the planning reserve margin and capacity deficit:

- Inclusion of climate change data in the load forecast and peak temperatures — when we accounted for average temperature trends it only slightly lowered the 1-in-2 winter peak and increased the summer peak. Despite the increase in summer peak temperatures, it does not come close to the winter peak level in this report's planning horizon. However, we saw an increase in volatility of temperatures which was accounted for in the resource adequacy and contributed to the overall increase in the planning reserve margin.

- Increase in peak demand — although the 1-in-2 winter peak lowered slightly, the updated electric vehicle (EV) forecast increased the demand. The increase in peak from the EV forecast was larger than the decrease from the climate change data, resulting in an overall increase to the 1-in-2 peak demand.

Climate change data also showed changes in the duration and frequency of loss of load events, which impacted the results. The data showed a decrease in event duration, less frequent events in the winter and more frequent events in the summer. Thus, increasing the effective load carrying capacity (ELCC) for shorter duration storage resources and solar.

Incorporating climate change in the modeling changed the hydroelectric generation profile. The climate change data showed the historical spring runoff is happening earlier in the year, changing hydropower availability. Thus, changing the generation profile of hydroelectric generation and leaving less water for the summer.

3.1. Reducing Market Reliance

Although the western energy market has had surplus capacity for more than a decade, PSE's available firm transmission to the Mid-Columbia market hub has been a cost-effective way to meet demand by purchasing energy supply from the regional power market. However, the supply and demand fundamentals of the wholesale electric market have changed significantly in recent years in two important ways: tightening supply and increasing pricing volatility.

In response to these changing conditions, we plan to replace those short-term market supplies with firm resource adequacy qualifying capacity contracts compliant with CETA that meet our resource adequacy requirements and align with a potential regional resource adequacy program. The peak capacity resource need and the preferred portfolio in this report reflect added firm capacity resources while reducing the number of short-term market purchases.

Our approach allows us to survey the market for available resource adequacy qualifying agreements, and it allows for the development of the regional resource adequacy program requirements, which will help inform PSE's future needs. Given the tightening of energy markets and to prepare for possible participation in the Western Resource Adequacy Program (WRAP), PSE is planning to reduce its reliance on short-term wholesale market purchases

We recognize this approach has challenges, including permitting and building generating and storage resources and transmission to meet growing demands in an increasingly complex permitting landscape. Although those challenges are real, we are confident the resource plan in this 2023 Electric Report puts us on a path to reach our clean energy goals and achieve the clean energy future our customers expect.

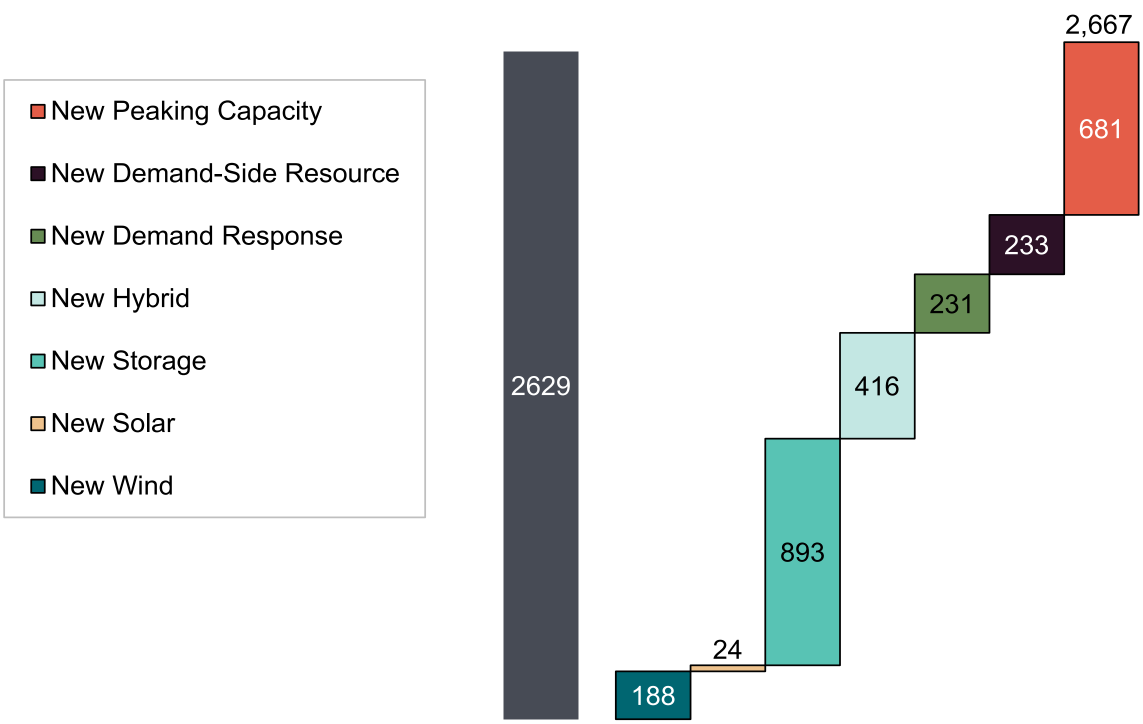
3.2. Winter Peak Driving Resource Capacity Additions

Even though we analyzed summer and winter peak capacity, the winter peak is higher than the summer peak. With the increase of renewable energy and energy storage in the portfolio, those resources contribute to the summer peak need better than they contribute to the winter. For example, solar has a four percent peak capacity contribution in the winter but a 55 percent contribution in the summer. We added solar to the portfolio because it meets the CETA requirement and the summer peak need, but it does very little to meet the winter peak need.

After meeting CETA and the summer peak, this leaves the winter peak short, so we need new peaking capacity to maintain resource adequacy for the winter. The winter peak capacity deficit is 2,626 MW, and we added 2,667 MW peak capacity to the portfolio. The summer peak deficit is 2,770 MW, and we added 3,025 MW peak capacity. The summer peak deficit is higher than the winter deficit because fewer resources are available in the summer than in the winter. However, the total winter peak is still higher than the summer.

This approach balances the winter peak and creates a summer peak surplus of more than 254 MW. Figure 3.6 shows the breakdown of the winter peak capacity contribution for new resources.

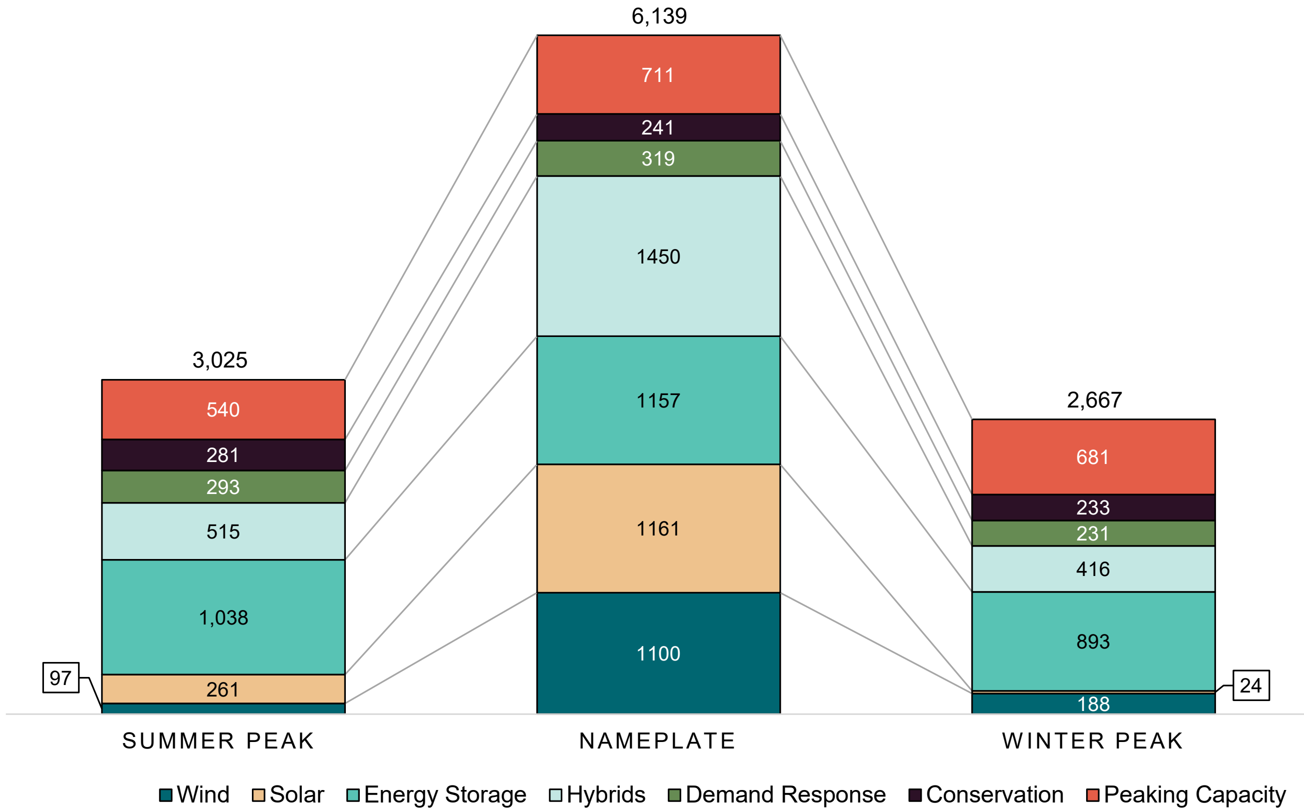
Figure 3.6: Meeting Winter Peak Need for 2029 (peak capacity MW)



3.3. Nameplate versus Peak Capacity

Because of the peak capacity contribution of each resource, we need more resources to meet the peak need. For example, solar's 24 MW peak capacity contribution requires over 1100 MW of installed nameplate capacity. After adjusting for peak capacity contribution, 6,139 MW of installed nameplate capacity on new resources adjusts to 3,025 MW summer peak capacity and 2,667 MW winter peak capacity, as detailed in Figure 3.7.

Figure 3.7: Nameplate Capacity Adjusted to Peak Capacity Contributions (MW)



3.4. Benefits of a Diverse Portfolio

As PSE and the region seek to decarbonize systems, the future of electricity is a diverse portfolio of non-emitting resources. A diverse energy mix is critical for energy security because it is less dependent on a single fuel source, reducing vulnerabilities due to market price, supply fluctuations, and political unrest. Multiple, reliable generation sources allow a utility to continue to provide power without disruption if one energy source fails. A diverse portfolio also reduces environmental impacts, improves reliability, and promotes innovation to meet the needs of PSE's more than 1.5 million customers. Maintaining resource diversity is the key to reducing emissions while preserving reliability and affordability.

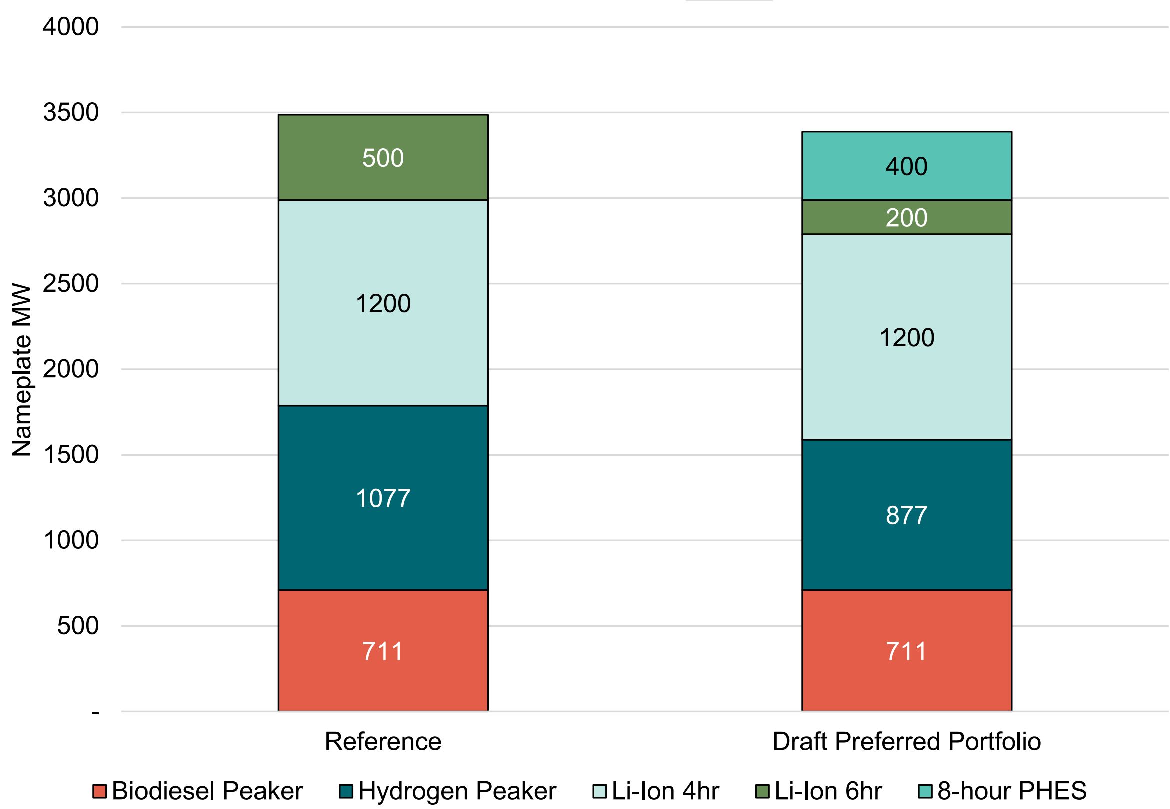
The least-cost reference portfolio relies primarily on a few resources because the model is designed to select the lowest-cost resources available. However, we need to consider factors such as risk and feasibility when considering resources to include in the preferred portfolio. For example, the least-cost reference portfolio relies heavily on 4-hour batteries because it is the lowest cost energy storage resource and hydrogen as a fuel. Hydrogen is the lowest cost, CETA-compliant fuel source for thermal resources. To develop the preferred portfolio, we adjusted away from the least-cost reference portfolio to bring more diversity and lower the technology and feasibility risks inherent in the least-cost reference portfolio.

The adjustment includes adding 400 MW of pumped hydro energy storage into the mix in 2026 plus 400 MW of Montana wind to diversify from the 1700 MW of battery energy storage.

Another possible adjustment that was tested, but not included in the preferred portfolio includes adding advanced nuclear small modular reactor (SMR) in 2032 to diversify from 2,800 (existing and new) MW of hydrogen-fueled thermal plants.

Figure 3.8 below shows how we adjusted the portfolio from the reference case to create a diverse portfolio that relies on multiple resources to meet demand.

Figure 3.8: Nameplate Additions by 2045 (MW)



Energy Storage: The least-cost reference portfolio adds 1,000 MW of 4-hour batteries by 2030 because they are the lowest-cost energy storage resources. We adjusted the types of energy storage resources for the preferred portfolio to include more diverse technologies. For the preferred portfolio, we added 200 MW of pumped hydroelectric energy storage (PHES) in Montana and 400 MW of new Montana wind along with the existing 350 MW of wind. An additional 200 MW of PHES located in the Pacific Northwest is also added to the preferred portfolio for a total of 400 MW of PHES. The remaining energy storage is then a mix of 4-hour and 6-hour batteries.

Advanced Nuclear (SMR): In the least-cost reference portfolio, we modeled building over 800 MW of new hydrogen peakers by 2045 on top of the 2,000 MW of existing resources converted from natural gas to hydrogen. By 2045, we projected hydrogen to account for 36 percent of the peak capacity contribution. This least-cost reference portfolio relies heavily on a single fuel source with an unknown supply, creating risk. As a way to diversity the portfolio, we can explore other technologies such as small modular nuclear for inclusion in the preferred portfolio in the future. There are many unknowns around new advanced nuclear technology. While the high cost of nuclear deterred us from including it in the preferred portfolio at this time, we will continue to monitor the maturity of the technology as a resource to help reduce the risks of relying on only a few technologies and a way to meet the CETA 100 percent requirement by 2045. In the future, we believe nuclear resources will be essential for diversifying our dispatchable generating resources, hedging against over-reliance on alternative fuels including hydrogen and biodiesel and ensuring we can meet peak capacity needs. Nuclear also provides a firm source of clean energy to the portfolio, whereas energy storage does not produce energy and is dependent on oversupply in the market.

4. Developing the Plan

We first developed a least-cost reference portfolio using the AURORA model's capacity expansion function. This portfolio did not address that the future of power is a diversified portfolio of non-emitting resources providing energy security and reliability for all customers. There is no single perfect answer or resource that will solve all our energy needs. That is why a diversified portfolio is critical, including a mix of utility-scale and distributed energy resources and a blend of intermittent, energy-limited, and firm-capacity resources. These are essential components when determining the portfolio mix.

4.1. Our Clean Energy Future

Puget Sound Energy has been an early leader in addressing climate change, investing billions in renewable resources and energy efficiency for homes and businesses. Now, we are on a path to meet our customers' current and future needs and reach Washington State's ambitious clean energy transformation policies and PSE's aspirational goals.

Under our proposed 2021 Clean Energy Implementation Plan, we will increase the amount of clean energy in our portfolio by 2025 as part of our progress toward meeting Washington State's 80 percent clean electricity by 2030 policy. As we work to create a new clean energy future and address climate change, we must do so in a way that ensures all our customers, especially historically marginalized communities, have a voice in and benefit from the transition to clean energy. We are applying an equity lens in this plan. We know that we cannot do this work alone. Therefore, we are partnering with our customers, communities, and others to build plans to address all our customers' needs while meeting key milestones.

Puget Sound Energy has served customers and communities across Washington State for nearly 150 years. We are committed to providing clean, safe, reliable, affordable, and equitable energy. With our commitment in mind and consulting with interested parties, we developed candidate portfolios that would better enable equity-enhancing resources and diversify technology risk.

4.2. Summary of Candidate Diverse Portfolios

The first step to developing a preferred portfolio is to start with a least-cost portfolio. A least-cost portfolio meets all the constraints in the lowest-cost way. These constraints are:

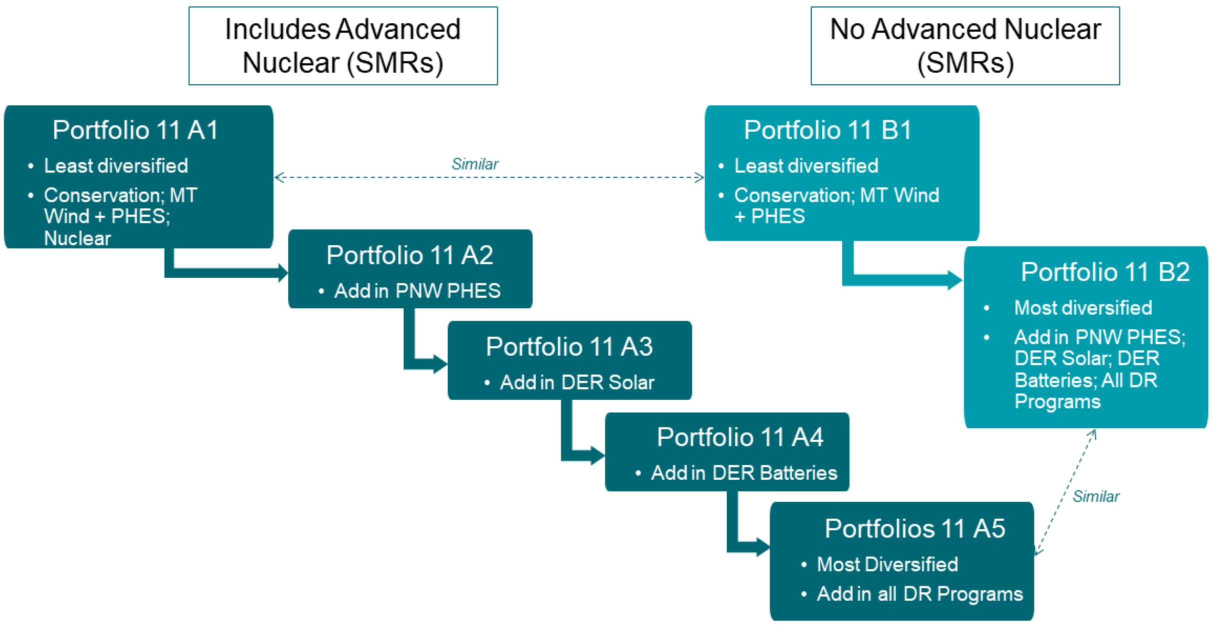
- Peak capacity plus planning margin
- Hourly customer demand for the year
- CETA renewable and clean-energy requirements
- Reduced market reliance at peak
- Transmission access for new resources

The least-cost portfolio gave us a starting point which we then adjusted to identify a feasible portfolio of diverse resources that consider equity and create customer benefits while maintaining reliability and affordability. We refined the least-cost portfolio with an eye towards maximizing benefits and reducing burdens to vulnerable populations and highly impacted communities consistent with CETA. Figure 3.9 shows a progression of diversified portfolios ranging from the least diverse portfolio 11 A1 to the most diverse portfolio 11 A5, with each step in-between adding an additional scheduled resource addition to increase the portfolio's diversity. Portfolios 11 B1 and 11 B2 were modeled at the request of interested parties and represent the least and most diversified portfolios (11 A1 and 11 A5) excluding advanced nuclear SMR additions.

To create a diverse portfolio, we:

1. Start with the least cost reference portfolio
2. Make incremental changes to the portfolio to test the sensitivity of the adjustment to resource builds and portfolio cost
3. Create a portfolio with different options from part 2, considering equity, cost, feasibility, reliability, and diversity of energy supply

Figure 3.9: Components of the Diverse Portfolios

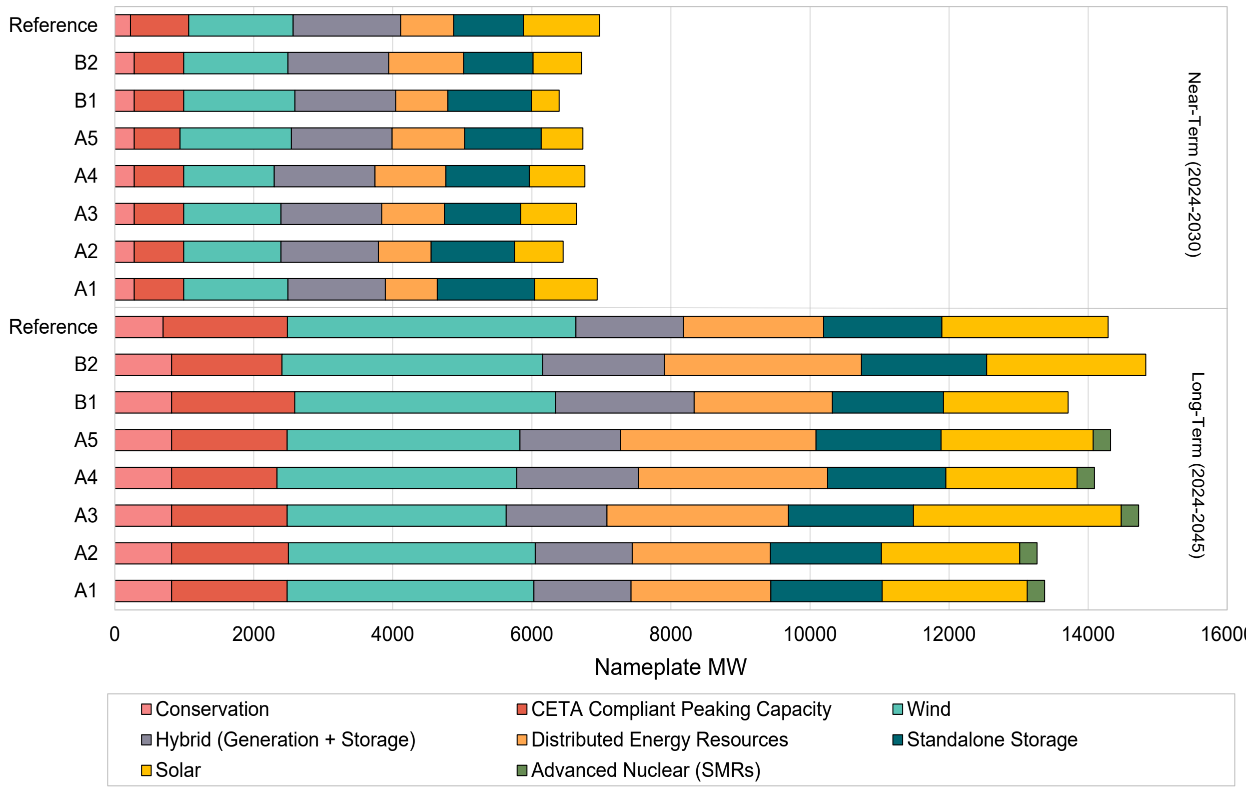


Portfolios 11 A5 and B2 are the most diverse portfolios and focus on increasing distributed resources such as energy storage, solar, conservation, and demand response.

Portfolios 11 A1, A2 and B1 are less diverse to increment in different changes starting with conservation increases and utility-scale resources.

We tested these portfolios to see how they enabled equitable outcomes for customers (see Section 4.3: Portfolio Benefit Analysis) and to determine the increased costs relative to the reference scenario. Figure 3.10 shows a breakdown of resource additions by portfolio. In the near term (2024 – 2030), the portfolios are very similar. PSE has a large need for resources to meet CETA and resource adequacy and there is a limited number of technologies that are commercially available and able to be constructed today. All the diverse portfolios have equal amounts of conservation and CETA-compliant peaking capacity, with the rest of the resources comprising demand response, wind, solar, energy storage, or a hybrid of renewable resources plus energy storage. For the longer term (2031 – 2045) the resource mix becomes more pronounced between portfolios though the need for conservation and CETA-compliant peaking capacity is a stable addition across all portfolios.

Figure 3.10: Resource Builds (Nameplate MW)



4.3. Portfolio Benefit Analysis

The Clean Energy Transformation Act requires utilities to consider equity and ensure all customers benefit from the transition to clean energy. However, AURORA, a traditional production cost model that we use for portfolio modeling, only solves for the least-cost solution. Therefore, we developed and used a portfolio benefit analysis tool to support our understanding of equity-related benefits and the associated costs within each portfolio, and inform our work as we strive to select a portfolio best suited to enable equitable outcomes for customers while also considering cost. The preferred portfolio provides the best pathway to improve equitable outcomes of all the portfolios we evaluated in this report. This outcome was driven primarily by increasing customer opportunities to participate in distributed energy and demand response programs.

The portfolio benefit analysis tool measures potential equity-related benefits to customers within a given portfolio and the tradeoff between those benefits and overall cost. We evaluated these benefits using quantitative customer benefit indicators (CBIs) and their metrics. Customer Benefit Indicators are quantitative and qualitative attributes we developed for the 2021 CEIP in collaboration with our Equity Advisory Group (EAG) and interested parties. These CBIs represent some of the focus areas in CETA related to equity, including energy and non-energy benefits, resiliency, environment, and public health.

For this report, we evaluated each portfolio using a subset of the CBIs proposed in the 2021 Clean Energy Implementation Plan, which as of this date is still pending Washington Utilities and Transportation Commission (Commission) approval. The subset of CBIs was selected based on whether the AURORA modeling tool could quantitatively evaluate them, i.e., AURORA already had a comparable metric. The CBIs we included in the portfolio benefit analysis are:

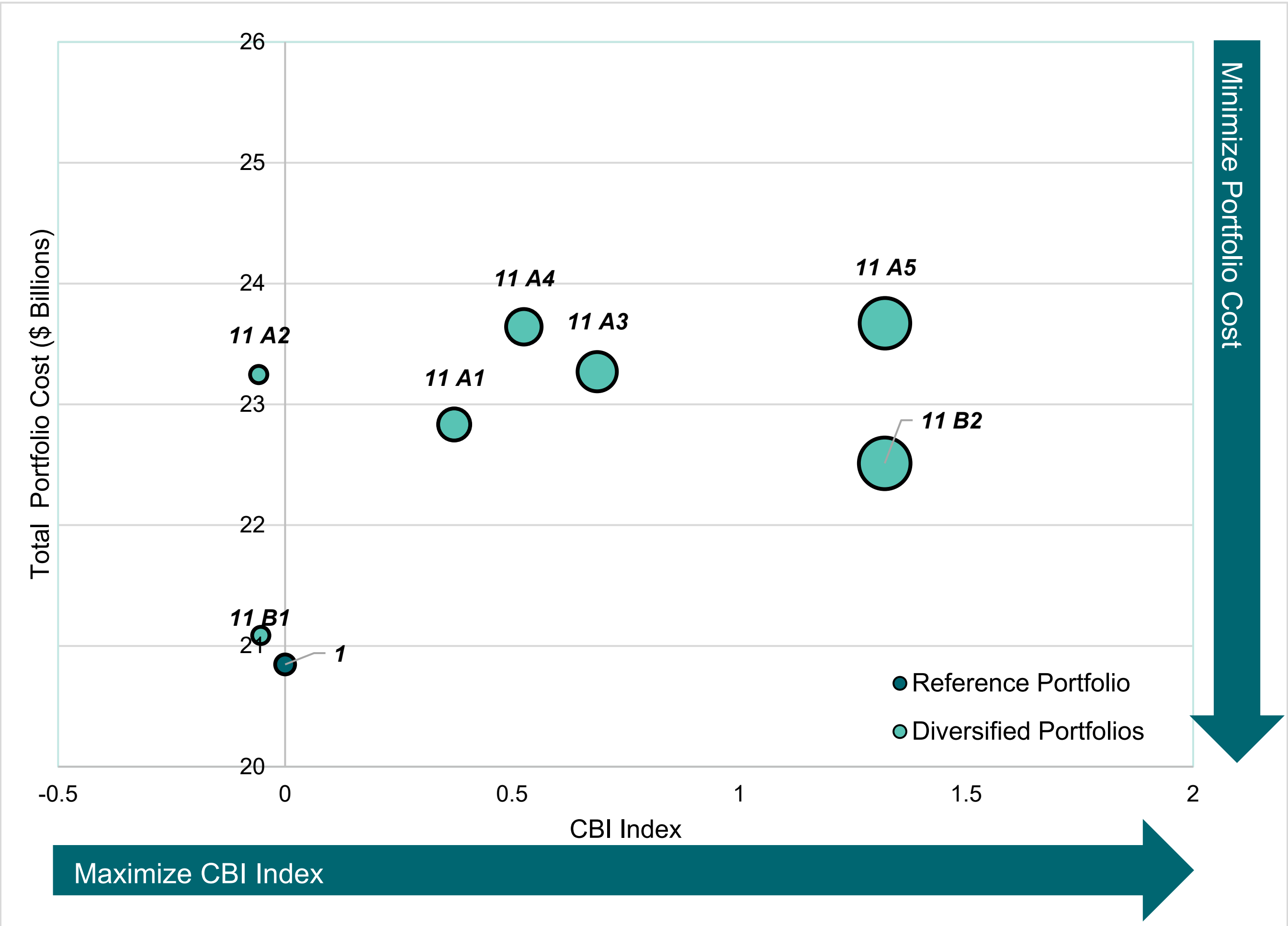
- **Improved access to reliable, clean energy** — measured by customers with access to distributed storage resources
- **Improved affordability of clean energy** — measured by the total portfolio cost
- **Improved outdoor air quality** — measured by sulfur oxides, nitrogen oxides, and particulate matter generated per portfolio
- **Increase the number of jobs** — measured by the number of estimated jobs generated for each portfolio
- **Increases participation in Energy Efficiency, Distributed Energy Resource, and Demand Response Programs** — measured by energy efficiency capacity added and the number of customers projected to participate in distributed energy resources and demand response programs
- **Reduced greenhouse gas emissions** — measured by the total amount of CO_2-eq1 generated per portfolio
- **Reduced peak demand** — measured by the decrease in peak demand achieved via demand response programs

The portfolio benefit analysis generates a CBI index for each portfolio, an aggregate measure of these CBIs (sans the portfolio cost) normalized to the reference, least-cost portfolio. A higher CBI index indicates that a portfolio enables more equity-related benefits than the reference portfolio. The CBI index juxtaposes each portfolio's total cost (direct costs plus externality costs). The plot (Figure 3.11) illustrates the tradeoff between increasing portfolio benefits and the associated metrics and costs. Compared to the reference portfolio, the most efficient portfolios have the highest CBI indices with minimal increase in portfolio cost and sit closest to the bottom right corner of the plot.

Figure 3.11 shows the results generated by the portfolio benefit analysis tool for all diversified portfolios analyzed in this report. We can see that portfolio 11 B2 is the most efficient of the diversified portfolios because it lies furthest to the right with the highest CBI index. Which is one of the reasons portfolio 11 B2 was selected as the preferred portfolio. It has the highest overall CBI index at 1.32 and is the most diversified portfolio without nuclear that we evaluated in the 2023 Electric Report.

[1] CO_2-eq or CO_2-equivelant is a measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP). Using the GWP, other greenhouse gases are converted to the equivalent amount of carbon dioxide.

Figure 3.11: Portfolio Benefit Analysis Tool Results



The high CBI index of portfolio 11 B2 comes from improvements in all CBIs considered in this analysis except for jobs, which varied only slightly from the reference portfolio by less than half a standard deviation (index = -0.41). The benefits in the preferred portfolio include some of the highest potential customer participation numbers for DER solar, DER storage, and demand response programs at 87,492, 18,524, and 750,943 participants, respectively. The preferred portfolio also reduces greenhouse gas and other harmful emissions in comparison to the reference portfolio (Table 3.2).

Table 3.2: Portfolio CBI Metrics

CBI Metric	1 Reference	11 A5 Diversified Portfolio	11 B2 Diversified Portfolio
Cost ($, Billions)	20.85	23.67	22.51
GHG Emissions (Short Tons)	48,824,734	41,543,008	44,372,601
SO_2 Emissions (Short Tons)	28,841	28,836	28,759
NO_x Emissions (Short Tons)	11,426	10,307	10,805

CBI Metric	1 Reference	11 A5 Diversified Portfolio	11 B2 Diversified Portfolio
PM Emissions (Short Tons)	9,036	8,873	8,940
Jobs (Total)	45,736	40,757	43,795
Energy Efficiency Added (MW)	695	818	818
DR Peak Capacity (MW)	291	320	320
DER Solar Participation (Total New Participants)	12,115	83,903	87,492
DR Participation (Total New Participants)	513,238	750,943	750,943
DER Storage Participation (Total New Participants)	8,125	18,524	18,524

The results of the portfolio benefit analysis indicate that increasing distributed and demand-side resources significantly increase the potential for more equitable outcomes for customers. In comparison to the reference portfolio, the preferred portfolio has the following additions:

- **Conservation**: increases to 371 MW by 2045, an increase of 113 MW above the least-cost conservation.
- **Demand Response**: increases to 446 MW by 2045, an increase of 41 MW above the least-cost portfolio.
- **Distributed solar**: added 30 MW per year from 2026–2045, a total of 630 MW added by 2045 above the least cost portfolio.
- **Distributed storage**: added 25 MW per year from 2026–2031, a total of 150 MW added distributed storage above the least cost portfolio.

The preferred portfolio achieved the highest CBI index of all portfolios evaluated in this 2023 Electric Report. In pursuing the preferred portfolio, we will adopt a pathway forward for acquiring the resources necessary for a more equitable distribution of customer energy and non-energy burdens and benefits.

4.4. Portfolio Costs

The portfolio costs include all costs associated with construction, interconnection, transmission, fuel, and operations and maintenance of new generating resources along with the costs to operating and maintain existing resources. We divided the portfolio costs into near-term resource additions before 2030 and longer-term, 21-year decisions for 2045. Adding additional distributed resources to the portfolio increases the equity metrics we used, but it also increases the cost of the portfolio. Figure 3.12 shows the annual portfolio costs for 2024–2029, and Table 3.3 shows the six-year net present value (NPV) of direct costs and the social cost of greenhouse gases (SCGHG).

Figure 3.12: Annual Portfolio Costs with Emissions 2024–2029 (billions of dollars)

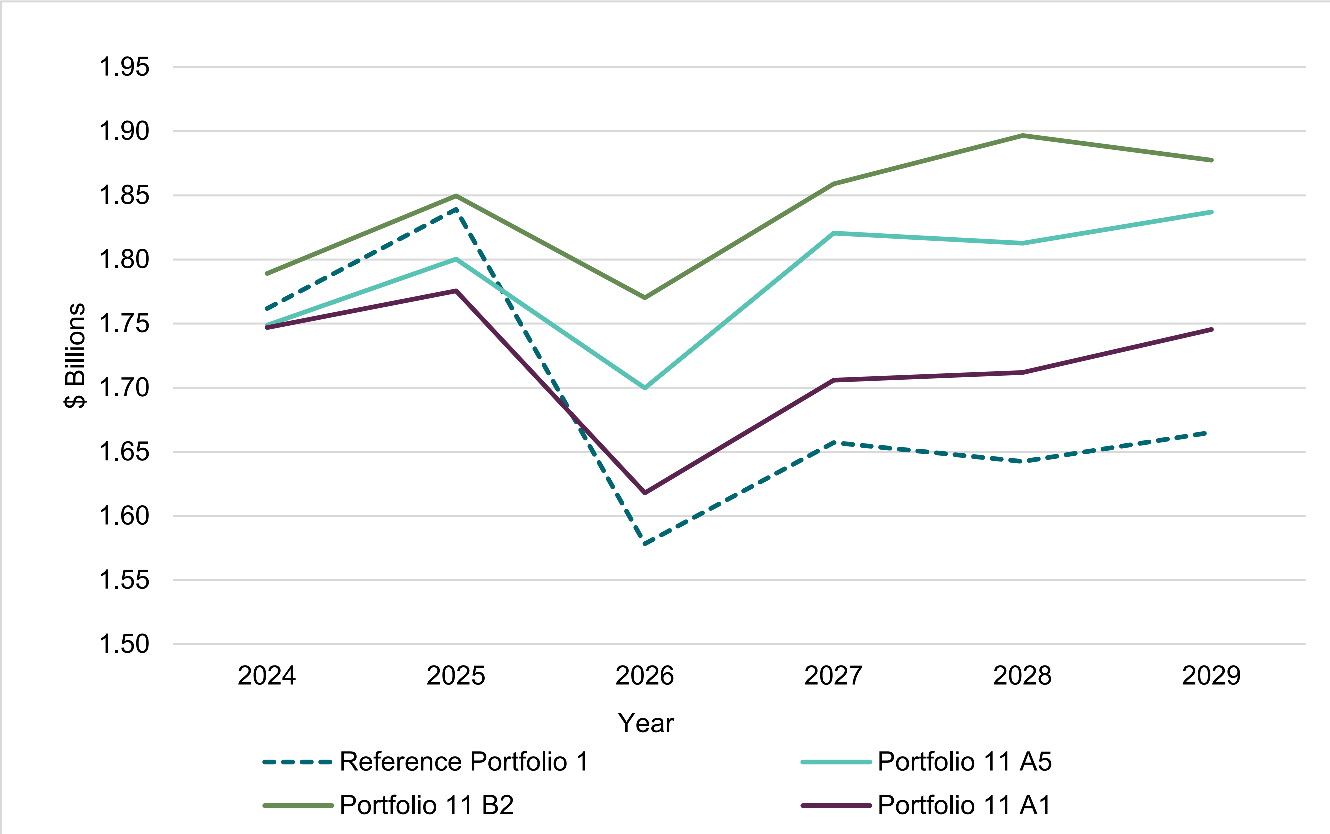


Table 3.3: Six-year NPV 2024–2029

Six-year NPV (2024–2029) (Billions of Dollars)	Reference Portfolio 1	Portfolio 11 A5	Portfolio 11 A1	Portfolio 11 B2
Portfolio Cost with SCGHG	8.14	8.55	8.24	8.81
Portfolio Cost without SCGHG	6.05	6.75	6.49	6.93
Social Cost of Greenhouse Gases (SCGHG)	2.08	1.80	1.75	1.88

The combination of increases in distributed resources, conservation, demand response, and diversifying the portfolio delays adding one peaking generation facility until after 2030 but increases the cost over the reference case by $700 - $880 million over the next six years.

4.5. Resource Plan Additions

Puget Sound Energy is committed to reaching CETA goals and achieving carbon neutrality by 2030 and a carbon-free electric energy supply by 2045. The electric resource plan reflects our path to meeting our CETA commitments. Our plan prioritizes delivering cost-effective, reliable conservation and demand response and distributed and centralized renewable and non-emitting resources to our customers at the lowest reasonable cost. The plan reduces direct PSE emissions and achieves carbon neutrality by 2030 through clean energy investments and projected alternative compliance options. The resources behind the plan can be divided into near-term and longer-term resources.

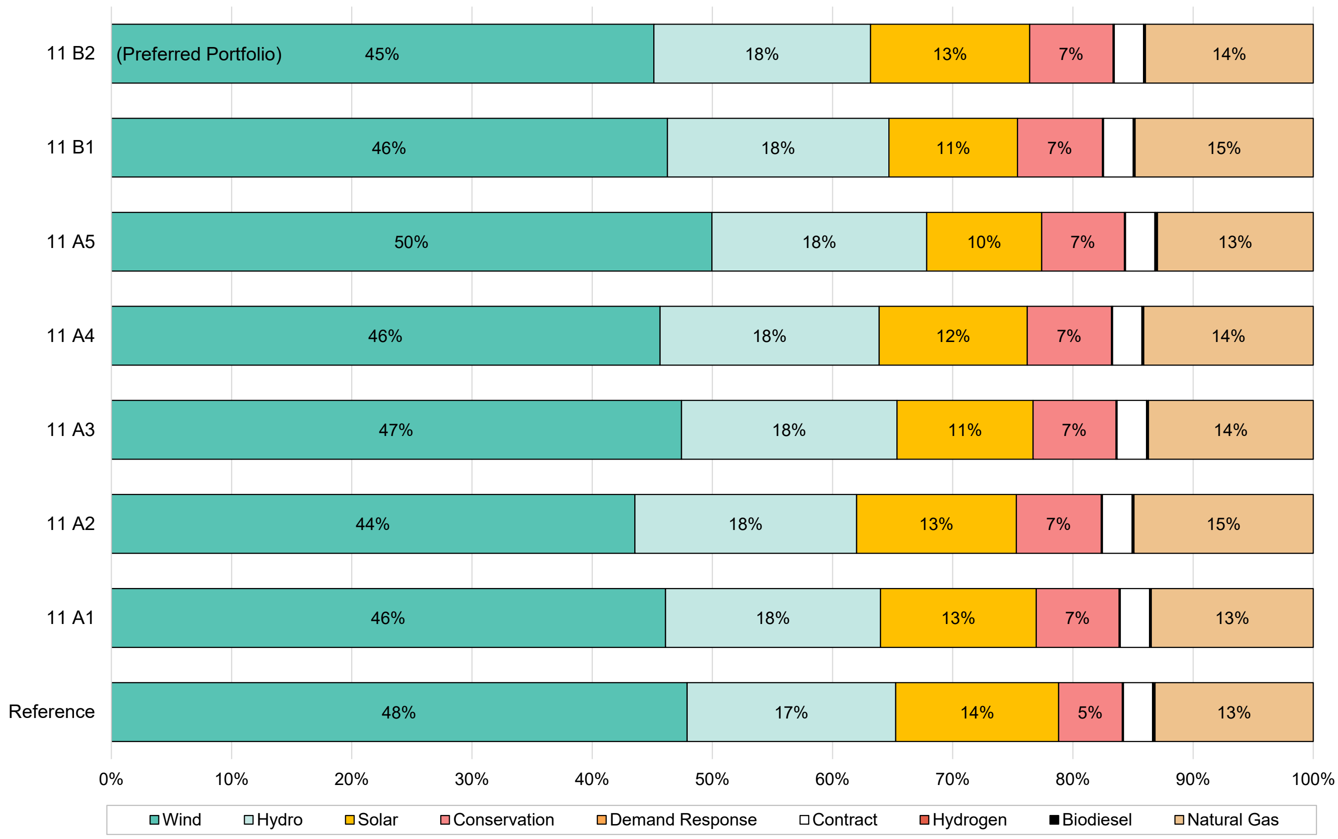
Near-Term Resources (2024–2029)

The utility scale and demand-side resources builds in the near term are similar across the diversified portfolios. In all the diversified portfolios, we need three peaking generation facilities by 2030 in order to maintain reliability as new variable resources are added. By 2030, almost 1,500 MW of new energy storage is added to help meet resource adequacy and ancillary services. Energy storage resources are not energy producing resources, they just store the energy produced from other resources so that it is available during peak hours. Given that over 3,000 MW of variable energy resources are added by 2030 to meet the CETA requirements, the energy storage resources will be needed to help store energy in low demand hours to be used later in high demand hours.

The difference between the portfolios is the amount of distributed energy resources added to the portfolio. We listened to interested parties and PSE's Equity Advisory Group (EAG) and heard the importance to add more distributed resources to the portfolio and increase customer participation in these programs. The preferred portfolio increases DER programs and has the highest CBI index. However, this comes at a higher cost as well.

No matter which portfolio is used for the preferred portfolio, the near-term resources are the same for utility scale resources, we need to meet CETA requirements and resource adequacy, and there are limited options available to achieve these needs in the next six years. Portfolio 11 B2 was chosen as the preferred portfolio because it enables the most equity-related benefits of all the portfolios we evaluated in this report. This outcome was driven primarily by increasing customer opportunities to participate in distributed energy and demand response programs.

Figure 3.13: Annual Energy 2030 – by Fuel Type (percent of generation)

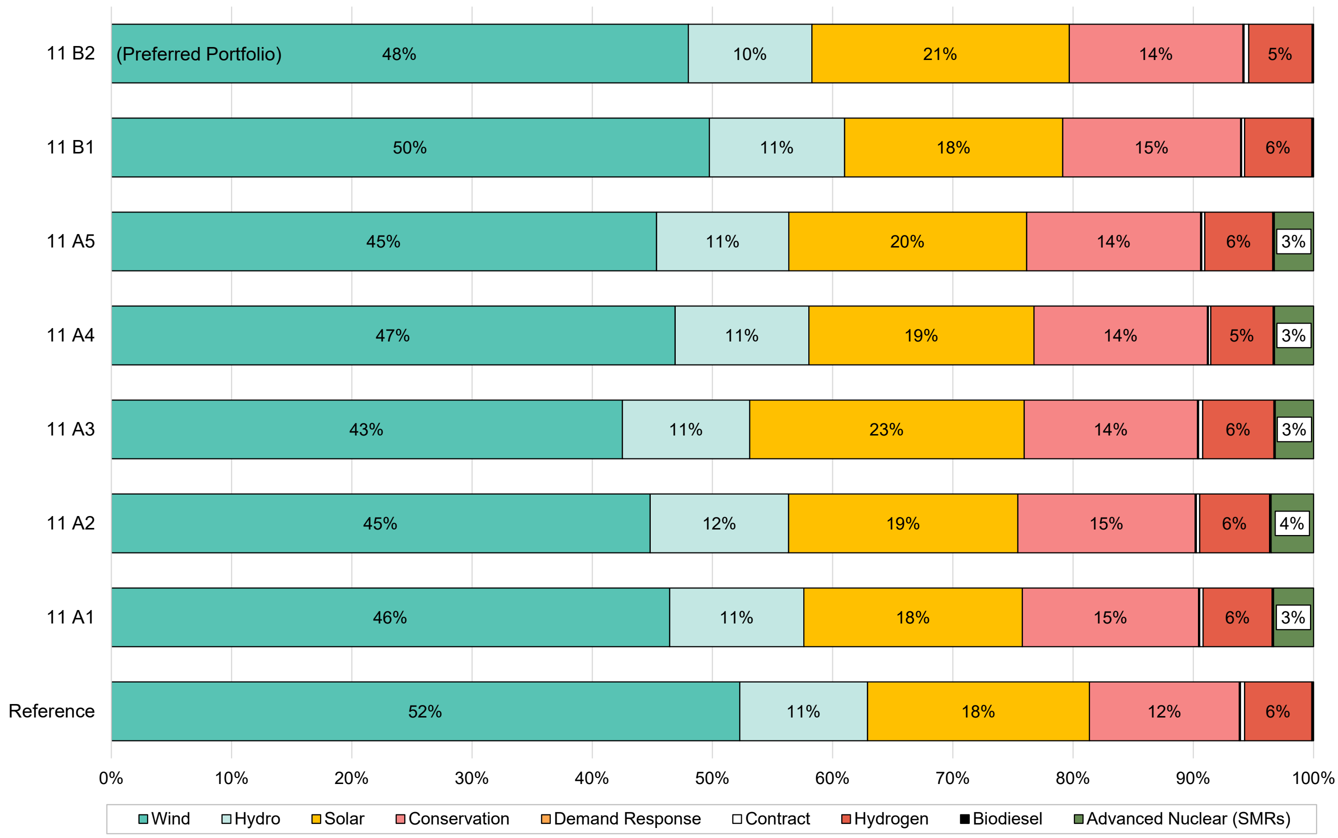


Long-Term Resources (2030–2045)

As we look further into the future, the resources become less certain. We know that technological advancements are needed in order to achieve 100 percent clean energy by 2045. This could be through alternative fuels used in combustion turbines such as hydrogen or through new small modular nuclear technology. Both options are promising but present their own unique risks and costs. We will continue to explore these and other resource options in the next and future IRP cycles.

Regardless of what technologies may be available in the long-term, it does not change the near-term resources and resource options. We are confident this preferred portfolio keeps us on a path to meeting the CETA 2030 requirements.

Figure 3.14: Annual Energy 2045 – by Fuel Type (percent of generation)



Resource Adequacy Information Session

PUGET SOUND ENERGY

August 24, 2022

Safety Moment

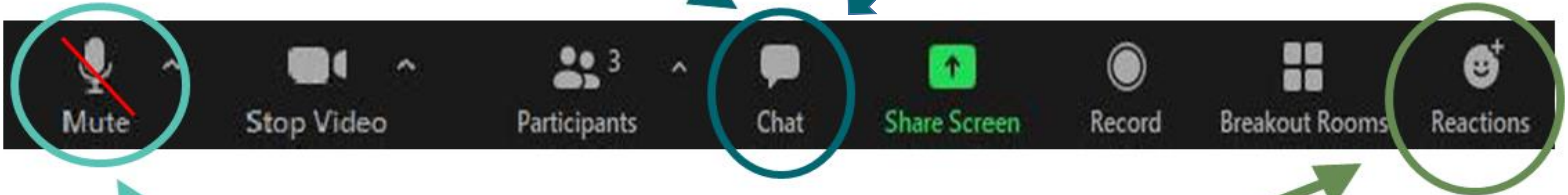
National Back to School Month

- Drive slow in residential neighborhoods and school zones in the morning and after school hours
- Watch for children on and near the road in the morning and after school hours
- Reduce distractions inside the car and focus on your surroundings
    - Ex. Set phone to *Do not disturb*

Welcome to the webinar and thank you for participating!

If you **want to type a question regarding the presentation**, insert **“Slide X followed by your question”** in the chat box!

If you **have a technical issue or a general question**, please type it in the chat box.



Please **keep yourself on mute** unless you are speaking.

If you want to **ask a question verbally,** click the ‘Reaction’ button and click on the **‘Raise Hand’** option and we will call on you.

This session is being recorded by Puget Sound Energy.
Third-party recording is not permitted.

Facilitator Requests

- Engage constructively and courteously towards all participants
- Respect the role of the facilitator to guide the group process
- "Take space and make space"
- Avoid use of acronyms and explain the technical questions

Agenda

Time	Agenda Item	Presenter
1:00 – 1:05 p.m. (5 min)	Opening	Sophie Glass, Triangle Associates
1:05 – 1:15 p.m. (10 min)	Recap from July Demand Forecast IRP / Meeting Purpose and Context	Phillip Popoff, PSE
1:15 – 1:50 p.m. (35 min)	Western Resource Adequacy Program Overview (WRAP)	Ryan Roy, WRAP
1:50 – 2:15 p.m. (25 min)	Regional Forecast	Aliza Seelig, PNUCC
2:15 – 2:25 p.m. (10 min)	Break	All
2:25 – 3:55 p.m. (90 min)	Summary of Resource Adequacy Modeling Results	Arne Olson & Joe Hooker, E3
3:55 – 4:00 p.m. (5 min)	Break	All
4:00: - 4:25 p.m. (25 min)	PSE Resource Needs & Market Reliance	Phillip Popoff, PSE
4:25 – 4:30 p.m. (5 min)	Next Steps	Sophie Glass, Triangle Associates
4:30 p.m.	Adjourn	Sophie Glass, Triangle Associates

PUGET SOUND ENERGY

Today's Speakers

Phillip Popoff
Director, Resource Planning Analytics, PSE

Arne Olson
Senior Partner, Energy + Environmental Economics (E3)

Joe Hooker
Associate Director, Energy + Environmental Economics (E3)

Ryan Roy
Director of Technology Modeling & Analysis, Western Power Pool

Aliza Seelig
Analytics and Policy Director, PNUCC

Sophie Glass
Co-facilitator, Triangle Associates

Recap from July Demand Forecast IRP

Phillip Popoff
Director, Resource Planning Analytics, PSE

How input from July meeting is shaping our work

Themes heard at July 12th Meeting (Demand Forecast)	What we did with it
Interest and concerns about the demand side resources in the IRP process. Some stakeholders expressed frustration that those elements were not included in the presentation.	PSE will consider how to improve the Integrated Resource Plan (IRP) process and the timing for presenting information to IRP stakeholders.
How does PSE incorporate compliance with the Climate Commitment Act within the Load Forecast? Given the state of gas and methane, is there some interaction with the load forecast?	PSE will analyze this after the portfolio analysis.
Stakeholders would like to provide input on conservation planning programs before they are implemented.	PSE develops these programs as part of the Biennial Conservation Plan that is filed with the UTC.
It is unclear if PSE is capturing heating trends for appliance use.	PSE will address this in the Conservation Potential Assessment (CPA).
Distribute the feedback document to participants by email instead of asking stakeholders to locate it on the IRP website.	PSE will update the location of the feedback form on the IRP website to make it more visible and link the feedback form in IRP emails.
Climate change: - Appreciation for including climate change and peak summer forecasts in load forecast. - Caution against lowering peak load expectation in the winter due to the possibility of wide swings in the wintertime due to climate change. - Weather variability takes out temperature swings and slides that show weather as variable are not weather-normalized.	PSE is working to improve climate change analysis. Load forecast reflects trends in normal peaks and resource adequacy will reflect variability.

Feedback and responses from July 12 meeting are addressed in the Feedback Report.

PSE PUGET SOUND ENERGY

PSE's Resource Adequacy Evolution

2021 All-Source Request For Proposal

- Aug of 2021, PSE hosted a workshop to discuss ELCC assumptions
  - PSE had an independent review of our resource adequacy model by E3
- Sept of 2021, E3 presented their findings to stakeholders
- Oct of 2021 PSE posted E3 ELCCs report along with PSEs action plan

2023 Electric Progress Report

- March of 2022, Resource adequacy modeling outsourced to E3 due to a key retirement
- E3 addressed made the updates PSE committed to making in Oct of 2021 to their RECAP model, results will be reviewed during the meeting today

Links to the above information can be found on the PSE IRP website here PSE | Get involved.

WRAP
POWERED BY WPP

Western Resource Adequacy Program

WRAP Presentation for PSE
August 24, 2022

Ryan Roy, Director of Technology, Modeling, and Analytics
Western Power Pool

Presentation Topics

- » WRAP Overview
- » Preliminary Metrics
- » Timeline and Status

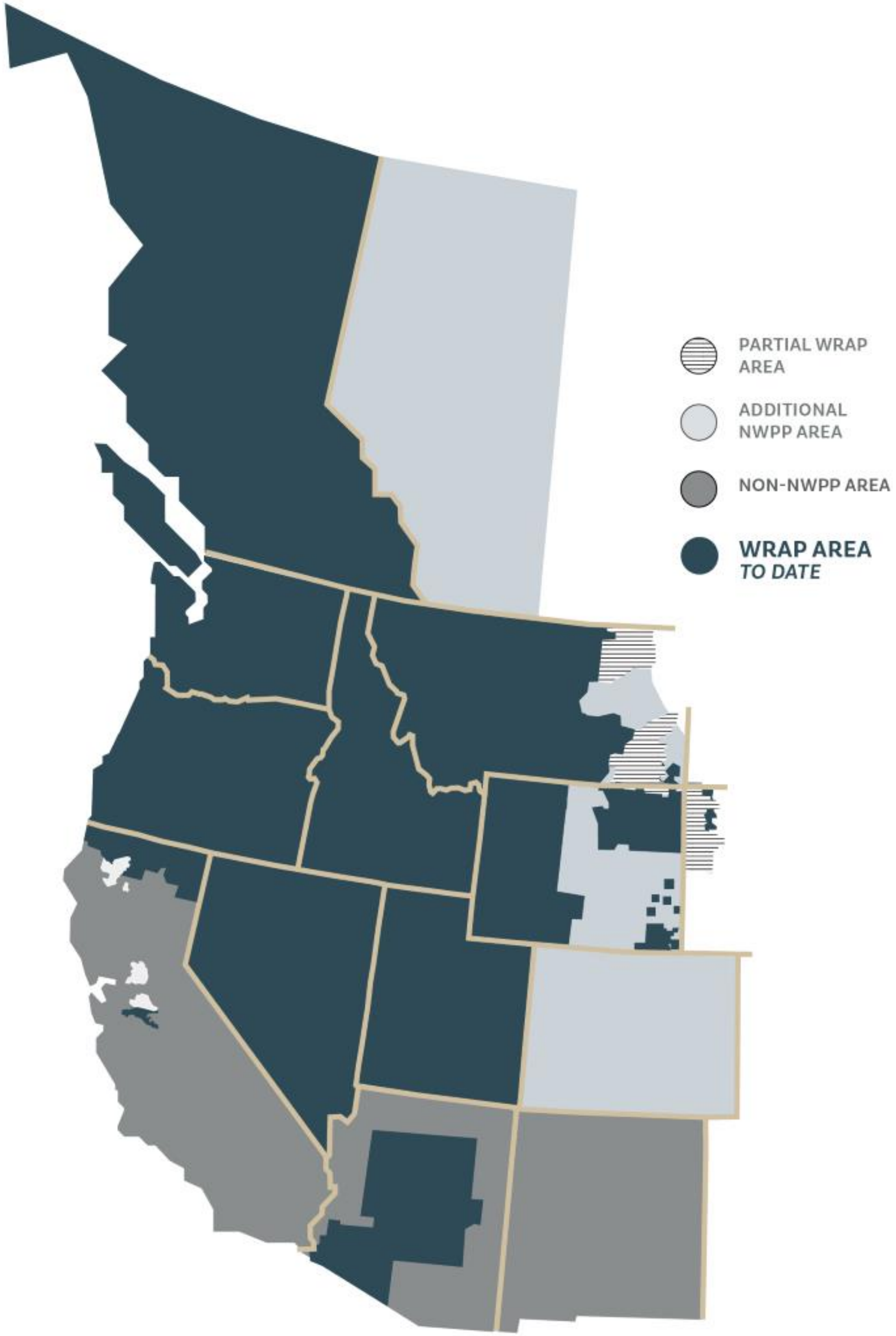
WRAP OVERVIEW

WRAP
POWERED BY WPP

Phase 3A Participants

Arizona Public Service
Avangrid
Avista
Black Hills
Basin Electric
Bonneville Power Administration
Calpine
Chelan PUD
Clatskanie PUD
Douglas PUD
Eugene Water & Electric Board
Grant PUD
Idaho Power
NorthWestern Energy
NV Energy
PacifiCorp
Portland General Electric
Powerex
Puget Sound Energy
Salt River Project
Seattle City Light
Shell
Snohomish PUD
Tacoma Power
The Energy Authority
Turlock Irrigation District

WRAP
POWERED BY WPP



- **Industry-driven initiative** for regional approach to help ensure resource adequacy in light of changing resource composition and increased resource uncertainty
  - Estimated peak winter load of 65,122 MW and summer load of 66,768 MW
- **Participation is voluntary**, with mandatory requirements once joined
- Implemented through **bilateral transactions under existing frameworks**

SOLVING A PROBLEM

» What WRAP does:

- » Implements a **binding forward showing** framework that requires entities to demonstrate they have secured their share of the regional capacity need for the upcoming season
- » Implements a **binding operational program** that obligates members with calculated surplus to assist participants with a calculated deficit on the hours of highest need
- » Leverages the binding nature of the operational program, together with modeled supply and load diversity, to **safely lower the requirements** in the forward showing and help **inform resource selection** for the region, **driving investment savings** for members and their end use customers

WRAP
POWERED BY WPP

Program Design Overview

Forward Showing Program

- Establishes a **regional reliability metric** (1 event-day in 10 years LOLE)
- Utilizes thoughtful modeling and analytics to:
  - Determine historical summer and winter **capacity critical hours** (CCHs) data sets for the region
  - Determine each resource type's **qualifying capacity contribution** (QCC) to the regional capacity needs
  - Determine a planning reserve margin (PRM) which is applied to peak load forecast based on P50 metric
- Showing requirement includes **deliverability** component
  - Firm or conditional firm transmission to meet 75% of P50 + PRM (paired with robust exception framework)
- Participant compliance obligation (7 months in advance of binding season) = **physically firm resources to meet P50 + PRM**

Determine Program Capacity Requirement

↓

Determine Resource Capacity Contribution

↓

Compliance Review of Portfolio

Program Design Overview

Operations Program

- Evaluates participants operational situation relative to Forward Showing assumptions (for load, outages, VER performance)
- Obligates participants with calculated surplus to assist participants with a calculated deficit on the hours of highest need
- Deficiency forecast on day before Operating Day (Preschedule Day) establishes Holdback Requirement for surplus participants
- Surplus Participant that fails to provide assigned Energy Deployment must pay Energy Delivery Failure Charge

PRELIMINARY METRICS

Phase 3A WRAP Metrics

» Metrics provided are based on modeling completed with data from current (Phase 3A) participants

» Metrics are only representative if:

- The WRAP exists (is FERC approved), has participants, and can share load and resource diversity amongst participants as anticipated
- Current participants move forward with WRAP in December 2022
- Participants are subject to binding obligations to share diversity

» Until we reach this status, each participant will continue to make assessments of their own circumstances to determine how to interpret these modeling results, what reserve margins to keep, etc.

WRAP
POWERED BY WPP

Phase 3A Planning Reserve Margins

- WRAP footprint was modeled in two main subregions:
  - Northwest (NW)
  - Desert Southwest / East (DSW/E)

	Winter 2023-2024					Summer 2024			
	Nov	Dec	Jan	Feb	Mar	Jun	Jul	Aug	Sep
NW	21.6%	17.7%	19.0%	19.9%	26.0%	16.5%	10.4%	10.3%	17.9%
DSW / E	20.1%	16.8%	16.9%	21.5%	21.9%	17.8%	12.1%	12.8%	20.3%

WRAP

POWERED BY WPP

QUALIFYING CAPACITY CONTRIBUTIONS

Resource Type	Accreditation Methodology
Wind and Solar Resources	Effective Load-Carrying Capability (ELCC) analysis
Run-of-River Hydro	Average monthly output on capacity critical hours (CCHs)
Storage Hydro	WPP-developed hydro model that considers the past 10 years generation, potential energy storage, and current operational constraints.
Thermal	Unforced capacity (UCAP) method.
Short Term Storage	ELCC analysis (recent update - to be completed next model run)
Hybrid Resource	"Sum of parts" method where energy storage resource will use ELCC and generator will use appropriate method as outlined above
Customer Side Resources	Can either register as a load modifier or as a capacity resource

3A Hydro Average QCCs

	Nameplate	Winter 2023-2024					Summer 2024			
		Nov	Dec	Jan	Feb	Mar	Jun	Jul	Aug	Sep
Storage (data from Phase 2B)	46,467	81%	83%	84%	83%	82%	77%	77%	77%	78%
Run of River (summer peaking)	2,815	19%	18%	14%	13%	15%	71%	71%	63%	63%
Run of River (winter peaking)	1,408	31%	34%	35%	37%	35%	30%	26%	21%	20%

WRAP
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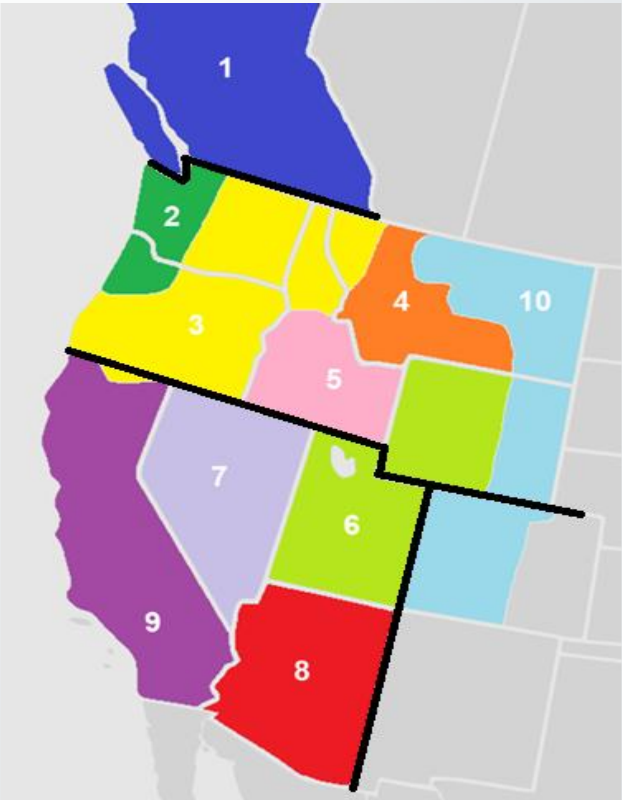
SOLAR ELCC ZONES

WRAP footprint split in two zones for solar resource ELCC modeling

- » Zone 1 – North
  - – Washington, Oregon, Idaho, Montana, Wyoming
- » Zone 2 – South
  - – California, Nevada, Utah, Arizona



WRAP
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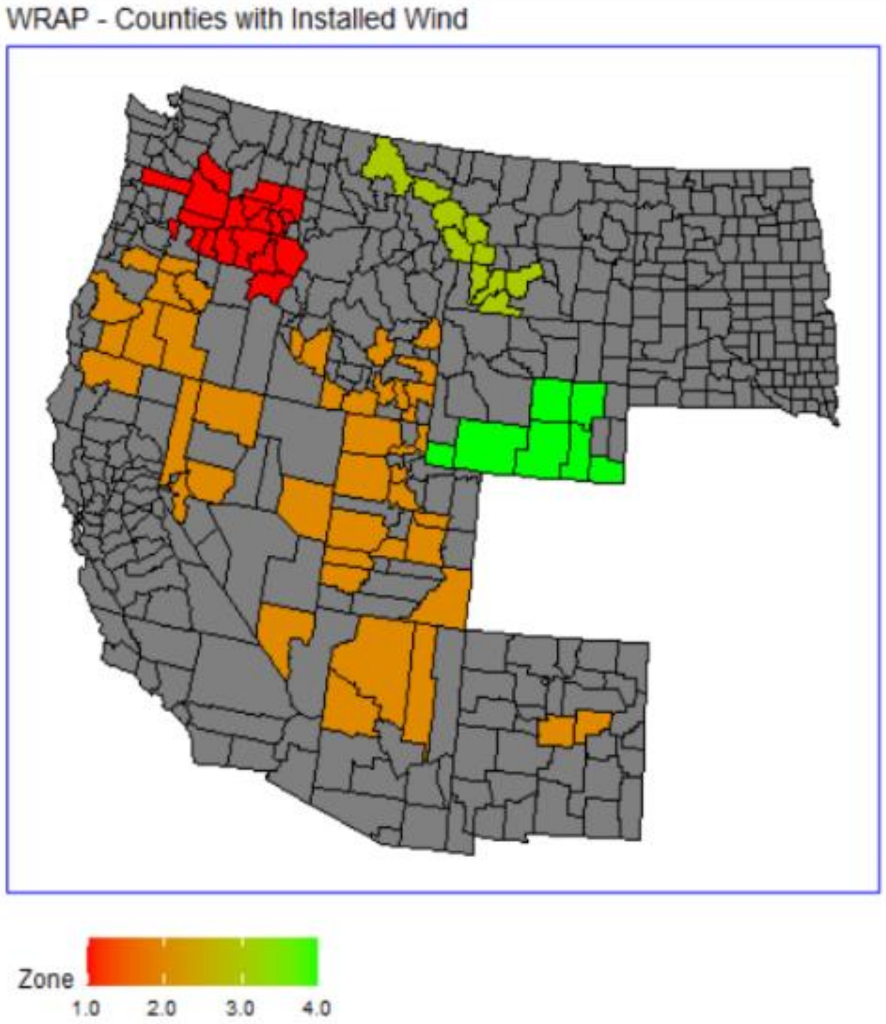
WRAP 3A SOLAR ELCC

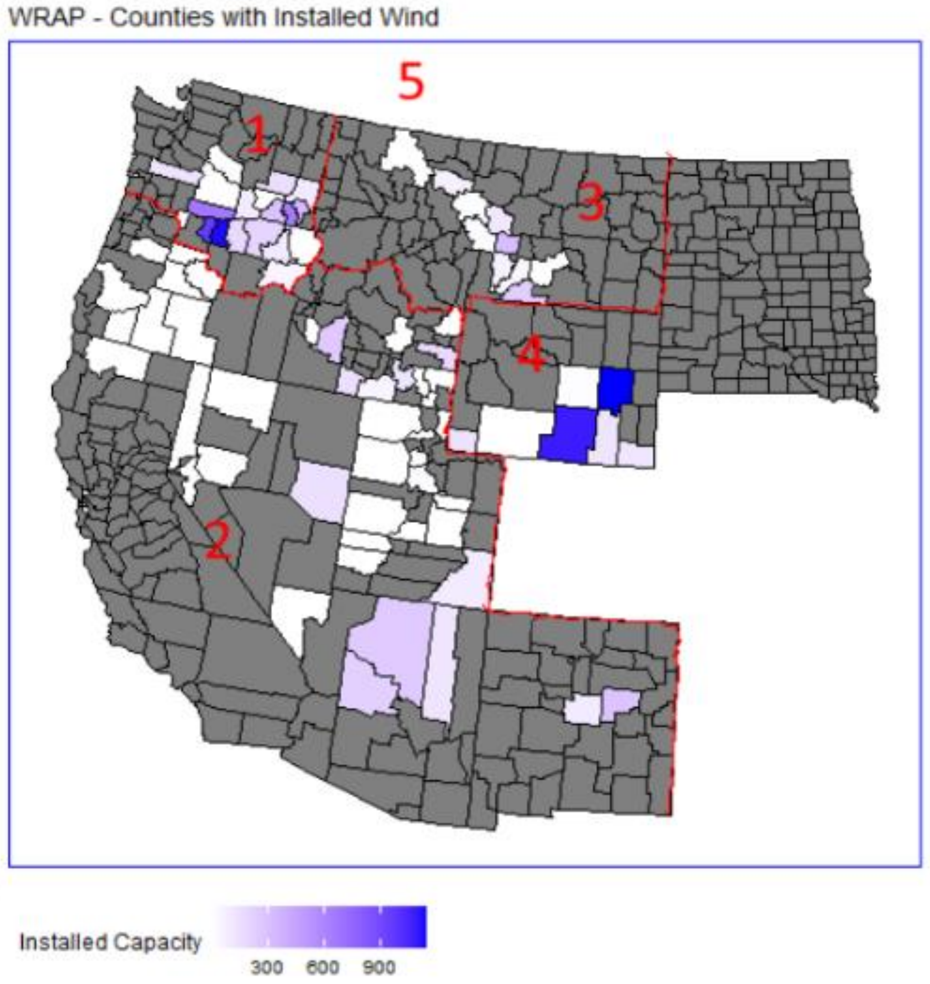
» Allocation of ELCC within each zone based on average monthly output on CCHs

– Anticipated to capture the time zone and geographic (East/West) diversity of resources

		Winter 2023-2024					Summer 2024			
	Nameplate	Nov	Dec	Jan	Feb	Mar	Jun	Jul	Aug	Sep
Zone 1 (North)	2,138 MW	2%	3%	3%	4%	5%	23%	30%	24%	13%
Zone 2 (South)	9,024 MW	3%	5%	7%	7%	5%	16%	24%	23%	11%

ELCC WIND ZONES





WRAP 3A WIND ELCC

	Nameplate	Winter 2023-2024					Summer 2024			
		Nov	Dec	Jan	Feb	Mar	Jun	Jul	Aug	Sep
Zone 1 (WA+)	5,734	10%	9%	8%	11%	13%	19%	22%	18%	13%
Zone 2	2,400	32%	30%	28%	32%	34%	18%	18%	16%	16%
Zone 3 (MT)	1,378	30%	29%	28%	23%	25%	13%	12%	13%	14%
Zone 4 (WY)	2,429	36%	32%	30%	27%	31%	15%	16%	14%	14%
Zone 5 (BC)	747	29%	28%	23%	24%	22%	18%	17%	21%	22%

WRAP
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$$Resource\ ELCC = Monthly\ ELCC\ MW * \left(\frac{Resource\ average\ hourly\ net\ power\ output\ on\ CCHs}{Zone\ total\ average\ hourly\ net\ power\ output\ on\ CCHs}\right)$$

For both wind and solar, analysis of historical average hourly net power output will utilize the following data:

- 3 years of data, if available
  - No less than 3 years will be utilized - if 3 years of data is not available, resource will receive (class ELCC %) x (nameplate) *
- Allocation of zonal ELCC to individual resource may be adjusted as actual production data is accumulated

*exception for new / repowered resources

Timeline and Status

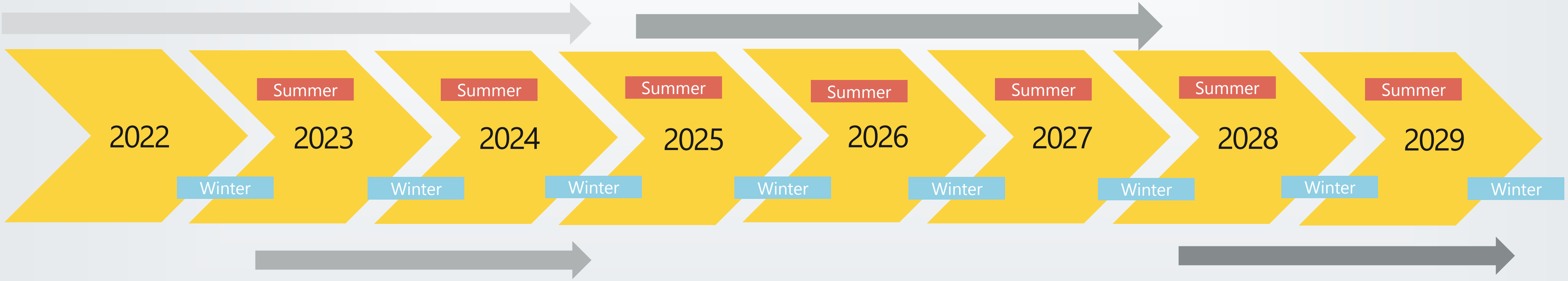
Transition Timeline

Non-Binding Forward Showing

Winter 22-23, Summer 23, Winter 23-24, Summer 24, Winter 24-25

Transition Seasons (Ops and FS)

Summer 25, Winter 25-26, Summer 26, Winter 26-27, Summer 27, Winter 27-28



Non-Binding Operations Program

Summer 23 (trial – will include testing scenarios), Winter 23-24, Summer 24, Winter 24-25

Binding Program Without Transition Provisions

Summer 28 and all seasons following

Current Phase Activities

PO collected data from participants

Design refinement and public webinars

PO running LOLE/ELCC models – *draft results to participants*

Showing for Winter 2022-2023 Non-Binding season

Showing for Summer 2023 Non-Binding season

Asking for sign ups in late 2022 for transition to Binding program

Oct 2021

We are here

Dec 2022

1/23 Requested effective date for WRAP implementation

Design refinements led into tariff drafting

Participant review of tariff in Spring

Draft tariff out for public review and webinar

Aiming to file with FERC in late August

Asking for FERC order prior to sign-up window

PO = Program Operator
LOLE = Loss of Load Expectation
ELCC = Expected Load Carrying Capacity

WRAP
POWERED BY WPP

THANK YOU

Ryan.Roy@westernpowerpool.org

For general inquiries or to be added to our mailing list:
wrap@westernpowerpool.org

PNUCC

2022 Northwest Regional Forecast

PUGET SOUND ENERGY IRP PUBLIC MEETING

AUGUST 24, 2022

Northwest Regional Forecast
A regional adequacy barometer

- Since 1946 public and private utilities have come together at the Pacific Northwest Utilities Conference Committee (PNUCC) to assess regional power supply
- For 70 years, adding up NW utilities' firm requirements & resources (sum-of-utilities integrated resource plans)
- Tracking trends using consistent assumptions
  - ✓ Annual energy
  - ✓ winter & summer peak 1-hour

The region

It's all utilities

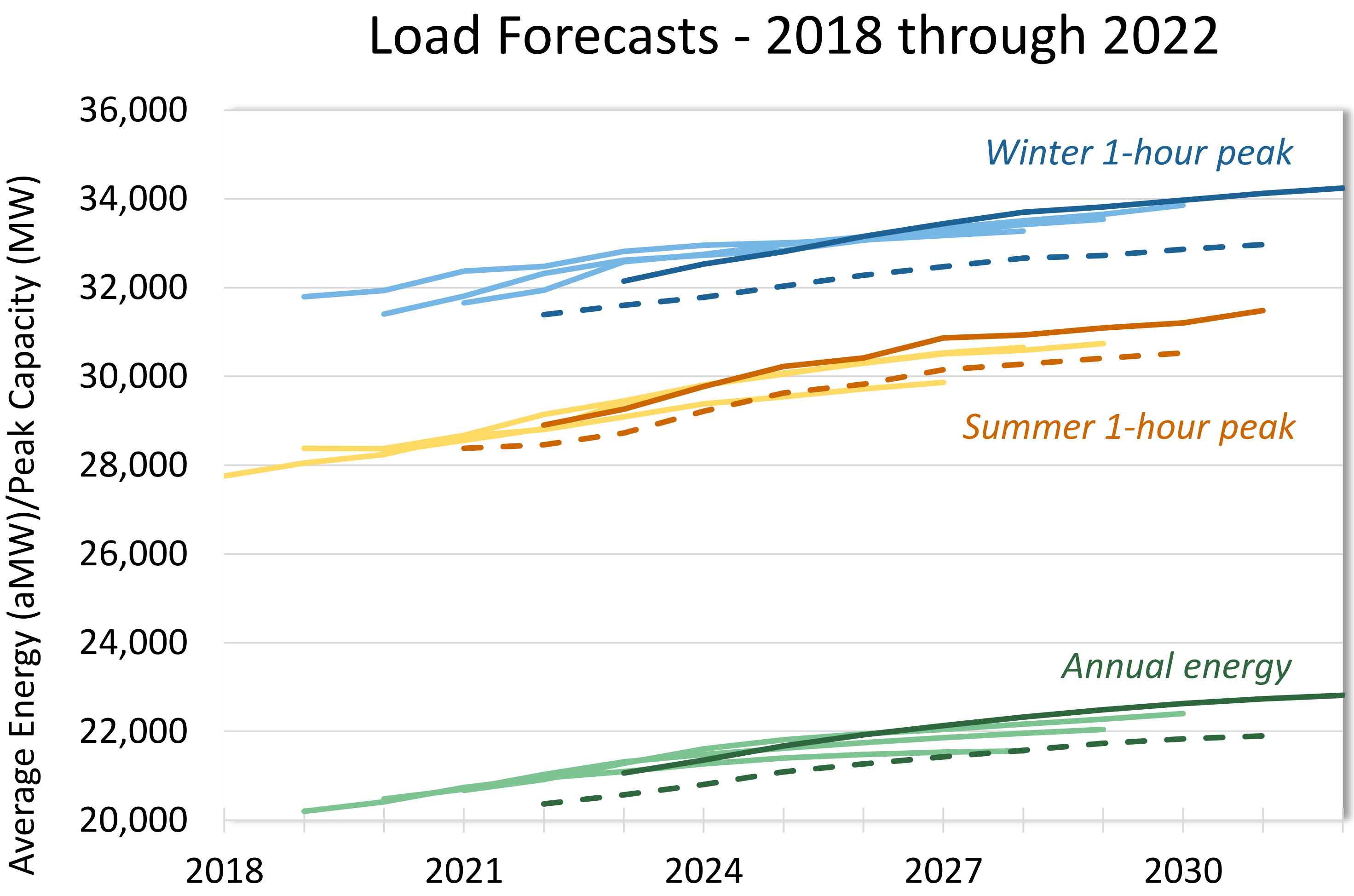
- Avista
- Benton PUD
- Bonneville Power
- Central Lincoln PUD
- Chelan PUD
- Clark Public Utilities
- Clatskanie PUD
- Cowlitz PUD
- Douglas PUD
- Emerald PUD
- EWEB
- Flathead Electric Coop.
- Franklin PUD
- Grant PUD
- Grays Harbor PUD
- Idaho Power
- Mason PUD #3
- NorthWestern Energy
- Pacific Power
- Pend Oreille County PUD
- PNGC Power
- Portland General Electric
- Puget Sound Energy
- Seattle City Light
- Snohomish PUD
- Springfield Utility Board
- Tacoma Power

PNUCC

Sum-of-utilities requirements & resources

Requirements	1-in-2 loads after energy efficiency 16% planning margin for peak Long-term export contracts
Demand side management	Utilities' savings forecasts
Generating resources	Utility-owned only Utilities' expected operation
Hydropower	Low water conditions (8% for peak)

Load forecast comparison

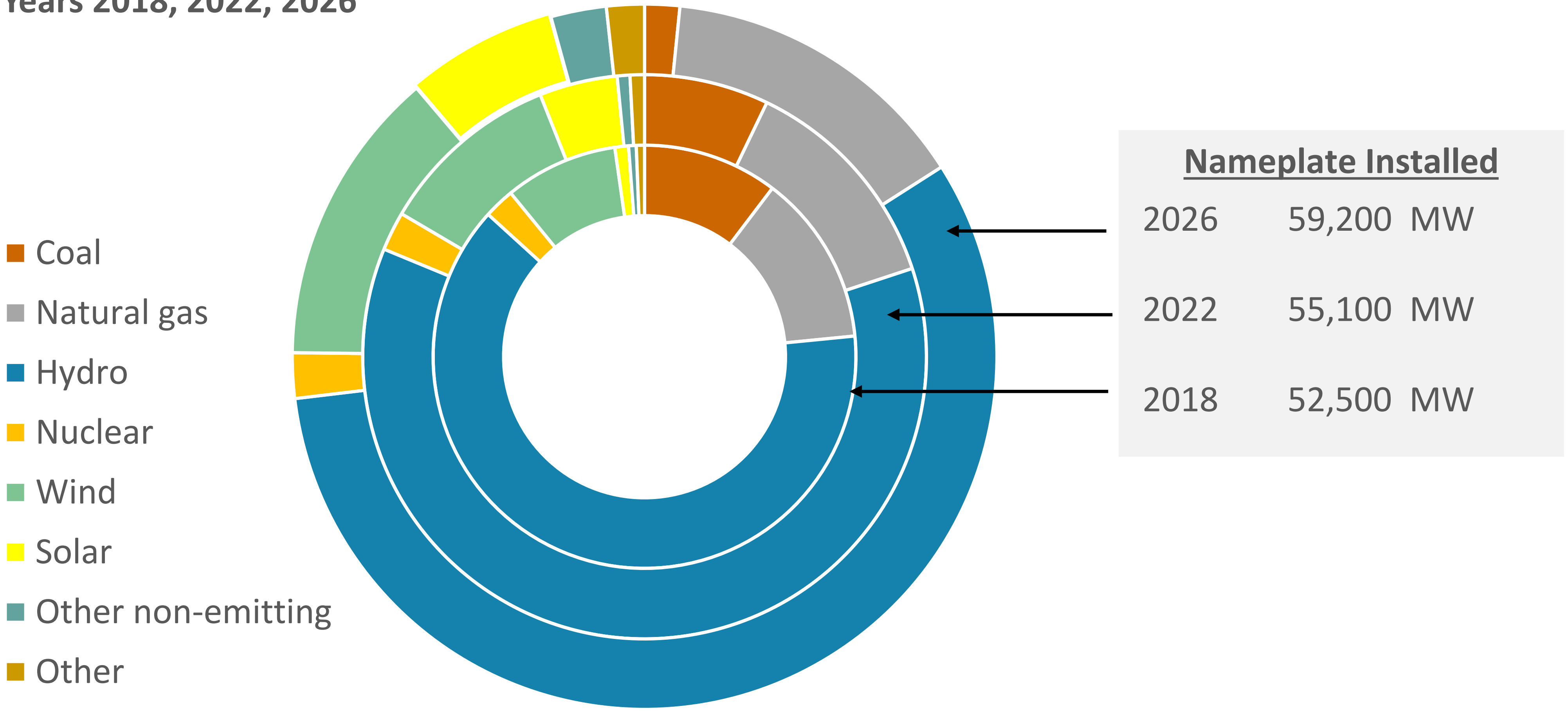


PNUCC

Generating resources evolving

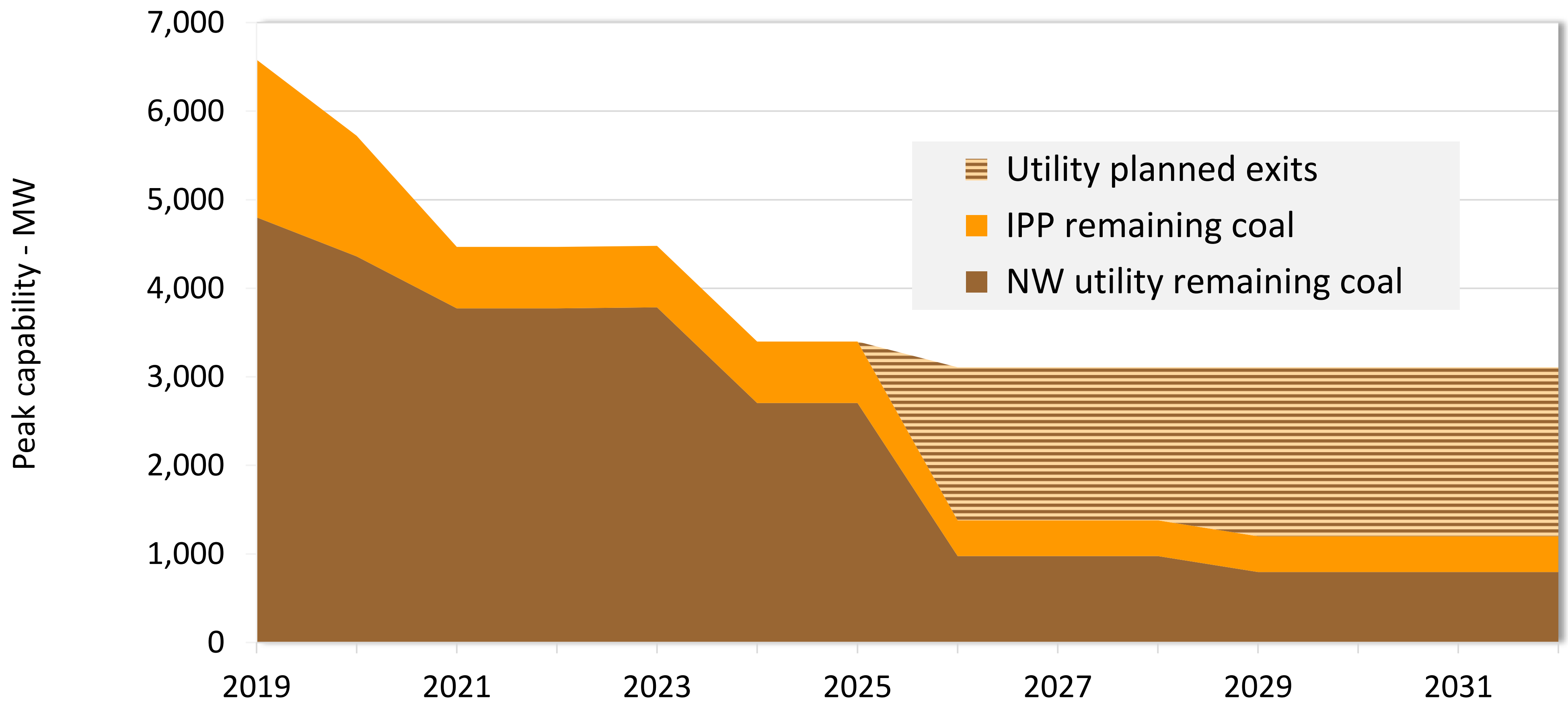
Northwest Utilities Generating Resources

Years 2018, 2022, 2026



PNUCC

Coal plant availability is declining

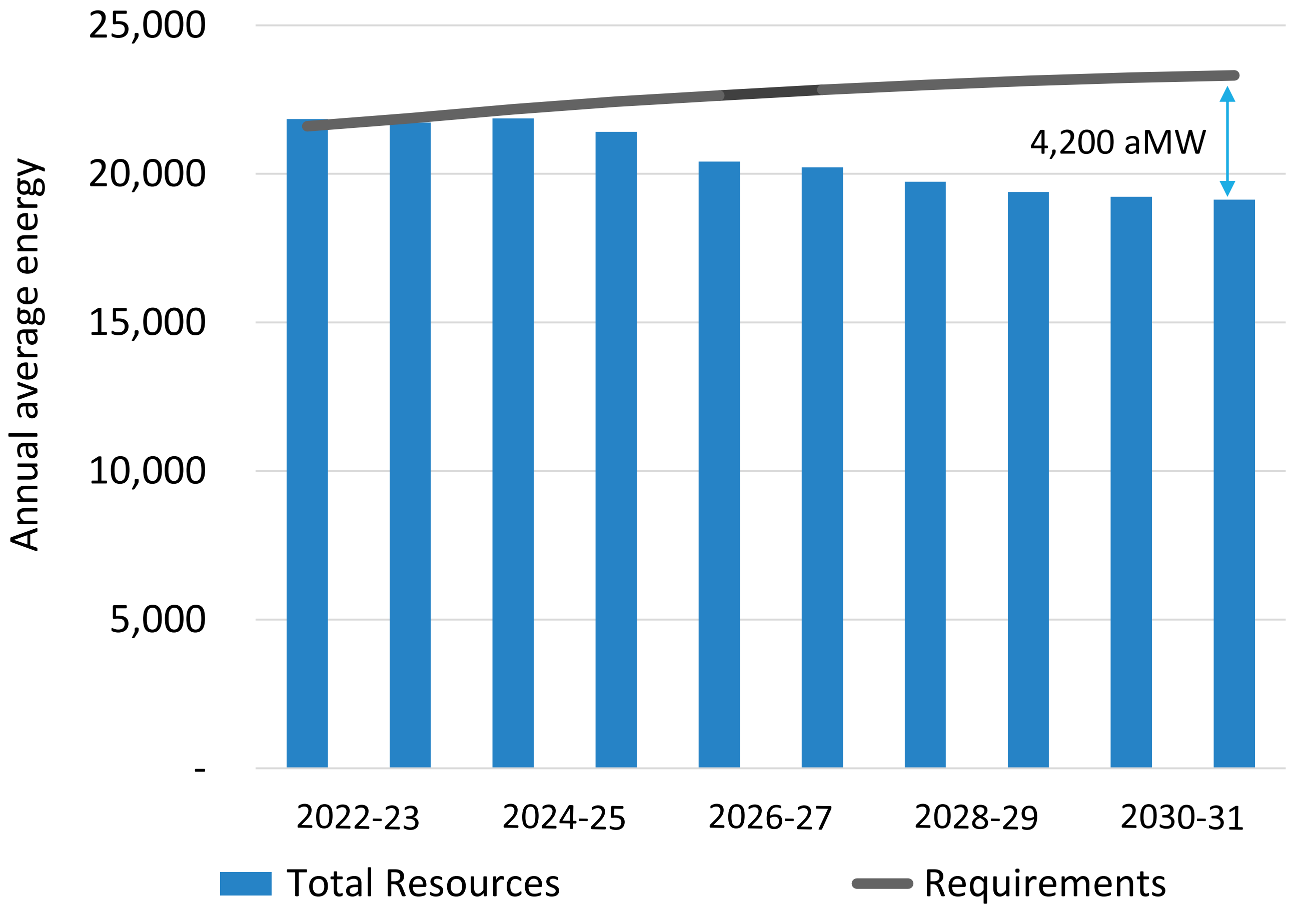


PNUCC

Energy need on the horizon

- Jim Bridger 1 & 2 offline in 2024 for conversion to natural gas
- Planned energy efficiency programs are part of load
- Demand response included in resources

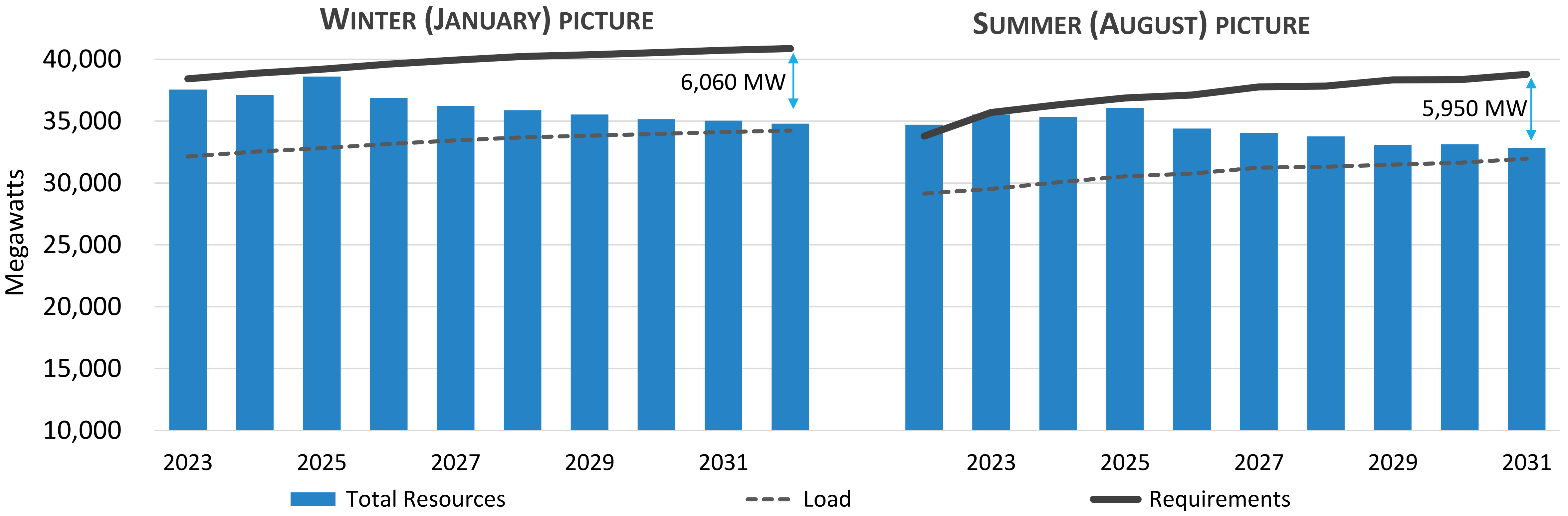
NORTHWEST ENERGY LOAD & RESOURCES PICTURE



Surplus/ (Deficit)	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	240	(150)	(311)	(1,015)	(2,220)	(2,601)	(3,259)	(3,735)	(4,007)	(4,187)

PNUCC

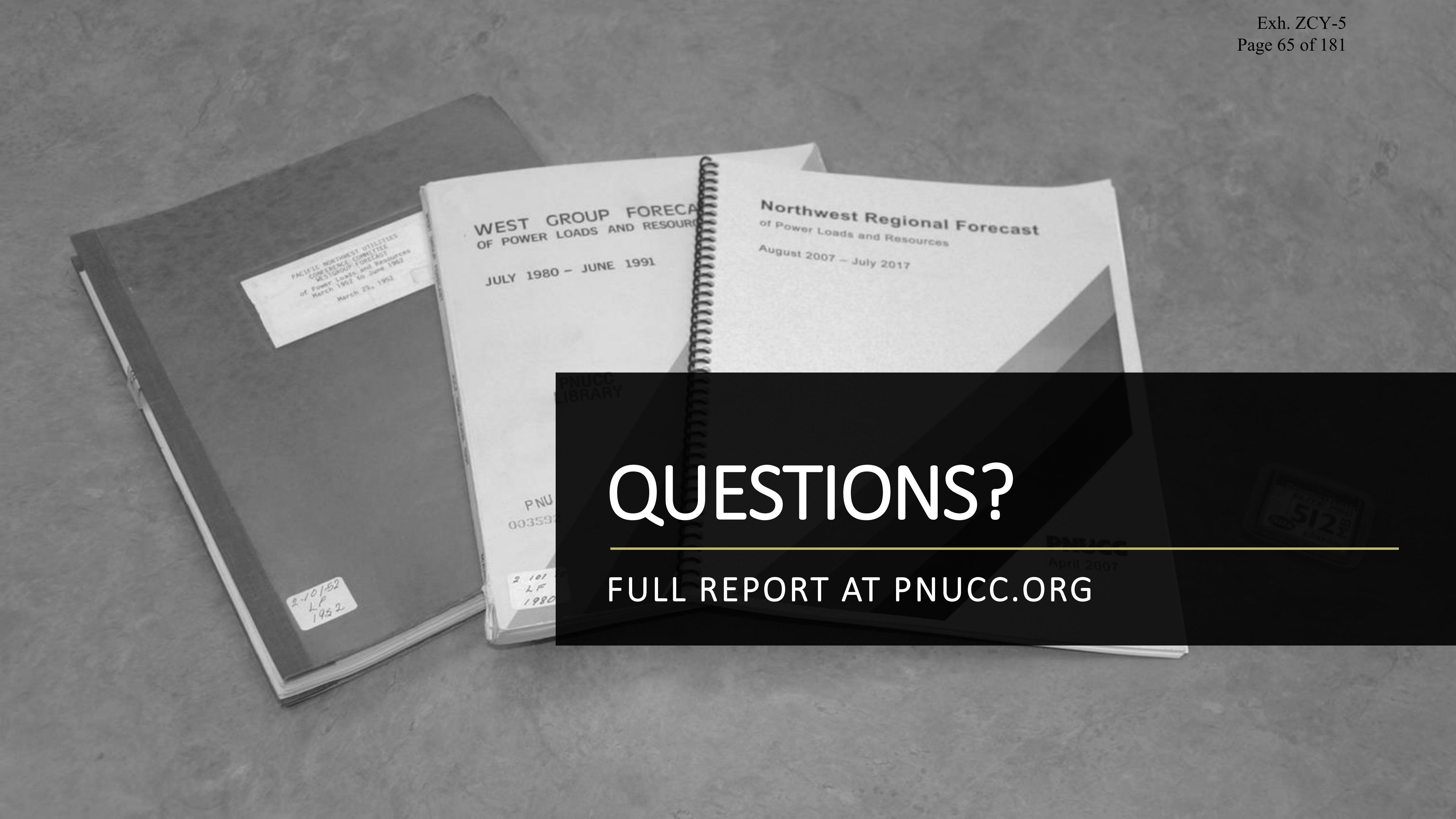
Peak load needs continue to grow



Surplus/ (Deficit)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
	(869)	(1,745)	(599)	(2,733)	(3,711)	(4,349)	(4,833)	(5,382)	(5,679)	(6,058)

2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
922	(165)	(981)	(803)	(2,720)	(3,727)	(4,064)	(5,242)	(5,215)	(5,945)

PNUCC



QUESTIONS?

FULL REPORT AT PNUCC.ORG

Break

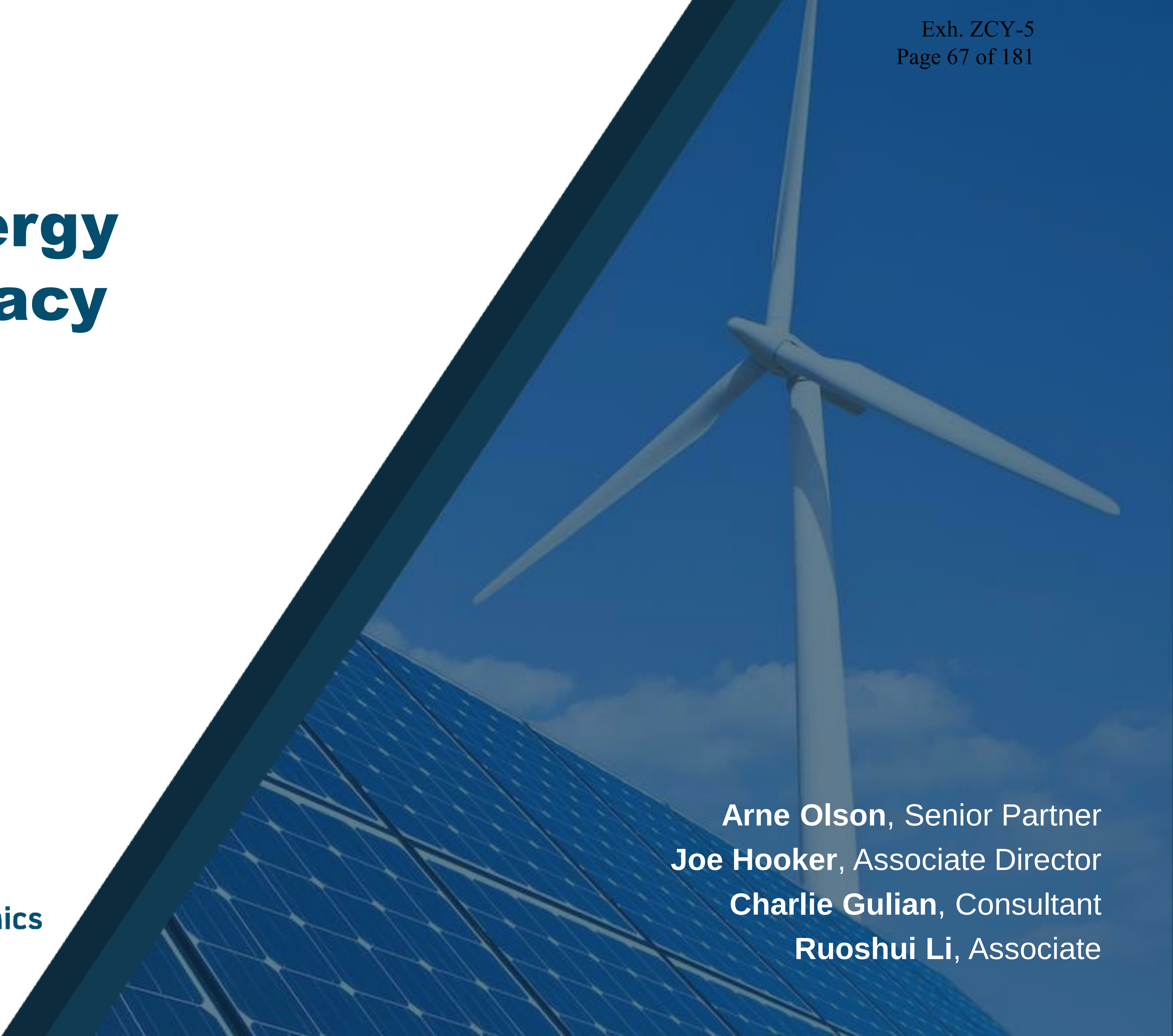
Please return in 5 minutes

**Monet Wind" by Eric Jensen of Roslyn, WA*

Puget Sound Energy Resource Adequacy

Stakeholder presentation

August 2022



Arne Olson, Senior Partner
Joe Hooker, Associate Director
Charlie Gulian, Consultant
Ruoshui Li, Associate

Energy+Environmental Economics

Agenda

- Background on resource adequacy
- Changes in the 2023 IRP
- Results
- Q&A

Energy + Environmental Economics (E3)

Technical and Strategic Consulting for the Clean Energy Transition

~90 consultants across 4 offices with expertise in energy economics, policy, modeling

San Francisco

New York

Boston

Calgary

250+ projects per year across diverse topic areas

Recent Projects

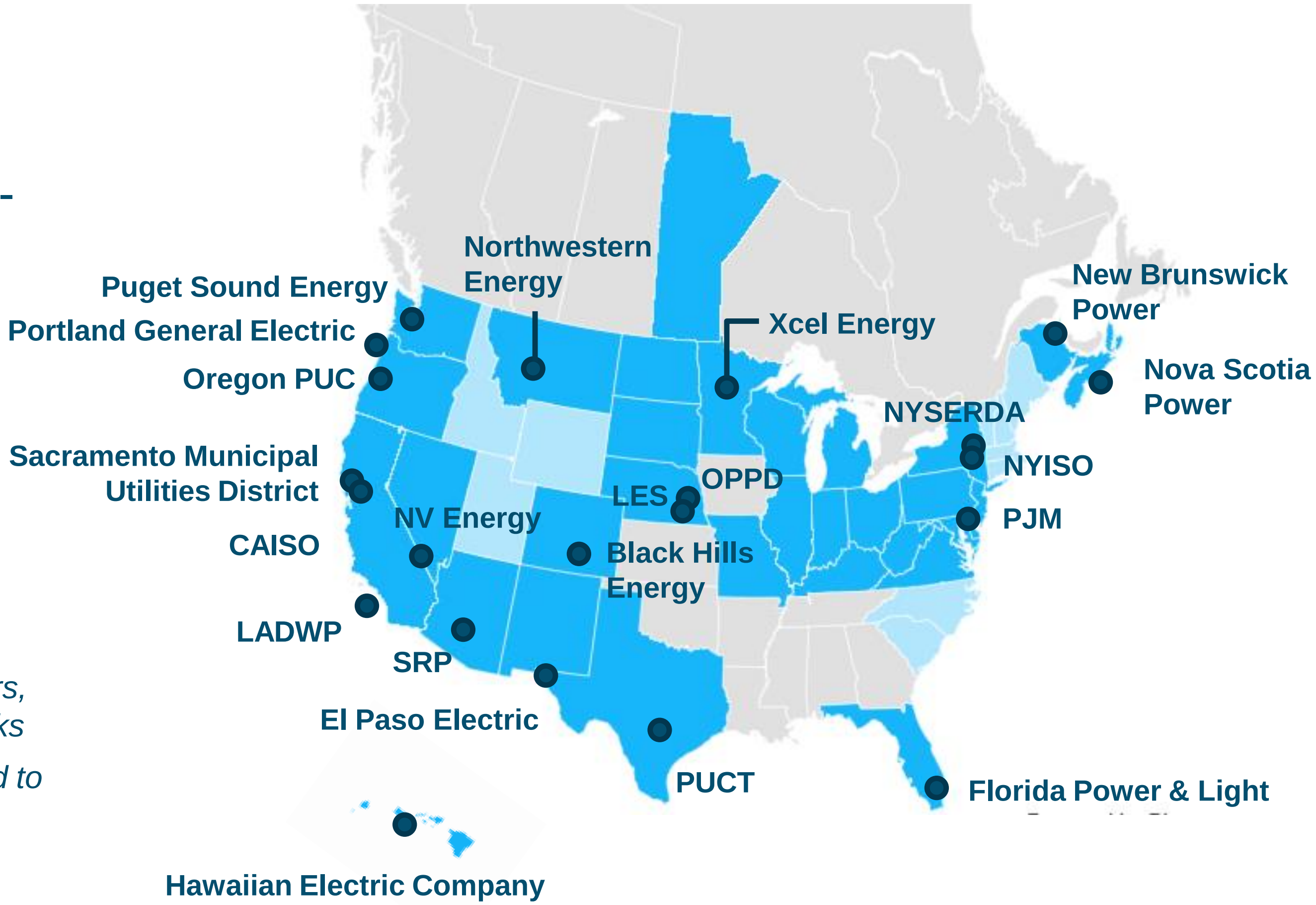
- Resource Adequacy in the Desert Southwest - E3 conducted a study to examine reliability in the Southwest and identify best practices for resource adequacy that will provide a durable foundation for utilities' planning efforts to preserve reliability in the region
- Lower Snake River Dams Power Replacement Study – E3 evaluated options for replacing power from the Lower Snake River dams across a wide range of scenarios. E3 developed alternative resource portfolios and estimated costs across these scenarios
- NorthWestern Energy Capacity Contribution Accreditation – E3 supported NWE's 2019 Resource Procurement Plan by calculating ELCCs to use for capacity accreditation

E3's experience performing resource adequacy analysis

E3 has developed RECAP, a proprietary model for performing loss of load analysis

- Simulation model for assessing resource availability over **hundreds of simulation years**
- **Time-sequential dispatch** for capturing energy-limited resource dynamics for hydro, energy storage, and demand response

E3 has worked directly with utilities across North America to study resource adequacy needs



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

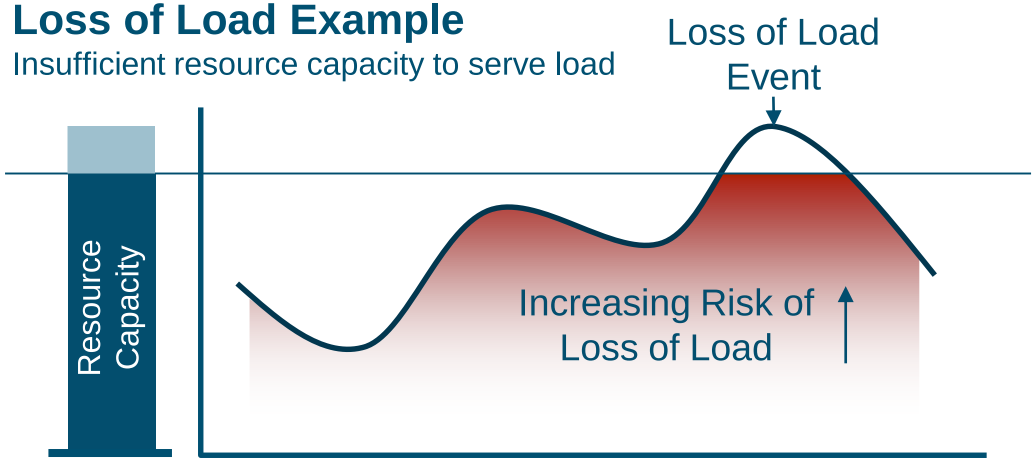
Background on Resource Adequacy

Energy+Environmental Economics

What is resource adequacy?

+ **Resource adequacy is a measure of the ability of a portfolio of generation 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
  - PSE uses a 5% LOLP standard

Loss of Load Example
Insufficient resource capacity to serve load

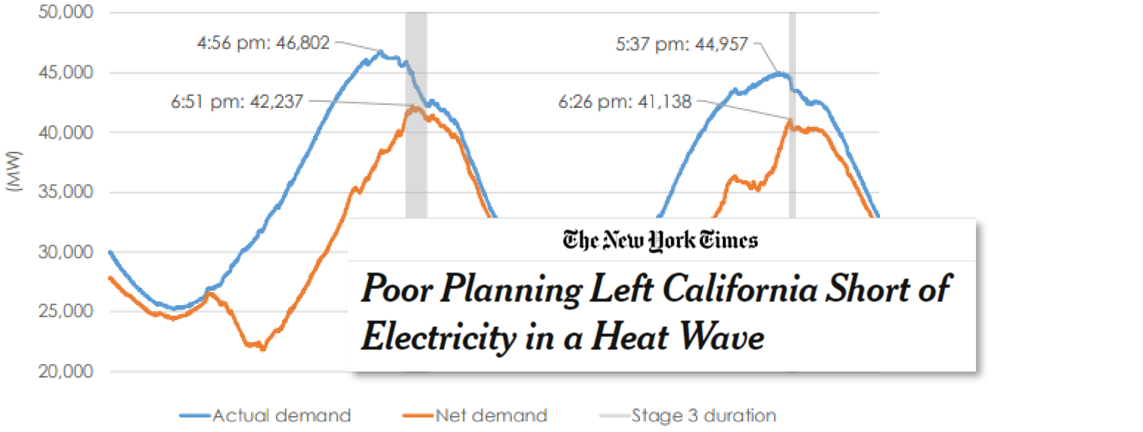


NERC Definition of Resource Adequacy:
"The ability of supply-side and demand-side resources to meet the aggregate electrical demand (including losses)"

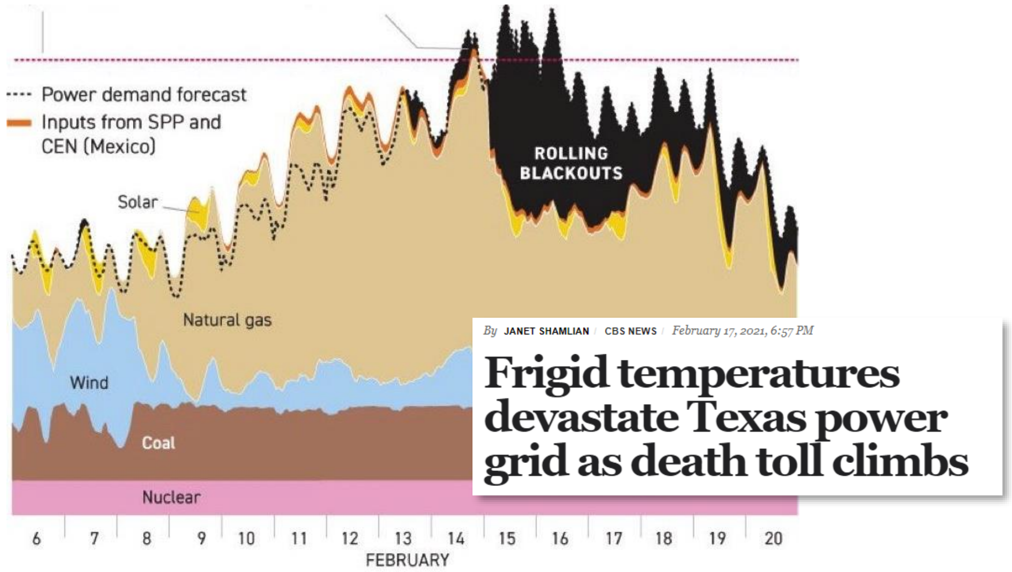
Source: NERC Glossary of Terms

Resource adequacy is increasing in complexity and importance

+ **Transition towards renewables and storage introduces new sources of complexity in resource adequacy planning**
  - The concept of planning exclusively for "peak" demand becoming obsolete
  - Resource adequacy frameworks must be modernized to consider conditions across all hours of the year – as underscored by California's rotating outages during August 2020 "net peak" period
+ **Reliable electricity supply is becoming increasingly important to society:**
  - Ability to supply cooling and heating electric demands in more frequent extreme weather events is increasingly a matter of life or death
  - Economy-wide decarbonization goals will drive electrification of transportation and buildings, making the electric industry the keystone of future energy economy



Graph source: http://www.caiso.com/Documents/Final-Root-Cause-Analysis-Mid-August-2020-Extreme-Heat-Wave.pdf

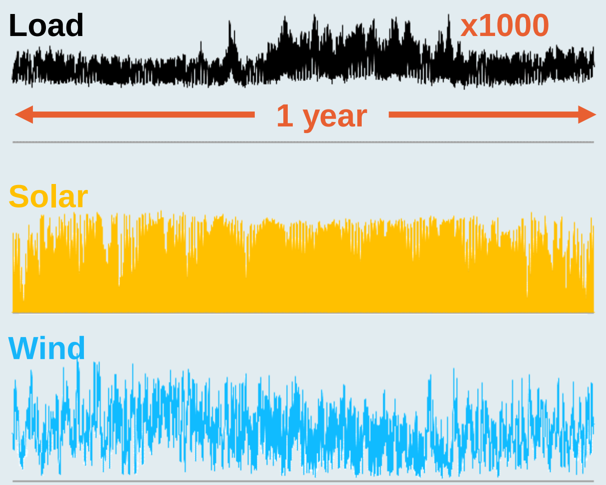


Graph source: https://twitter.com/bcshaffer/status/1364635609214586882

Planners are increasingly using LOLP models to support enhancements to resource adequacy

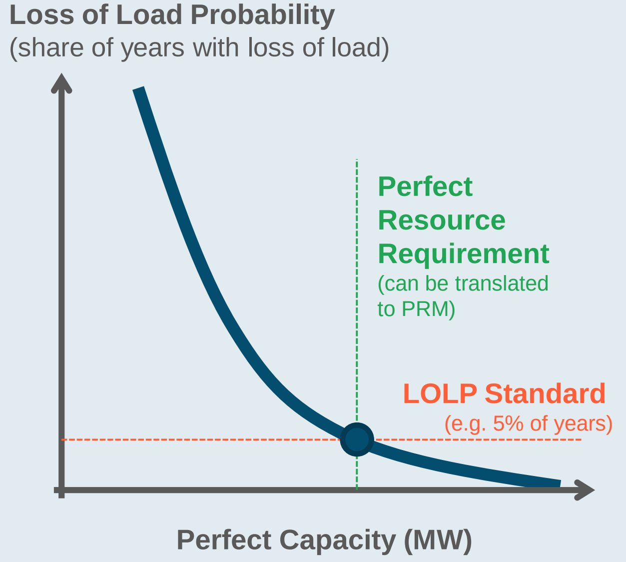
Develop a representation of the loads and resources of an electric system in a loss of load probability model

LOLP modeling allows a utility to evaluate resource adequacy across all hours of the year under a broad range of weather conditions, producing statistical measures of the risk of loss of load



Identify the amount of perfect capacity needed to achieve the desired level of reliability

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

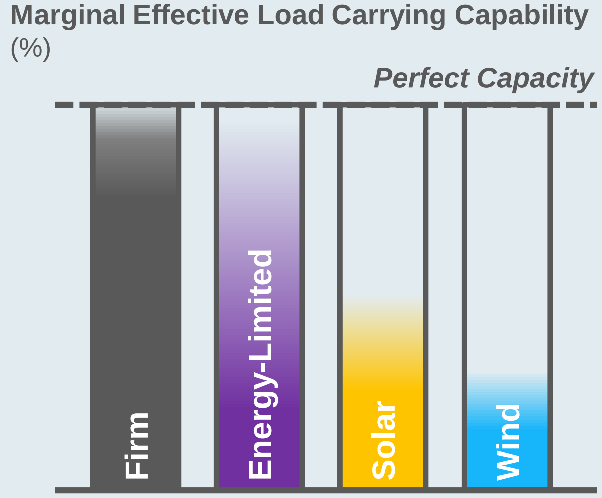


Outputs:

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

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

PRM and ELCC

Planning Reserve Margin (PRM)

The PRM is the total amount of capacity needed to satisfy PSE's reliability target, which is 5% loss of load probability (or 1 in 20 years with loss of load).

"How many MW needed in total"

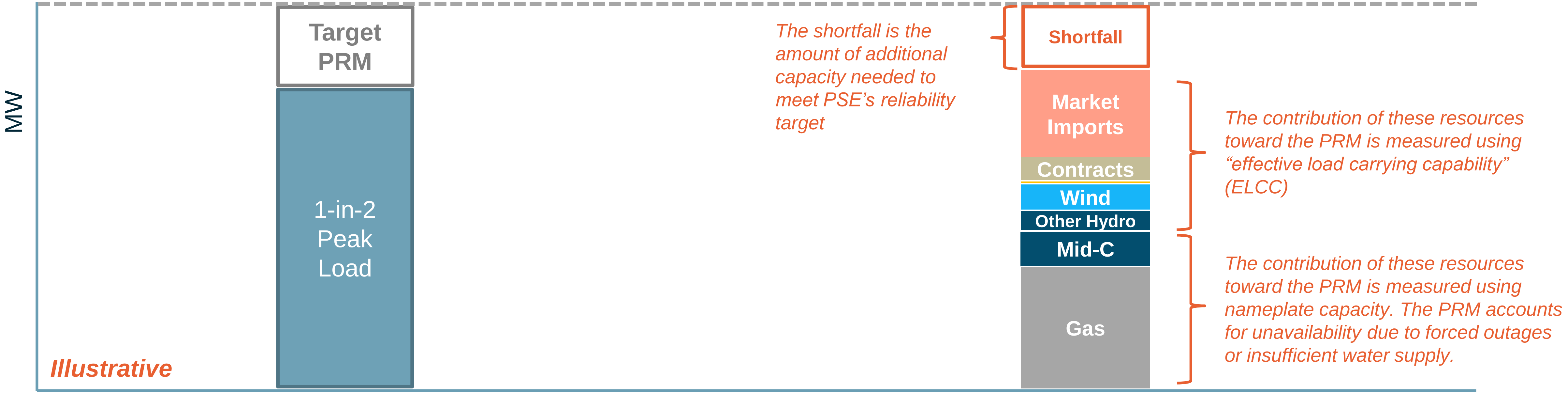
Measured as % above PSE's expected peak load

Effective Load Carrying Capability (ELCC)

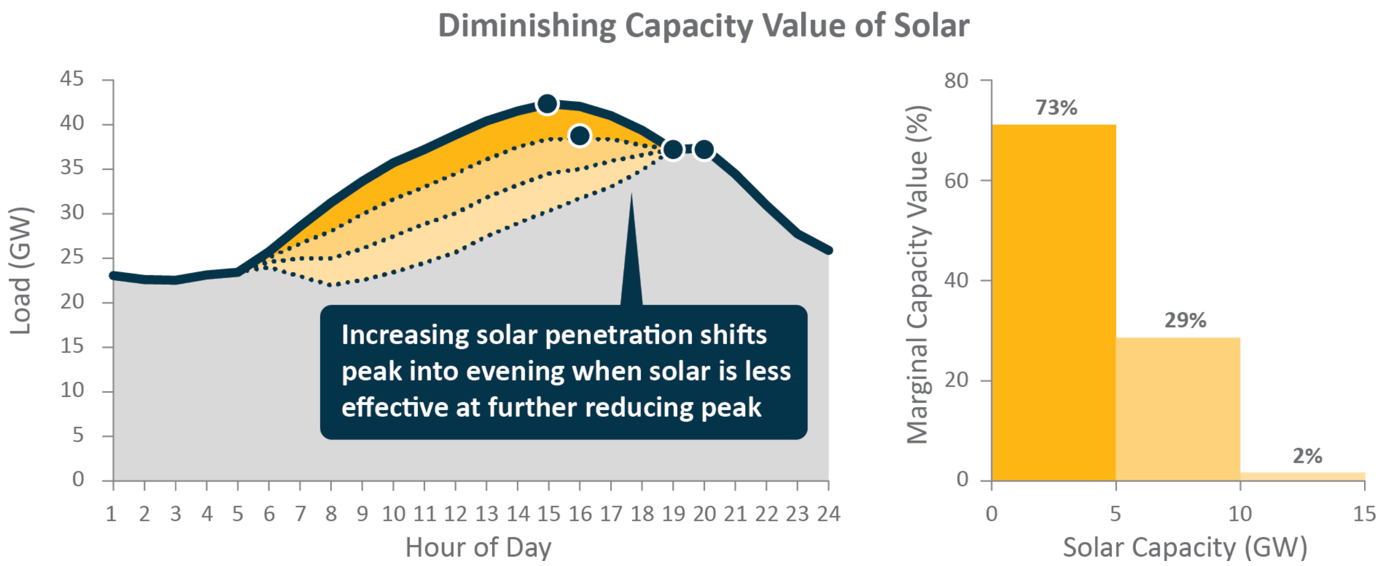
The ELCC is the equivalent "perfect" capacity that a resource provides in meeting PSE's reliability target

"How many MW provided by each resource"

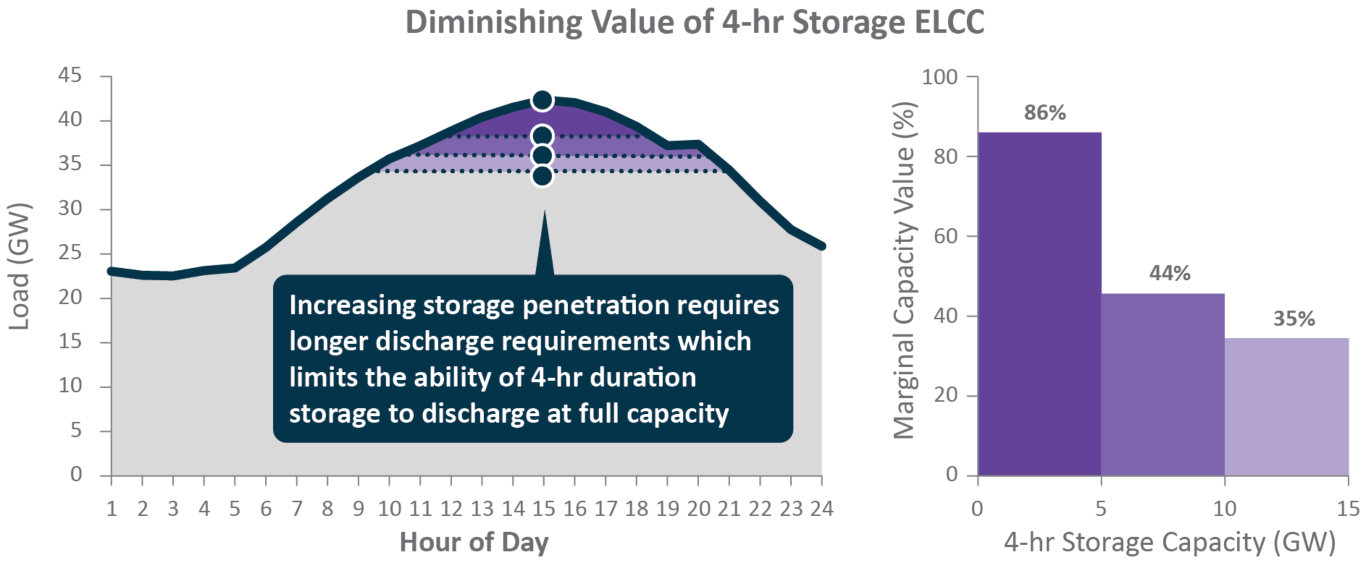
Measured as % of nameplate capacity



ELCC captures saturation effects at increasing penetrations



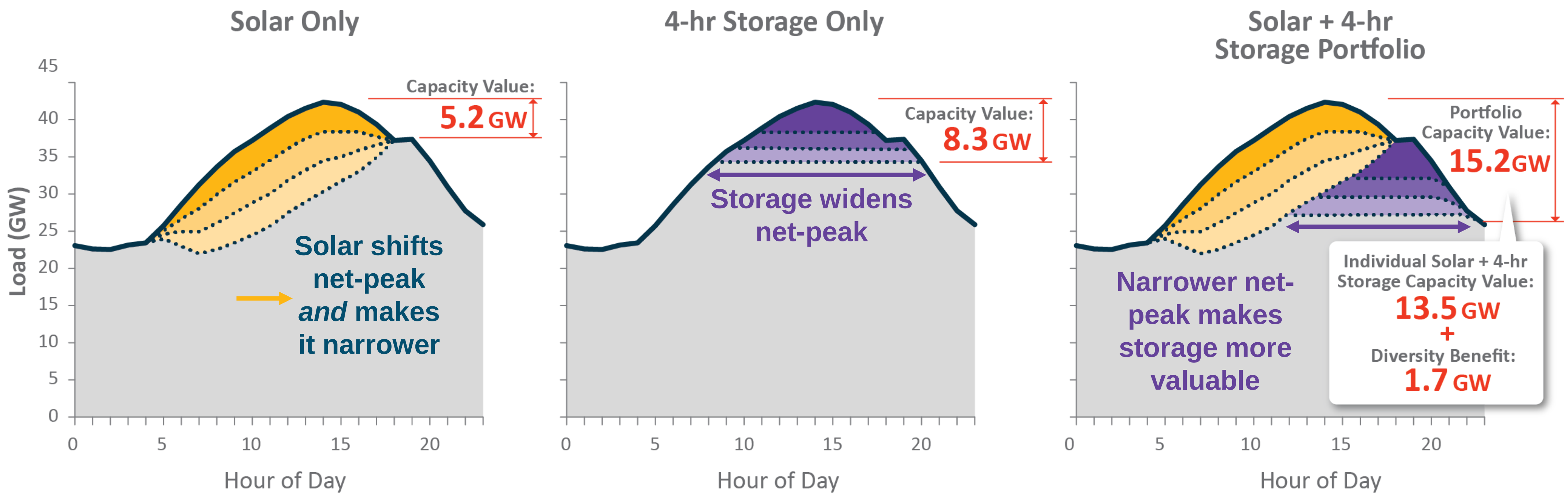
Solar and other **variable resources** (e.g. wind) exhibit declining value due to variability of production profiles



Storage and other **energy-limited resources** (e.g. DR, hydro) exhibit declining value due to limited ability to generate over sustained periods

ELCC captures diversity benefits among technologies

- Resources with complementary characteristics can result in a greater ELCC than the sum of their parts. These synergistic interactions are also described as a "diversity benefit"
- As penetrations of intermittent and energy-limited resource grow, the magnitude of these interactive effects will increase and become non-negligible



Changes in the 2023 IRP

Energy+Environmental Economics

Changes in the 2023 IRP

Input	Changes
Framework	• Seasonal PRM and ELCCs rather than annual values
Climate change	• Modeling across three climate models, which represent different climate futures
Load	• Simulations of the future rather than historical observations • Appropriately incorporating long-term temperature trends when studying a single snapshot year ◆
Operating reserves	• Balancing reserves updated based on modeled intra-hour variability
Hydro	• Simulations of the future rather than historical hydrological conditions • Flexibility to shift Mid-C and Baker generation based on hydrological conditions ◆
Wind and solar	• Simulations for 250 years, provided by DNV
Market imports	• Simulations based on simulated regional loads and resources
Storage	• No minimum state of charge applied to the contracted energy capacity ◆ • Can discharge at rated capacity for the rated duration ◆ • NWPP Reserve Sharing Program can be called when modeling the ELCC of storage ◆ • Forced outages modeled for storage • Can provide operating reserves without fully discharging

◆ *Recommended changes in E3's Sept. 2021 report: "Review of Puget Sound Energy Effective Load Carrying Capability Methodology"*

Market availability

PSE ← Mid-C

2,031 MW transmission rights can be used to transfer:

- Mid-C generation (560 MW nameplate)
- Wild Horse generation (273 MW nameplate)
- Market imports (subject to availability and transmission)

Market purchase curtailments:

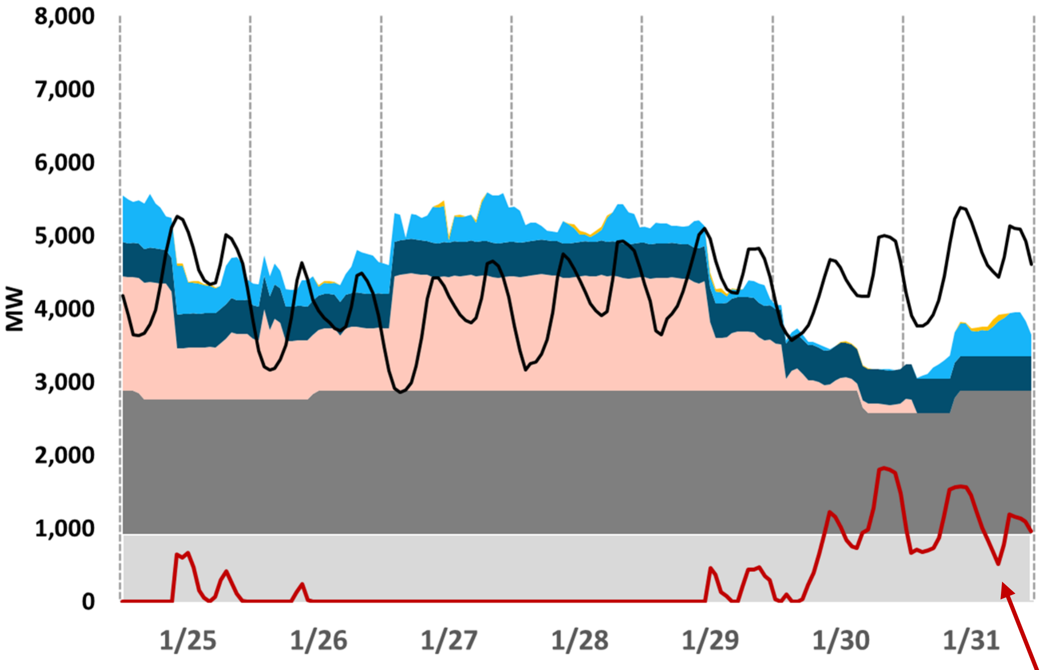
	Winter				Summer			
	2021	2023 A	2023 C	2023 G	2021	2023 A	2023 C	2023 G
Avg. # curtailment events per year	0.22	0.10	0.00	0.18	0.79	22.10	18.93	10.43
Avg. curtailment duration (hr)	37.7	8.8	2.5	28.3	9.4	10.6	9.6	10.4
Avg. MWh curtailment per year	5,792	445	2	5,991	3,234	189,140	143,927	84,398

The 2023 IRP has shorter market purchase curtailment events in winter

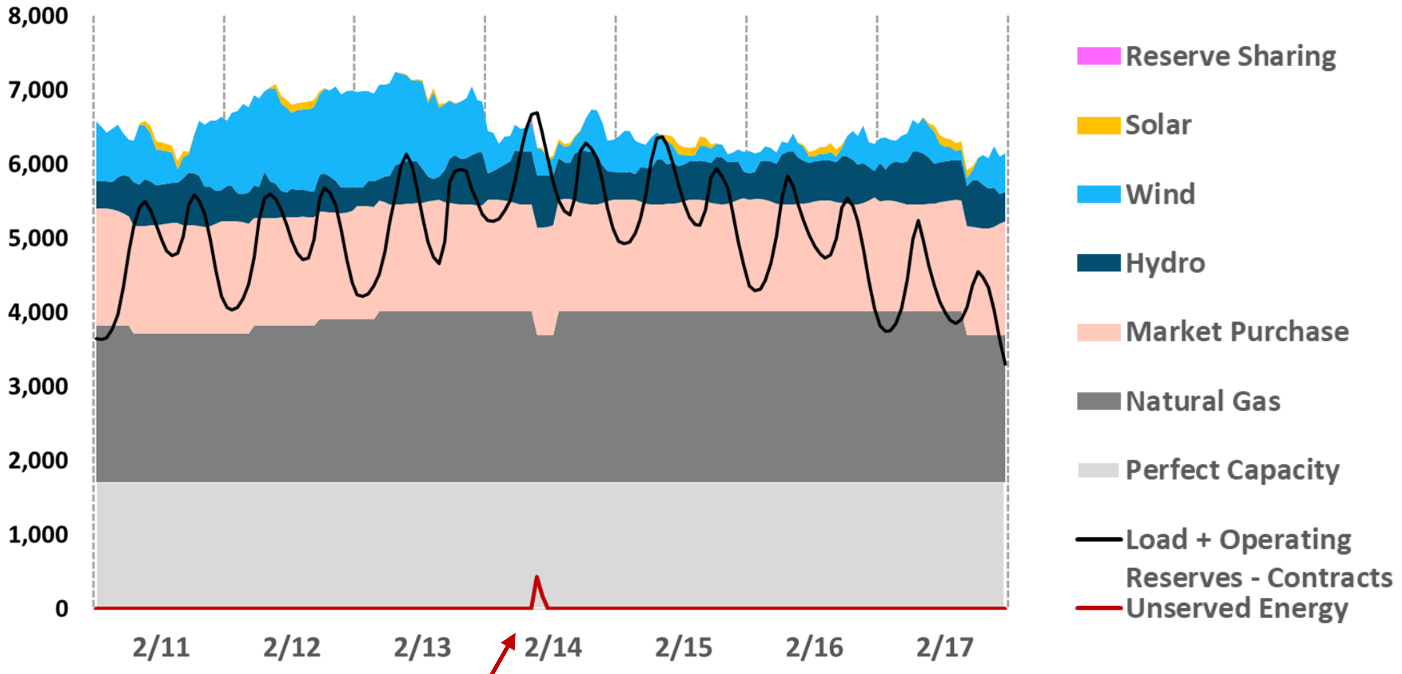
The 2023 IRP has much more market purchase curtailments in summer

Example winter weeks with loss of load

2021 IRP: winter week in 2027



2023 IRP: winter week in 2029, Model G

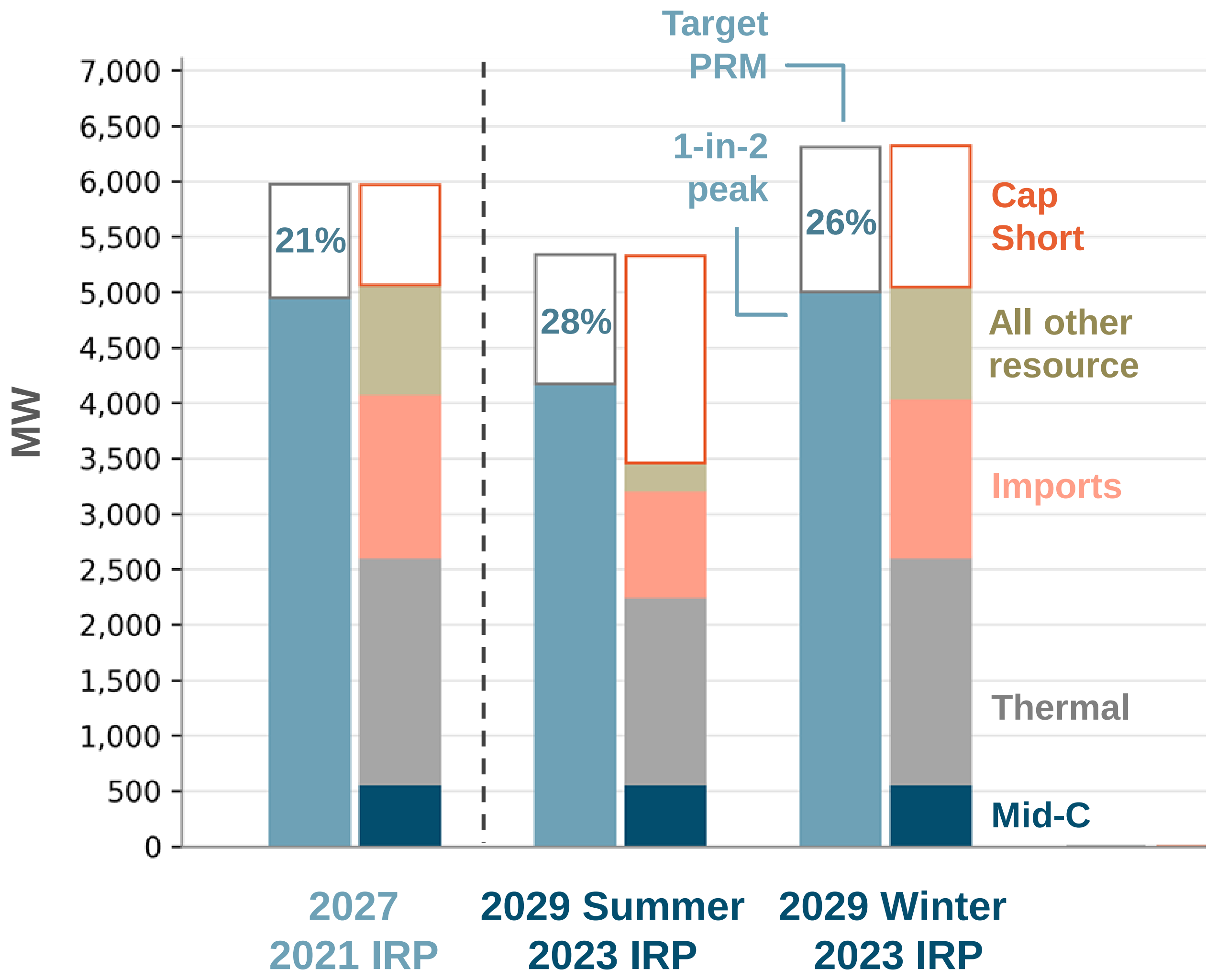


The 2021 IRP results show longer duration loss of load events than the 2023 IRP results

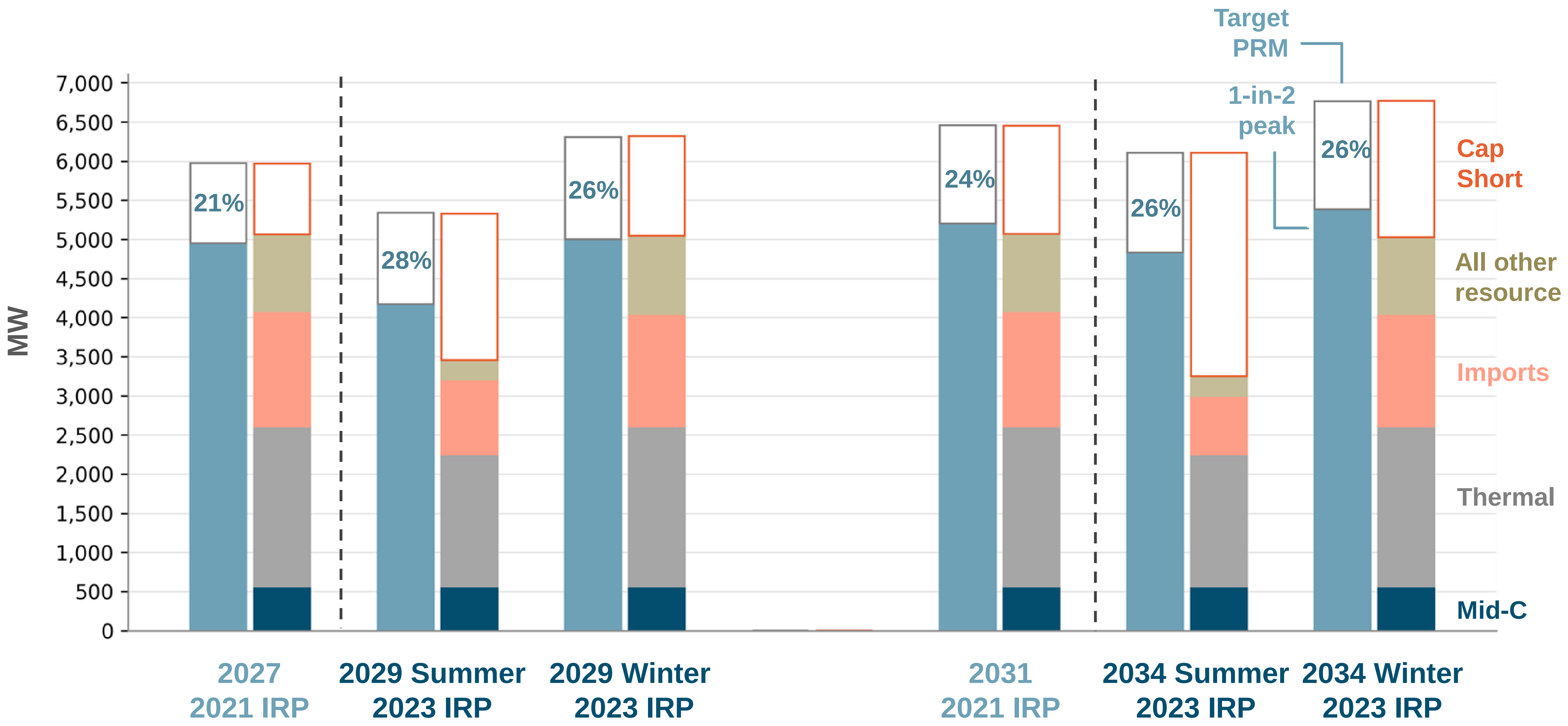
2023 IRP Results

Energy+Environmental Economics

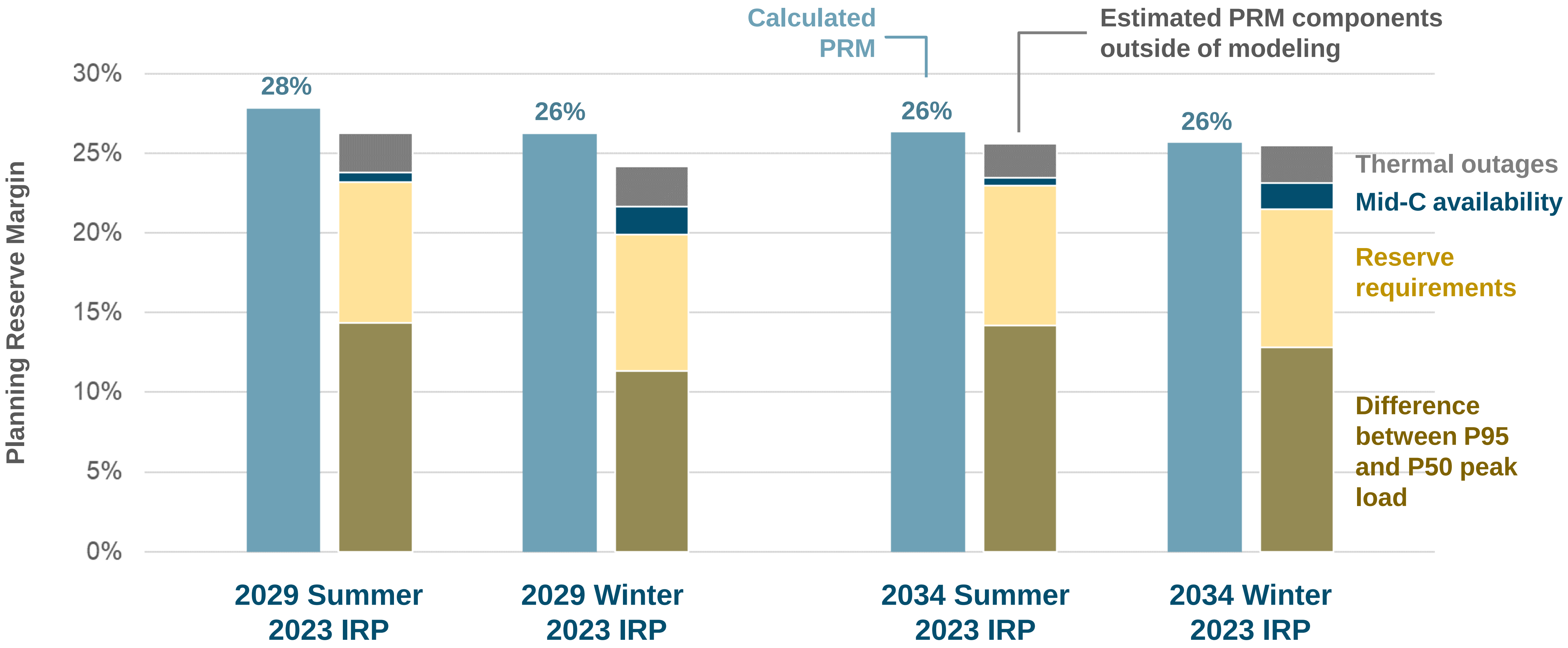
Planning reserve margin



Planning reserve margin



Planning reserve margin components



Effective load carrying capability

Resource	2021 IRP Annual	2023 IRP Winter	2023 IRP Summer
British Columbia Wind	N/A*	34%	13%
Idaho Wind	24%	12%	17%
Montana Central Wind	30%	39%	27%
Montana East Wind	22%	32%	19%
Offshore Wind	48%	32%	41%
Washington Wind	18%	13%	5%
Wyoming East Wind	40%	52%	34%
Wyoming West Wind	28%	39%	34%
DER Ground Mount Solar	1%	4%	28%
DER Rooftop Solar	2%	4%	28%
Idaho Solar	3%	8%	38%
Washington East Solar	4%	4%	55%
Washington West Solar	1%	4%	53%
Wyoming East Solar	6%	11%	29%
Wyoming West Solar	6%	10%	28%

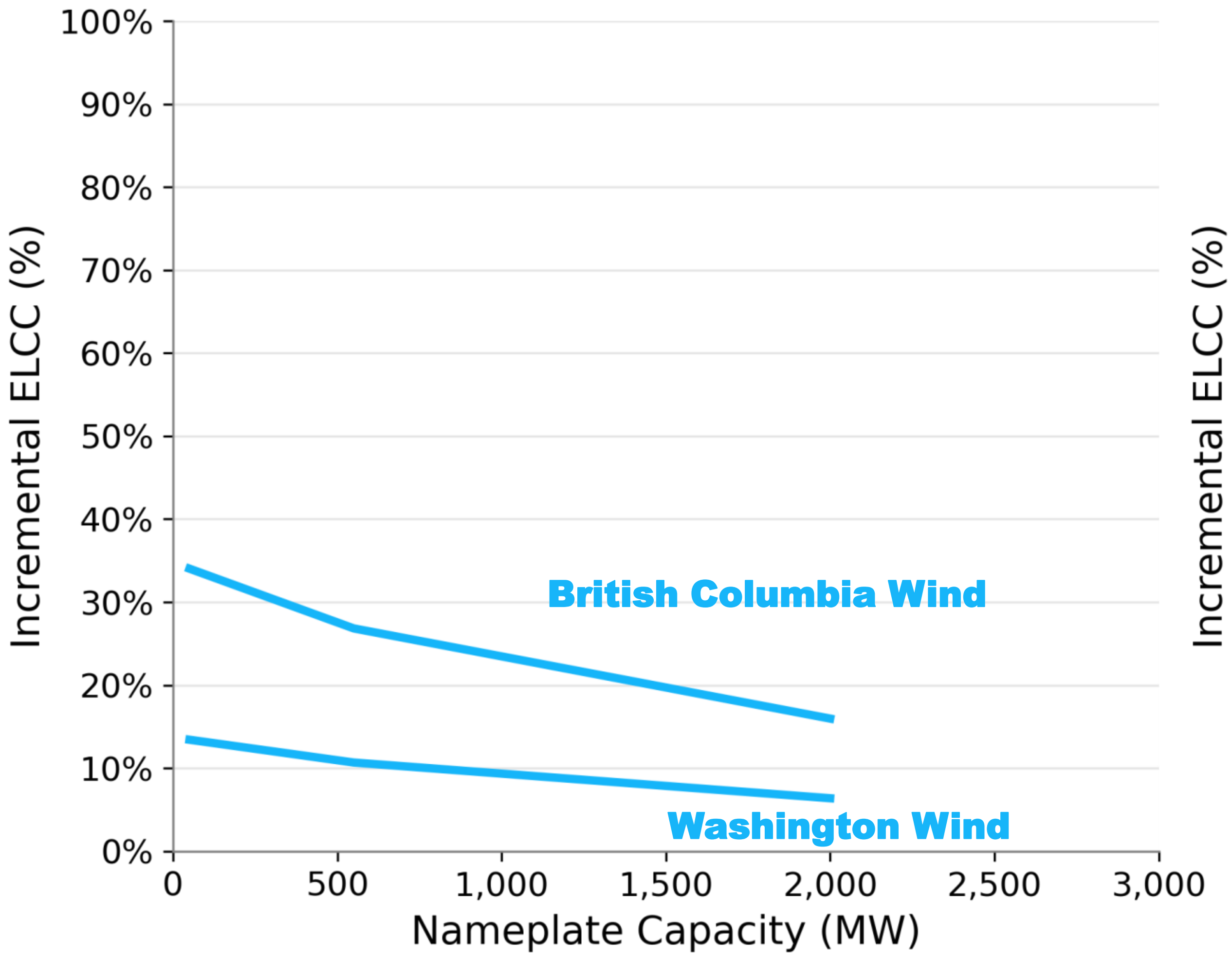
Resource	2021 IRP Annual	2023 IRP Winter	2023 IRP Summer
Li-ion Battery (2-hour)	12%	84%	88%
Li-ion Battery (4-hour)	25%	96%	95%
Li-ion Battery (6-hour)	N/A*	98%	98%
Pumped Storage (8-hour)	37%	99%	99%
Demand Response (3-hour)	26%	69%	95%
Demand Response (4-hour)	32%	73%	99%
Frame Turbine	N/A*	96%	98%
Reciprocating Engine	N/A*	96%	96%
Combined Cycle	N/A*	84%	92%

- The wind and solar ELCCs for winter are similar to the ELCCs from the 2021 IRP
- Compared with winter ELCCs, summer ELCCs are lower for wind and higher for solar
- The storage and demand response ELCCs are higher than the ELCCs from the 2021 IRP

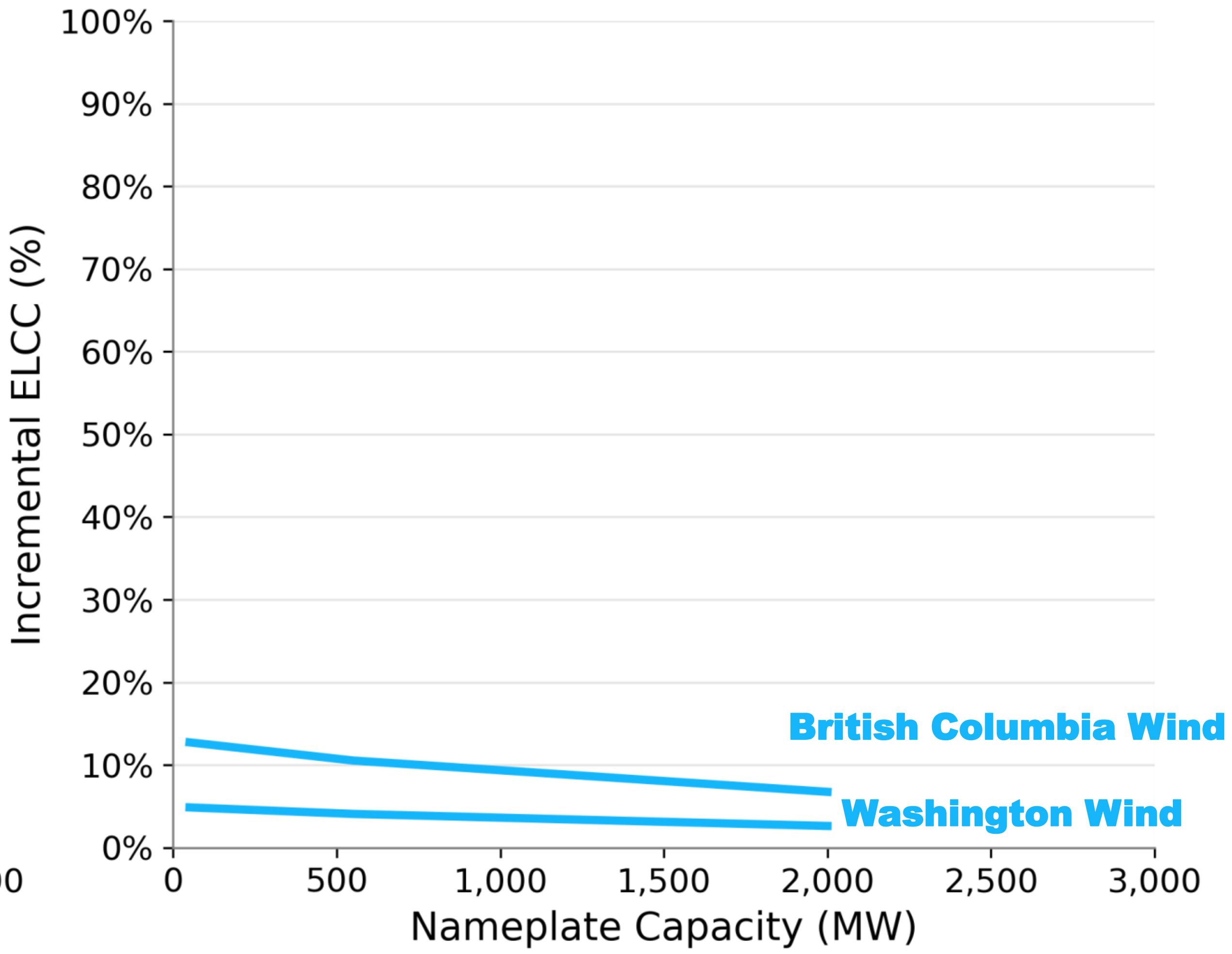
** The 2021 IRP did not include British Columbia Wind or 6-hour Li-ion Battery resource options. The 2021 IRP included gas plant options but did not model ELCC for these resources based on forced outage rates and maintenance schedules*

Pacific Northwest Wind ELCC saturation curves

Winter

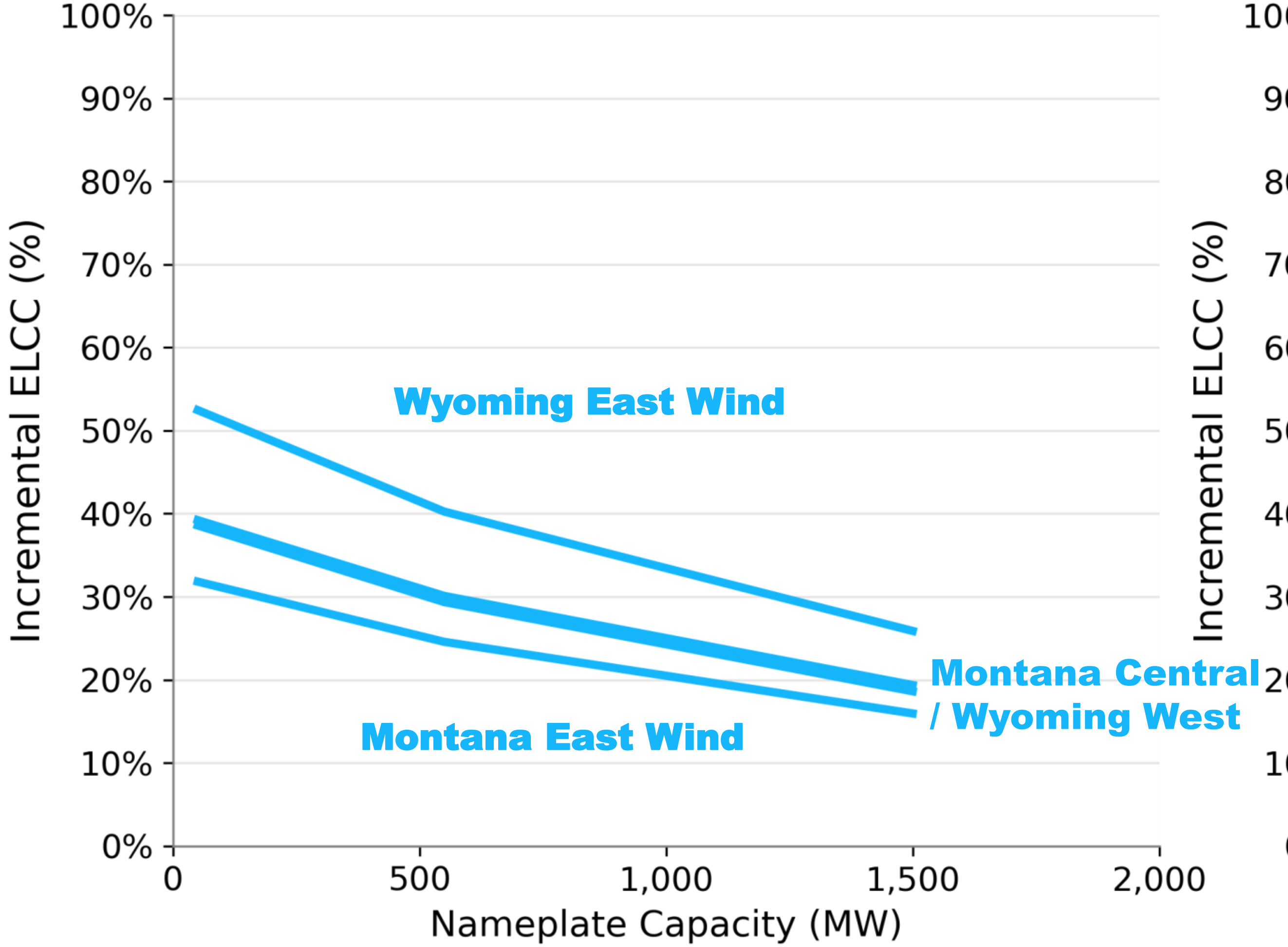


Summer

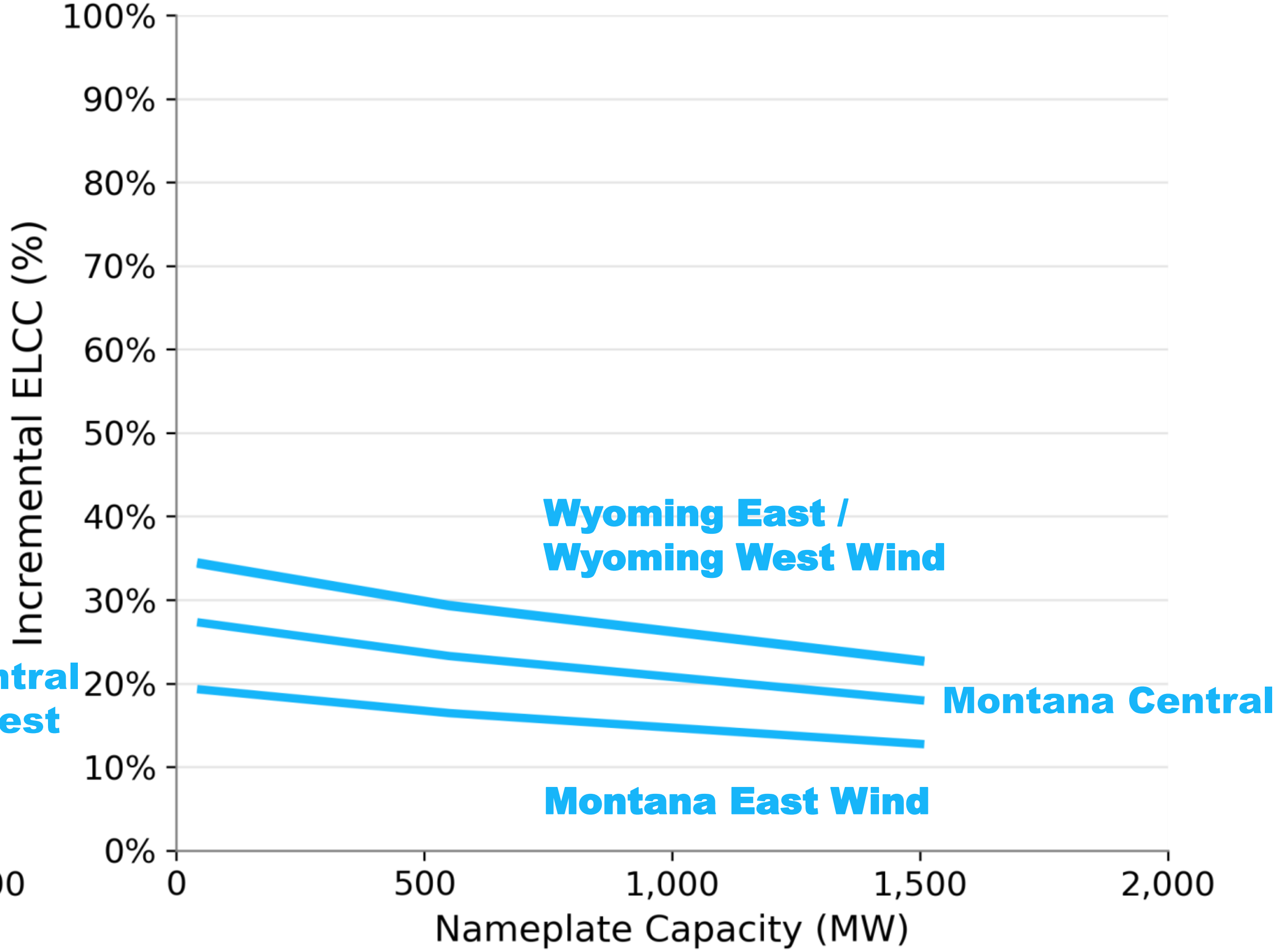


Rockies Wind ELCC saturation curves

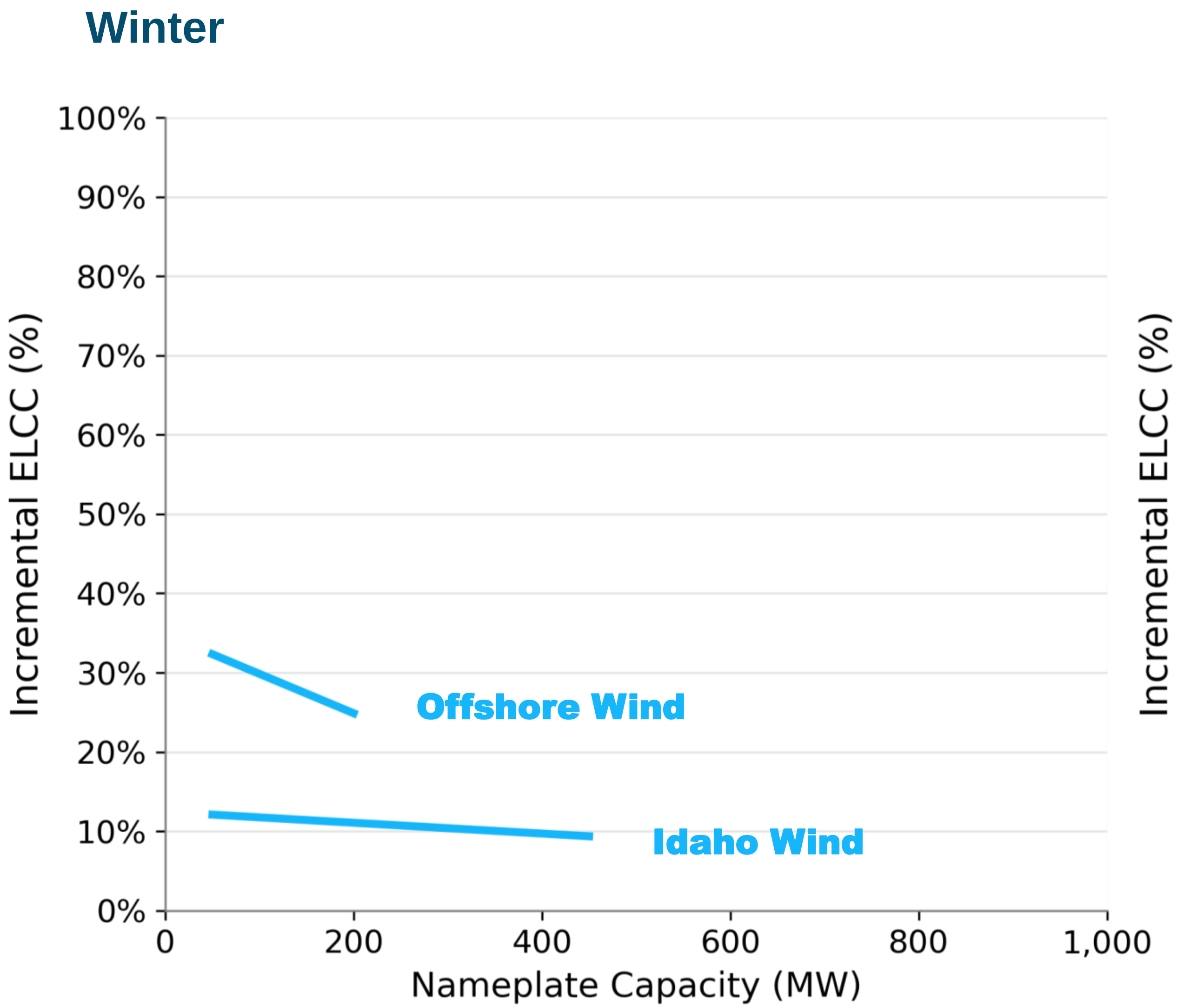
Winter

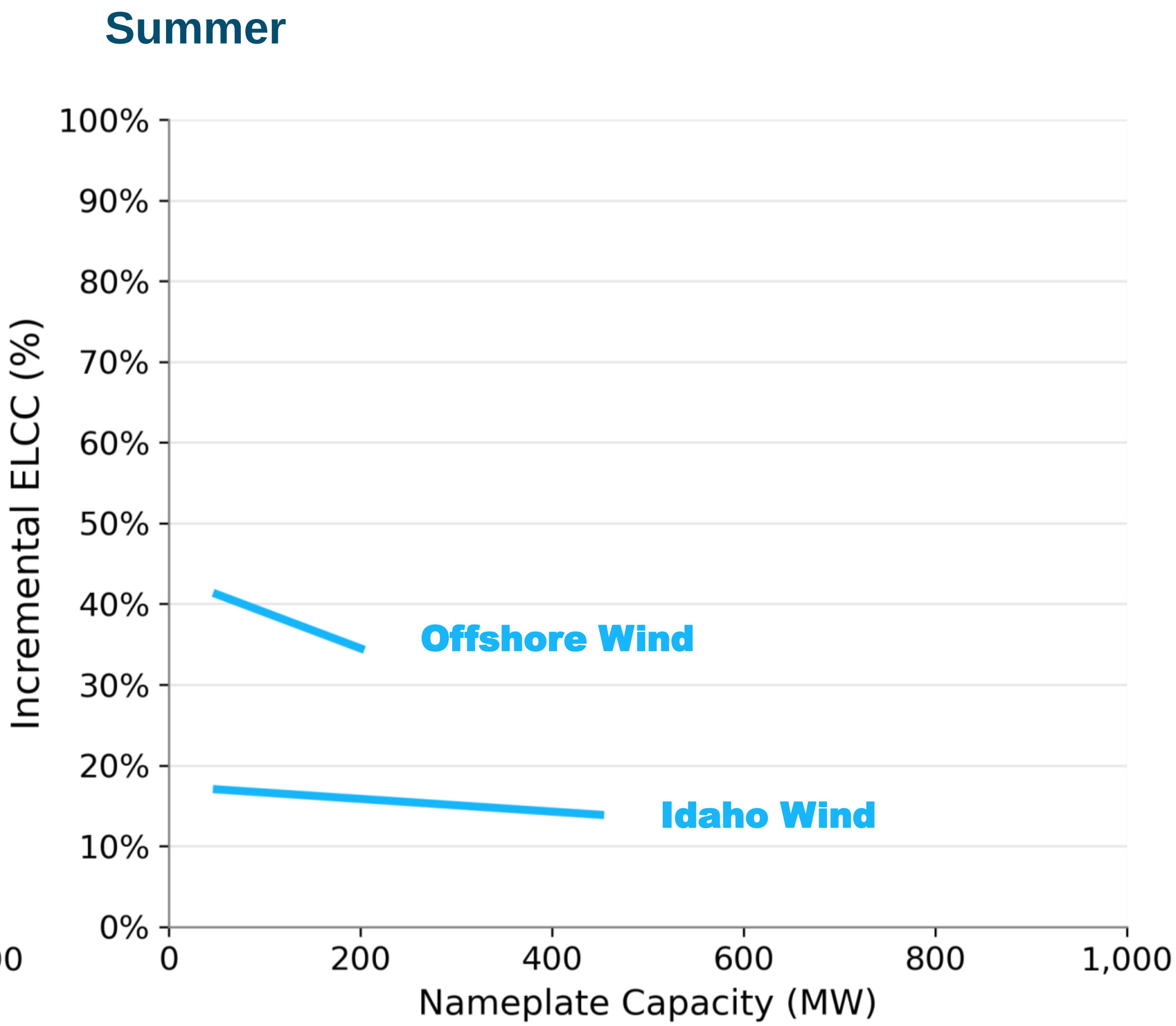


Summer



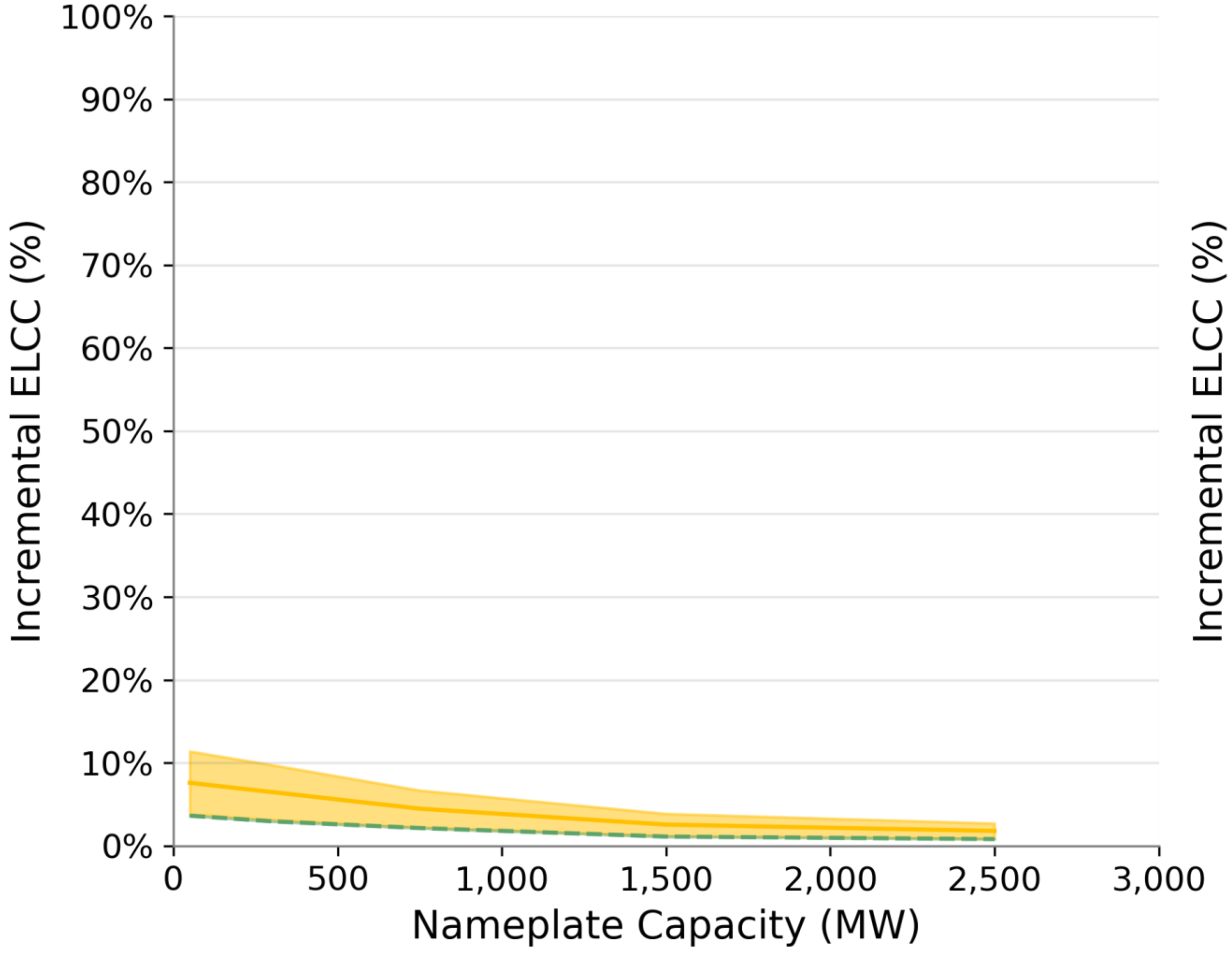
Idaho Wind and Offshore Wind ELCC saturation curves



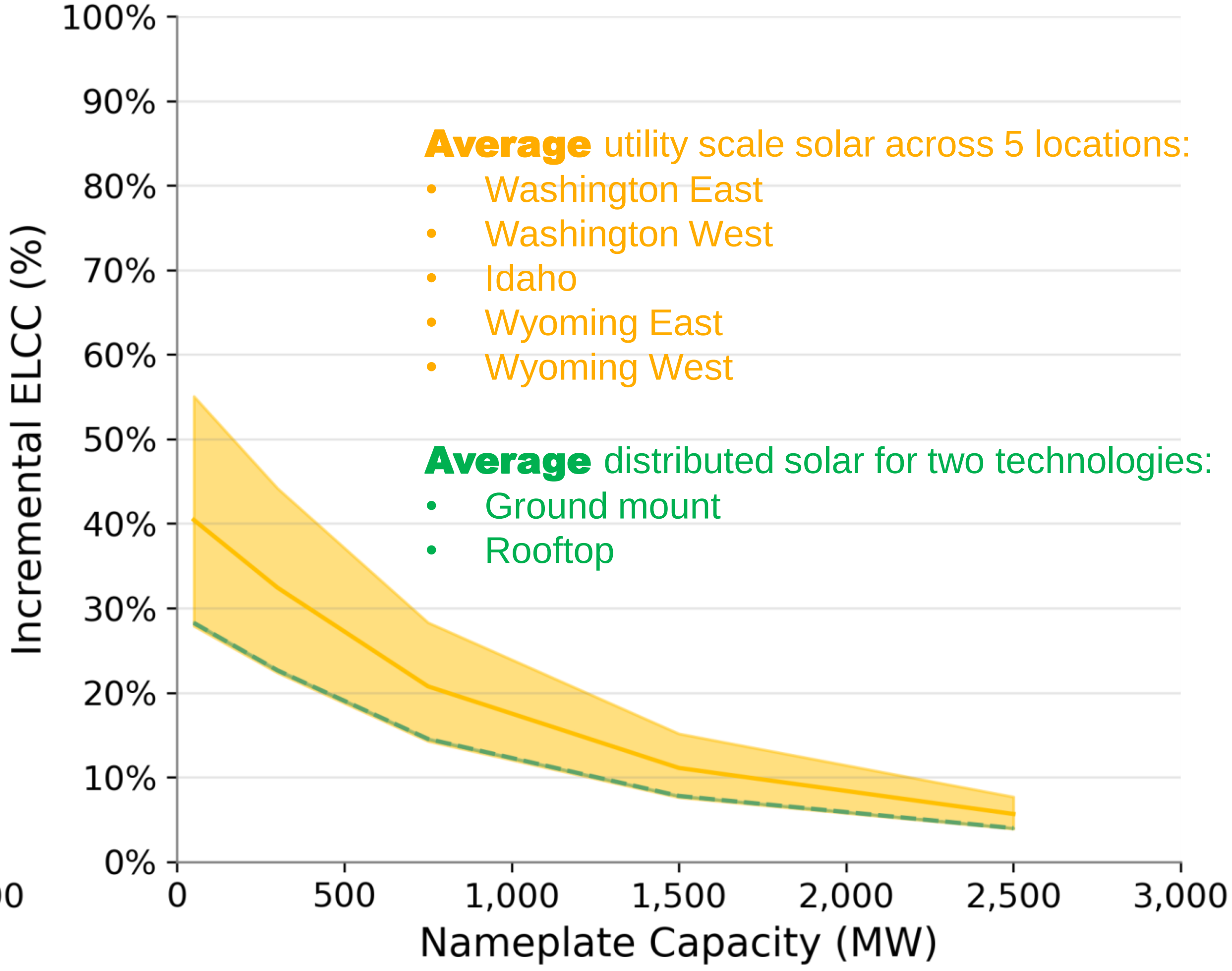


Solar ELCC saturation curves

Winter

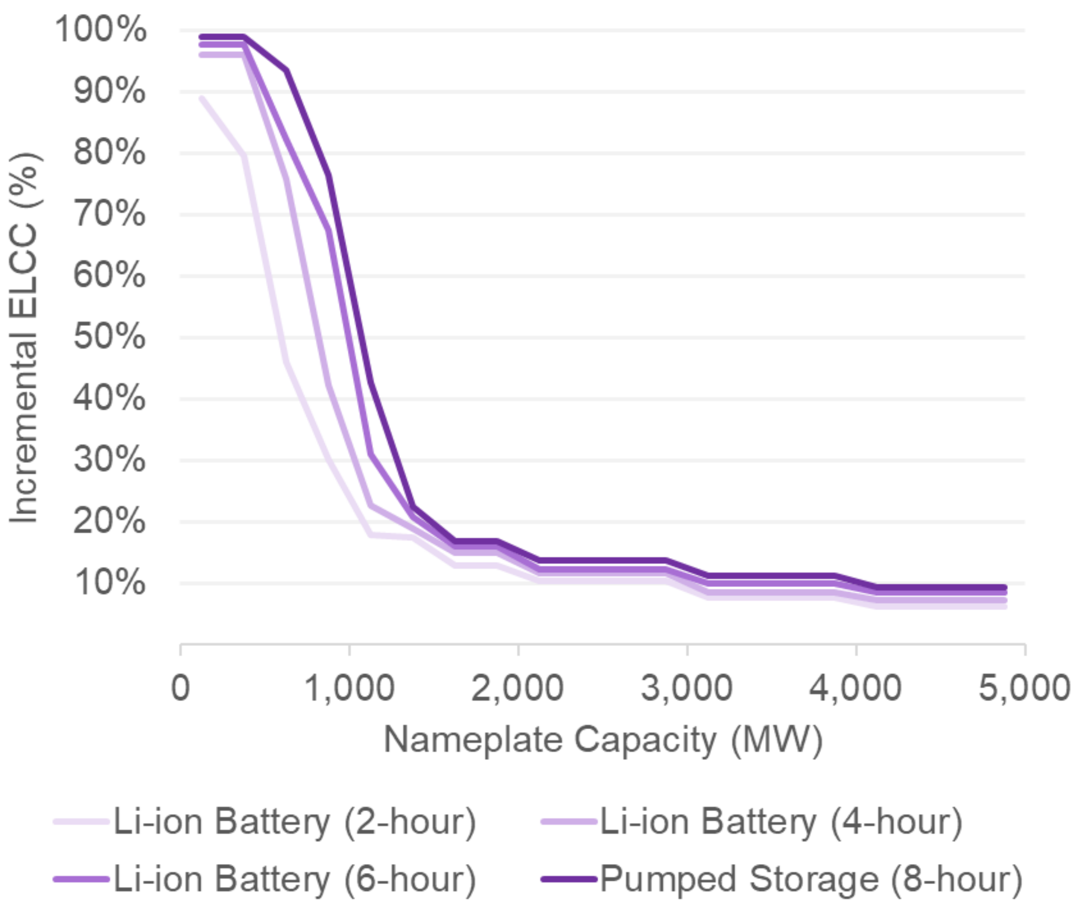


Summer

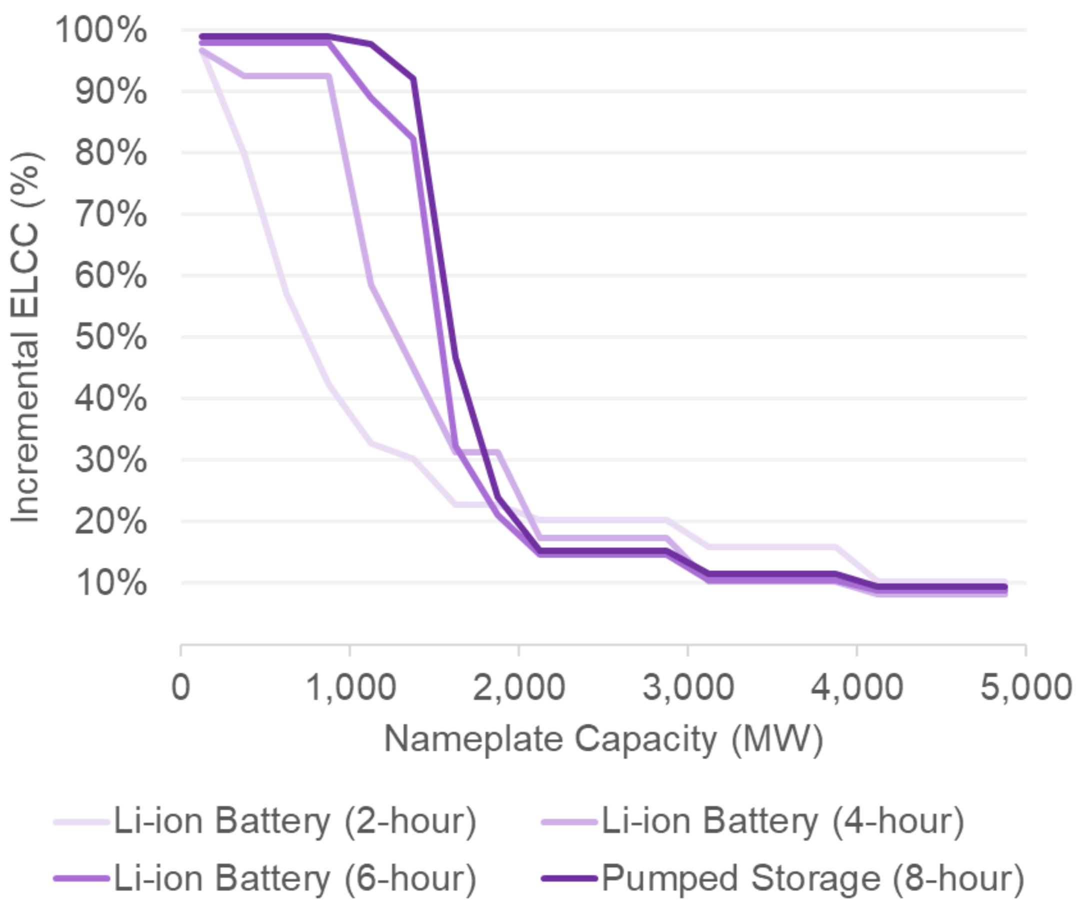


Storage ELCC saturation curves

Winter



Summer



Summary of key results

+ The PRM is 26-28%, depending on the year and season
+ The Winter PRM and Winter ELCC results for existing/contracted resources are consistent with results from the 2021 IRP
+ Loss of load events are shorter in duration in the 2023 IRP, resulting in a higher ELCC for storage and demand response
+ Compared with the Winter ELCC results, the Summer ELCC results are higher for solar and storage, lower for wind and market imports

Thank You

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Energy+Environmental Economics

Recommendations not incorporated in the 2023 IRP

Input	Changes not made
Wind and solar	• The modeling does not include correlations between load and renewable output during extreme events. For example, in the Pacific Northwest, intense cold weather could drive increased demand and decreased renewable output at the same time. These impacts are not included in the modeling
Market imports	• The modeling of the Pacific Northwest region does not add sufficient resources in the region to hit a loss of load probability of 5% for the region. E3 recommended performing this as a sensitivity to see if it would result in an increase in the ELCC of storage resource. The new analysis does not include this sensitivity, but it does result in a very high ELCC for storage at initial tranches.

These were recommended changes in E3's Sept. 2021 report: "Review of Puget Sound Energy Effective Load Carrying Capability Methodology." As discussed in the report, E3 recommends exploring load/wind/solar correlations in future IRP cycles. E3 also recommends revisiting the 5% sensitivity in future IRP cycles.

PSE Resource Needs & Market Reliance

2023 IRP Progress Report Check In

Phillip Popoff
Director, Resource Planning Analytics, PSE

PUGET SOUND ENERGY

Capacity Need Before Examining Market Reliance

E3 Results Resources (MW)				
	2029	**2029**	**2034**	**2034**
Resource	Winter	Summer	Winter	Summer
Mid-C Hydro	560	560	560	560
Thermal	2,050	1,688	2,050	1,688
All other resources	997	244	981	252
Short-Term Market Purchases	1,440	961	1,434	751
Additional perfect capacity for 5% LOLP	**1,272**	**1,875**	**1,746**	**2,856**
Total Resources	6,319	5,329	6,771	6,107

PSE Resource Adequacy Study – Capacity Needs

E3 2023 IRP Planning Reserve Margin								
	2021 IRP				2023 IRP			
	Annual				2029		2034	
	2027 (MW)	2029 (MW)	2031 (MW)	2034 (MW)	Winter (MW)	Summer (MW)	Winter (MW)	Summer (MW)
Additional perfect capacity for 5% LOLP	907	**1,039**	1,381	1,611	**1,272**	1,875	1,746	2,856
Normal Peak - Before Conservation	4,949	5,058	5,199	5,372	5,104	4,300	5,588	4,845

- **2023 IRP results for winter are similar to the 2021 IRP results**
- **Summer capacity needs for the 2023 IRP increase significantly**
- **Drivers**
  - Increased peak demand
  - Climate change impacts on load and hydro

	Winter 2029		
Variance in Need	2021 IRP	2023 IRP	Change
Additional perfect capacity for 5% LOLP	**1,039**	**1,272**	**233**

	Winter 2029		
Source of Variance	2021 IRP	2023 IRP	Change
Normal Peak Load Forecast	5,058	5,104	46
Planning Reserve Margin	1,045	1,215	170
Capacity Value of Existing Resource	3,586	3,607	22
Import	1,479	1,440	(39)
Total Variance			233

PSE PUGET SOUND ENERGY

Market Reliance: Defined

What is market reliance?

Reliance on the availability and purchase of electricity through the wholesale electricity market, which may not be physically firm.

Why is this important?

PSE's current transmission portfolio assumes approx. 1,500 MW of electricity from the Mid-Columbia (Mid-C) trading hub to the PSE load center for distribution to customers.

PSE PUGET SOUND ENERGY

Market Reliance: 2021 IRP Background

2021 IRP Market Risk Assessment

- PSE evaluated ongoing availability of short-term power contracts
  - Recommended gradually reducing market reliance on short-term Mid-C market purchases by ~1000 MW by 2027.
  - Reducing PSE's market reliance increases PSE's capacity need.

PSE committed to ongoing review and evaluation of this topic in the 2023 IRP Electric Progress Report, including:

- Consideration of ongoing technological advancements.
- The outcome of the All-Source RFP.
- Regional resource adequacy developments (i.e., the WRAP).

Market Reliance: Update

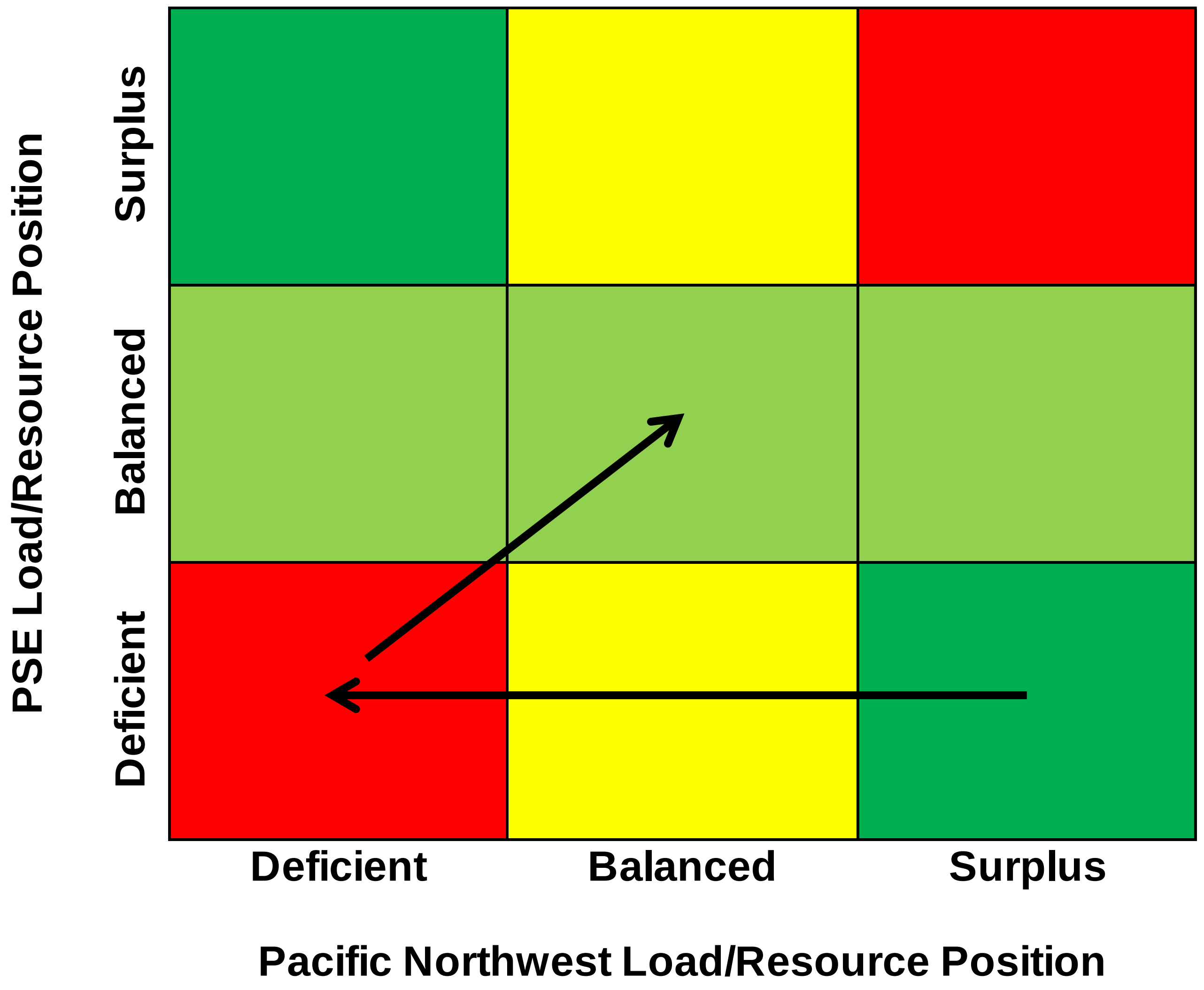
What is changing?

PSE has been closely examining its market reliance assumptions since the 2021 IRP and intends to reduce the amount it relies on market for capacity.

Need to phase out Market Reliance by first WRAP binding period—2028

- Regional resource adequacy assessment studies highlight that the region is moving from surplus to short capacity.
- Significant risk of higher regional load growth with electrification of buildings and transportation, data centers, and possibly hydrogen manufacturing.
- As PSE implements the WRAP, PSE can develop and fine-tune its exposure limits, if appropriate.

Market Reliance: Risk Matrix from Prior IRPs



REUTERS

My View Following Saved

May 13, 2022 · 4:36 PM PDT
Last Updated 16 days ago

United States

Texas grid operator calls for power conservation as temperatures, prices soar

UTILITY DIVE

DIVE BRIEF

California governor floats 5-GW, $5.2B 'reliability reserve' amid possible electricity shortfalls

Published May 17, 2022

T&DWorld

TRANSMISSION RELIABILITY

MISO's Annual Planning Resource Auction Results Underscore the Reliability Imperative

April 21, 2022

Some parts of the region fall short of their Resource Adequacy requirements.

T&D World Staff

NERC Assessment

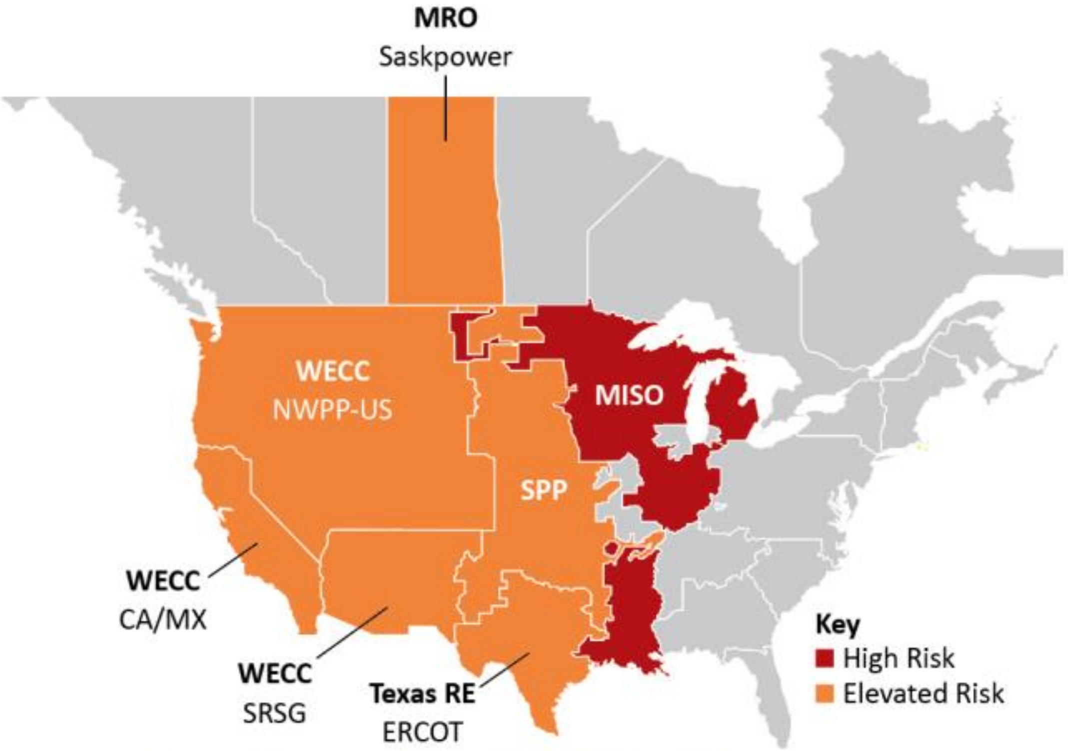


Figure 1: Summer Reliability Risk Area Summary

Seasonal Risk Assessment Summary	
High	Potential for insufficient operating reserves in normal peak conditions
Elevated	Potential for insufficient operating reserves in above-normal conditions
Low	Sufficient operating reserves expected

Inspired
PUBLIC SERVICE

WECC's analysis of resource adequacy over the next 10 years

- Both demand and resource availability variability are increasing, and the challenges they present appear **worse now than they did in the 2020 Western Assessment of Resource Adequacy.**

- Under current planning reserve margins (PRM), **all subregions in the West show many hours at risk** of load loss over the next 10 years.

- To **mitigate resource adequacy risks** over the near-term (1–4 years) and long-term (5–10 years), **PRMs need to be increased**—in some cases significantly—or other actions taken to reduce the probability that demand exceeds resource availability.

- As early as **2025, all subregions will be unable to maintain the one-day-in-ten-year** (ODITY) resource adequacy threshold—99.98%—because they will not be able to eliminate the hours at risk for loss of load even if they build all planned resource additions and import power.

- Resource adequacy risks **could get worse before they get better if action is not taken immediately** to mitigate near-term risks and prevent long-term risks.

Market Resource Adequacy

Northwest Power and Conservation Council - Mixed Messages

- 2019 Adequacy Report: region at 26% LOLP by 2026.
- 8th Power Plan: no formal RA report but draft new model shows region at 0% LOLP.

PNUCC - Northwest Regional Forecast	2029		2034	
	Winter	Summer	Winter	Summer
PNUCC - Regional NRF Short	4,830	5,240	6,060	5,950
Identified Available Firm Resources in Region (Operational)	1,700	-	1,700	-
CA Imports	3,400	-	3,400	-
Net regional shortage	(270)	5,240	960	5,950
Note: PNUCC data not provided past 2031. PNUCC numbers for 2033 persisted from latest year available				

Adjusted PNUCC data shows:

- Winter: Region will be ~balanced by 2029 then **deficit by 2034.**
- Summer: **Severely short before summer of 2029.**

PSE PUGET SOUND ENERGY

Key Elements of Need for Additional Capacity

E3 Results Resources (MW)				
	2029	2029	2034	2034
Resource	Winter	Summer	Winter	Summer
Mid-C Hydro	560	560	560	560
Thermal	2,050	1,688	2,050	1,688
All other resources	997	244	981	252
Short-Term Market Purchases	1,440	961	1,434	751
Additional perfect capacity for 5% LOLP	**1,272**	**1,875**	**1,746**	**2,856**
Total Resources	6,319	5,329	6,771	6,107

Adjusted to Eliminate Short Term Market Reliance Resources (MW)				
	2029	2029	2034	2034
Resource	Winter	Summer	Winter	Summer
Mid-C Hydro	560	560	560	560
Thermal	2,050	1,688	2,050	1,688
All other resources	997	244	981	252
Short-Term Market Purchases	-	-	-	-
Additional perfect capacity for 5% LOLP	**2,712**	**2,836**	**3,180**	**3,607**
Total Resources	6,319	5,329	6,771	6,107

Resource Adequacy: Conclusions

Capacity Need

- PSE will use E3's work that incorporates climate change as the basis of capacity need to meet resource adequacy targets.

Effective Load Carrying Capability

- ELCC's presented by E3 will be used to fill the capacity need.

Reliance on Short-Term Markets for Firm Capacity

- PSE will phase out reliance on short-term markets for capacity, consistent with E3. ELCC calculations.

Impact of Need and ELCC Updates on Resource Plan

- We are excited to see those, too!
- Portfolio analysis will be ramping up.

Next Steps

Sophie Glass, Co-facilitator, Triangle Associates

IRP Stakeholder Feedback Process

Feedback form: PSE IRP - Feedback Form

August 26	A recording of the webinar and the transcript of the chat will be posted to the IRP website so those who were unable to attend can review.
August 31	Feedback forms are due. Feedback should focus on questions regarding the presentation.
September 21	A feedback report of **questions** collected from the feedback form, along with PSE's responses, and a meeting summary will be shared with stakeholders and posted to pse.com/irp

PUGET SOUND ENERGY

Next Steps and How to Stay in Touch

Next meetings with IRP stakeholders

- Sept. 13, 2022 – Electric Progress Report: final resource need and Conservation Potential Assessment (CPA) results
- Sept. 22, 2022 – Gas Utility IRP: Final scenarios and gas alternatives, and CPA results

irp@pse.com

pse.com/irp

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Third-party recording is not permitted.

PUGET SOUND ENERGY

Appendix

Common Acronyms

Acronym	Meaning
CCHs	Capacity Critical Hours
CPA	Conservation Potential Assessment
DSW / E	Desert Southwest / East
E3	Energy + Environmental Economics
ELCC	Effective Load Carrying Capacity
LOLE	Loss Of Load Events
LOLP	Loss Of Load Probability
NW	Northwest
ODITY	One-day-in-ten-year
RA	Resource Adequacy
PNUCC	Pacific Northwest Utilities Conference Committee
PO	Program Operator
PRM	Planning Reserve Margin
QCC	Qualifying Capacity Contribution
UCAP	Unforced Capacity
UTC	Washington Utilities and Transportation Commission
WECC	Western Electricity Coordinating Council
WRAP	Western Resource Adequacy Program

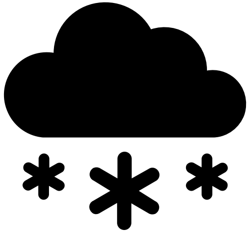
Electric Draft Portfolio Results

2023 Electric Progress Report

December 12, 2022

PUGET SOUND ENERGY

Safety Moment



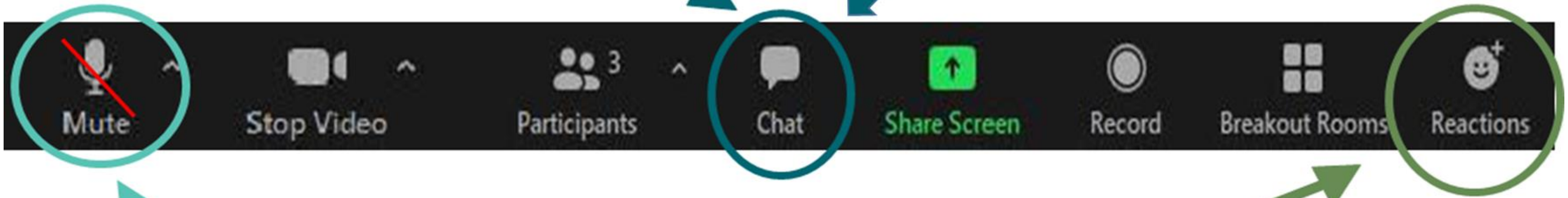
Winter Safe Driving Tips

- Check your tire tread depth and replace tires if necessary.
- Check your tire pressure. Pressure drops as the temps drop.
- Avoid using cruise control in wintry conditions.
- Increase following distance in low visibility or during rainy or snowy weather.
- Keep extra blankets, bottled water, and phone charger in your vehicle.

Welcome to the Webinar!

If you **want to type a question regarding the presentation,** insert **"Slide X followed by your question"** in the chat box!

If you **have a technical issue or a general question**, please type it in the chat box.



Please **keep yourself on mute** unless you are speaking.

If you want to **ask a question verbally,** click the 'Reaction' button and click on the **'Raise Hand'** option and we will call on you.

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Facilitator Requests

- Engage constructively and courteously towards all participants.
- Respect the role of the facilitator to guide the group process.
- Take space and make space.
- Avoid use of acronyms and explain technical questions.

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Agenda

Time	Agenda Item	Presenter
9:00 a.m. – 9:10 a.m.	Introduction and agenda review	Sophie Glass, Triangle Associates
9:10 a.m. – 9:25 a.m.	Progress Report Process	Elizabeth Hossner, PSE
9:25 a.m. – 9:50 a.m.	Distributed Energy Resources	Heather Mulligan, PSE
9:50 a.m. – 10:50 a.m.	Resource Plan Modeling Results	Elizabeth Hossner, PSE
10:50 a.m. – 11:00 a.m.	Break	
11:00 a.m. – 11:55 a.m.	Candidate Portfolios Discussion	All
11:55 a.m. – 12:00 p.m.	Next Steps	Sophie Glass, Triangle Associates
12:00 p.m.	Adjourn	All

Today's Speakers

Phillip Popoff

Director, Resource Planning Analytics, PSE

Elizabeth Hossner

Manager, Resource Planning and Analysis, PSE

Heather Mulligan

Manager, Customer Energy Renewable Programs, PSE

Sophie Glass

Facilitator, Triangle Associates

Electric Progress Report Process

2023 Electric Progress Report

December 12, 2022

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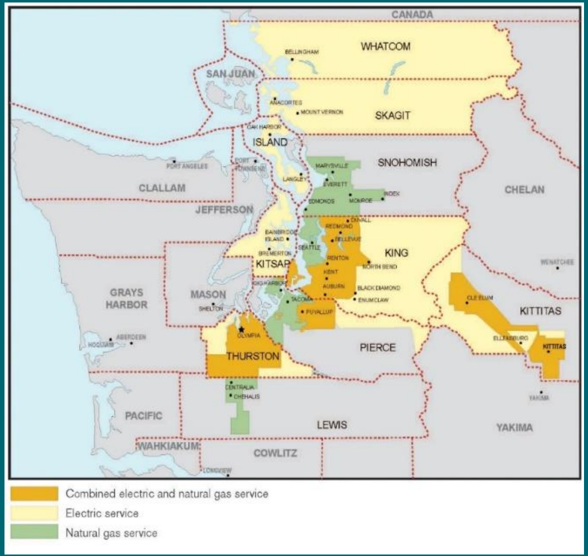
Puget Sound Energy



- Washington's largest and oldest utility, **serving 1.5 million customers** in 10 counties covering over 6,000 square miles
- Our **3,100+ employees** live and work in the communities we serve.
- We share our customers' **concern for the environment**, balanced with their expectations for uncompromised **reliability, affordability and safety**.
- **24 million MWh** annual sales
- **5,000 MW** winter peak

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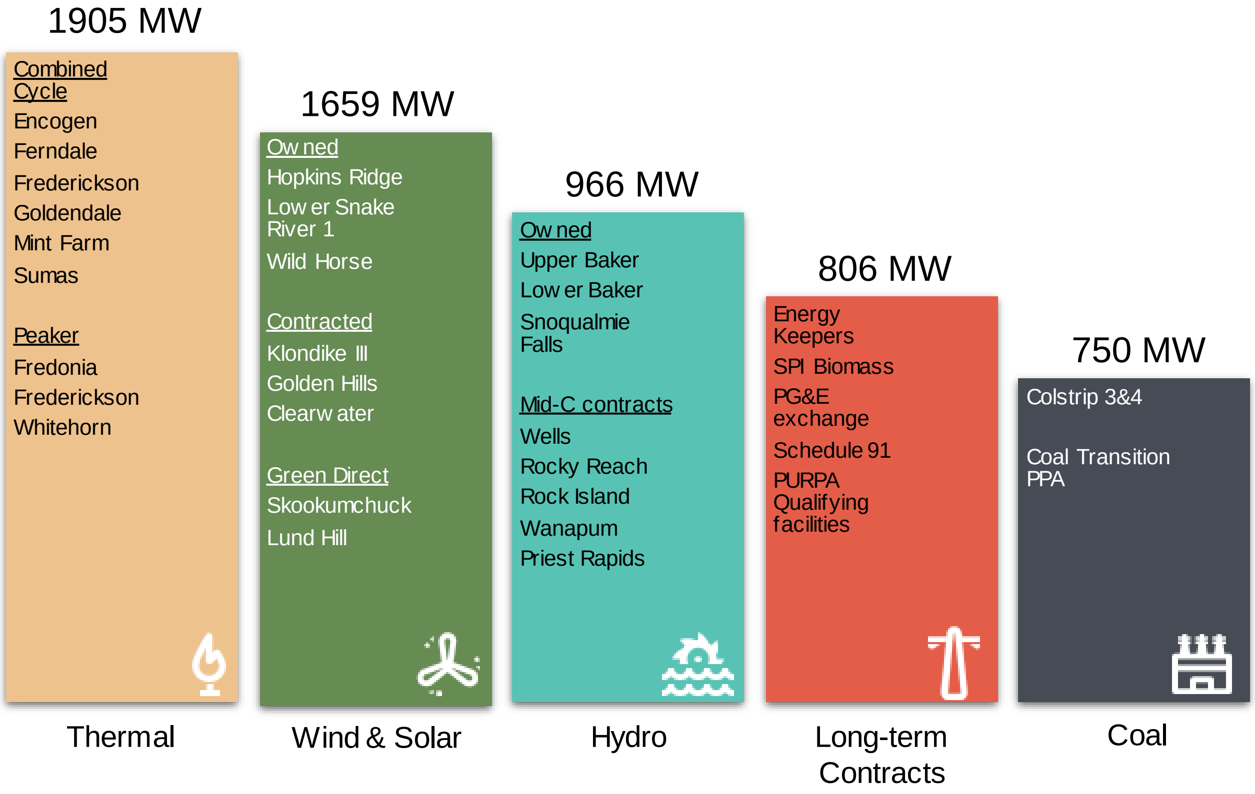
PSE's Current Nameplate Electric Generating Resources



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Resource Planning Foundations

- Continue to be a **clean energy leader**, in and beyond our region
- Meet our **CETA obligations**
  - 2025: Eliminate coal-fired resources
  - 2030: Greenhouse gas neutral
  - 2045: 100 percent of all retail sales of electricity supplied by renewable and non-emitting resources
  - Ensure **resource adequacy** while delivering a clean energy transition
- The future of power is a **diversified portfolio of non-emitting resources** providing energy security and reliability for all customers
- Ensure **equity for all customers** from the transition to clean energy
- Ensure **consistency with CEIP**

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How Public Participation Shaped our Work

- ✓ Reduce market reliance
- ✓ Incorporate climate change data and model winter and summer demand
- ✓ Consider range of resource alternatives and emerging technologies
- ✓ Model battery cycling at various frequencies, capacities, and types
- ✓ Model hybrid renewables and diverse energy storage resources
- ✓ Incorporate Inflation Reduction Act
- ✓ Embed equity

New Challenges and Opportunities

- Climate Commitment Act (CCA)
- Inflation Reduction Act
- Climate Change Modeling
- Reliability and Transmission Constraints
- Electrification Analysis

Distributed Energy Resources

Clean Energy Products & Services in Operation Today

Heather Mulligan, Manager, Customer Energy Renewable Programs, PSE

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PSE Clean Energy Products and Services

PSE MATCH

GREEN POWER
- PNW REC purchases
- 62K residential, commercial, municipal customers

SOLAR CHOICE
- Solar RECs WA and ID
- 915K customers
- Residential, small commercial

CARBON BALANCE
- PNW third-party-verified carbon offsets
- 21K customers

PSE REPLACE

COMMUNITY SOLAR
- Expands access to new, 100% local solar
- 4 projects completed

RENEWABLE NATURAL GAS
- Replaces a portion of gas usage with local RNG supply
- ~5K customers

GREEN DIRECT
- Long-term partnership for dedicated resources
- 41 corporate/gov. customers

PSE GENERATE

NET METERING
- Up to 100 kW
- 15K+ customers; 130 MW
- All customer types

SMALL POWER PRODUCERS
- 100 kW – 5 MW
- Small renewable developers

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Green Power Solar Grants

- Awarded each year since 2016
- Opens each year in mid/late June through summer
- Non-profits and tribal entities that provide services to low-income or black, indigenous and people of color (BIPOC) communities
- $3.4M awarded over 5 years
- 48 projects funded, totaling 1.66 MW
- $750K available in 2023
- Funded by Green Power & Solar Choice programs and their participants

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Green Direct

- Partnership with Corporate and Governmental customer to drive new renewable energy in Washington

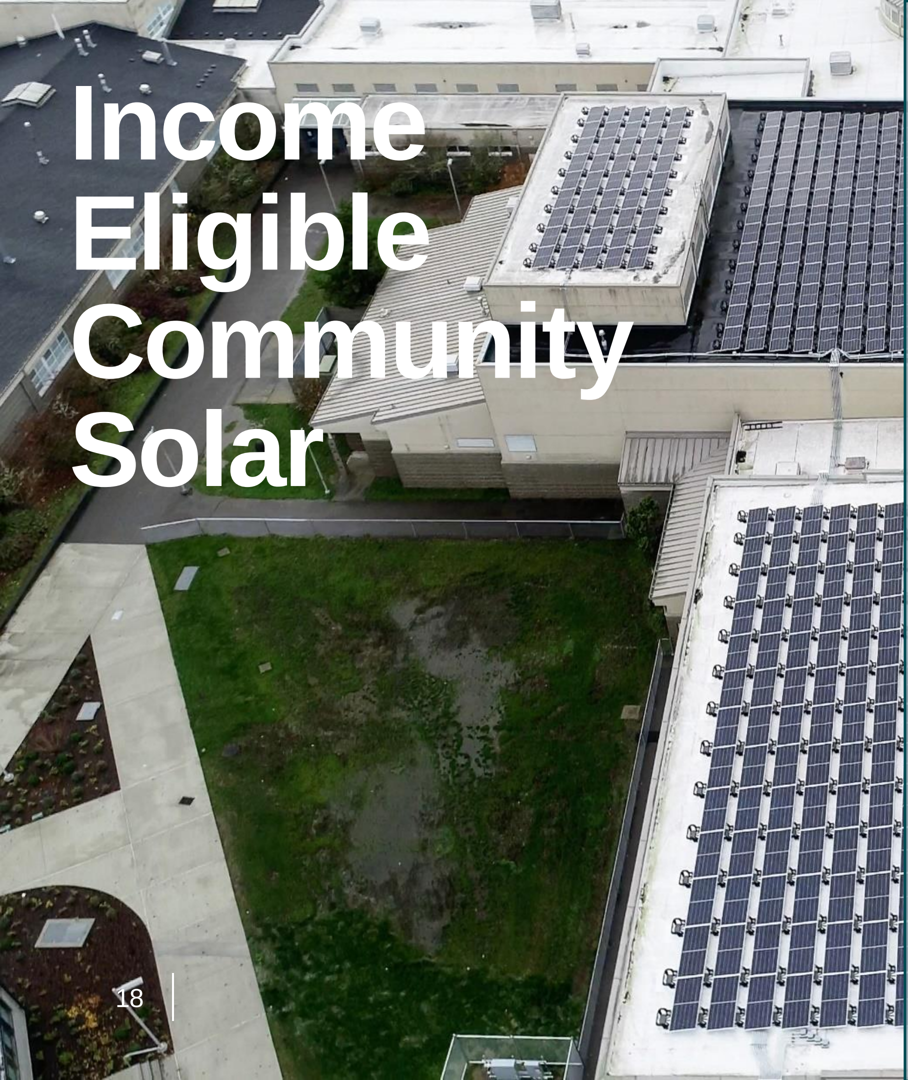
- Skookumchuck Wind
- 137 MW's in Lewis County
  - Online in November 2020

- Lund Hill Solar
  - 150 MW in Klickitat County
  - Project completed this month

Community Solar

- Premium energy offering, residential focus
- Launched in Nov 2021
  - 3 sites in Western Washington – ~1 MW
  - 2 sites in Eastern Washington – 10 MW
  - More sites under development
- Western WA Solar installations **at the neighborhood level**
- Participants receive a credit based on actual generation
- Each share equals 1.46 kW

Income Eligible Community Solar



- $0 / per share cost
- Predictable monthly credit
- Annual true-up (always in customer favor)
- No contract
- No proof of income
- **20% of total program (20 MW) set aside**
- Annual re-affirm for eligibility

*Household average annual income level is at or below 200% of the Federal Poverty Level (FPL)

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Customer Connected Solar

- Support for customers interconnecting solar at their home or business
- Customers with up to 100 kW can Net Meter – receive credit for energy put back on grid
- Customers generate their own renewable energy, lowering their electricity bills and reducing their carbon footprint.
- PSE offers information to help customers find qualified installers; and ensures safe interconnection to the grid.

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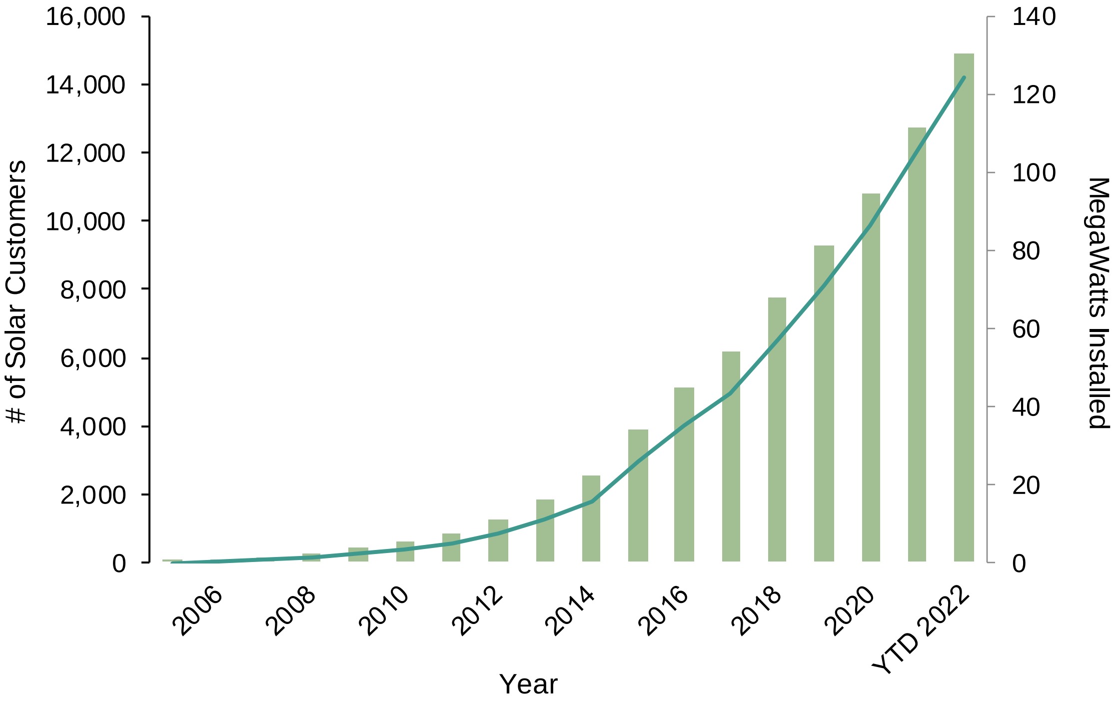
Customer Connected Solar Growth



As of October 31st, over 15,500 customers have installed over 130 MW's of solar.

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What's Next: Distributed Solar & Storage RFP

- Projects between 200 kilowatts to 4.99 MWs, connected to PSE's Distribution System.
- Ground or rooftop mounted, including canopies and parking structures.
- Solar and Solar + Storage
- Bids must be submitted in Q1 2023
- Projects to be completed by the end of 2025
- Emphasis on projects that provide clean energy solutions to Highly Impacted Communities and Vulnerable Populations and their service providers

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Resource Plan Modeling Results

2023 Electric Progress Report

December 12, 2022

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Things to Keep in Mind

- In the following slides we will look at the least cost (reference) portfolio
- The reference portfolio is not the preferred portfolio
- Once we walk through the reference portfolio, we will discuss the sensitivities and some candidate portfolios
- We will then spend time getting your feedback on the candidate portfolios (during this meeting and in writing following the meeting)

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CETA Commitments

- PSE is the Pacific Northwest's largest utility producer of renewable energy
- PSE currently owns and contracts for over 10 million MWh of renewable energy annually.
- Meet Clean Energy Transformation Act standards

2025: Eliminate coal-fired resources from its allocation of electricity to Washington retail electric customers

2030: Greenhouse gas neutral

2045: 100 percent of all retail sales of electricity supplied by renewable and non-emitting resources

Reliability: maintain resource adequacy targets

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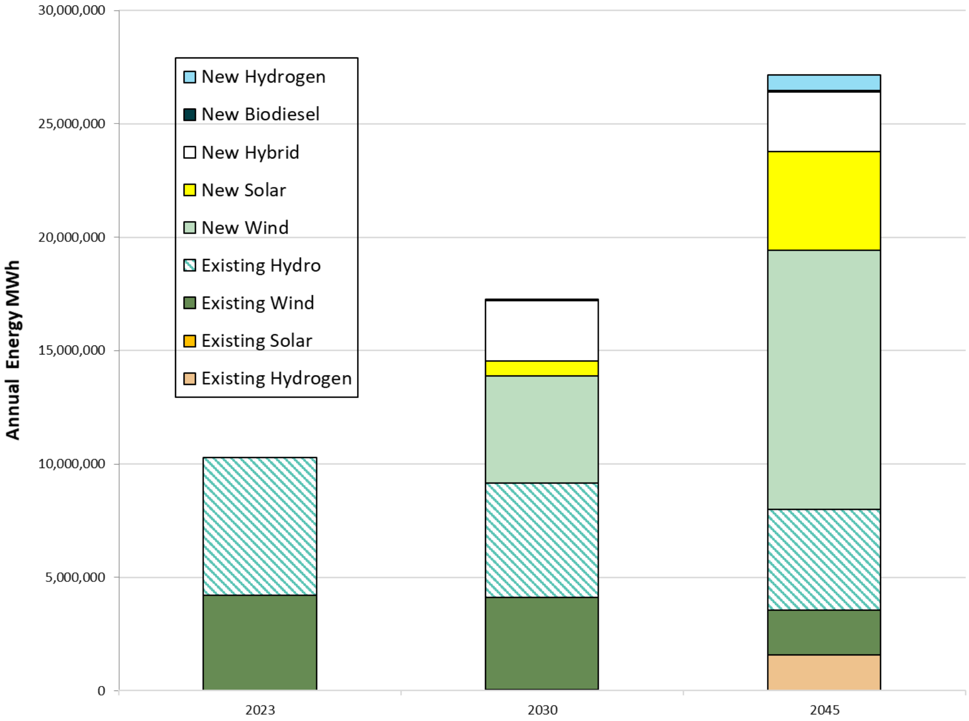
100 Percent Clean Energy by 2045: Least Cost (reference)

CETA Compliant Totals -

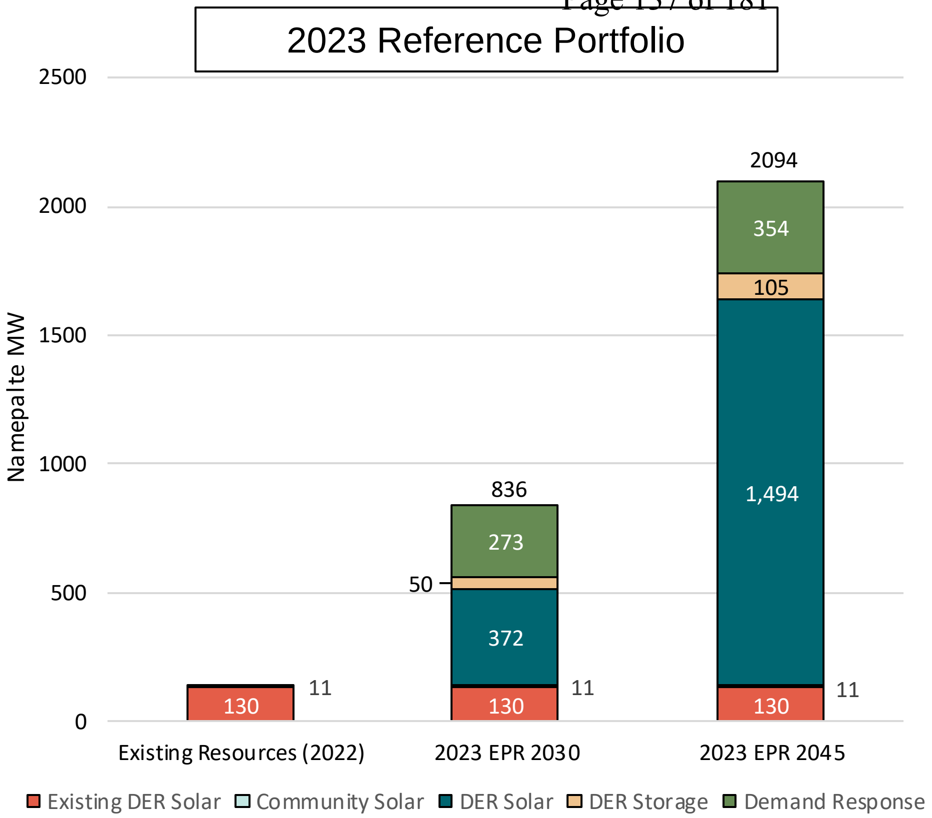
- Over 10 million MWh in 2023
- Over 17 million MWh in 2030
- Over 27 million MWh in 2045



Meeting Future Growth

Significant increase in distributed energy resources by 2030:

- ✓ **Solar**: Over 300 MW of DER solar **added** by 2030 and growing to almost 1,500 MW by 2045
- ✓ **Demand Response**: Over 300 MW nameplate added by 2045
- ✓ **Battery Storage**: 50 MW added of DER storage by 2030 along with over 1,000 MW of large utility scale energy storage



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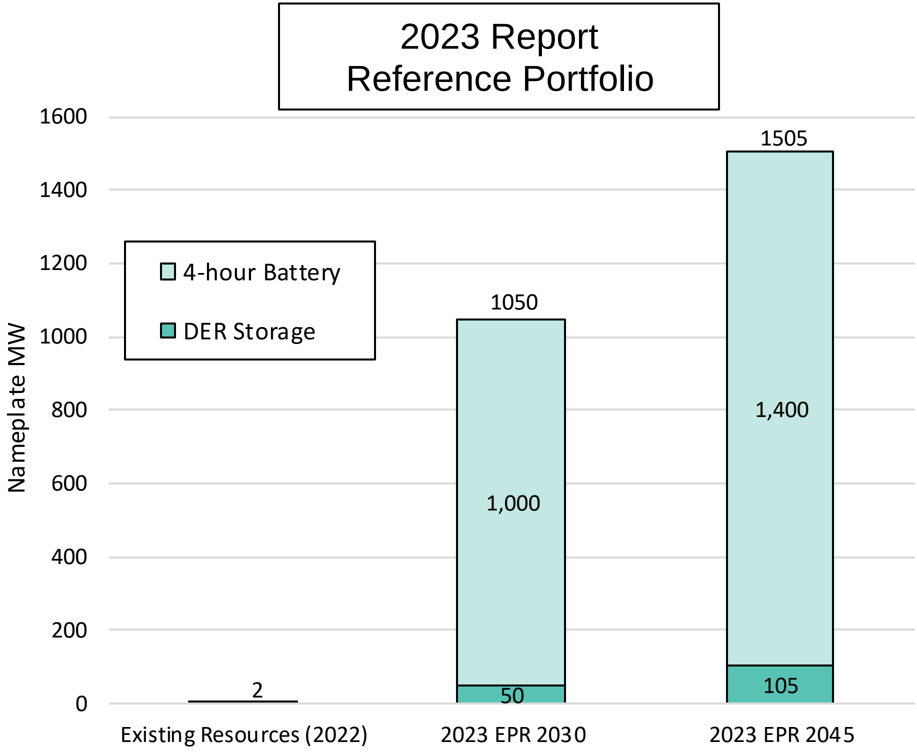
Energy Storage

Significant increase in energy storage resources:

- Over 1,000 MW increase by 2030
- Over 1,500 MW increase by 2045



Wind Resources

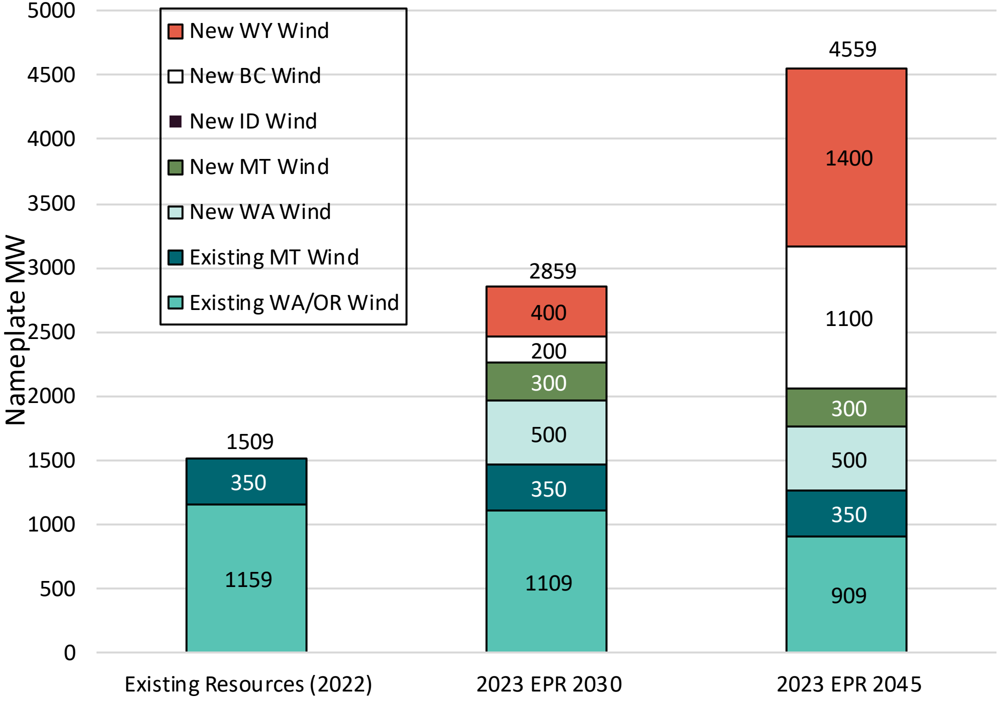
Significant increase in energy storage resources:

- 1,400 MW additional by 2030
- 3,300 MW additional by 2045

Restricted transmission through 2030

Assume new transmission available after 2035

2023 Report
Reference Portfolio



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Resource Adequacy

PSE analyzed both the winter and summer peak capacity needs.

Climate Change Data

- Slightly lowered the winter peak
- Increased the summer peak
- Still winter peaking through planning horizon

Electric Vehicle Forecast

- Increased peak demand from the EV forecast was larger than the decrease from the climate change data
- Overall increased demand

Market Reliance

- Availability of dispatchable generation resources are declining
- Market supply and demand fundamentals have tightened
- Market power prices and volatility are increasing
- Reliance on market as significant source of energy supply is risky

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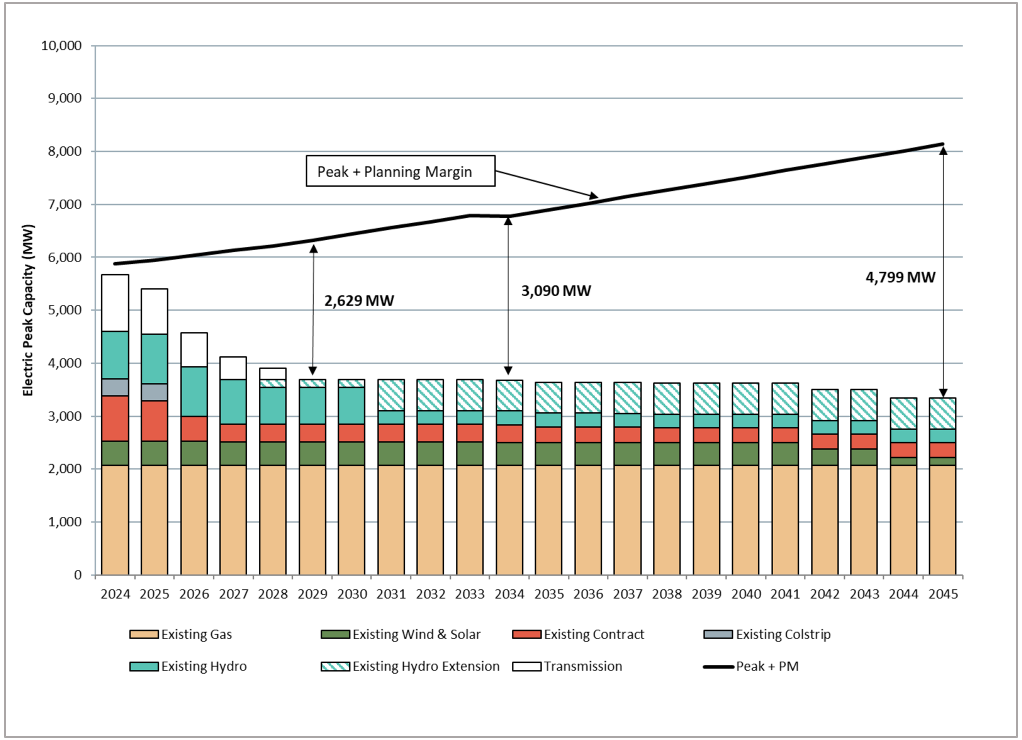
Winter Peak Driving Resource Capacity Additions

- Winter peak > summer peak through 2045
- Renewable and energy storage peak capacity contribution is larger in the summer
- New renewable and non-emitting resources will meet summer but not winter peaks
- New peaking capacity resources are needed



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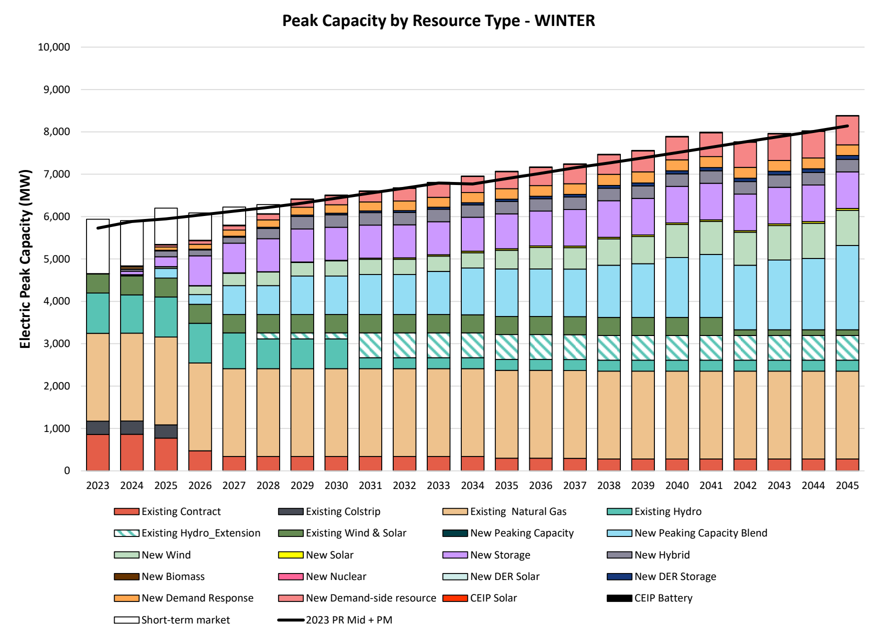
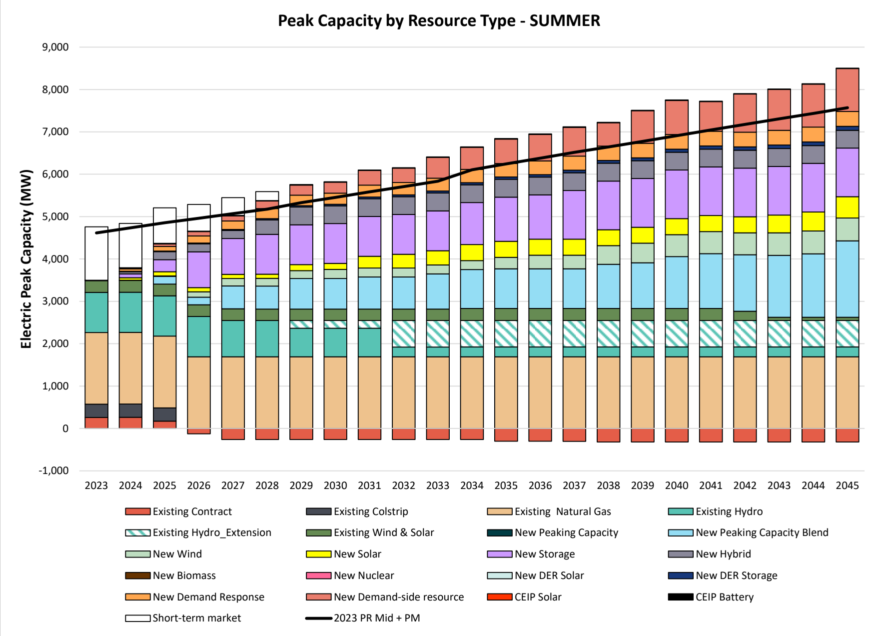
Meeting Winter and Summer Peak





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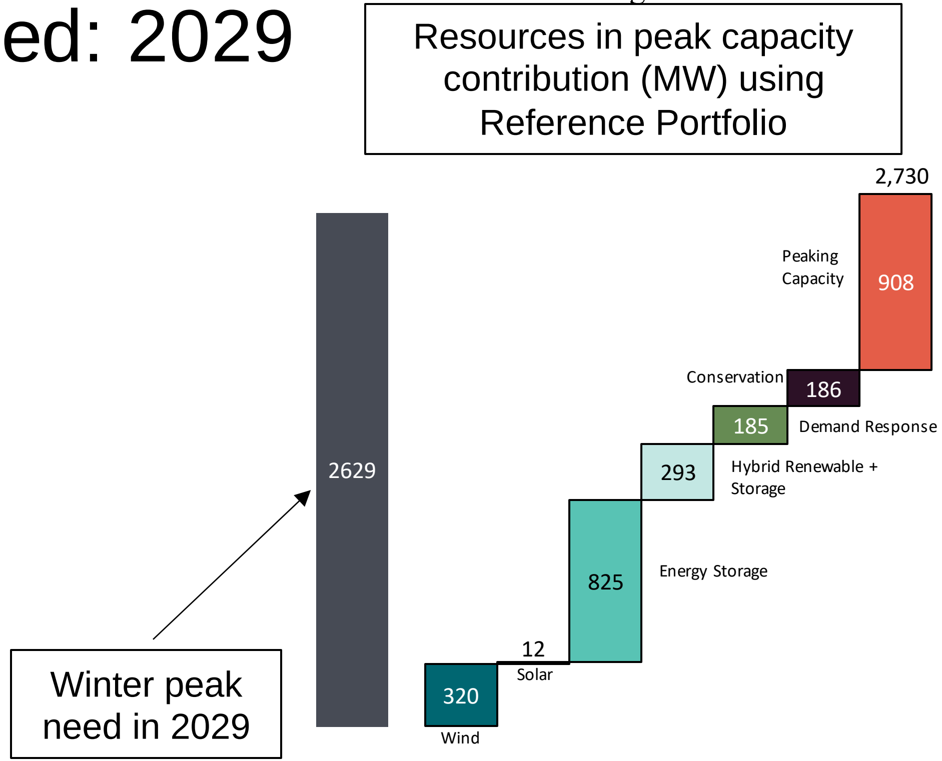
Meeting Winter Peak Need: 2029

The peak need is met using **new** capacity through a combination of:

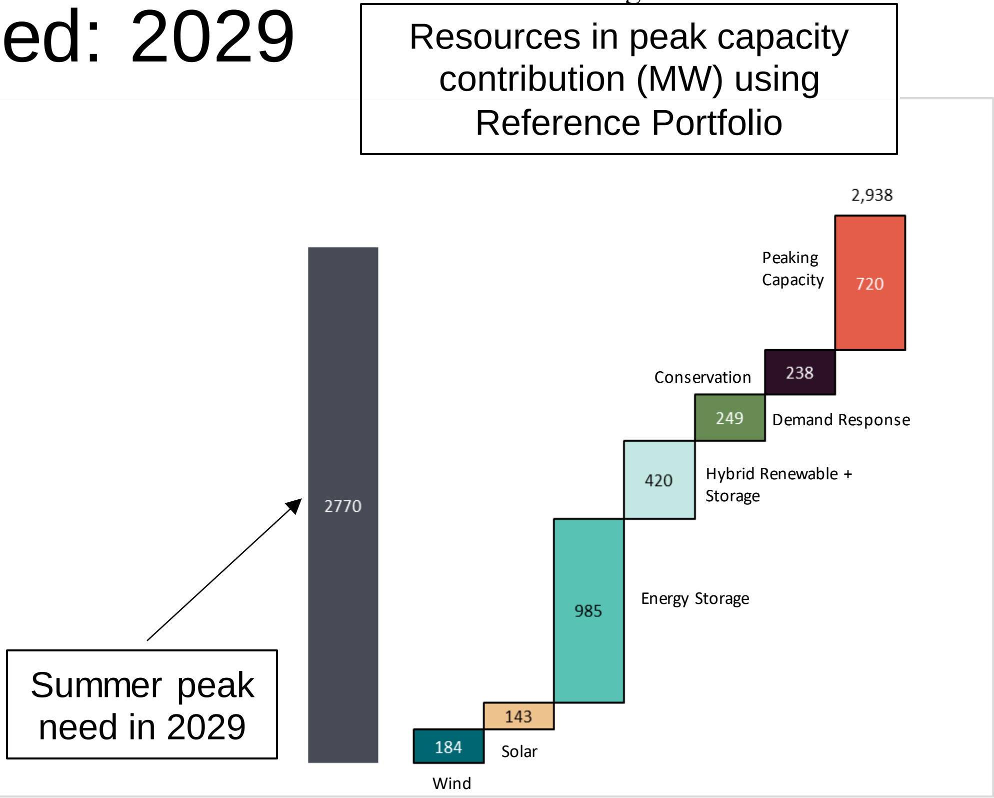
- Conservation
- Demand response
- Clean energy resources
- Energy storage
- CETA compliant peaking capacity



Meeting Sumer Peak Need: 2029

The peak need is met using **new** capacity through a combination of:

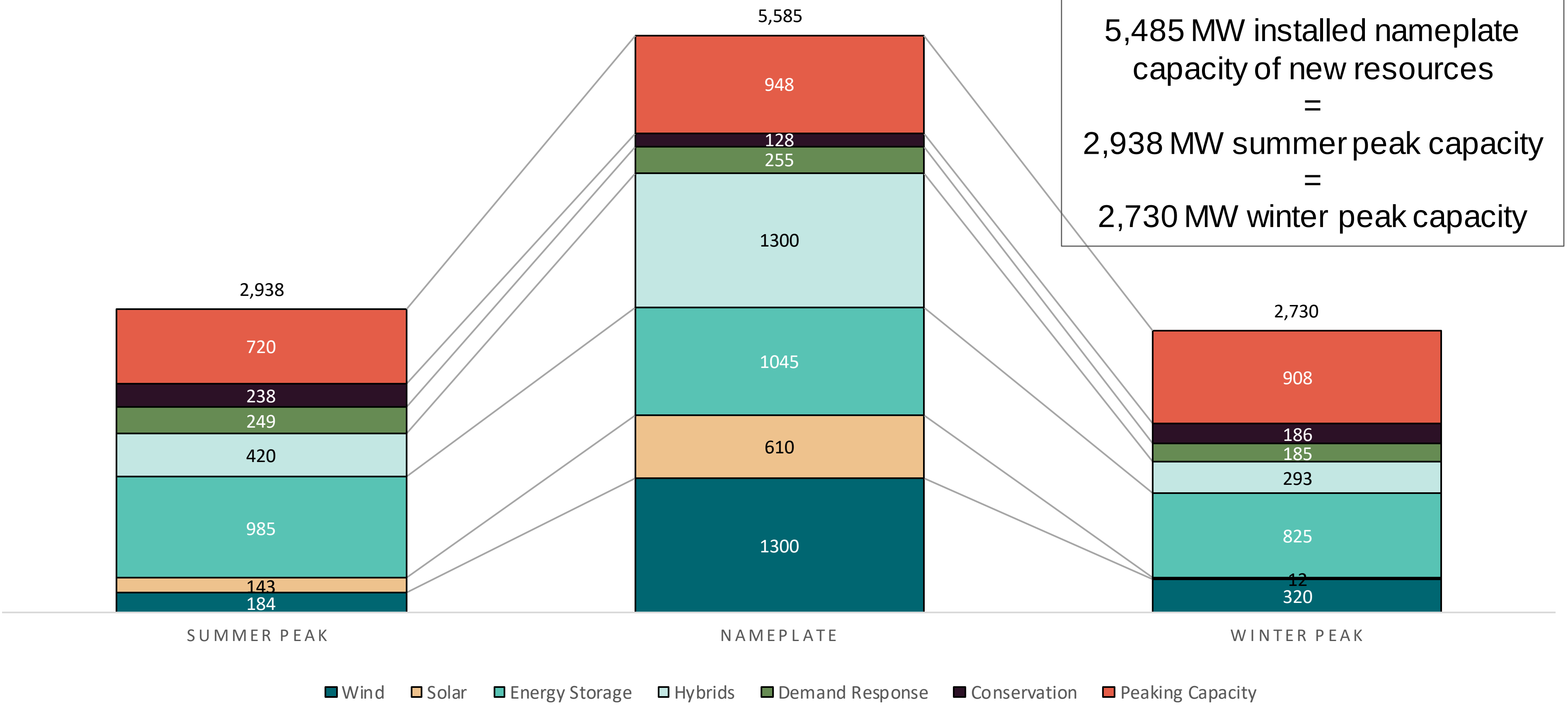
- Conservation
- Demand response
- Clean energy resources
- Energy storage
- CETA compliant peaking capacity



Nameplate Vs. Peak Capacity for 2029

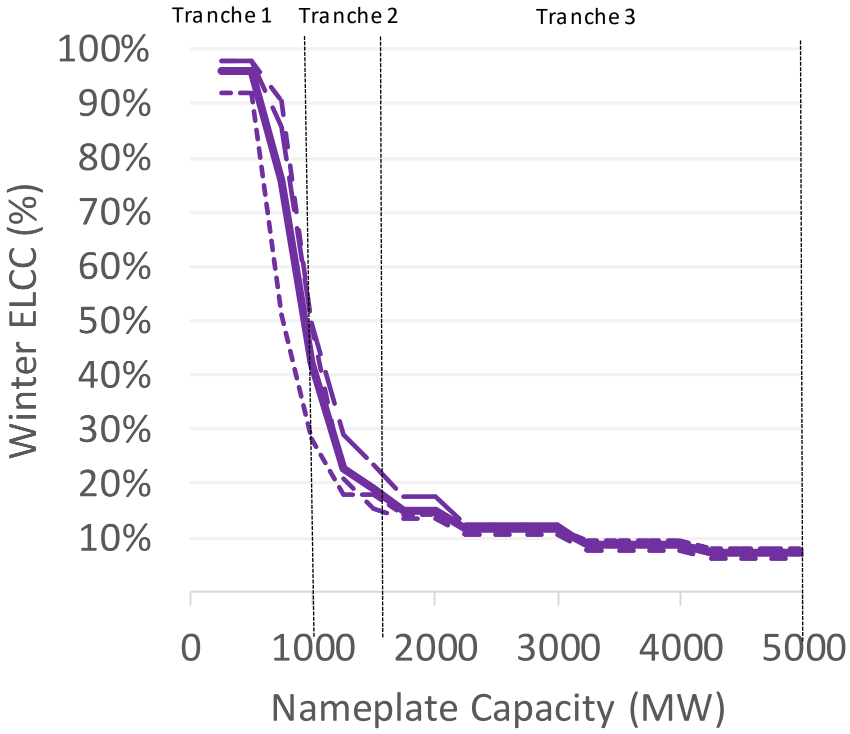
After adjusting for peak capacity contribution

5,485 MW installed nameplate capacity of new resources
=
2,938 MW summer peak capacity
=
2,730 MW winter peak capacity



Storage Peak Capacity Contribution

- Climate change data suggest shorter and less frequent winter events; more frequent summer events
- Increasing the ELCCs for shorter duration storage resources and solar
- Saturation effect can impact ELCCs significantly



Energy Storage Saturation ELCC (%)	Tranche 1 (0 -1,000 MW)	Tranche 2 (1,000 -1,500 MW)	Tranche 3 (1,500 -5,000 MW)
2-hour battery	61%	18%	3%
4-hour battery	78%	21%	10%
6-hour battery	86%	26%	11%
8-hour PHES	92%	33%	12%

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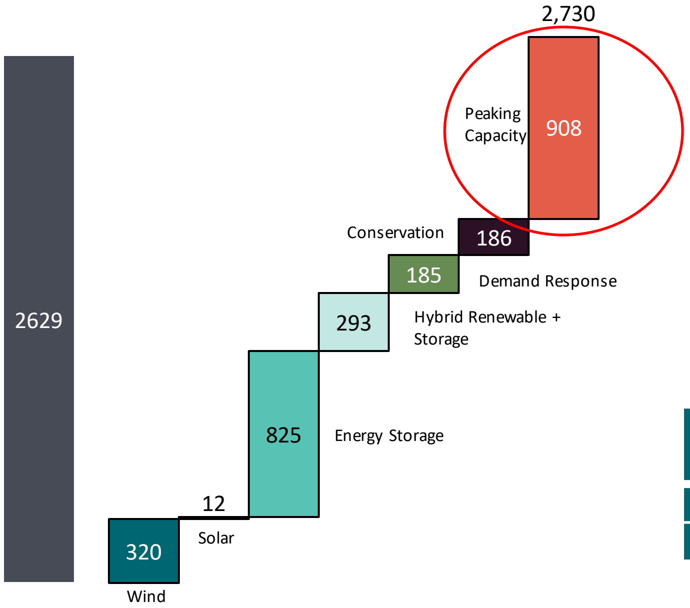
Alternatives for Achieving 900 MW Winter Peak Capacity



What other resources are available instead of the peaking capacity?

Note: Must account for peak capacity contribution and saturation curves

Energy Storage: In order to replace 908 MW of peak capacity, would need an additional 8,575 MW of installed nameplate energy storage.

Energy Storage Saturation ELCC	Balanced Portfolio	Tranche 2 @ 21%	Tranche 3 @ 10%	Additional
Nameplate	1,045 MW	455 MW	8,120 MW	8,575 MW
Peak Capacity	825 MW	96 MW	812 MW	908 MW

Note: calculation is intended to be illustrative and not result of the portfolio model

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Benefits of a Diverse Portfolio

- The future of electricity is a diversified portfolio of non-emitting resources
- A diverse energy mix is less dependent on a single source of fuel
- This will reduce risks due to market price and supply fluctuations
- Multiple, reliable generation sources allows a utility to provide power without disruption if one energy source fails, during extreme peak events, or during low hydro conditions
- A diverse energy portfolio reduces environmental impacts, improves reliability, and promotes innovation to meet needs to PSE's customers

Creating a Diverse Portfolio

- Modeled alternative energy generation and storage solutions (must be commercially viable)
- Modeled multiple battery scenarios (cycling frequency, capacity, type)
- Modeled hybrid scenarios (wind, solar, storage)
- Studied range of storage alternatives (e.g., chemical, gravity, compressed and liquid air)
- Transmission capacity is primary factor limiting renewables integration

Alternative Fuel Supply

Biodiesel

- Peaker and alternative fuel supply are commercially available
- Derived from waste cooking oil or dedicated crops
- Facilities in WA can manufacture over 100 million gal./year
- PSE has experience with diesel handling and protocol
- Modeling Assumptions:
  - 237 MW frame peaker would require 25,000 gallons/hour = 1.2 million gallons for 48-hour peak event
  - 7 days of fuel supply on site (approx. 2% capacity factor for year)
  - $15 million capital cost assumed for storage tank and infrastructure

US Department of Energy alternative Fuel Price Report, January 2022, https://afdc.energy.gov/files/u/publication/alternative_fuel_price_report_january_2022.pdf

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Emerging Technologies

Small Modular Nuclear

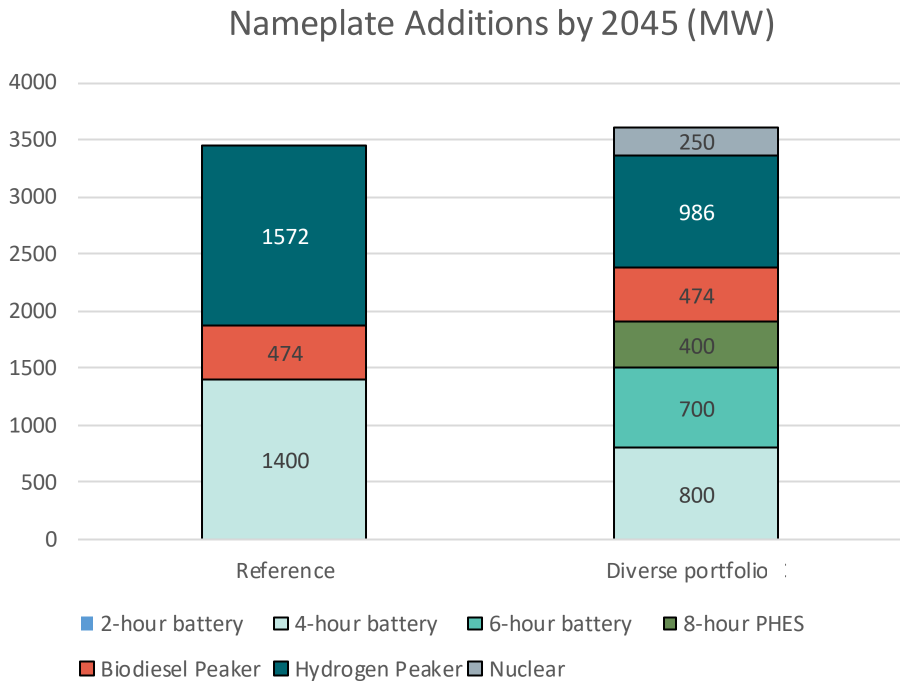
- Not available today
- Some data available through Energy Information Administration (EIA)
- Modules are similar in design to reactors used in submarines
- Additional research and development needed to scale up production.
- Modeling Assumptions:
    - 50 MW units for a total of 250 MW available starting in 2032

Hydrogen

- Not available today
- Technology exists to blend hydrogen with natural gas
- Large scale electrolyzers are an emerging technology
- Additional research and development needed to scale up production
- Will require large amount of low- or no-carbon electricity
- Modeling Assumptions:
    - Hydrogen is a fuel can that can be used in a combustion turbine or fuel cells
    - Fuel blending with NG starts at 30% in 2030 and grows to 100% by 2045

Diverse Energy Mix Example

- A diversified portfolio relies on multiple resources to meet demand
- A diversified portfolio has a combination of 4-hour, 6-hour and PHES technology
- A diversified portfolio has a mix of biodiesel and hydrogen peakers, and small modular nuclear to meet peak demand



Integrating Equity

- Expanded upon 2021 IRP approach
- Evaluated traditional least cost portfolio against customer benefit indicators (CBIs) in the CEIP:
  - CBIs are equally weighted
  - Public provided great feedback on this methodology
- Refined portfolio with goal of maximizing benefits and reducing burdens to vulnerable populations and highly impacted communities
- Intend to improve methodology for the 2025 IRP and future CEIP cycles

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Diversified Portfolio

Goal: Identify a feasible portfolio of diverse resources that prioritizes equity and creates customer benefits while maintaining reliability and affordability.

To create the diversified portfolio:

1. Start with the least cost reference portfolio

2. Make incremental changes to the portfolio to test the sensitivity of the adjustment to builds and portfolio cost

3. Create a portfolio with different options from part 2

Considerations: equity, cost, feasibility, reliability, and diversity of energy supply

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Considerations When Building a Diversified Portfolio

Near-term Additions	Longer-term Additions
• Needs to be commercially available • Limited transmission expansion • Must meet resource adequacy and customer demand	• More resource types available to explore emerging technologies • Expanding transmission to more remote renewable resources

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Portfolios Evaluated

Portfolio ID	Portfolio Name	Description
1	Reference	Least-cost and CETA compliant
2	Conservation Bundle 10	Increase conservation to 358 aMW by 2045
3	Conservation Bundle 7	Increase conservation to 284 aMW by 2045
4	DER Solar	Added 30 MW per year of DER rooftop solar from 2026-2045
5	DER Batteries	Added 25 MW per year of DER batteries (3hr Li-ion) from 2026-2031
6	MT Wind PHES, All East Wind	Added 400 MW MT East Wind + 200 MW MT PHES in 2026
7	MT Wind PHES, Central & East Wind	Added 200 MW MT East Wind + 200 MW MT Central Wind + 200 MW MT PHES in 2026
8	PNW PHES	Added 200 MW of PNW PHES in 2026
9	Nuclear	Added 250 MW of nuclear in 2032
10	Restricted Thermal	Thermal builds were prohibited before 2030
11	Diversified Portfolio	Combinations of Portfolios 2-10, see later slides for details
12	100 Percent Non-Emitting by 2030	Existing thermal retired by 2030, no new thermal allowed
13	High Carbon Price	CCA ceiling price used for all carbon allowances

Non-emitting Portfolios by 2030

Considered infeasible due to real-world limitations

Portfolio 10: Restricted thermal (no thermal builds before 2030)

- 4,700 MW Li-ion batteries added by 2030
- Additional 750 MW Li-ion batteries added from hybrid resources by 2030

Portfolio 12: 100% non-emitting by 2030:

- Model unable to solve without real-world constraints removed (i.e., build limits, transmission restrictions, adjusting nuclear availability to 2024)
- Portfolio costs $32 billion (60% cost increase from the Reference)
- Winter peak need met with nuclear builds starting in 2027 (technology not likely available)

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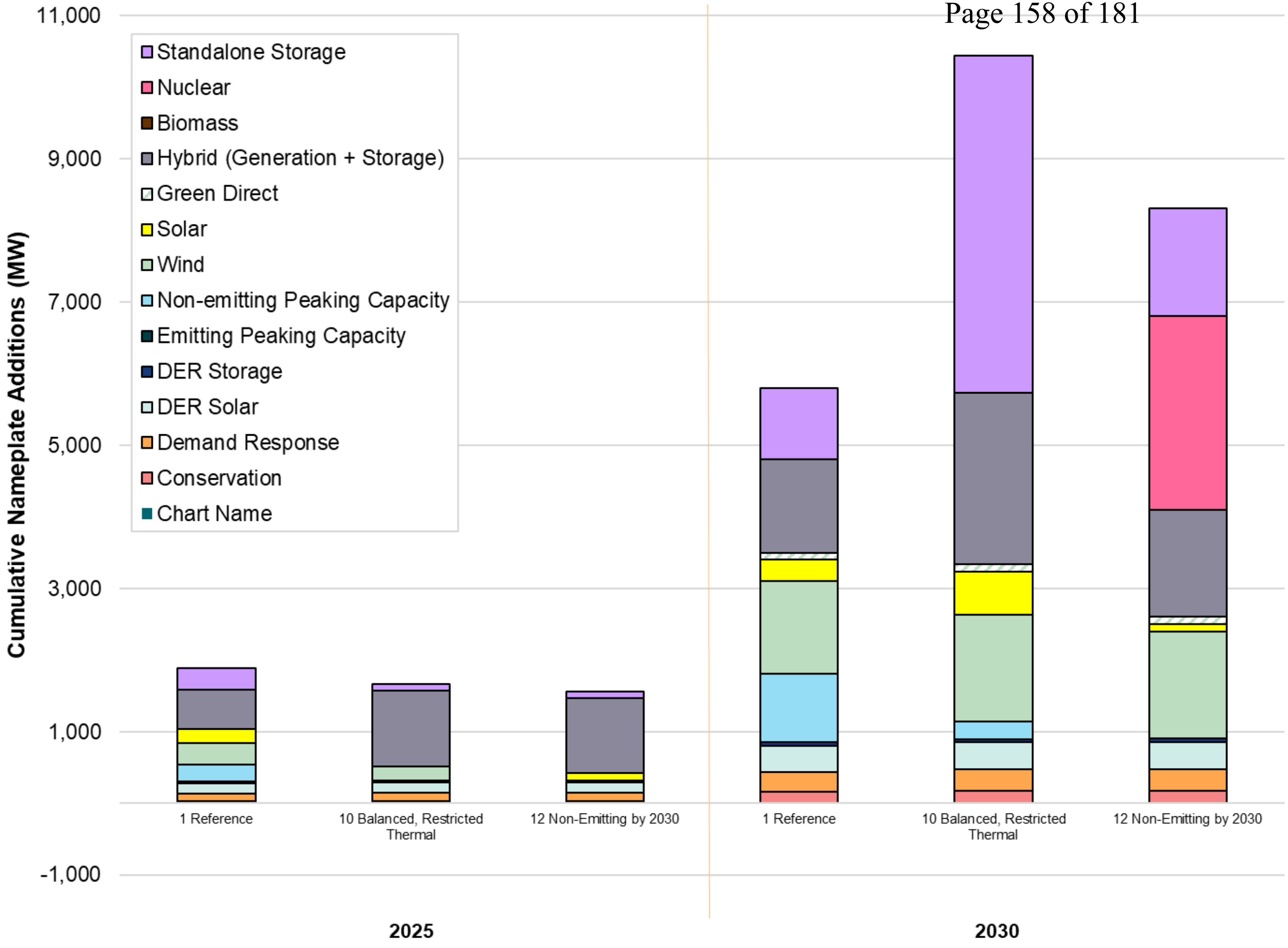
Restricted Thermal and Non-emitting by 2030 Portfolios



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Additional Portfolios Evaluated

Reference portfolio:
Least cost mix of resources to meet CETA requirements

- Increased conservation
- Increased DER solar
- Increased DER storage
- Add MT PHES + MT wind in 2026
- Add PNW PHES in 2026
- Add nuclear in 2032
- Restricted new peaking capacity before 2030
- Increased Demand Response

Candidate Diversified Portfolios: combinations of portfolios from list

- 11.0
- 11.1
- 11.2
- 11.3
- 11.4
- 11.5

Draft Preferred Portfolio

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Diversified Portfolios Iterations

Portfolio ID	Description
11.0	Combination of the following Portfolios: • **Portfolio 3**: Increase conservation by 284 aMW by 2045 • **Portfolio 4**: DER solar added - 30 MW/year from 2026-2045 • **Portfolio 5**: DER batteries added - 25 MW/year from 2026-2031 • **Portfolio 6**: Added 400 MW MT East Wind + 200 MW MT PHES in 2026 • **Portfolio 8**: Added 200 MW PNW PHES in 2026 • **Portfolio 9**: Nuclear added - 250 MW in 2032
11.1	Combination of the following: • **Portfolio 11.0** (above) • **Added all Demand Response programs**
11.2	Updated 11.1 with the following: • **Advanced battery builds**: 400 MW of 4hr Li-ion built in 2024/2025 instead of in 2025/2026 • **Delayed 1 biodiesel peaker** build from 2024 to 2026

Diversified Portfolios Iterations

Portfolio ID	Description
11.3	Combination of the following Portfolios: • **Portfolio 3**: Increase conservation by 284 aMW by 2045 • **Portfolio 6**: Added 400 MW MT East Wind + 200 MW MT PHES in 2026 • **Portfolio 8**: Added 200 MW PNW PHES in 2026 • **Portfolio 9**: Nuclear added - 250 MW in 2032
11.4	Combination of the following: • **Portfolio 3**: Increase conservation by 284 aMW by 2045 • **Portfolio 4**: DER solar added - 30 MW/year from 2026-2045 • **Portfolio 6**: Added 400 MW MT East Wind + 200 MW MT PHES in 2026 • **Portfolio 8**: Added 200 MW PNW PHES in 2026 • **Portfolio 9**: Nuclear added - 250 MW in 2032
11.5	Combination of the following Portfolios: • **Portfolio 3**: Increase conservation by 284 aMW by 2045 • **Portfolio 6**: Added 400 MW MT East Wind + 200 MW MT PHES in 2026 • **Portfolio 9**: Nuclear added - 250 MW in 2032

Diversified Portfolios Iterations

Portfolio 11.5
- Least diversified
- Conservation; MT Wind + PHES; Nuclear

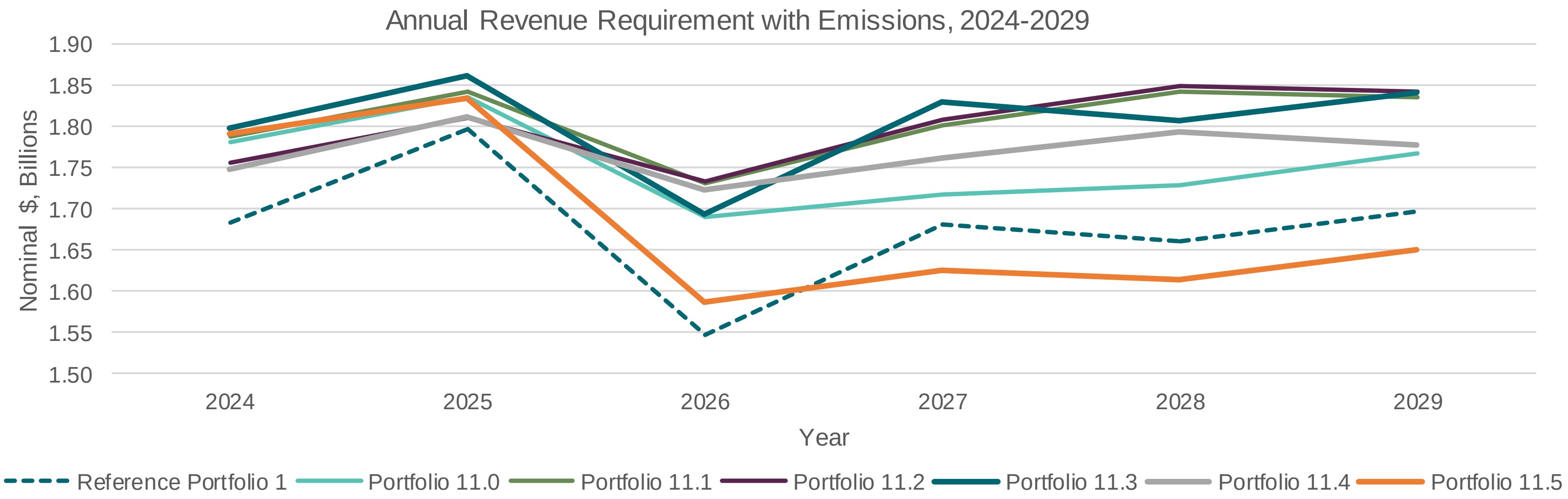
Portfolio 11.3
- Add in PNW PHES

Portfolio 11.4
- Add in DER Solar

Portfolio 11.0
- Add in DER Batteries

Portfolios 11.1 & 11.2
- Most Diversified
- Add in all DR Programs

Diversified Portfolios: Near-term Costs



6 Year NPV (2024-2029) ($ Billions)	Reference Portfolio 1	Portfolio 11.0	Portfolio 11.1	Portfolio 11.2	Portfolio 11.3	Portfolio 11.4	Portfolio 11.5
Revenue Requirement with Emissions	8.06	8.42	8.66	8.62	8.66	8.48	8.11
Revenue Requirement without Emissions	6.14	6.78	6.90	6.86	6.89	6.77	6.53
Emissions Costs	1.92	1.64	1.76	1.76	1.76	1.72	1.58

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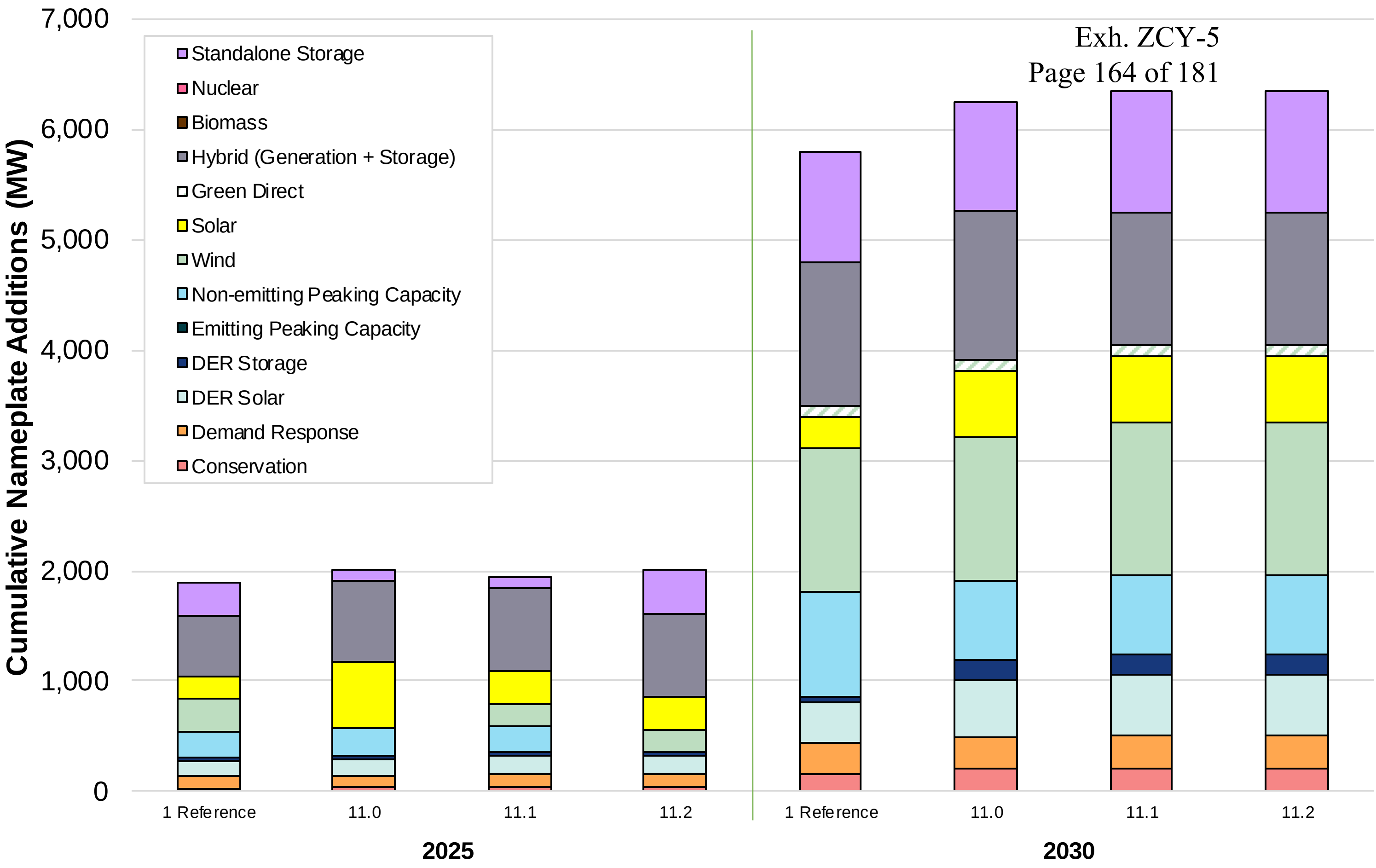
Diversified Portfolios: Near-term Resource Builds



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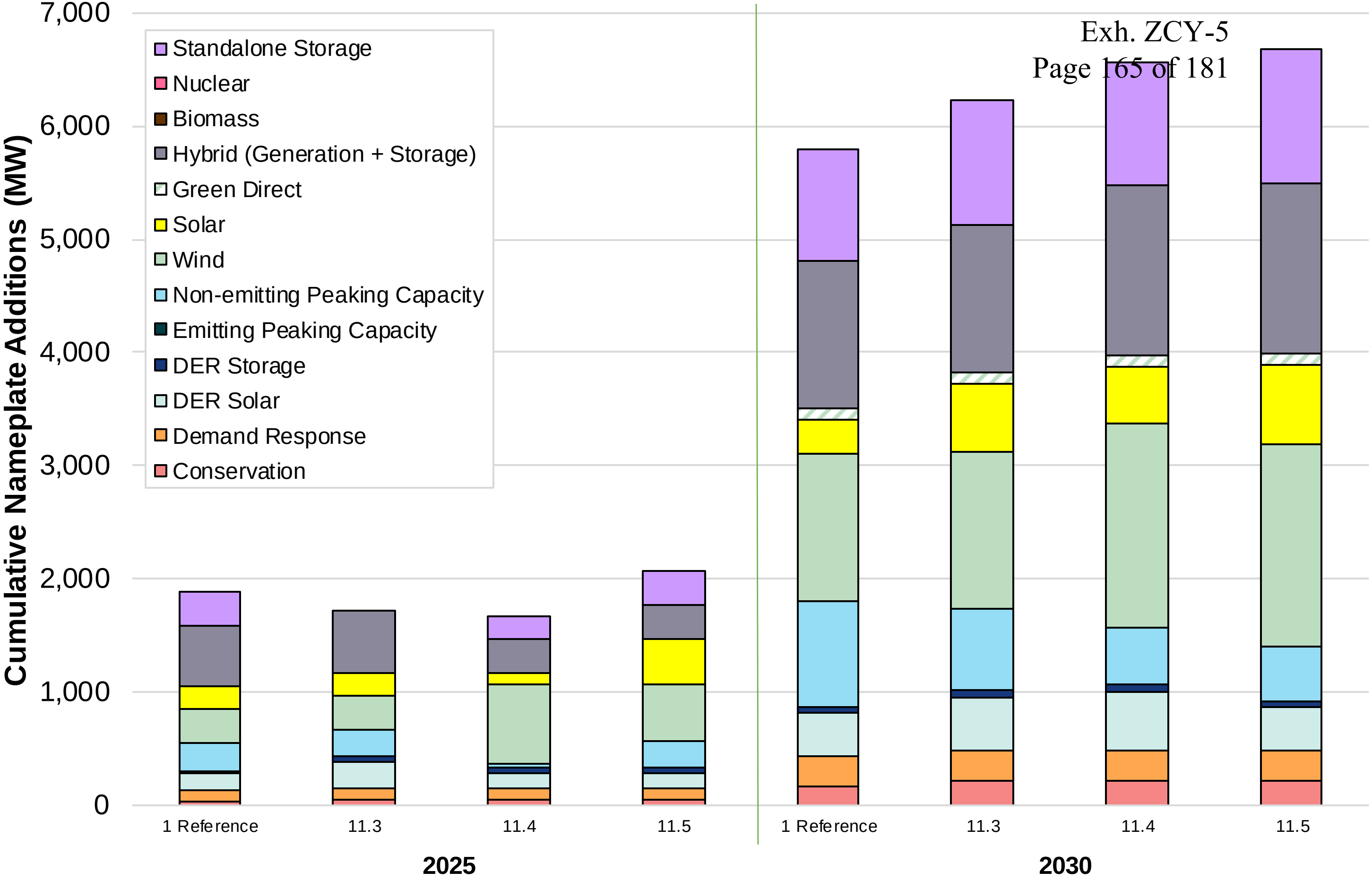
Diversified Portfolios: Near-term Resource Builds - Continued



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Key Differences

Changes from Reference:

Portfolios 11 – 11.3 - have a combination of

- increased distributed resources,
- increased conservation and
- increased Demand response

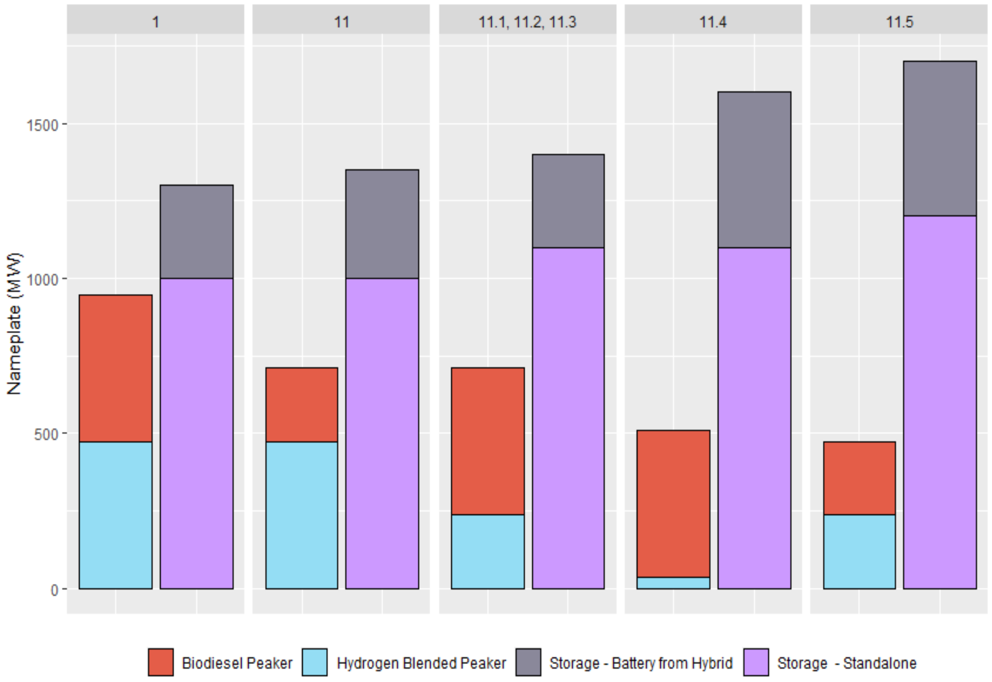
reduced the peaking capacity from 4 peakers to 3 by 2030 at a cost range of $640 - $760 Million over 6 years (NPV 2024 – 2029)

Portfolios 11.4 and 11.5 – have a combination of

- increased utility scale energy storage
- increased conservation and
- Increased hybrid resources

Reduced peaking capacity from 4 peakers to 2 by 2030 at a cost range of $45 - 65 Million over 6 years (NPV 2024 – 2029)

Cumulative Builds in 2030



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Customer Benefit Indicator (CBI) Tool

Goal: Illuminate customer benefits and burdens of each portfolio beyond cost and assist PSE in evaluating the types and amounts of resources needed to serve load.

CBI Metrics Evaluated:

- GHG Emissions
- SO_2, NO_x, PM
- Quantity of Jobs
- DR Peak Contribution
- DER Solar, DER Storage, & DR Participation
- EE Added

Note: some CBIs are not included in this tool due to lack of available data from LTCE modeling output.

- Consistent with approach presented in September / October 2022
- Uses modeling outputs to compare CBIs between portfolios
- Normalizes data: all portfolios are evaluated against the reference portfolio (portfolio 1)
- Each portfolio is assigned an overall index

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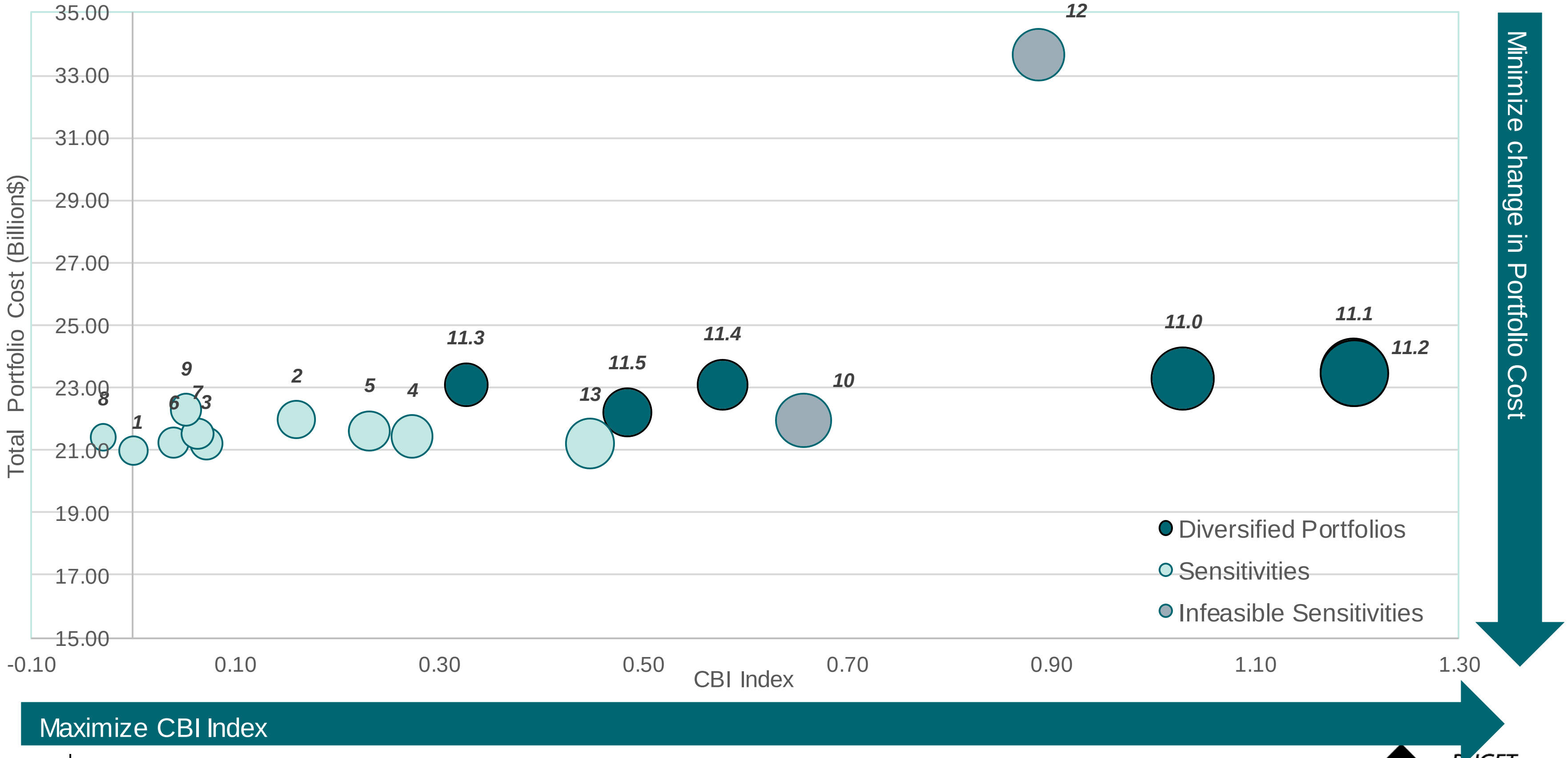
CBI Tool - Results

Portfolios	Descript	CBI Index	Portfolio Cost (2020 $, Billions)	% Change in Portfolio Cost from Reference	CBI Index per Dollar Spent
1	Reference	0.00	20.97	--	1.0
2	Conservation Bundle 10	0.16	21.97	4.8%	1.7
3	Conservation Bundle 7	0.07	21.20	1.1%	1.3
4	DER Solar	0.27	21.44	2.2%	2.3
5	DER Batteries	0.23	21.62	3.1%	2.1
6	MT Wind PHES, All East Wind	0.04	21.22	1.2%	1.2
7	MT Wind PHES, Central & East Wind	0.06	21.52	2.6%	1.3
8	PNW PHES	-0.03	21.41	2.1%	0.9
9	Nuclear	0.05	22.29	6.3%	1.2
10	Restricted Thermal	0.66	21.96	4.7%	4.0
11.0	Diversified Portfolio	1.03	23.29	11.1%	5.4
11.1	Diversified Portfolio	1.20	23.48	11.9%	6.1
11.2	Diversified Portfolio	1.20	23.47	11.9%	6.1
11.3	Diversified Portfolio	0.33	23.10	10.1%	2.4
11.4	Diversified Portfolio	0.58	23.10	10.1%	3.5
11.5	Diversified Portfolio	0.49	22.21	5.9%	3.2
12	100 Percent Non-Emitting by 2030	0.89	33.65	60.5%	3.6
13	High Carbon Price	0.45	21.21	1.1%	3.1

CBI Index and Total Portfolio Cost (with Emissions)



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CBI Results - Diversified Portfolios

- Best overall CBI indices = 1.20 (Portfolios 11.1 & 11.2)
- Increased CBI indices driven by participation in:
  - DER solar
  - DER storage
  - DR programs
- GHG emissions reduced by ~11-15 million short tons
- About $2.8 billion more than Reference Portfolio (~12% cost increase)

Increased total customer count in DER and DR programs → CBI: Energy and Non-Energy Benefits, Reduction of Burdens

Reduced the metric tons of CO_2 → CBI: Environmental

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Diversified Portfolios

Meets Clean Energy Transformation Act (CETA) Standards

Cumulative Resource Additions by 2045 (MW)	1 Reference	11.0	11.1	11.2	11.3	11.4	11.5
Demand Side Resources	**880**	**1,022**	**1,064**	**1,064**	**989**	**978**	**1,019**
Conservation	526	624	624	624	635	624	624
Demand Response	354	399	440	440	354	354	395
Distributed Energy Resources	**1,599**	**2,367**	**2,407**	**2,407**	**1,712**	**2,212**	**1,612**
DER Solar	1,494	2,099	2,114	2,114	1,594	2,094	1,494
DER Storage	105	267	292	292	117	117	117
Supply Side Resources	**10,431**	**10,003**	**10,397**	**10,397**	**10,579**	**11,073**	**11,052**
Emitting Peaking Capacity	0	0	0	0	0	0	0
Non-emitting Peaking Capacity	2,046	1,515	1,460	1,460	1,442	1,333	1,515
Wind	3,200	2,800	2,800	2,800	3,000	3,100	3,500
Solar	2,389	1,592	1,891	1,891	1,892	1,895	2,490
Green Direct	100	100	100	100	100	100	100
Hybrid (Generation + Storage)	1,296	1,846	1,996	1,996	1,795	2,395	1,497
Biomass	0	0	0	0	0	0	0
Nuclear	0	250	250	250	250	250	250
Standalone Storage	1,400	1,900	1,900	1,900	2,100	2,000	1,700
Total	**12,910**	**13,392**	**13,867**	**13,867**	**13,280**	**14,263**	**13,683**

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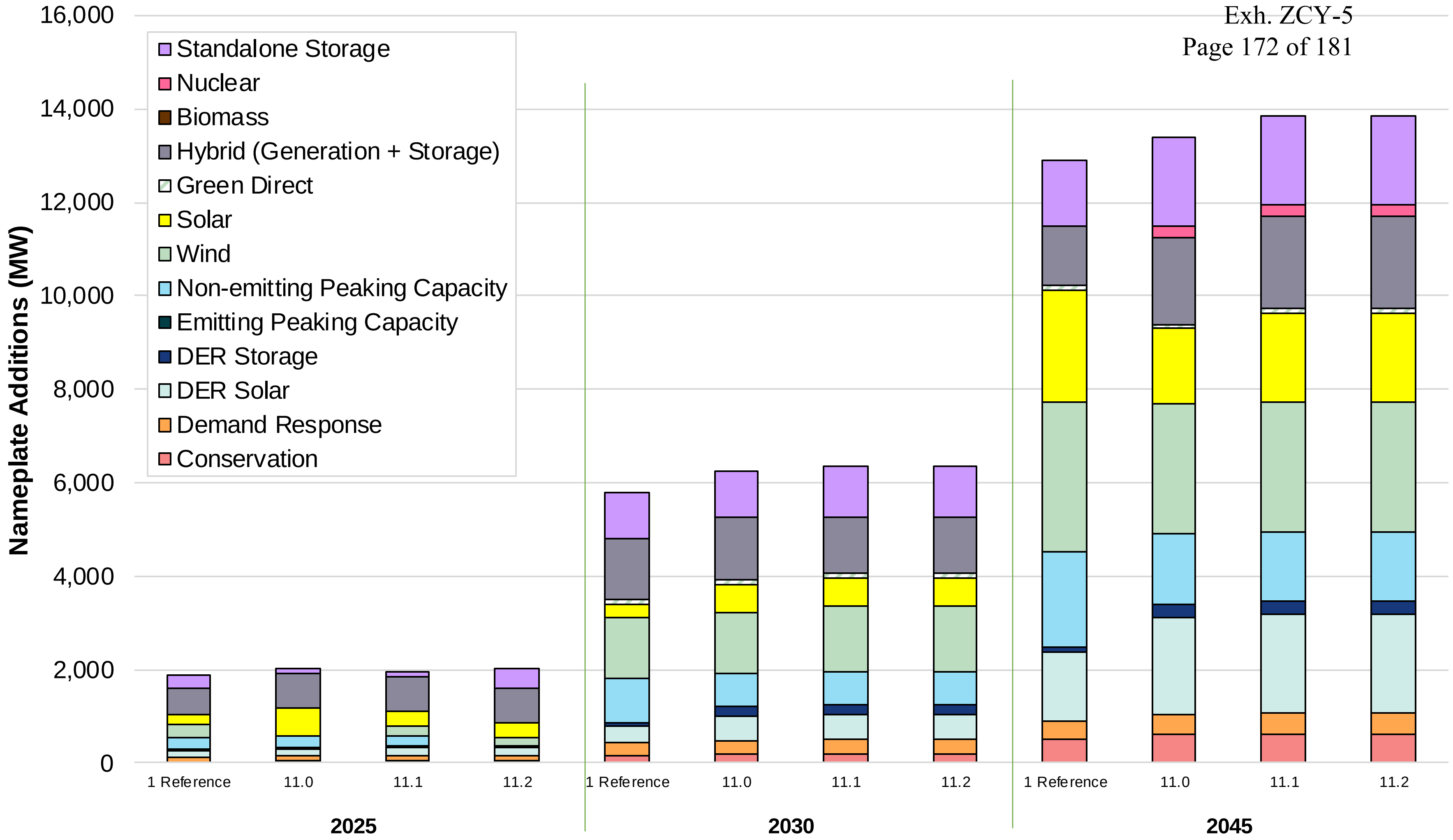
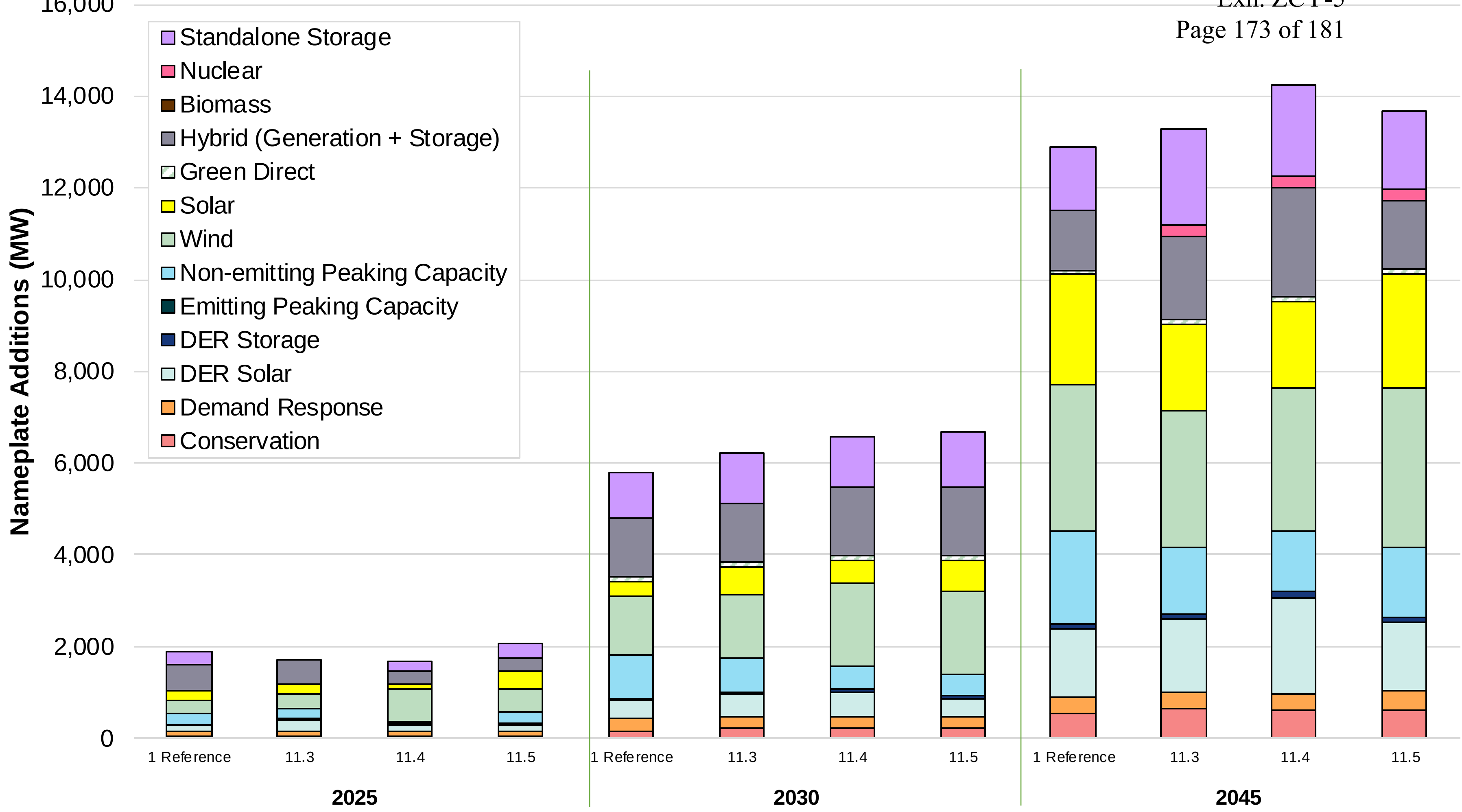

Nameplate Additions (MW)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Standalone Storage
Nuclear
Biomass
Hybrid (Generation + Storage)
Green Direct
Solar
Wind
Non-emitting Peaking Capacity
Emitting Peaking Capacity
DER Storage
DER Solar
Demand Response
Conservation
1 Reference
11.0
11.1
11.2
2025
2030
2045


Standalone Storage
Nuclear
Biomass
Hybrid (Generation + Storage)
Green Direct
Solar
Wind
Non-emitting Peaking Capacity
Emitting Peaking Capacity
DER Storage
DER Solar
Demand Response
Conservation
Nameplate Additions (MW)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1 Reference
11.3
11.4
11.5
1 Reference
11.3
11.4
11.5
1 Reference
11.3
11.4
11.5
2025
2030
2045

Diversified Portfolio CBI Index Comparison

CBI Metric		1 Reference Portfolio	11.0	11.1	11.2	11.3	11.4	11.5
Cost ($, billions)	↓	20.97	23.29	23.48	23.47	2 3.10	2 3.10	2 2.21
Average Index	↑	0	1.03	1.20	1.20	0.33	0.58	0.49
GHG Emissions	↑	0	1.13	0.83	0.83	0.89	1.13	1.14
SO_2, No_x, PM Emissions	↑	0	0.28	0.22	0.22	0.23	0.27	0.25
Jobs	↑	0	0.03	0.24	0.24	0.25	0.20	-0.04
DR Peak Capacity	↑	0	0.49	0.94	0.94	0.00	0.00	0.45
DER Solar Participation	↑	0	2.25	2.30	2.30	0.37	2.23	0.00
Energy Efficiency Added	↑	0	0.63	0.63	0.63	0.71	0.63	0.63
DR Participation	↑	0	1.29	1.96	1.96	0.00	0.00	1.28
DER Storage Participation	↑	0	2.14	2.47	2.47	0.17	0.17	0.17

Considerations When Building a Diversified Portfolio

Near-term Additions	Longer-term Additions
• Needs to be commercially available • Limited transmission expansion • Must meet resource adequacy and customer demand	• More resource types available to explore emerging technologies • Expanding transmission to more remote renewable resources

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Break

Please return in 10 minutes

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Candidate Portfolios Discussion

2023 Electric Progress Report

December 12, 2022

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Discussion Questions

1. The diversified portfolios were developed to reduce risks associated with over reliance on one or a few resources. Do you agree this type of resource diversification should be a priority?

The diversified portfolios require trade-offs:

- Utility scale resources are less expensive to diversify but result in lower CBI scores
- Localized resources (Distributed Energy Resources or DER) are more expensive but result in higher CBI scores

2. How would you prioritize these trade-offs between resource types, costs, and various CBI metrics?

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Next Steps

2023 Electric Progress Report

December 12, 2022

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Electric Progress Report Timeline

- **December 14, 2022** – Webinar recording and chat transcript posted
- **December 19, 2022** – Feedback form for Dec. 12 meeting closes
- **January 24, 2023** – Draft Chapter 3: Resource Plan Decisions of the 2023 Electric Progress Report posted; feedback form opens
- **February 7, 2023** – Deadline to submit feedback on draft 2023 Electric Progress Report
- **March 14, 2023** – Final results presentation
- **March 31, 2023** – Final 2023 Electric Progress Report Submitted

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Gas Integrated Resource Plan Timeline

- **January 10, 2023** – Feedback form opens
- **January 17, 2023** – Draft gas portfolio results meeting
- **January 24, 2023** – Draft Gas Utility IRP published
- **February 7, 2023** – Deadline to submit feedback on draft Gas Utility IRP
- **March 14, 2023** – Final gas portfolio results presentation
- **March 31, 2023** – Final 2023 Electric Progress Report Submitted

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