Analysis Regional Portfolio Model Results

Conservation Resources Advisory Committee September 2, 2015
Outline

- Key Resource Strategy Findings
- RPM Refresher: What it does & how we use it
- Key Findings for all resources & policies
- Key Findings for Energy Efficiency
- Principle Elements of Resource Strategy
Status

- Results in this presentation are findings to date
- They form the basis of the proposed draft plan
- Currently in discussion and review with Council
- Looking for CRAC feedback
Key Resource Strategy Findings

- Least-cost resource strategies consistently rely on conservation and demand response to meet future energy and capacity needs.
- Demand response or increased reliance on external markets are potentially competitive options for providing winter capacity to meet regional resource adequacy requirements.
- Replacement of announced coal plant retirements can generally be achieved with only modest new development of natural gas generation.
- Northwest exports play a significant role in regional resource development.
- Compliance with EPA CO2 emissions limits at the regional level, is attainable through resource strategies that do not depart significantly from those that are not constrained by those regulations.
WHAT THE RPM DOES
&
HOW WE USE IT
The Council Uses Scenario Analysis to “Stress Test” Resource Strategies Against These Uncertainties

**Resource Strategies** – actions and policies over which the decision maker *has control* that will affect the outcome of decisions

**Futures** – circumstances over which the decision maker *has no control* that will affect the outcome of decisions

- Load Uncertainty
- Resource Uncertainty
  - Output
  - Cost
  - Construction Lead Times
- Wholesale Electricity Market Price Uncertainty

**Scenarios** – Combinations of Resource Strategies and Futures used to “stress test” how well what we control performs in a world we don’t control
Scenario Analysis Will Seek to Identify Resource Strategies That Are:

- Best suited to replace existing generating resources with known retirement dates
- Robust against the risk of a range of future
  - Load growth
  - Hydro conditions
  - Loss of existing generation resources
  - Lower “average,” but occasionally volatile gas and electric market prices
  - GHG emissions controls
  - Reliance on power market imports
  - Uncertain technology change
  - “What we don’t know, we don’t know”
### 7P Scenario “Stresses”

<table>
<thead>
<tr>
<th>Scenario 1A</th>
<th>Existing Policy, No Uncertainty</th>
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</thead>
<tbody>
<tr>
<td>Scenario 1B</td>
<td>Existing Policy, No Carbon Risk</td>
</tr>
<tr>
<td>Scenario 2B</td>
<td>Carbon Reduction - Social Cost of Carbon</td>
</tr>
<tr>
<td>Scenario 2C</td>
<td>Carbon Risk</td>
</tr>
<tr>
<td>Scenario 3A</td>
<td>Maximum Carbon Reduction, Existing Technology</td>
</tr>
<tr>
<td>Scenario 4A</td>
<td>Unplanned Loss of Major Non-GHG Emitting Resource</td>
</tr>
<tr>
<td>Scenario 4B</td>
<td>Planned Loss of Major Non-GHG Emitting Resource</td>
</tr>
<tr>
<td>Scenario 4C</td>
<td>Faster Near-Term Pace of Conservation Deployment</td>
</tr>
<tr>
<td>Scenario 4D</td>
<td>Slower Near-Term Pace of Conservation Deployment</td>
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<tr>
<td>Scenario 5B</td>
<td>Increased Reliance on External Market</td>
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</tbody>
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### 7P Sensitivity “Stresses”

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>1B_No Coal Retirements</td>
</tr>
<tr>
<td>S2</td>
<td>1B_Low Gas Prices</td>
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<tr>
<td>S2.1</td>
<td>2C_Low Gas Prices</td>
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<tr>
<td>S3</td>
<td>1B_No Demand Response</td>
</tr>
<tr>
<td>S3.1</td>
<td>2C_No Demand Response</td>
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<tr>
<td>S5</td>
<td>1B_35% RPS</td>
</tr>
<tr>
<td>S6</td>
<td>2B_95th Percentile SCC</td>
</tr>
<tr>
<td>S7</td>
<td>2B_No Conservation</td>
</tr>
<tr>
<td>S8</td>
<td>2B_95th Percentile SCC w/No Conservation</td>
</tr>
<tr>
<td>S9</td>
<td>1B_No Transmission and Distribution Cost Deferral Credit</td>
</tr>
<tr>
<td>S10</td>
<td>1B_No Conservation Adder</td>
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</tbody>
</table>
Compare Resource Strategies Across 800 Futures for All Scenarios & Sensitivities

Comparison Metrics

- Distribution of Net System Cost ($)
- Distribution of Conservation development (aMW & MW)
- Distribution of RPS Resource development (aMW & MW)
- Average Thermal Resource development (aMW & MW)
- Distribution of Demand Response development (MW)
- CO2 emissions for Total Regional Power System and Plants Affected by EPA’s Proposed 111(d) Regulation (tons)
A Resource Strategy’s Cost and Risk Depend on the Future

Number of Observations

Net Present Value Power Cost (millions)->

Cost for Future 1

Cost for Future 2
Expected Cost and Risk Metrics

Expected Value of Resource Strategy’s Cost = Average Cost Across All Futures

Expected Value of Resource Strategy’s Risk = Average Cost of “Worst” 10% of Futures
Many RPM Results Are Shown As Distributions Across All Futures

Higher values show more likely outcomes

Average Values Across All Futures

Higher values show more extreme outcomes
Notable RPM Revisions Since 6P

- Explicit Test for System Adequacy
  - ARM – Adequacy Reserve Margin
  - Both Energy and Capacity
  - Build trigger for energy or for capacity

- Revised Logic for Lost-Opportunity
  - Not lost forever if frequent measure turnover
KEY FINDINGS ALL RESOURCES
Key Finding:
Average Conservation Development Across Scenarios Varies Little Across Scenarios Except Under Sustained Low Gas Prices and Increased RPS
Key Finding:

The **Probability and Amount** of Demand Response Varies Over a Wide Range, and is Particularly Sensitivity to Extra-Regional Market Reliance Assumptions.
Key Finding:
Average New Renewable Resource Development **Does Not** Significantly Increase Under Carbon Emissions Reduction Policy Scenarios Except For A Policy That Sets Renewable Portfolio Standard at 35%

![Graph showing annual energy contribution (aMW) for different scenarios from 2021 to 2035.](image)

- **RPS at 35%**
- **Social Cost of Carbon - High**
- **Low Gas Prices with Carbon Risk**
- **Existing Policy, No Carbon Risk**
- **Maximum CO2 Reduction**
- **No Demand Response with Carbon Risk**
- **Slower Conservation Deployment**
- **No Demand Response, No Carbon Risk**
- **Social Cost of Carbon - Base**
- **Faster Conservation Deployment**
- **Carbon Risk**
- **Unplanned Loss of Major Resource**
- **Planned Loss of Major Resource**
- **Low Gas Prices, No Carbon Risk**
- **Increased Market Reliance**
Key Finding:
There is a Low Probability of Any Thermal Development by 2021
Except Under Scenarios That Increase RPS or Do Not Develop Demand Response
Key Finding:
The Probability of Thermal Development by 2026 Is Modest
Except In Scenarios That Assume All Coal Plant Retirements or Do Not Develop Demand Response
Key Finding:
Reduction of Regional Exports Generally Reduces Need for In Region Resource Development, Except with Increased RPS or When No Carbon Cost Risks Are Considered

- Planned Loss of Major Resource
- Unplanned Loss of Major Resource
- Social Cost of Carbon - High
- Social Cost of Carbon - Base
- Low Gas Prices with Carbon Risk
- Carbon Risk
- Slower Conservation Deployment
- Faster Conservation Deployment
- No Demand Response with Carbon Risk
- Low Gas Prices, No Carbon Risk
- Increased Reliance on External Market
- Existing Policy, No Carbon Risk
- Maximum CO2 Reduction
- No Demand Response, No Carbon Risk
- RPS at 35%
Key Finding:
There is A Very High Probability of Meeting EPA 111(d) Emissions Limits Across All Scenarios and Future Conditions Tested

Probability Across All Futures of Meeting EPA CO2 2030 Emission Limits
Least-Cost Strategies Have a Wide Range of Average Net Present Value System Cost

NPV Cost & Risk with Carbon Cost Included

- Low Gas Prices, No Carbon Risk
- Increased Market Reliance
- Existing Policy, No Carbon Risk
- No Demand Response, No Carbon Risk
- Low Gas Prices with Carbon Risk
- Maximum CO2 Reduction
- No Demand Response with Carbon Risk
- Slower Conservation Deployment
- Carbon Risk
- Faster Conservation Deployment
- RPS at 35%
- Social Cost of Carbon - Base
- Planned Loss of Major Resource
- Unplanned Loss of Major Resource
- Social Cost of Carbon - High
Least-Cost Strategies Have a Wide Range of Average Net Present Value System Cost

NPV of System Cost & Risk without Carbon Cost

- Low Gas Prices, No Carbon Risk
- Increased Market Reliance
- Existing Policy, No Carbon Risk
- No Demand Response, No Carbon Risk
- Low Gas Prices with Carbon Risk
- Maximum CO2 Reduction
- No Demand Response with Carbon Risk
- Carbon Risk
- Slower Conservation Deployment
- Faster Conservation Deployment
- Social Cost of Carbon - Base
- RPS at 35%
- Planned Loss of Major Resource
- Unplanned Loss of Major Resource
- Social Cost of Carbon - High

Average System Cost w/o CO2$
Average System Risk w/o CO2$ (TailVar90)
Reminder: Efficiency Inputs

Energy Efficiency 7P Supply Curve

Technical Achievable Potential (aMW)

TRC Net Levelized Cost (2012$/MWh)

- Lost Opportunity
- Retrofit
Reminder: Levelized Cost Bins

Program Year

- $aMW$

- $>/170$
- $140-170$
- $110-140$
- $80-110$
- $50-80$
- $20-50$
- $<20$/MWh
Reminder: Levelized Cost Bins

Program Year

1,800
1,600
1,400
1,200
1,000
800
600
400
200
0

aMW

>170
140-170
110-140
80-110
50-80
20-50
<20 $/MWh
Reminder: Baseline Load Forecast is Lower & Narrower Range

![Graph showing forecast regional loads from 2014 to 2034]

- Forecast Regional Loads (aMW)
- Year

- 2014
- 2016
- 2018
- 2020
- 2022
- 2024
- 2026
- 2028
- 2030
- 2032
- 2034

6P and 7P lines on the graph represent different forecast scenarios.
Key Findings EE

- Average conservation development varies little across scenarios
- Meet most (90%) load growth & retirement via EE & DR
- Build EE for energy if cheaper than market
  - Lots cheaper than market
- Build EE for adequacy when needed
  - Needed now in most cases
  - Adequacy need is bigger driver than ramp rates
  - Capacity value of EE is makes it a valuable resource for system adequacy
- Narrow range of development of EE within a scenario
- High system cost of buying only spot market price EE
- External Market assumptions impact EE build for adequacy
- Not much difference between Lost Opp vs Retrofit
Key Finding:
Average Conservation Development Across Scenarios Varies Little Across Scenarios Except Under Sustained Low Gas Prices and Increased RPS
Most Load Growth Met with EE & DR

- Under 90 percent of the futures energy efficiency meets all load growth through 2030 and under 60 - 70 percent of the futures all load growth through 2035

But only if DR and all cost-effective EE acquired

Low probability of thermal build by 2026 – even with Boardman & Centralia closed
Meet Most Load Growth with EE & DR

Net Load After Conservation Is Relatively Flat

Least Cost Strategies for All Scenarios Have Similar Net Loads as 6P Loads Net of Conservation
Least-Cost Plans Build EE Greater Than Spot Market Price

- Always builds EE cheaper than spot market
- Builds EE if needed for system adequacy (ARM for capacity or energy)
- Builds EE for adequacy starting 2016 in most futures
- Compare Scenario 1B and Sensitivity s10
  - S10 limits EE build to spot-market price
Strategies Using Spot Market Price for EE Avoided Cost Are More Expensive & Risky
But NPV System Cost Much Higher

1B: Average NPV Cost $87 billion

S10: Average NPV Cost $101 billion
Least-Cost Strategies Build More EE Than Strategy Using Spot Market Price Avoided Cost

**Distribution Conservation Development by 2021**

- **Sum of Scenario 1B**
- **Sum of Sensitivity S10 - Scenario 1B_No Conservation Adder**

**Scenario 1B: Existing Policy, No Carbon Risk**
Least-Cost Strategies Build More EE Than Strategy Using Spot Market Price Avoided Cost

Distribution Conservation Development by 2026

Scenario 1B: Existing Policy, No Carbon Risk
Least-Cost Strategies Build More EE Than Strategy Using Spot Market Price Avoided Cost

Scenario 1B: Existing Policy, No Carbon Risk
What About Only Building EE if Less Costly than Short Term Market Price?

Big drop in Least-Cost EE Strategy

Average Conservation Build (Energy aMW)

- Scenario 1B - Existing Policy, No Carbon Risk
- Sensitivity S10 - Scenario 1B_No Conservation Adder
Why Build EE Over Spot Market?

- Most futures need resources for system adequacy (energy or capacity)
- EE is cheaper than other resources that can be used for system adequacy
Lots of EE Between Spot Market Price & Cost of New Generation

Technical Achievable Potential (aMW)

TRC Net Levelized Cost (2012$/MWh)

- Lost Opportunity
- Retrofit
Because More Expensive Resources Fill the Gap

**Winter Peak Contribution (MW)**

- **Scenario 1B** - Existing Policy, No Carbon Risk
- **Sensitivity S10** - Scenario 1B_No Conservation Adder

<table>
<thead>
<tr>
<th>Resource</th>
<th>Average of 2021</th>
<th>Average of 2026</th>
<th>Average of 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>10000</td>
<td>8000</td>
<td>6000</td>
</tr>
<tr>
<td>DR</td>
<td>2000</td>
<td>4000</td>
<td>6000</td>
</tr>
<tr>
<td>Renewable</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Thermal</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Bar chart showing contributions for different years and scenarios.
Conservation is the Single Largest Source of Winter Peak Development in Least Cost Resource Strategies

Scenario 1B: Existing Policy, No Carbon Risk
Narrow Range of EE Build For Least-Cost Strategies Across 800 Futures within a Scenario

70% of futures between 1300-1325 aMW

70% of futures between 1425-1450 aMW
Narrow Distribution Later Too

**Distribution Conservation Development by 2026**

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon - Base

Plus or minus 100 aMW from mean by 2026 (+-3%) for ~90% of futures

**Distribution Conservation Development by 2035**

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon - Base

Plus or minus 200 aMW from mean by 2035 (+-5%) for ~90% of futures
Most Scenarios Show Narrow Ranges of EE Build for Least-Cost Resource Strategies

Distribution of Conservation Development by 2026

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon - Base
- Sum of 2C - Carbon Risk
- Sum of 3A - Maximum CO2 Reduction, Existing Technology
- Sum of 4A - Unplanned Loss of Major Resource
- Sum of 4B - Planned Loss of Major Resource
- Sum of 4C - Faster Near-Term Pace of Conservation Deployment
- Sum of 4D - Slower Near-Term Pace of Conservation Deployment
- Sum of 5B - Increased Market Reliance
- Sum of Sensitivity S6 - Scenario 2B_SCC at 95%
- Sum of Sensitivity S3.1 - Scenario 2C_NoDR
- Sum of Sensitivity S3 - Scenario 1B_No DR
- Sum of Sensitivity S2.1 - Scenario 2C_Low Gas Prices
- Sum of Sensitivity S2 - Scenario 1B_Low Gas Prices
- Sum of Sensitivity S5 - Scenario 1B_RPS at 35%
Why Narrow Range of EE Build?

- Building for adequacy in near term
- Reduced range of uncertainties
  - Gas price, load forecast, fixed carbon scenarios
- Most variance due to changes in growth
  - Higher EE potential when more new additions
  - Narrow range of load growth
Building for Adequacy?

- Compare 1B with and without DR
With No DR, More EE Built 2021

Distribution Conservation Development by 2021

Scenario 1B: Existing Policy, No Carbon Risk
With No DR, More EE Built 2026

Distribution Conservation Development by 2026

Scenario 1B: Existing Policy, No Carbon Risk
Sensitivity S3 – No Demand Response Without DR Both Net Present Value System Cost and System Risk Increase by ~$1 billion

- **Scenario 1B - Current Policy, No Carbon Risk**
- **Sensitivity S3 - Scenario 1B_No Demand Response**
What About Low Gas Prices?

Scenario S2: Lower Gas & Electric Spot-Market Prices

- **Natural Gas Prices (95% CI)**
  - Spot Market Electricity Prices (95% CI)
Lower Gas Prices Reduce Coal Use & Exports, Increase Gas Use, Little Change in EE

Changes in Energy Dispatch with Systematically Lower Gas and Electric Market Prices

1. Sum of Net Market Exports (aMW) in 2026
2. Sum of Existing Hydro Dispatch (aMW) Flat
3. Sum of Existing Coal Dispatch (aMW) in 2026
4. Sum of Existing Gas Dispatch (aMW) in 2026
5. Sum of New Gas Generation Dispatch (aMW) by 2026
6. Sum of Renewable Resources (aMW) by 2026
7. Sum of Conservation (aMW) by 2026
Results of Sensitivity Study S2
Scenario 1B – Existing Policy, No Carbon Risk, Low Gas Prices

Compared to 1B – Existing Policy, No Carbon Risk

- Slightly decrease conservation
  - -17 aMW by 2021
  - -74 aMW by 2026
  - -300 aMW by 2035
- Demand response development is nearly identical
- Slightly change in renewables
  - 40 aMW by 2021
  - -90 aMW by 2035
- Large reduction coal generation
  - -1800 aMW in 2021
  - -1150 aMW in 2026
  - -1050 aMW in 2035
- Slightly increased new natural gas generation
  - +35 aMW in 2035
- Slightly increased existing natural gas generation
  - +235 aMW in 2021 and 2026
  - +125 aMW in 2035
- Slightly decreased regional exports
  - - 390 aMW in 2021
  - -540 aMW in 2026
  - -1375 aMW in 2035
What if Boardman & Centralia Don’t Retire?

Average Conservation Build (Energy aMW)

- Scenario 1B - Existing Policy, No Carbon Risk
- Sensitivity S1 - Scenario 1B_No Coal Retirements

Minor change in least-cost EE strategy

2021 2026 2035

aMW

- 500
- 1,000
- 1,500
- 2,000
- 2,500
- 3,000
- 3,500
- 4,000
- 4,500
What if We Could Import More Power for Adequacy?

NPV System Costs are also 2 billion $ lower ($85 billion vs $87 billion)  
This assumes the market price variance of imports remains ~same
What About Fast-Slow Ramp Rate Sensitivity?

20 Years, All Measures All Cost Bins (33% Shift)
Little Difference in Average Conservation Build

Average Conservation Build (Energy aMW)

- Scenario 2C - Carbon Risk
- Scenario 4C - Faster Near-Term Pace of Conservation Deployment
- Scenario 4D - Slower Near-Term Pace of Conservation Deployment

Year: 2021, 2026, 2035

Values: 0, 500, 1,000, 1,500, 2,000, 2,500, 3,000, 3,500, 4,000, 4,500, 5,000

Northwest Power and Conservation Council
Not Much Difference in Distribution Either (2021)

Distribution Conservation Development by 2021

Probability

aMW of EE

Sum of Scenario 4C
Sum of Scenario 4D
Sum of Scenario 2C
Nor in 2026

Distribution Conservation Development by 2026

- Sum of Scenario 4C
- Sum of Scenario 4D
- Sum of Scenario 2C

aMW of EE

Probability

2900 3000 3100 3200 3300 3400 3500

0% 10% 20% 30% 40% 50% 60%
Results of Ramp Rate Sensitivity

- Not much difference in EE Build out
- Why:
  - In Slow Ramp, RPM builds higher cost EE
    - Building for adequacy
    - EE a low-cost adequacy solution even using higher cost bins
    - Even considering cost of “EE overbuild” for energy
What About Lost-Opp vs Retrofit?

- RPM not finding consistent value preference for Lost-Opp
- Why? New modeling: Most Lost-Opp not lost forever
What About Carbon?

Carbon Reduction Policy Comparisons
Carbon Reduction Policy Comparisons

- Review of Five Scenarios/Sensitivity Studies
  - Scenario 2B – Social Cost of Carbon (@ 3% Estimate of SCC)
  - Scenario 2C – Carbon Risk
  - Scenario 3A – Maximum Carbon Reduction with Existing Technology
  - Sensitivity S5 – Social Cost of Carbon @ 95% Percentile Estimate of SCC
  - Sensitivity S6 – Renewable Portfolio Standard @ 35%

- Basis of Comparison:
  - Scenario 1B – Existing Policies, No Carbon Risk
The 90\textsuperscript{th} Percentile Annual 111(d) System CO2 Emissions for the Least Cost Resource Strategies for All Scenarios Are Below The EPA’s Proposed Limit for 2030
Average Conservation Development Increases Under Alternative Carbon Emissions Reduction Policies Compared to No Carbon Risk - Except for RPS @ 35% Policy
Scenarios That Consider Carbon Risk Develop More EE by 2021 - Except 35% RPS

Distribution of Conservation Development by 2021

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon - Base
- Sum of 2C - Carbon Risk
- Sum of 3A - Maximum CO2 Reduction, Existing Technology
- Sum of Sensitivity S5 - Scenario 1B_RPS at 35%
- Sum of Sensitivity S6 - Scenario 2B_SCC at 95%
Scenarios That Consider Carbon Risk Development
100 – 300 aMW More EE by 2026

Distribution of Conservation Development by 2026

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon - Base
- Sum of 2C - Carbon Risk
- Sum of 3A - Maximum CO2 Reduction, Existing Technology
- Sum of Sensitivity S6 - Scenario 2B_SCC at 95%
- Sum of Sensitivity S5 - Scenario 1B_RPS at 35%

Probability vs. aMW of EE

Northwest Power and Conservation Council
Scenarios That Consider Carbon Risk Develop 200 – 400 aMW More EE by 2035

**Distribution of Conservation Development by 2035**

- Sum of 1B - Existing Policy, No Carbon Risk
- Sum of 2B - Social Cost of Carbon Base
- Sum of 2C - Carbon Risk
- Sum of 3A - Maximum CO2 Reduction, Existing Technology
- Sum of Sensitivity S5 - Scenario 1B_RPS at 35%
- Sum of Sensitivity S6 - Scenario 2B_SCC at 95%
PNW Cumulative CO2 Emissions Reductions Highest Under Resource Strategies That Must Respond Immediately to Carbon Reduction Policies
Retirement of Coal & Inefficient Gas Generation Are The Lowest Cost PNW Power System CO2 Emission Reduction Resource Strategies

- Social Cost of Carbon - Base
- Maximum CO2 Reduction
- Carbon Risk
- Social Cost of Carbon - High
- RPS at 35%

CO2 Emissions Reduction Cost (2012$/MTE)
Findings from Carbon Scenarios

Details at: http://www.nwcouncil.org/media/7149441/5.pdf

- **EE**
  - Carbon scenarios build slightly more EE

- **Renewables:**
  - Carbon scenarios do not drive RR build higher
  - Solar PV and wind provide limited or no winter peaking capacity

- **Demand Response:**
  - Carbon scenarios do not drive DR build higher

- **Existing Gas Generation**
  - All carbon scenarios drive Existing Gas Generation higher, except 35% RPS
  - Running existing gas plants more is a low-cost way to displace coal

- **New Gas Generation**
  - Two carbon scenarios drive New Gas build higher
  - Maximum Emissions Reduction Scenario (3A) & Social Cost of Carbon at the 95th Percentile Policies

- **Exports**
  - Somewhat lower in all carbon scenarios except 35% RPS

- **Carbon Emissions**
  - All scenarios meet new 111(d) and 111(b)
  - Retirement of coal & inefficient gas are lowest cost strategies
  - Earliest action strategies have largest cumulative reduction in CO2
Summary EE Observations

- All least-cost resource strategies rely heavily on conservation to meet *both* winter capacity and energy needs.
- In 90 percent of the futures, energy efficiency meets all load growth through 2030.
- Significant amounts are available below projected future market prices:
  - 1200 aMW by 2021 and 3500 aMW by 2035 <$30/MWh
- Capacity value of EE is makes it a valuable resource for system adequacy:
  - EE produces ~2.0 MW/aMW saved during winter.
- EE development is essential to attaining carbon emissions reductions.
- EE developed under least cost resources strategies does not significantly increase when carbon risk is considered.
PRINCIPLE ELEMENTS OF RESOURCE STRATEGY
Seven Principle Elements of Least-Cost & Least-Risk Resource Strategies

- Develop Conservation
  - 1400 aMW by 2021
  - 3100 aMW by 2026
  - 4500 aMW by 2035
- Expand Use of Demand Response
- Satisfy Existing Renewable Portfolio Standards
- Option limited gas-fired generation for capacity and other ancillary services as dictated by local utility circumstances
- Reducing regional exports in order to serve in-region energy and capacity demand can result in lower total NPV System Cost and less need for new resource development
- Expand Resource Alternatives (EE & Non-GHG emitting)
- Monitor and Be Prepared to Adapt to Changing Conditions