Final Short List Development for the
All Source Request for Proposals
November 16, 2009

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 has been modified and updated from that proposed in a paper submitted on January 5, 2009, based on input received during the technical conference in Docket No. 07-035-94 held on November 2, 2009.

The modeling approach consists 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 portfolios[1] 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

[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.

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 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.) Resource additions past 2020 will be fixed for all portfolios to remove the impact of out-year resource optimization on bid/benchmark resource selection.

The System Optimizer will produce an optimized portfolio for each combination of carbon dioxide (CO_2) 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 CO_2 tax assumptions ranging from $8/ton to $100/ton, coupled with a range of natural gas price forecasts based on PacifiCorp's official September 30, 2009 forecast price curves. 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 CO_2 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	09//30/09 FPC
1	$45	Adjusted 09/30/09 FPC
2	$70	Adjusted 09/30/09 FPC
3	$100	Adjusted 09/30/09 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

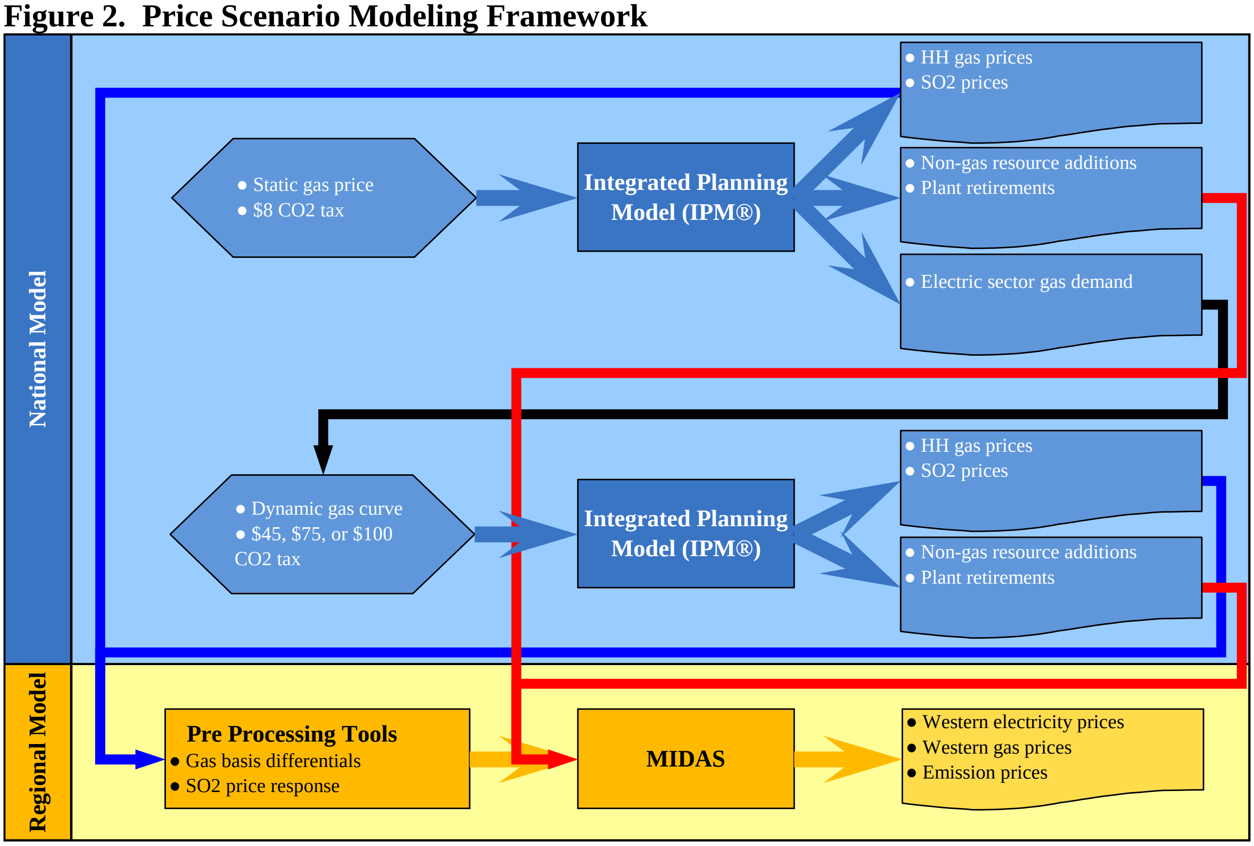
*The CO_2 tax is applied starting in 2013 for all scenarios. The values listed above are in 2008$. The nominal tax for each year of the forecast period is based upon PacifiCorp's September 2009 inflation forecast.
**For scenarios with CO_2 taxes ranging from $45/ton to $100/ton, natural gas prices are adjusted to reflect changes in electric sector natural gas demand.

Projections for the price scenarios will be 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 CO_2 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 will be developed from one of three underlying natural gas price projections – either the 09/30/09 FPC, a low price forecast, or a high price forecast. For the scenarios that couple these underlying gas price forecasts with an $8/ton CO_2 tax, IPM® is used to establish a point of reference for electric sector natural gas demand. For those scenarios with higher CO_2 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 CO_2 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 CO_2 tax. Consequently, each of the scenarios has 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 for the 2008 IRP portfolio modeling are summarized below. These market prices are provided for illustrative purposes only as they reflect outdated forward price curves. These market price scenarios will be updated based on PacifiCorp's September 30, 2009 official forward price curve and locked down with the IE prior to the receipt of the benchmark and market bids. 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 SO_2 allowance prices.

Figure 3. Average Annual Henry Hub Natural Gas Prices

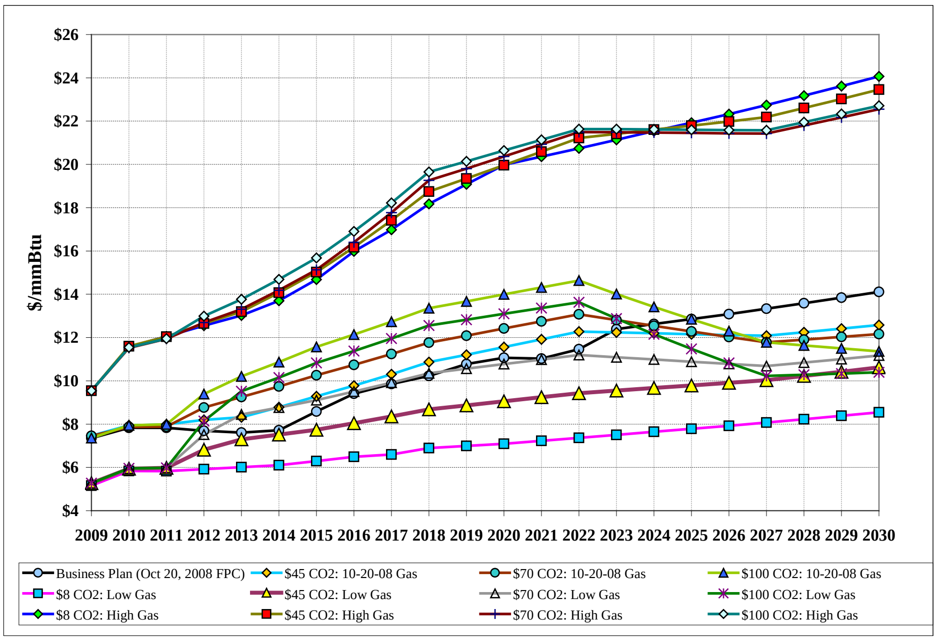


Figure 4. Mid-Columbia HLH Average Annual Electricity Prices

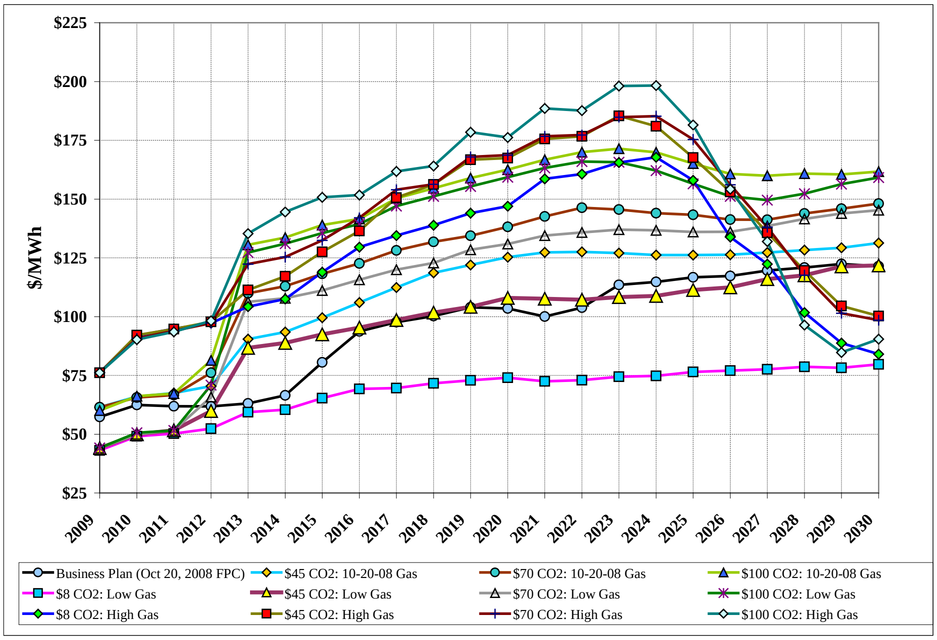


Figure 5. Mid-Columbia LLH Average Annual Electricity Prices

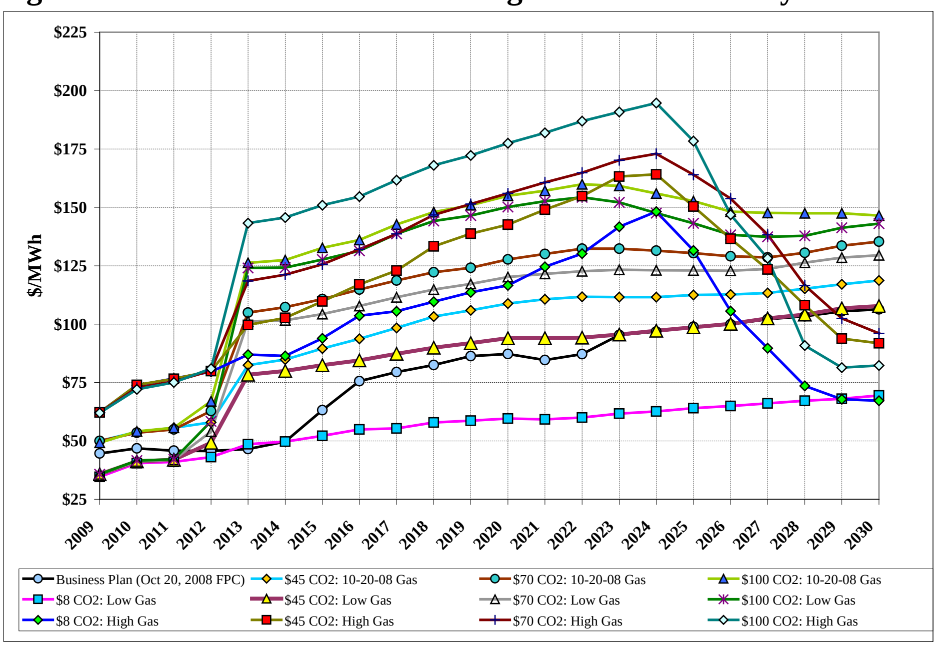


Figure 6. Palo Verde HLH Average Annual Electricity Prices

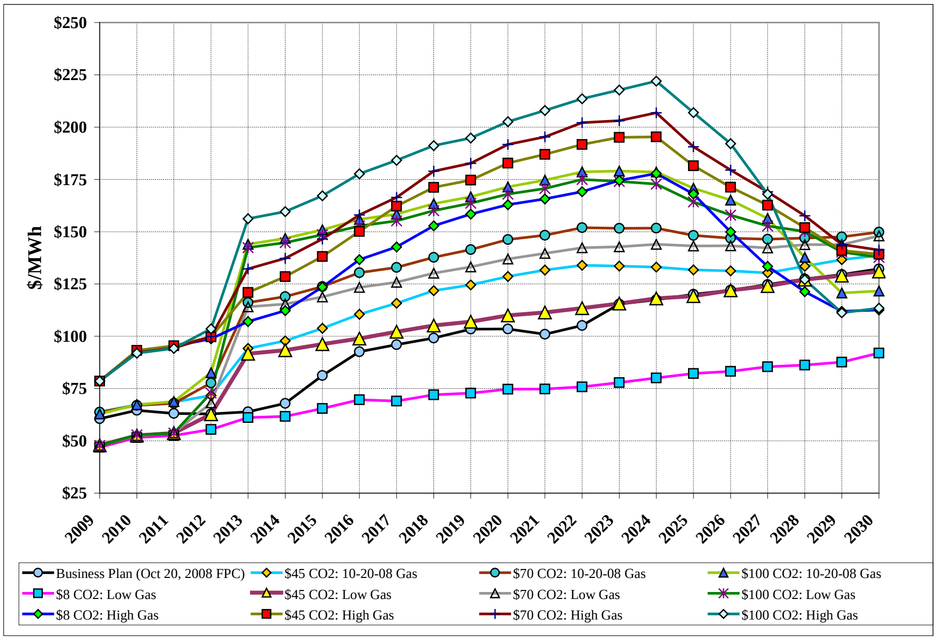


Figure 7. Palo Verde LLH Average Annual Electricity Prices

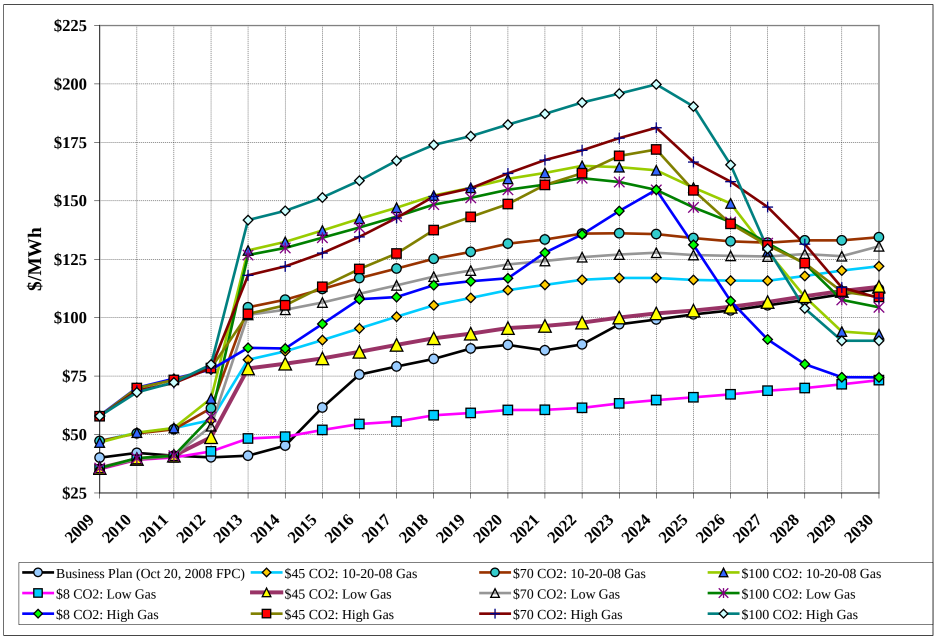
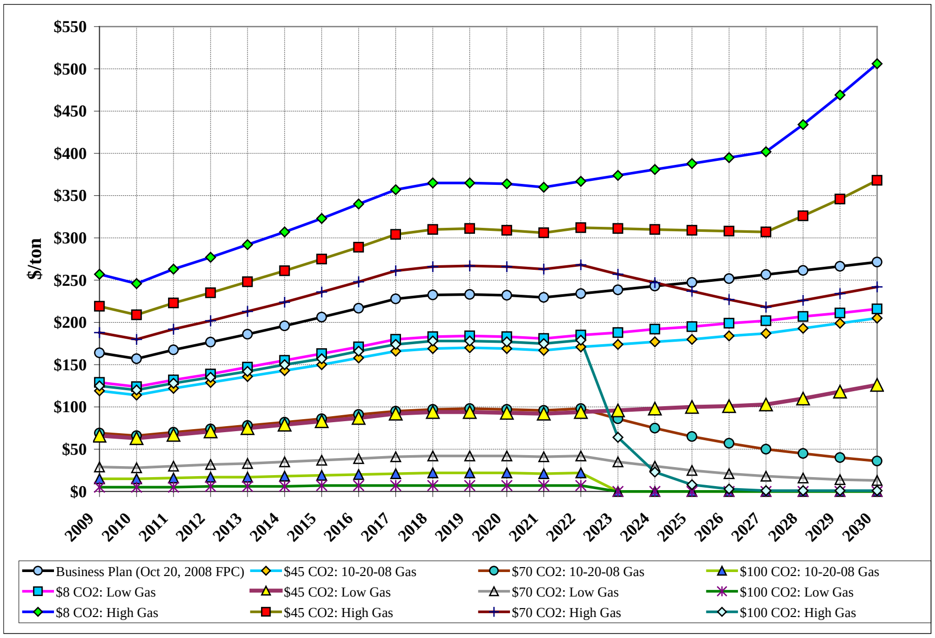


Figure 8. Average Annual SO_2 Allowance Prices



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.[3] To capture CO_2 emission costs and associated dispatch impacts, simulations will be conducted using different CO_2 cost adders.[4] 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
- 95^{th} percentile PVRR – The PVRR of the iteration that represents the 95^{th} percentile for the 100 simulation iterations.
- Customer rate impact – Levelized net present value of the year-to-year changes in the customer dollar-per-megawatt-hour price for 2014-2028.[5]
- Risk-adjusted PVRR – Calculated as the mean PVRR plus the expected value (EV) of the 95^{th} percentile PVRR, where EV = P $(PVRR)_{95}$ x 5%.
- 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 Served – 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.

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

[3] Based on a sample size statistical analysis conducted for the 2004 IRP, PacifiCorp determined that 100 iterations exceeded the minimum number needed to be confident (at least at a 95% confidence level) that the sampled iteration mean is close to the true iteration mean. See Appendix G, pp. 98-99, of the 2004 IRP for details on the statistical analysis.

[4] PacifiCorp will consider for the next IRP the inclusion of CO_2 cost as a stochastic variable in the Monte Carlo simulations. Study work is needed to ensure that the gas and wholesale electricity price responses to different CO_2 cost levels is properly accounted for in the stochastic simulations. The selection of a stochastic model for CO_2 costs should also be a topic for discussion at an IRP public meeting.

[5] See page 172 of the 2008 IRP for a description of this cost measure.

- CO_2 emissions footprint – The amount of CO_2, in tons, attributable to generation sources (direct emissions).

The key stochastic performance measure used to assess each resource portfolio is risk-adjusted PVRR. (See Appendix A for a detailed description of risk-adjusted PVRR and the Company's rationale for selecting it as the primary portfolio evaluation measure.) Resource portfolios will be ranked according to the average risk-adjusted PVRR across three CO_2 cost levels: $8, $45, and $100. In the event that the top-ranked portfolios are not materially different based on risk-adjusted PVRR (i.e., the PVRR differences among the top portfolios is less than 0.5%), then the top-ranked portfolios will be re-ordered on the basis of customer rate impact. Use of customer rate impact as a performance tie-breaker recognizes that this measure was given the second-highest importance weight for portfolio ranking for the 2008 IRP.

Individual resource bids in the top-ranked portfolio constitute the final shortlist bids. These short-listed bids will also be ranked according to their frequency of occurrence in the top four portfolios based on the ranking scheme described above.

Step 3b: Deterministic Scenario Analysis

Purpose
The purpose of this final step is to use the System Optimizer to determine PVRRs for the four top-performing resource portfolios 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 CO_2 cost assumptions.

Methodology
The resource portfolios 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 its integrated resource planning process. PacifiCorp will develop 12 different portfolios using a capacity expansion optimization model that accounts for 12 combinations of key input variables reflecting alternative price scenarios. The optimizations will include the bid and Company benchmark resources as capacity options. 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 CO_2 tax levels in each simulation. A measure of risk-adjusted portfolio cost that accounts for high-end risk potential will serve as the key portfolio performance measure. PacifiCorp will select resources from the top-performing portfolio for shortlist development, and will also rank the individual bids according to their frequency of occurrence in the four top-performing portfolios. This two-step ranking approach assures the Company that the shortlist bids are robust performers under a range of potential price futures, and addresses the Utah Independent Evaluator's concerns regarding portfolio ranking.[6] The final deterministic risk assessment step identifies the range of portfolio costs that result when each portfolio is subjected to different price scenarios.

As a result of the bid evaluation process, the conditional shortlist bids will be unblinded and bidders contacted by the Independent Evaluator. The shortlist bids will be required to meet the conditional requirements within 20 business days. The remaining bidders will be advised that they have not made the conditional final shortlist.

[6] Comments of Merrimack Energy as Utah Independent Evaluator Regarding the Methodology for Portfolio/Resource Selection, December 29, 2008.

APPENDIX A: RISK-ADJUSTED PVRR

The purpose of the risk-adjusted PVRR measure is to present a convenient numerical combination of two stochastic PVRR measures regularly reported for resource portfolios evaluated for the IRP and other production cost simulation studies. These two measures are the stochastic mean PVRR, and a measure of high-end cost risk: the 95th percentile PVRR. (The 95th percentile PVRR is the PVRR corresponding to the iteration out of the 100 Monte Carlo production cost iterations representing the 95th percentile.) PacifiCorp also reports a number of other stochastic risk measures such as the upper-tail mean PVRR (based on the five iterations with the highest PVRR), the production cost standard deviation, risk exposure[7] (upper-tail mean PVRR minus mean PVRR), and the 5th percentile PVRR.

The rationale behind the risk-adjusted PVRR is to have a single "risk-adjusted" cost measure for ranking portfolios that avoids the pitfalls of assigning utilities or importance weights for expected cost and high-end cost risk. Deriving such relative value indicators is a complex undertaking that needs to account for the decision-maker's attitude towards risk and uncertainty under a range of alternative futures. A simpler approach that avoids subjective weighting methods is to use the expected value of a high-cost portfolio outcome to adjust the PVRR for risk. The expected value of the 95th percentile PVRR—determined by multiplying the 95th percentile PVRR by its outcome probability, or 5 percent—serves as a reasonable and transparent risk adjustment.

Prior to adoption of the risk-adjusted PVRR measure, the only method used by the Company to combine expected and high-end cost risk concepts was to develop scatter-plot graphs showing mean PVRR versus upper-tail mean PVRR for each portfolio. This graphical method is convenient for visually showing relative portfolio performance with respect to the trade-off between expected and high-end portfolio cost outcomes. However, such graphs do not incorporate information regarding preferences for risk avoidance or cost outcome probabilities, and therefore cannot be used to directly rank portfolios. The risk-adjusted PVRR measure avoids this shortcoming.

[7] This risk measure is no longer being reported in the IRP. The 95th percentile PVRR and upper-tail mean PVRR are viewed as sufficient for capturing high-end cost risk.