# Revised Resource Strategy Analysis

January 13, 2016

Northwest Power and Conservation Council

SEVENTH NORTHWEST POWER PLAN

## Revised Analysis Reflects Input and Modeling Changes

- Revised RPM logic to test for resource adequacy quarterly, rather than only in winter quarter
- Developed quarterly Adequacy Reserve Margins (ARMs)
- Developed quarterly Associated System Capacity Contribution factors (ASCC) for
  - CCCTs,
  - Energy efficiency
  - Wind
  - Solar PV
- Assigned Aeroderivative gas-fired turbines and geothermal resources the ASCC for CCCTs

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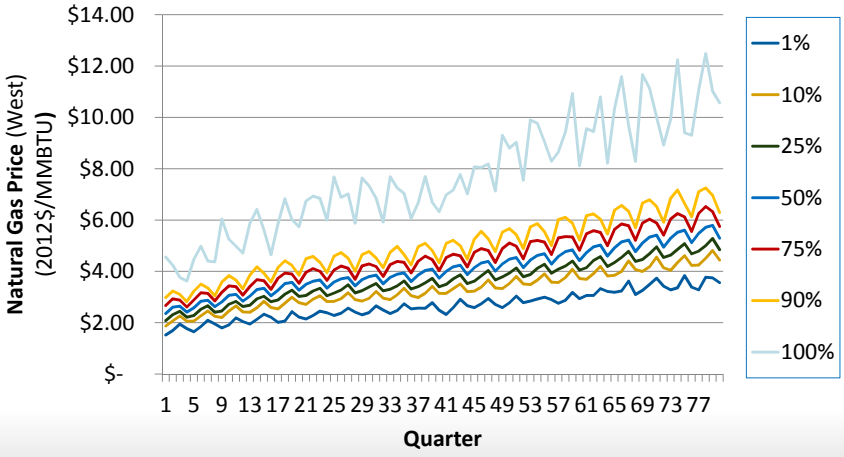
# Revised Analysis Reflects Input and Modeling Changes

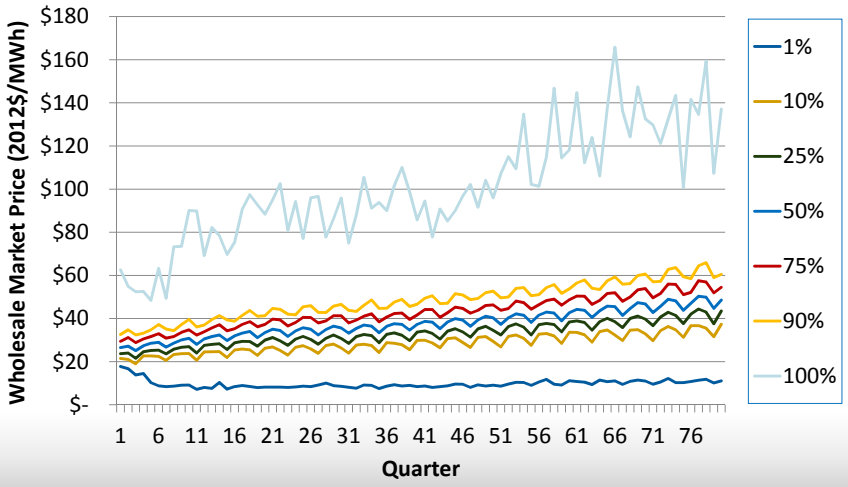
- Revised natural gas price, external electricity market price and load forecasts
- Changes discussed previously – no large narrative impacts
  - Updated conservation and demand response supply curves – discussed Tuesday, no material changes
  - Reduce RPS requirements to reflect RPS based on sales rather than utility load.
  - Added new solar PV and geothermal resources into the model
  - Updated maximum potential for other renewable resources and solar resource costs to reflect changes in Investment Tax Credits (ITC)
- Representation of existing resource capability
  - Revised critical hydro representation to a low percentile (2.5%) representation of historic quarterly hydro
  - Reduced regional existing resource availability to account for estimated total region balancing and flexibility reserves
  - Updated historical hydro dispatch to reflect revised regional "INC" and "DEC" reserves



# Revised Natural Gas Price Range Used in RPM



# Revised Wholesale Electricity Price Range Used in RPM

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# Representation of Existing Resource Capability

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# Usual Caveats

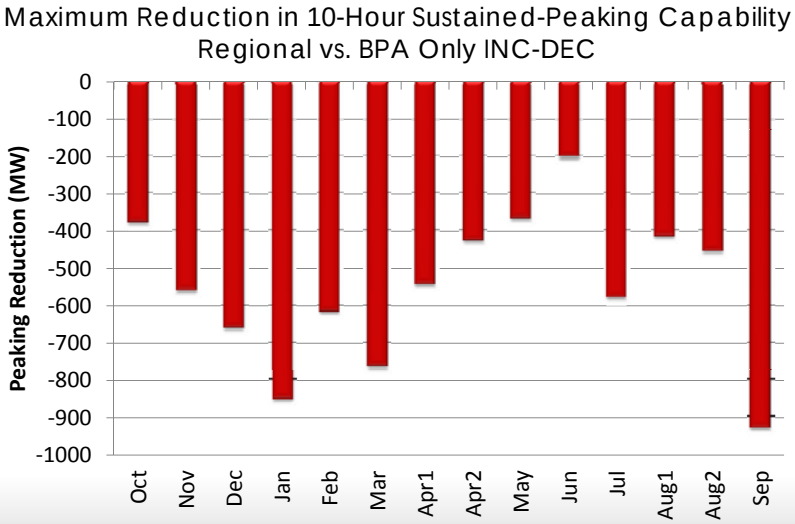
- This shows an average picture of load-resource balance, every one of the 800 futures modeled in the RPM have a different load-resource balance
- Changes should be viewed as a directional indication between Draft and proposed Final inputs



# Terminology Primer

- INC – represents a type of reserves on the power system that involves either increasing generation output or decreasing load on the system
- DEC – represents a type of reserves on the power system that involves either decreasing generation output or increasing load on the system
- ARM – Adequacy Reserve Margin
- ASCC – Associated System Capacity Contribution

## Effects of Balancing Reserve Changes






## Types of Adequacy

- RPM examines adequacy for both energy and capacity
- The Associated System Capacity Contribution estimates the relationship between energy and capacity based on the capabilities of the system resource portfolio
- RPM builds resources when either energy or capacity or both are in deficit

# Adequacy Reserve Margin

- Coordinates between GENESYS and RPM to identify the need for rate-based resources to maintain reliability
- Should not be compared to Planning Reserve Margin
  - ARMs may be zero or negative when relying on in-region Independent Power Producers or external markets and still meet adequacy standards



# Calculating Quarterly ARMs

- ARMs are based on the Council's annual adequacy standard of maximum 5% Loss Of Load Probability (LOLP)
  - Which means, there is a 5% or less probability of taking emergency action to maintain reliability
- Draft used Q1 ARM to represent annual load-resource balance requirements
- Quarterly ARMs and seasonal hydro are required to represent the seasonal load-resource balance to meet quarterly LOLP targets
  - Action item COUN-3 calls for a review of adequacy metric

| | Q1 Jan-Mar | Q2 Apr-Jun | Q3 Jul-Sep | Q4 Oct-Dec |
|---|---|---|---|---|
| LOLP | 1.9% | 0% | 0.5% | 2.3% |

# Associate System Capacity Contribution

- The Associated System Capacity Contribution (ASCC) represents the contribution of a resource to system capacity, e.g. reflects the ability of the hydro system to store water
- In the Draft plan, energy efficiency and Combined Cycle Gas Turbines (CCGT) had ASCCs based on Q1 peak contribution
- The proposed Final uses ASCCs based on quarterly LOLP



# Renewable Resource Associated System Capacity Contribution for Draft and Final Plan

| | | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|---|
| Solar PV | Draft | 0% | 52% | 88.2% | 0% |
| | Final | 25.9% | 80.5%* | 80.5% | 42% |
| | | | | | |
| Wind | Draft | 5% | 5% | 5% | 5% |
| | Final | 2.6% | 11.3%* | 11.3% | 8.3% |
| | | | | | |
| Geothermal | Draft | N/A | N/A | N/A | N/A |
| | Final | 128% | 100%* | 102% | 120% |

* - Note a lack of adequacy issues in Q2 makes the system capacity contribution essentially zero. The numbers used here are from Q3 to avoid computational difficulties.

## Other Resource Associated System Capacity Contribution for Draft and Final Plan

| | | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|---|
| Energy Efficiency | Draft | 120% | 120% | 120% | 120% |
| | Final | 124% | 101%* | 114% | 116% |
| | | | | | |
| Natural Gas Fired Generation | Draft | 99.1% | 99.1% | 99.1% | 99.1% |
| | Final | 128% | 100%* | 102% | 120% |

* - Note a lack of adequacy issues in Q2 makes the system capacity contribution essentially zero. The numbers used here are from Q3 to avoid computational difficulties.



## Draft Plan "Average" Balance

| ENERGY (aMW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Load | 22,730 | 22,510 | 21,276 | 21,448 |
| Resource | 23,129 | 23,440 | 23,506 | 23,523 |
| Critical Year Q1 Hydro | 10,642 | | | |
| Energy ARM | -2.93% | | | |
| **Resource - Load*(1+ARM)** | **1,066** | **1,590** | **2,855** | **2,704** |

| CAPACITY (MW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Expected Peak Load | 31,207 | 31,468 | 25,310 | 26,713 |
| Peak Resource | 30,716 | 31,181 | 31,184 | 31,544 |
| Critical Year Q1 Peak Hydro | 18,785 | | | |
| Capacity ARM | 3.04% | | | |
| **Resource - Load*(1+ARM)** | **- 1,442** | **- 1,246** | **5,104** | **4,018** |

# Proposed Final Plan "Average" Balance

| ENERGY (aMW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Load | 21853 | 21333 | 19034 | 19770 |
| Resource | 24314 | 23440 | 26659 | 23451 |
| Hydro (2.5 percentile) | 11827 | 10642 | 13794 | 10569 |
| Energy ARM | 1.97% | -3.09% | 0.00% | -0.37% |
| **Resource - Load*(1+ARM)** | **2031** | **2766** | **7624** | **3755** |

| CAPACITY (MW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Expected Peak Load | 30988 | 30497 | 23893 | 25098 |
| Peak Resource | 28646 | 30186 | 29191 | 28231 |
| Peak Hydro (2.5 percentile) | 16715 | 17790 | 16792 | 15404 |
| Capacity ARM | -0.51% | 0.65% | 0.00% | 7.52% |
| **Resource - Load*(1+ARM)** | **-2184** | **-508** | **5298** | **1246** |



# Draft to Proposed Final Deltas

| ENERGY (aMW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Load | - 877 | - 1177 | - 2241 | -1678 |
| Resource | 1185 | 0 | 3152 | -72 |
| Hydro | 1185 | 0 | 3152 | -73 |
| Energy ARM | 4.90% | -0.16% | 2.93% | 2.56% |
| **Resource - Load*(1+ARM)** | **965** | **1176** | **4770** | **1051** |

| CAPACITY (MW) | Q4 2015 | Q1 2016 | Q2 2016 | Q3 2016 |
|---|---|---|---|---|
| Expected Peak Load | -219 | -972 | -1416 | -1615 |
| Peak Resource | -2070 | -994 | -1993 | -3313 |
| Peak Hydro | -2070 | -994 | -1993 | -3381 |
| Capacity ARM | -3.55% | -2.40% | -3.04% | 4.47% |
| **Resource - Load*(1+ARM)** | **-742** | **738** | **194** | **- 2771** |

# Impacts

- Final shows more energy surplus than Draft
  - Due primarily to updated lower load forecast
  - Seasonal ARMs show Q4 and Q1 have a similar energy adequacy situation
- Final shows less capacity surplus than the Draft
  - While the expected peak load decreased, the peak hydro capability also decreased based on updated INC and DEC reserves
- Seasonal ARMs and corresponding hydro capacity result in potential capacity needs for all quarters except Q2



# Revised Scenario Analysis

- Updated Seven Scenarios (So far)
  - Existing Policy
  - Existing Policy with No Demand Response
  - Existing Policy with Increased Reliance on External Market
  - Social Cost of Carbon – Mid-Range
  - Maximum Carbon Reduction – Existing Technology
  - All Existing Coal Retirement
  - All Existing Coal Retirement with only Renewable Resource Replacements

*These scenarios were updated to assess whether draft plan's recommended resource strategy and action plan recommendations should be modified.*

# Updated Scenario Analysis Addresses Three Primary Questions

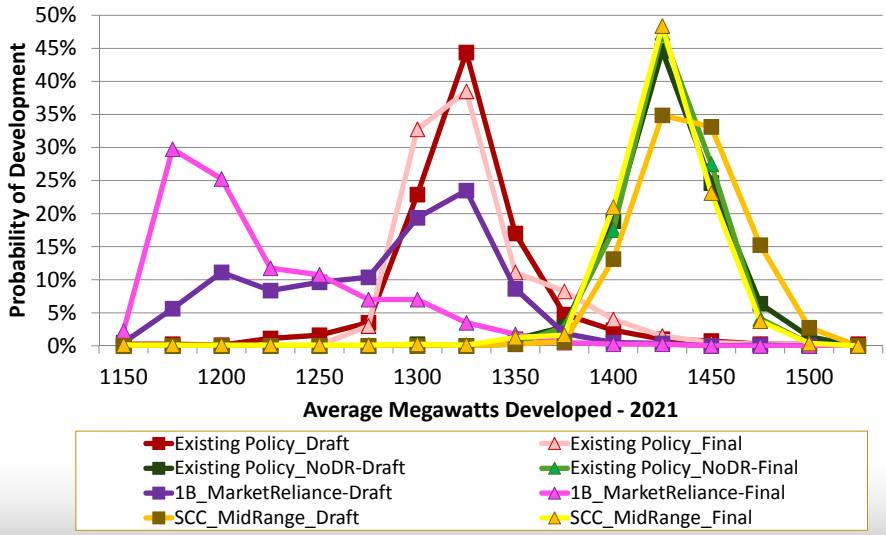
- Should the Resource Strategy's regional conservation goal and demand response development be modified?
  - Public comment was divided on whether the plan should express its conservation goal as a range or single value
  - Public comment was divided on whether the plan should have a goal for a demand response
- Should the Resource Strategy's findings regarding the need for new natural gas generation development be modified?
  - Public comment was divided on whether the plan found too little need for gas resource development or adequately conveyed the lack of need
- Should the Resource Strategy's findings on the benefits of Renewable Resource development be revised
  - Public comment stated the Draft Plan's analysis of renewable resources did not reflect accurate value and system impacts



# Factors Driving the Pace Conservation Development

- Need for capacity
- Assumptions about Demand Response development
- Assumptions about the availability and cost of external market resources "in extreme weather and poor water" conditions"
- Assumptions about further CO2 emissions reduction policies

## Updated Scenario Analysis Shows Little Change In Conservation Development Patterns Across Scenarios Compared To Draft Plan

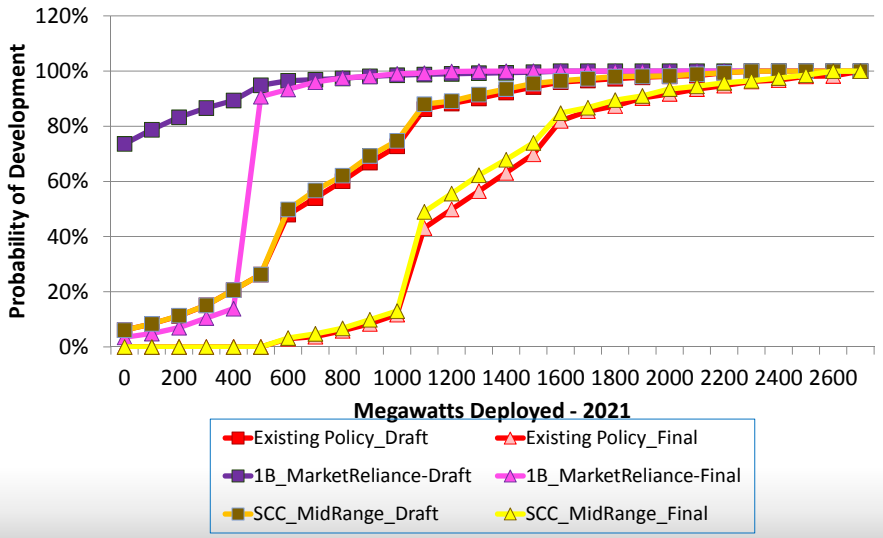





## Factors Driving the Pace Demand Response Development

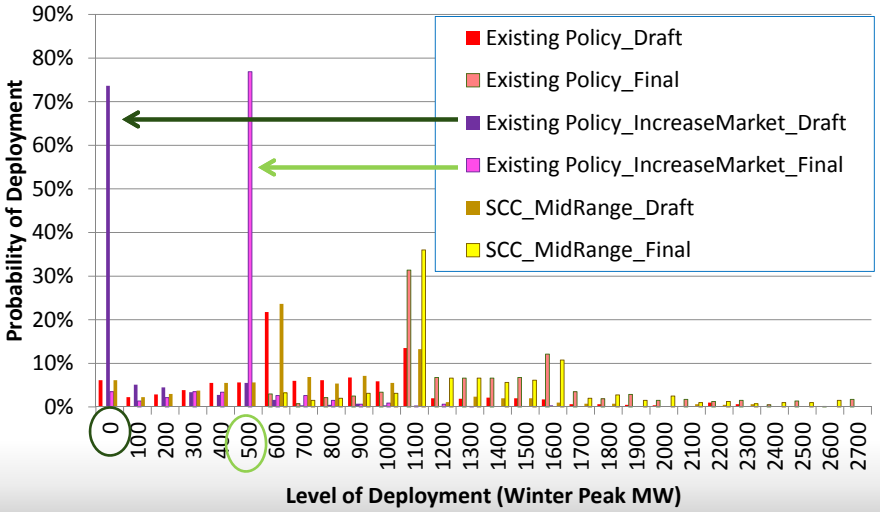
- Need for capacity
- Assumptions about conservation development
- Assumptions about the availability and cost of external market resources "in extreme weather and poor water" conditions"
- Assumptions about further CO2 emissions reduction policies

## Updated Scenario Analysis Shows Material Change In Demand Response Development Through 2021

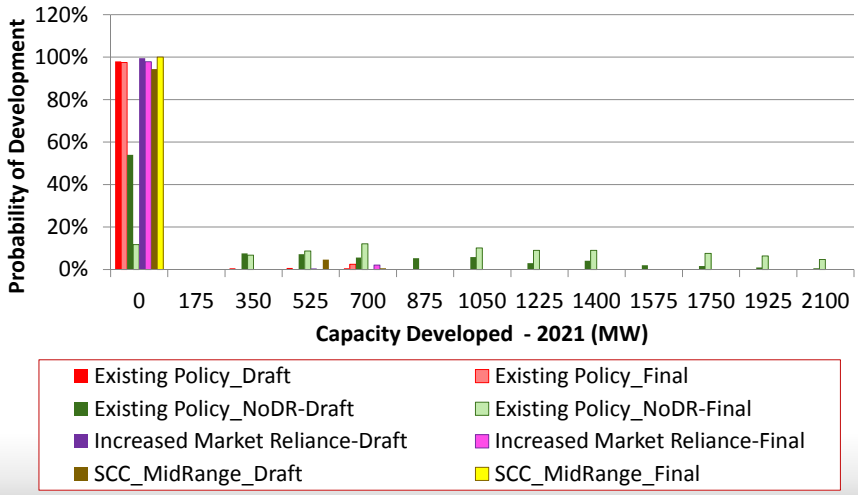





## Demand Response Deployment Probability in 2021 by Level of Winter Capacity



## Updated Scenario Analysis Shows Little Change In New Gas Generation Development Patterns Across Scenarios Compared To Draft Plan, Except for the "No DR" Scenario



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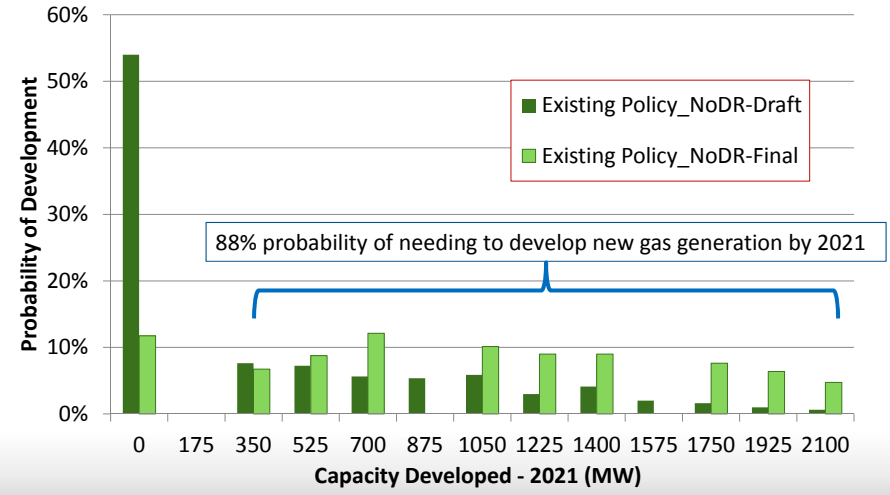

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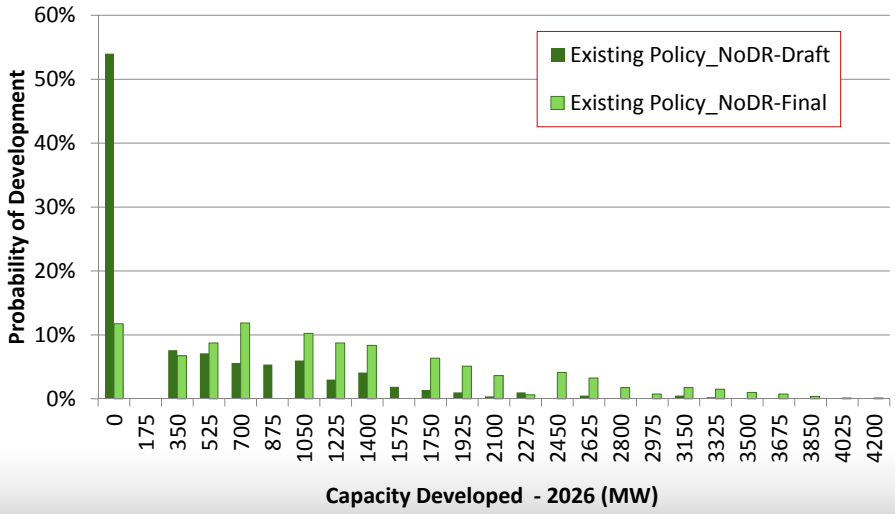
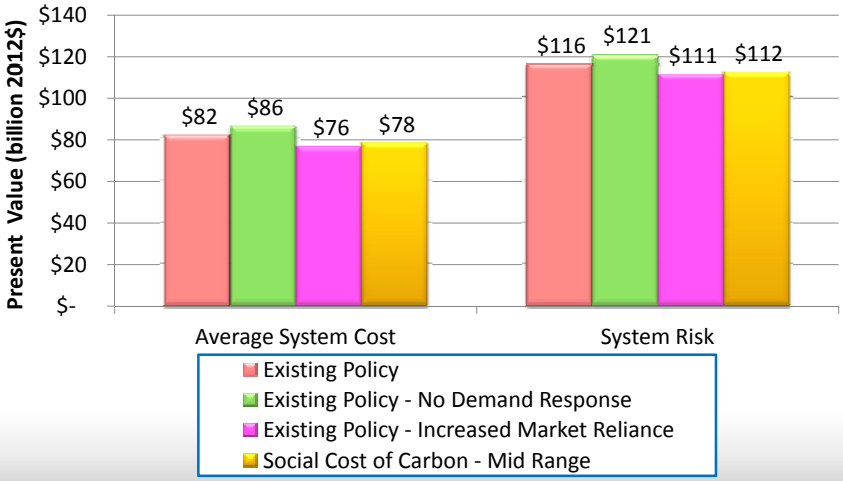





## Balancing and Flexibility Curtailment Analysis FY 2021

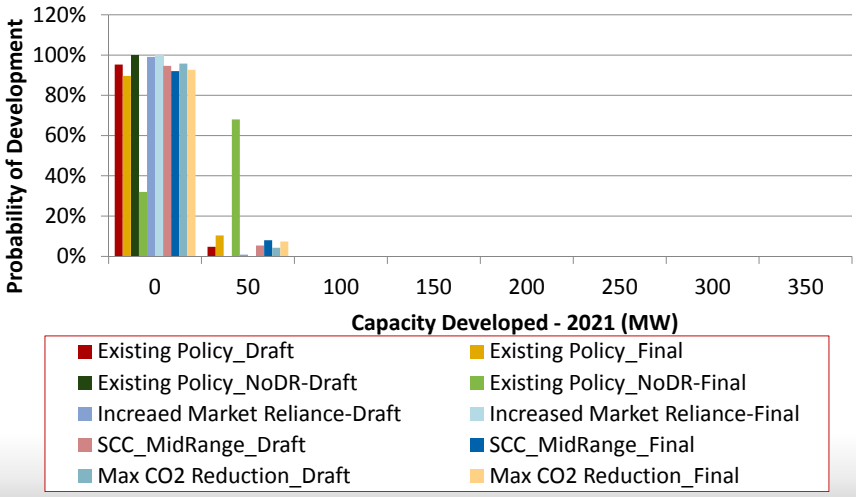
| Name of Scenario | Hydro Years (out of 80) | Percent of Hydro Years | Total Events | Morning Ramp Hours | Evening Ramp Hours | Peak Hours | Off-Peak Hours |
|---|---|---|---|---|---|---|---|
| Existing System | 37 | 46.25% | 260 | 95 | 7 | 748 | 2 |
| Existing system +1400 EE | 17 | 21.25% | 38 | 7 | 0 | 74 | 4 |
| Existing system +1400 EE + 620 DR | 6 | 7.50% | 14 | 6 | 0 | 31 | 0 |
| Existing system +1400 EE + 1360 DR | 3 | 3.75% | 8 | 1 | 0 | 13 | 2 |

# System Cost and Economic Risk of Alternative Resource Strategies






# Updated Scenario Analysis Shows Little Change In Renewable Generation Development Patterns Across Scenarios Compared To Draft Plan, Even With Revised Capacity Values



# Observations

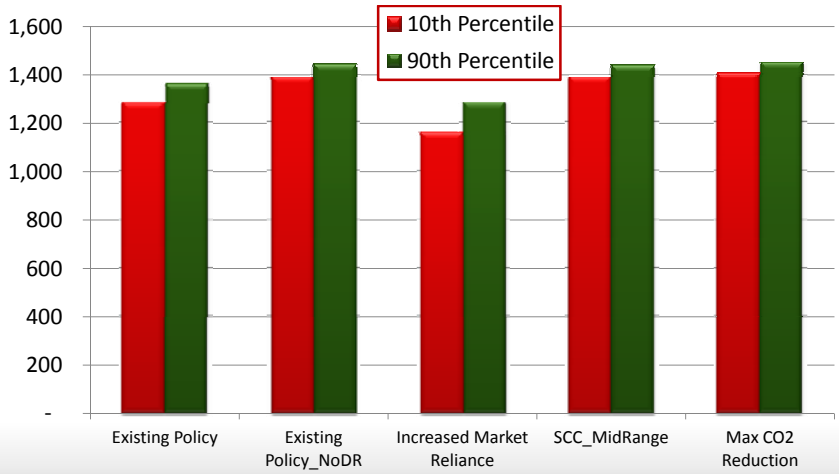
- Development of demand response slightly reduces the need for energy efficiency and significantly lowers the probability of building new natural gas generation
  - Without demand response, average energy efficiency development increases from 1300 to 1400 aMW
  - Without demand response the probability of needing to build new gas generation by 2021 increases from around 2% to nearly 90%
- Consideration of policies that are aimed at further reducing CO2 emissions increases average energy efficiency development from 1300 to 1400 aMW
- Without developing the draft plan's energy efficiency and approximately 600 MW of demand response the region may not meet adequacy standards and could have difficulty providing reserves for balancing and flexibility
  - Alternatively, the region could build additional new gas-fired generation
  - This alternative resource strategy increases system cost by $4 billion and system risk by $5 billion



## Observations Regarding Range vs. Single Value

- Within individual scenarios the range of energy efficiency development is much narrower than in the 6th Plan
  - 6th Plan – 300 aMW spanned 80% of futures
  - 7th Plan - 40 – 120 aMW spanned 80% of futures
- Across scenarios the 1300 to 1450 aMW spans 80% of the futures
  - The system is building for adequacy
  - Not all scenarios are equally probable

# Range of Energy Efficiency Development






# Two Remaining Resource Strategy Action Items

- The draft plan's regional conservation goal (RES-1)
  - Bonneville, utility trade associations, and individual utilities recommended that the final plan specify the conservation goal as a range
  - Environmental and renewable energy advocates and many individuals, on the other hand, strongly endorsed retaining the draft plan's goal to develop 1,400 average megawatts of energy efficiency by 2021 as a minimum
- The draft plan's call for the development of demand response (RES-4)
  - Bonneville and utilities supported retaining the language in the draft plan's action item, which did not set a regional goal for demand response development
  - Environmental and renewable interest groups stated that the final plan should be specific about the level of Demand Response that should be developed, recommending 700 to 1,100 MW be targeted by 2021