2013
Integrated Resource Plan
IRP Modeling and Results Update
Draft Preferred Portfolio

March 21, 2013
Agenda

• Draft Preferred Portfolio Overview
  – Initial screening
  – Final screening
  – Portfolio selection

• Other results
  – PaR RPS analysis
  – PaR Energy Gateway Segment D update
IRP Schedule

• Remaining meetings
  
  – April 5, 2013 (Friday)
    • Follow-up from March 21, 2013 meeting
    • Sensitivity case results
    • Preferred Portfolio to Action Plan
  
  – April 17, 2013 (Wednesday)
    • Chapter Review and wrap-up
Status Update

- Prioritization of 2013 IRP Modeling
  - All core cases for EG-1 but for C19 (medium, then high, then zero CO\(_2\))
  - Core cases for EG-2 with RPS but for C19 (medium, then high, then zero CO\(_2\))
  - EG-5 core cases with RPS but for C19 (medium, then high, then zero CO\(_2\))
  - EG-3 and EG-4 core cases with RPS but for C19 (medium, then high, then zero CO\(_2\))
  - Sensitivities (System Optimizer and PaR)
  - Remaining cases without RPS (EG2, EG5, then EG3 and EG4), medium, then high, then zero CO\(_2\))
  - All other cases

- Improvements to model code have significantly reduced the run failure rates discussed at the February 27, 2013 public input meeting

- Run times remain long; however this is being mitigated with hardware and “hardwork”
  - 38 work stations
  - 3 SQL servers
  - 6 databases

- As of February 27, 2013 we had completed 11 PaR runs

- As of March 18, 2013 we have completed 246 PaR runs (out of 282 core case PaR studies required to complete low, medium, and high scenarios for all core case portfolios)

- Currently working on outstanding core cases and sensitivities
Preferred Portfolio Overview
Preferred Portfolio Overview

• The draft preferred portfolio is case EG2-C07 (the detailed portfolio is provided as a separate handout)
  – First 10-years of resource needs are primarily met with DSM and FOT resources
  – The first natural gas resource, a 423 MW J-Class 1x1 CCCT is added in 2024
  – 202 MW of incremental wind resources by 2022 and 858 MW of incremental wind is required by 2032
  – No incremental coal unit retirements (beyond the announced retirement of the Carbon plant)

• Reduced loads drive similarities among most core case portfolios, particularly in the front 10-years of the planning horizon
  – Differences in the location and timing of incremental renewable resources between EG1 and EG2 through EG5
  – Differences in DSM are largely driven by accelerated ramp rate assumptions for certain core cases
  – The 2013 IRP Action Plan will be consistent with the top performing portfolios (as measured by least cost/least risk)

• Given portfolio similarities, differences in cost/risk tradeoffs among portfolios are very small
  – Very “tight” grouping of portfolios with least cost and least risk outcomes
  – Portfolios with extensive early coal unit retirements are consistently high cost/risk “outliers” (these portfolios result in a system heavily dependent upon natural gas)

• Initial estimates of benefits from the System Benefit Tool (SBT) support continued pursuit of Energy Gateway investments

• The Company will develop a number of action items associated with the Gateway Transmission project that will address
  – Review of reducing potential rate impacts (and improved economics) of Energy Gateway Segment D by staging the implementation dates for sub-segments to best align with resource needs
  – Application of the SBT to additional Energy Gateway Segments
  – Continued refinement of the SBT

• The 2013 IRP action plan will also be influenced by the results of the unit-specific coal plant environmental upgrade/convert/retire/replace analysis included in Confidential Volume III
Portfolio Screening

- Identify top performing portfolios that are within a targeted range of cost and risk
  - Cost metric = stochastic mean PVRR
  - Risk metric = upper tail mean PVRR (average of top five cost iterations) net of the stochastic mean PVRR
  - Netting the stochastic mean PVRR from the upper tail mean PVRR is done to isolate fixed costs common to all iterations

- Three step process
  - Pre-screening of outlier cost/risk portfolios
  - Initial screening among remaining portfolios using cost/risk scatter plots
  - Final screening using risk adjusted net PVRR results and other considerations

- The 2011 IRP used a cost variance threshold of $500 million from the lowest cost portfolio to complete initial screening of low cost and low risk portfolios

- Initial screening for the 2013 IRP applies a percentage-based threshold to account for differences in portfolio costs among different CO₂ price scenarios
  - A threshold at 2% of stochastic mean from the lowest cost portfolio was adopted
  - This threshold produced a reasonable range of outcomes given the PVRR results from portfolios analyzed in this IRP
    - Zero CO₂ threshold = $560 million
    - Medium CO₂ cost threshold = $640 million
    - High CO₂ cost threshold = $760 million
System Benefit Tool (SBT) benefits of $655 million for Segment D (EG2) are applied to all core cases from the EG2 through EG5 scenarios – Benefits were not applied to EG1, which does not include Segment D – As the SBT is expanded to cover other segments of the Energy Gateway project in future IRPs, additional benefits may further offset portfolio costs from Energy Gateway Scenarios EG3 through EG5

Portfolios that cannot satisfy state & assumed federal RPS requirements are not considered as preferred portfolio candidates – Cases C01, C02, C04, C06, C08, C10, C12 – Results from these cases will be used to discuss how state RPS requirements affect system costs and will still provide value to stakeholders in the 2013 IRP report

Case C19 was not considered as a preferred portfolio candidate – The project associated with case C19 (Zephyr DC line) provides no reliability benefits to PacifiCorp’s existing transmission system and may require additional infrastructure additions to meet reliability standards for the existing system – The DC line does not provide for interconnection of new resources except at the termination points established if the project were constructed and does not allow for multiple interconnection points with the existing PacifiCorp transmission system – The proposed DC line with PacifiCorp participation is more expensive than Energy Gateway Segment D
Pre-screen: Remove Outlier Cases (EG-2 Example)

- Cases that are extreme outliers (those above and to the right of the dashed red line) are excluded from further screening.

- Very similar trend among all EG scenarios (see separate handout).

- Cases excluded in this step:
  - C14
  - C05
  - C09
  - C18
Initial Screen

- Portfolios within the dashed redline are selected as least cost/least risk candidates (2% of least cost threshold applied)

<table>
<thead>
<tr>
<th>Core Cases</th>
<th>Energy Gateway Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>C03</td>
<td>EG1, EG2, EG3, EG4</td>
</tr>
<tr>
<td>C07</td>
<td>EG1, EG2</td>
</tr>
<tr>
<td>C11</td>
<td>EG1</td>
</tr>
<tr>
<td>C15</td>
<td>EG1, EG2</td>
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<tr>
<td>C16</td>
<td>EG1, EG2</td>
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</table>
Preferred Portfolio Final Screening
Energy Not Served (ENS) Discussion

- ENS is generally lower among EG1 portfolios as compared to portfolios from the other Energy Gateway scenarios.

- One would expect incremental transmission would reduce ENS (improved connection between load and generation).

- Further review of the details show that the apparent ENS “advantage” of EG1 is driven by an out year anomaly that coincides with the location of out year resource additions:
  - EG1-C03 adds out year gas resources in NE Wyoming
  - EG2-C03 adds out year gas resources in Utah
  - This is driving the apparent annual average variance between the two portfolios, but it is heavily weighted in the last years of the 20-year planning period.

- Absent the out year anomalies, ENS measures are similar among candidate portfolios and among CO₂ scenarios.

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### Annual Stochastic Mean ENS (EG1-C03 and EG2-C03): Medium CO₂

![Graph showing annual stochastic mean ENS for EG1-C03 and EG2-C03 over the years 2013 to 2032.](image-url)
### Final Screening: Energy Not Served (Stochastic Mean)

<table>
<thead>
<tr>
<th>Case</th>
<th>Zero CO2</th>
<th>Medium CO2</th>
<th>High CO2</th>
<th>CO2 Scenario Average</th>
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<tbody>
<tr>
<td></td>
<td>Average Annual ENS, 2013-2032 (GWh)</td>
<td>Change from Lowest Emission Portfolio</td>
<td>Rank</td>
<td>Average Annual ENS, 2013-2032 (GWh)</td>
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<td>13.5</td>
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<td>27.7</td>
<td>9</td>
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<td>13.9</td>
<td>4</td>
<td>14.3</td>
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<td>30.8</td>
<td>30.8</td>
<td>11</td>
<td>31.5</td>
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</table>

- This metric helps to identify potential portfolio outliers with regard to ENS
- Stochastic mean, average annual ENS over the 2013 – 2032 planning horizon
Final Screening: Energy Not Served (Upper Tail Mean)

This metric helps to identify potential portfolio outliers with regard to ENS in the upper tails of the PaR stochastic simulation.

Upper tail mean, average annual ENS over the 2013 – 2032 planning horizon.

<table>
<thead>
<tr>
<th>Case</th>
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<th>CO2 Scenario Average</th>
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<tr>
<td></td>
<td>Average Annual ENS, 2013-2032 (GWh)</td>
<td>Change from Lowest Emission Portfolio</td>
<td>Rank</td>
<td>Average Annual ENS, 2013-2032 (GWh)</td>
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Final Screening: Risk Adjusted PVRR (with ENS)

<table>
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<tr>
<th>Case</th>
<th>Risk Adjusted PVRR (Zero CO2) ($m)</th>
<th>Change from Lowest Cost Portfolio (Zero CO2) ($m)</th>
<th>Rank</th>
<th>Risk Adjusted PVRR (Medium CO2) ($m)</th>
<th>Change from Lowest Cost Portfolio (Medium CO2) ($m)</th>
<th>Rank</th>
<th>Risk Adjusted PVRR (High CO2) ($m)</th>
<th>Change from Lowest Cost Portfolio (High CO2) ($m)</th>
<th>Rank</th>
<th>CO2 Scenario Average</th>
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</thead>
<tbody>
<tr>
<td>EG1-C03</td>
<td>$29,131</td>
<td>$279</td>
<td>4</td>
<td>$33,297</td>
<td>$237</td>
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<td>$0</td>
<td>6</td>
<td>$34,179</td>
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<td>$33,709</td>
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<td>$33,060</td>
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<td>7</td>
<td>$40,108</td>
<td>$421</td>
<td>7</td>
<td>$34,245</td>
</tr>
</tbody>
</table>

- This metric combines cost and risk measures
- Stochastic mean plus the expected value of the 95th percentile production cost PVRR
- Expected value of 95th percentile = $\text{PVRR}_{95} \times 5\%$
Final Screening: Risk Adjusted PVRR (without ENS)

- Cases EG1-C15 and EG2-C15, both with accelerated DSM, yield the highest ranking risk adjusted net PVRR

- Cases EG1-C03, EG1-C16, EG2-C07 and EG2-C03 also rank high in relation to the C15 cases

- The aforementioned ENS anomaly is influencing the apparent cost advantage of EG1 portfolios on a risk adjusted net PVRR basis (ENS is priced at $1,000/MWh)

- The table below shows the risk adjusted net PVRR rankings absent the cost of ENS

<table>
<thead>
<tr>
<th>Case</th>
<th>Zero CO2</th>
<th>Medium CO2</th>
<th>High CO2</th>
<th>CO2 Scenario Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk Adjusted PVRR w/o ENS ($m)</td>
<td>Change from Lowest Cost Portfolio ($m)</td>
<td>Rank</td>
<td>Risk Adjusted PVRR w/o ENS ($m)</td>
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<tr>
<td>EG1-C15</td>
<td>$28,706</td>
<td>$20</td>
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<td>$28,686</td>
<td>$0</td>
<td>1</td>
<td>$32,909</td>
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Final Screening: CO₂ Emissions

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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>EG1-C03</td>
<td>863,055</td>
<td>8,106</td>
<td>3</td>
<td>828,908</td>
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<tr>
<td>EG2-C03</td>
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<td>797,023</td>
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<td>794,513</td>
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<td>796,014</td>
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<td>10</td>
<td>812,066</td>
<td>18,187</td>
<td>10</td>
</tr>
</tbody>
</table>

- This metric helps to identify potential emission outliers among portfolios
- Accumulated annual emissions over the 2013 – 2032 planning horizon (stochastic mean)
- Accumulated emissions are similar among most candidate portfolios (note that 4 million tons equates to an annual average of 0.2 million tons per year
Accelerated DSM Discussion

• Cases EG1-C15 and EG2-C15 include accelerated DSM assumptions

• While the risk adjusted PVRR is low for these cases, the costs assumed to implement the DSM in this portfolio are highly uncertain (administrative and incentives)

• There is no ramp rate associated with the accelerated DSM in this case, creating potentially significant acquisition challenges

• For these reasons, the Company has not selected Cases EG1-C15 and EG2-C15 for its preferred portfolio

• Nonetheless, the potential benefits of acquiring increased DSM resources early is evident in these two cases, and the 2013 IRP will consider findings from these cases in its action plan
  – Specific action items targeting accelerated acquisition of cost-effective DSM resources that can be used to mitigate FOT purchases in the 10-year action plan period
  – Specific action items to address regulatory challenges with pursuing accelerated DSM targets
Comparison of Top Portfolios (2013 – 2022)

Final Screening Portfolio Comparison (2013 - 2022)

Cumulative Capacity (MW)

-500
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500

EG2-C07
EG2-C03
EG1-C16
EG1-C03
EG2-C07
EG2-C03
EG1-C16
EG1-C03
EG2-C07
EG2-C03
EG1-C16
EG1-C03

2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

Gas Conversion
Class 2 DSM
Class 1 DSM
FOTs
CCCT
Frame SCCT
Aero
Other
Wind
Utility Solar
Geothermal PPA
End of Life Retirement
Early Retirement
Comparison of Top Portfolios (2023 – 2032)

Final Screening Portfolio Comparison (2023 - 2032)
Nominal Revenue Requirement Impacts

- Annual real levelized revenue requirement is converted to nominal revenue requirement costs.
- Annual nominal revenue requirement costs from Cases EG2-C03 and EG1-C03 are netted against Case EG2-C07 (the case with the lowest risk adjusted net PVRR without ENS).
- A negative figure reflects lower costs relative to EG2-C07.
- Transmission investments have a long life (58 years) as compared to resources (25 years for wind).
- Transmission capital tends to increase nominal revenue requirement in the near-term and reduces revenue requirement over the long-term as it depreciates.
Preferred Portfolio Selection

- The Company has selected Case EG2-C07 as the draft preferred portfolio for the 2013 IRP

- While candidate portfolios are very similar among the front 10-years of the planning period, Case EG2-C07 yields the best risk adjusted net PVRR result among top screened portfolios when accounting for the anomalous ENS “benefits” associated with EG1 portfolios

- Estimated benefits from the System Benefit Tool (SBT) support continued pursuit of the Windstar-Populus Energy Gateway investment
  - Factors that would affect the incremental amount of wind required on the system (i.e. higher retail sales, federal environmental and tax policies, cost allocation of resources that meet state RPS requirements) would provide additional system benefits to customers
  - With prospective future additions of other Energy Gateway segments, the incremental capacity of Segment D would increase without any incremental cost, providing additional system benefits to customers

- The Company will develop a number of action items associated with the Gateway Transmission project that will address
  - Review of reducing potential rate impacts (and improved economics) of Energy Gateway Segment D by staging the implementation dates for sub-segments to best align with resource needs
  - Application of the SBT to additional Energy Gateway Segments
  - Continued refinement of the SBT

- The Company will also develop detailed action items associated with DSM given results from the accelerated DSM cases EG2-C15 and EG1-C15
  - Specific action items targeting accelerated acquisition of cost-effective DSM resources that can be used to mitigate FOT purchases in the 10-year action plan period
  - Specific action items to address regulatory challenges with pursing accelerated DSM targets
2013 IRP OTHER STOCHASTIC MODELING RESULTS
Resources required to meet RPS requirements add incremental system costs that are partially offset by system benefits (difference between the blue line and the red bars).

On a PVRR basis, projected benefits increase with higher CO$_2$ price assumptions:
- On average, 56% of the cost is offset under the zero CO$_2$ case
- On average, 65% of the cost is offset under the medium CO$_2$ case
- On average, 80% of the cost is offset under the high CO$_2$ case
Incremental renewable resource costs are lower under EG-2 because Energy Gateway Segment D provides access to Wyoming wind resources that have high capacity factors.

As compared to EG-1, inclusion of the lower cost Wyoming wind resources in the preferred portfolio increases the proportion of renewable resource costs that are offset by system benefits:
- On average, 60% of the cost is offset under the zero CO₂ case
- On average, 70% of the cost is offset under the medium CO₂ case
- On average, 89% of the cost is offset under the high CO₂ case
Renewable Resource Benefits

- Renewable resources provide zero-emission energy to the system
  - Costs are offset by system energy benefits
  - Renewable energy credits (RECs) can be sold to further offset resource costs
  - All states see benefits, which may or may not offset all of the costs

- Renewable resources can be used for state RPS requirements
  - RECs can be used to meet state RPS obligations
  - Those states with an RPS requirement benefit

- Renewable resources can be used to meet prospective federal RPS requirements or otherwise reduce costs associated with potential future federal green house gas policies
  - RECs can be used to meet federal RPS obligations
  - All states benefit

- To minimize system costs, the 2013 IRP assumes that state RPS-eligible RECs from renewable resources that would otherwise not be cost effective absent an RPS obligation are situs assigned to states with existing RPS rules

- The 2013 IRP does not address how costs for incremental renewable resources might be allocated among the states
Stochastic Energy Gateway Results: EG-2 vs. EG-1, Medium CO₂

- Change in system PVRR costs are inclusive of $655 million of benefits resulting from the System Benefits Tool (SBT) draft calculations.

- Segment D provides access to low cost Wyoming wind resources, as evidenced by improved economics among those cases that include RPS requirements.

- Factors that would affect the incremental amount of wind required on the system (i.e. higher retail sales, federal environmental and tax policies, cost allocation of resources that meet state RPS requirements) would provide additional system cost savings not captured in the figure above.

- Zero and high CO₂ price scenarios show a similar trend (next slide).
Stochastic Energy Gateway Results: EG-2 vs. EG-1, Zero and High CO₂

EG-2 vs. EG-1: Zero CO₂

Change in System PVRR ($b)

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PVRR of Incremental Transmission Cost

EG-2 vs. EG-1: High CO₂

Change in System PVRR ($b)

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PVRR of Incremental Transmission Cost