Northwest Power and Conservation Council

January 26, 2012

MEMORANDUM

TO: Power Committee

FROM: Massoud Jourabchi

SUBJECT: Role of wholesale electricity prices in Council planning

During the January 2012 Power Committee meeting, Council member Jim Yost asked about how wholesale electricity prices were forecast and used in the Council's planning. This presentation will provide background on this question. The presentation will provide an overview of the Council's planning methodology and will describe the main roles of wholesale electricity prices in the Council's planning. These include:

1. Estimation of future average retail prices in the Demand forecasting model;
2. Development of supply curves for conservation resources in the ProCost model;
3. Development of a resource plan in the Regional Portfolio Model; and
4. Valuation of generating resources and efficiency measures.

The role and level of detail of wholesale market prices is different in each of these uses.

The demand forecasting model uses average annual wholesale prices in the development of average annual retail costs of electricity. Annual wholesale prices at Mid-C are averaged then subtracted from the average annual retail rates for the same period to calculate a proxy for transmission and distribution charges. A similar approach is used to forecast retail prices for natural gas and oil.

The ProCost model develops conservation supply curves for use in the Regional Portfolio Model (RPM) and to help determine cost-effectiveness of conservation measures. The ProCost model compares the present value cost of conservation with the present value cost of electricity purchased in the wholesale market over the conservation measure's life. Because wholesale market prices vary based on the time of day as well as the season, the ProCost model uses the actual load shapes of each measure's savings so that the price of power purchases being avoided are consistent with the timing of the savings. Currently, ProCost aggregates hourly wholesale electricity prices and efficiency savings into four time bins for each month of the year. These time bins represent "high load" hours, "shoulder period" hours, and "off peak" hours during the week and "off peak" hours on weekends and holidays.

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Historically, this level of granularity was deemed sufficient to capture the range of relative price differences forecast to occur over the course of a year. However, due to the increased concern with regional capacity constraints (at least economically, if not physically) the ProCost model may be revised to capture hourly (i.e., 8,760 hours per year) conservation load shapes and market prices.

The Regional Portfolio Model uses wholesale electricity prices at Mid-C to help calculate the present value of total system cost. This model uses an average quarterly price forecast for high load hours and low load hours. However, it does not use a single price forecast but rather develops 750 different future paths for the market prices to recognize and reflect the uncertainty and volatility of these prices in the Power Plan.

Wholesale electricity price forecasts are the basis for valuing resources in the market. If a generating resource is being offered for sale, for example, its value depends on how often it would be dispatched and the difference between its cost and the wholesale market price of electricity when it is operating assessed over its future and discounted back to its present value. Similar value calculations can be made for efficiency measures. In many cases, other factors enter into the value equation, such as risk or environmental emissions.

In summary, the wholesale electricity price forecast is used at different levels of detail in different areas of the Council's analysis depending on what level of detail is needed to assess the value of resource choices accurately. In order to accommodate this variety of price aggregations, the Aurora model forecasts wholesale electricity prices on an hourly basis so they can be aggregated into the various levels of detail used in the Council's planning models and analysis.

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Role of Wholesale Electricity Prices in Council's Planning

February 7, 2012

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1

In This Presentation

- Role of various models in the plan
- Role of wholesale market prices in various models
- Level of detail of prices in each model

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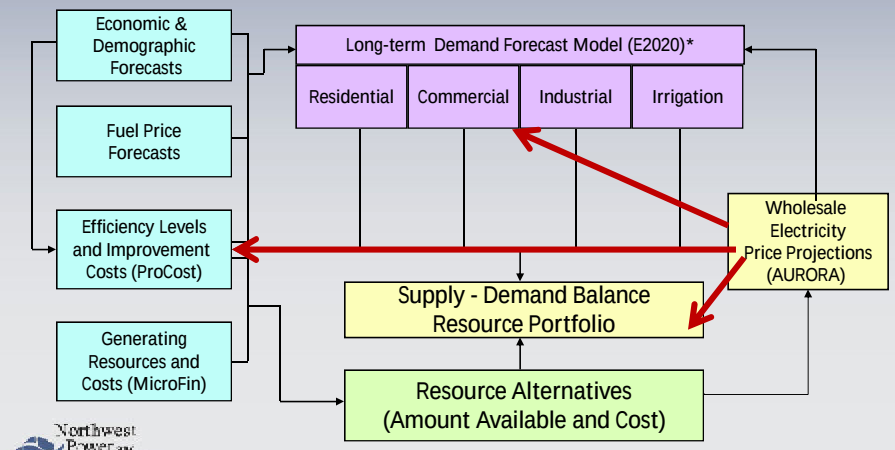
2

Council's Power Planning Process



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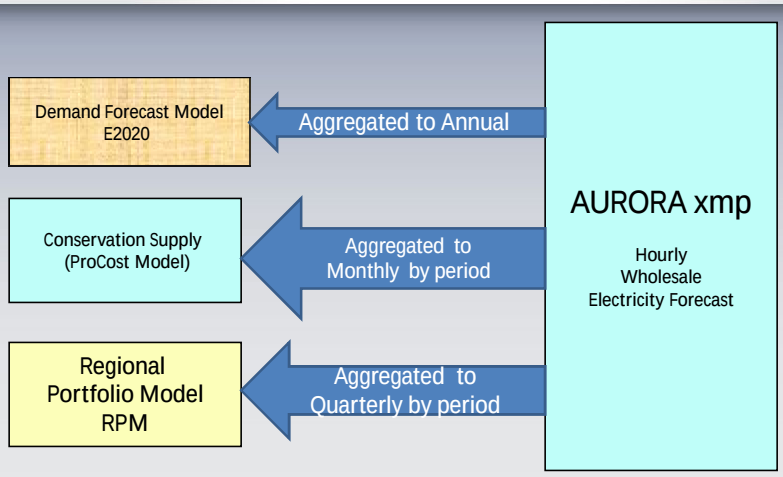
*- including demand for transportation in each sector

3

Main Applications of Wholesale Electricity Price Projections



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4

How The Demand Forecasting Model Uses Wholesale Prices

- The Demand forecasting system produces a load forecast used in the Plan
- Wholesale electricity prices are used to estimate average retail prices which, along with other fuel prices, are used in forecasting customer's fuel and efficiency choices
- Hourly price forecast at Mid-C is aggregated into annual values

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5

How ProCost Model Uses Market Prices?

- Conservation supply curves are used to estimate the quantity and cost of conservation resources for the Plan
- The Council's conservation cost-effectiveness analysis compares savings with forecast market prices *at the time the savings occur*
- Market prices are used in the conservation supply analysis to calculate the 10% Regional Act Credit and Model Conservation Standards cost-effectiveness, which by law requires testing from utility and consumer perspective.
- Hourly market prices are aggregated into monthly bin prices.

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6

Definition of Load Segment Hours — Time Bins Currently Used

Hour	Monday	Tuesday	Wednesd	Thursday	Friday	Saturday	Sunday	Holiday
1	3	3	3	3	3	4	4	4
2	3	3	3	3	3	4	4	4
3	3	3	3	3	3	4	4	4
4	3	3	3	3	3	4	4	4
5	2	2	2	2	2	2	2	4
6	2	2	2	2	2	2	2	3
7	2	2	2	2	2	2	2	3
8	2	2	2	2	2	2	2	3
9	1	1	1	1	1	2	2	2
10	1	1	1	1	1	2	2	2
11	1	1	1	1	1	2	2	2
12	1	1	1	1	1	2	2	2
13	1	1	1	1	1	2	2	2
14	1	1	1	1	1	2	2	2
15	1	1	1	1	1	2	2	2
16	1	1	1	1	1	2	2	2
17	1	1	1	1	1	2	2	2
18	1	1	1	1	1	2	2	2
19	2	2	2	2	2	2	2	3
20	2	2	2	2	2	2	2	3
21	2	2	2	2	2	2	2	3
22	2	2	2	2	2	2	2	4
23	3	3	3	3	3	4	4	4
24	3	3	3	3	3	4	4	4

Bins:

1) Weekday Peak Load Hours
2) Weekday Shoulder and Weekend Peak Hours
3) Weekday and Weekend Off-peak Hours
4) Weekend and Holiday

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7

How Market Prices Are Used in the Regional Portfolio Model

- The Regional Portfolio Model is used to assess cost and risk of alternative resource plans.
- The RPM uses market clearing prices at Mid C to value resources against market.
- The RPM does not use a single forecast, the base market price projections are varied to introduce uncertainty into the analysis, creating 750 alternative future paths for the prices.
- Hourly price projections for Mid-C market are averaged into quarterly bins which are divided into High and Low Load hours.
  - High Load Hours (Monday-Saturday hours 6 am t0 10 pm)*
  - Low Load Hours (all other hours)

- *- except NERC holidays

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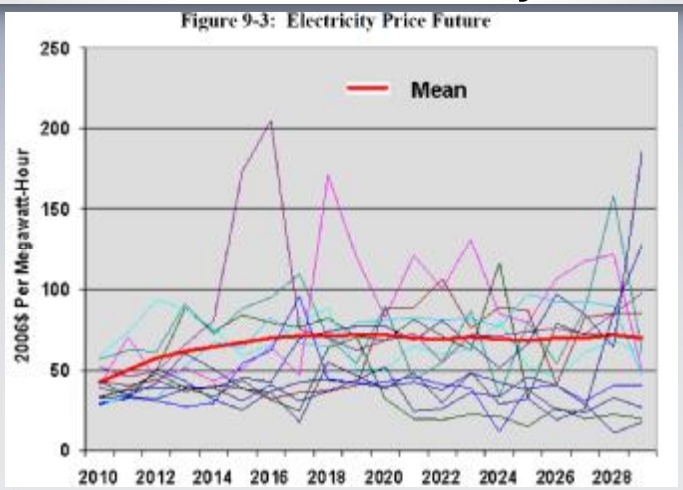
8

An Example of Alternative Future Paths Used by RPM



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9

Other Applications Of Wholesale Electricity Price Forecast

In addition to use in the Council's modeling applications, the wholesale price of electricity is also used for:

- Initial screening of future generation resources
- Estimating market value of hydro resources

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10

In Summary

- Primary use of the wholesale electricity price forecast is in support of modeling work.
- Currently, the Aurora model produces hourly price forecasts, that are then aggregated to annual, monthly or quarterly levels for different periods, depending on the needs of the various models the Council uses.
- To a lesser extent, market price forecasts are also used for preliminary screening of technologies and for valuing change in hydro output and other ad hoc studies.

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11