2013 Integrated Resource Plan

Transmission Benefit Evaluation
Stochastic Modeling and Preferred Portfolio Selection

November 5, 2012
Overview

• Transmission benefit evaluation
• **Lunch: 11:30am PT / 12:30pm MT**
• Stochastic modeling and preferred portfolio selection approach
TRANSMISSION BENEFIT EVALUATION
Overview

• 2011 IRP Action Plan commitment
• Transmission System Benefits Tool
  – Overview
  – Review of Sigurd-Red Butte benefits evaluation
  – Segment D preview
Commitment per 2011 IRP Action Plan

• In the scenario definition phase of the IRP process, the Company will address with stakeholders the inclusion of any transmission projects on a case-by-case basis.
  – Develop an evaluation process and criteria for evaluating transmission additions
  – Review with stakeholders which transmission projects should be included and why.

• Based on the outcome of these steps, PacifiCorp will provide appropriate transmission segment analysis for which the Company requests acknowledgement.
System Benefits Tool (“SBT”) – Overview

- IRP models identify the scenario with the lowest PVRR from an energy delivery view, but cannot capture a broader range of operational and reliability benefits provided by new transmission capacity.

- A new approach is required to capture these incremental benefits.

- No “off the shelf” or “one size fits all” approach available, but methodologies used by various transmission planning groups are a helpful starting point.
SBT – Overview (continued)

• The SBT measures benefits that are incremental to those identified via IRP modeling

• Development of the SBT metrics is a long-term objective that will require regulator and stakeholder input

• **Near-term objective:** Use SBT to build support for continued progress on transmission segments for which PacifiCorp is seeking acknowledgement

• **Long-term objective:** Use SBT to complement IRP modeling for a more complete picture of costs and benefits of each IRP scenario
### System Operational and Reliability Benefits Tool

**Project Title**

**Project Segment if Applicable**

<table>
<thead>
<tr>
<th>Benefit Category</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
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<td>Segment(s)</td>
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**Benefit Category**

- **Operational Cost Savings**
  - Savings

- **Wheeling Revenue Opportunity**
  - ATC Firm
  - ATC Non Firm
  - Path Transfer Capability (MW)
  - Path Transfer Capability (MW)

- **Segment Loss Savings Benefits**
  - Energy
  - Capacity

- **Segment Reliability Benefits**
  - N-1
  - N-1-1
  - Load loss
  - System Disturbance & Islanding

- **Customer & Regulatory Benefits**
  - Disturbance Cost for Regulatory Inquiry/Compliance
  - Customer Costs Derived from Industry Data

- **Avoided Capital**

- **Improved Generation Dispatch**
  - Generating Resources behind constraint (MW)
  - Capacity Contribution
  - Contingency Reserves

**Total Scenario Benefits (minus Wheeling Revenue)**

**Total Scenario Benefits (minus Wheeling Revenue & minus Net Power Costs)**

**Capital Cost By Segment (Total $M)**

**Benefit to Cost (Present Value Total Benefits minus Wheeling)/Segment Capex 2012)**

**Capital Cost Paid by Other Network Customers (%)**

**Benefit to Cost (Present Value Total Benefits minus Wheeling/Net PAC Contribution)**
SBT Case Study

(See Sigurd-Red Butte SBT Summary Sheet, provided separately)

• Benefits evaluated:
  – Operational cost savings
  – Segment loss savings (energy and capacity)
  – Reliability benefits
  – Customer and regulatory benefits
  – Avoided capital cost
  – Improved generation dispatch
  – Wheeling revenue opportunity
Operational Cost Savings

• A production cost model, with detailed system topology and assumptions, may be used outside the IRP process to determine operational benefits attributable to new transmission.

• These more granular benefits will only be included as part of the SBT to the extent they are incremental to those identified in the IRP modeling (i.e. no duplication of benefits), and may include:
  – Net Power Cost savings
  – Improved generation dispatch
  – Avoided generation costs
  – Avoided wheeling and firm energy purchases
Segment Loss Savings

Energy

• New transmission operated in parallel with an existing line reduces impedance, resulting in lower energy line losses.
• Forward energy price curve used to monetize the value of line loss energy savings as an avoided market purchase.

Capacity

• Lower line losses reduce overall system demand and the amount of generation capacity needed.
• Generation capacity savings calculated using the 5 highest system power flow days in a year and multiplying the base capital cost of a combined cycle gas generating plant by the capacity value of the line loss savings.
Reliability Benefits

• This metric quantifies the performance benefits to the existing system due to the addition of a new line.

• Benefits derived from:
  1. Avoidance of transmission capacity reductions (“derates”)
  2. Reductions in forced generator outages
  3. Reduced exposure to loss of customer firm load (calculated where appropriate)

• The system performance criteria used by the Company is specified in the mandatory NERC and WECC basic Transmission System Planning Standards and Performance Criteria.
Customer & Regulatory Benefits

• Transmission limitations increase the likelihood of a need to curtail load under abnormal conditions

• Such circumstances can result in economic impacts, including lost retail energy sales, lost sales for retail customers, equipment damage, lost product due to spoilage, and others.

• Outage and curtailment risk is significantly reduced with new transmission capacity

• The Company is currently investigating how this metric is used in other regions and how it may be applied as part of the SBT evaluation approach
Avoided Capital Cost

- If a transmission project avoids underlying upgrades for load service or reliability needs, the avoided cost of those projects are included as benefits.

- The avoided cost of replaced or deferred investments is a commonly used metric in transmission benefit analysis.

- The SBT factors in the one-time capital investment avoided costs for projects displaced by new transmission.
Improved Generation Dispatch

- Transmission constraints prevent the Company from dispatching the most economic resources to meet customer needs.
- The SBT calculates the value associated with generation that, with the addition of new transmission capacity, could be dispatched for reserves purposes.
- Calculated as the difference between the minimum unit operating limit and the amount of increased transmission capacity provided by the new segment(s) up to the maximum output of each unit.
- The benefit value of this generation is based on the reduced need for incremental new generation at the cost of acquiring generation or market purchases, whichever is lower.
Wheeling Revenue Opportunity

- The SBT reviews new incremental transmission capacity for each segment analyzed and identifies the value of this new capacity
- The present value of the segment’s wheeling revenue is based on PacifiCorp’s currently filed long-term point-to-point wheeling charge of $26,535 per MW-year and the new transfer capability
- Incremental system capacity is determined by comparing the initial path transfer capability with the improved path capacity

NOTE: This wheeling revenue opportunity value is mutually exclusive of the benefits discussed previously.
Sigurd-Red Butte Benefits Summary

- Operational cost savings.......................... $569 m
- Segment loss savings............................... $65 m
- Reliability benefits................................. $1 m
- Customer and regulatory benefits............ TBD
- Avoided capital cost................................. $0
- Improved generation dispatch................... $0
- Wheeling revenue opportunity............... $57 m

TOTAL (minus wheeling): $635 m
Windstar-Populus SBT Preview

Assess combined benefits/synergies of 2 sub-segments

Assess combined benefits/synergies of all 3 sub-segments
STOCHASTIC MODELING AND PREFERRED PORTFOLIO SELECTION APPROACH
Stochastic Modeling Approach

• Core case portfolios and selected sensitivity case portfolios will be simulated using the Planning and Risk (PaR) model in Monte Carlo mode (100 iterations)
  – PacifiCorp may omit portfolios that are essentially identical to others

• Modeling CO$_2$ prices
  – Execute multiple PaR simulations with differing CO$_2$ price forecasts
Preferred Portfolio Selection

• Initial portfolio screening step
  – Select the portfolio with the lowest stochastic mean PVRR as well as portfolios within $500 million of the least-cost portfolio
  – Select the portfolio with the lowest stochastic upper-tail mean PVRR as well as portfolios within $500 million of the lowest upper-tail mean PVRR portfolio
  – Select portfolios within both least-cost groups as the top performers
Sample Scatter-plot
(Core Cases, Energy Gateway Scenario 1)

- Mean PVRR within $500 million of least cost portfolio, Case C-2
- Upper-tail mean PVRR within $500 million of least cost portfolio, Case C-6
Preferred Portfolio Selection, cont.

• Final screening step: Top performers evaluated based on the following measures
  – Risk-adjusted PVRR = stochastic mean PVRR plus the expected value of the 95\textsuperscript{th} percentile production cost PVRR (Expected Value = PVRR_{95} \times 5\%)
  – Generator CO\textsubscript{2} emissions: derived from the PaR production cost model; reflects the average of the 100 Monte Carlo iterations
  – Energy Not Served (ENS): Amount of load (GWh) that cannot be met with generation
    • Two measures: average annual ENS and upper-tail mean ENS for 2013-2032
• Additional portfolio performance measures as tie-breakers:
  – **10-year customer rate impact**: Cumulative incremental percentage increase through 2020 relative to the 2011 forecasted system full revenue requirements
  – **Resource diversity**: Represented as the generation share attributable to renewables and DSM for a representative year (2020)
  – **Deterministic risk assessment**: Run top-performing portfolios through System Optimizer to determine cost differences across gas price/CO$_2$ price futures