Load Forecast
2019
For use in Resource Adequacy

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In today’s presentation

- Review of loads in 2012
- Resource adequacy needs
  - Load forecast methodology
  - Drivers of the forecast
  - Treatment of conservation
  - Incorporating impact of weather
  - Forecast for 2019
Regional Loads (MWA and MW)
2012 Regional Loads Actual and weather Normalized

<table>
<thead>
<tr>
<th></th>
<th>Energy Mwa</th>
<th>Winter Peak MW</th>
<th>Summer Peak MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 WN</td>
<td>20,972</td>
<td>28,770</td>
<td>24,893</td>
</tr>
<tr>
<td>2012 Actual</td>
<td>20,747</td>
<td>29,570</td>
<td>27,317</td>
</tr>
<tr>
<td>Difference</td>
<td>(225)</td>
<td>800</td>
<td>2,424</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual Load</th>
<th>Load After Adj for temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>20,666</td>
<td>21.152</td>
</tr>
<tr>
<td>2008</td>
<td>21,350</td>
<td>21.219</td>
</tr>
<tr>
<td>2009</td>
<td>20,925</td>
<td>20,704</td>
</tr>
<tr>
<td>2010</td>
<td>20,348</td>
<td>20,640</td>
</tr>
<tr>
<td>2011</td>
<td>21,096</td>
<td>20,791</td>
</tr>
<tr>
<td>2012</td>
<td>20,747</td>
<td>20,972</td>
</tr>
</tbody>
</table>
Resource Adequacy Needs

- Hourly loads projected 5 years from current year
- Projected loads under 1928-2012 Regional temperature conditions
- Treatment of conservation
  - Add Embedded conservation
  - Subtract 6th Power Plan conservations targets
### Information flow for Short-term Electricity Demand Forecasting System

1. Obtain Daily Regional Temperatures 1928-2012
2. Obtain hourly Loads by Balancing Authority and calculate daily regional load Model 1995-2012
3. Obtain actual monthly and annual forecast of regional employment
4. Calculate Hourly Load Allocation Factors for each day
8. Adjust for Embedded and Target Conservation amounts
9. Loads for Resource Adequacy work
   - Create 84 sets of 8760 hourly Load Forecasts for 2019 For use in RA analysis
Input Data Sets

- Hourly load data for 1995-2012 (from WECC)
- Hourly temperatures data for 1990-2012 from Western Regional Climate Center
- 1928-2012 Daily temperature from 4 sites in the region
- Hourly Direct Service Industry load data for 1993-2012 from Bonneville Power Administration
- Forecast of regional employment 2013-2019
- Forecast of DSI load from BPA 2012 WhiteBook
- Estimates of past (1978-2009) efficiency acquisition levels (Utility Programs, NEEA, State Codes, Federal Appliance Standards)
Calculating Daily Average Regional Temperature

- Start with hourly temperature for the four sites (Portland PDX, SeaTac, Boise and Spokane airports)

- Weight the site temperature to calculate a weighted regional average for each day.

- Monthly weights (load weighted) were developed by BPA for each site.
Short-term Model Structure

- A structural time series model is adopted to represent the load for electricity in the region as a function of cyclical, weather and economic variables.

- The general specification of the demand model is represented by:
  - where: \( L = f(S, W, DE, I) \)
- \( L \) = net average daily electricity load in the region (net of Direct Service Industries)
- \( S \) = variables depicting seasonal variations in load,
- \( W \) = deviation in temperature variables generated via a regression model
- \( DE \) = economic variables, and
- \( I \) = indicator variables.
Structural Equation

Model structure
Log format
Fourier series to capture cyclical behavior
Accounting for holidays
Accounting for load response to temperature
Captures limits to load growth as temperature increases
Driven with regional employment

Explains 96% of variations in daily historic load
Economic Driver of Short-term Forecast
1995-2019 Regional Employment

[Bar chart showing regional employment trends from 1995 to 2019.]
Treatment of Conservation (Avoiding Double Counting)

- Resource Adequacy analysis requires that:
  1. Amount of conservation that is embedded in load be calculated and added back into the load forecast, to create a gross load forecast.
  2. The 6th Power Plan conservation targets be subtracted from the gross load.
  3. Conservation targets are given the same hourly profile as the load.
NW Energy Efficiency Acquisitions (Cumulative MWA)
NW Energy Efficiency Acquisitions (Incremental MWA)

- State Code
- Federal standards
- Market Transformation
- Utility Programs
**Structural Equation For Forecast of Incremental Conservation Embedded in the loads**

- Incremental Conservation achievement 1977-2011
  - Code and standards
  - Market Transformation
  - Programmatic

- Historic conservation is regressed against employment (as an indicator of economic condition)

- 94% of historic variations is explained.

### Table: Dependent Variable: CONSERVATION_ACTUAL_INC

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLOYMENT</td>
<td>0.111749</td>
<td>0.033989</td>
<td>3.287784</td>
<td>0.0025</td>
</tr>
<tr>
<td>C</td>
<td>-405.5139</td>
<td>184.4397</td>
<td>-2.198625</td>
<td>0.0363</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.833971</td>
<td>0.114340</td>
<td>7.293812</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

- R-squared: 0.936914
- Adjusted R-squared: 0.932971
- S.E. of regression: 29.83815
- Sum squared resid: 28490.08
- Log likelihood: -166.9472
- F-statistic: 237.6214
- Prob(F-statistic): 0.000000

Inverted AR Roots: .83
Treatment of Conservation for Resource Adequacy Analysis

Annual Level of Conservation* Acquisition (MWa)

<table>
<thead>
<tr>
<th>Year</th>
<th>Actual</th>
<th>Embedded</th>
<th>6th Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>258</td>
<td>275</td>
<td>200</td>
</tr>
<tr>
<td>2011</td>
<td>278</td>
<td>278</td>
<td>220</td>
</tr>
<tr>
<td>2012</td>
<td>250</td>
<td>286</td>
<td>240</td>
</tr>
<tr>
<td>2013</td>
<td>293</td>
<td>293</td>
<td>260</td>
</tr>
<tr>
<td>2014</td>
<td>305</td>
<td>305</td>
<td>280</td>
</tr>
<tr>
<td>2015</td>
<td>316</td>
<td>316</td>
<td>290</td>
</tr>
<tr>
<td>2016</td>
<td>327</td>
<td>327</td>
<td>320</td>
</tr>
<tr>
<td>2017</td>
<td>337</td>
<td>337</td>
<td>340</td>
</tr>
<tr>
<td>2018</td>
<td>346</td>
<td>346</td>
<td>350</td>
</tr>
<tr>
<td>2019</td>
<td>354</td>
<td>354</td>
<td>360</td>
</tr>
</tbody>
</table>
## Treatment of Conservation

<table>
<thead>
<tr>
<th>Cumulative Embedded conservation</th>
<th>Cumulative targeted</th>
<th>Increase in Load</th>
<th>Simulated June 2013</th>
<th>used in hourly load adj.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulated June 2013</td>
<td>6th plan targets</td>
<td>Delta Mw to be Added</td>
<td>WN Load net of DS load</td>
<td>percent of total load</td>
</tr>
<tr>
<td>2013-2013</td>
<td>293</td>
<td>260</td>
<td>33</td>
<td>20,389</td>
</tr>
<tr>
<td>2013-2014</td>
<td>598</td>
<td>540</td>
<td>58</td>
<td>20,540</td>
</tr>
<tr>
<td>2013-2015</td>
<td>914</td>
<td>830</td>
<td>84</td>
<td>20,690</td>
</tr>
<tr>
<td>2013-2016</td>
<td>1,242</td>
<td>1,150</td>
<td>92</td>
<td>20,829</td>
</tr>
<tr>
<td>2013-2017</td>
<td>1,579</td>
<td>1,490</td>
<td>89</td>
<td>20,954</td>
</tr>
<tr>
<td>2013-2018</td>
<td>1,925</td>
<td>1,840</td>
<td>85</td>
<td>21,069</td>
</tr>
<tr>
<td>2013-2019</td>
<td>2,279</td>
<td>2,200</td>
<td>79</td>
<td>21,174</td>
</tr>
<tr>
<td>2013-2020</td>
<td>2,640</td>
<td>2,565</td>
<td>75</td>
<td>21,271</td>
</tr>
</tbody>
</table>
Caveats to the Forecast

- **Adjustment to BPA loads for 2009-2011**
  - increased BPA BA load by 5%~250 MWa
- **Conservation achievements in 2012**
  - We assumed 280MWa- actual seems to be closer to 250
  - Embedded Conservation estimated
  - Load shape for conservation resource is assumed to be same as the Load.
- **Past and Future Impact of Solar Rooftop and Demand Response** are not explicitly modeled.
- **Future Federal appliance standards** are not modeled
Caveats to the Methodology

- An econometric Load forecast beyond 3-5 year is risky.
- Actual shape of conservation is not knowable.
- Estimating embedded conservation is that, an estimate.
- Impact of weather on daily and hourly loads far exceed uncertainty about conservation.
2019 Regional Net Load Forecast Average, and Peak Loads
Comparison of Range of Load Forecasts (as prepared by PNUCC – Dick Adams)
Limits to the RA Analysis

- Given the above caveats regarding the methodology and the data, it is my recommendation to:
  - 1) Take the econometrically forecasted loads (3-5 years forward look, under the 84 temperature-year condition) without any further adjustments - the reference case.
  - 2) Do sensitivity (+/- 2.5%) on reference case.
We are currently working on developing the forecast of load for Southern Idaho. This forecast will be used to parse regional loads into:
- PNW West
- PNW East
- Southern Idaho