MEMORANDUM

TO: Power Committee
FROM: Ben Kujala
SUBJECT: Further Detail on Load Forecast

BACKGROUND:

Presenter: Ben Kujala and Steve Simmons

Summary: At the September meeting, staff presented a proposed load forecast for the 2021 Power Plan. This will be a chance to answer questions raised both at that presentation and any subsequent questions received from the Power Committee Members.

Relevance: The Power Act requires a 20 year load forecast.

Further Detail on Load Forecast
October 15, 2019

Steve Simmons and Ben Kujala
Follow-up on Questions and Concerns

- Population Forecast
- Transportation Forecast - EV penetration
- Behind The Meter Solar
- Review of Load Forecast
Staff Proposed Load Forecast

Medium Economic Growth and CanESM2 GCM

<table>
<thead>
<tr>
<th></th>
<th>2000-2021</th>
<th>2021-2041</th>
<th>2041-2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting Case</td>
<td>0.7%</td>
<td>0.55%</td>
<td>0.8%</td>
</tr>
<tr>
<td>with Temp. impacts</td>
<td>0.7%</td>
<td>0.51%</td>
<td>0.7%</td>
</tr>
<tr>
<td>With Temp and Secondary impacts</td>
<td>0.7%</td>
<td>0.71%</td>
<td>0.9%</td>
</tr>
<tr>
<td>With Temp and Secondary impacts and Frozen Efficiency</td>
<td>0.7%</td>
<td>0.73%</td>
<td>1.0%</td>
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Energy Load Forecast
medium economic growth and CanESM2 GCM

Annual Energy aMW

<table>
<thead>
<tr>
<th>AAGR</th>
<th>2021-2041</th>
<th>2021-2050</th>
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<tbody>
<tr>
<td>BaseCase</td>
<td>0.28%</td>
<td>0.37%</td>
</tr>
<tr>
<td>Climate1_NoXGO_Base_NoFreeze</td>
<td>0.33%</td>
<td>0.44%</td>
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<tr>
<td>Climate1_XGO_Base_NoFreeze</td>
<td>0.55%</td>
<td>0.66%</td>
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<tr>
<td>Climate1_XGO_Base_Freeze</td>
<td>0.61%</td>
<td>0.72%</td>
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Medium Economic Conditions
How did we adjust the population?

1. Take total population estimate by state
2. Apply state-to-state movement based on ACS data to estimate projected population flows to the Northwest
3. Isolate movement from Midwest and Southern states into the region – look at Global Insight baseline data
4. Project share of forecast 2040 population that would migrate based on climate change (reduce Midwest population consistent with a trajectory of 8.1% less by 2065 and similarly South population consistent with a trajectory of 4.5% less by 2065)
5. Use ACS based movement to proportion the population reduced in the Midwest and the South into the Northwest
By 2050 the base forecast projects a 25% growth in population from 2017

With additional climate change induced migration - the growth from 2017 is 34%
% of Population Gains by Category for the Four Northwest States

- **Historic 1997 - 2017**: 60% from Birth/Death rates, 40% from Migration
- **Historic 2010 - 2017**: 66% from Birth/Death rates, 34% from Migration
- **Base Forecast 2017 - 2050**: 87% from Birth/Death rates, 13% from Migration
- **Base Forecast 2017 - 2050 w/Climate Change Induced Migration**: 64% from Birth/Death rates, 9% from Migration

Legend:
- % from Birth/Death rates
- % from Migration
- % from Climate Change Induced Migration
Annualized Population Growth Rates (%) for the Four Northwest States

- Historic 1997 - 2017: 1.29%
- Historic 2010 - 2017: 1.26%
- Base Forecast 2017 - 2050: 0.68%
- Base Forecast 2017 - 2050 w/Climate Change Induced Migration: 0.90%
Behind the Meter
Solar Forecast
Summary

1. Costs of installing behind the meter solar (i.e. distributed solar, rooftop PV,...) systems have dropped significantly, and are expected to continue declining

2. Installed capacity of behind the meter solar in the residential, commercial and industrial sectors has been growing recently in the Northwest –though it is a relatively new phenomena

3. Our load forecast reflects this growth and expects this trend to continue
Key assumptions that inform our forecast

1. We rely on historic data time series for generation and capacity from the US Energy Information Administration (EIA)
   1. State Energy Data System (SEDS)
   2. EIA 861 report and related data query tools

2. We rely on our internal generating resource expertise to estimate behind the meter solar costs – both historic; and a forecast of future costs

3. We developed a suite of solar profiles (hourly rooftop generation) across 60 geographic sites in the Northwest – by running the National Renewable Energy Lab (NREL) System Advisory Model
Forecast mechanics

1. Energy2020 (Load Forecasting Tool) – uses historic information to calibrate consumer choice parameters
   a. Installed capacity (and generation)
   b. Solar costs

2. Moving forward - our forecast of solar costs & retail electricity rates – along with solar generation profiles – inform the future consumer choices

3. The forecast of capacity from behind the meter solar – is classified as “Cogen” in the forecast model – and reduces the overall load forecast and affects:
   a. Energy (aMW)
   b. Peak (MW)
Forecast model is showing strong growth in solar capacity over time – especially in residential rooftop.

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MW)</th>
<th>Annual Energy (aMW)</th>
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<tbody>
<tr>
<td>2025</td>
<td>1,072</td>
<td>175</td>
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<tr>
<td>2035</td>
<td>3,330</td>
<td>595</td>
</tr>
<tr>
<td>2041</td>
<td>5,820</td>
<td>1032</td>
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Much of solar generation is during the spring and summer months.

Solar generation profiles are superimposed on the system load profile to estimate peak load reductions - which primarily occur in late afternoon in the summer.
Transportation Forecast
Summary

1. Electric passenger vehicles are relatively new to the Northwest and the load forecast

2. Sales of electric vehicles began around 2011 – and have been growing – in 2017 there were around 11,500 new electric vehicle sales – which corresponds to a 1.9% market share of sales

3. We forecast growth in overall vehicle sales, and in electric vehicle sales – with electric gaining market share from gasoline vehicles – resulting in electrical load growth

4. Passenger vehicle stock has a slow turnover rate – limiting the velocity that electric vehicles can gain market share

5. With limited initial data – load profiles for electric vehicles exhibit a sharp late afternoon peak – as commuters arrive home and plug-in for the next day

6. Electric vehicles tend to have slightly higher capital costs than gasoline counterparts, but have much better operating efficiency

The overall vehicle fleet – all technologies - is becoming more efficient over time
Key assumptions that inform our forecast

1. Growth in energy demand for transportation driven from our economic forecast from IHS-Global Insights population growth

2. Vehicle capital cost estimates by technology from EIA Annual Energy Outlook (AEO)
   * Note: we will be making adjustments downward – current electric vehicle capital costs in the model are weighted heavily towards high end models such as Tesla – which are significantly more expensive than the typical gasoline car on the market. More lower price electric models will be coming on the market

3. Fuel prices including retail $/gal gasoline (from EIA AEO), and our retail electric price

4. New vehicle efficiency – mpg – based on federal Café standards

5. Vehicle Stock turnover rate – using an average vehicle life span of around 17 years – but this may be adjusted

6. Charging profiles were developed based on a raw data from an Avista Electric Vehicle Supply Equipment pilot
Forecast mechanics

1. **Energy2020 (Load Forecasting Tool)** – uses historic information to calibrate consumer choice parameters
   a. Historic demand for electric vehicles over time relative to other technologies
   b. Capital and operating costs of electric vehicles relative to other technologies
   c. Very limited history with electric vehicles

2. Moving forward – the growth in transportation demand is estimated from population growth, vehicle stock retirement, and vehicle efficiency

3. The market share of electric vehicles results from past preferences, adjustments, and future costs

4. The demand for electricity from vehicles is new load growth which affects
   a. Energy (aMW)
   b. Peak (MW)
Draft Forecast - subject to change
Electricity Demand - annual aMW
Cars and light duty trucks
Battery Electric (BEV) and Plug In
Hybrid Electric (PHEV)

Annual electricity consumption per electric vehicle in stock declines over time - the average is around 2,800 kWh per vehicle per year

Draft Forecast
-subject to change
Current load profiles indicate a large late afternoon peak - this assumes mostly home charging.

As charging stations are added to workplace and retail locations - profile is expected to level out, along with utility programs to incent smart charging.