Regional Portfolio Model Redevelopment Update

October 2014

Overview of Phase 1 Scope

- Phase 1 RPM Functionality
  1. 750 6th Plan Futures
  2. Calculate 20-year NPV
  3. Discretionary and Lost Opportunity Conservation
  4. CO2 emission tracking
  5. Dispatch of existing and new resources
  6. Economic RPS allocation
- Future functionality
  1. Optimization and efficient frontier
  2. Creation of futures

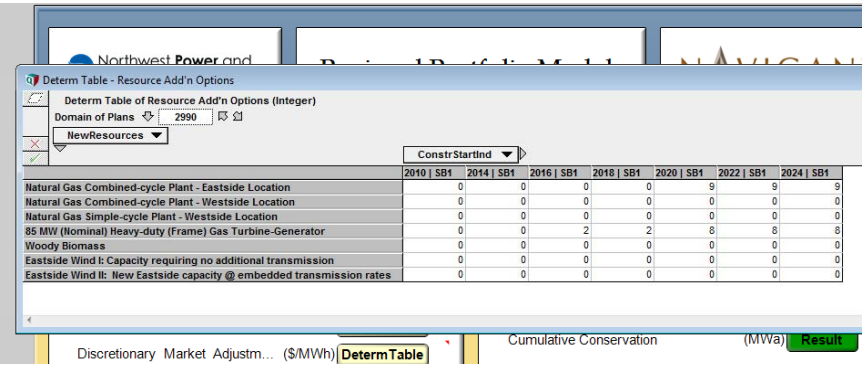
Redevelopment Progress

- Phase 1 – Plan Calculation Logic
  - Delivered 1 week prior to contract deadline
  - Created distributions of model results from 750 input futures used to develop 6th Plan
  - Model outputs compared to results from RPM used in to develop 6th plan to test comparability
- Council staff and independent contractors (D. Logan and M. Schilmoeller) reviewed Phase 1 Model
- Systems Analysis Advisory Committee Scheduled to Preview Model
- Progress on Phase 2 ahead of schedule

Phase 1 - Preview

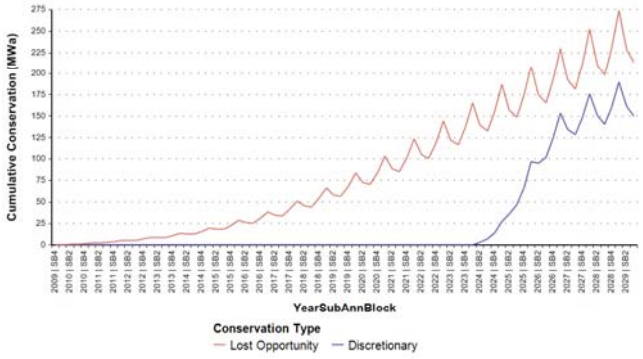
- Examples of model outputs
  - Optioned/Build Schedules
  - Conservation Development
  - Existing Plant Dispatch
  - Regional Imports/Exports
  - Cost to Serve Region
- Graphics from the model have a consistent look and feel, the following figures and graphs give a small preview of the redeveloped model.

Optioned Builds Input



The model allows an input of which new plants have an option to be built for a selected subset of periods, similar to the 6th Plan RPM software.

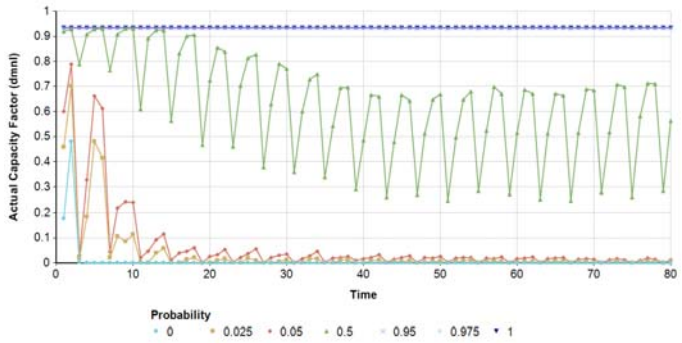
Standard Deviation of Conservation by Type



The model allows calculation of various statistics, which can be insightful. Here we see no standard deviation in the acquisition of discretionary conservation for the first 13 years, i.e. the same value occurred in all 750 futures for those years.

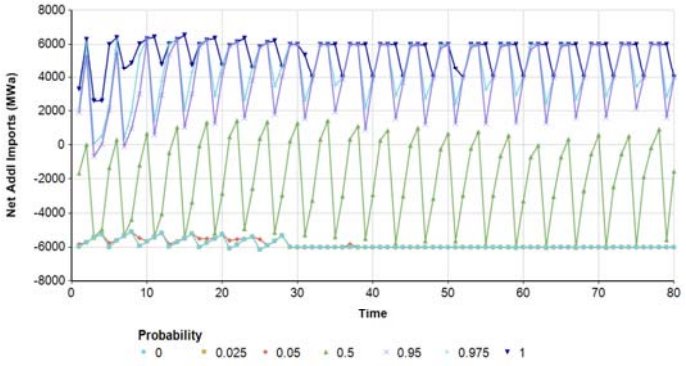
TE3

Boardman Dispatch Probability Bands



Each element of the model can be graphically examined. Here we have a probabilistic view of the capacity factor for Boardman. We can see it ranges from being fully dispatched to minimally dispatched with seasonality showing up in the central tendency.

Regional Import/Export

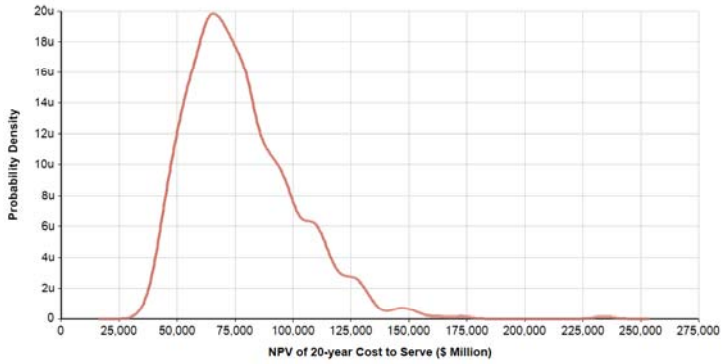


Similarly, we see imports and exports as a probabilistic representation.

Slide 7

TE3 Is this a comparison of the existing and redeveloped dispatch of Boardman. If so, need to state that in title and show legend, because it isn't clear. If not, what is this telling us?
Tom Eckman, 9/29/2014

Cost To Serve Region



Another method of viewing the model output in a probabilistic manner is as a probability density function. Basically, the most likely outcomes are where the curve is the highest.

Navigant 6th Plan Comparison

Overview of phase 1 deliverable

Navigant compared output of the new RPM with output from the old RPM to the extent practicable.

» Navigant compared output of the old RPM (model L813) with the new RPM for four distinct "plans," specifically:
- Plan 2990 (Least Risk Plan)
- Plan 4267 (Least Cost Plan)
- Plan 3 (Minimalist Plan – i.e., zero "optioned" resources)
- Plan 4 (Maximal Plan – i.e., many "optioned" resources)

» Key outputs/performance indicators compared included:
- NPV of 20-year cost to serve (including distribution of outcomes across all futures)
- Equilibrium electricity prices over time (able to compare for two of the plans)
- Capacity addition costs over time (an indicator of capacity addition algorithm similarity)
- Model run times

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Overview of phase 1 deliverable

Model differences will inevitably result in slightly different output.

» Key model differences precluding exact output replication include -- in order of estimated importance (judgment based):
- Equilibrium price algorithm
  - New RPM has a more precise algorithm for finding equilibrium prices.
  - Algorithm finds the single, unique solution to congestion price (compared with old RPM, whose algorithm permits price differences without congestion)
- Imperfections in reproduction of input data by Council staff
- Price-responsive hydro (not in phase 1 RPM)
- Demand response (not in phase 1 RPM)
- Calculation of stochastic forced outages (not in phase 1 RPM)
- Multi-phase construction (single phase in new RPM vs multi-phase in old RPM)

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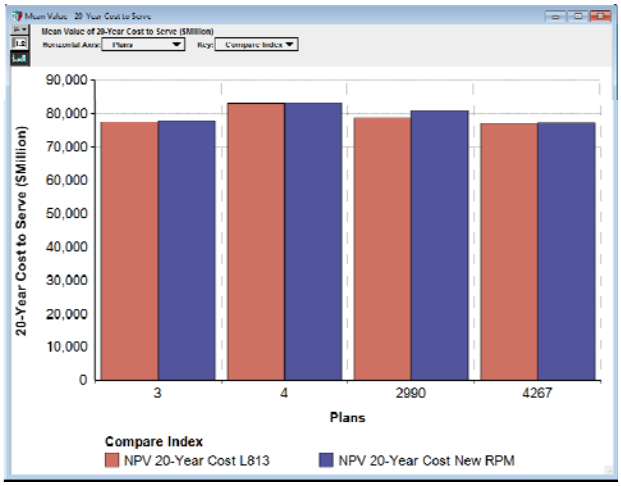
Output Comparisons » Mean value of 20-year cost to serve

Difference in mean value of 20-year cost to serve (over all 750 futures) varies between 0.2% and 2.7 % across the four plans compared.



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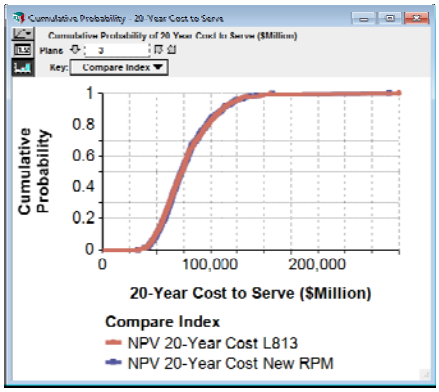
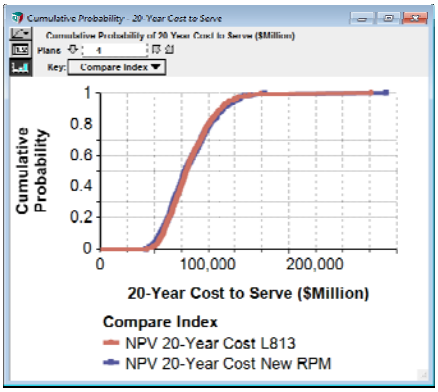
Output Comparisons » Cumulative distribution of 20-year cost to serve

Cumulative probability distributions of 20-year cost to serve region are well aligned between old RPM and new RPM.

Plan 3 (Minimalist Plan)



Plan 4 (Maximal Additions)



NAVIGANT ENERGY

Output Comparisons » Cumulative distribution of 20-year cost to serve

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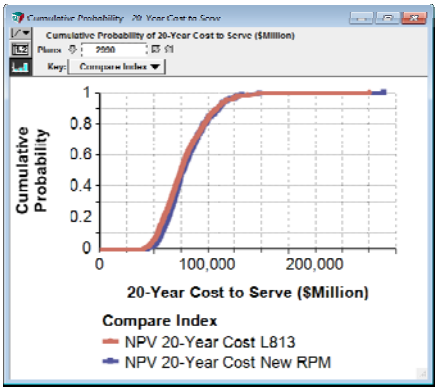
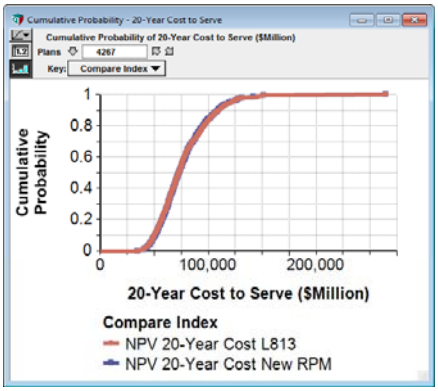
Plan 2990 (Least Risk)



Plan 4267 (Least Cost)



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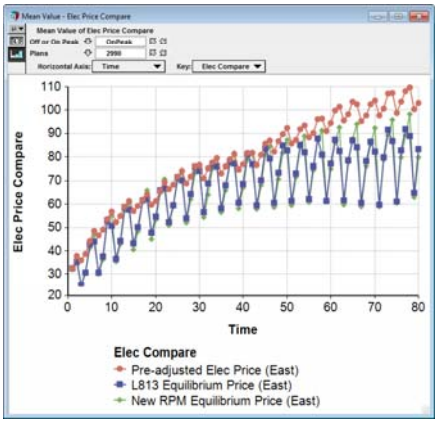
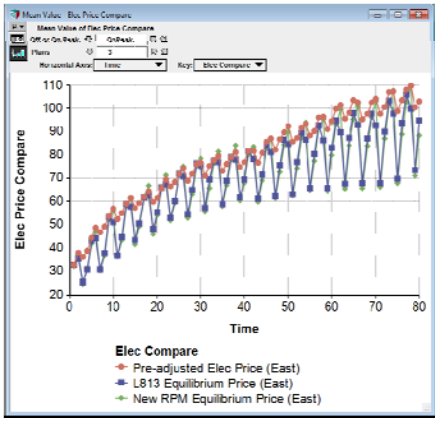
Output Comparisons » Equilibrium electricity prices

Equilibrium prices follow similar behavior (though different due to algorithm improvements) for the 2 plans able to be compared.

Plan 2990 (Least Risk)



Plan 3 (Minimalist Plan)

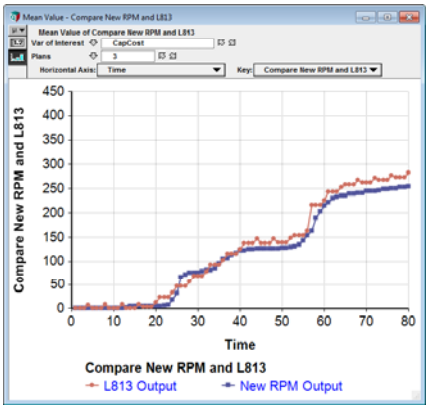


NAVIGANT ENERGY

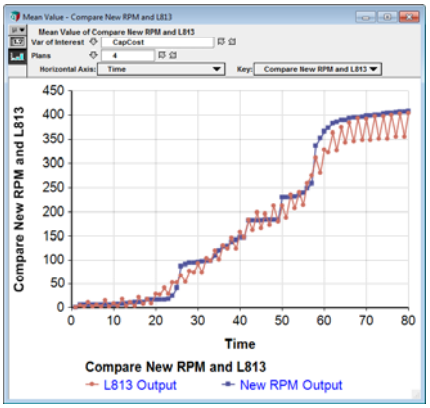
Output Comparisons » Capacity addition costs

Mean capacity addition costs are very similar between the old and new RPM, across all four plans compared.

Plan 3 (Minimalist Plan)



Plan 4 (Maximal Additions)



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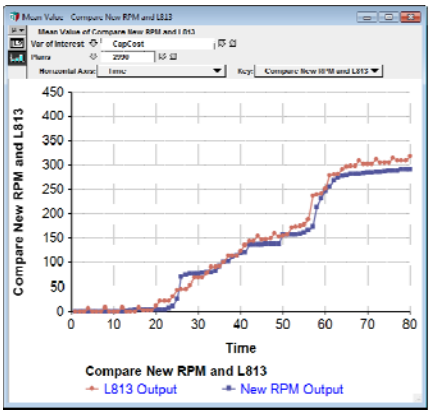
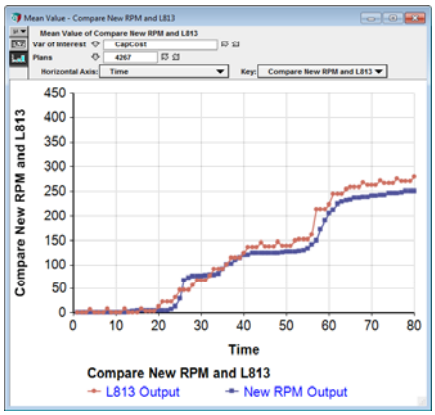


Plan 4267 (Least Cost)



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Phase 1 model run times are roughly 4-5 times faster with the current computers and new RPM than with the old computers and RPM.