Jeffery C. Allen
Chair
Idaho

Ed Schriever
Idaho

Doug Grob
Montana

Mike Milburn
Montana

KC Golden
Vice Chair
Washington

Thomas L (Les) Purce
Washington

Ginny Burdick
Oregon

Louie Pitt, Jr.
Oregon

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

January 02, 2024

MEMORANDUM

TO: **Council Members**

FROM: **Steven Simmons**

SUBJECT: **Update on the long-term load forecast project**

BACKGROUND:

Presenter: Steven Simmons

Summary: The Council's 2021 Northwest Power Plan identified several dynamic changes taking place across the west that impact our power system. In particular the potential for large future load growth from the electrification of buildings and vehicles.

Given this dynamic, the Council embarked on a project to explore new tools that could facilitate a sustainable approach to end use load forecasting which would support power planning well into the future. A suite of forecasting tools, collectively referred to as the Statistically Adjusted End Use Forecasting Framework by Itron, was judged to be the most well rounded of the identified options.

With our collaboration, ITRON is in the process of building out the Statistically Adjusted End Use (SAE) Forecasting Framework to meet our long-term demand forecasting needs.

The project kicked off in the fall of 2023 and is expected to be completed in April of 2024. This initial forecast will offer staff the ability to become familiar with the tools and provide the starting base for the next power plan

load forecasting work. The presentation today will provide a status update on the project to date, and next work.

Relevance: Per the Northwest Power Act, as part of its regional power plan the Council is required to develop and include "a demand forecast of at least twenty years…". In addition to producing the long-term demand forecast, data from the load forecast model is used to inform the energy efficiency and demand response potential assessments. The forecast is also a key input to many of our power planning models including GENESYS, Aurora, and capital expansion models.

Workplan: B.1.1 Update load forecasting capabilities to better reflect the current power system.

Background: Traditionally, the power staff have developed the long-term load forecast using an *end-use* approach. The SAE forecasting framework developed by ITRON uses a modified approach, combining end-use methods with statistical modeling, and is widely used in the utility industry.

More Info: For further background, please see the following presentations to the Council:
https://www.nwcouncil.org/fs/18335/2023_06_6demand.pdf
https://www.nwcouncil.org/fs/18252/2023_04_2.pdf
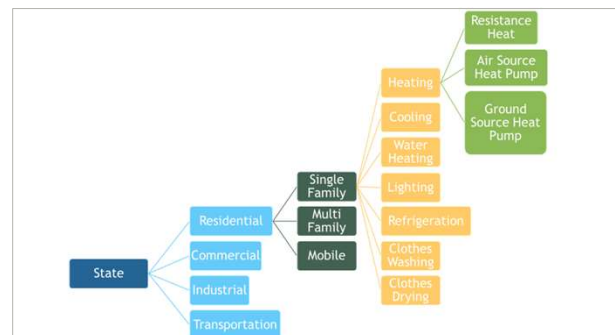
Update on the Long-Term Load Forecast

Steven Simmons
Portland Oregon
January 09, 2024

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

1

Agenda

1. Load Forecasting at the Council
2. Overview of the SAE Forecasting Framework
3. Project Status
4. Next work

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

2

2

Load Forecasting at the Council

The Northwest Power Act specifies that the Power Plan include a ***demand forecast of at least twenty years***

Load Forecasts are used in many of our analytical and planning processes

1. Energy Efficiency Analysis
2. Resource Adequacy Assessments
3. Wholesale Electric Price Forecasting
4. Capital Expansion Modeling

The forecast is used to help evaluate what resources best meet regional needs, with an emphasis on conservation as a resource

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

3

3

Load Forecasting at the Council
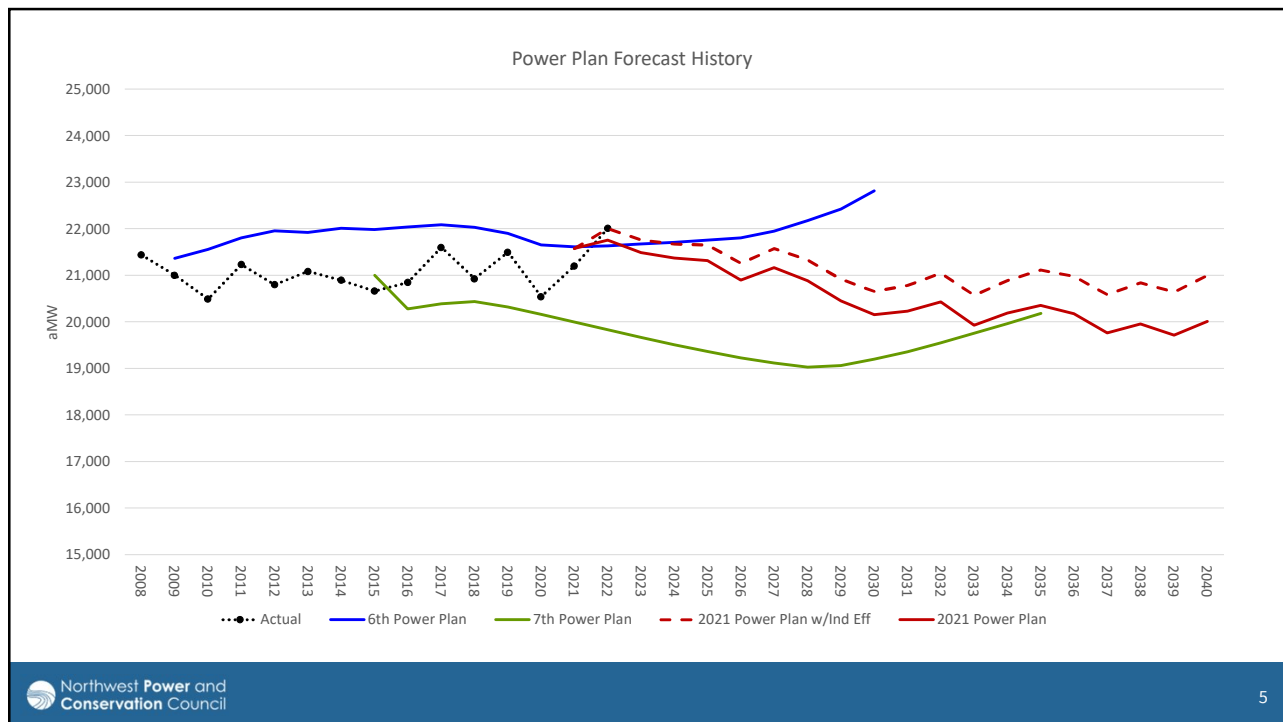
Long-Term Load Forecast ↔ End Use

An **End Use Load Model** – often called "bottoms up" modeling relies on summing up individual forecasts of demand for each electric end-use.

- 20 + year forecast of load, by state, sector, and end-use
- Enables analysis for evaluating long term trends in growth, efficiency, electrification, technology

Short-Term Load Forecast ↔ Econometric

An **Econometric Model** specifies the **statistical** relationship that is believed to hold between various economic quantities and weather to demand

- Single year load forecast for a specific year typically within a 5-year window
- Less data intensive than the end-use forecast
- Is more tied to historic use patterns of existing technologies and behaviors for the region as a whole

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

4

4

Slide 5

Power Plan Forecast History

Legend: Actual · 6th Power Plan · 7th Power Plan · 2021 Power Plan w/Ind Eff · 2021 Power Plan

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

5

Slide 6
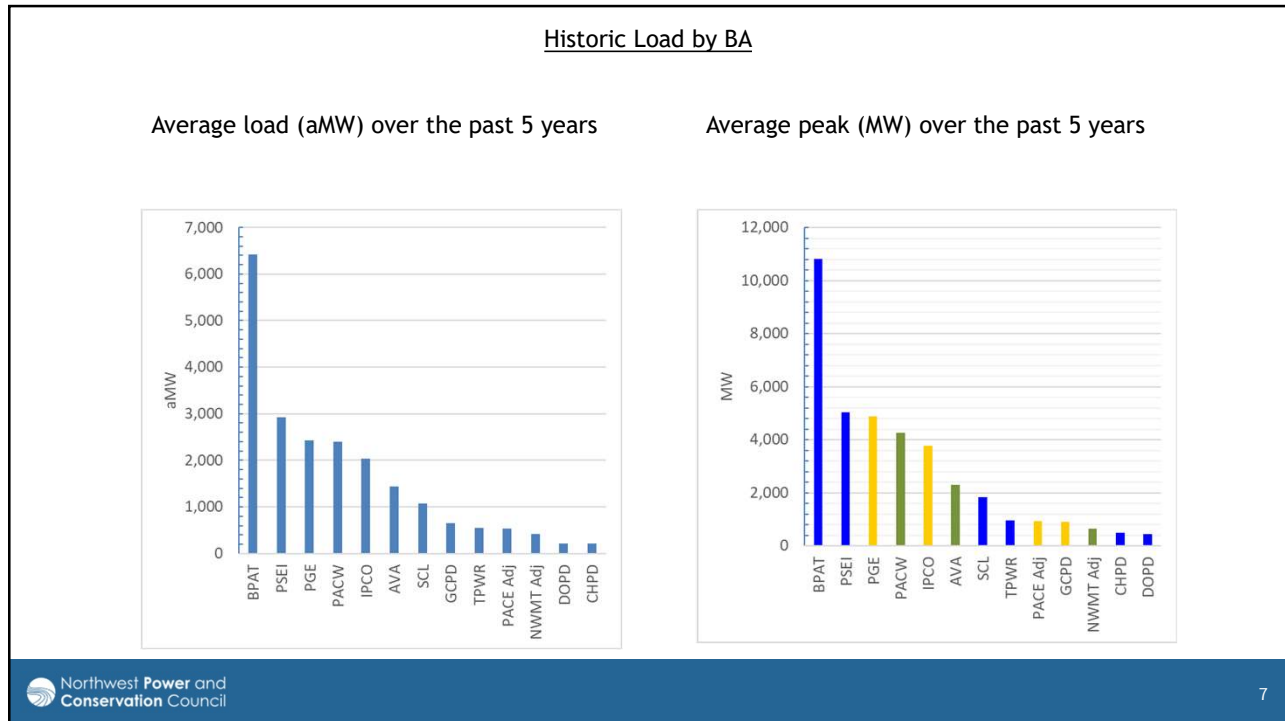
Itron SAE Load Forecasting Suite

- This fall we kicked off the project to re-develop our long-term load forecasting within the ITRON SAE forecasting suite
- The project timeline is shooting for delivery of an initial forecast and training on the new tools in April 2024
- SAE - Statistically Adjusted End-Use - forecasting model combines end-use and econometric methods for capturing the load effects of
  - Structure changes – such as saturation and efficiency trends
  - Economic trends
  - Weather
  - New technologies such as electric vehicles
- Forecast by Balancing Authority – 13 in region
- Integrated MetrixND and MetrixLT tools – to build monthly and hourly forecasts

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

6

3

Historic Load by BA

Average load (aMW) over the past 5 years

Average peak (MW) over the past 5 years

7

Modeling Framework

Weather Data:
  Actual History
  Normal Monthly Weather
  Normal Peak Weather

Economic Data:
  Households
  Income
  Employment
  Output

Load Data:
  BA Monthly Energy
  BA Monthly Peak
  BA Hourly

EIA End-Use Data
  Saturation History & Fcst
  Efficiency History & Fcst

NPCC End-Use Data

NEEA End-Use Data

SAE Models Monthly Energy

SAE Models Monthly Peak

Hourly Profile Models
  BA System
  Electrification
  Solar
  Data Center

Hourly Framework

Baseline Forecasts
  BA Monthly Energy
  BA Monthly Area Peak

+

Electrification Forecasts

+

Solar

+

Data Center & Large Load Adj

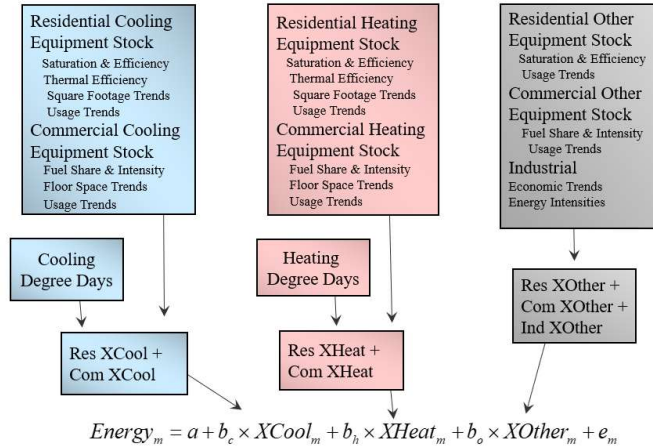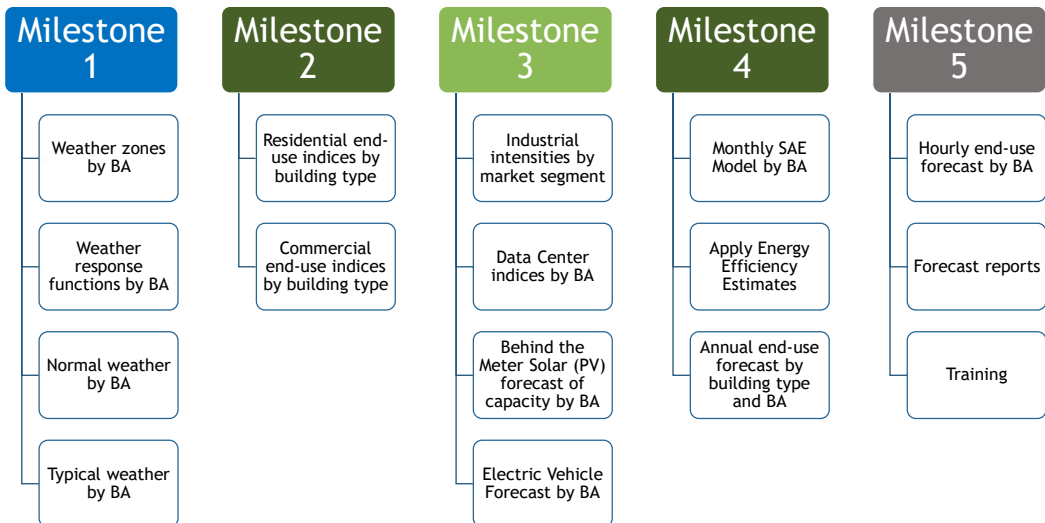**=**

Final Adjusted Forecast

8

Statistically Adjusted End-use (SAE) Modeling Framework

- Data inputs
  - Household income
  - Household size
  - Commercial square footage
  - Weather
  - End-Use Saturation
  - End-Use Efficiency
  - End-Use consumption
  - Thermal shell integrity
- Based on the Energy Information Administration's (EIA) Annual Energy Outlook for the Pacific region
- Calibrated using NPCC end-use data

Residential Cooling Equipment Stock
Saturation & Efficiency
Thermal Efficiency
Square Footage Trends
Usage Trends
Commercial Cooling Equipment Stock
Fuel Share & Intensity
Floor Space Trends
Usage Trends

Residential Heating Equipment Stock
Saturation & Efficiency
Thermal Efficiency
Square Footage Trends
Usage Trends
Commercial Heating Equipment Stock
Fuel Share & Intensity
Floor Space Trends
Usage Trends

Residential Other Equipment Stock
Saturation & Efficiency
Usage Trends
Commercial Other Equipment Stock
Fuel Share & Intensity
Usage Trends
Industrial
Economic Trends
Energy Intensities

Cooling Degree Days

Heating Degree Days

Res XOther + Com XOther + Ind XOther

Res XCool + Com XCool

Res XHeat + Com XHeat

$$Energy_m = a + b_c \times XCool_m + b_h \times XHeat_m + b_o \times XOther_m + e_m$$

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

9

| Done |
| In progress |
| Starting soon |
| Not yet started |

Milestone 1
- Weather zones by BA
- Weather response functions by BA
- Normal weather by BA
- Typical weather by BA

Milestone 2
- Residential end-use indices by building type
- Commercial end-use indices by building type

Milestone 3
- Industrial intensities by market segment
- Data Center indices by BA
- Behind the Meter Solar (PV) forecast of capacity by BA
- Electric Vehicle Forecast by BA

Milestone 4
- Monthly SAE Model by BA
- Apply Energy Efficiency Estimates
- Annual end-use forecast by building type and BA

Milestone 5
- Hourly end-use forecast by BA
- Forecast reports
- Training

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

10

Weather related tasks - Milestone 1

- 32 weather sites across the 13 BAs – which will include temperatures and GHI (global horizontal irradiance)
- Daily multi-part weather response functions for each balancing authority
- Defined "Typical Weather Pattern" by BA

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

11
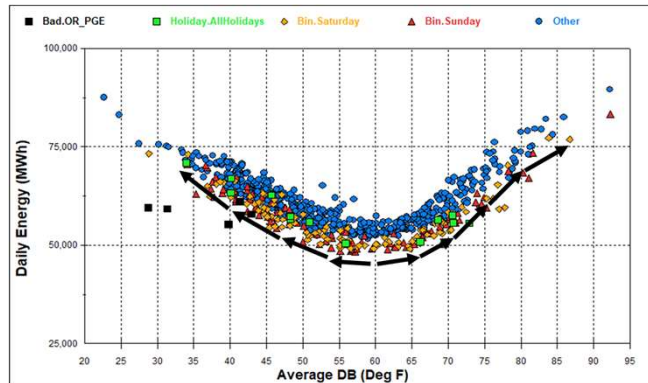
11

Key work in-progress and upcoming

1. Residential and Commercial end-use indices – collaborating this task using some of our end use data on consumption with the EIA data sets
2. **Behind the meter solar installed capacity by BA– historic and forecast - collaboration**
3. **Data Center forecast by BA – collaboration**
4. **Electric Vehicle forecast by BA – collaboration**
5. Energy Efficiency forecast and frozen efficiency approach

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

12

12

Data Centers, Electric Vehicles, BTM Solar

2021 Power Plan
Forecasts (aMW)
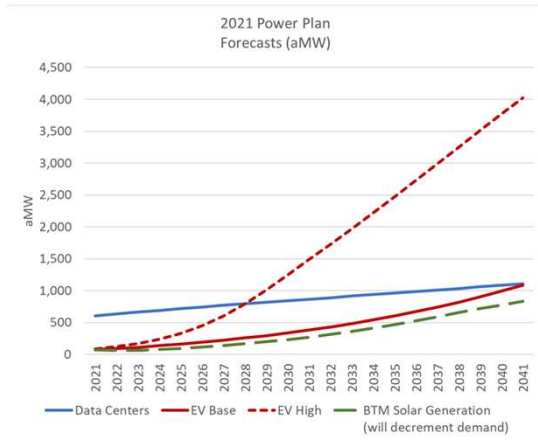
1) Data Centers
- Load forecast will be substantially larger
- We are breaking out data centers into their own category and by BA – will rely on Council forecast

2) Electric Vehicles
- Forecast of vehicles & charging ports by type and location (Level 1,2,3 and res, workplace, public)
- May utilize existing forecast sources (PNNL Vehicle Electrification Model, Energy Innovation Energy Policy Simulator)

3) BTM Solar
- by BA, will rely on our forecast of capacity
- Will utilize GHI on a greater spatial detail for generation profiles

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

13

13