Economic, Load, and Customer Forecasts

Grant D. Forsyth, Ph.D.
Chief Economist
Technical Advisory Committee Meeting
August 18, 2020
Main Topic Areas

• Service Area Economy
• Long-run Energy Forecast
• Peak Load Forecast
• Long-run Gas Customer Forecast
Service Area Economy

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Distribution of Employment, 2019

Avista WA-ID-OR MSA
- Private Goods: 14%
- Government: 16%
- Private Services: 70%

U.S.
- Private Goods: 14%
- Government: 15%
- Private Services: 71%

Avista WA-ID-OR MSA Government
- Federal: 11%
- State: 20%
- Local: 69%

U.S. Government
- Federal: 12%
- State: 23%
- Local: 65%

Source: BLS and author’s calculations.
Non-Farm Employment Growth, 2009-2020

Non-Farm Employment Growth (Dashed Shaded Box = Recession Period)

Service Area employment level same as 2013/14 period.

Source: BLS, WA ESD, OR ED and author’s calculations.
MSA Population Growth, 2007-2019

2008-2012: Employment Growth Slowing = Slowing In-migration

Population Growth in Avista WA-ID-OR MSAs

2013-2019: Employment Growth Increasing = Increasing In-migration

Source: BEA, U.S. Census, and author’s calculations.
GDP Growth Assumptions: 2021 IRP vs. 2020 IRP

Source: Various and author’s calculations.
Basic Forecast Approach

1) Monthly econometric model by schedule for each class.
2) Customer and UPC forecasts.
3) 20-year moving average for “normal weather.”
4) Economic drivers: GDP, industrial production, employment growth, population, price, natural gas penetration, and ARIMA error correction.
5) Native load (energy) forecast derived from retail load forecast.
6) Current forecast is the “Summer/Fall Forecast” done in June.

1) Boot strap off medium term forecast.
2) Apply long-run load growth relationships to develop simulation model for high/low scenarios.
3) Include different scenarios for renewable penetration with controls for price elasticity, EV/PHEVs, and natural gas penetration.
The Long-Term Relationship, 2021-2045

Load = Customers X Use Per Customer (UPC)

Load Growth ≈ Customer Growth + UPC Growth

Assumed to be same as population growth for residential after 2025, commercial growth will follow residential, and slow decline in industrial.

Assumed to be a function of multiple factors including renewable penetration, gas penetration, and EVs/PHEVs.
Residential Customer Growth, 2020-2045

Annual Residential Customer Growth Rates

Average annual growth rate from 2021-2045 = 0.8%. Shape of time-path mimics a combination of IHS (ID) and OFM (WA) population forecasts.
Residential Solar Penetration, 2008-2019

Customer Penetration vs. Customers Since 2008

- Share of Residential Solar Customers to Total Residential Customers
- Customers

- 2008
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019

Graph showing the increase in share of residential solar customers from 2008 to 2019, with a steady increase in penetration as the number of customers grows.
Current penetration is 0.3% and typical size is 7,800 watts. By 2045, penetration will be near 2.6% of residential customers and average size of installed systems will be over 10,000 watts.
Residential EVs/PHEVs, 2021-2045

Projected Residential EVs/PHEVs

- 2020 ≈ 2,000
- 2045 ≈ 107,000

2020 IRP Projected EV/PHEV
2021 IRP Projected EV/PHEV
Net Solar and EV/PHEV Impact, 2021-2045

Average Megawatt Impact of Solar and EV/PHEV

- 2021 IRP Solar aMW (Load Reduction)
- 2021 IRP EV/PHEV aMW (Load Addition)
- 2021 Net IRP Solar and EV/PHEV Impacts aMW
Native Load Forecast, 2021-2045

Total Native Load Forecast, Average Megawatts

EV/PHEV “Bend”

<table>
<thead>
<tr>
<th>IRP</th>
<th>Avg. Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020 IRP</td>
<td>0.3%</td>
</tr>
<tr>
<td>2021 IRP</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

Medium Term

Long Term

- 2021 IRP Base-Line Native Load
- 2020 IRP Base-Line Native Load
Climate Change: A Trended 20-year Moving Average (Preliminary!)

**20-yr MA CDD**

**20-yr MA HDD**

- **Annual 20-yr MA, Avista Trend**
- **Annual 20-yr MA, NWCC Trend**
- **Current 20-yr MA**
# Annual Native Load Forecast with Climate Change, 2026-2045 (Preliminary!)

<table>
<thead>
<tr>
<th>IRP</th>
<th>Avg. Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021 IRP, No Trend Base-Line</td>
<td>0.23%</td>
</tr>
<tr>
<td>2021 IRP, NWCC Trend</td>
<td>0.13%</td>
</tr>
<tr>
<td>2021 IRP, Avista Trend</td>
<td>0.21%</td>
</tr>
</tbody>
</table>

- **2021 IRP, No Trend Base-Line**: 0.3% lower than non-trend base-line.
- **2021 IRP, NWCC Trend**: 2% lower than non-trend base-line.
Native Load Growth Forecast, 2021-2045

Load Recovery from Recession

EV/PHEV “Bend”

2021 IRP Base-Line Native Load Growth

2020 IRP Base-Line Native Load Growth
Residential UPC Growth: 2021-2045

Base-Line Scenario: Residential UPC Growth Rate

Source Avg. Annual Growth

<table>
<thead>
<tr>
<th>Source</th>
<th>Avg. Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021 IRP</td>
<td>-0.24%</td>
</tr>
<tr>
<td>EIA</td>
<td>0.03%</td>
</tr>
</tbody>
</table>

Graph showing the growth rate of residential UPC from 2021 to 2045.
Long-Run Load Forecast: Conservation Adjustment

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Comparison of Native Load Forecasts, 2021-2045

Average Megawatts Load Comparison with Conservation Adjustment

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<tr>
<th>Source</th>
<th>Avg. Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021 IRP</td>
<td>0.3%</td>
</tr>
<tr>
<td>No Conservation</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Graph showing the comparison of average megawatts load with and without conservation adjustments from 2021 to 2045.
Peak Load Forecast

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The Basic Model

• Monthly time-series regression model that initially excludes certain industrial loads and EVs (but those are added back in for the final forecast).

• Based on monthly peak MW loads since 2004. The peak is pulled from hourly load data for each day for each month.

• Explanatory variables include HDD-CDD and monthly and day-of-week dummy variables. The level of real U.S. GDP is the primary economic driver in the model—the higher GDP, the higher peak loads. Model allows GDP impact to differ between winter and summer.

• The coefficients of the model are used to generate a distribution of peak loads by month based on historical max/min temperatures since 1890, holding GDP constant. A starting expected peak load is then calculated using the average peak load simulated for that month going back to 1890. Model shows Avista is a winter peaking utility for the forecast period; however, the summer peak is growing at a faster than the winter peak.

• For comparison in the 2021 IRP, peak load is also calculated by averaging simulated peak loads over the last 30 years and 20 years.

• The model is also used to calculate the long-run growth rate of peak loads for summer and winter using a forecast of GDP growth under the “ceteris paribus” assumption for weather and other factors.
Peak Forecasts for Winter and Summer, 2021-2045

- Winter Peak Avg. Growth 2021-45: 0.37%
- Summer Peak Avg. Growth 2021-45: 0.44%
Load Forecasts for Winter Peak, 2011-2043
Load Forecasts for Summer Peak, 2011-2045

Summer Peak Forecast: Current and Past

Megawatts

- 2009 IRP
- 2011 IRP
- 2013 IRP
- 2015 IRP
- 2017 IRP
- 2020 IRP
- 2021 IRP

Peak Forecasts for Winter and Summer 30-Year Average Weather, 2021-2045

![Graph showing peak forecasts for winter and summer 30-year average weather, 2021-2045. The graph displays the trend of megawatts for each year from 1997 to 2045, with predictions for future years.]
Peak Forecasts for Winter and Summer 20-Year Average Weather, 2021-2045
Long-Run Customer Forecast: Natural Gas

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Firm Customers (Meters) by State and Class, 2019

Firm Customers by State

- WA: 47%
- ID: 24%
- OR: 29%

Firm Customers by Class

- Residential: 90%
- Commercial: 10%
- Industrial: 0.1%
System All Types of Industrial Customers, 1997-2020


OR Firm Industrial
WA-ID Firm Industrial

OR Firm Industrial: 291
WA-ID Firm Industrial: 31
2001: 216
2005: 216
2010: 24
2015: 24
2020 Est: 24
Customer Forecast Models

• Forecast models are structured around each schedule, in each class, by jurisdiction. In the case of OR, this is done individually for each of Avista’s service islands.

• Time series transfer function models (models with regressions drivers and ARIMA error terms).

• Simple time series smoothing models (for schedules with little customer variation).

• Same models used for the bi-annual revenue model forecast pushed out to 2045. The forecasts for this IRP were generated from the “Summer/Fall 2020” forecast completed in June.

• Customer forecasts are sent to Gas Supply for inclusion in the SENDOUT model.

• Example of transfer function model: WA sch. 101 residential customers…
Transfer Function Model Example

\[
C_{t,y,WA101.r} = \alpha_0 + \tau \text{POP}_{t,y,SPK} + \omega_{SD} D_{t,y} + \omega_{OL} \text{D}_{Oct\ 2015=1} + \omega_{OL} \text{D}_{Feb\ 2016=1} + \omega_{OL} \text{D}_{Mar\ 2018=1} + \omega_{OL} \text{D}_{Nov\ 2018=1} + \text{ARIMA}_t \epsilon_{t,y} (12,1,0)(0,0,0)_{12}
\]
Getting to Population as a Driver, 2020-2025 & 2026-2045

Average GDP Growth Forecasts:
- WSJ, FOMC, Bloomberg, etc.
- Average forecasts out 5 full calendar years.

Non-farm Employment Growth Model:
- Model links year y, y-1, and y-2 GDP growth to year y regional employment growth.
- Forecast out 5 full calendar years.
- Averaged with IHS employment growth forecasts.

Regional Population Growth Models:
- Model links regional, U.S., and CA year y-1 employment growth to year y county population growth.
- Forecast out 5 full calendar years for Spokane, WA; Kootenai, ID; and Jackson+Josephine, OR.
- Averaged with IHS growth forecasts.
- Growth rates used to generate population forecasts for use in regression models—important driver for main residential and commercial schedules.

Deviation in the most recent forecast!

Kootenai and Jackson: IHS population growth forecasts for 2026-2045

Spokane: OFM population growth forecasts for 2026-2045

OR Douglas, Klamath, and Union counties: IHS population growth forecasts for 2020-2045

Monthly Interpolation assumes: \( P_N = P_0 e^{rN} \)
WA-ID Region Firm Customers, 2021-2040 (2018 IRP)

<table>
<thead>
<tr>
<th>IRP</th>
<th>Avg. Annual Growth 2021-2040</th>
</tr>
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<tbody>
<tr>
<td>2021</td>
<td>1.1%</td>
</tr>
<tr>
<td>2018</td>
<td>1.2%</td>
</tr>
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</table>

≈ +1,400
OR Region Firm Customers, 2021-2040 (2018 IRP)

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<td>0.8%</td>
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<tr>
<td>2018</td>
<td>0.9%</td>
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IRP Avg. Annual Growth

- 2021: 0.8%
- 2018: 0.9%

Approximately -2,800
Medford, OR Region Firm Customers, 2021-2040 (2018 IRP)

<table>
<thead>
<tr>
<th>IRP</th>
<th>Avg. Annual Growth 2021-2037</th>
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<tbody>
<tr>
<td>2021</td>
<td>0.9%</td>
</tr>
<tr>
<td>2018</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

IRP Avg. Annual Growth 2021-2037

≈ +310
Roseburg, OR Region Firm Customers, 2021-2040 (2018 IRP)

<table>
<thead>
<tr>
<th>IRP</th>
<th>Avg. Annual Growth 2021-2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>0.4%</td>
</tr>
<tr>
<td>2018</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Approximately -1,900 customers compared to 2021.
Klamath, OR Region Firm Customers, 2021-2040 (2018 IRP)

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<thead>
<tr>
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<tr>
<td>2021</td>
<td>0.7%</td>
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<tr>
<td>2018</td>
<td>1.0%</td>
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≈ -1,200
La Grande, OR Region Firm Customers, 2021-2040 (2018 IRP)

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≈ +30
### System Firm Customers, 2021-2040 (2018 IRP)

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<td>2018</td>
<td>1.1%</td>
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- WA-ID-OR Base 2018: ≈ -1,400
- WA-ID-OR Base 2021:
WA-ID Region Firm Customer Range, 2021-2045

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low Growth</th>
<th>Base Growth</th>
<th>High Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA-ID Customers</td>
<td>0.7%</td>
<td>1.1%</td>
<td>1.5%</td>
</tr>
<tr>
<td>WA Population</td>
<td>0.4%</td>
<td>0.7%</td>
<td>1.0%</td>
</tr>
<tr>
<td>ID Population</td>
<td>0.8%</td>
<td>1.4%</td>
<td>2.0%</td>
</tr>
<tr>
<td>WA-ID Population</td>
<td>0.5%</td>
<td>0.8%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>
OR Region Firm Customer Range, 2021-2045

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low Growth</th>
<th>Base Growth</th>
<th>High Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customers</td>
<td>0.5%</td>
<td>0.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Population</td>
<td>0.3%</td>
<td>0.5%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

- **ORFIRMCUS Base**
- **ORFIRMCUS High**
- **ORFIRMCUS Low**
System Firm Customer Range, 2021-2045

<table>
<thead>
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<td>1.1%</td>
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</tbody>
</table>
# Summary of Growth Rates

<table>
<thead>
<tr>
<th>System</th>
<th>Base-Case</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1.0%</td>
<td>1.4%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.5%</td>
<td>0.8%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Industrial</td>
<td>-0.8%</td>
<td>2.2%</td>
<td>-3.8%</td>
</tr>
<tr>
<td>Total</td>
<td>1.0%</td>
<td>1.3%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WA</th>
<th>Base-Case</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1.0%</td>
<td>1.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.4%</td>
<td>0.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Industrial</td>
<td>-0.8%</td>
<td>1.9%</td>
<td>-3.6%</td>
</tr>
<tr>
<td>Total</td>
<td>1.0%</td>
<td>1.3%</td>
<td>0.7%</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>ID</th>
<th>Base-Case</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>1.4%</td>
<td>2.0%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.4%</td>
<td>1.0%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>Industrial</td>
<td>-1.0%</td>
<td>1.8%</td>
<td>-3.4%</td>
</tr>
<tr>
<td>Total</td>
<td>1.3%</td>
<td>1.9%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OR</th>
<th>Base-Case</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>0.7%</td>
<td>0.9%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.6%</td>
<td>0.8%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Industrial</td>
<td>0.0%</td>
<td>4.5%</td>
<td>-10.6%</td>
</tr>
<tr>
<td>Total</td>
<td>0.7%</td>
<td>0.9%</td>
<td>0.5%</td>
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