Northwest **Power** and **Conservation** Council

May 7, 2024

MEMORANDUM

TO: **Council Members**

FROM: **Daniel Hua**

SUBJECT: **Short Term Load Forecast for Resource Adequacy Assessment**

BACKGROUND:

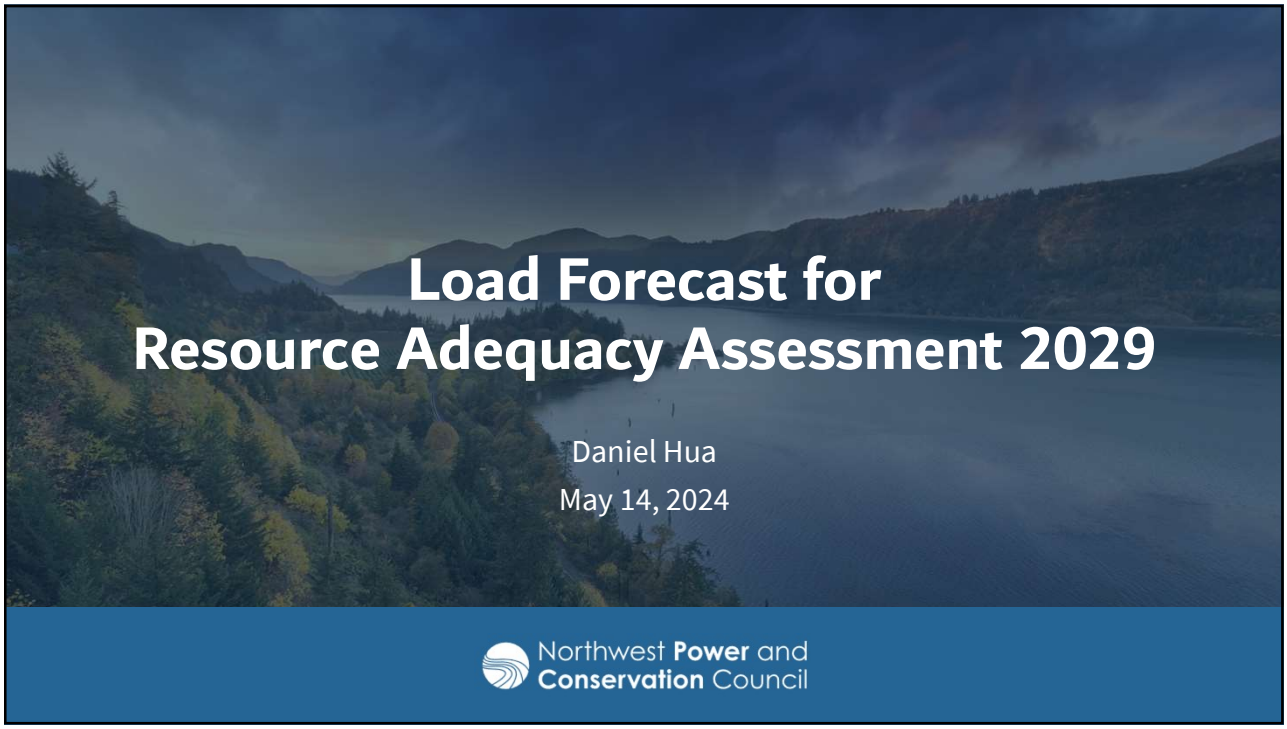
Presenter: Daniel Hua

Summary: Staff will provide the short term load forecast that supports Resource Adequacy Assessment studies of the Northwest Power System for operating year 2029. The short term load forecast model is developed from historical loads and input data which include regional population, economic indices, and temperatures, among other inputs. The model is then used to predict a portion of the hourly loads for 2029 using forecasted input data for 2029. Due to the more recent growth in electric vehicle (EV) and data center (DC) loads, and to the selected input data, the model by itself is not sufficient to capture the dependences of these loads. Therefore, staff developed estimates for these loads separately (as presented at the March Power Committee meeting), and they are incorporated into the final load forecast for 2029. Furthermore, to test the strategy from the 2021 Power Plan as part of the adequacy assessment, the Power Plan energy efficiency savings are also incorporated in the final load forecast. Overall, this annual averaged load forecast for 2029 is higher than that estimated in the 2021 Power Plan for 2029 due to three main drivers: the load growth per unit population and associated economic activities, and the rates of load growth of electric vehicles and data centers. These load growths are also higher than those used in the

Resource Adequacy Assessment for 2027 which would also have increased the load forecast for that assessment.

Relevance: The Council usually performs an annual Resource Adequacy (RA) Assessment of the Northwest power system 5 years into the future, which will be 2029. One of the inputs of the RA Assessment is the short term load forecast.

Workplan: A.2.2 Create an updated in-region hourly load forecast to support Periodic Studies on Regional Adequacy.



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LOAD FORECASTING AT THE COUNCIL

1. Two types of Load Forecasts
   - A. Long-Term Forecast
     - i. Power Plan Forecast
     - ii. Monthly forecast of load across 20+ years
     - iii. End-Use Methodology
   - B. Short-Term Forecast
     - i. Adequacy Assessment Forecast
     - ii. Annual system load from 1 to 5 years out – shaped into an hourly pattern
     - iii. Econometric (regression model) Methodology
2. Both rely on historic demand, weather and economic conditions

1. Long-Term (End-Use) Forecast
   - A. Captures future changes in
     - i. Stock characteristics
     - ii. Efficiencies
     - iii. Codes and Standards
     - iv. End-Uses – new and existing
   - B. Compiling a forecast is data, labor and time intensive –resulting in slow turn around times
2. Short-Term (Econometric) Forecast
   - A. Captures recent overall trends in load and simply projects forward
   - B. Requires relatively simple data sets and has a quick turn-around times
   - C. Can struggle with accurately projecting future new uses of energy and changing behavior of exiting uses – this limits the forecast horizon

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FORECAST COMPARISON

The Resource Adequacy Assessment Forecast for 2029 is projecting higher loads than the 2021 Power Plan Long Term Forecast for 2029:

1. Forecast Timing – the Resource Adequacy Assessment Forecast for 2029 has three additional years of recent load, weather and economic history to work with
2. Much of the growth in load projections is explained by the updated information and forecasts for Data Centers and Electric Vehicles
3. There is still some additional growth projected after these two drivers – which can mean there is another growth signal in the recent load history or some facet of efficiency that is being missed, as an example the load reduction due to future codes and standards

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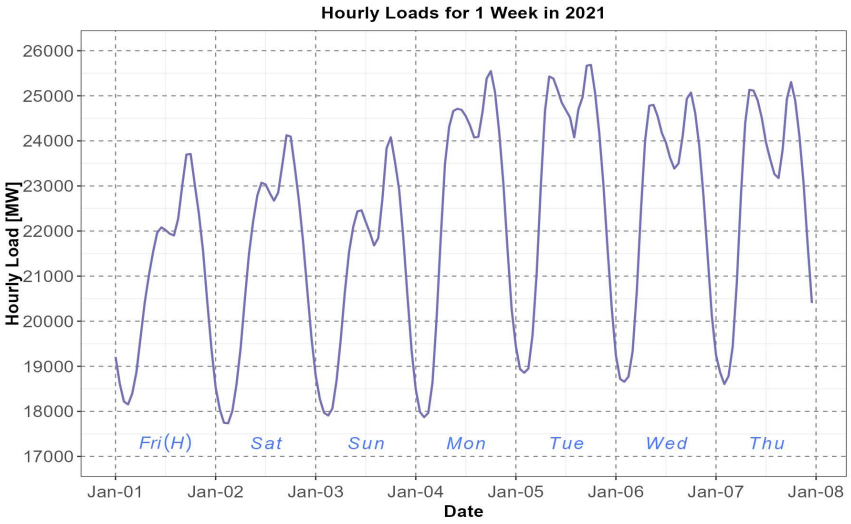
What is The Short-Term Load Forecast Model?



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Two Types of Models

- The Load Forecast Model consists of two parts:
  - A model to forecast the *annual averaged load**
  - Another model to forecast the *hourly load ratios:*

    (hourly load ratios) = (hourly loads) / (annual averaged load)

- Finally, the hourly load forecast is calculated from outputs of the two models:

  *(hourly load) = (hourly load ratios) × (annual averaged load)**

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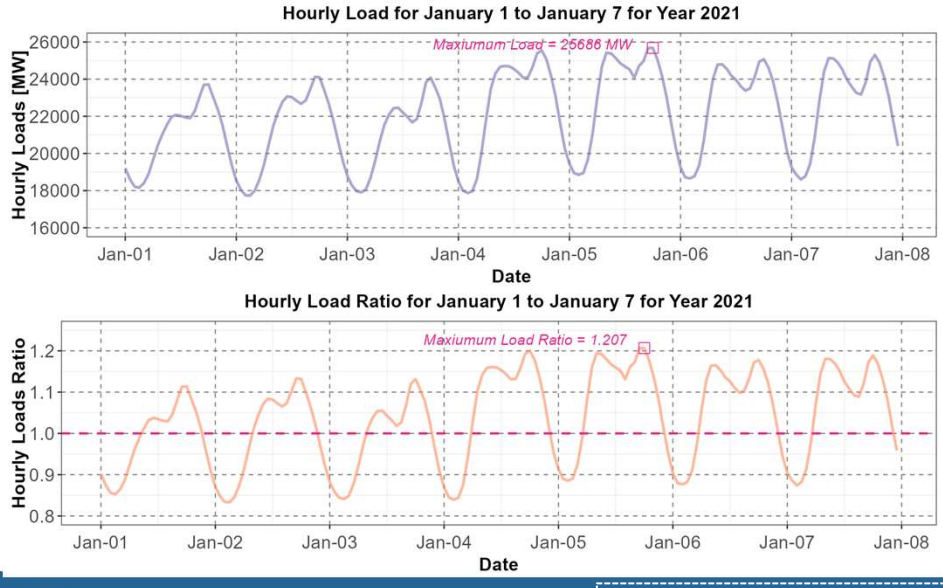
**adjustments for energy efficiency savings, electric vehicle loads and data center loads*

The Hourly Load Ratio



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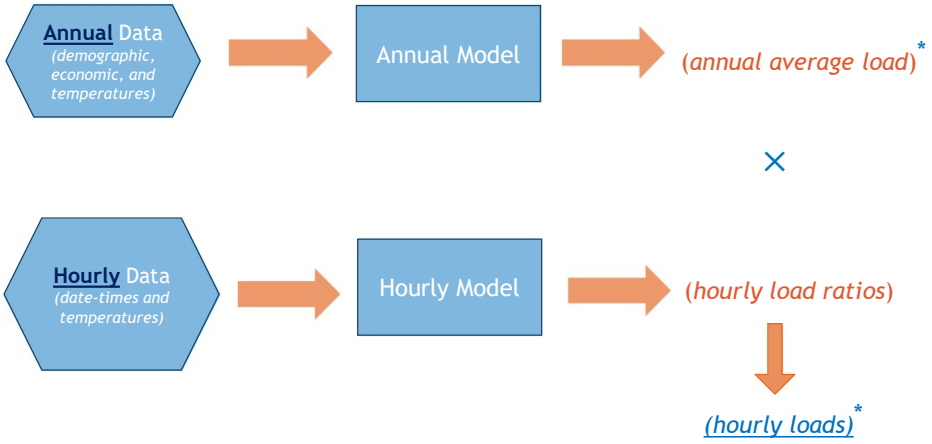
annual averaged load for 2021 = 21,286 aMW

hourly ratio = (load) / (annual averaged load)
1.207 = (25,686 MW) / (21,286 aMW)

Types of Data for the Two Models



*adjustments for energy efficiency savings, electric vehicle loads and data center loads

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Outline

- The annual model forecast for annual averaged load
- The hourly model forecast for hourly load ratio
- Combining the two models - the hourly load forecast
  - *How well do they replicate the historical loads?*
  - *Load forecasts for 2029 with adjustments for energy efficiency savings, electric vehicle loads and data center loads*

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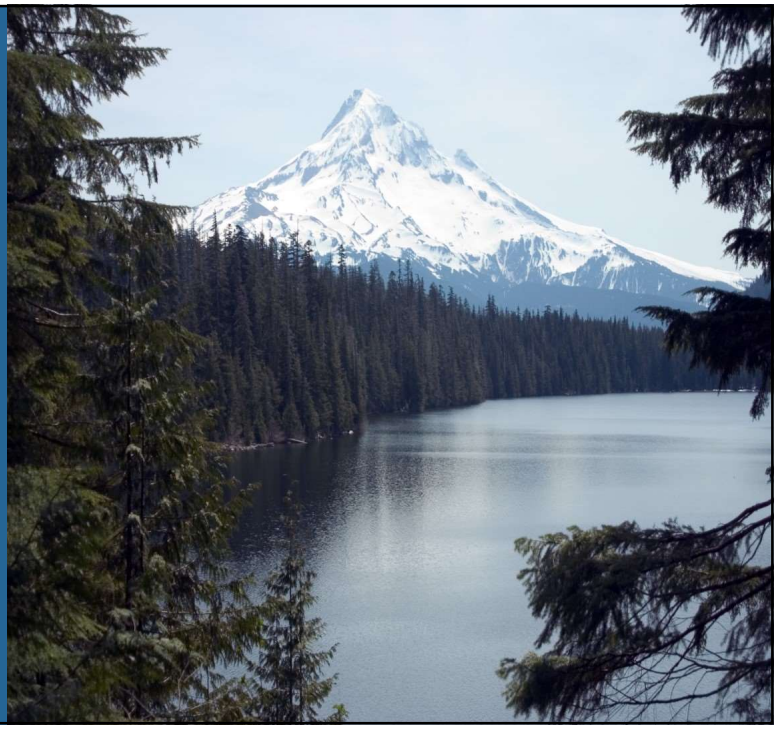
Annual Model



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Predictor Data for the Annual Model

- Population
- Number of households
- Gross State Products (*GSP*)
- Non-Farm Employment
- Personal Income
- Recession: (2001, 2008, 2009, 2020)
- Cooling-Degree-Days (*CDDs*)
- Heating-Degree-Days (*HDDs*)

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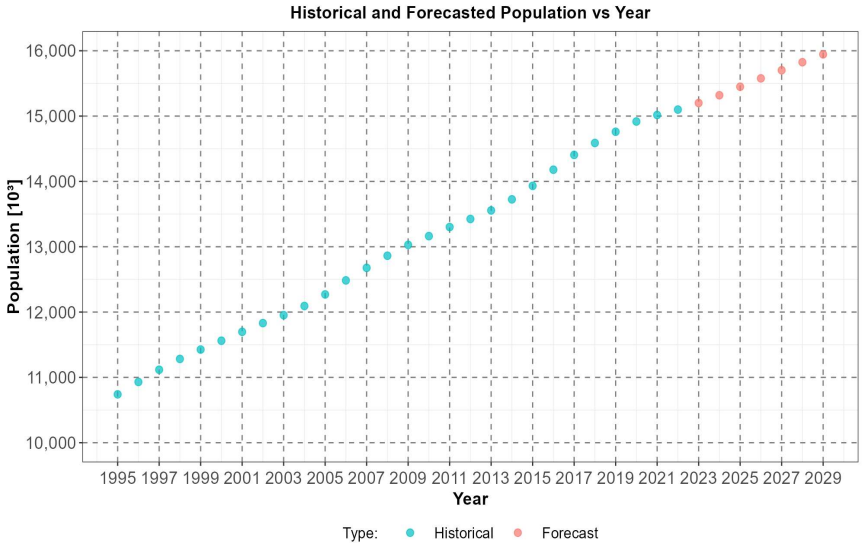
Predictor Data - Population



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IHS Markit data set

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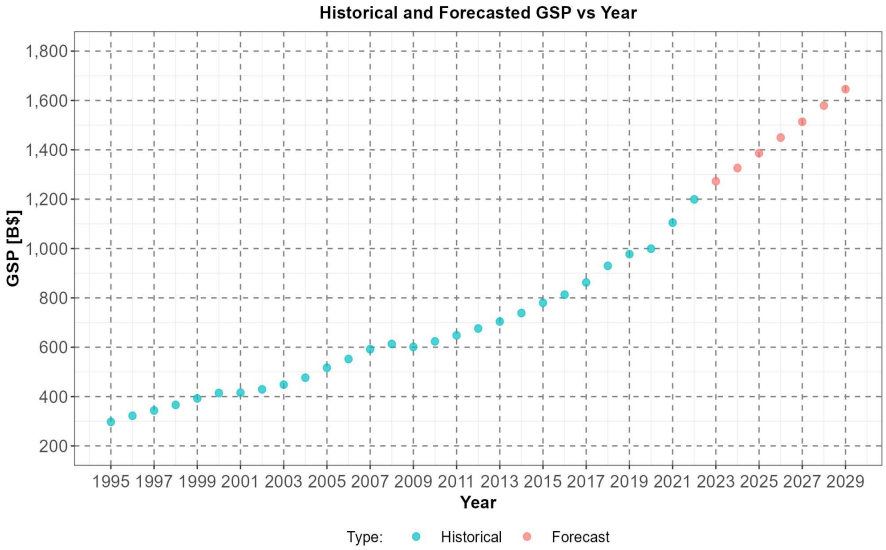
Predictor Data - GSP



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IHS Markit data set

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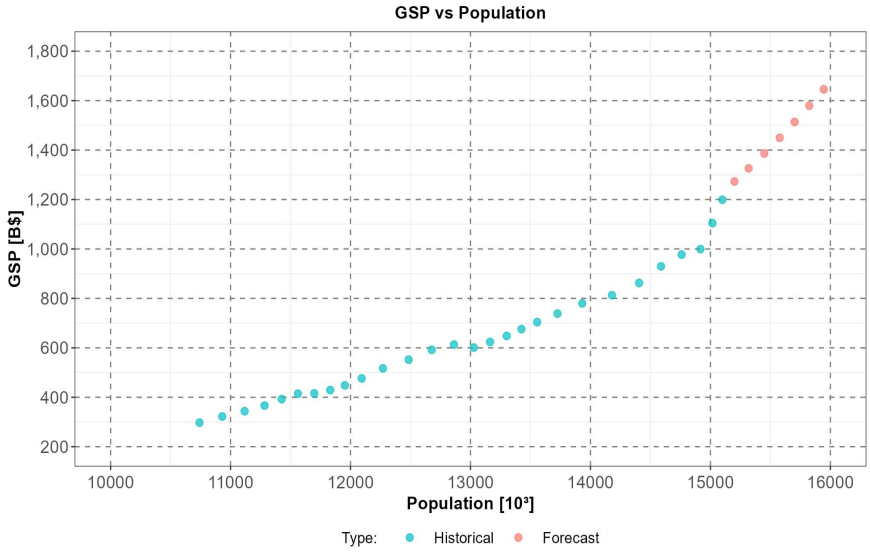
GSP vs Population



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IHS Markit data set

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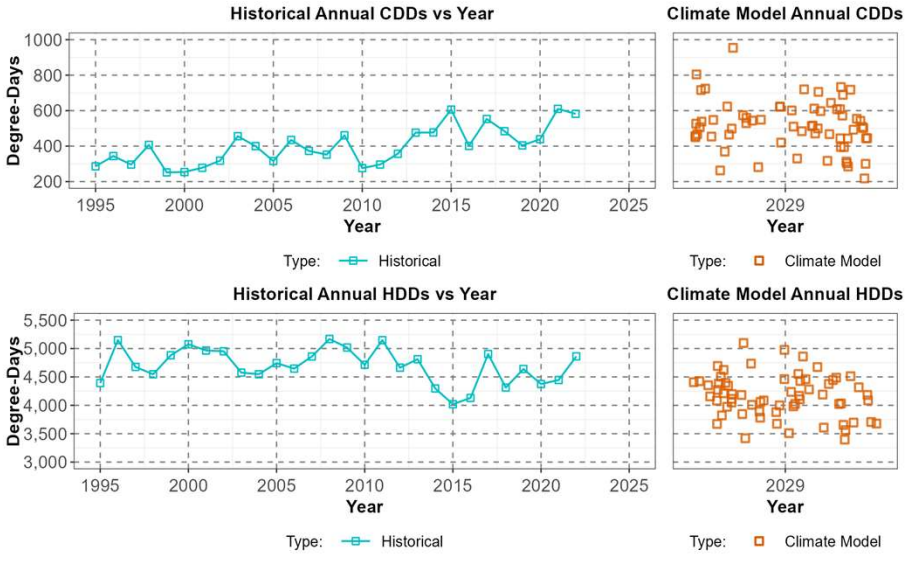
CDDs and HDDs



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The Annual Averaged Load

- With the chosen predictor variables, the annual model is not expected to be able to produce good estimates for:
  - Annual Averaged Energy-Efficiency Savings (*EE*)
  - Annual Averaged Electric Vehicle Load (*EV*)
  - Annual Averaged Data Center Load (*DC*)
- Therefore, the annual model is developed without the *EE savings*, *EV*, or *DC* loads
- The annual model forecast will then be adjusted by
  - subtracting the 2021 Power Plan target *EE savings, and*
  - adding the forecasted *EV* and *DC* loads (*produced by other specialized models*)

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Target EE Savings, Forecasted EV and DC Loads and Other Predictor Data

- Predictors in Annual Load Model

	Population (10^6)	Annual CDDs	Annual HDDs
2022	15.1	582	4,862
2029	15.9	*climate models*	*climate models*

- Power Plan Target EE Savings and
- Forecasted EV and Data Center Loads from other Models

	EE Savings	EV Loads	Data Center Loads
2023 to 2029	926	1,048	2,384*

*Reference: 2,386 aMW
High: 3,976 aMW

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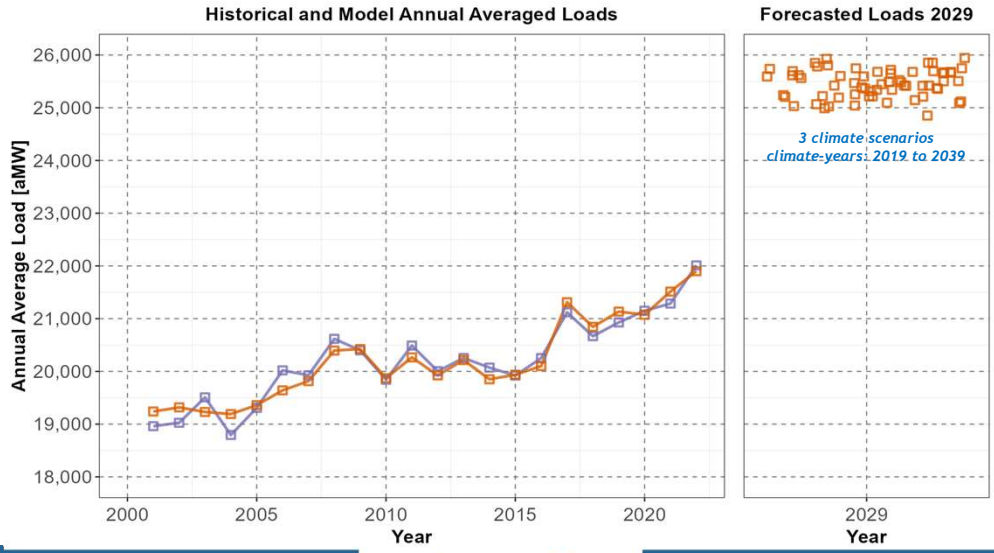
Historical and Forecasted Loads for 2029



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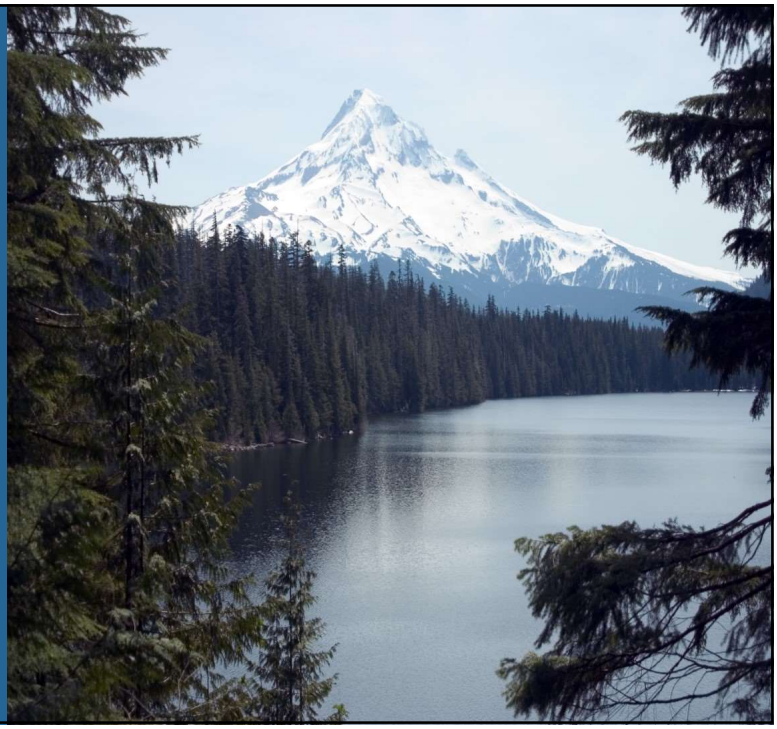
Hourly Model



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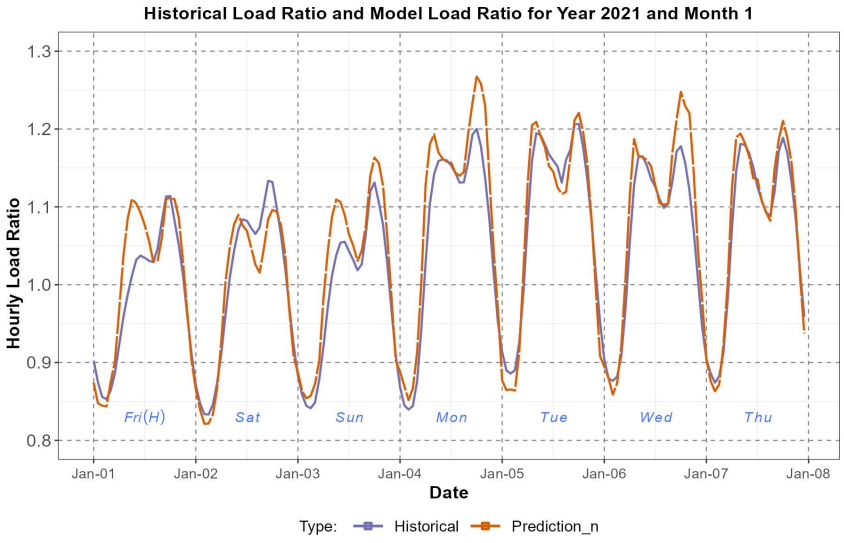
Predictor Data for Hourly Models

- Date-Time data:
  - hours of a day: *0, 1, …, 23*
  - weekdays, weekends: *Mon, Tues, …, Fri, Sat, Sun*
  - major holidays: *New Year's, Memorial, July-4th, Labor Day, Thanksgiving, Christmas week*
  - months: *Jan, Feb, …, Nov, Dec*
  - days of the month: *1, …, 30, 31*
- Temperature data:
  - hourly temperatures at the airports in *Boise*, *Portland*, *Spokane*, and *Seattle*

Hourly Model: Historical Load Ratio vs Prediction



Combining the Annual and Hourly Models*: Comparisons to Historical Loads

**And adjust for historical EE savings, EV and data center loads*

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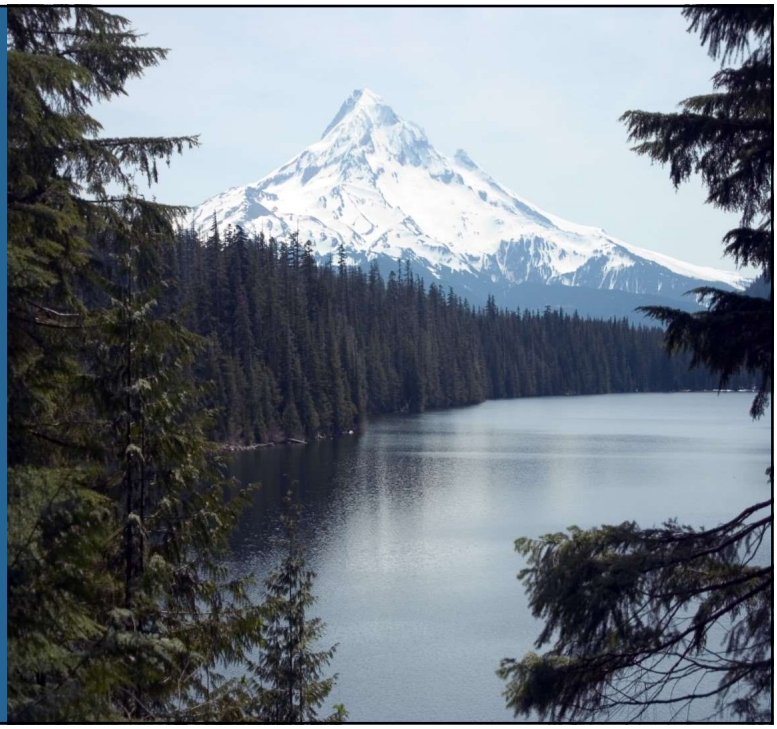

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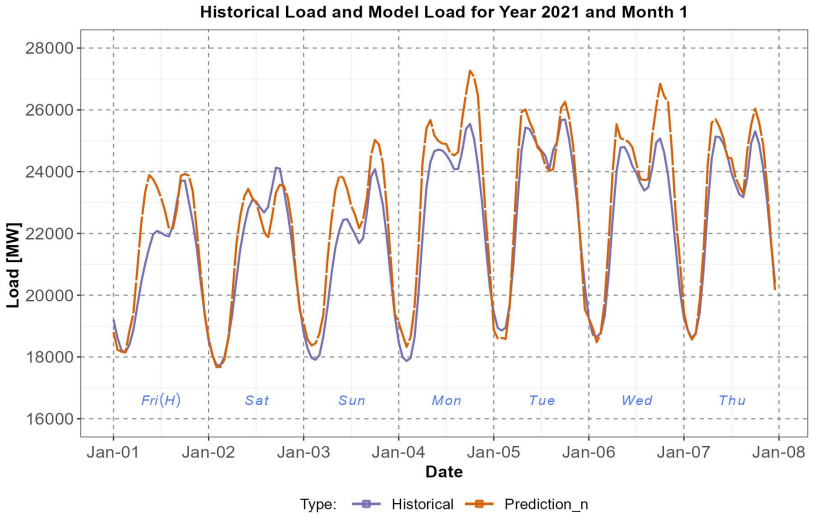
Load Forecast Model Prediction vs Historical Loads



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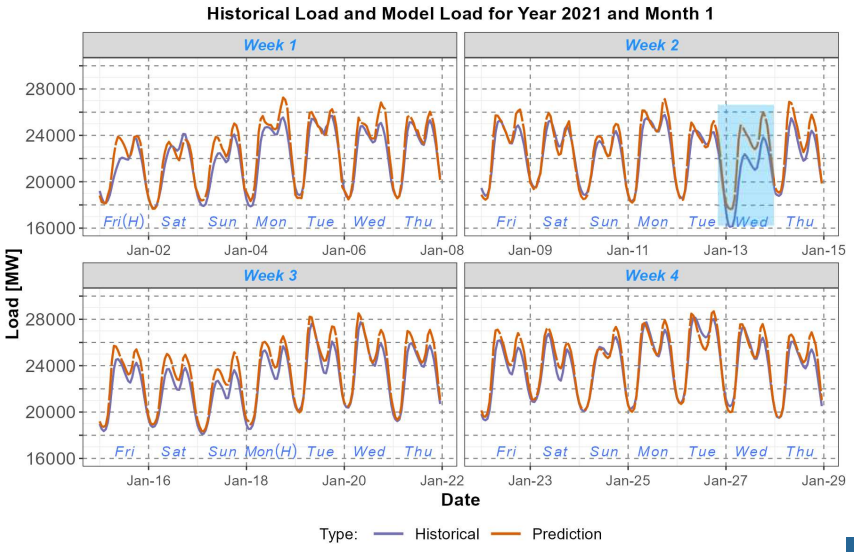
Load Forecast Model Prediction vs Historical Loads: Jan 2021



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NEWS > SPOKANE

Woman killed, 100K without power in aftermath of brutal windstorm

Jan. 13, 2021 | Updated Wed., Jan. 13, 2021 at 9:47 p.m.

https://www.spokesman.com/stories/2021/jan/13/wind-knocks-out-power-to-50000-customers-in-spokan/

Rescuers in Oregon were searching through mud as deep as 10 feet Wednesday after a landslide east of Portland, looking for a person who was believed to have been swept away by the debris flow.

The landslide was triggered by an overnight wind and rain storm made worse by recent heavy rainfall. The storm left more than 600,000 homes and businesses without power, knocked down trees and shut down highways across Oregon and Washington.

https://www.wunderground.com/article/news/news/2021-01-13-northwest-storm-wind-power-outage-landslide-impacts/

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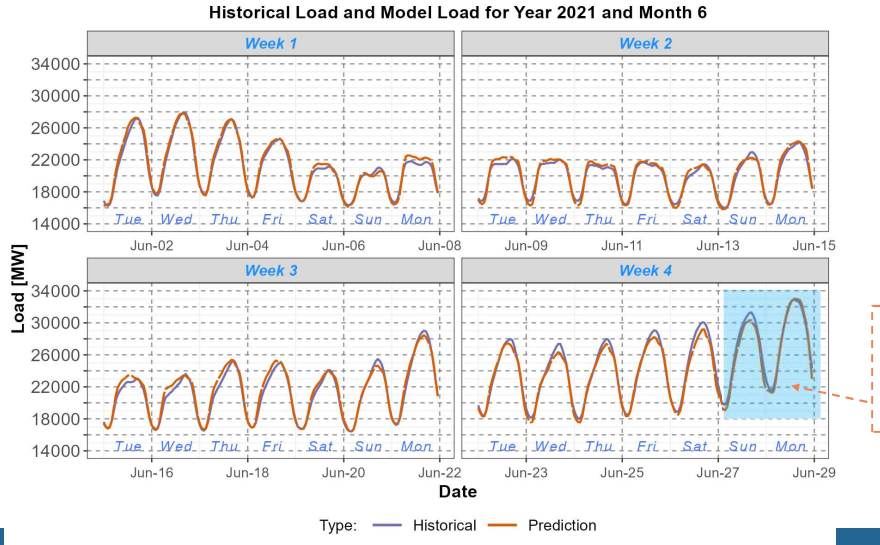
Load Forecast Model Prediction vs Historical Loads: Jun 2021 – Heat Dome



Max $PDX \geq 110F$
Max $SEA \geq 100F$
Max $GEG \geq 100F$
Max $BOI \approx 100F$

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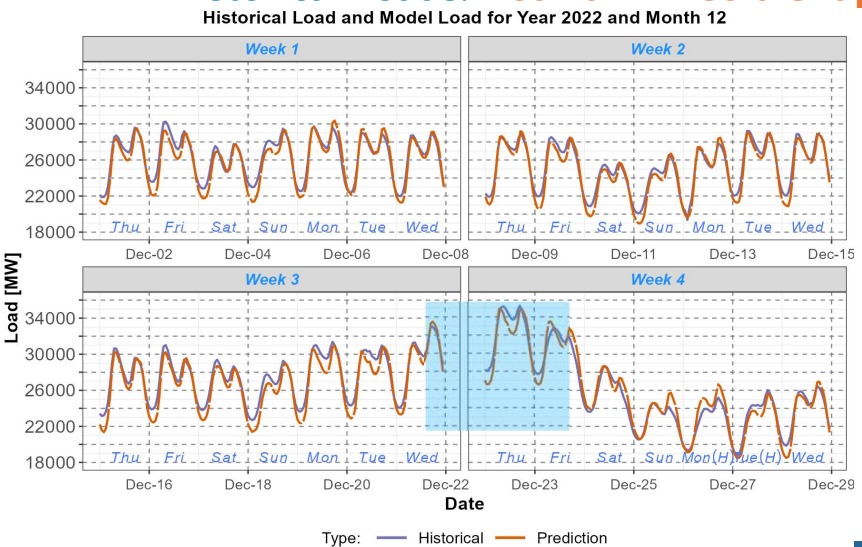
Load Forecast Model Prediction vs Historical Loads: Dec 2022 – Cold Snap



$20F \leq PDX \leq 40F$
$18F \leq SEA \leq 30F$
$-10F \leq GEG \leq 8F$
$8F \leq BOI \leq 30F$

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Combining the Annual and Hourly Models*: Forecast for 2029 *(examples)*

*And adjust for historical EE savings, EV and data center loads

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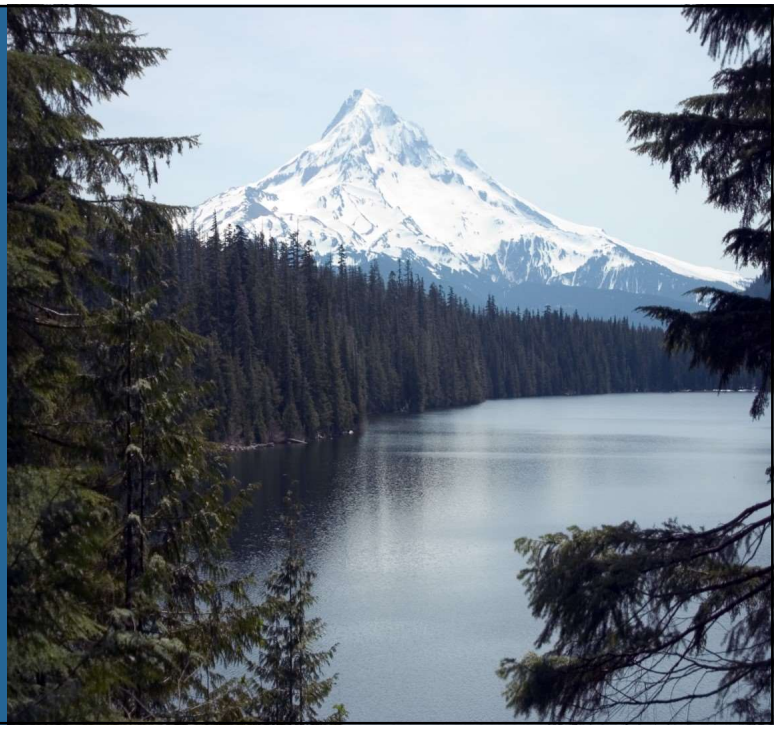

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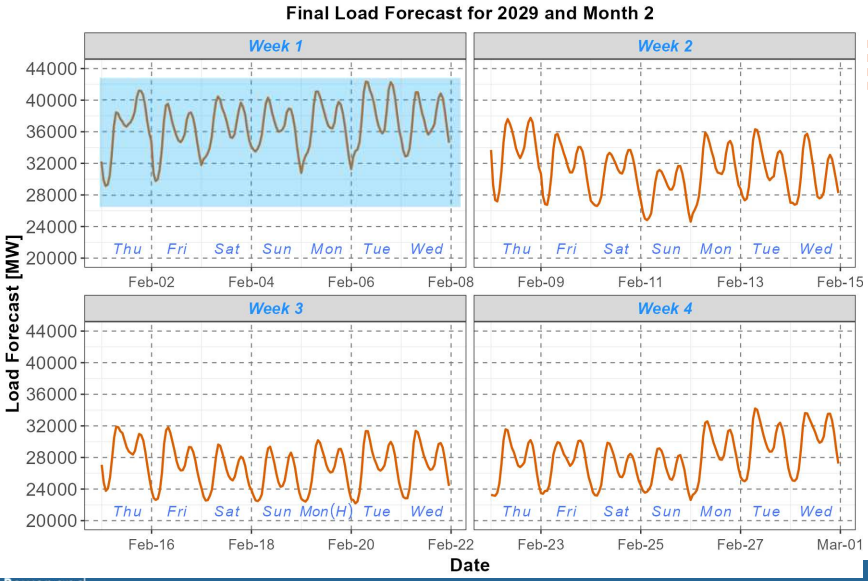
Load Forecast for 2029, Feb – Cold Snap



CNRM-CM5 Climate Model Temperature-year 2021

$$6F \le PDX \le 31F$$
$$10F \le SEA \le 38F$$
$$-16F \le GEG \le 21F$$
$$-14F \le BOI \le 34F$$

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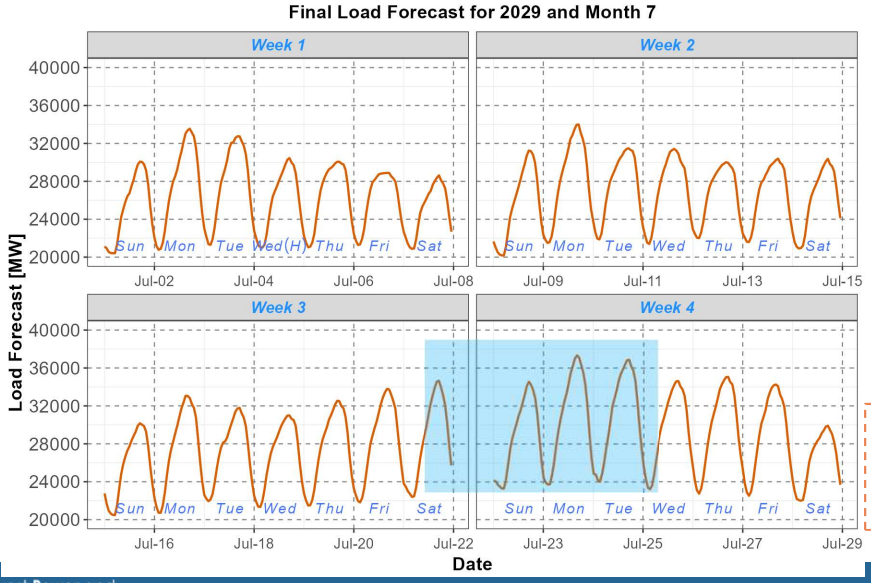
Load Forecast for 2029, Jul – Heat Wave



CanESM2 Climate Model
Temperature-year 2022

$97F \leq Max\ PDX \leq 107F$
$96F \leq Max\ SEA \leq 101F$
$100F \leq Max\ GEG \leq 104F$
$102F \leq Max\ BOI \leq 106F$

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