Overview of the Northwest Power and Conservation Council’s Power Plan Development Process

Webinar

October 15, 2014

Agenda

- What’s in a Power Plan?
  - Major Elements
    (Briefing on the Act’s complete legal requirements is scheduled for full Council in November)
  - What are the major analytical steps in the Plan development process?
    - What models are used?
    - What role does each model play in plan development?
  - How do we engage the public/stakeholders in Plan development?
What’s In A Plan?

A demand forecast of at least twenty years

6th Plan Load Forecast
A forecast of resources required to meet forecast demand by resource priority type

The 6th Plan’s resource strategy can be summarized in five specific recommendations:

• Cost-effective energy efficiency should be developed aggressively and on a consistent basis for the foreseeable future.
• Expand the supply of cost-effective renewable resources options
• Meet remaining needs for energy and capacity with natural gas-fired generation.
• Address the challenges of wind integration through improvements in system operating procedures and business practices.
• Expand long-term resource alternatives.

An energy conservation program

6th Plan Energy Efficiency Goals

- Retrofit
- Lost-Opportunity
Including model conservation standards (MCS)

Goal - MCS designed to produce all power savings that are **cost-effective for the region and economically feasible for consumers**

... shall include (but not limited to) standards applicable to

- (A) New and Existing Structures
- (B) Utility, customer and governmental conservation programs
- (C) Other consumer actions for achieving conservation

and, surcharge methodology if recommended

The Council may recommend that the BPA Administrator impose surcharges of not less than 10% nor more than 50% of BPA’s applicable rates to recover costs incurred because savings from the model conservation standards have not been achieved

*The Code of Hammurabi contained the “Original” MCS Surcharge Policy -*

“If a builder has built a house for a man, and has not made his work sound, and the house he built has fallen, and caused the death of its owner, that builder shall be put to death.”
Regional reliability and reserve requirements

Pacific Northwest Power Supply Adequacy Assessment for 2019

May 7, 2014

Research and development recommendations

Sixth Power Plan Action Plan Examples

- CONS-20. In order to ensure the long-term supply of conservation resources, develop and fund a regional research plan that directs development, demonstration, and pilot program activity.

- GEN-7. Commercialize and confirm low-carbon resources with special Northwest promise.
A methodology for determining quantifiable environmental costs and benefits

6th Plan Methodology

- The four components of Council’s methodology are:
  1. Include the cost of meeting existing environmental regulations
  2. Where possible, quantifying the potential costs of new regulations
  3. Account for the environmental benefits that may be associated with specific resources; and,
  4. Recognize additional environmental effects that may remain after compliance with existing regulations

A fish and wildlife program

Columbia River Basin Fish and Wildlife Program 2014
An Action Plan

Sixth Power Plan Action Plan

- Introduction
- Conservation
- Deployment
- Adaptive Management
- Development and Confirmation
- Generating Resources
- Generating Resource Acquisition
- Adequacy of System Integration Services
- Information to Support Sound Planning and Decisionmaking
- Future Role of Bonneville
- Ensuring Adequacy
- Demand Response
- Smart Grid
- Transmission
- Fish and Power
- Monitoring Plan Implementation
- Maintaining and Enhancing Council’s Analytical Capability

Plan Development Process

1. Establish Values for Key Input Assumptions
2. Identify Major Issues
3. Estimate Future Loads, Resource Cost and Availability
4. Conduct Resource Portfolio Analysis
   - Identify Resource Needs
   - Test Alternative Resource Strategies
   - Agree on Preferred Alternative for Draft Plan
5. Issue Draft Plan
6. Take Public Comment
7. Conduct Additional Analysis in Response to Public Comment
8. Issue Final Plan
Plan Development Analytical Process Flow

- **Electricity Demand Forecast**
- **Units & Baseline Unit Use**
- **Energy Efficiency Resource Potential Assessment**
- **Energy Efficiency “Supply Curves”**
- **Council Reviews Cost and Risk of Alternative Resource Portfolios**
- **Council Adopts Plan’s Resource Portfolio Management Strategy and Action Plan**
- **Generating Resource Cost & Availability**
- **Distributions of Key Drivers (e.g., Fuel prices, wholesale market prices)**
- **Generating Resource Potential Assessment**

Models Used in Council Plan Development

- **Energy 2020**
- **Fuel Price Forecasting Model**
- **AURORA xmp® Electricity Market Model**
- **GENESYS**
- **Regional Portfolio Model (RPM)**
Council Planning Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy 2020</strong></td>
<td>Energy 2020 is an open source model developed by Systematic Solutions, Inc. This model has been customized for and by the Council. Used to forecast the hourly demand for electricity, potential applications for efficiency resources, ensure consistency between the demand forecasts and efficiency assessment.</td>
</tr>
<tr>
<td><strong>Fuel Price Forecasting Model</strong></td>
<td>Council developed model. Used to convert assumptions about fuel commodity prices to regional wholesale prices at various locations, and to convert to estimate retail fuel prices for input to demand forecasts and resource costs estimates.</td>
</tr>
<tr>
<td><em><em>AURORAxmp</em> Electricity Market Model</em>*</td>
<td>Proprietary model from EPIS, Inc. Production cost model used to forecast hourly wholesale electricity market prices at various pricing points in the western U.S. (WECC area). Can also be used to forecast hourly and total system NOx, SOx, and CO2 emissions.</td>
</tr>
<tr>
<td><strong>GENESYS (GENeration Evaluation SYSTEM)</strong></td>
<td>Council developed model that performs hourly chronological simulation of the Northwest’s resources using many different assumptions for uncertain variables, including 1) river flows (which affect the amount of water for hydroelectric generation), 2) temperature (which affects demand for electricity), 3) forced outage conditions for generating resources and 4) wind generation.</td>
</tr>
<tr>
<td><strong>Regional Portfolio Model (RPM)</strong></td>
<td>Council developed model used to identify low-cost and low-risk resource strategies given uncertain future conditions and policies. It determines cost-effectiveness of alternative generating and efficiency resources. Time resolution is quarterly, with capacity assessments done for peak hour within period.</td>
</tr>
</tbody>
</table>

Energy 2020 Demand Forecasting Model

- **Economic and Demographic Forecast**
  - Population
  - Employment
  - Industrial Output

- **State Codes and Federal Standards**

- **Fuel Price Forecast**
  - Natural Gas
  - Fuel Oil
  - Coal

- **Generating Resource Costs**

- **AURORAxmp and GENESYS - Hourly Level PNW Electricity Demand**

- **Energy Efficiency Assessment**
  - Units (e.g., homes, water heaters, sq/ft. office buildings, industrial load, etc.)

- **Regional Portfolio Model**
  - Monthly Loads by High and Low Load Period
  - Peak Hourly Load by Quarter
Fuel Price Forecast Model (FuelMod)

Annual Forecast of Henry HUB Spot Market Natural Gas Price

USDOE Energy Information Administration Forecast of Coal and Oil Prices

Historic Natural Gas price data at pricing hubs and burner tips

Fuel Price Forecast Model

- All Fuel Prices
- Gas Prices
- Energy 2020
- Regional Portfolio Model
- Generating Resource Assessment
- Conservation Resource Assessment

AURORA® Electricity Market Model

Hourly Load Forecast
- PNW
- Remainder of WECC (From Energy 2020)

Monthly Hydro System Output (From GENESYS)

Fuel Price Forecast
- Natural Gas
- Coal
- Fuel Oil (From Fuel Price Model)

Transmission Limitations

Existing and New Generating Resource Characteristics
Annual Hourly Load Forecast, including Energy Efficiency for “Test Year” Simulated Using Temperatures from 77 Historical Weather Years from Energy 2020

Monthly River Flows from 80 Historical Water Years

Existing Generating Resource Characteristics, Including Forces Outage Rates

Known New Generating Resource Additions

Limits on Imports • Winter • Summer

Monthly Hydro-System Output

Regional Resource Adequacy Trend Council Standard LOAD hectares is 3%

Loss of Load Probability

Regional Resource Adequacy Trend Council Standard LOAD hectares is 3%

Genesys

Regional Portfolio Model “Stress Tests” Alternative Resource Strategies Against a Wide Range of Futures

Regional Portfolio Model

Resource Supply Curve

NPV System Cost (billion 2006$)

Portfolio ABCD

Regional Portfolio Model

Regional Portfolio Model

Annual Load Growth

Resource Supply Curve

Cumulative Supply (MW)

Portfolio ABCD

NPV System Risk (2006$billions)

Portfolios

Regional Portfolio Model

Portfolio ABCD

NPV System Cost (2006$billions)

Portfolios

Regional Portfolio Model

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Regional Portfolio Model (RPM)

**What It Does**
- Tests alternative resource mixes and development timing (aka, Resource Strategies) against a range of future conditions (e.g., load growth, natural gas prices, emissions costs/limits, etc.)
- Identifies the “least cost” Resource Strategy for a given level of “risk”

**What It Doesn’t Do**
- Determine what is an acceptable level of “risk”
- Determine what is an acceptable level of “cost”
- Decide which Resource Strategy is “The Plan”

Council Financial Calculators

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
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<tbody>
<tr>
<td>ProCost</td>
<td>Council developed tool. Used to calculate levelized costs of saved energy from efficiency resources based on measure and program cost and how the capital, operating and financing costs of installation are shared between consumers and ratepayer funded programs.</td>
</tr>
<tr>
<td>MicroFin</td>
<td>Council developed tool. Used to calculate the levelized cost of generating resources based on each project’s cost structure and the share of capital, operating and financing costs borne by different project sponsors.</td>
</tr>
</tbody>
</table>
Microfin and ProCost Are Used to Provide Cost Comparisons Between Resources with Different Patterns of Annual Cost (i.e., cash flows) and Lifetimes

![Comparative Cash Flow and Levelized Cost](chart.png)

Requirements for Power Plan Advisory Committees

The **Northwest Power Act** requires the Council to insure widespread public involvement in the formulation of regional power policies

- Establish a voluntary scientific and statistical advisory committee (SSAC) to assist in the development and amendment of the power plan
- Ensure membership includes representatives of the Federal and various regional, State, local, and Indian Tribal Governments, consumer groups, and customers
Seven-for-Seven Power Plan Advisory Committees

- Conservation Resources Advisory Committee (CRAC)
- Demand Forecasting Advisory Committee (DFAC)
- Natural Gas Advisory Committee (NGAC)
- Generating Resources Advisory Committee (GRAC)
- Resource Adequacy Advisory Committee (RAAC)
- System Analysis Advisory Committee (SAAC)
- Resource Strategies Advisory Committee (RSAC)

Formation and Operation of Power Plan Advisory Committees

- Committees chartered for two years
- Committees report to the Executive Director
- Council staff usually chair & vice chair, though not required
- Members selected based on their technical expertise and experience.
  - Council solicits nominations for membership from regional stakeholders
  - Final appointments made by the Executive Director
- All meetings are open to the public
  - All notices, agendas, materials, minutes, membership lists, etc. are posted on each committee’s webpage
- Committees serve in advisory capacity only
  - No votes are taken
  - Role is to review information, vet assumptions and information and make recommendations to the Council.
- All advisory committees help develop action plan
Role of Council Members and Staff

- Council members are free to participate in all Advisory Committee meetings
- Staff
  - Prepare agenda and materials for the meetings
  - Facilitate meetings
  - Certify meeting minutes (required by law)
  - Report to the Executive Director and Council Members on all progress and recommendations

Advisory Committee that Also Assist in Plan Development

- Regional Technical Forum – Assist with review of conservation potential assessments
Sample of Issues On Which Advisory Committee Input Might Be Sought

- What should the Plan assume about the adoption of Emerging Technologies, such as solid-state lighting and solar photovoltaics (PV)?
- How should the Plan incorporate the 2020 provisions of the Energy Independence and Security Act’s (EISA) general service lighting requirements?
- What cost reductions and performance improvements should be assumed for new wind and solar photovoltaics generating resources?
- What should be the upper and lower bounds of natural gas prices from 2016 – 2025?

Next Time - Planning for Uncertainty

- **Resource Strategies** – actions and policies over which the decision maker *has control* that will affect the outcome of decisions

- **Futures** – circumstances over which the decision maker *has no control* that will affect the outcome of decisions

- **Scenarios** – Combinations of Resource Strategies and Futures used to “stress test” how well what we control performs in a world we don’t control
Questions?

Backup Slides
What’s in a Power Plan?
Illustrative Plan Table of Contents:

Executive Summary and Introduction
Chapter 1: Action Plan
Chapter 2: Resource Strategy
Chapter 3: Bonneville’s Obligations
Chapter 4: Analytical Inputs
  Section 1: Financial Assumptions
  Section 2: System Needs Assessment
  Section 3: Reserve and Reliability Assessment and Methods
  Section 4: Impact of Emerging Technologies on Loads and Resources
  Section 5: System Capacity and Flexibility Resources
  Section 6: Regional Adequacy Standards
  Section 7: Electricity Demand Forecast
  Section 8: Conservation Resource Supply Assumptions
  Section 9: Demand Response Supply Assumptions
  Section 10: Generating Resources and Energy Storage Technologies Supply Assumptions
Chapter 5: Developing a Resource Strategy (RPM)
Chapter 6: Coordinating with Regional Transmission Planning
Chapter 7: Environmental Methodology and Due Consideration for Environmental Quality
Chapter 8: Fish and Wildlife Program
Chapter 9: Model Conservation Standards and Surcharge Policy

Basic Requirements of the Northwest Electric Power Planning and Conservation Act of 1980

The Plan Shall Include:

- A demand forecast of at least twenty years
- A forecast of power (energy and capacity) resources required to meet forecast demand by resource priority type (e.g., conservation, renewable, etc.)
- An energy conservation program, including model conservation standards; and a methodology for calculating surcharges if recommended
- Regional reliability and reserve requirements, including recommended cost-effective methods of providing reserves
- Research and development recommendations;
- A methodology for determining quantifiable environmental costs and benefits
- A fish and wildlife program
Council’s Planning Process

- Longest running Integrated Resource Planning Process in US (and likely the world)
- Council has published six regional plans since 1983
- Council has no regulatory authority over utilities or state commissions*
- However, Council’s plans serve as a reference against which utility specific IRPs are reviewed

*Resource acquisitions by the Bonneville Power Administration (BPA), a federal power marketing agency, must be “consistent with the Plan”

GENESYS Inputs

<table>
<thead>
<tr>
<th>Into GENESYS</th>
<th>From</th>
<th>Comments</th>
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<tr>
<td>Electricity prices</td>
<td>AURORAxmp</td>
<td>For resource dispatch</td>
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<tr>
<td>Generating resources</td>
<td>Council’s Generating Resource Database</td>
<td>Existing and planned</td>
</tr>
<tr>
<td>Hourly loads</td>
<td>Short-term Load Model</td>
<td>Single operating year</td>
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<tr>
<td>Energy efficiency</td>
<td>Power Plan targets</td>
<td>Incorporated directly into the hourly loads</td>
</tr>
<tr>
<td>Firm contracts</td>
<td>BPA White Book</td>
<td>Into and out of region only</td>
</tr>
<tr>
<td>Hydro data (e.g. BiOp)</td>
<td>BPA hydro studies</td>
<td>Subtracted from loads</td>
</tr>
<tr>
<td>Hourly wind generation</td>
<td>Council's temperature correlated synthetic data</td>
<td>Based on the federal fleet, subtracted from load</td>
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### RPM Inputs

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<td>Frozen efficiency loads</td>
<td>Energy 2020 - Long-term Load Forecasting Model</td>
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<td>Energy efficiency</td>
<td>Council’s EE supply curves</td>
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<td>Monthly hydro generation</td>
<td>GENESYS</td>
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<tr>
<td>Hydro peak vs. Energy</td>
<td>TRAP model</td>
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<td>Annual load/resource</td>
<td>GENESYS</td>
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<td>Seasonal peak-hour</td>
<td>GENESYS</td>
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<tr>
<td>minimum balance</td>
<td>Adequacy check for energy</td>
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<tr>
<td>planning margin</td>
<td>Adequacy check for capacity (new for 7th plan)</td>
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### Generating Resource Cost

**6th Plan Generating Resource Cost Assumptions**

- **Emission (CO2) cost**
- **Transmission & Losses**
- **System Integration**
- **Plant costs**

<table>
<thead>
<tr>
<th>Levelized Lifecycle Cost (2006$/MWh)</th>
<th>Coal</th>
<th>Coal 2%</th>
<th>Molalla 2%</th>
<th>Ambraek 5%</th>
<th>Col Creek 35%</th>
<th>Col Creek 55%</th>
<th>Table Mountain 35%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>$0</td>
<td>$5</td>
<td>$10</td>
<td>$15</td>
<td>$20</td>
<td>$25</td>
<td>$30</td>
</tr>
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**Assumptions:**
- Transmission cost & losses to point of LSE wholesale delivery
- 2020 service - no federal investment or production tax credits
- Base load operation (CC - 85% CF, Nuclear 87.5% CF, SCPC 85%)  
- Medium NG and coal price forecast (6th Plan draft) 
- 6th Plan draft mean value CO2 cost (escalating, $8 in 2012 to $47 in 2029)
Sixth Plan Resource Portfolio*

*Expected Value Build Out. Actual build out schedule depends on future conditions