

**Bruce A. Measure**  
Chair  
Montana

**Rhonda Whiting**  
Montana

**W. Bill Booth**  
Idaho

**James A. Yost**  
Idaho



**Tom Karier**  
Washington

**Phil Rockefeller**  
Washington

**Bill Bradbury**  
Oregon

**Joan M. Dukes**  
Oregon

January 10, 2012

## MEMORANDUM

**TO:** Power Committee

**FROM:** Massoud Jourabchi

**SUBJECT:** Report on Action Item ANLYS-9: Development of the supply side of the demand forecasting system

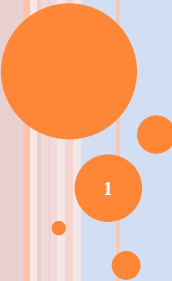
One of the action items of the Sixth Power Plan was Action Item ANLYS-9, which called for development of the supply side of the demand forecasting system. The goal of this action item is to enhance the Council's ability to evaluate the effects of various policy initiatives in a more cohesive manner and to streamline the analytical tools used in the Council's planning process.

We have prepared a progress report on this action item. We will discuss the reasons behind the integration of the supply and demand modules of the long-term forecasting system and the approach we used in our investigation. We will present an overview of the Council's planning methodology, including the role of wholesale price forecasts and how the supply module of the Energy2020 model can be integrated with the demand forecasting module allowing for a more streamlined modeling process. We will discuss the results of the comparison between price forecasts from the current modeling tool, Aurora, and the Energy2020 model.

Over the next few months, we intend to produce a whitepaper describing the results of our investigation. We plan to make this paper available to outside parties for feedback.

Attachment

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**REPORT ON ACTION ITEM ANLYS-9.  
DEVELOPMENT OF THE SUPPLY SIDE  
OF THE DEMAND FORECASTING  
SYSTEM**  
( EXPLORING THE SUPPLY SIDE OF ENERGY 2020)  
January 10-11 2012  
Portland Oregon  
Massoud Jourabchi

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**IN THIS PRESENTATION**

- ⌄ **Why we want to integrate the supply and demand side of the long-term forecasting tool?**
- ⌄ **Progress report on our investigation**
- ⌄ **Next steps**

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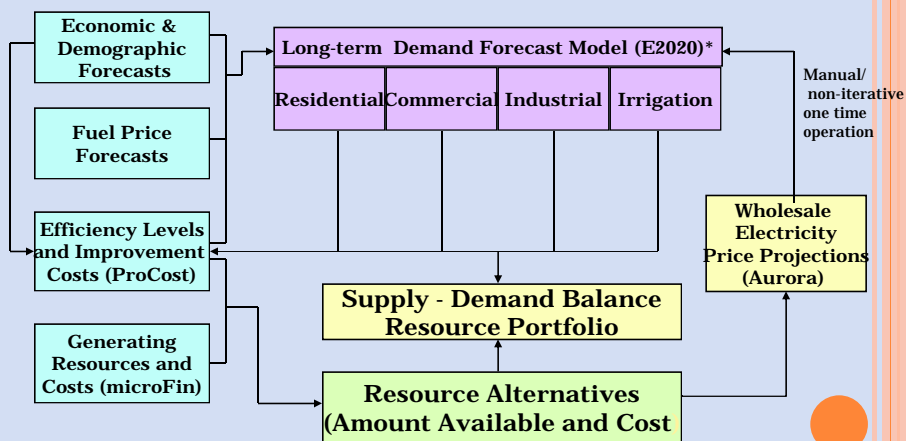
## WHY ARE WE DOING THIS?

- ⌘ Integration of the supply and demand modules allows for more efficient modeling of supply and demand for electricity in the region.
- ⌘ Allows for a more iterative process of incorporating the impact of a change in market prices on demand.
- ⌘ Increases the efficiency of Council staff resources committed to operating two different models.
- ⌘ Potential to reduce staff requirements for maintaining and operating different models
- ⌘ Facilitate more integrated policy evaluations.

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## CURRENT STRUCTURE OF COUNCIL'S POWER PLANNING PROCESS



\* - including demand for transportation in each sector

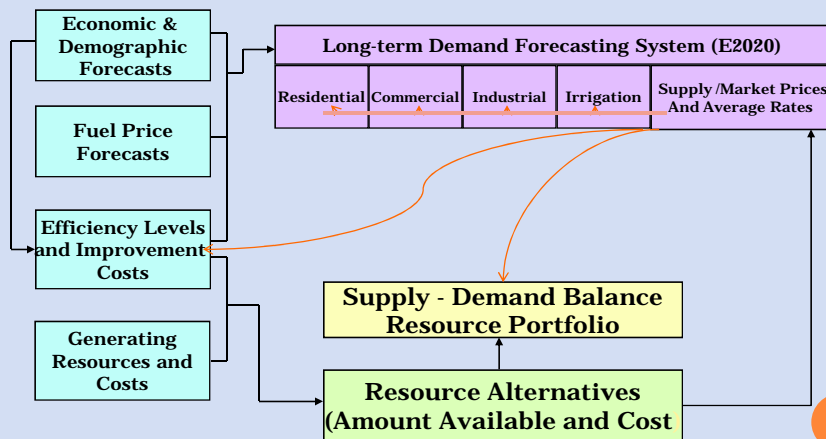
## MODELS WE CURRENTLY USE

- ⌘ Energy 2020 model to forecast demand for electricity in the region;
- ⌘ Aurora model to forecast wholesale price of electricity at Mid C
- ⌘ Regional Portfolio Model to select least risk, minimum cost resource additions.
- ⌘ Genesys model to assess adequacy of regional resources, with focus on hydro resources.
- ⌘ ProCost model to assess the conservation resource cost and potential.
- ⌘ Microfin model to calculate the levelized cost of generating resources

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## POSSIBLE REVISION TO COUNCIL'S POWER PLANNING PROCESS- INTEGRATING SUPPLY AND DEMAND MODULES



Orange lines includes flow of market price projections

## HOW ELECTRICITY MARKET PRICE PROJECTIONS ARE USED?

- ⌘ Valuing conservation resources
- ⌘ Valuing other resources in RPM model
- ⌘ Estimating delivered price of electricity, used in demand forecasting model.
- ⌘ Also Used by outside parties

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## ALTERNATIVE MARKET PRICE MODELS- AURORA

- ⌘ Aurora is a proprietary fundamentals production costing model
  - Principal applications include:
    - ⌘ Long & short-term electricity price forecasting
    - ⌘ Integrated Resource Plan development
    - ⌘ Transmission planning
    - ⌘ Power plant economic assessments
    - ⌘ CO2 and other emissions forecasting
- ⌘ Among users of the Aurora model we find
  - ⌘ Bonneville Power Administration
  - ⌘ Portland General Electric
  - ⌘ Puget Sound Energy, Avista, Idaho Power, Tacoma Public Utilities, EWEB, TransAlta, TransCanada, Iberdrola, Grant Co. PUD, Seattle City Light, Snohomish Co. PUD,
  - ⌘ Others outside region

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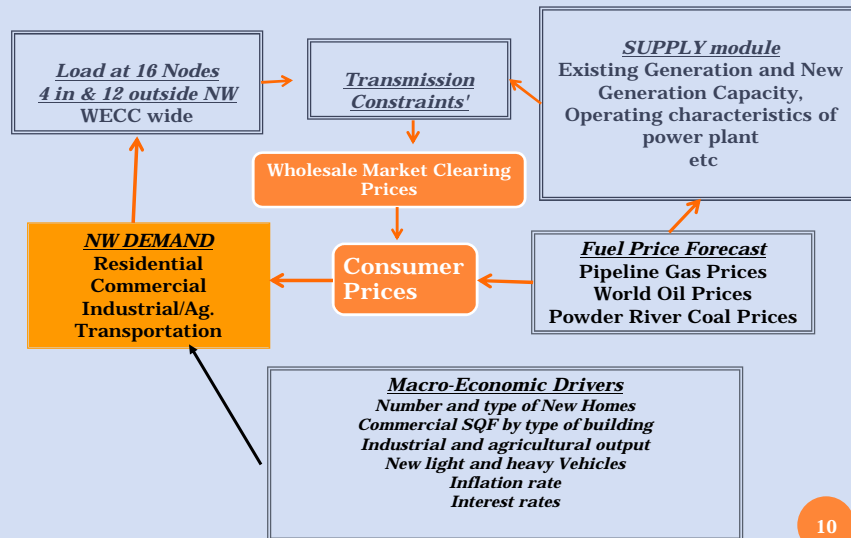
## ALTERNATIVE MARKET PRICE MODELS- ENERGY 2020 (E2020)

- ⌘ The Energy 2020 Model is an integrated policy analysis model used by Council in developing a long-term demand forecast.
  - Principal applications include:
    - ⌘ Demand Forecasting
    - ⌘ Long-term electricity price forecasting
    - ⌘ IRP development
    - ⌘ Transmission planning
    - ⌘ Power plant economic assessments
    - ⌘ CO2 and other emissions forecasting
- ⌘ It has been used extensively for evaluation of various state and national energy policies.
- ⌘ Among users of Energy 2020 we find:
  - ⌘ National Energy Board of Canada , Western Climate Initiative
  - ⌘ Bonneville Power Administration, California Air Resources Board
  - ⌘ Environment Canada, New England Governor's Conference
  - ⌘ States of Massachusetts, Vermont, Hawaii, Michigan, Illinois, and Wisconsin
  - ⌘ Westar Energy (Western Resources), Southern Companies
  - ⌘ Saskatchewan Energy and Mines

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## ENERGY 2020 RELATIONSHIPS



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**TO FORECAST MARKET PRICES THESE MODELS  
USE SIMILAR METHODS WITH MINOR DIFFERENCES**

- ⌘ **Both are production costing models**
- ⌘ **Both optimize resource dispatch WECC wide, subject to load and transmission constraints.**
  - Aurora can use a chronological (hourly) dispatch
  - E2020 model dispatch of units is non-chronological
- ⌘ **Review of the two methods has not identified significantly different results for most of the Council's applications.**

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**PROGRESS REPORT ON OUR INVESTIGATION**

- ⌘ **E2020 model code was obtained from BPA and modified to meet Council's needs.**
- ⌘ **Inputs to the E2020 model and Aurora model were synchronized.**
  - Fuel prices, loads, transmission topology, existing thermal, hydro, and wind generation were matched.
- ⌘ **The Mid-C price forecast from the two models were compared.**
- ⌘ **Both models were validated with 2008-2010 observed prices at Mid-C.**
- ⌘ **Results of E2020 forecast was run through the RPM model.**
- ⌘ **Estimates of future CO2 emissions were compared.**
- ⌘ **Supporting databases were updated.**

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### PROGRESS REPORT ON OUR INVESTIGATION

- ⦿ E2020 model code was obtained from BPA and modified to meet Council’s needs.
- ⦿ Inputs to the E2020 model and Aurora model were synchronized.
  - Supporting databases were updated.
  - Each model was set up with common load-resource zone and transmission topology, and assumptions regarding existing thermal plants.
  - Historical (2008 –10) and forecast fuel prices, loads and wind generation were input to the two models.
  - Hydro dispatch from AURORA was input to E2020
- ⦿ The Mid-C price forecast from the two models were compared.
- ⦿ Both models were validated with 2008-2010 observed prices at Mid-C.
- ⦿ Results of E2020 forecast was run through the RPM model.
- ⦿ Estimates of future CO2 emissions were compared.

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IF THE TWO MODELS ARE PROVIDED WITH THE SAME INPUTS, THEY PRODUCE COMPARABLE FORECAST OF PRICES  
 ANNUAL PRICES AT MID-C (NOMINAL DOLLARS PER MWH)



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**OTHER COMPARISONS SHOW THAT THE TWO MODEL'S RESULTS ARE COMPARABLE.**

- ⊕ **Forecasts of Mid-C prices were compared**
  - Average annual prices were close.
  - High Load Hour prices were close.
  - Low load hours prices were higher in E2020 model
- ⊕ **E2020 forecast prices for 2008-2030 were used in RPM model. No significant change in conservation targets were found.** (this work is being refined).
- ⊕ **CO2 Emissions from the two models were compared and found to produce similar levels of CO2** (this work is being refined).

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**CO2 EMISSIONS LEVELS (PRELIMINARY)**



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Aurora run shown here was used in development of 6<sup>th</sup> plan

## VALIDATING MODELS

(COMPARISON OF MODEL RESULTS AND OBSERVED PRICES)

- ❖ As a validity test on the models, both E2020 and Aurora models were tested against actual monthly market prices at Mid-C for the period 2008-2010.
- ❖ Using this process we were able to refine our assumptions about plant operations.
- ❖ The forecast of future prices are improved because of this validation to actual conditions.
- ❖ Although we do not expect an exact match to observed prices, the models' estimates were close to observed market prices, except for low load periods and especially for June period.
- ❖ The reasons for differences are being investigated

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### COMPARISON OF MID-C ACTUAL AND MODELED PRICES (2009-2010) WORK-IN-PROGRESS



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## NEXT STEPS

- ⌄ **Preparing a white paper on our investigation of options for integrating supply and demand modules in our analytics. Seeking input from interested parties in the region**
- ⌄ **Presenting our findings to outside parties and advisory committees such as PNUCC, System Analysis Advisory Committee.**
- ⌄ **Over the next month or two we will continue refinement to both models inputs, and after the discussions with advisory committees we will decide whether or not E2020 is a suitable alternative to Aurora model.**
- ⌄ **We will also evaluate options for maintaining the existing power plant database.**

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## CONSIDERATIONS

- ⌄ **Much of the effort of using a fundamentals model is maintaining the input data bases. Data base management will continue regardless of which models are used.**
- ⌄ **AURORA is supplied with a WECC default data base. The Council uses some, but not all the information of this data base.**
- ⌄ **Bonneville and other utilities in the Northwest use AURORA for price forecasting and resource planning. The Council receives requests to share its data and to discuss results with other regional users.**
- ⌄ **E2020 uses open-source code, allowing the model to be customized or refined, and facilitating understanding of the model's operation.**
- ⌄ **AURORA's code is proprietary and while user input is sought by the vendor for improving the model, improvements are subject to competing requests and available vendor staff.**
- ⌄ **AURORA has a professional user interface and sensitivity studies can be quickly set up and run. However, base case development can be very time-consuming.**
- ⌄ **Because AURORA is a proprietary model an annual licensing fee is required**
- ⌄ **AURORA uses a 12-month structure whereas the BPA/Council version of E2020 uses a 14-hydrologic period structure similar to GENESYS.**

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## SUMMARY

- ⌘ As part of the 6<sup>th</sup> Power Plan Action Items, the mid-plan review, and ongoing refinement of our analytics, we have been investigating options for forecasting the wholesale price of electricity.
- ⌘ One option is replacing our current model for projecting electricity prices with an integrated supply and demand forecasting system.
- ⌘ This could improve our analytics and enhance our policy analysis capabilities.
- ⌘ As a byproduct of our investigations, regardless of which model is selected, the analytical tools for forecasting market clearing price projections have been enhanced greatly.

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Questions?

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