Selected Findings from Scenario’s 1A, 1B and 2C Updated to Reflect Revisions in ARM and Peak Load Calculations

Systems Analysis Advisory Committee Meeting

5/21/15
What We Have Today

- Comparison of the Least Cost Resource Strategies across 800 futures for three Scenarios (No Uncertainty (1A), Current Policy (1B) and Carbon Risk (2C))
  - Distribution of Net System Cost ($)
  - Distribution of conservation development (aMW and MW)
  - Distribution of RPS resource development (aMW and MW)
  - Distribution of Thermal Resource development (aMW and MW)
  - CO₂ emissions without carbon risk uncertainty (Scenario 1B) and with carbon risk uncertainty (Scenario 2C) for Total Regional Power System and Plants Affected by EPA’s Proposed 111(d) Regulation
  - Opportunity to Review Selected RPM Results for Selected Futures
Least Cost Strategy Comparison Between Scenarios 1A and 1B

Net System Cost - ($2012 billions)

Probability

- Least Cost Strategy - Scenario 1B
- Least Cost Strategy - Scenario 1A
- Mean
- System Risk
- System Risk
Average Cumulative Conservation Build – Energy
Scenarios 1A and 1B

- Scenario 1B - Least Cost
- Scenario 1A - Least Cost
Average Total RPS Resource Build – Energy
Scenarios 1A and 1B

Year

Energy (aMW)

Least Cost Strategy - Scenario 1B

Least Cost Strategy - Scenario 1A
Average Cumulative Renewable Generation – Energy
Scenarios 1A and 1B

- Scenario 1B - Least Cost
- Scenario 1A - Least Cost

Year

Energy (aMW)
Average Cumulative Conservation Build – Winter Peak
Scenarios 1A and 1B

Year/Period

Contribution to Winter Peak (MW)

Scenario 1B - Least Cost
Scenario 1A - Least Cost
Average Cumulative Demand Response – Winter Peak
Scenarios 1A and 1B

Year/Quarter

Contribution to Winter Peak (MW)

Scenario 1B - Least Cost
Scenario 1A - Least Cost
Average Cumulative Renewable Generation – Winter Peak
Scenarios 1A and 1B

Year/Quarter

Contribution to Winter Peak (MW)

Scenario 1B - Least Cost
Scenario 1A - Least Cost
Average Cumulative Thermal Generation – Winter Peak
Scenarios 1A and 1B

Year/Quarter

Contribution to Winter Peak (MW)

Scenario 1B - Least Cost
Scenario 1A - Least Cost
Average Cumulative Demand Response – Summer Peak

Scenarios 1A and 1B

<table>
<thead>
<tr>
<th>Year/Quarter</th>
<th>Contribution to Summer Peak (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 Q3</td>
<td>0</td>
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<tr>
<td>2021 Q3</td>
<td>600</td>
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<tr>
<td>2026 Q3</td>
<td>600</td>
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<td>2031 Q3</td>
<td>600</td>
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</tbody>
</table>

- Scenario 1A - Least Cost
- Scenario 1B - Least Cost
Average Cumulative Renewable Generation – Summer Peak

Year/Quarter

Contribution to Summer Peak (MW)

Scenario 1B - Least Cost

Scenario 1A - Least Cost
Winter Peaking Capacity of New Resources - Least Cost Strategy Scenario 1A

Cumulative Capacity (MW)

- Demand Response
- Renewable Generation
- Thermal Generation
- Conservation

Year/Quarter

2020 Q1
2025 Q1
2030 Q1
2035 Q1
Winter Peaking Capacity of New Resources - Least Cost Strategy Scenario 1B

Cumulative Capacity (MW)

Year/Quarter

2020 Q1 2025 Q1 2030 Q1 2035 Q1

Demand Response
Renewable Generation
Thermal Generation
Conservation
<table>
<thead>
<tr>
<th>Percent of Futures with Economic Builds</th>
<th>2020</th>
<th>2035</th>
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</thead>
<tbody>
<tr>
<td>Least Cost Scenario 1B</td>
<td>0%</td>
<td>1%</td>
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<tr>
<td>Least Cost Scenario 2C</td>
<td>0%</td>
<td>5%</td>
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Average Cumulative Thermal Generation – Summer Peak
Scenarios 1A and 1B

Contribution to Summer Peak (MW)
Year/Quarter

Scenario 1B - Least Cost
Scenario 1A - Least Cost

2016 Q3 2021 Q3 2026 Q3 2031 Q3
Distribution of Net System Cost for Least Cost Resource Strategy in Scenarios 1B and 2C

- Least Cost Strategy - Scenario 1B
- Least Cost Strategy - Scenario 2C
- Mean
- System Risk

Net System Cost - ($2012 billions)
Distribution of Cumulative Conservation Builds - 2035

- Least Cost Strategy - Scenario 1B
- Least Cost Strategy - Scenario 2C
Average Cumulative Conservation Build – Energy

- **Scenario 1B - Least Cost**
- **Scenario 2C - Least Cost**
Distribution of Total RPS Resource Builds - 2035

- Least Cost - Scenario 1B
- Least Cost - Scenario 2C
Average Annual RPS Resource Additions

- Least Cost Strategy - Scenario 1B
- Least Cost Strategy - Scenario 2C

Energy (aMW)

Year

Average Cumulative RPS Resource Generation

- Energy

<table>
<thead>
<tr>
<th>Year</th>
<th>Scenario 1B - Least Cost</th>
<th>Scenario 2C - Least Cost</th>
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<td>2035</td>
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Average Cumulative Energy Generation of New Resources - Least Cost Strategy Scenario 1B

Cumulative Energy (aMW)

Year

Demand Response
Renewable Generation
Thermal Generation
Conservation
Average Cumulative Energy of New Resources - Least Cost Strategy Scenario 2C

- Demand Response
- Renewable Generation
- Thermal Generation
- Conservation
Average Winter Peaking Capacity of New Resources - Least Cost Strategy Scenario 1B

Cumulative Capacity (MW)

Winter Year

Demand Response
Renewable Generation
Thermal Generation
Conservation
Average Winter Peaking Capacity of New Resources - Least Cost Strategy Scenario 2C

Winter Year

Cumulative Capacity (MW)

- Demand Response
- Renewable Generation
- Thermal Generation
- Conservation
Average Cumulative Conservation – Winter Peak Capacity

- Scenario 1B - Least Cost
- Scenario 2C - Least Cost
Average Cumulative Demand Response – Winter Peak

Year/Quarter

Contribution to Winter Peak (MW)

Scenario 1B - Least Cost
Scenario 2C - Least Cost

Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN
Average Cumulative RPS Generation – Winter Peak

Year/Quarter

Contribution to Winter Peak (MW)

- Scenario 1B - Least Cost
- Scenario 2C - Least Cost
Average Cumulative Demand Response – Summer Peak

Scenario 1B - Least Cost
Scenario 2C - Least Cost
Average Cumulative Renewable Generation – Summer Peak

Contribution to Summer Peak (MW)

Year/Quarter

Scenario 1B - Least Cost
Scenario 2C - Least Cost
Total Regional Power System CO2 Emissions - 2030

- Least Cost 1B Strategy 2030
- Least Cost 2C Strategy 2030
- Mean
- 90th percentile

Historical Range of Existing System CO2
CO2 Emissions for In-Region Resources Affected by EPA’s Proposed Clean Power Plan 111(d) Regulation - 2030

- Least Cost 1B Strategy 2030
- Least Cost 2C Strategy 2030
- Mean
- 90th percentile
- EPA Target
Thermal Resource Dispatch with Carbon Risk

![Diagram showing thermal resource dispatch with carbon risk from 2016 to 2031.](image)

- DR
- New Renewables
- Existing Renewables
- New Gas
- Existing Gas
- Other Coal
- Centralia
- Boardman
- Other Must Run
- CGS

Generation (aMW)

2016 2021 2026 2031
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Scenario Name</th>
<th>Priority</th>
<th>Modeling Effort</th>
<th>DRAFT Schedule</th>
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<tbody>
<tr>
<td>1B</td>
<td>Existing Policy with Uncertainty, w/o GHG reduction risk</td>
<td>1</td>
<td>Med</td>
<td>April</td>
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<td>1A</td>
<td>Existing Policy without Uncertainty, w/o GHG reduction risk</td>
<td>2</td>
<td>Med</td>
<td>April</td>
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<td>2C</td>
<td>Existing Policy with Uncertainty and with uncertain GHG reduction risk/target. Example Policy Target = Mitigate to Estimated GHG Damage Cost</td>
<td>3</td>
<td>Low</td>
<td>April</td>
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<td>2B</td>
<td>Existing Policy with Uncertainty and with certain GHG reduction risk/target. Example Policy Target = Clean Power Plan/Clean Air Act 111(d) goal (e.g., 30% below 2005 level by 2030)</td>
<td>4</td>
<td>Low</td>
<td>Early May</td>
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<td>4C</td>
<td>Major Resource Uncertainty – Faster Pace of Conservation Deployment</td>
<td>5</td>
<td>Low</td>
<td>Early May</td>
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<tr>
<td>4D</td>
<td>Major Resource Uncertainty – Slower Pace of Conservation Deployment</td>
<td>6</td>
<td>Low</td>
<td>Early May</td>
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<td>2A</td>
<td>Existing Policy with Uncertainty and with certain GHG reduction risk/target. Example Policy Target = Clean Power Plan/Clean Air Act 111(d) goal (e.g., 30% below 2005 level by 2030)</td>
<td>7</td>
<td>Med</td>
<td>Late May</td>
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<td>3A</td>
<td>Lowering carbon emissions with current technology</td>
<td>8</td>
<td>Med</td>
<td>Late May</td>
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<tr>
<td>4A</td>
<td>Major Resource Uncertainty - Unexpected Loss of Major Resource (e.g., CGS Forced Retirement)</td>
<td>9</td>
<td>Med/High</td>
<td>Late May</td>
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<tr>
<td>4B</td>
<td>Major Resource Uncertainty Anticipated Loss of Major Resource(s) (e.g., Snake River Dam Removal,)</td>
<td>10</td>
<td>Low</td>
<td>Late May</td>
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<td>3B</td>
<td>Lowering carbon emissions with emerging technology (e.g., storage, CO₂ heat pumps, SSL)</td>
<td>11</td>
<td>High</td>
<td>Not Modeled</td>
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<td>5A</td>
<td>Integration of Variable Resources (i.e., Managing the NW Impact of the &quot;Duck Curve&quot;/50% CA RPS)</td>
<td>12</td>
<td>Med/High</td>
<td>Early June</td>
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<td>6A</td>
<td>Climate Change Load Impacts Resulting from Direct Effects of Climate Change</td>
<td>13</td>
<td>Low</td>
<td>Early June</td>
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<tr>
<td>6B</td>
<td>Climate Change Hydro Impacts</td>
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<td>High</td>
<td>Early June</td>
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<td>5B</td>
<td>Southwest Market Liquidity Variability</td>
<td>15</td>
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<td>Early June</td>
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