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

February 3, 2015

MEMORANDUM

TO: **Council members**

FROM: **Tom Eckman and Ben Kujala**

SUBJECT: **Proposed Standard Scenario Results Comparison Metrics**

BACKGROUND:

Presenter: Tom Eckman and Ben Kujala

Summary: Staff will present a proposed set of standardized metrics that will be generated for each scenario tested in the Regional Portfolio Model (RPM). It is anticipated that the results of the RPM, in addition to being presented to the Council, will be made available to regional stakeholders via the web. To facilitate comparison of results across scenarios, staff is proposing that a "standard" set of RPM outputs be made available in consistent format (i.e., graphic and/or tabular).

Relevance: Interpretation of the results of the RPM's scenario analysis generally requires comparison of not only of the most successful resource strategies for a specific scenario, but also comparisons of results across scenarios. Identifying the primary factors or "metrics" that will be used to compare RPM results will allow staff to build the capability to automate the generation these outputs for each model run.

Workplan: 1.D. Development of the Seventh Power Plan

Background: The Council uses the results of the RPM scenario analyses to test how alternative resource strategies perform under a wide range of future conditions. While a resource strategy's *cost* and *risk* are the primary determinants used by the RPM to select the most successful strategies,

these are not the only metrics of interest. For example, in both the Fifth and Sixth Plan's Council members and stakeholders were also interested in comparing alternative resource strategies based on their level of conservation development, carbon emissions, average revenue requirements and resource mixes. Staff, anticipating that these and other metrics will also be of interest during the development of the Seventh Plan, is proposing to generate a standard set of RPM outputs for each scenario.

More Info: See Table 1 below.

Table 1 - DRAFT Potential Standard Metrics to Be Reported for Scenario Comparison

Potential Metrics[1]	Proposed Standard Output Units and Format
Net Present Value (NPV) System Cost	Billions 2012$, Provide Average and Graph of Distribution Across All Futures by Deciles
Normalized NPV System Cost	Billions 2012$/MWa, Provide Average and Graph of Distribution Across All Futures by Deciles
NPV System Risk (TailVAR^{90})	Billions 2012$, Provide Average and Graph of Distribution Across All Futures by Deciles
Normalized NPV System Risk(TailVAR^{90})	Billions 2012$/MWa, Provide Average and Graph of Distribution Across All Futures by Deciles
Resource Mix by Fuel/Resource Type	MWa in 2020, 2025, 2030 & 2035 and Graph of Distribution Across All Futures by Deciles
Energy Efficiency	"
Hydro	"
Natural Gas	"
Coal	"
Wind	"
Utility Scale Solar PV	"
Distributed Solar PV	"
Other Renewable	"
Market Purchases	"
Resources Acquired to Satisfy Adequacy Standard	MW of Capacity by Resource Type & Year Across All Futures by Deciles
Resources Acquired Based on Economics	MW of Capacity by Resource Type & Year Across All Futures by Deciles
Average Monthly Bill	2012$/Month Across All Futures by Deciles
Average Revenue/kWh	2012$/kWh Across All Futures by Deciles
GHG Emissions	CO_2 MMTE (Should this include methane?) Across All Futures by Deciles

[1] These metrics would be reported for the "least cost" and "least risk" resource strategies for each scenario tested. In addition, results for specific resource strategies that may or may not satisfy the RPM's "least risk for the lowest cost" optimization objective can be compared.

Scenarios Proposed for Testing

And Potential Standard Metrics for Their Comparison

February 10, 2015

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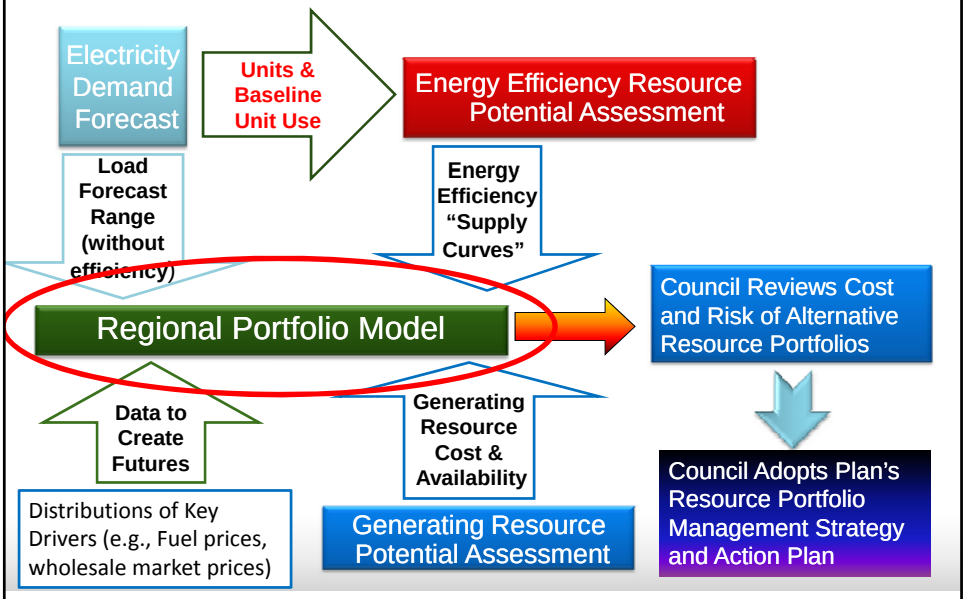
SEVENTH NORTHWEST POWER PLAN

Where Are We In The Plan Development Process?



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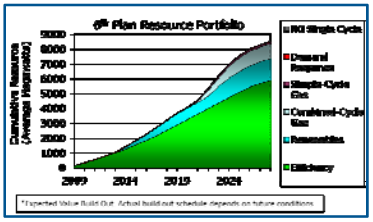
Scenarios Are Created by Combining Resource Strategies and Futures

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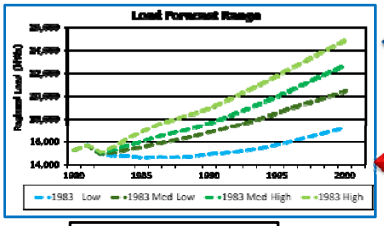
Scenarios – Combinations of *Resource Strategies* and *Futures* used to "stress test" how well what we control performs in a world we don't control

How Scenarios Test The Major Sources of Uncertainty

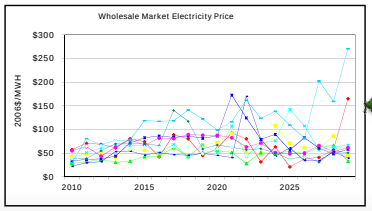


Tested Using A Range of Futures

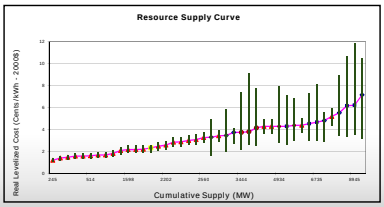
Tested by Alternative Resource Strategies Across A Range of Futures

Load Uncertainty

Resource Uncertainty
- Cost (Capital, Fuel and O&M, Regulatory)
- Output (Heat & forced outage rates)
- Construction Lead Times



Tested Using A Range of Futures



Wholesale Market Price Uncertainty

Proposed Scenarios Were Designed By Varying "Stresses" and "Constraints"

- Some scenario's subject potential resources strategies to futures that impose one or more <u>*stresses*</u>. *Examples:*
  - *Uncertain GHG emissions limits or costs*
  - *Unanticipated Loss of major resource(s)*
  - *Climate change impacts on loads and hydro-system output*
- Some scenario's <u>*constrain*</u> potential resources strategies across <u>*all*</u> futures: *Examples:*
  - *GHG emissions limits or costs*
  - *Maximum pace of conservation development*
  - *Fixed retirement schedule for existing coal generation*
  - *Increased reliance on variable resources across the PNW/CA*
  - *Availability of emerging technology (generation, storage and EE)*
- Some scenarios place *no limits on the uncertainty* surrounding future conditions or on potential resource strategies?

Proposed Scenarios Were Selected by Considering . . .

- What insight/information do we expect to get from this scenario?
  - Resource strategies that are "robust" across range of future conditions
  - Need for near term resource development actions (EE and generation)
- What insights/information might be gained by comparing the results of this scenario with those of other scenarios? Examples:
  - Cost of risk mitigation reduction
  - Cost of carbon emission reduction compared to estimated societal cost of damage
  - Impact of carbon cost/emissions constraints on energy efficiency and/or renewable resource developments
  - Potential value of storage, etc.
- What insights/information might be gained by comparing the *least risk* and/or *least cost* resource strategies under this scenario?
  - With resource strategies that have equivalent *cost* but higher *risk*?
  - With resource strategies that have equivalent *risk* but higher *cost*?

Scenario Number	Scenario Name	Scenario Description	Key Stress Factors /Constraints Tested
1A	**Existing Policy without Uncertainty**, w/o GHG reduction risk	Existing RPS, state and federal environmental regulations, including MATS and haze, CA and BC carbon costs, state carbon limits on new generation. Average value across all futures for all major sources of uncertainty.	Known generation fleet retirements and regulatory compliance costs. Are RPM results similar to Aurora "build out" under comparable assumptions?
1B	**Existing Policy with Uncertainty**, w/o GHG reduction risk	Existing RPS, state and federal environmental regulations, including MATS and haze, CA and BC carbon costs, state carbon limits on new generation. Distribution of values for all major sources of uncertainty across all futures. No carbon regulation or cost risk.	Cost and Value of uncertainty risk mitigation with known generation fleet retirements and regulatory compliance costs Delineated by 1B – 1A

Scenario Number	Scenario Name	Scenario Description	Key Stress Factors /Constraints Tested
2A	**Existing Policy *with* Uncertainty and *with certain* GHG reduction risk/target**. Proposed Policy Target = Clean Power Plan/Clean Air Act 111(d) goal (e.g., 30% below 2005 level by 2030	Existing RPS, state and federal environmental regulations, including MATS and haze, CA and BC carbon costs, state carbon limits on new generation. Distribution of values for all major sources of uncertainty across all futures. *Scenarios will test specific carbon reduction targets or costs. Example:* Resource strategies must result in 30% less GHG emissions by 2030 compared to 2005 (or some variant of this policy)	Cost and Value of uncertainty risk mitigation with known generation fleet retirements and regulatory compliance costs Delineated by 2A – 1B
2B	**Existing Policy *with* Uncertainty and *with certain* GHG reduction risk/target**. Proposed Policy Target = Mitigate to Estimated GHG Damage Cost	Existing RPS, state and federal environmental regulations, including MATS and haze, CA and BC carbon costs, state carbon limits on new generation. Distribution of values for all major sources of uncertainty across all futures. *Scenarios will test specific carbon reduction targets or costs. Example:* GHG emissions cost/price set equivalent to the US Interagency Working Group on Social Cost of Carbon (SCC)	Cost and Value of uncertainty risk mitigation with known generation fleet retirements and regulatory compliance costs. If SCC is used to represent damage cost, resulting portfolios theoretically achieve GHG mitigation equivalent to damage costs. Delineated by 2B – 1B
2C	**Existing Policy *with* Uncertainty *and with uncertain* GHG reduction risk/target**.	Existing RPS, state and federal environmental regulations, including MATS and haze, CA and BC carbon costs, state carbon limits on new generation. Distribution of values for all major sources of uncertainty across all futures. *Scenarios will test specific carbon reduction targets or costs.* GHG emissions cost/price allowed to vary across futures between $X and $Y	Cost and Value of uncertainty risk mitigation without known generation fleet retirements and regulatory compliance costs Delineated by 2C – 1B

Scenario Number	Scenario Name	Scenario Description	Key Stress Factors /Constraints Tested
3A	**Lowering carbon emissions with current technology**	Determine lowest feasible power system carbon emissions resource strategies using ***only available*** generation, storage and energy efficiency ***technologies***, including anticipated cost reductions. May include retirement of all regional coal plants and replacement with no or lower carbon emitting resources.	Cost and risk of minimizing power system GHG emissions feasible with existing technology Delineated by 3A – 2C
3B	**Lowering carbon emissions with emerging** technology (e.g., storage, CO_2 heat pumps, SSL)	Determine lowest feasible power system carbon emissions resource strategies ***using emerging*** generation, storage and energy efficiency ***technologies***, including anticipated cost reductions. May include retirement of all regional coal plants and replacement with no or lower carbon emitting resources.	Cost and risk of minimizing power system GHG emissions feasible with emerging technology Delineated by 3B – 3A

Scenario Number	Scenario Name	Scenario Description	Key Stress Factors /Constraints Tested
4A	**Major Resource Uncertainty** - ***Unexpected*** Loss of Major Resource (e.g., CGS Forced Retirement)	Determine the resource strategies best suited to managing the unanticipated loss of a major (>1000 MW) non-GHG emitting resources	Cost and risk associated with unanticipated loss of major, non-GHG gas emitting resource Delineated by 4A – 2C
4B	**Major Resource Uncertainty** ***Anticipated*** Loss of Major Resource(s) (e.g., Snake River Dam Removal,)	Determine the resource strategies best suited to managing the loss of a major hydro resources	Cost and risk associated with replacement of existing hydro-generation. Delineated by 4B – 2C
4C & D	**Major Resource Uncertainty** – Pace of Conservation Deployment	Determine the resources that would be developed/displaced if the deployment of energy efficiency is faster or slower than anticipated	Cost and risk associated with assumed upper and lower limits on pace of conservation in resource strategies Delineated by 4C/4D – 2C

Scenario Number	Scenario Name	Scenario Description	Key Stress Factors /Constraints Tested
5A	**Integration of Variable Resources** (i.e., Managing the NW Impact of the "Duck Curve"/50% CA RPS)	Determine the resource strategies that would best serve the region should CA achieve a 50 percent RPS using primarily solar PV	Cost and risk associated with potentially large extra-regional surpluses available at low prices during certain periods of the day and year Delineated by 5A – 2C
5B	**Southwest Market Uncertainty:** Liquidity and Variability	Determine the resource strategies that would best serve the region under different scenarios of Southwest market availability.	Cost and risk associated with uncertainty in price and liquidity associated with the Southwest Market. Delineated by 5B – 2C
6	**Climate Change**	Determine the impact on resource strategies under forecast future hydro-power output conditions and load conditions	Change in hydro output and system load shape Delineated by 6 – 2C

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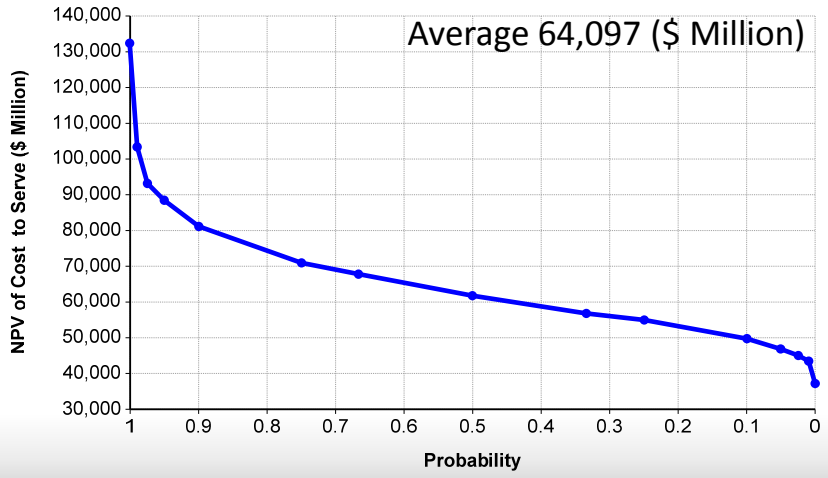
NPV System Cost



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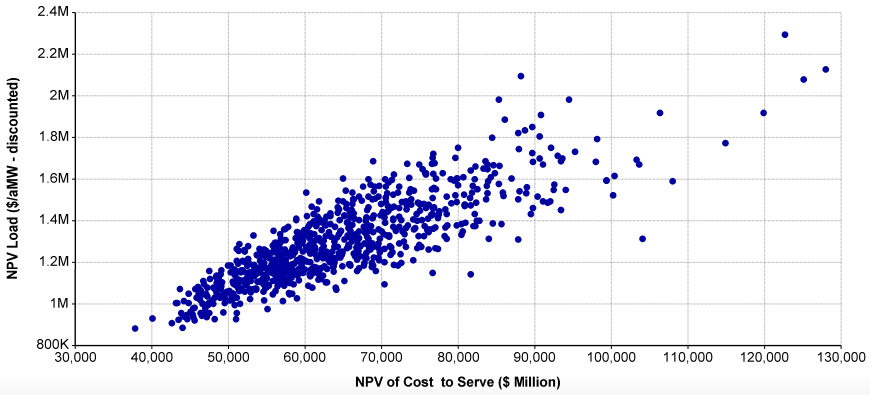
"Normalized" NPV vs. Total NPV



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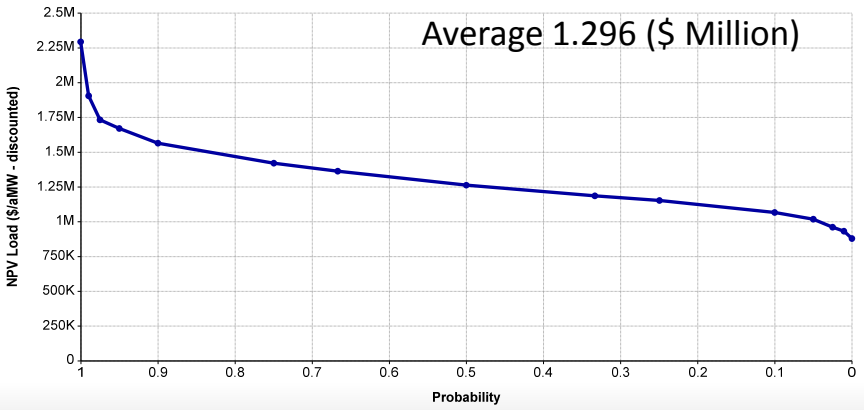
"Normalized" NPV



Energy Dispatch By Water Year