Northwest **Power** and
Conservation Council

July 5, 2023

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis**

SUBJECT: **2023 Puget Sound Energy Electric Progress Report**

BACKGROUND:

Presenter: Elizabeth Hossner, Manager of Planning and Analysis, PSE

Summary: This presentation will summarize key findings from the 2023 Electric Progress Report from Puget Sound Energy (PSE).

Relevance: The 2023 Electric Progress Report is the most recent planning exercise to determine how PSE will serve their customers' needs over the next 20 years. Due to increasing loads and changing Washington and federal policies, this progress report features increased future reliance on non-emitting resources and DERs and discusses options for addressing resource deliverability issues. Tracking and understanding where utilities are headed is critical to informing our mid-term assessment and next power plan.

Workplan: Coordinate with regional utilities on integrated resource planning and other activities to share plan findings and leverage utility insights and advancements.

More Info: Puget Sound Energy 2023 Electric Progress Report

2023 Electric Progress Report

Elizabeth Hossner, Manager, Resource Planning and Analysis, PSE

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June 26, 2023

1

Highlights

PSE is committed to reaching the goals of the Clean Energy Transformation Act (CETA) and achieving carbon neutrality by 2030 and carbon free electric energy supply by 2045. The electric resource plan presented reflects these changes and goals. It includes:

- Significant investments in renewable resources
- Acquiring conservation resources
- Developing and refining methods to embed equity into resource decisions
- Pursuing demand response programs
- Integration of distributed energy resources like residential solar and battery energy storage
- Reduced reliance on short-term market purchases in response to the changing western energy market
- Inclusion of alternative fuels to operate new generating plants
- Exploring new capacity options to drive diversity in energy supply

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New challenges and opportunities

- Climate Commitment Act (CCA)
- Inflation Reduction Act
- Climate Change modeling for demand and hydro generation
- Resource Adequacy modeling for two peaks: Winter & Summer
- Reliability amidst lots of renewable resources
- Electrification analysis and coordination with the gas portfolio
- Quantifying customer benefits

3

Resource planning foundations

This 2023 Electric Report is a planning exercise that evaluates how PSE will meet customer electric supply needs. The analysis considers policies, costs, changing economic conditions, and the existing energy system to develop a plan to meet the needs of our customers at the lowest reasonable cost over the next 20+ years.

Key objectives, which lay the foundation for this and all future resource plans:

- ✓ Build a **reliable, diversified** power portfolio of non-emitting resources
- ✓ 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

4

Public participation snapshot

Access through online webinars and recordings

14	64	135	251
IRP webinars recorded and posted online	Average number of webinar participants	Organizations participated in webinars	Unique individuals participated in webinars

Online interested party feedback

45	10
Feedback forms received and responded to	Feedback reports prepared

E-newsletter communication

29	1,210
Email communications distributed	Interested parties opting to receive IRP newsletter

irp@pse.com
pse.com/irp

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How public feedback shaped our work

✓Reduced market reliance

✓Incorporated climate change data and modeled winter and summer demand

✓Considered a range of resource alternatives and emerging technologies

✓Modeled battery cycling at various frequencies, capacities, and types

✓Modeled hybrid renewable and energy storage resources

✓Incorporated Inflation Reduction Act*

✓Embedded equity

✓Excluded small modular nuclear (SMR) from final portfolio

*Multiple public participation participants urged PSE to incorporate demand-side resource impacts as well. These federal programs are still taking shape and PSE does not have enough information to model these impacts. Therefore, in this IRP, we were not able to analyze how those layers of subsidies might affect customer decisions with regard to retaining or replacing appliances.

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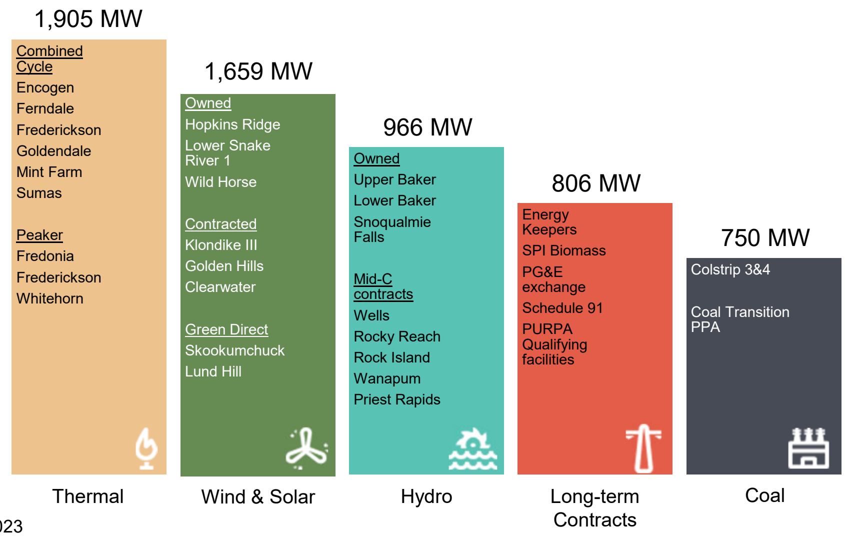
PSE currently has just over 6,000 MW nameplate of owned and contracted electric generating resources



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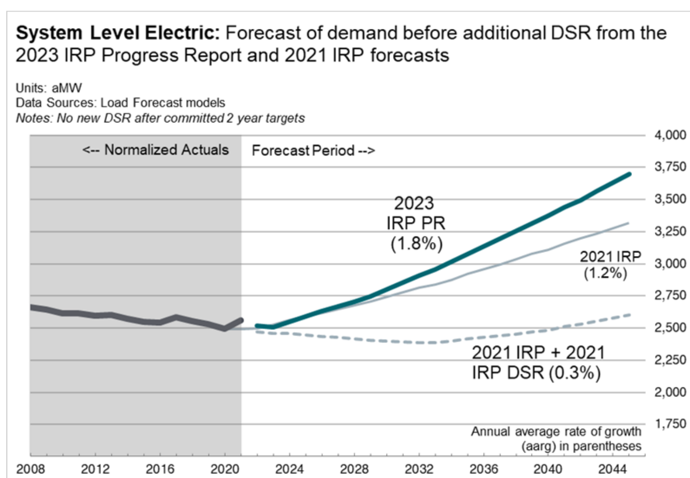
Energy demand forecast for 2023 Electric Progress Report

- Demand lower by -0.4% in 2024 and higher by ~9% 2040.
- Positive customer growth, steady use per customer (UPC), and EV growth yield demand growth, before DSR.
  - Applying DSR will result in an "after DSR" forecast with lower growth than "before DSR."
- Major updates: Normal Degree Days and EV forecast.



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Changes in the preferred portfolio from 2021 IRP

Key Drivers for change in resource mix:

- Increase in demand forecast results in increased builds
- Market reliance shedding results in increased peak need and more builds
- Updated resource adequacy modeling resulted in increased ELCC for energy storage
- Updated resource costs result in shift toward hybrid resources
- Updated Conservation Potential Assessment (CPA) changes value of conservation and results in less conservation.

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2023 Electric Progress Report

Preferred Portfolio

Resource Additions (Nameplate MW)	2021 IRP 2030	2021 IRP 2040	2023 Progress Report 2030	2023 Progress Report 2040
Demand Side Resources	**758**	**1,221**	**618**	**1,094**
Conservation[1]	576	1,016	282	657
Demand Response	182	206	336	437
Distributed Energy Resources[2]	**295**	**792**	**739**	**1,815**
DER Solar	260	723	552	1,567
DER Storage	35	69	187	248
Supply Side Resources	**3,209**	**4,936**	**5,360**	**9,177**
CETA Compliant Peaking Capacity[3]	255	729	711	985
Capacity Contracts	979	979	0	0
Wind	1,400	2,500	1,400	2,900
Solar	400	498	699	1,894
Green Direct	0	0	100	100
Hybrid (Total Nameplate)	0	0	1,449	1,597
Hybrid Wind	*0*	*0*	*600*	*700*
Hybrid Solar	*0*	*0*	*400*	*398*
Hybrid Storage	*0*	*0*	*450*	*499*
Biomass	0	30	0	0
Nuclear	0	0	0	0
Standalone Storage	175	200	1,000	1,700
Total	**4,262**	**6,949**	**6,717**	**12,086**

1. *Conservation in aMW includes energy efficiency, codes and standards, and distribution efficiency.*
2. *Distributed Energy Resources (DER) storage and solar includes CEIP storage and solar additions, non-wires alternatives, distributed storage and solar additions, and net-metering solar.*
3. *CETA compliant peaking capacity is functionally similar to natural gas peaking capacity, but operates using non-emitting hydrogen or biodiesel fuel.*

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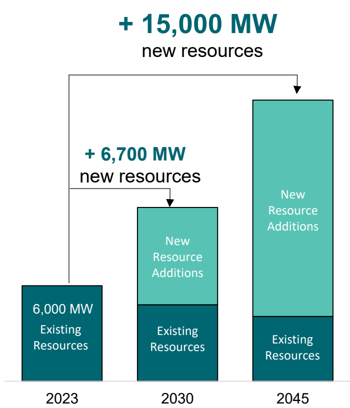
Electric generating resources need estimated to almost double by 2030



By 2030 that's equivalent to*…

+ 23 Wild Horse size wind projects

+ 5 Whitehorn size peaking facilities

+ 700 shipping containers for battery storage
~97 acres (4.2 million sq. ft.) double stacked

+ 35,500 residential solar installations

+ 450 school community solar projects

+ 190 commercial solar installations

*Equivalent measures are illustrative

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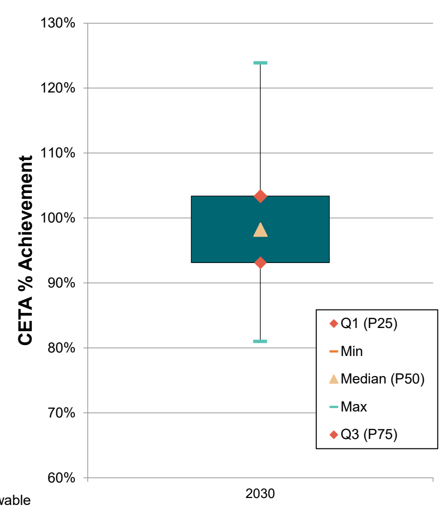
Meeting the CETA requirement in 2030

- Preferred portfolio exceeds at least 80 percent of retail sales supplied with renewable and non-emitting energy based on ranges for load, wind, solar and hydro generation
- Load reducing resources include
  - Conservation
  - Demand response
  - Voluntary renewable programs
    - Net-metering
    - Community solar
    - Green Direct
  - PURPA* contracts



*Public Utility Regulatory Policy Act (PURPA) qualifying facilities (QFs) are smaller generating units that use renewable resources, such as solar and wind energy, or alternative technologies, such as cogeneration

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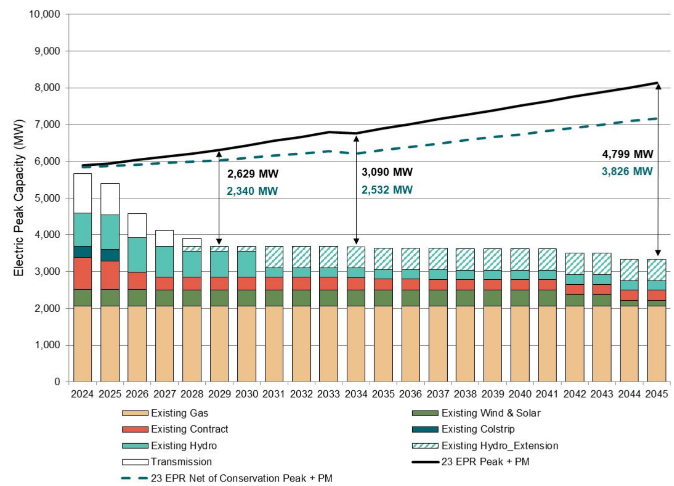
Winter peak driving effective capacity additions

- Winter peak > summer peak through 2045

  2,629 MW by 2029 is needed to achieve 5% loss of load probability.
  - Reduced to 2,340 MW after conservation
- 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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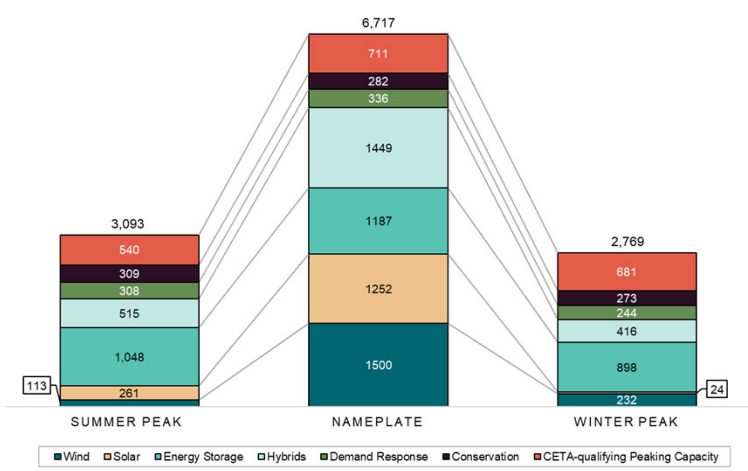
2030 nameplate vs. peak capacity



After adjusting for peak capacity contribution

6,717 MW installed nameplate capacity of new resources
=
3,093 MW summer peak capacity
=
2,769 MW winter peak capacity

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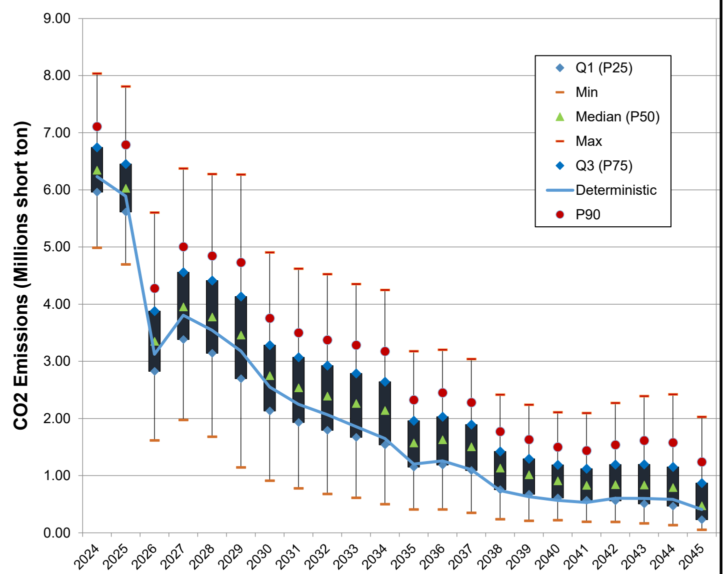
Range of annual emissions for preferred portfolio

- Includes CCA price in cost of dispatch for thermal resources and includes market sales and Transalta Coal Transition contract
- Decline in emissions after 2025 from Colstrip and Centralia PPA expiration at the end of 2025
- Decrease starting in 2030 through 2044 when natural gas and hydrogen fuel blending starts for existing and thermal resources
- Any remaining emissions in 2045 are due to emissions from unspecified market purchase



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Model updates for progress report

Climate change analysis

- 30 years of temperature data (rolling 15 years actual + 15 years forward)
- Hydro generation data downscaled from the 3 climate models

Social Cost of Greenhouse Gases

- 2021 IRP used multi-step process to calculate SCGHG costs and then apply costs back into model for resource decisions
- Progress Report used updated methodology to remove multi-step process and SCGHG is dynamically calculated with dispatch in the model for the resource decision

Portfolio Benefit Analysis

- Measures potential equity-related benefits to customers within a given portfolio and the tradeoffs between those benefits and overall cost

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Portfolio benefit analysis

- The Clean Energy Transformation Act requires utilities to consider equity and ensure all customers benefit from the transition to clean energy
- We expanded on our 2021 approach; will improve methodology for 2025 IRP and future CEIPs
- Evaluated traditional least cost portfolio against customer benefit indicators (CBIs) in the Progress Report:
  - 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
- 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.

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Customer Benefit Indicators (CBI)

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
Increase **participation in 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-eq generated per portfolio
Reduced peak demand	• measured by the decrease in peak demand achieved via demand response programs

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Portfolio evaluation for customer benefits

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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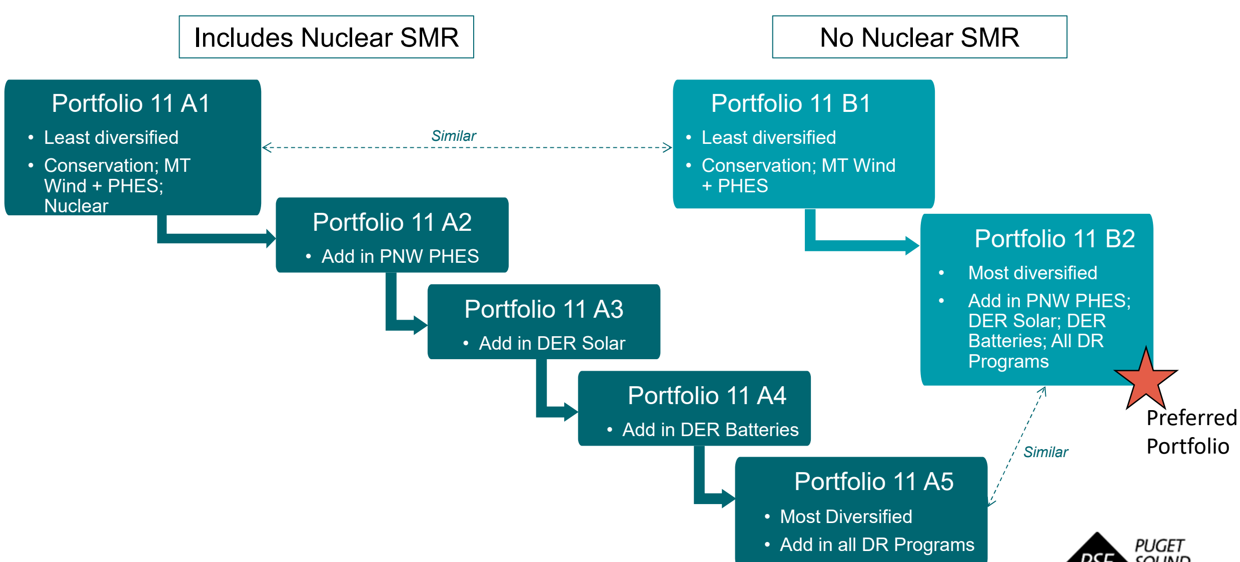
19

Diversified Portfolios



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20

Portfolio Benefit Analysis

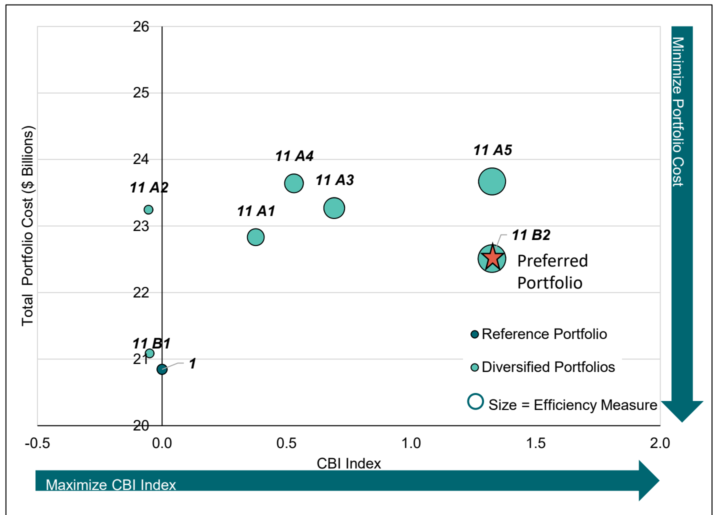
High CBI index for portfolio 11 B2

- ➢ Improvements in all CBIs considered in this analysis except for jobs

The benefits include some of the highest potential customer participation numbers for

- DER solar
- DER storage
- Demand response

CBI results and 22-yr portfolio cost with SCGHG (2024 – 2045)



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Action plan

Renewable and Non-Emitting Resources

- Participate in hydrogen research and development
- Study biodiesel and renewable diesel availability and firm acquisition
- Study advanced nuclear and other emerging technologies
- Research and deploy energy storage
- Examine repowering or upgrading existing generation

Distributed Energy Resources

- Expand distributed energy resources and demand response
- Acquire energy efficiency

Resource Deliverability

- Expand regional transmission capacity

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Thank you for attending

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23

Appendix

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24

Demand forecast updates and impacts

	UPDATE	GENERAL IMPACT
CLIMATE CHANGE	Updated normal temperature assumptions reflecting continued warming over time	Decreases energy and peaks for heating and increases energy and peaks for cooling
ELECTRIC VEHICLES (EVs)	Includes impact of recent legislation and forecast of medium and heavy duty EVs	Increases electric energy and peak forecasts
ECONOMY & COVID	More optimistic economic outlook than assumed for 2021 IRP	Increases energy and peak forecasts
OTHER	E.g., Incorporated recent actual customer counts and billed sales data, new major block loads	Increases energy and peak forecasts

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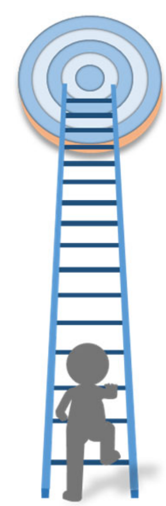
This is the first step for incorporating climate change into planning

Content presented today is PSE's **first step in reflecting climate change in the demand forecast and resource plan**

We expect the methodologies and data available **will continue to evolve over time**

There are **no industry standards or best practices** for climate change assumptions. PSE is part of the EPRI Climate READi project which is focused on creating industry standards for using climate change data in utility planning processes.

This is a summary of the information presented to PSE's stakeholder at the January 20th, 2022 meeting.



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Climate change models for the region have been developed and used by the Northwest Power and Conservation Council

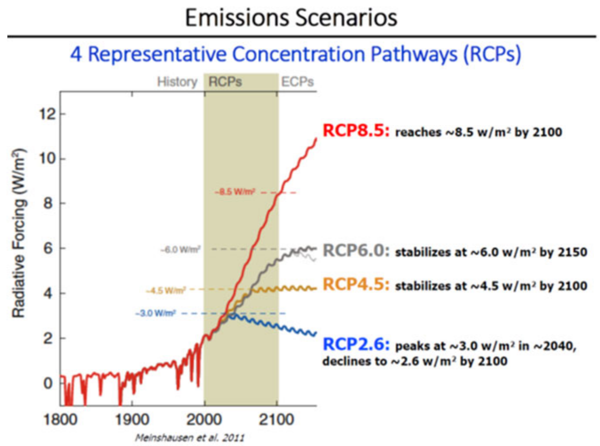
•A **coalition including climate scientists**, Bonneville Power Administration, US Army Corps of Engineers, and Bureau of Reclamation created climate models for the region

www.nwcouncil.org/2021powerplan_summary-climate-change-scenarios

•The Northwest Power and Conservation Council's draft 8th Power Plan was issued in September 2021

www.nwcouncil.org/2021-northwest-power-plan

•The Council uses temperature projections downscaled for the region from three different Global Circulation Models



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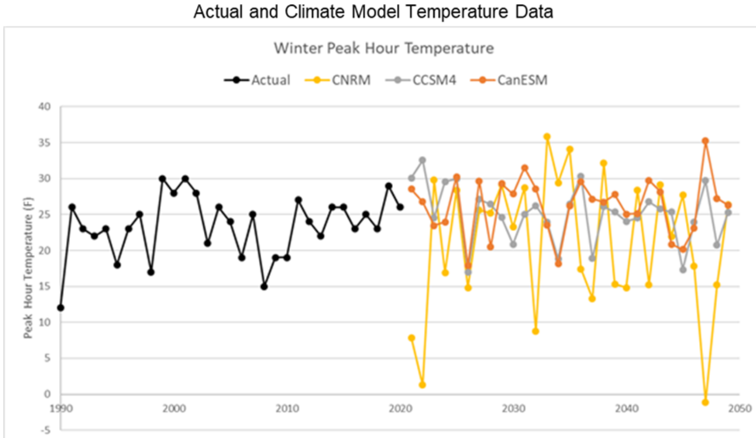
Electric peak hour temperature in winter increases

- PSE used the same approach to determine updated normal peak temperatures
- For electric normal peak, we used a 30-year centered rolling time period to determine "1-in-2 chance" peak temperatures

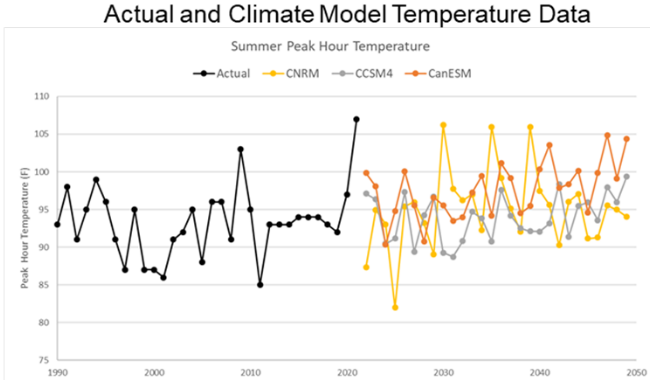
Actual and Climate Model Temperature Data



PUGET SOUND ENERGY

Electric peak hour temperature in summer increases

Actual and Climate Model Temperature Data



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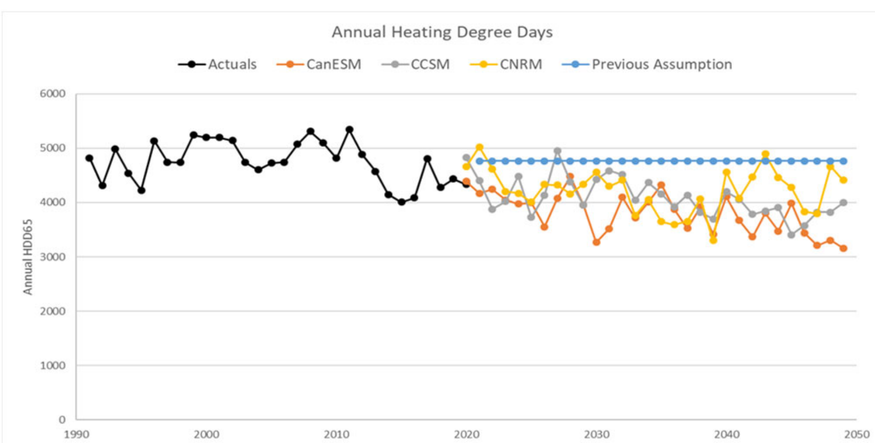
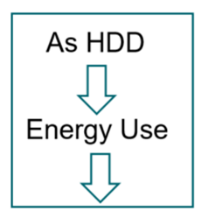
To explore the data, we calculated annual heating degree days from the climate model temperatures





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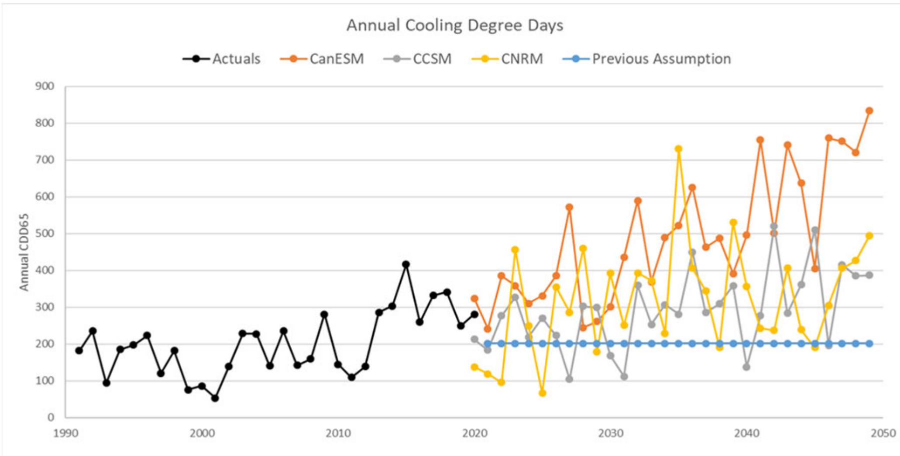
We calculated annual cooling degree days from the climate model temperatures



As CDD ⇧ Energy Use ⇧

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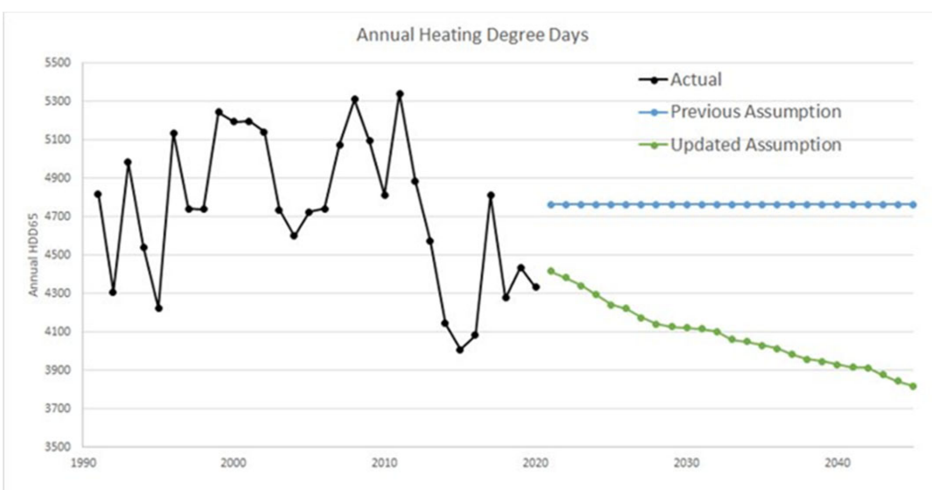
31

For energy modeling, we used a 30-year normal HDD, centered on the year of interest, rolling forward over time



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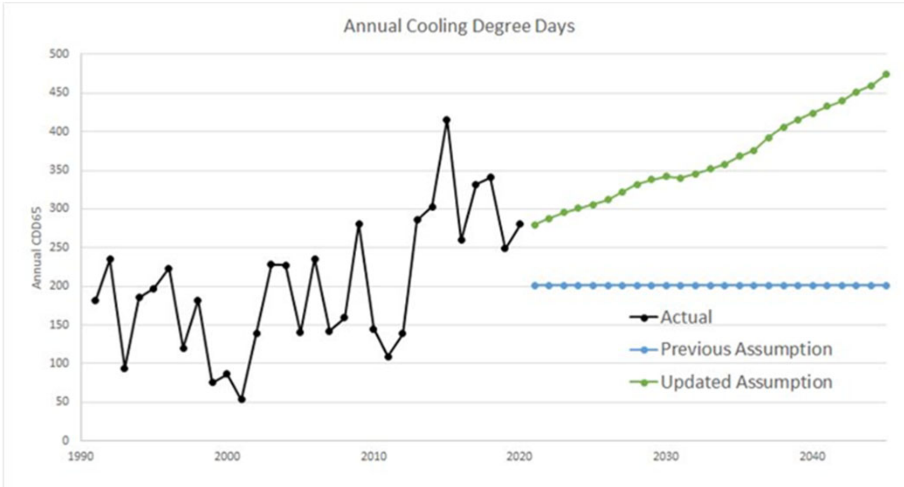

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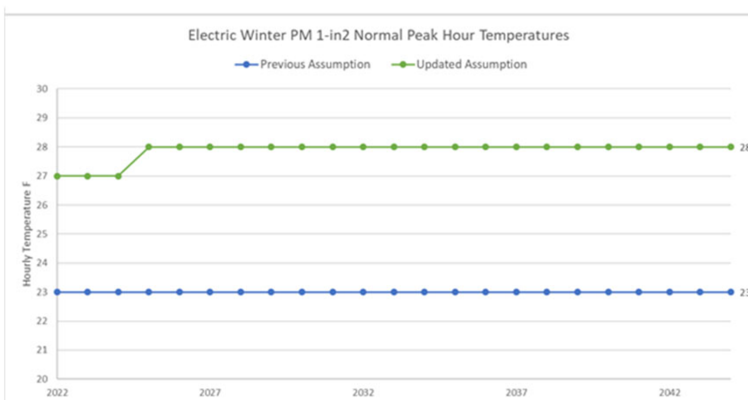
Electric peak hour temperature in winter increases

- PSE used the same approach to determine updated normal peak temperatures
- For electric normal peak, we used a 30-year centered rolling time period to determine "1-in-2 chance" peak temperatures



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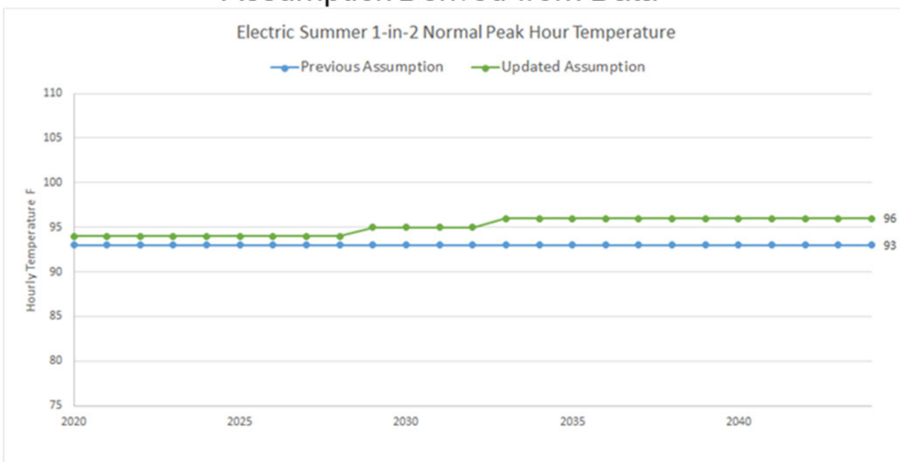
34

Electric peak hour temperature in summer increases

Assumption Derived from Data



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35

Summary of how climate model data are used in the IRP

Model	Measurement	Calculation	Based on Time Period
Energy - Electric and Natural Gas	Degree Days	Average	15 years actual + 15 years forward
Peak – Electric Winter	Hourly Temperature	Median (1-in-2 chance)	15 years actual + 15 years forward
Peak – Electric Summer	Hourly Temperature	Median (1-in-2 chance)	15 years actual + 15 years forward
Peak – Natural Gas Utility	Daily Temperature	1-in-50 chance	2010 - 2049

Individual years of climate model data were used in the Resource Adequacy model to analyze variability in temperatures and loads.

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36

Climate change in the resource adequacy model

Before:

- Used historic weather run through the demand forecast model and peak model to determine a range of possible future hourly demands

Now:

- Used 30 years of climate change data from each of the 3 downscaled climate models to determine a range of possible future hourly demands
- This data is paired with corresponding hydro data downscaled from the 3 climate models

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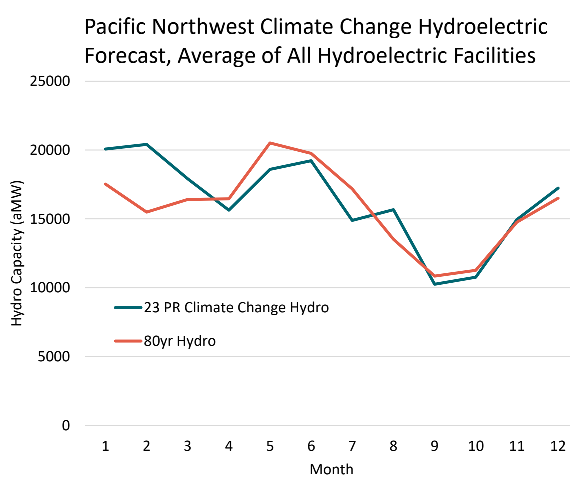
Climate change hydro data

- Adapted from the climate change hydroelectric forecast created by the Northwest Power and Conservation Council in the 2021 Power Plan
- The hydroelectric forecast represents an average of all three climate change scenarios and an average of the hydroelectric conditions for the 30-year timespan of the climate change scenarios
- Calculated hydroelectric capacity based on expected hydroelectric output from the GENESYS regional resource adequacy model using streamflow data representative of the climate change scenarios.



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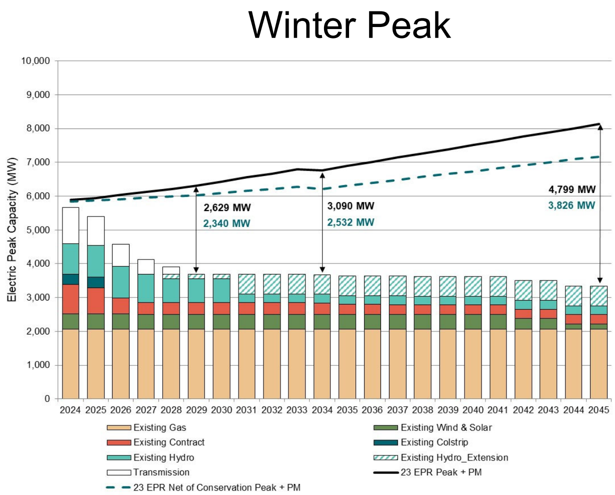

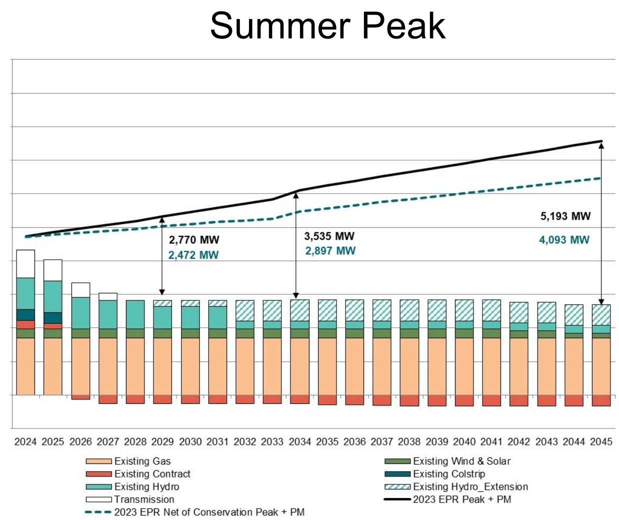

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Diversified portfolios iterations – nuclear included

Portfolio ID	Description
11 A1	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
11 A2	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 A3	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

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Diversified portfolios iterations – nuclear included

Portfolio ID	Description
11 A4	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 A5	Combination of the following: • **Portfolio A4** (above) • **Added all Demand Response programs**
11 A5, modified, may not run	Updated A5 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

41

Diversified portfolios iterations – no nuclear

Portfolio ID	Description
11 B1	Combination of the following Portfolios (similar to 11 A1): • **Portfolio 3**: Increase conservation by 284 aMW by 2045 • **Portfolio 6**: Added 400 MW MT East Wind + 200 MW MT PHES in 2026
11 B2	Combination of the following Portfolios (similar to 11 A5): • **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 • **Add All DR Programs**

42

Portfolio CBI Metrics

CBI Metric	1 Reference	11 A5 Portfolio	11 B2 Preferred Portfolio
22-year Cost with SCGHG ($, 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
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

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Hydrogen fuel risk

Preferred Portfolio:

- New blend hydrogen peakers start in 2039

Participant Concern:

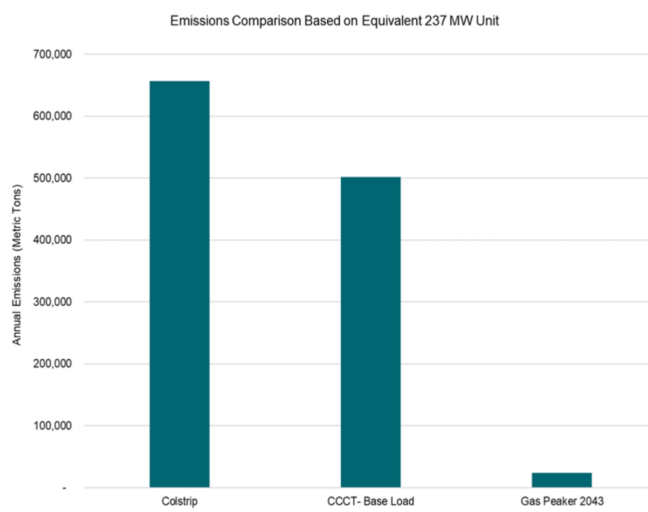
- What if PSE built peakers that will blend to full hydrogen but hydrogen is not available as planned?

Response:

- PSE would not start building a hydrogen peaker in 2035 if hydrogen supply is unavailable
- Benefits of a dual-fuel unit: biodiesel provides back-up (reliability), the unit could run on biodiesel if hydrogen unavailable

Further Analysis:

- Comparison of the emissions profile of a gas peaker in 2043, if it had to run on gas only, as compared to Colstrip and a CCCT of equal capacity.



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