Northwest **Power** and **Conservation** Council

January 6, 2015

MEMORANDUM

TO: **Power Committee members**

FROM: **Ben Kujala**

SUBJECT: **RPM Update and Discussion on the Impact of Model Elements**

BACKGROUND:

Presenter: Ben Kujala

Summary: Since the last Council meeting, the second phase of the project was delivered on schedule on December 19th.

The second phase primarily incorporated the logic to create a set of futures (750 futures were used in the 6th Plan). Staff is now able to begin testing draft 7th plan data in the new model.

Through the process of testing and assisting in the development of the new model staff is continuing identify and discuss key elements of the model. Staff will continue the discussion from the last Power Committee meeting with an emphasis on elements that may need to be changed for scenario analysis.

Relevance: The Regional Portfolio Model will be used to provide analytics for the Resource Strategy in the Seventh Power Plan.

Workplan: 1.E. Redevelopment of Regional Portfolio Model

Background: Navigant is redeveloping the Regional Portfolio Model for the Seventh Power Plan. The project is scheduled to be completed in three phases. The first phase was completed before the October 1st deadline, the

second phase was completed on the December 19th deadline and the third phase is scheduled to be delivered to the Council by February 12th with Council acceptance and signoff scheduled for March 13th. Council staff is supported on this project by contractors Doug Logan and Michael Schilmoeller.

More Info: Summary information and updates are available at http://www.nwcouncil.org/energy/rpm/home/.

Northwest **Power** and **Conservation** Council

January 6, 2015

MEMORANDUM

TO: **Council members**

FROM: **Tom Eckman and Ben Kujala**

SUBJECT: **Major Regional Portfolio Model (RPM) Inputs and Drivers**

BACKGROUND:

Presenter: Tom Eckman and Ben Kujala

Summary: Staff will present an assessment of the RPM input assumptions and internal decision logic that most significantly affect results. Since the RPM redevelopment is not scheduled for completion until mid-February, this is a preliminary assessment based on staffs' current understanding of the re-developed model and the use of the original RPM.

Relevance: The Council's analysis benefits from transparency. Clearing identifying those RPM input assumptions/data and internal model logic that most significantly influences the model's results enhances this transparency. Moreover, knowing which inputs "really matter" will permit both the Council and stakeholders to better focus their policy discussions and deliberations.

Workplan: 1.D. Prepare for Seventh Power Plan and maintain analytical capability.
Prepare scenarios for analysis.

Background: The Council's RPM is used to assess the cost and risks of alternative resource strategies across a range of potential future conditions. Like all computer simulation models, the RPM requires hundreds of inputs and operates using user specified decision logic. Because the RPM was

designed specifically to test resource strategies against a range of futures and policies its results reflect the data inputs and assumptions consistent with those policies and futures.

More Info: See Attachment Matrix of RPM Input Assumptions and Decision Logic

RPM Input and Drivers and Their Impact on Results

January 13, 2015

Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN

Presentation Purpose

This presentation is intended to:

- Identify data, inputs, logic or parameters that are required to create an RPM scenario for analysis; and
- Continue the Discussion from the December P4 meeting about those RPM inputs that most significantly impact results;
- Identify data, inputs, logic or parameters that should be subject to Council discussion

This presentation is not intended to:

- Request Council Member decisions on the inputs/parameters for the 7th Plan;
- Represent an exhaustive list of everything needed to build a scenario in the RPM; or
- Be a final assessment of the RPM inputs "that matter most."

Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN

Challenges for Building RPM Scenarios

- The RPM has hundreds or possibly thousands of input assumptions and parameters.
- ***Most*** of these inputs are based on or estimated from historical observations, e.g., forced outage rates, natural gas price volatility, correlation between wholesale electricity prices and natural gas prices, hyrdo-system water conditions, etc.
- ***Some*** inputs are based on expert judgment and policy assumptions, e.g., the cost of curtailment, future carbon cost/regulation, share of RPS met with actual resources (not RECs), etc.

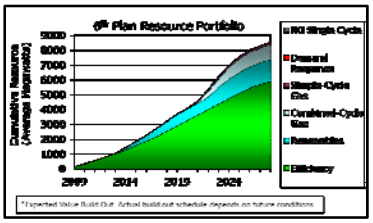
What Are Policy-Based Drivers?

- Policy-based drivers are inputs, logic or parameters that
  - Reflect policy goals (e.g., reduce carbon emissions, minimize cost, minimize risk, build renewable resources, etc.)
  - Involve expert judgment/policy interpretation
  - Are not derived from actual data or other Council models (e.g., GENESYS, AURORA)
  - Typically vary across RPM scenarios

Policy-Based Drivers Are Found In Both Resource Strategies and Futures

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



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- **Load Uncertainty**
- **Resource Uncertainty**
  - **Output**
  - **Cost**
  - **Construction Lead Times**
- **Wholesale Electricity Market Price Uncertainty**

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Scenarios – Combinations of *Resource Strategies* and *Futures* used to "stress test" how well what we control performs in a world we don't control

Sample Policy-Based Drivers

Input Assumption	RPM Element	Implication
Natural Price Forecast Range	Creates "futures" used to test resource strategies	The larger the range of future gas prices considered the greater the risk associated with reliance on gas-fired generation
Limits on regional electricity imports/exports	Resource Strategy Assumption that determines need for in-region resource development	The larger import limits assumed the less need there is for in-region resource development and the greater the risk of market price exposures
Cost of curtailment	Creates "futures" used to test resource strategies	Directly affects cost and risk of under/over building

And, (generally)
"set and forget" the fine tuning dials

Scenarios Focus on the "Big Knobs"

"Big Knob" Data Inputs

- Electricity/Natural Gas Price Forecast Range
- Load Forecast Range
- Hydro Generation (80 Water Years)
- Conservation Resource Characteristics
- Demand Response Resource Characteristics
- New Generating Resource Characteristics, e.g. Heat Rate, Capital Cost, Variable Operation and Maintenance Cost, Planning Cost, etc.
- Existing Resource Characteristics, Including Regulatory Compliance Costs and Announced Closures

"Big Knob" Model Resource Strategy Constraints

- Limits on Imports/Exports from the region
- Upper/Lower Bound Wholesale Electricity Prices
- Carbon Price/Emission Limits
- Energy and Capacity Reliability (i.e., Planning Reserve) Requirements (from GENESYS)
- RPS Target Achievement Rate (i.e., share of RPS actually achieved with resources)
- Limits on Conservation Acquisition
  - Maximum Annual Conservation
  - Maximum Conservation Available Over 20 years
  - Maximum Change Year-over-Year Conservation Acquisitions (i.e., Ramp Rates)

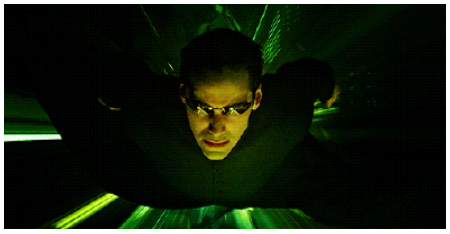
"Big Knob" Model Logic

- Energy/Capacity Adequacy Resource Construction/Acquisition Decision Rules
- RPS Resource Construction/Acquisition Decision Rules
- Conservation Supply Scaling, i.e. how much does a change in load forecast increase/decrease the conservation availability

Scenario Development

- Each scenario/sensitivity study proposed for testing will require delineation of all "major" data, logic and strategy constraints
- Some scenarios/sensitivity studies proposed for testing will require delineation of some "medium" impact data, logic and strategy constraints
- Few, if any scenarios/sensitivity studies proposed for testing will require changing "low" impact data, logic and strategy constraints

Now Let's Enter



The Matrix

RPM Input Matrix

Element	Source	Resource Strategy OR Future?	Rule Summary Description	Details	Level of Impact on RPM Results	Impact Description	Notes
Markets	RPM Policy Input OR Derived by RPM	Resource Strategy	Limits on Electricity Imports/Exports	How much out of region electricity can be imported and how much regional electricity can be exported	High	Import and export limits impact when the equilibrium electricity price diverges from the external electricity price. Assuming greater reliance on imports limits regional resource development.	Limits on electricity imports/exports are used in both GENESYS and RPM. RPM may treat this as a decision variable (i.e., input that varies by resource strategy tested). Upper limit set by transmission constraints.
Conservation	RPM Policy Input	Resource Strategy	Annual Limits on Conservation Resource Acquisition	How much conservation can be acquired in a year	High	Limits constrain the pace of conservation acquisition, especially over the period typically covered by the Plan's Action Plan.	Annual limits for retrofit conservation resources are set by institutional constraints. Annual limits on lost-opportunity conservation resources set by stock turnover rate.
Conservation	RPM Policy Input	Resource Strategy	Annual Limits on Change in Conservation Resource Acquisitions	How much conservation can be accelerated/decelerated	High	Limits constrain the pace of conservation acquisition, especially over the period typically covered by the Plan's Action Plan.	Set by assumed institutional constraints

Markets	RPM Policy Input	Resource Strategy	Upper Bound (Backstop) Electricity Price	Cost of curtailment.	High	Curtailment cost assumptions directly effect the cost and risk of a resource strategy. Higher curtailment cost produce resource strategies with more resource development than lower curtailment cost assumptions	Curtailment costs are sometimes considered equivalent to "capacity payments" in organized markets with forward capacity markets
Generation	RPM Policy Input	Resource Strategy	RPS Target Achievement Rate	This factor sets the fraction of state RPS obligations that are assumed to be achieved by the region	High	This will impact how much "above market" RPS generation is added. Higher achievement rates produce greater RPS resource development, but only for renewable resources that are not determined to be cost-effective.	
Conservation	RPM Policy Input	Resource Strategy	Resource Acquisition Decision Criteria	What are the economic criteria used to determine whether additional conservation resources are acquired	High	This impacts the timing and amount of conservation acquired	
Generation	RPM Policy Input	Resource Strategy	Resource Acquisition Decision Criteria	What are the economic criteria used to determine whether additional generating resources proceed with construction	High	This impacts the timing and amount of generation constructed	
Conservation and Generation	RPM Data Input	Resource Strategy	Planning Reserves	What are the criterion used to determine whether additional conservation, demand response or generating resources are acquired to maintain system reliability	High	This impacts the timing and amount of conservation generating resources and demand response measures constructed to maintain system reliability	Obtained from GENESYS, but may require iteration between RPM and GENESYS

Load Forecast	RPM Data Input	Futures	Load Forecast Range	Establishes lower and upper bounds for load growth (pre-conservation)	High	The larger the range of load forecast over which resource strategies are tested, the more robust the results. However, large ranges increase volatility, hence please greater value on risk mitigation.	
Markets	RPM Data Input	Futures	Wholesale Market Price Forecast Range	Establishes lower and upper bounds for wholesale electricity prices	High	The larger the range of wholesale electricity prices forecast over which resource strategies are tested, the more robust the results. However, large ranges increase volatility, hence please greater value on risk mitigation.	
Markets	RPM Data Input	Futures	Natural Gas Market Price Range	Establishes lower and upper bounds for wholesale natural prices	High	The larger the range of wholesale electricity prices forecast over which resource strategies are tested, the more robust the results. However, large ranges increase volatility, hence please greater value on risk mitigation.	
Generation	RPM Data Input	Resource Strategy	New Generating Resource Characteristics	Determines the acquisition cost, dispatch cost, forced outage rate and . of new generating resources	High		

Conservation	RPM Data Input	Futures	Conservation Resource Characteristics/Supply Curve	Determines the acquisition cost and load shape of energy efficiency resources	High	Conservation defers the need for new generation additions for both energy and capacity. Hence, if more of it available, the lower both the cost and risk of all resource strategies.	The "shape" of the conservation supply curve (how much is available at varying prices) significantly affects its economic and risk mitigation benefits.
Markets	RPM Data Input	Futures	Carbon Price/Emissions Limits	Sets either the market clearing price of carbon emissions or the upper limit on emissions.	High	Constraints on carbon emissions from existing generation may limit their availability and/or dispatch cost.	Constraining carbon emissions through pricing policies (e.g., carbon taxes, cap and trade) will have a different impact on resource strategies than planning physical limits on emission levels. Carbon constrained scenarios can be defined using either or both policy mechanisms.
Conservation	RPM Data Input	Resource Strategy	Lost Opportunity Conservation Availability Load Growth Scalar	This factor scales lost opportunity conservation potential with the load growth pattern occurring in each future tested.	Medium	Lost opportunity conservation potential is a function of economic growth. The more new homes and commercial buildings that are constructed in the region the larger the conservation potential.	Scalar will be determined based estimates of lost-opportunity conservation potential across high, medium and low load forecast scenarios.
Conservation and Generation	RPM Policy Input	Resource Strategy	Electricity Price Smoothing Time	How much price history within a future should be used to evaluate cost-effectiveness for both conservation and generation	Medium	This impacts the price used for deciding when to acquire a resource. Longer smoothing periods reduces price volatility that might otherwise produce false option/build decisions.	

Generation	RPM Data Input	Resource Strategy	Existing Generating Resource Characteristics	Determines the dispatch cost, forced outage rate and . of existing generating resources	Medium	Changes in the dispatch cost and/or availability of existing resources affects the need for and timing of new resource acquisitions	Regulatory compliance cost may alter dispatch cost and/or availability of existing generators under specific sensitivity studies
Demand Response	RPM Data Input	Futures	Demand Response Resource Characteristics/Supply Curve	Determines the acquisition cost and load (capacity) impact of demand response resources	Medium	Demand response resources may displace need for addition generation capacity to satisfy regional adequacy standards	
Generation	RPM Policy Input	Resource Strategy	Maximum Optioned Capacity per Period	The maximum amount of capacity that can be added within a period	Low	Limiting number of potential resource strategies tested reduces model run time, since resource strategies with unrealistic resource development schedules are excluded from testing.	
Generation	RPM Policy Input	Resource Strategy	Maximum Optioned Capacity Total	The maximum capacity that can be optioned over the planning horizon	Low	Limiting number of potential resource strategies tested reduces model run time, since resource strategies with unrealistic resource development schedules are excluded from testing.	
Generation	RPM Policy Input	Resource Strategy	Resource Option Acquisition Decision Criteria	What are the criteria used to determine whether additional generating resources are optioned	Low	This impacts the timing and amount of generation optioned	
Markets	RPM Policy Input	Resource Strategy	Lower Bound Electricity Price	Cost of spill	Low	Cost of spill may move heavily oversupplied resource strategies further from the efficient frontier	Extra-regional development of renewable resources may produced extended periods of West Coast market "oversupply." May require specific sensitivity study to assess impact. EIM/SCED may reduce frequency/duration of oversupply.

Generation	RPM Policy Input	Resource Strategy	Upper Bound for Resource Additions	Limits how many plants can be built over the planning horizon	Low	Limiting number of potential resource strategies tested reduces model run time, since resource strategies with unrealistic resource development schedules are excluded from testing.	
Conservation	RPM Policy Input	Resource Strategy	Conservation Acquisition Cost Range	Limits the range of values that can be tested to determine the maximum acquisition cost for Lost Opportunity and Discretionary Conservation resources	Low	This sets the range of cost over wholesale electricity market prices the optimizer should explores. Larger ranges increase model run time, but only change results if upper bound is too limiting.	
Generation	RPM Policy Input	Resource Strategy	Resource Addition Periods	Establishes the frequency at which resource addition decisions are considered by the model	Low	This term set the frequency (quarterly, annually, bi-annually) at which the model considers acquiring new resources. The greater the frequency the slower the model run time.	
Generation	RPM Data Input	Futures	Hydro-System Output (80 years)	Establishes hydro-system output	Low	Impacts the compatibility of new generation with existing system.	Variations in hydro-system output through may be modeled to reflect changes in the CRT and climate change scenarios