

Proposed Final Short List Development for the All Source Request for Proposals Workshop December 11, 2008

Introduction

This paper describes the proposed modeling approach and decision process used to develop the final conditional short list for the All Source Request for Proposals. The modeling approach consisted of Steps 2 and 3 of the bid evaluation process, which would be applied after establishment of the initial short list of bidders (Step 1). These two modeling steps are:

Step 2—Portfolio Development/Optimization

Step 3—Risk Analysis

Step 3a: Stochastic Analysis

Step 3b: Deterministic Scenario Analysis

These modeling steps will use PacifiCorp’s integrated resource planning modeling systems as well as resource portfolio evaluation principles applied for the 2008 Integrated Resource Plan and 2009 Business Plan. The key resource evaluation principle is that of resource robustness. A bid resource is considered robust if it appears in the most cost-effective resource portfolios developed under a reasonably wide range of potential futures, and after adjusting portfolio costs for sources of risk. The three-step bid evaluation process and the application of the resource robustness principle will result in a natural division of eligible proposals which will split the proposals into “top tier” and “bottom tier” groups.

IRP Evaluation process

Step 2: Portfolio Development/Optimization

Purpose

The purpose of this step is to use Ventyx Energy LLC’s *System Optimizer* capacity expansion model (previously called the Capacity Expansion Model) to develop optimized portfolios¹ using the bid and benchmark resources, and based on a range of alternative cost assumptions. In addition to portfolio screening for stochastic production cost analysis, this step indicates the frequency with which bids and benchmarks are selected under alternative futures modeled on a deterministic basis.

Methodology

The starting point for System Optimizer portfolio development is the set of preferred resources and input assumptions from PacifiCorp’s 2009 business plan and the 2008 IRP. The preferred portfolio resources, developed assuming a 12 percent capacity planning reserve margin, will be removed as

¹ An optimized portfolio refers to a capacity expansion plan that minimizes the present value of revenue requirements (PVRR) over a 20-year period based on the set of input assumptions and planning reserve margin constraints. The capacity expansion plan accounts for the dispatch of both existing and future resource options, factors in amortized investment costs for generation and transmission resources, and solves for the optimal level of spot market transactions for system balancing.

resource options in order to create a capacity deficit that the model must fill with combinations of bid and benchmark resources. (The model is also allowed to select a variable quantity of firm market purchases, or “front office transactions” to ensure that a specified annual planning reserve margin is maintained.)

The System Optimizer will produce an optimized portfolio for each combination of carbon dioxide (CO₂) and natural gas price assumptions input into the model (“price scenarios”). In addition to a base case price scenario, eleven additional price scenarios will be modeled.

The price scenarios reflect CO₂ tax assumptions ranging from \$8/ton to \$100/ton, coupled with a range of natural gas price forecasts. Note that all assumptions will be locked down by the Independent Evaluator (“IE”) prior to the receipt of the market bids.

Figure 1 summarizes the combinations of CO₂ and natural gas price assumptions for each price scenario.

Figure 1. 2008 All Source RFP Price Scenario Summaries

Scenario	CO ₂ Tax (2008\$/ton)*	Natural Gas**
Base	\$8	10/20/08 FPC
1	\$45	Adjusted 10/20/08 FPC
2	\$70	Adjusted 10/20/08 FPC
3	\$100	Adjusted 10/20/08 FPC
4	\$8	Low
5	\$45	Adjusted Low
6	\$70	Adjusted Low
7	\$100	Adjusted Low
8	\$8	High
9	\$45	Adjusted High
10	\$70	Adjusted High
11	\$100	Adjusted High

*The CO₂ tax is applied starting in 2013 for all scenarios. The values listed above are in 2008\$. The nominal tax for each year of the forecast period is based upon PacifiCorp’s June 2008 inflation forecast.

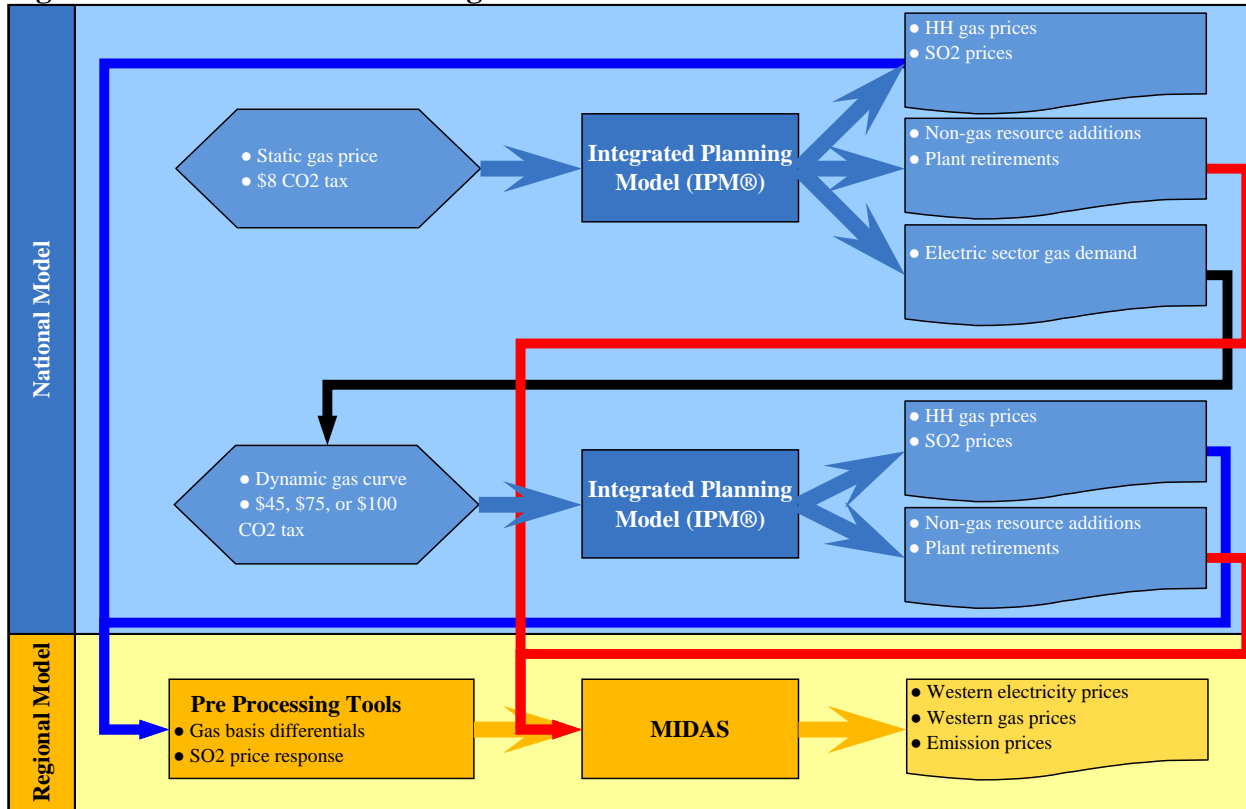
**For scenarios with CO₂ taxes ranging from \$45/ton to \$100/ton, natural gas prices are adjusted to reflect changes in electric sector natural gas demand.

Projections for the price scenarios were developed with a methodology consistent with the approach used to produce PacifiCorp’s official forward price curves (FPCs). The methodology relies upon two electric sector simulation models: the Integrated Planning Model (IPM®) and Midas. IPM®, developed by ICF International, is a linear programming market simulation tool with a detailed representation of every boiler and generator in North America. The linear program’s objective function determines the least cost means of meeting electric energy and capacity requirements over time. Outputs from IPM® include an internally consistent forecast of resource additions that incorporate renewable portfolio standards, electric energy and capacity prices, natural gas and coal prices, electric sector fuel consumption, and emission prices for policies administered in a cap-and-trade framework. Midas, licensed from Ventyx Energy LLC, is an hourly chronological dispatch model with a detailed representation of supply and demand variables influential to western power markets and is used to develop a long-term electricity price forecast.

The CO₂ tax assumptions used in the price scenarios are assumed to be imposed upon the entire U.S. electric sector. Given the scope of the tax, IPM® is used to simulate the overarching impact upon supply and demand dynamics that are critical to natural gas, electricity, and emission markets. Results from IPM® are then input into Midas to produce an electricity price forecast for those markets accessible to PacifiCorp’s system.

All scenarios are developed from one of three underlying natural gas price projections – either the 10/20/08 FPC, a low price forecast, or a high price forecast. For the scenarios that couple these underlying gas price forecasts with an \$8/ton CO₂ tax, IPM® is used to establish a point of reference for electric sector natural gas demand. For those scenarios with higher CO₂ tax assumptions (\$45/ton, \$70/ton, or \$100/ton), IPM® is configured with natural gas supply curves calibrated to the electric sector gas demand from the corresponding \$8/ton CO₂ tax scenario. With this dynamic gas price structure in IPM®, natural gas prices are able to respond to changes in gas demand that are triggered by the costs imposed by the CO₂ tax. Consequently, each of the scenarios have a unique natural gas price forecast that is a variant of one of the three underlying projections. Figure 2 shows how scenario variables and model results flow among models.

Figure 2. Price Scenario Modeling Framework



The market price scenario results are summarized below. Figure 3 shows average annual Henry Hub natural gas prices, Figures 4 and 5 show average annual electricity prices for Mid-Columbia, Figures 6 and 7 show average annual electricity prices for Palo Verde, and Figure 8 shows SO₂ allowance prices.

Figure 3. Average Annual Henry Hub Natural Gas Prices

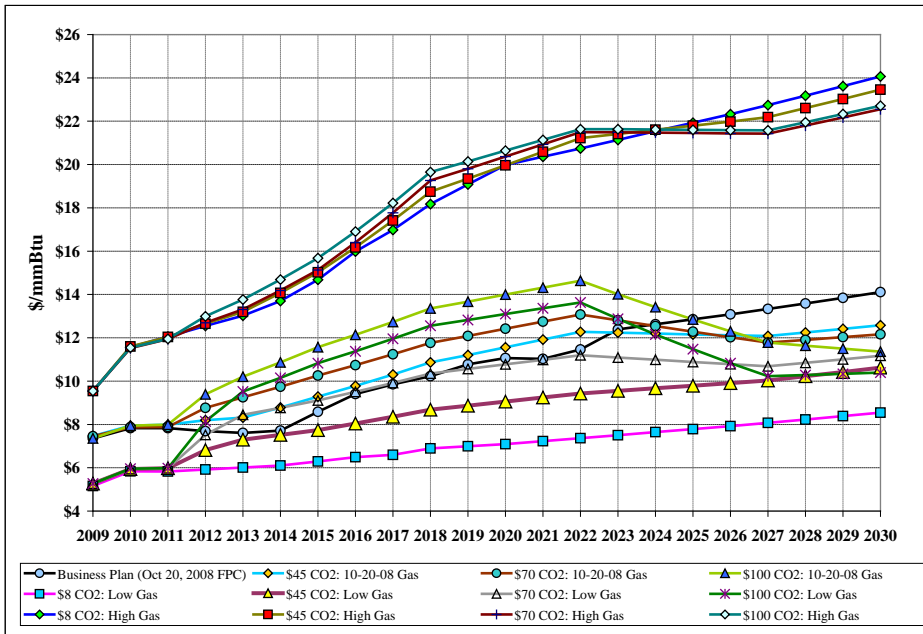


Figure 4. Mid-Columbia HLH Average Annual Electricity Prices

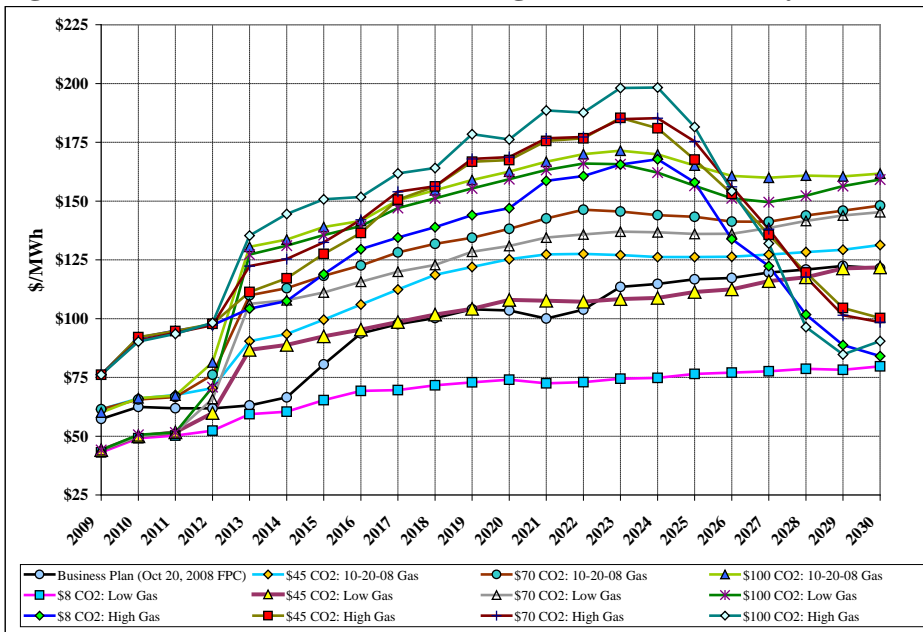


Figure 5. Mid-Columbia LLH Average Annual Electricity Prices

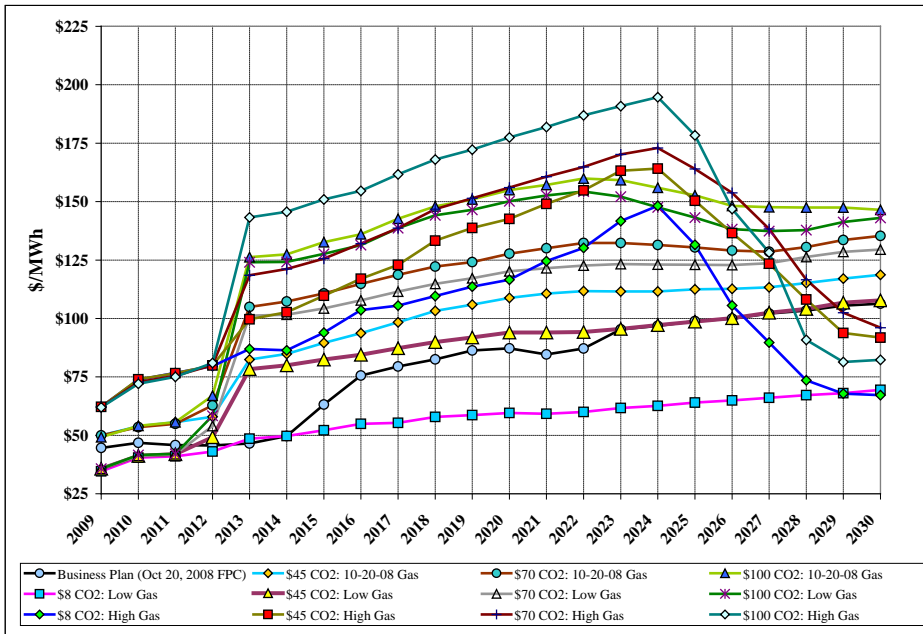


Figure 6. Palo Verde HLH Average Annual Electricity Prices

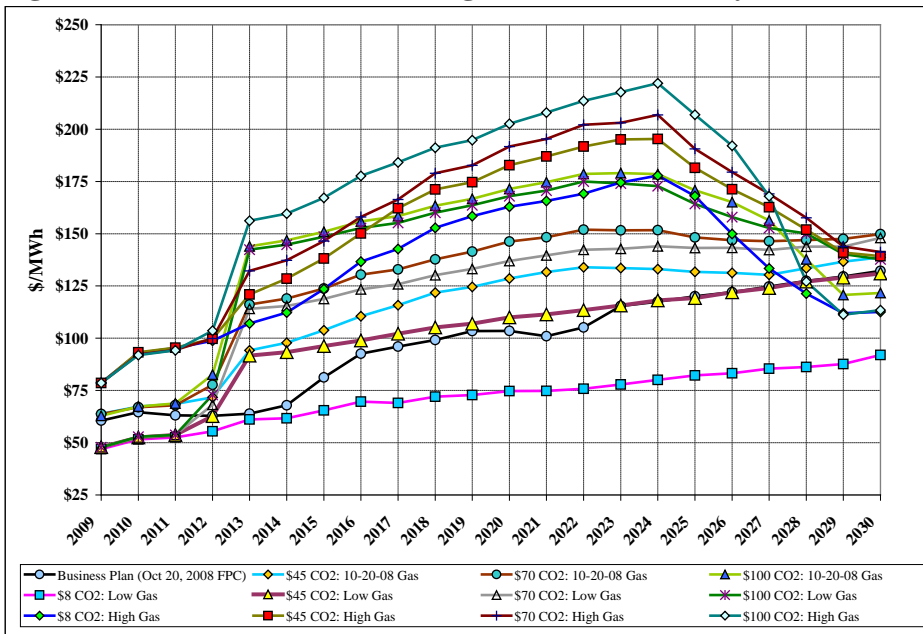


Figure 7. Palo Verde LLH Average Annual Electricity Prices

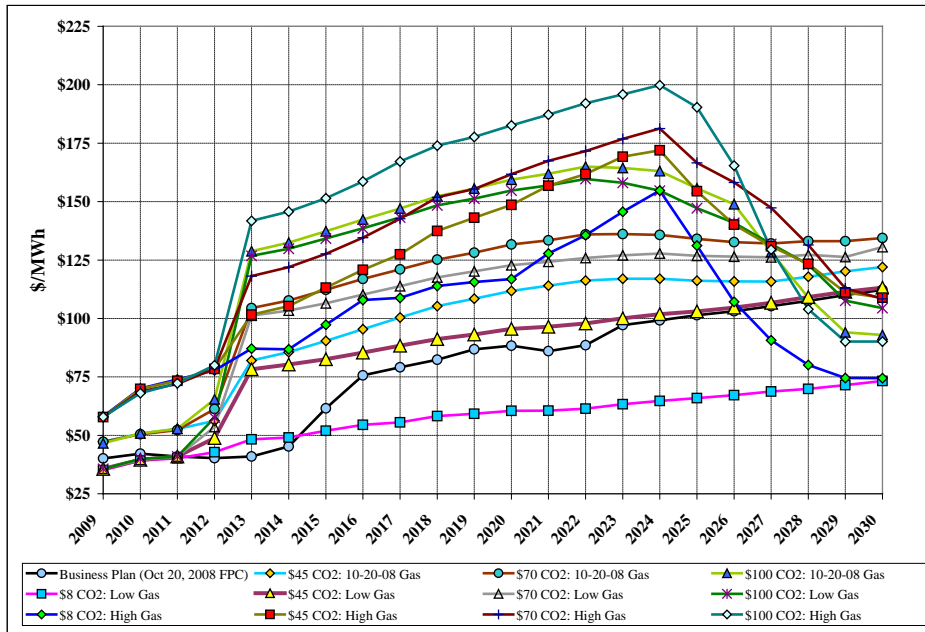
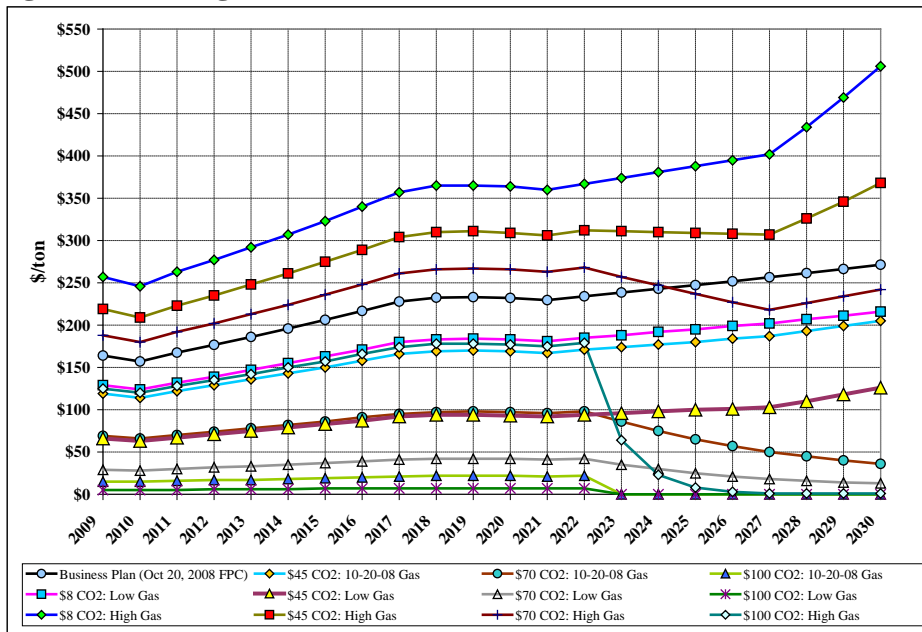


Figure 8. Average Annual SO₂ Allowance Prices



To select the System Optimizer portfolios for the stochastic production cost analysis using the Planning and Risk model, the number of cases will be condensed to groups with unique sets of bid and benchmark resources.

Step 3—Risk Analysis

Step 3a: Stochastic Analysis

Purpose

The purpose of this step is to formulate stochastic cost and risk profiles for each of the unique portfolios developed from Step 2, and then identify the bid and benchmark resources that appear consistently in the top-performing portfolios based on both cost and risk measures.

Methodology

The unique portfolios from Step 2 are simulated using Ventyx Energy LLC’s Planning and Risk (PaR) production cost model in stochastics mode. The PaR simulation produces a dispatch solution that accounts for chronological unit commitment and dispatch constraints.² Stochastic risk is captured in the PaR production cost estimates by using Monte Carlo random sampling of five variables: loads, commodity natural gas prices, wholesale electricity prices, hydro energy availability, and thermal unit availability for new resource options. The simulation is conducted for 100 model iterations using the sampled variable values. To capture CO₂ emission costs and associated dispatch impacts, simulations will be conducted using different CO₂ cost adders. This model set-up is identical to the stochastic simulations conducted for the IRP.

The capital and fixed costs resulting from the System Optimizer portfolio is added to the net variable cost from the PaR simulation to derive a real-levelized PVRR. For each simulation, the stochastic cost and risk measures calculated include the following:

- Mean PVRR – Mean of the PVRR for the 100 simulation iterations
- 95th percentile PVRR – The PVRR of the iteration that represents the 95th percentile for the 100 simulation iterations
- Risk-adjusted PVRR – Calculated as the mean PVRR plus the expected value (EV) of the 95th percentile PVRR, where $EV = P(PVRR)_{95} \times 5\%$.³
- Variable cost standard deviation – A measure of production cost variability risk, calculated as the standard deviation of annual variable costs for the 100 simulation iterations.
- Average annual Energy Not Served⁴ – Energy Not Served (ENS) is a condition where there is insufficient generation available to meet load because of physical constraints or market conditions. The stochastic ENS results are averaged across all 100 iterations and reported on an average annual GWh basis for the 20-year simulation period.
- CO₂ emissions footprint – The amount of CO₂, in tons, attributable to generation sources (direct emissions).

The key stochastic performance measure used to assess each resource set is risk-adjusted PVRR. Resource sets will be ranked according to this measure for each of the CO₂ cost adder scenarios, as well as the frequency of bid and benchmark resources appearing in the top-ranking resource sets. A

² In contrast, the System Optimizer does not model unit commitment or the holding of reserves.

³ This metric expresses a low-probability portfolio cost outcome as a risk premium applied to the expected (or mean) PVRR based on the 100 Monte Carlo simulations.

⁴ Energy Not Served (ENS) is a condition where there is insufficient generation available to meet load because of physical constraints or market conditions. The stochastic ENS results, averaged across all 100 iterations and reported on an average annual GWh basis for the 20-year simulation period, are used to compare the reliability between portfolios given extreme modeled conditions for the five stochastic variables.

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high relative frequency among the top-performing portfolios is indicative of a robust resource under the range of stochastic futures and CO₂ cost scenarios. The resource robustness principle was applied in the IRP preferred portfolio selection process, and is viewed by PacifiCorp as the fairest resource selection criterion.

Step 3b: Deterministic Scenario Analysis

Purpose

The purpose of this final step is to use the System Optimizer to determine PVRRs for the top-performing resource sets under alternative case assumptions. This scenario analysis determines the range of costs that could result given a fixed set of resources under varying gas/electricity price and CO₂ cost assumptions.

Methodology

The resource sets will be simulated in the System Optimizer from Step 2, keeping the resources for each set fixed but allowing the System Optimizer to dispatch the resources as part of its least-cost portfolio solution.

Conclusion

PacifiCorp uses a portfolio analysis approach for bid resource evaluation consistent with that used for its integrated resource planning process. This portfolio analysis approach is based on the integrated resource planning principle of “resource robustness”. A bid resource is considered robust if it appears in the most cost-effective resource portfolios developed under a range of potential futures, and after considering stochastic and scenario risks.

PacifiCorp will develop 12 different portfolios according to combinations of key input variables and accounting for the impact of company benchmarks included in the portfolio analysis. A screening process is then applied to limit these portfolios to just those with unique sets of bids and benchmark resources.

The set of 12 optimized portfolios will be subjected to Monte Carlo production cost simulation, incorporating different CO₂ tax levels in each simulation. Based on a measure of risk-adjusted portfolio cost that accounts for high-end risk potential, specific bids will appear in the top-performing portfolios. As a result, the top tier of bids will be unblinded and contacted by the Independent Evaluator. The top tier bids will be required to meet the conditional requirements within 20 business days. The bottom tier bidders will be advised that they have not made the conditional final shortlist.