Northwest **Power** and
Conservation Council

March 31, 2015

MEMORANDUM

TO: **Council members**

FROM: **Ben Kujala**

SUBJECT: **Discussion of Scenario 1B and Related Scenario Analysis Updates**

BACKGROUND:

Presenter: Tom Eckman and Ben Kujala

Summary At the March Council Meeting, staff presented a list of proposed scenarios to the Power Committee Members and the full Council. The first scenarios to be run will establish much of the structure of the model for all subsequent scenarios. This presentation will examine four different resource strategies using the draft inputs for scenario 1B to discuss the type of results being produced by the RPM and how what insights might be gained from analysis of those results.

The resource strategies selected for presentation will examine four different conservation purchase strategies in combination with difference generation resource options. These resource strategies are:

- No Conservation, generation or demand response resources available
- Low Conservation without generation or demand response resources available
- Medium Conservation with only low cost demand response and natural gas-fired peaking generators available
- Medium Conservation with all generation resource options available
- High Conservation with all generation resource options available

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Using these resource strategies staff will discuss the outputs from RPM and look at methods for comparing them. Staff will be seeking Council guidance on how best to communicate the results of future scenario analysis to be presented at Power Committee webinars and meetings.

Relevance: One of the primary tools used to inform the development of the Council's Seventh Power Plan are the results of its scenario analysis. Selection of the scenarios to be tested during the development process is a critical step in this process, since it establishes scope of the constraints and "stresses" to which potential resource strategies to which will be subjected.

Workplan: 1. B. Develop Seventh Power Plan and maintain analytical capability

- Define resource portfolio

Background: The RPM was recently redeveloped by Navigant for the Council. The draft inputs for the starting scenarios have been finalized. This presentation is to examine outputs from RPM with the initial data and discuss methods for comparison of resource strategies.

More Info: The RPM or Regional Portfolio Model was recently redeveloped by Navigant for the Council. The RPM estimates the regional costs and risks associated with pursuing resource development strategies and it uses optimization to look for strategies that minimize the estimated cost and risk. The draft inputs for the starting scenarios have been finalized. This presentation is to examine outputs from RPM with the initial data and discuss methods for comparison of resource strategies.

Northwest **Power** and **Conservation** Council

March 31, 2015

MEMORANDUM

TO: **Power Committee**

FROM: Tom Eckman, Charles Grist, Kevin Smit, Tina Jayaweera, Gillian Charles, Steve Simmons and John Ollis

SUBJECT: Updated Resource Characteristics Assumptions for use in the Regional Portfolio Model

BACKGROUND:

Presenter: Tom Eckman

Summary: Staff will present a brief summary of changes in input assumptions for conservation, generation resource and demand response resources to the Regional Portfolio Model (RPM). Staff views these as minor adjustments to the data presented at the March Council meeting in Eugene. The most significant of these changes are:

- Extending the earliest date new combined cycle combustion turbines could be brought on line by one to two years, depending on technology.
- Reducing the near-term (2020) availability of conservation by 150 aMW
- Reducing the lowest-cost block of demand response resources by 205 MW
- Finalizing the draft Renewable Portfolio Standards assumptions

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Relevance: Resource characteristics such cost, construction lead times, amount available and load shape are major drivers in the selection of resource strategies.

Workplan: 1. B. Develop Seventh Power Plan and maintain analytical capability.

- Update conservation, demand response supply curves
- Update generation resource database

Background: Staff presented the “near final” input assumptions for conservation, generation and demand response resources to the RPM at the March Council meeting in Eugene. Since that meeting staff review and response to stakeholder comments resulted in revisions and corrections to those inputs. While staff views these as minor revisions we believe the Council should be aware of the changes.

More Info: See Attached Summary

Summary of Changes to Resource Assessment Data for Use in RPM

Generating Resource Characteristics

Adjusted earliest availability dates for three generating resources

- Combined Cycle Combustion Turbines were moved out slightly to more accurately reflect planning and construction time frames
  - CCCT Adv 1 (Wet Cool) was moved out 2 years from 2018 to 2020
  - CCCT Adv 2 (Dry Cool) was moved out 1 year from 2020 to 2021
- Utility Scale Solar PV in Idaho was moved out from 2016 to 2018.
- A portion of the potential new solar PV development was reclassified as an existing resource to reflect current activity

Finalized Draft Renewable Portfolio Standards (RPS) Assumptions

- Committed resources as of 2016 allocated to OR/WA/MT based on known renewable energy credit (REC) agreements
  - Assumed 50% of Idaho's unassigned wind and solar PV RECs are available to Washington, Oregon and Montana
- REC banking allowed based on each state's banking provisions – banked RECs used for RPS compliance first, then new RECs generated
- Assumed 100% achievement with state targets (percentage of obligated load required to be renewable) - as opposed to 95% in the Sixth Plan, based on the recent passage of RPS at the time and uncertainty over compliance
  - Assumed 13.9%[1] "target" for WA in 2020 for modeling purposes, rather than the statutory 15%, in order to capture alternative compliance methods that are already being utilized in WA.
    - 4% cost cap – the point at which utilities spend at least 4% of their retail revenue requirement on the incremental cost (the difference between the cost of the renewable resource and a comparable non-renewable resource) of renewable energy/RECs
    - No load growth – when a utility experiences no load growth, they are not required to spend above 1% of retail revenue requirement on renewable energy/RECs

Conservation Resource Characteristics

- Five measures were added to the commercial sector potential
  - Ductless Heat Pump in small buildings
  - Demand Control Kitchen Vent Hoods
  - Web Enabled Programmable Thermostats for small commercial buildings
  - HVAC Economizer Control
  - Exit Signs (Light Emitting Capacitor)
- Revised maximum program ramp rates on several measures
- Revised mix of industrial sales by sub-industry
- Revised measure-level inputs based on external comments and internal review
- Incorporated new data for residential sales of LED lighting

Summary of Net Impacts on Cumulative Savings Potential by 2035

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[1] Based on analysis by the Washington Department of Commerce, Energy Office

- Residential: Down -350 aMW
- Commercial: Up 300 aMW
- Industrial: Up 36 aMW
- Ag: Down -7 aMW
- Utility: Down -18 aMW
- **Total: Down -40 aMW (less than 1%)**

Summary of Net Impacts on Cumulative Savings Potential by 2020

- Total: **Down (150) aMW (about 10%)**
- Due to:
  - Changes to ramp rates
  - Error correction
  - New residential lamp sales data showing higher penetration of LED

Impact on Cost Profile

- Minor shifts in cost bins – mostly compensating changes

Demand Response Resource Characteristics

- Reduced the number of refrigerated warehouses in the NW region to reflect better data on the number of facilities in the region and to maintain internal consistency with conservation assessment and load forecast.
- This reduced the potential DR resource available in the lowest cost block by 205 MW. This also slightly increased the cost, reduced the maximum acquisition rate and altered the seasonal shape of this block.

Scenario 1B and Related Scenario Analysis

April 7, 2015

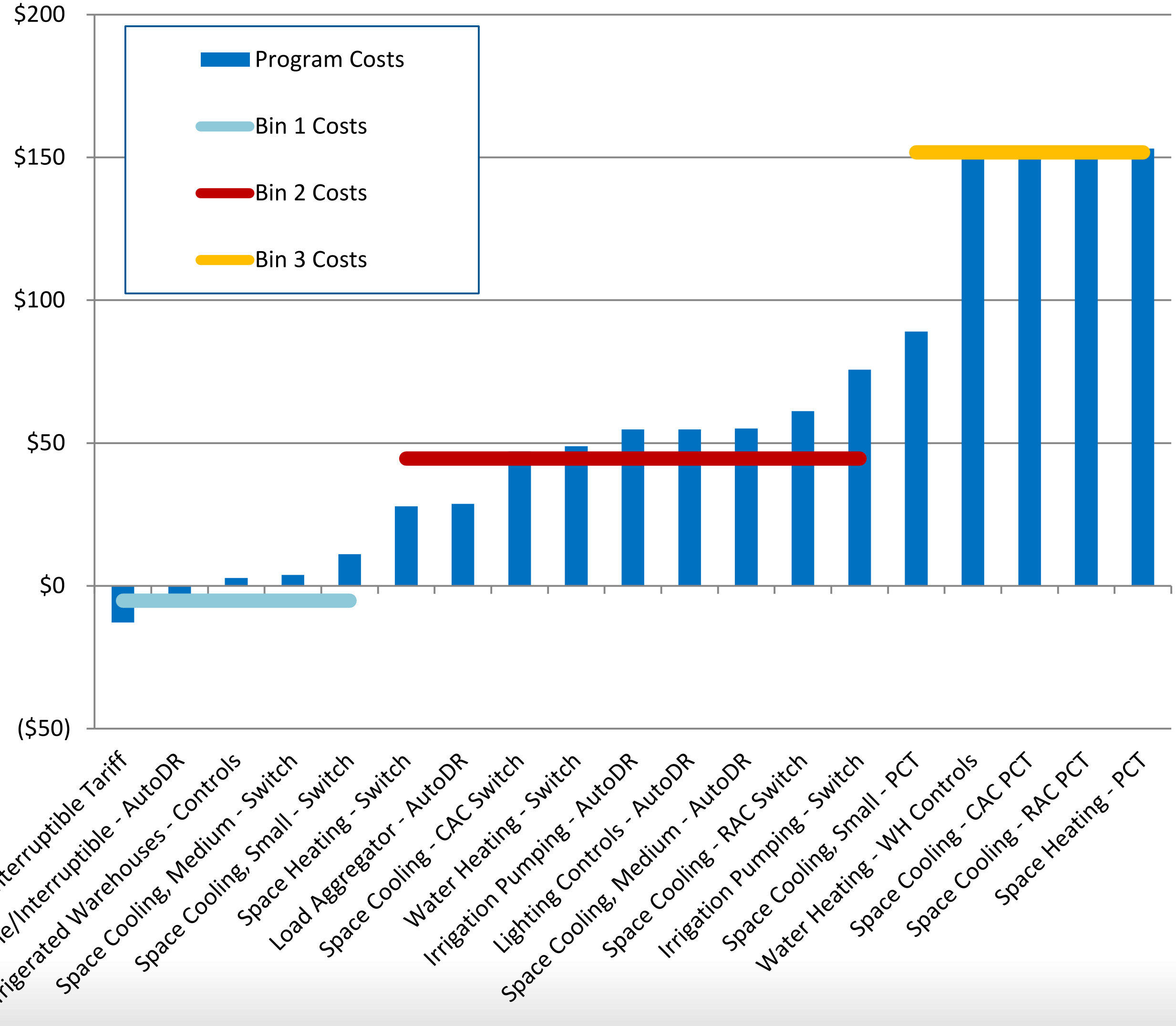
RPM Disclaimers

- The long-term capacity expansion logic is still being reviewed so there is still potential for revision.
  - Received current version April 4th
  - The SAAC and RAAC will be reviewing the RPM's capacity expansion logic which uses GENESYS results to ensure resource strategies satisfy regional adequacy standards
- *Caveat emptor –*
  - All results in this presentation *are still preliminary*
  - The RPM test resource strategies across 800 different futures
    - Each future has a unique result
    - Staff interpretations of results, communicated with terms like "on average" or "in general," will likely not hold in one or more of those futures.
  - If these qualification are missing it is more likely that it is because of trying to fit information on a slide deck rather than because they were intentionally not included.

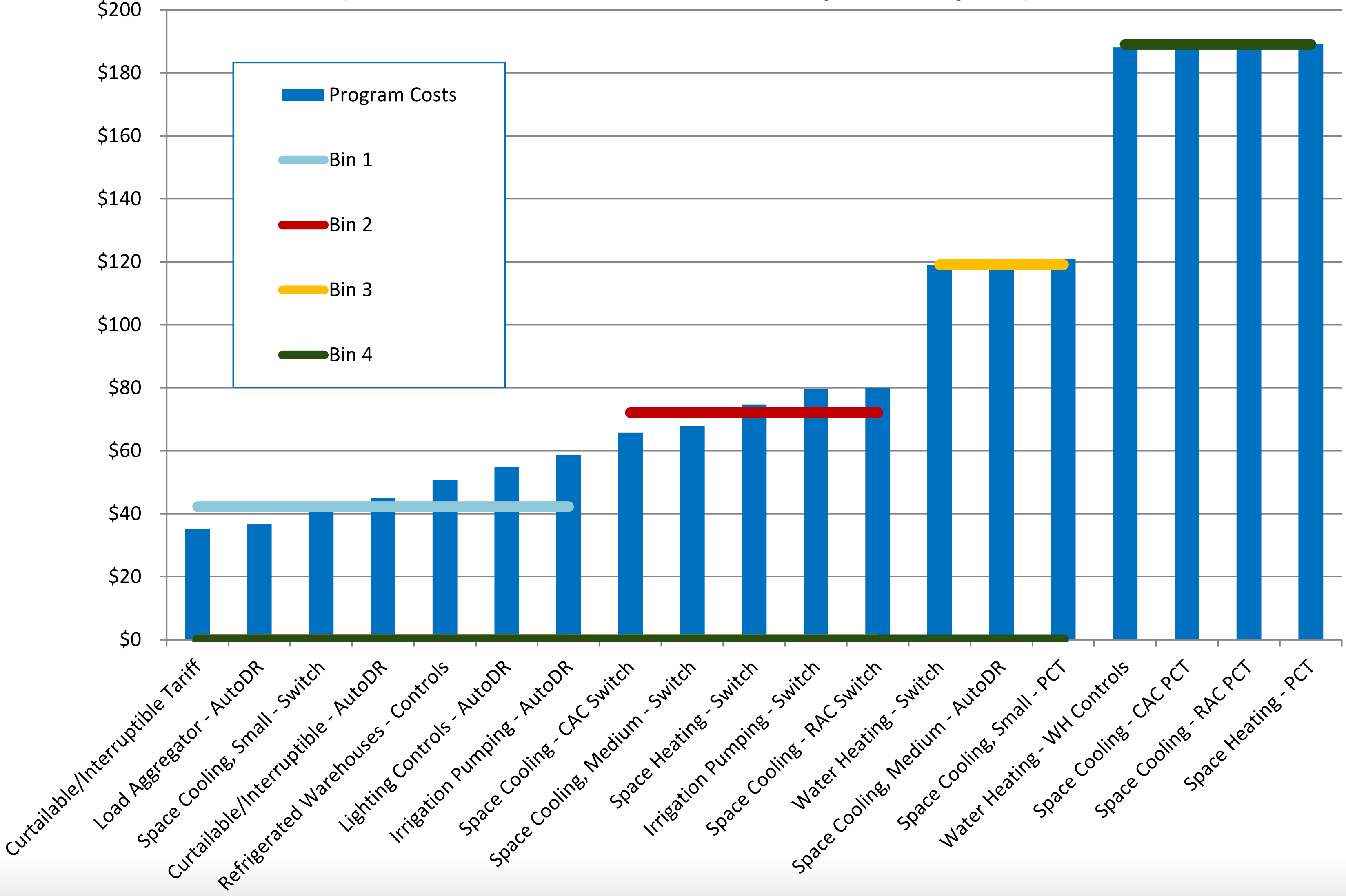
Critical Guidance Needed – Demand Response Incentive Payments

- Stakeholder feedback thus far broadly supports including incentive payments as part of the cost
- A joint FERC/DOE report "A Framework for Evaluating the Cost-Effectiveness of Demand Response" recommends
  - *However, it is important to recognize that cost-shifting is not a matter of cost effectiveness. Cost increases to one customer that are offset by cost reductions to another customer can lead to no net additional cost. In economic terms, this is referred to as a "transfer payment" from one customer to another, and according to economic theory these payments should not be considered as either a cost or a benefit because they cancel each other out.*
- Question: Should payments to customers who curtail be considered a cost of Demand Response?

Demand Response Resource Programs by Cost Bin (No Incentives, 2012$ per kW-year)



Demand Response Resource Programs by Cost Bin (Added Incentive Cost, 2012$ per kW-year)



Bin	Program	Net Levelized Fixed Costs in $/kW-year	Bin Weighted Average in $/kW-year	Percent of Potential
Bin 1	Curtailable/Interruptible Tariff	$35	$42	14.8%
Bin 1	Load Aggregator - AutoDR	$37	$42	3.7%
Bin 1	Space Cooling, Small - Switch	$43	$42	0.5%
Bin 1	Curtailable/Interruptible - AutoDR	$45	$42	14.8%
Bin 1	Refrigerated Warehouses - Controls	$51	$42	2.7%
Bin 1	Lighting Controls - AutoDR	$55	$42	4.5%
Bin 1	Irrigation Pumping - AutoDR	$59	$42	0.1%
Bin 2	Space Cooling - CAC Switch	$66	$72	2.7%
Bin 2	Space Cooling, Medium - Switch	$68	$72	1.2%
Bin 2	Space Heating - Switch	$75	$72	7.4%
Bin 2	Irrigation Pumping - Switch	$80	$72	0.3%
Bin 2	Space Cooling - RAC Switch	$80	$72	0.1%
Bin 3	Water Heating - Switch	$119	$119	12.8%
Bin 3	Space Cooling, Medium - AutoDR	$119	$119	5.8%
Bin 3	Space Cooling, Small - PCT	$121	$119	0.5%
Bin 4	Water Heating - WH Controls	$188	$189	1.4%
Bin 4	Space Cooling - CAC PCT	$189	$189	6.3%
Bin 4	Space Cooling - RAC PCT	$189	$189	2.9%
Bin 4	Space Heating - PCT	$189	$189	17.3%

Results with Different DR Inputs

- Without incentives, around 1200 MW of DR is built by 2020 on average
- With incentives, around 1050MW of DR is built by 2020 on average
- With incentives and DR options delayed until 2018, when the first options for thermal plants are available, around 550 MW of DR is built by 2020 on average

Policy Implications

- Model will take input in either form
- Issue revolves around whether "incentives" are a measure of the implementation cost of DR or transfer payment between customers
  - DOE/FERC treat DR incentives as "transfer payments"
  - Incentives (plus hard cost for marketing and controls) are proxy for "measure cost", hence a real cost to society that would not be incurred without DR
  - Incentives are ignored in EE cost, because they are assumed to offset all or a portion of the total hard cost, marketing and administrative cost associated with measure installation

Critical Guidance Needed – Climate Change Load Impacts

- Staff recommends using climate change informed loads as a single scenario not in all scenarios because
  - Near-term impacts may reduce resource requirements
  - Long-term impacts get close to parity but don’t show a substantial increase in need, even by the end of the study
  - Many effects would not be captured (e.g., impacts on entire WECC loads and market prices) thus taking temperature impacts alone likely substantially understates the impact
  - Significant staff effort to required to align energy efficiency potential assessment with climate change impacts

Near-term Impacts

- Climate change informed loads lower the resource requirement in the model in the near-term, by 2020:
  - With climate change informed loads and minimal conservation the model builds around 1350 MW of capacity on average
  - Without climate change informed load and minimal conservation model builds around 1660 MW of capacity on average

Long-term Impacts

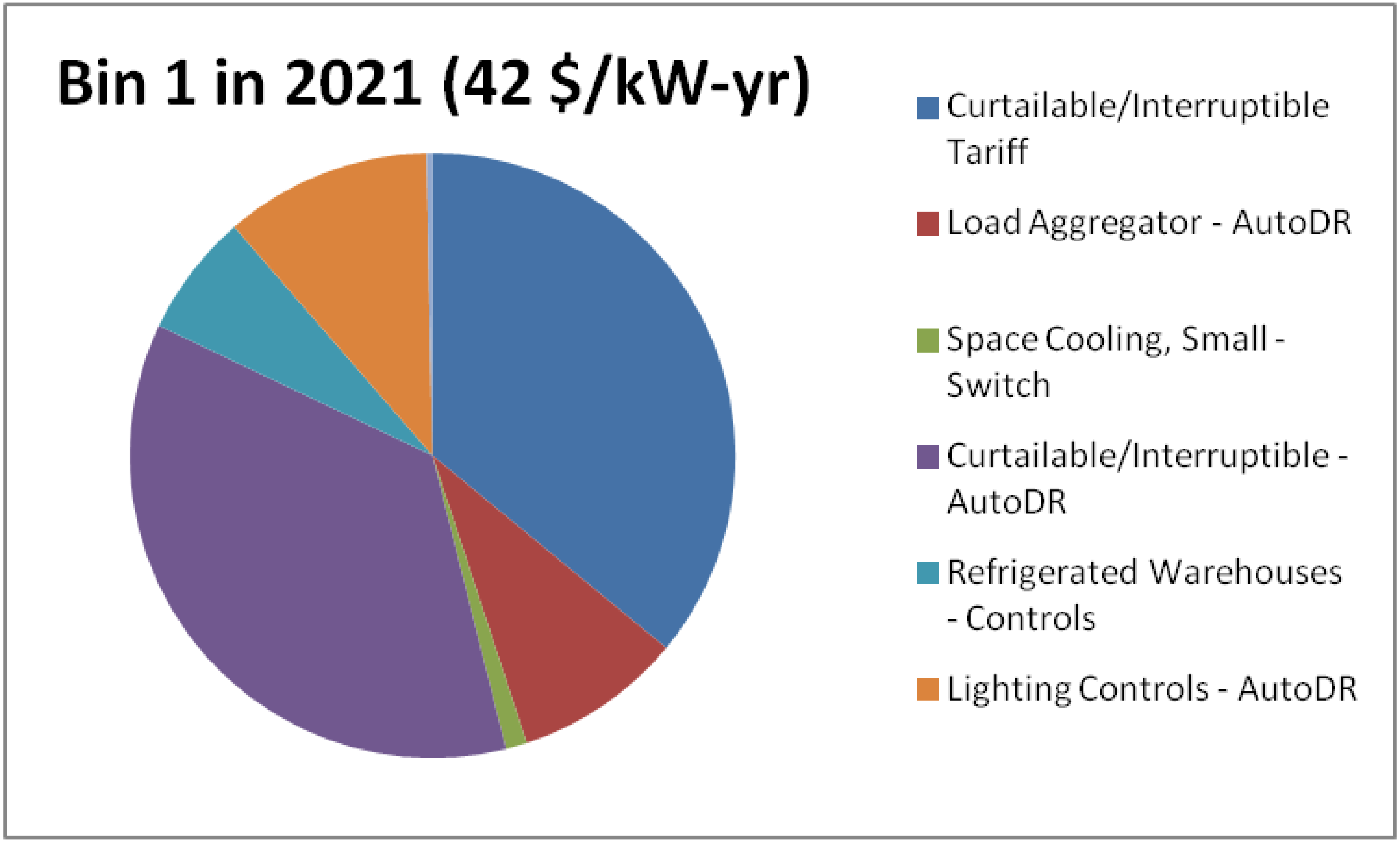
- Less DR and generating resources constructed on average
- A very small increase in RPS requirements on average is likely based on flatter loads throughout the year

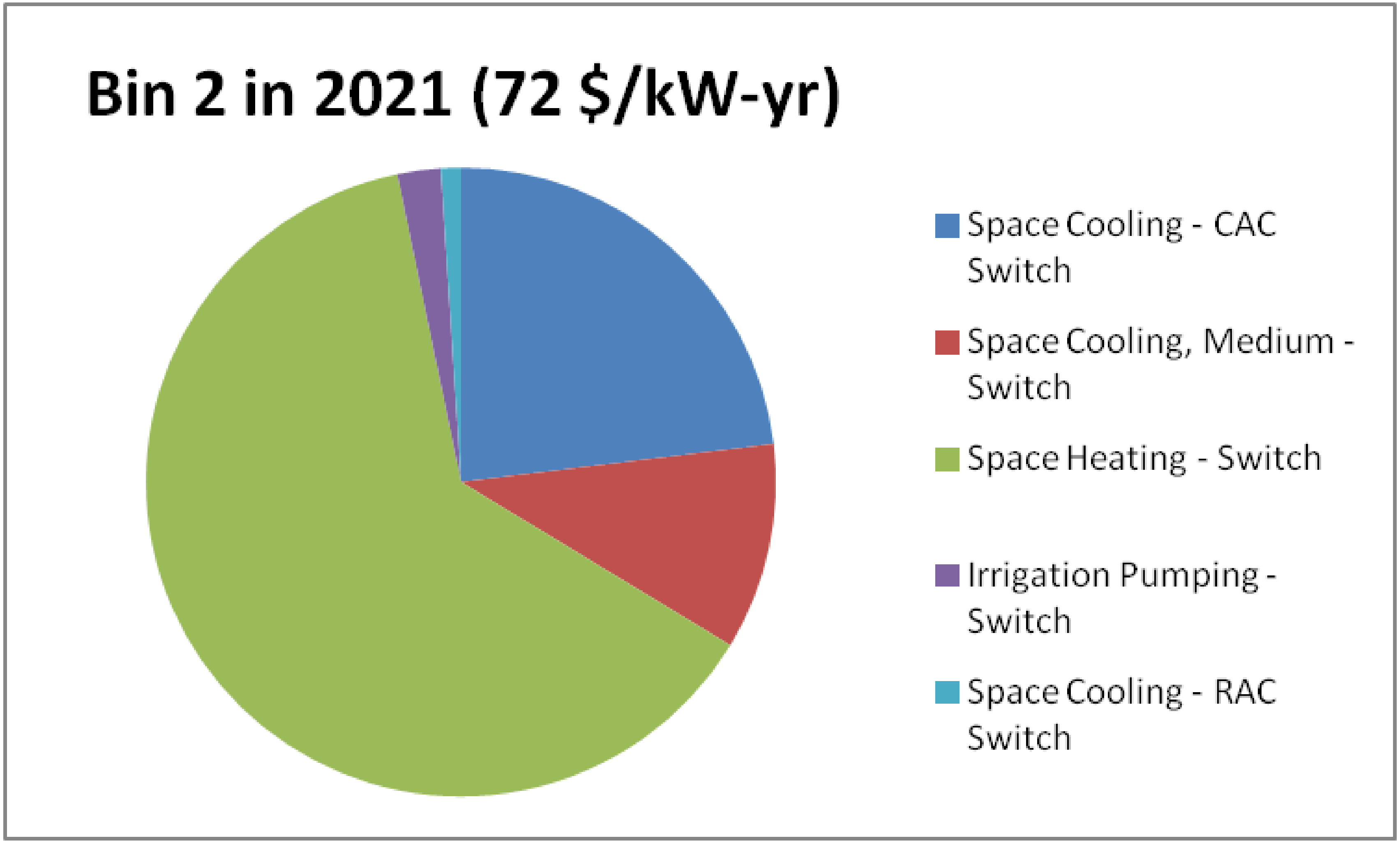
RPM Run with Minimal Conservation Comparison

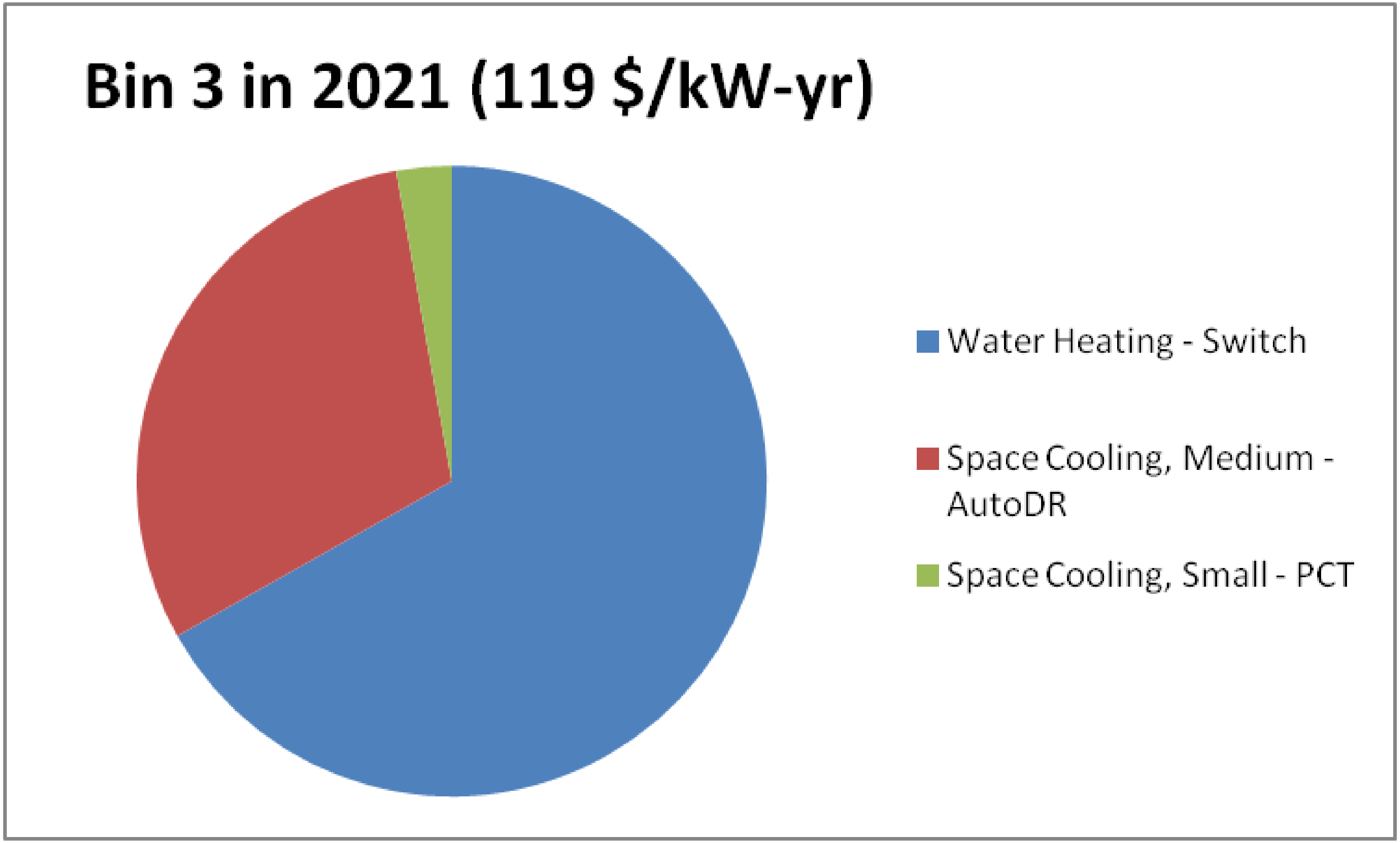
	Climate Change Informed	No Load Adjustment
DR	1700 MW	1850 MW
Generating Resources	630 MW	660 MW
Renewables	2050 MW	2010 MW

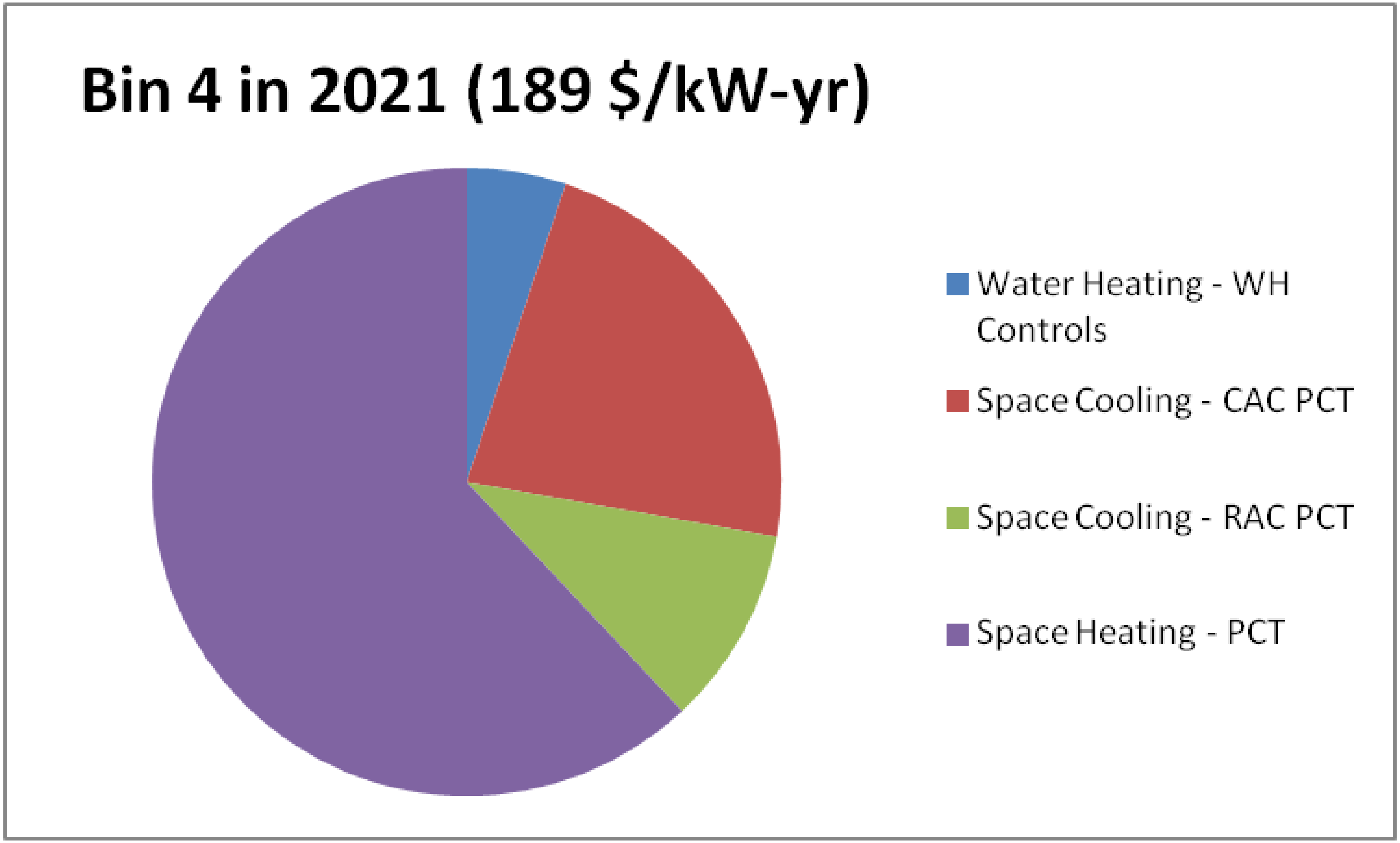
Backup Slides

BIN COMPOSITION WITH INCENTIVES


Bin 1 in 2021 (42 $/kW-yr)
Curtailable/Interruptible Tariff
Load Aggregator - AutoDR
Space Cooling, Small - Switch
Curtailable/Interruptible - AutoDR
Refrigerated Warehouses - Controls
Lighting Controls - AutoDR


Bin 2 in 2021 (72 $/kW-yr)
Space Cooling - CAC Switch
Space Cooling, Medium - Switch
Space Heating - Switch
Irrigation Pumping - Switch
Space Cooling - RAC Switch


Bin 3 in 2021 (119 $/kW-yr)
Water Heating - Switch
Space Cooling, Medium - AutoDR
Space Cooling, Small - PCT


Bin 4 in 2021 (189 $/kW-yr)
Water Heating - WH Controls
Space Cooling - CAC PCT
Space Cooling - RAC PCT
Space Heating - PCT

BIN COMPOSITION WITHOUT INCENTIVES

What's In Each Bin?

<u>Bin 1</u>

The RPM can purchase up to **1689 MW (Summer Peak)** and **1595 MW (Winter Peak)** at **-$5.20** (in 2012$/kW-yr) over the course of the study.

Over 76% of the bin is made up of

Curtailable/Interruptible Tariff : **-$13**

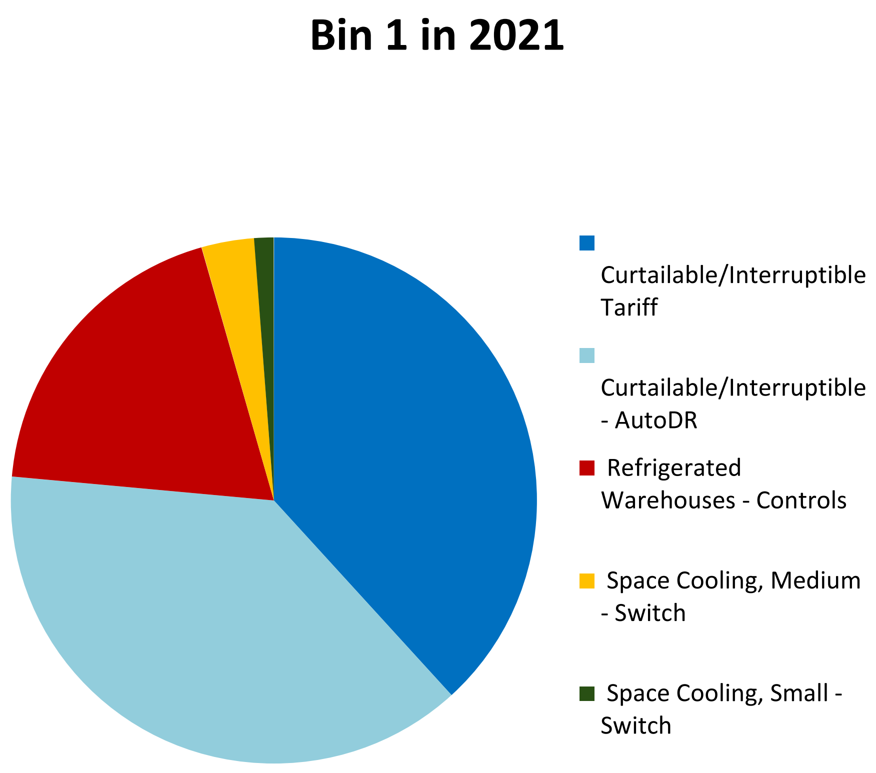
Curtailable/Interruptible Tariff (ADR): **-$3**

Less than 24% is made up of

Refrigerated Warehouses: **$3**

Space Cooling, Medium - Switch: **$4**

Space Cooling, Small - Switch: **$11**



Bin 1 Cumulative MW

Bin 1	2016	2017	2018	2019	2020	2021		2035
Curtailable/Interruptible Tariff	26	131	238	348	462	550		646
Curtailable/Interruptible - AutoDR	26	131	238	348	462	550		646
Refrigerated Warehouses - Controls	13	65	119	174	231	275		323
Space Cooling, Medium - Switch	4	17	27	34	39	46		54
Space Cooling, Small - Switch	1	6	10	13	15	17		20

What's In Each Bin?

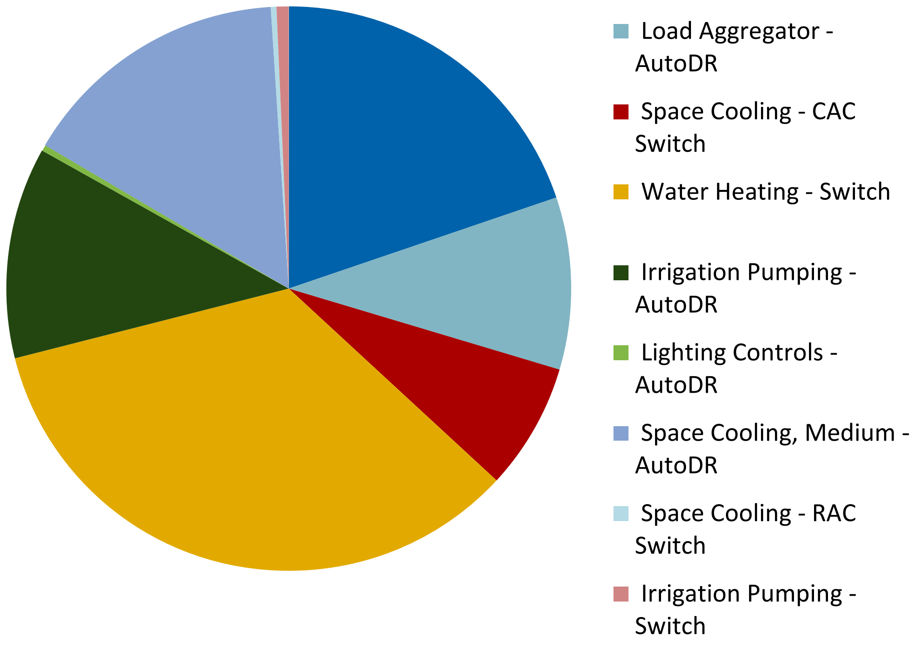
<u>Bin 2</u>

The RPM can purchase up to **1299 MW (Summer Peak)** and **1312 MW (Winter Peak)** at **$44.53** (in 2012$/kW-yr) over the course of the study.

Over 54% of the bin is made up of
Residential Water Heating: **$49**
Space Heating- Switch: **$28**

Less than 46% is made up of
Space Cooling, Medium (ADR): **$55**
Irrigation Pumping (ADR): **$55**
Load Aggregator (ADR): **$29**
Space Cooling, CAC Switch: **$47**
Irrigation Pumping - Switch: **$76**
Lighting Controls (ADR): **$55**
Space Cooling, RAC Switch: **$61**

Bin 2 in 2021



Bin 2 Cumulative MW

Bin 2	2016	2017	2018	2019	2020	2021		2035
Load Aggregator – AutoDR	6	33	60	87	115	138		161
Space Heating – Switch	21	98	159	204	231	276		325
Space Cooling - CAC Switch	8	36	58	74	85	101		119
Water Heating - Switch	22	113	206	302	400	477		562
Irrigation Pumping - AutoDR	0	1	2	3	4	5		6
Lighting Controls – AutoDR	8	40	73	107	142	169		198
Space Cooling, Medium - AutoDR	7	40	80	127	182	217		254
Space Cooling - RAC Switch	0	2	3	3	4	5		5
Irrigation Pumping - Switch	0	2	4	6	8	10		11

What's In Each Bin?

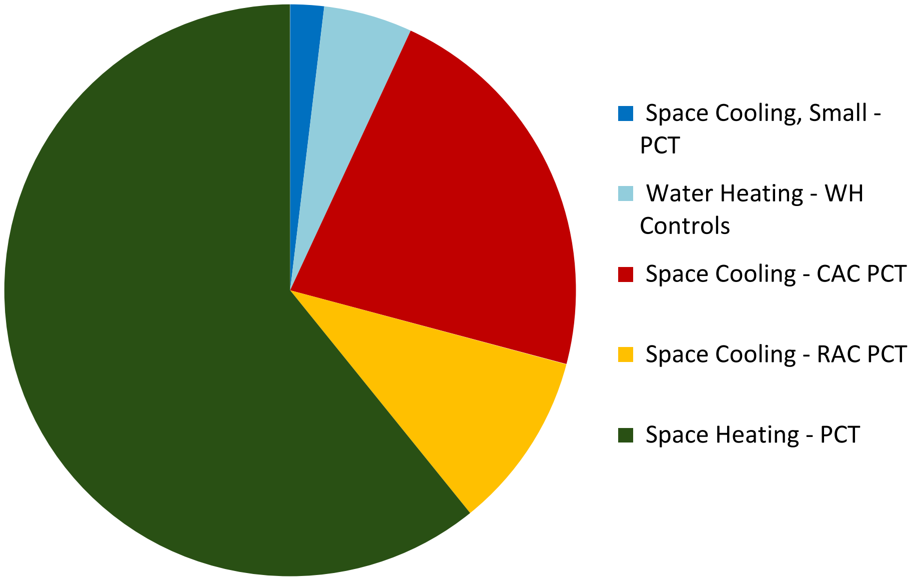
<u>Bin 3</u>

The RPM can purchase up to **827 MW (Summer Peak)** and **489 MW (Winter Peak)** at **$151.81** (in 2012$/kW-yr) over the course of the study.

Over 60% of the bin is made up of
Space Heating – PCT: **$153**

Less than 44% is made up of
Space Cooling, CAC PCT – Switch: **$153**
Space Cooling, RAC PCT- Switch: **$153**
Water Heating (ADR): **$152**
Space Cooling, Small – PCT: **$89**

Bin 3 in 2021



Bin 3 Cumulative MW

Bin 3	2016	2017	2018	2019	2020	2021		2035
Space Cooling, Small – PCT	1	4	8	12	17	20		24
Water Heating - WH Controls	2	13	23	34	44	53		62
Space Cooling - CAC PCT	8	44	87	138	198	236		278
Space Cooling - RAC PCT	4	20	39	62	89	106		125
Space Heating – PCT	21	120	238	378	540	644		759

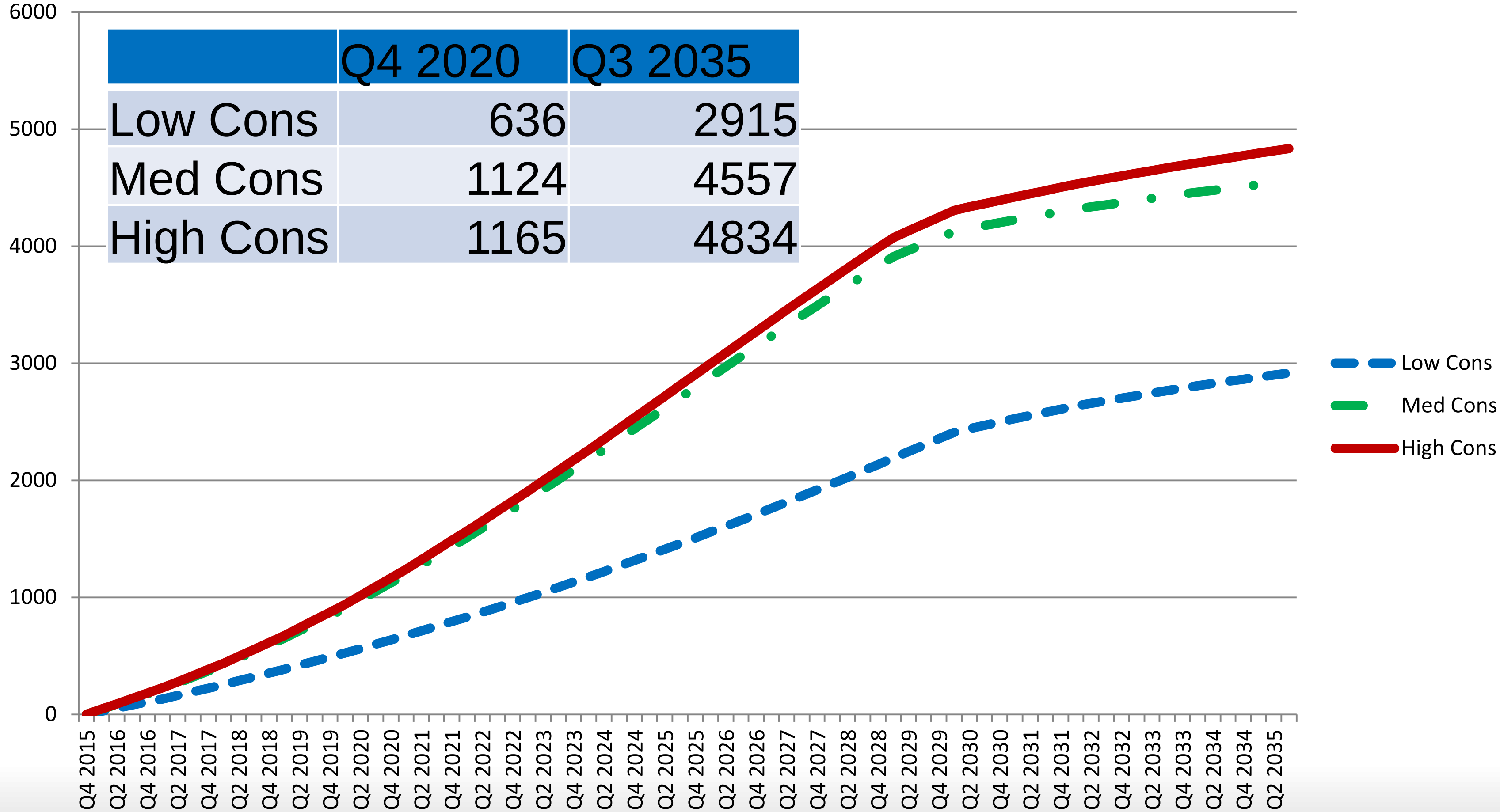
Scenario 1B Strategy Examples

Resource Strategies

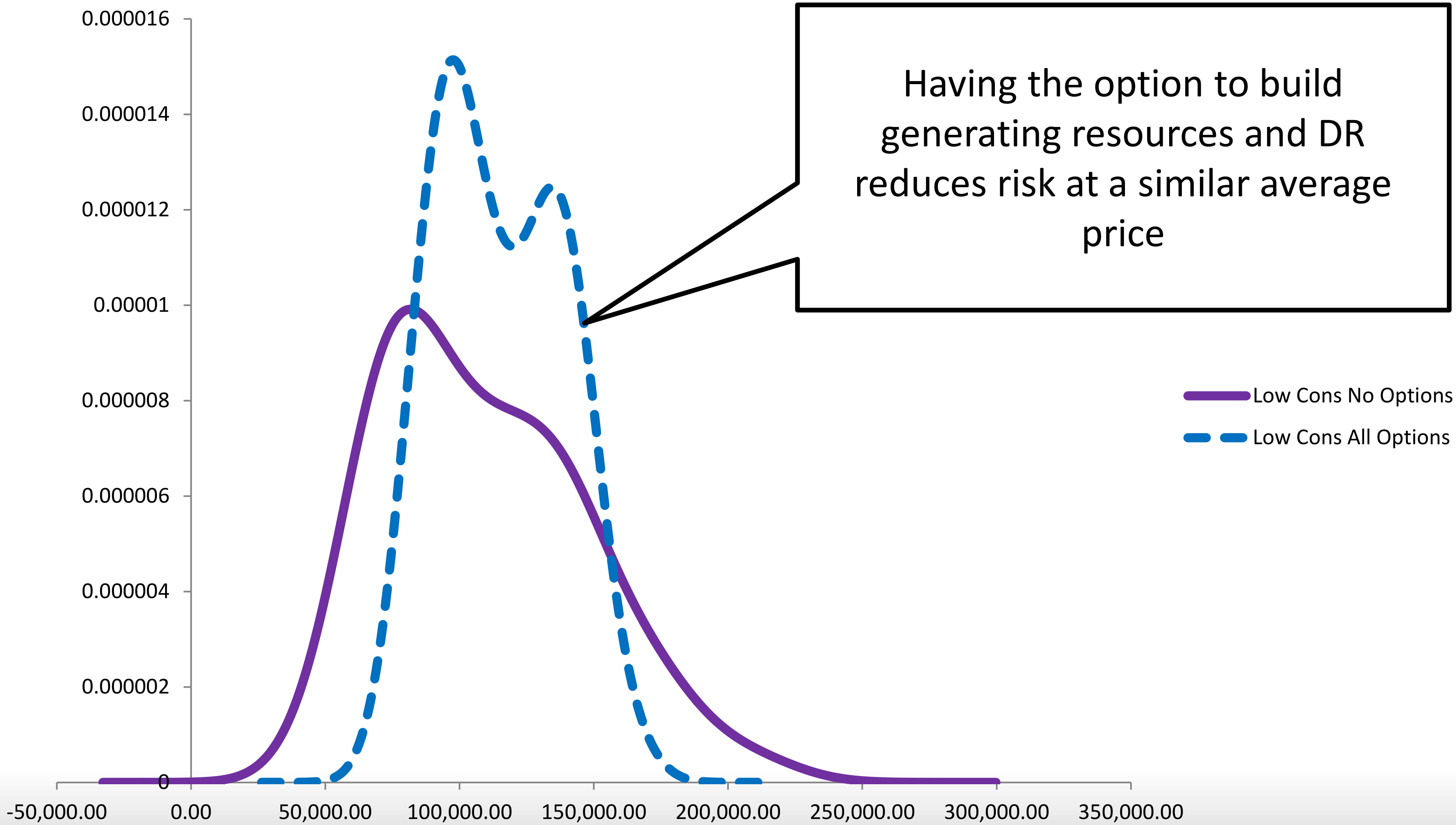
- No Resource Options – No Conservation
- No Resource Options – Low Conservation
- All Resource Options – Low Conservation
- All Resource Options – Medium Conservation
- All Resource Options – High Conservation

Conservation Strategies

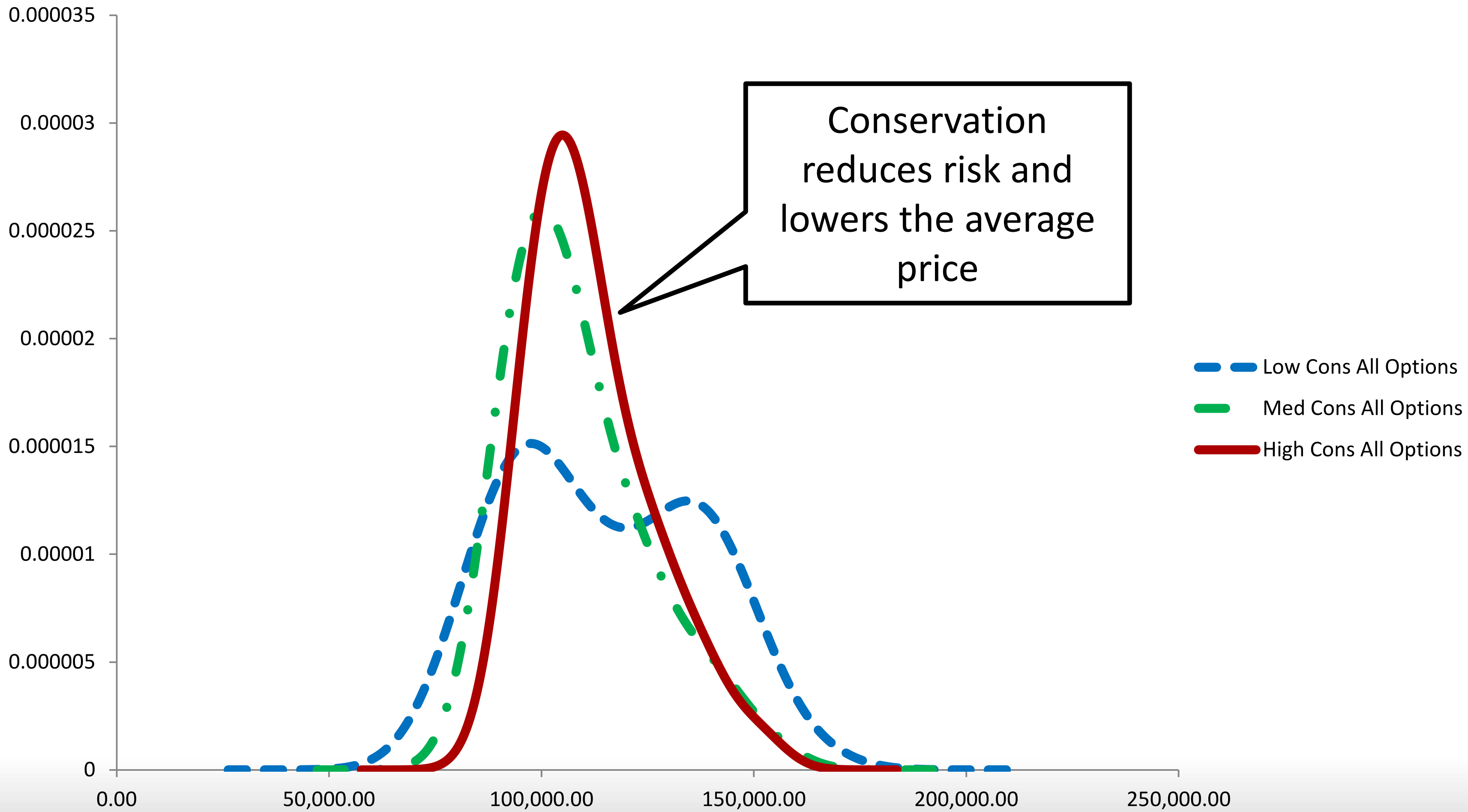
	Q4 2020	Q3 2035
Low Cons	636	2915
Med Cons	1124	4557
High Cons	1165	4834



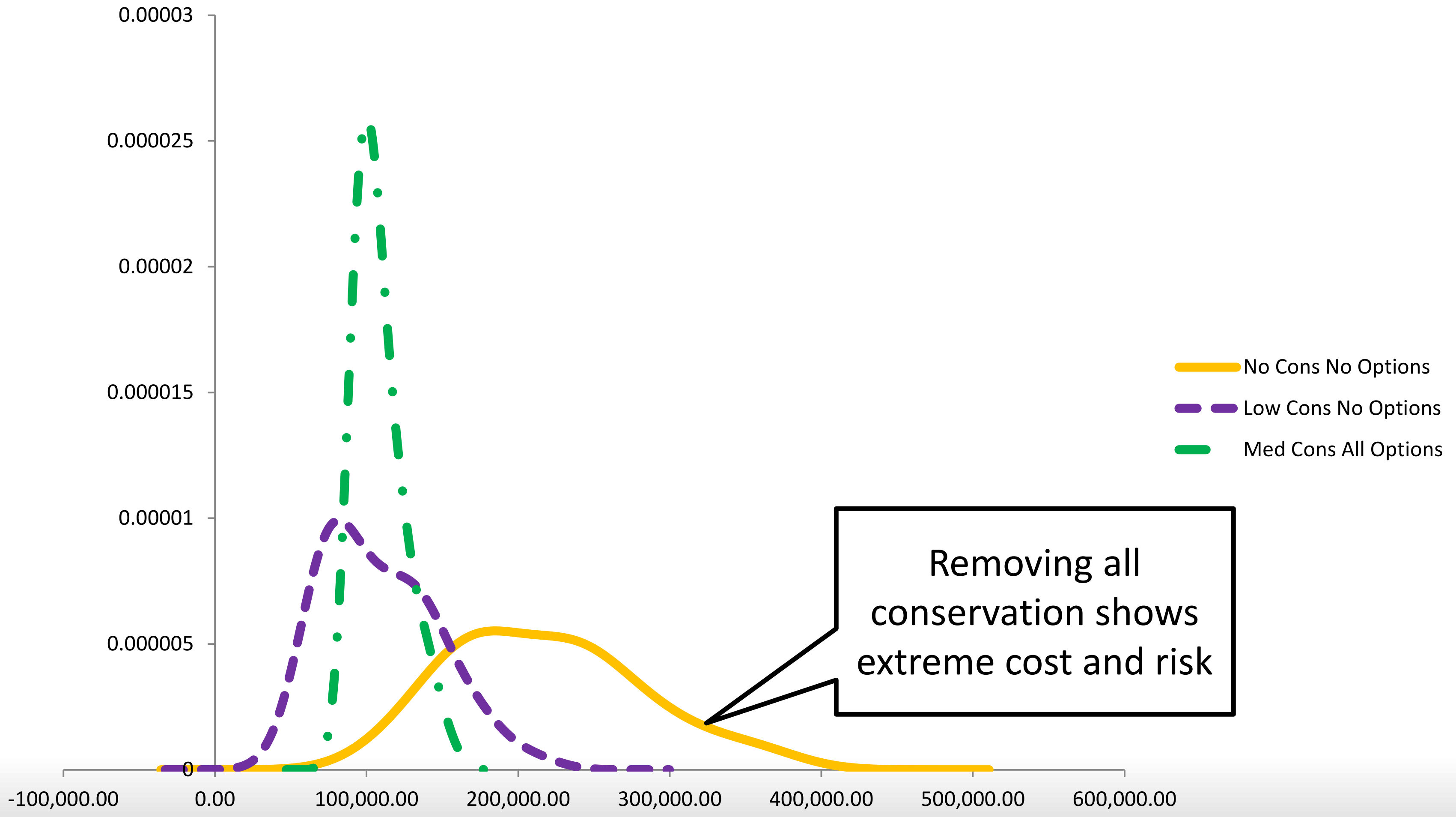
Impact of Options on NPV



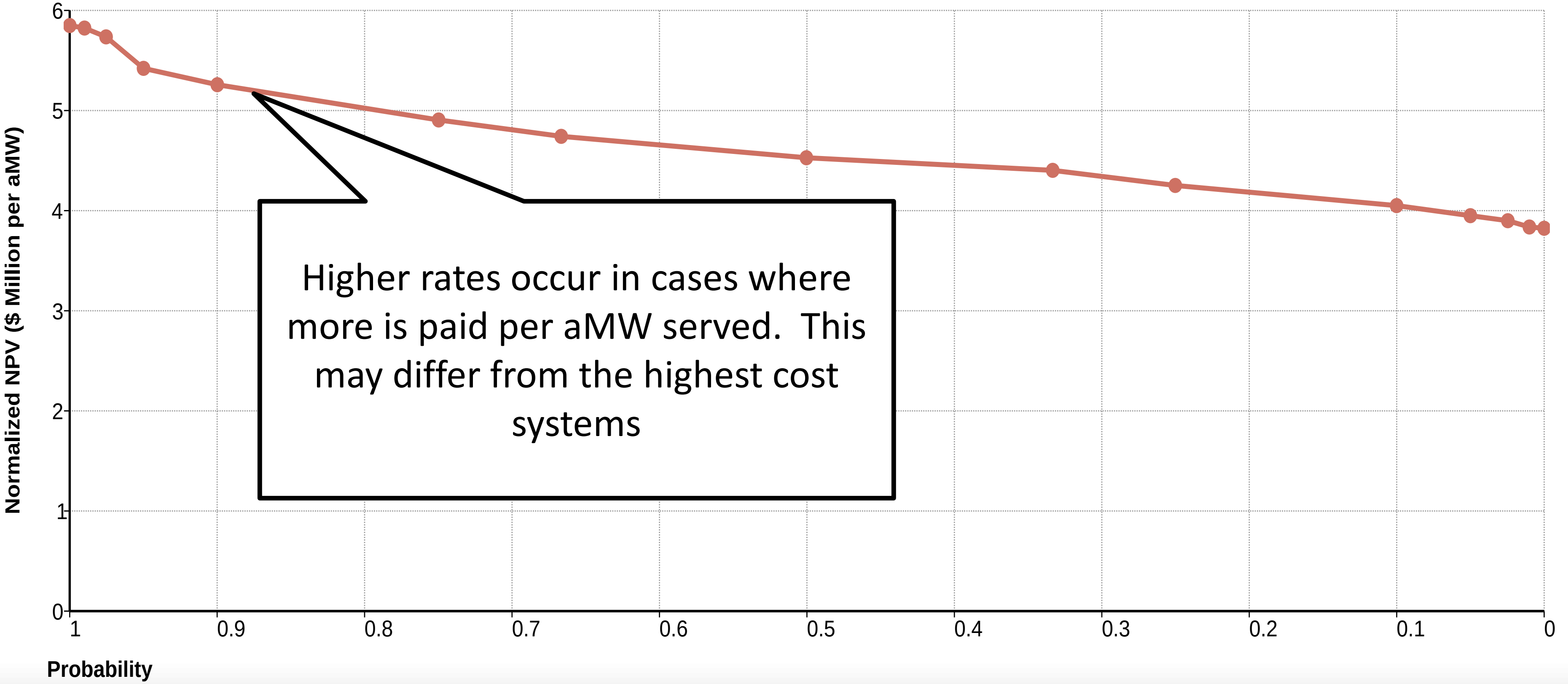
Impact of Conservation on NPV



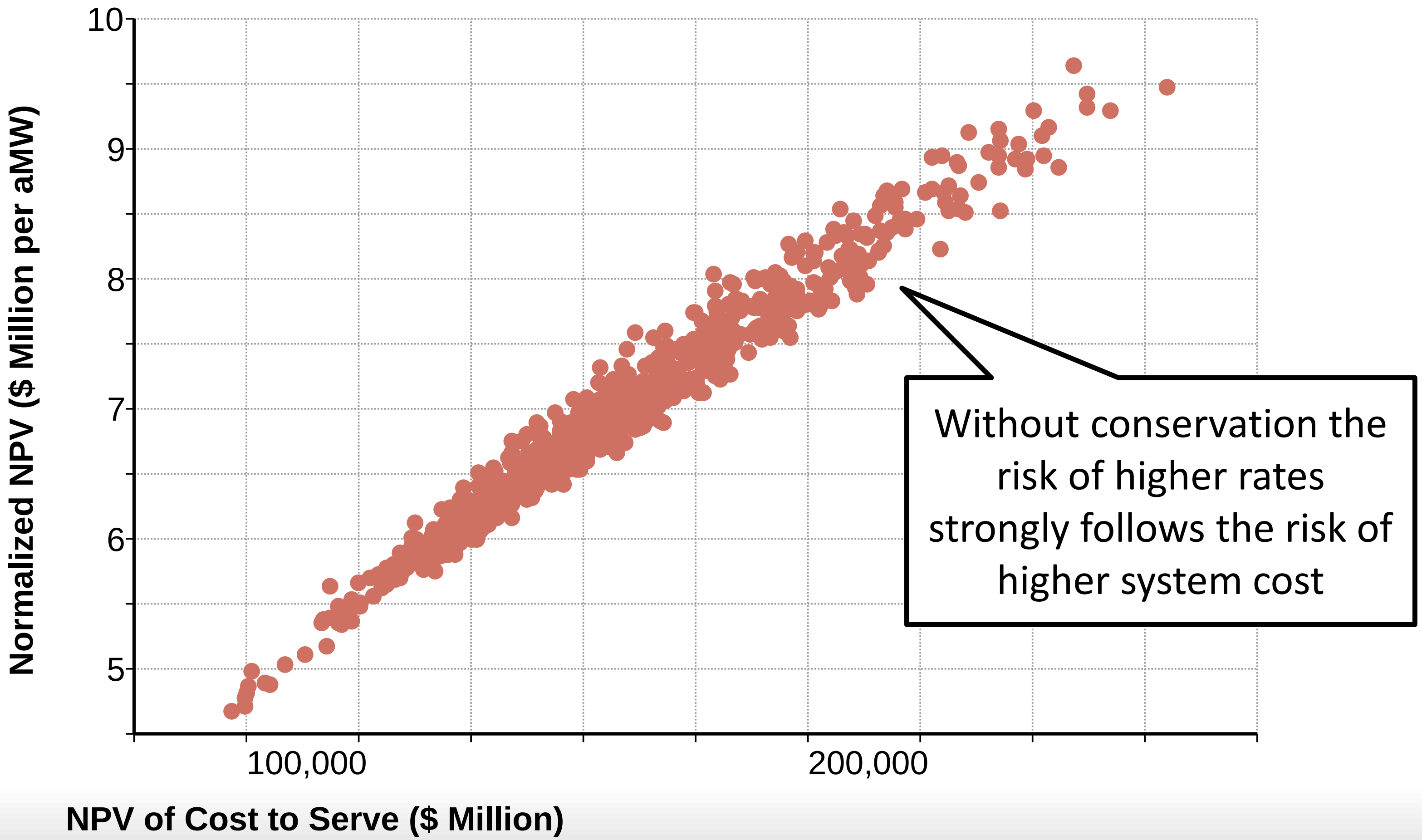
Impact of Zero Conservation



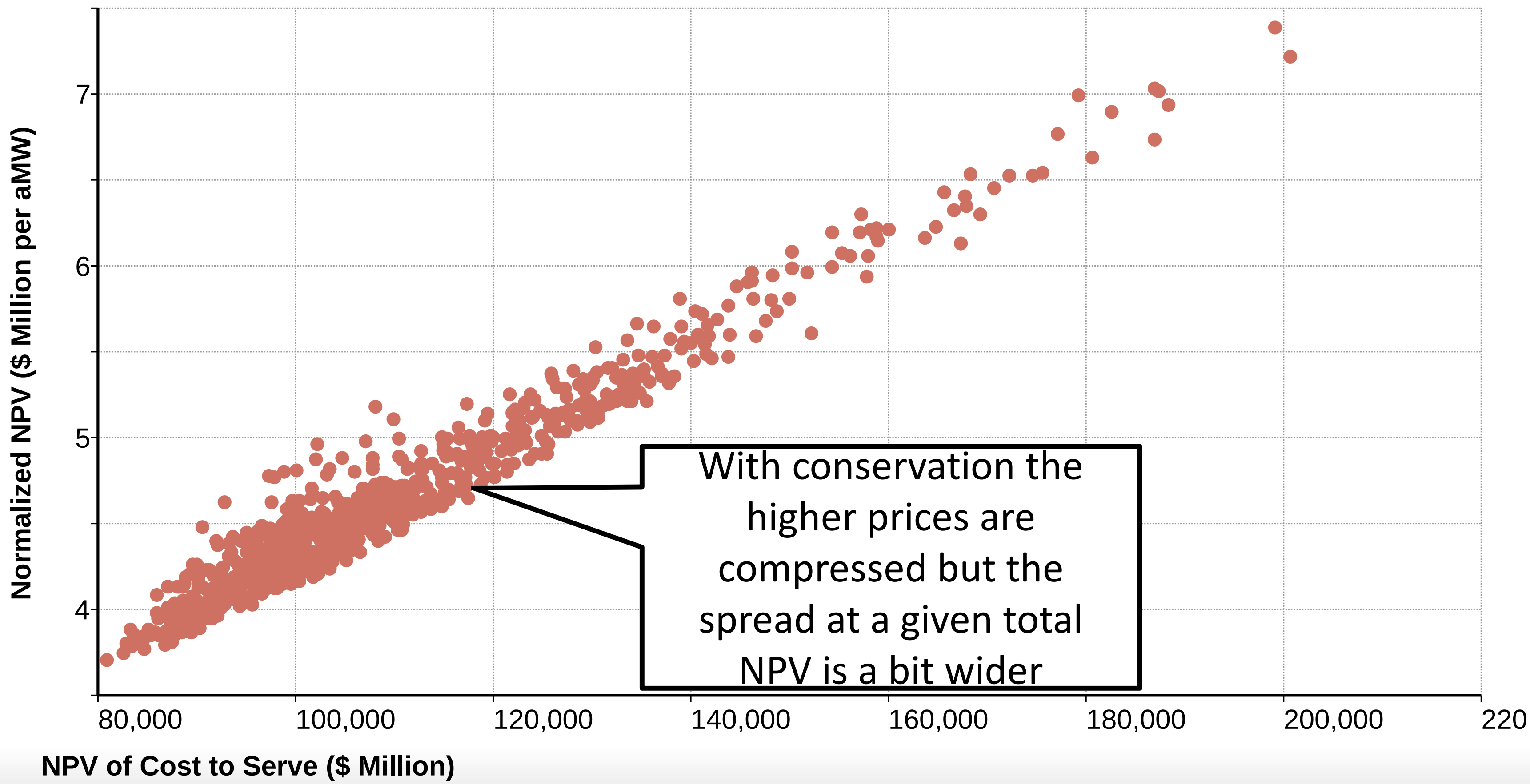
Normalized NPV Medium Conservation



Normalized NPV vs. NPV with No Conservation



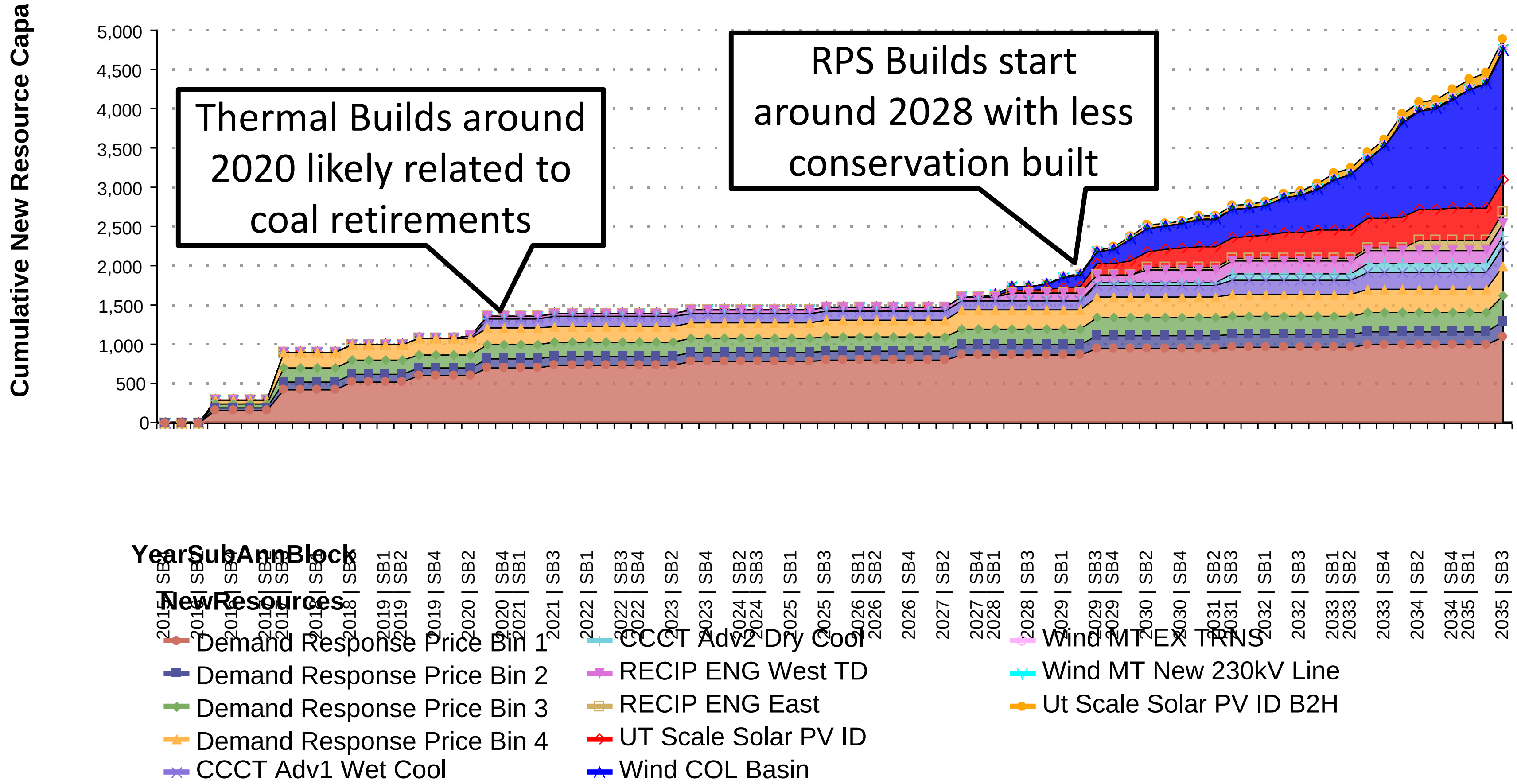
Normalized NPV vs. NPV with Medium Conservation



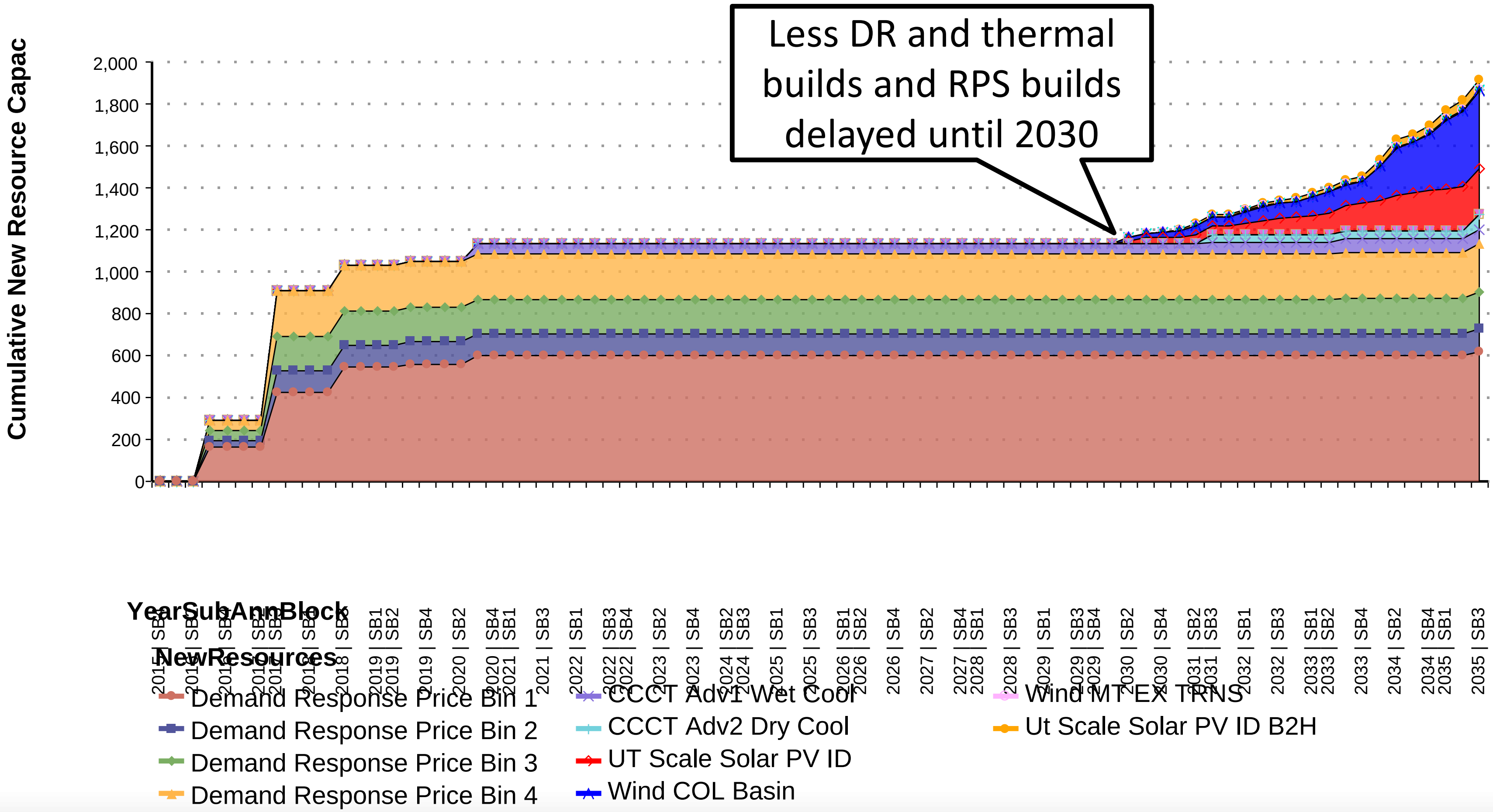
Periods with Economic Builds with Low Conservation

Period Range	Percentage of Futures
By Q4 2020	1%
By Q3 2035	12%

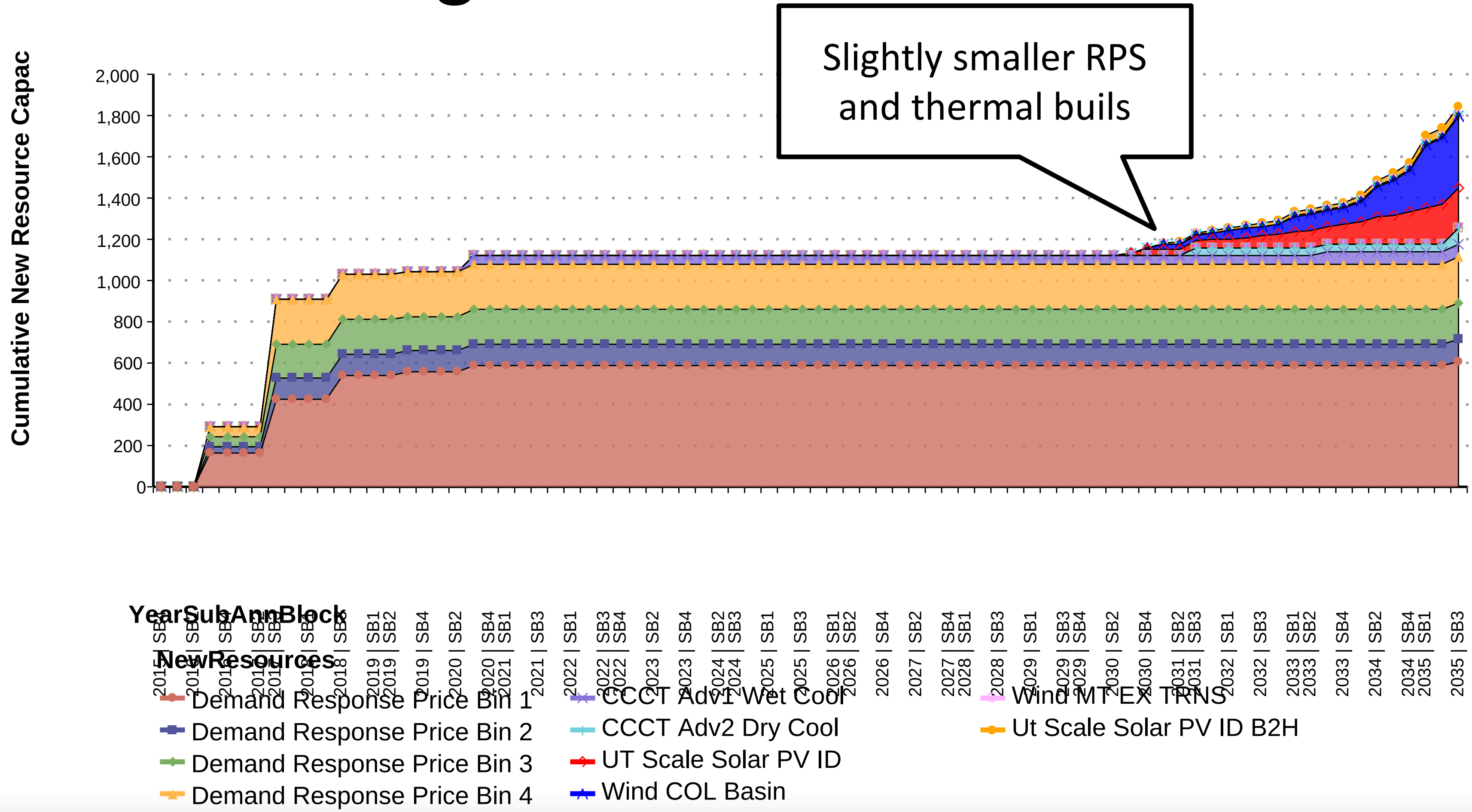
Average Resource Build with Low Conservation



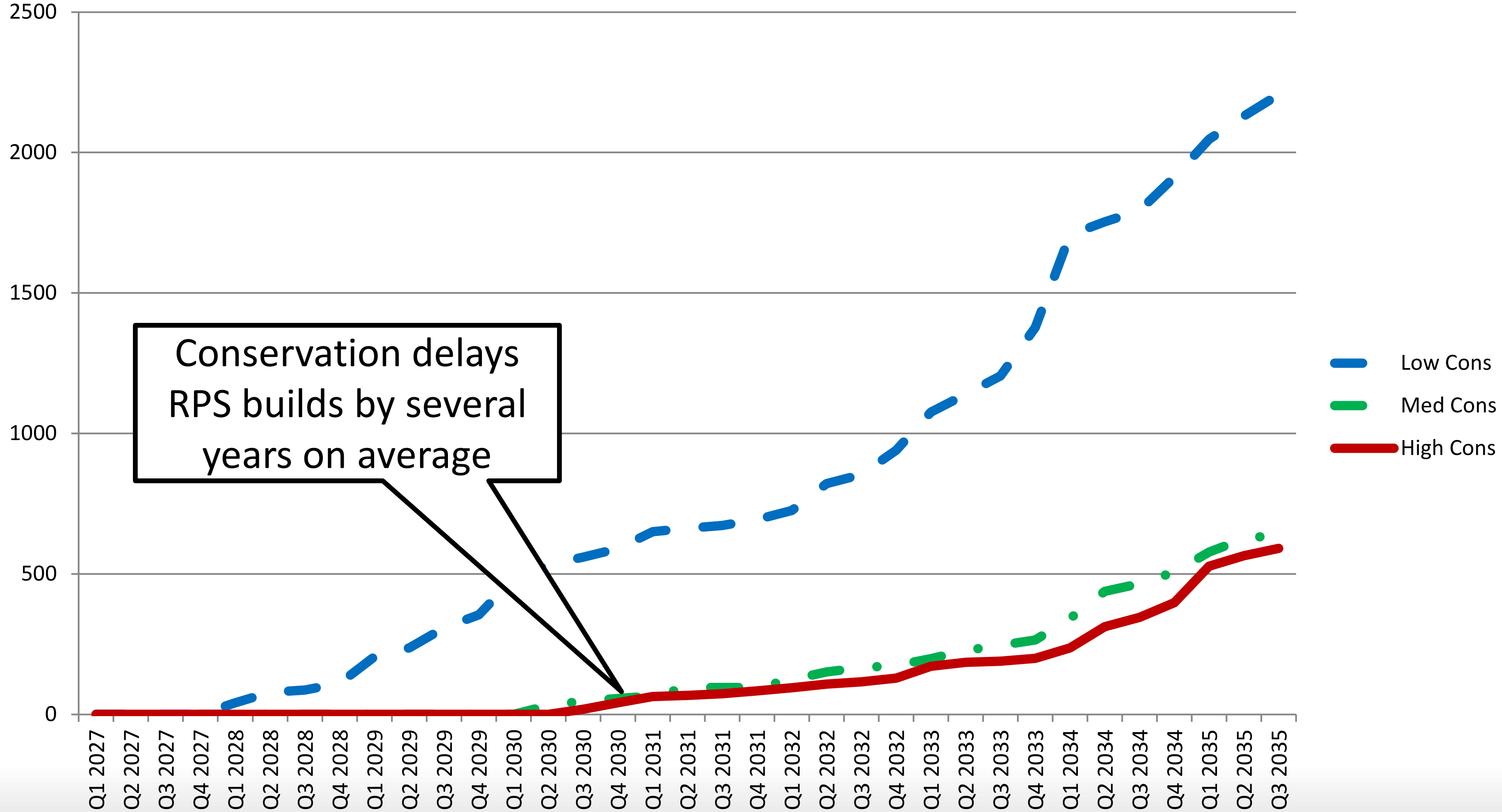
Average Resource Build with Medium Conservation



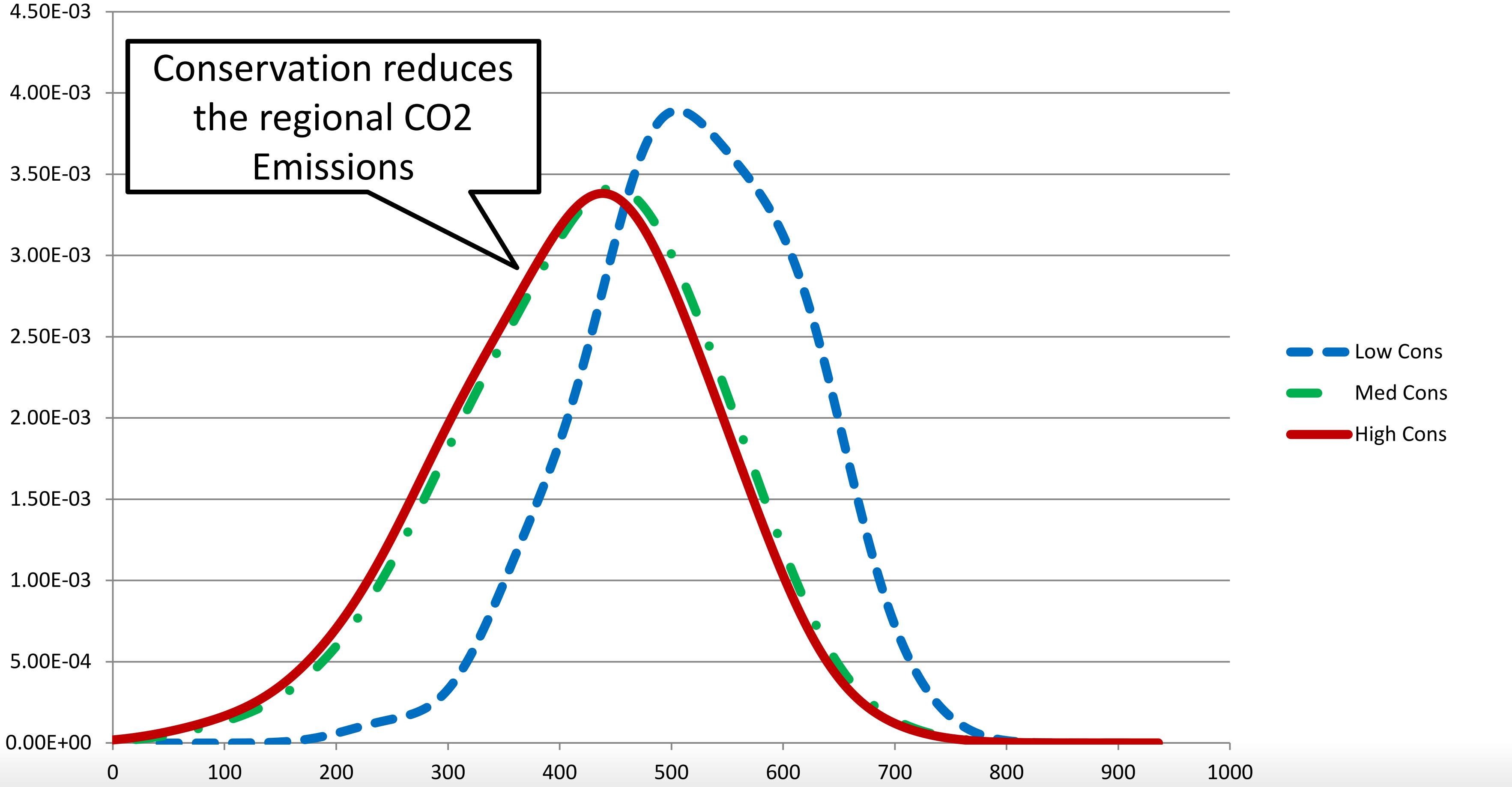
Average Resource Build with High Conservation



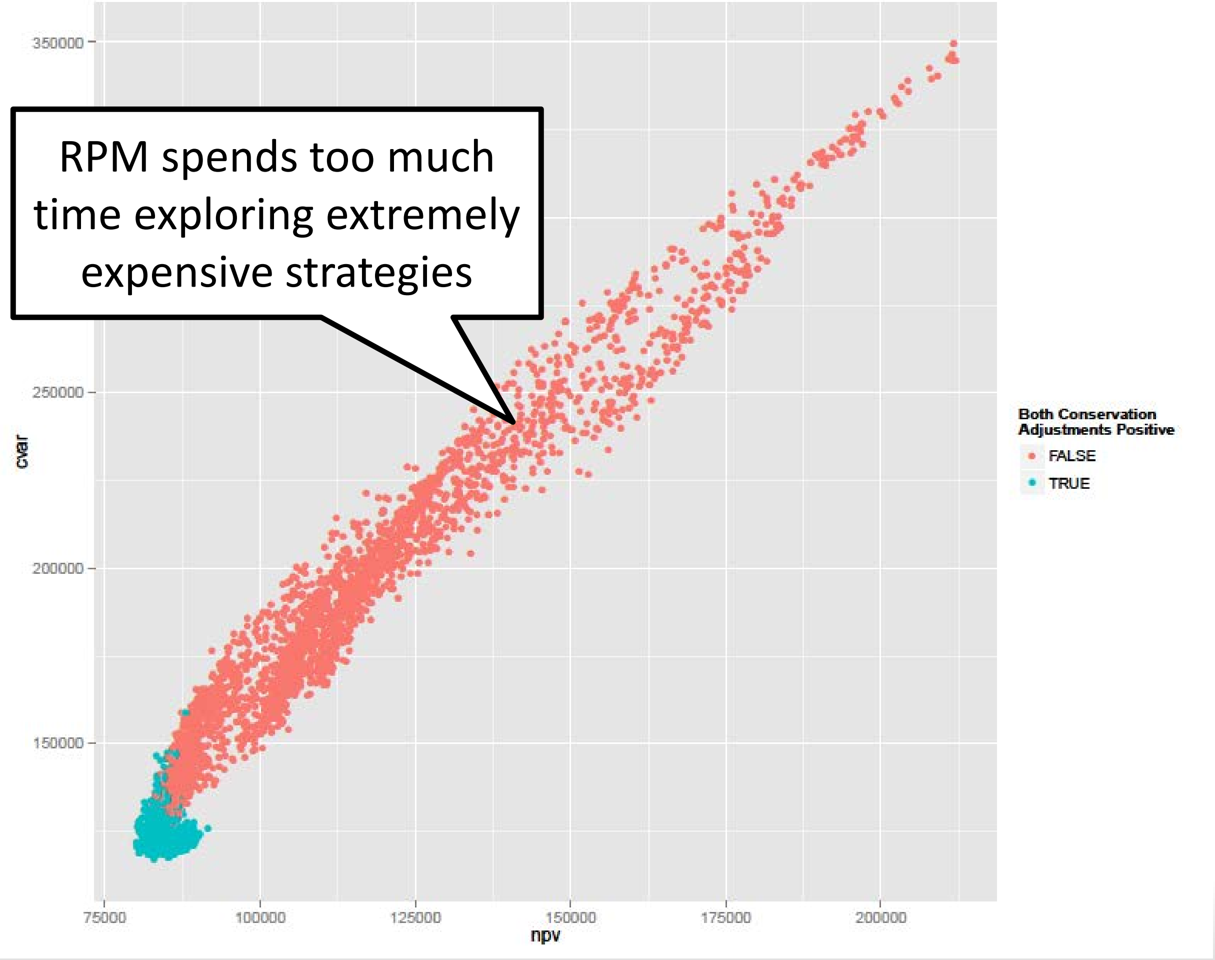
Average RPS Build



CO2 Emissions Distribution



Should Conservation Be Examined At Prices Under Market Parity?



QUESTIONS?

Update on Scenario Analysis

April 8, 2015

Guidance on Scenario Input Assumptions

- Scenario 2B – Which Social Cost of Carbon Should Be Assumed?
  - *Proposal - Use Interagency Working Group Estimates based on 3% Discount Rate*
- Scenarios 4C and 4D – What Should Be the Range of Conservation Resource Uncertainty Tested?
  - *Proposal – Assume 33 percent faster and 33 percent slower maximum pace of conservation resource development*
- All Scenarios – Should the Potential Direct Impacts (i.e., increased temperatures) of Climate Change Be Assumed in All Scenarios or Treated As Sensitivity Study
  - *Proposal – Treat as sensitivity study*
- Demand Response – How should we establish the "cost" of demand response resources?
  - *Proposal – Use "incentive payments" as a proxy for the cost of developing demand response resources that require load curtailment (Note: This cost is in addition to marketing, administration and hardware cost required to enable DR)*

RPM Results Disclaimers

- The long-term capacity expansion logic is still being reviewed so there is still potential for revision.
  - Received current version April 4th
  - The SAAC and RAAC will be reviewing the RPM's capacity expansion logic which uses GENESYS results to ensure resource strategies satisfy regional adequacy standards
- *Caveat emptor* –
  - All results in this presentation ***are still preliminary***
  - The RPM test resource strategies across 800 different futures
    - Each future has a unique result
    - Staff interpretations of results, communicated with terms like "on average" or "in general," will likely not hold in one or more of those futures.
  - These qualification are missing because they wouldn't fit on every slide!

What We Compare in the RPM

- Single *Resource Strategies* across a single future (or subsets of futures) to ascertain why it is more or less “successful” under specific conditions
- Multiple *Resource Strategies* across 800 futures within a single *Scenario* to find the “least cost” and “least risk” resource strategies
- The “least cost” and “least risk” *Resource Strategies* across multiple *Scenarios* to find the most robust *Resource Strategies*

What We Have Today

- Comparison of four illustrative *Resource Strategies* across 800 futures
  - Distribution of Net System Cost ($)
  - Distribution of conservation development (aMW)
  - Impact of conservation development levels on Net System Cost ($)
  - Distribution of RPS resource development (MW)
  - Impact of conservation development levels on other resource development (MW)
  - Impact of conservation development levels on CO_2 emissions (tons)

First – A Note About Terminology
What's Do We Mean by Net System Cost?

- Costs of building and operating new resources and operating (e.g., fuel costs, fixed O&M) the existing power system
- Benefits and costs from selling (+$) or buying (-$) power outside the region
- Penalties (-$) associated with not meeting system adequacy requirements (referred to as "curtailment cost.")

Illustrative Resource Strategies

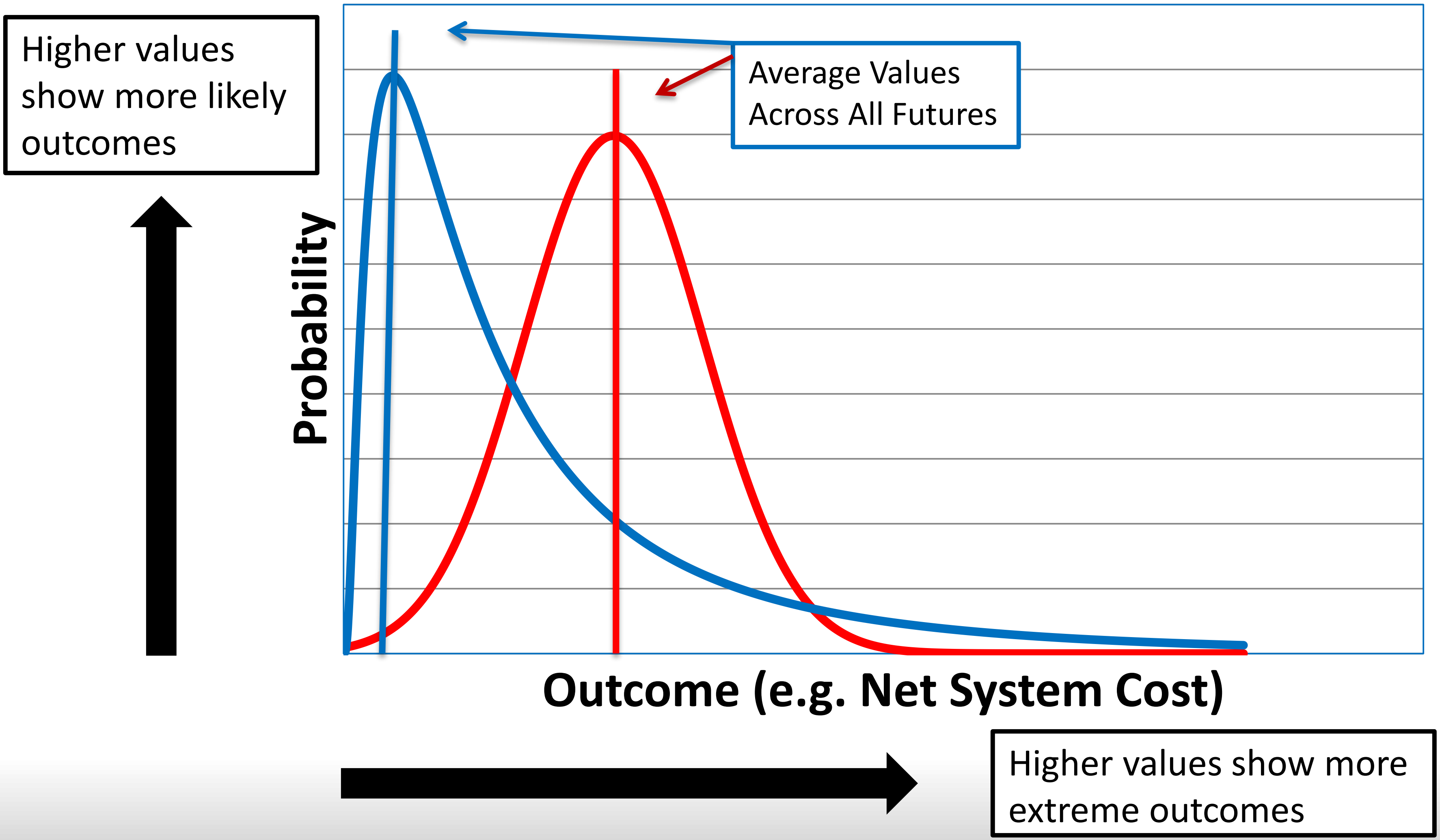
- ***No New Resource Additions***
  - No conservation, no new generation except for RPS required generation
- ***Conservation Resource Additions At Cost Up to Short-Run Market Price (aka: low conservation)***
  - No new generation except for RPS required generation
- ***Generation Resource Additions for Reliability and Economics with "low conservation"***
- ***Generation Resource Additions for Reliability and Economics with "high conservation"***
  - Conservation Resource Additions At Costs Exceeding Long-run generating resource costs without carbon emissions limits/costs.

The RPM "Builds" Resources to Maintain Resource Adequacy or Because It's Economical (i.e., profitable) To Do So

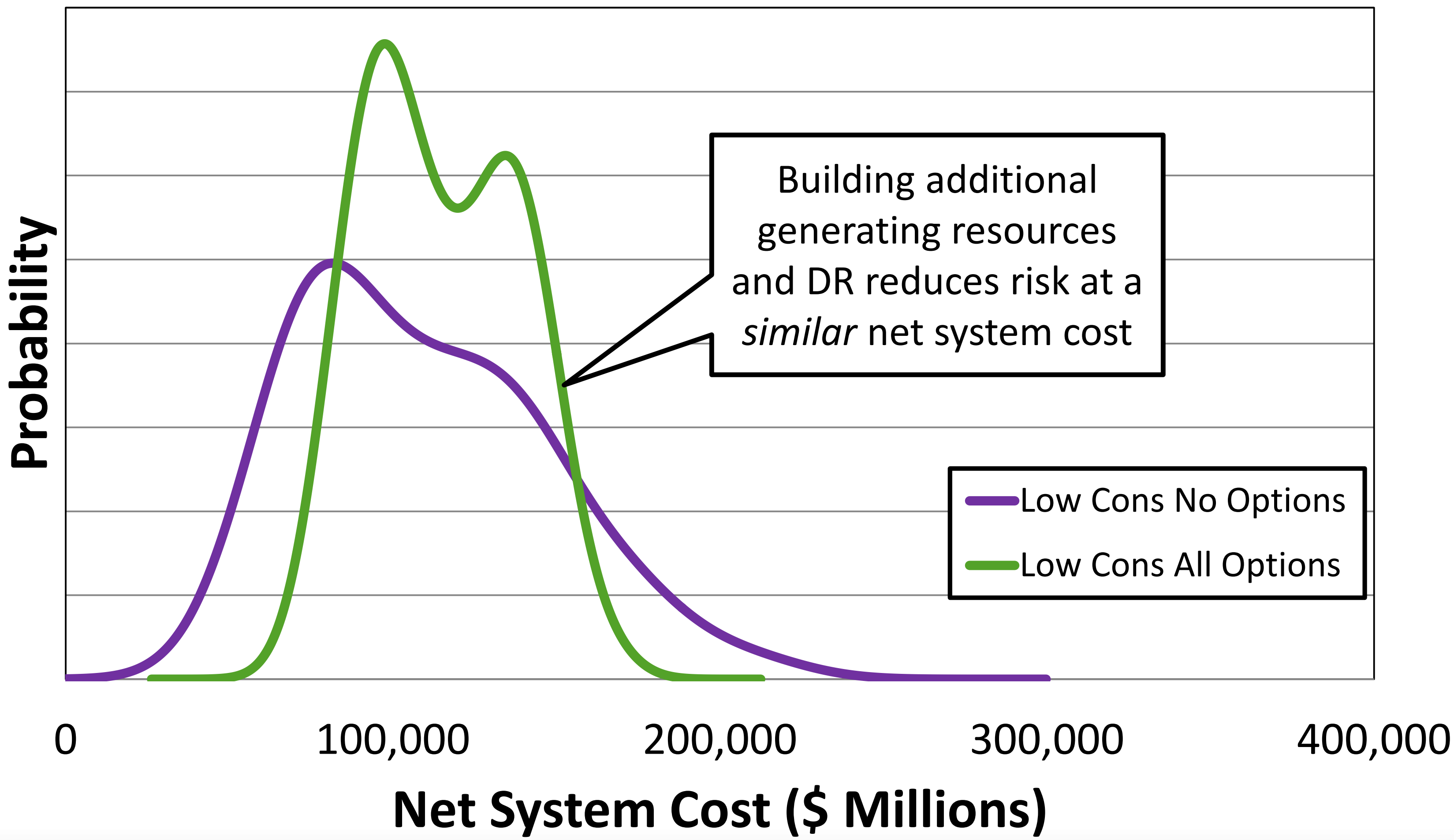
Period Range	Percentage of Futures
By Q4 2020	1%
By Q3 2035	12%

. . .But Mostly for Reliability

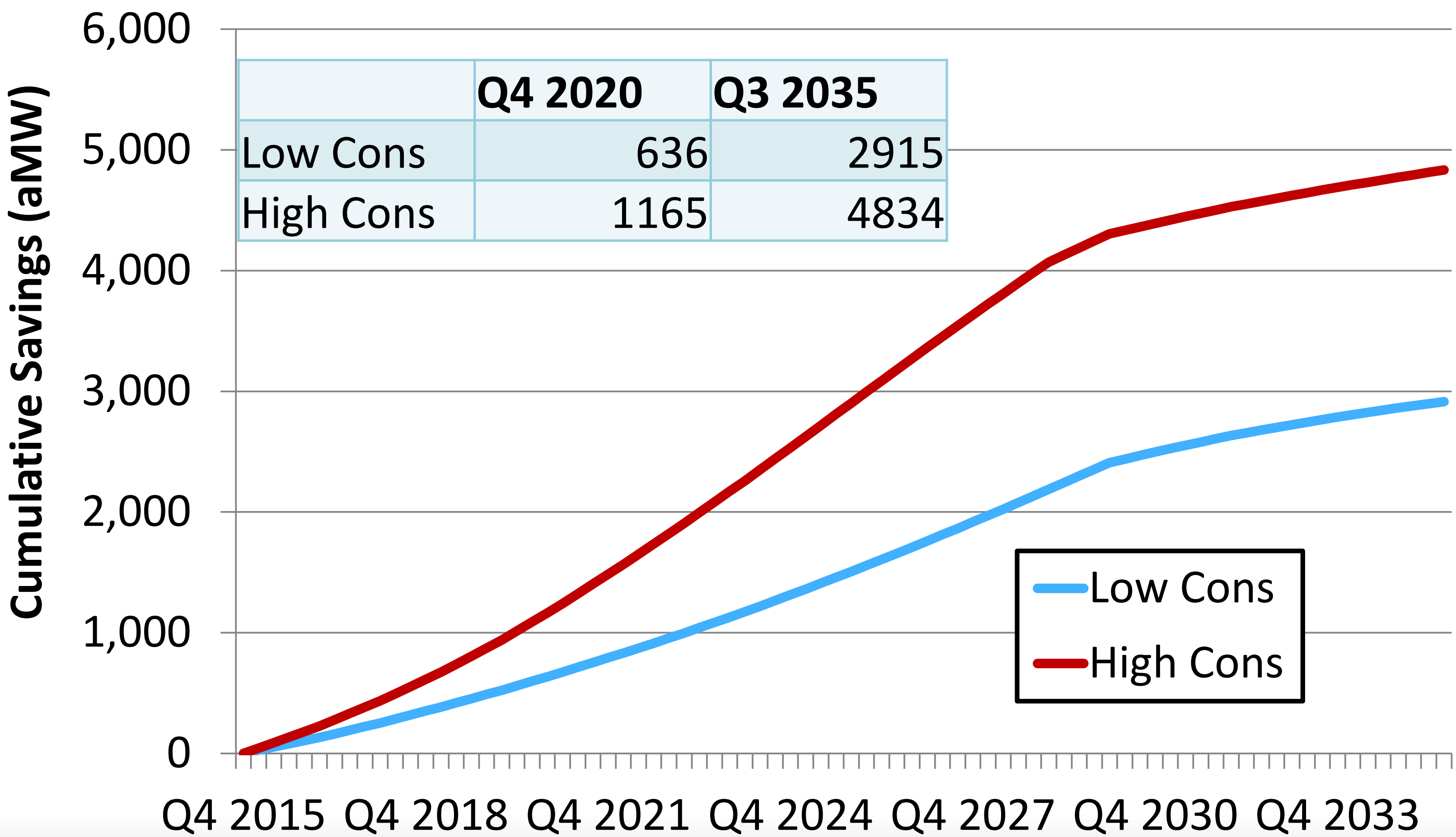
Many RPM Results Are Shown As Distributions Across All Futures



Net System Cost of No New Generation vs. Additional Generation Resource Strategies

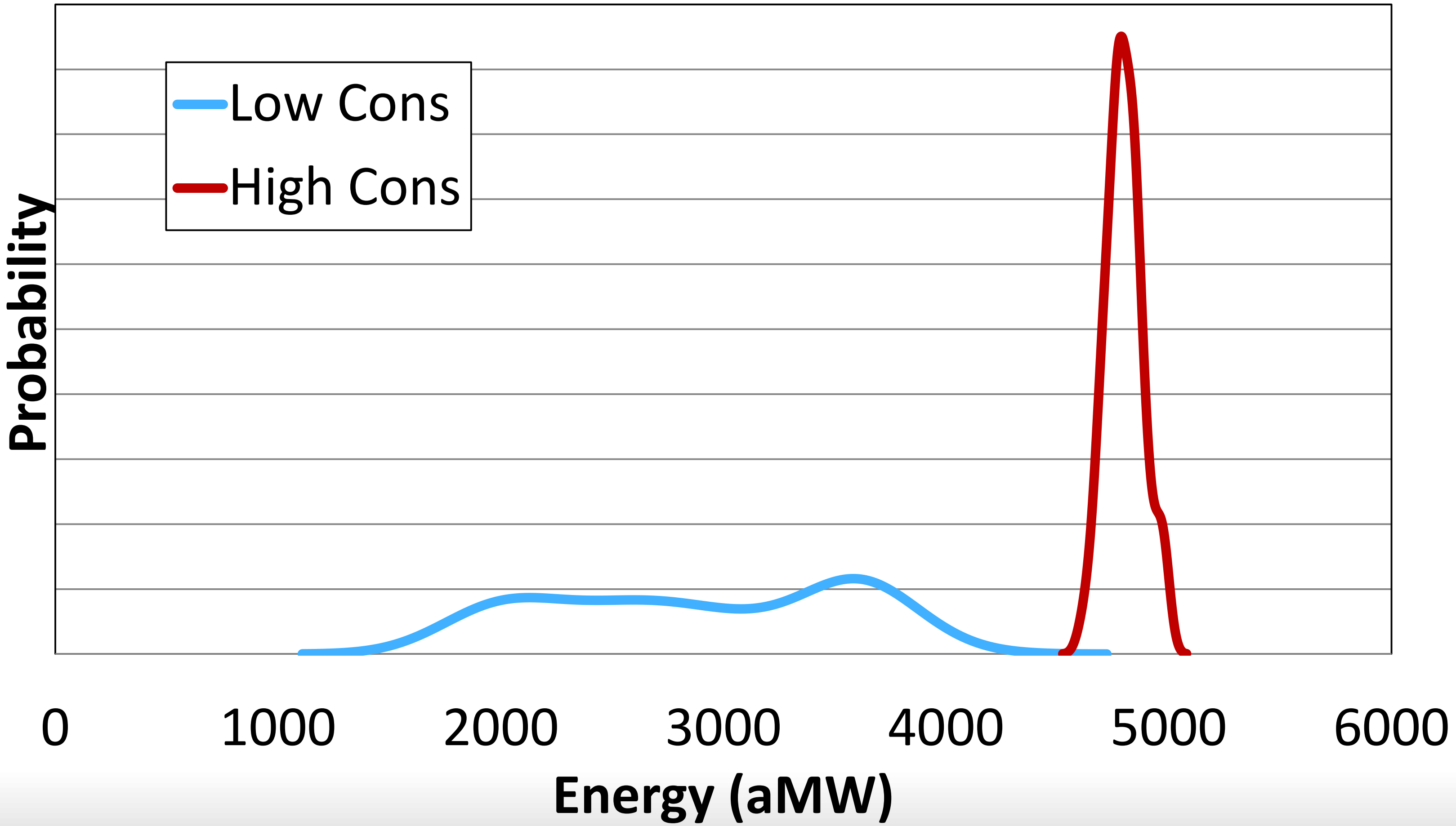


Conservation Development by Resource Strategy

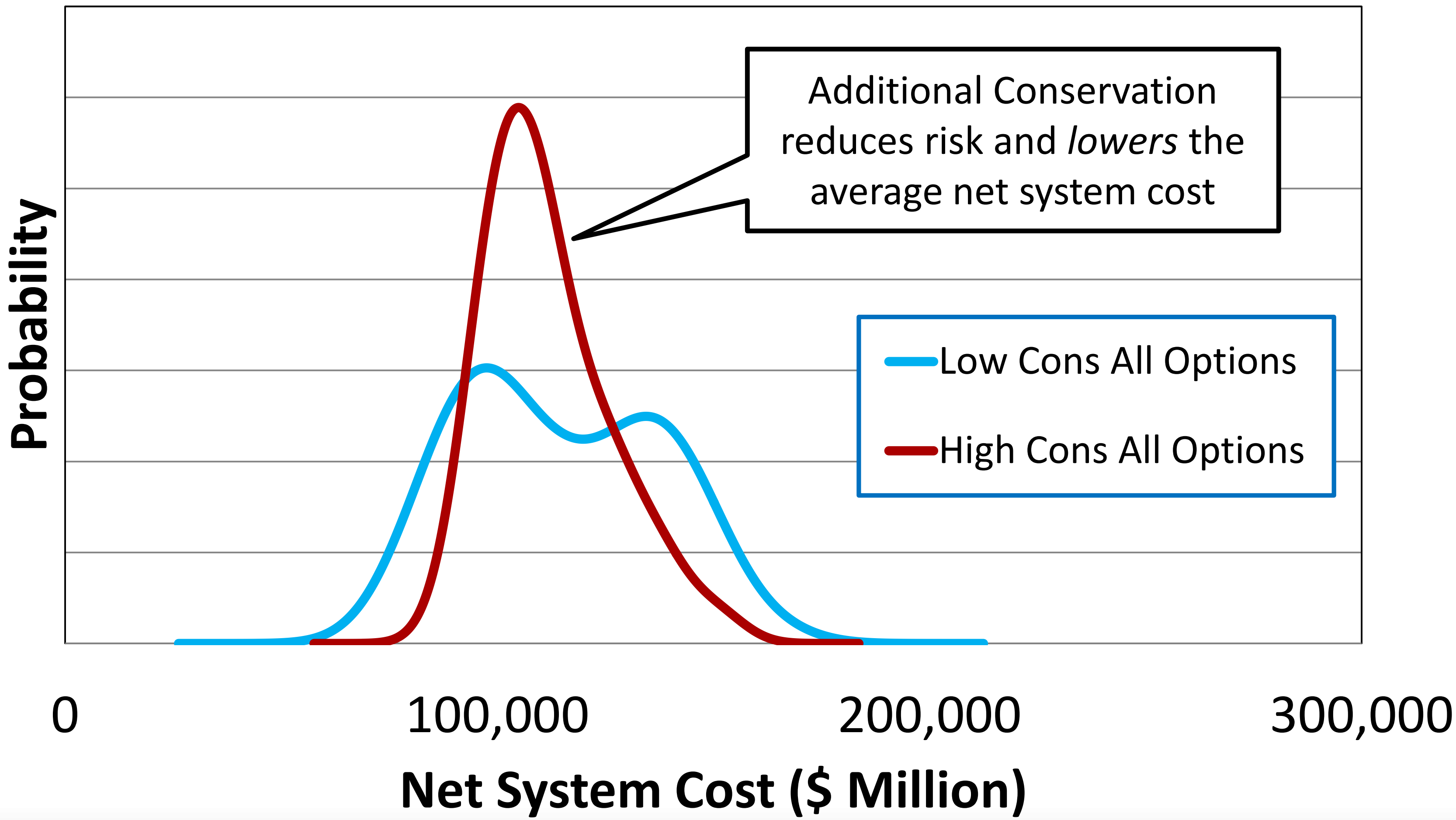


	Q4 2020	Q3 2035
Low Cons	636	2915
High Cons	1165	4834

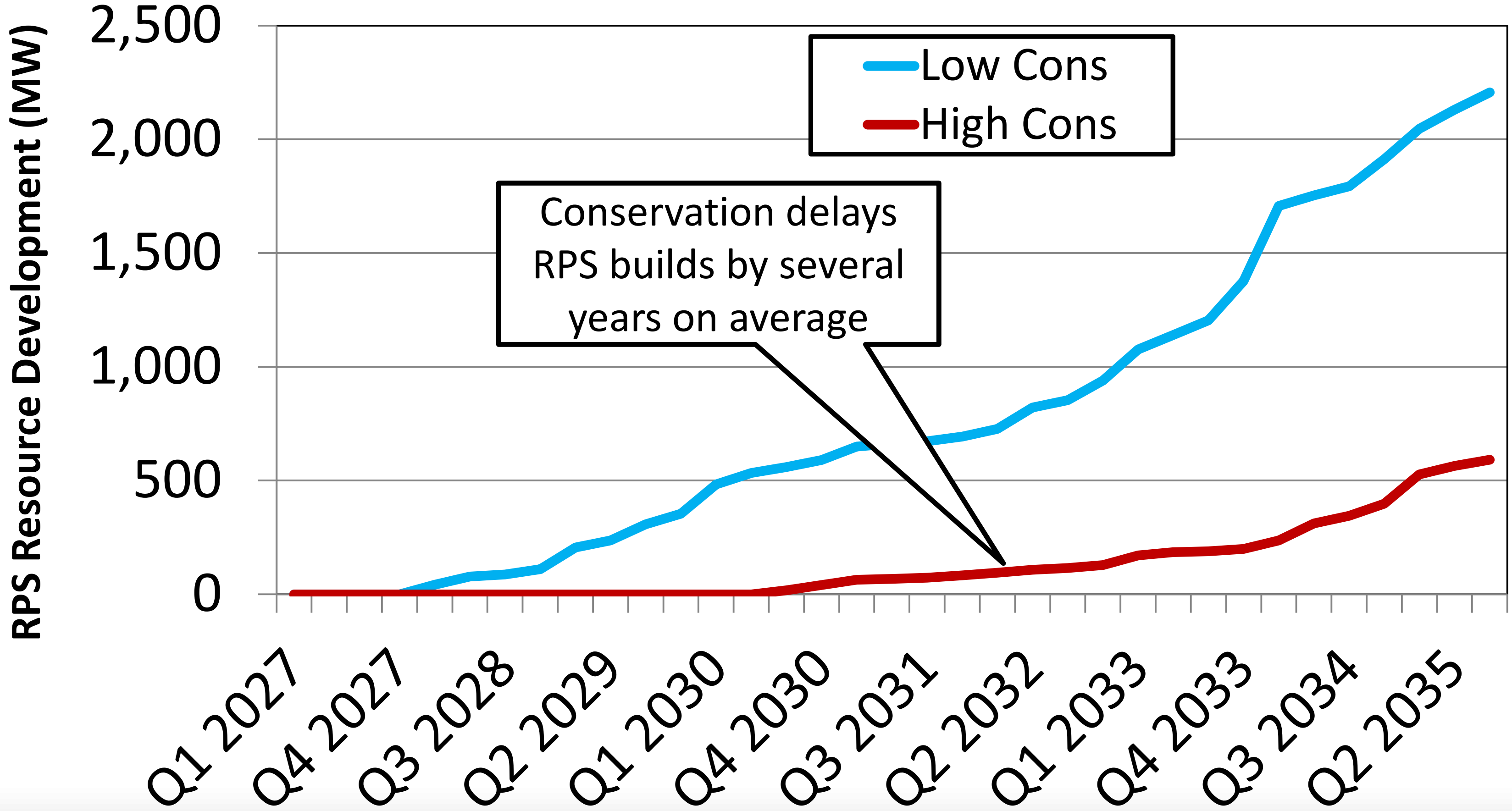
Total Study Conservation Development



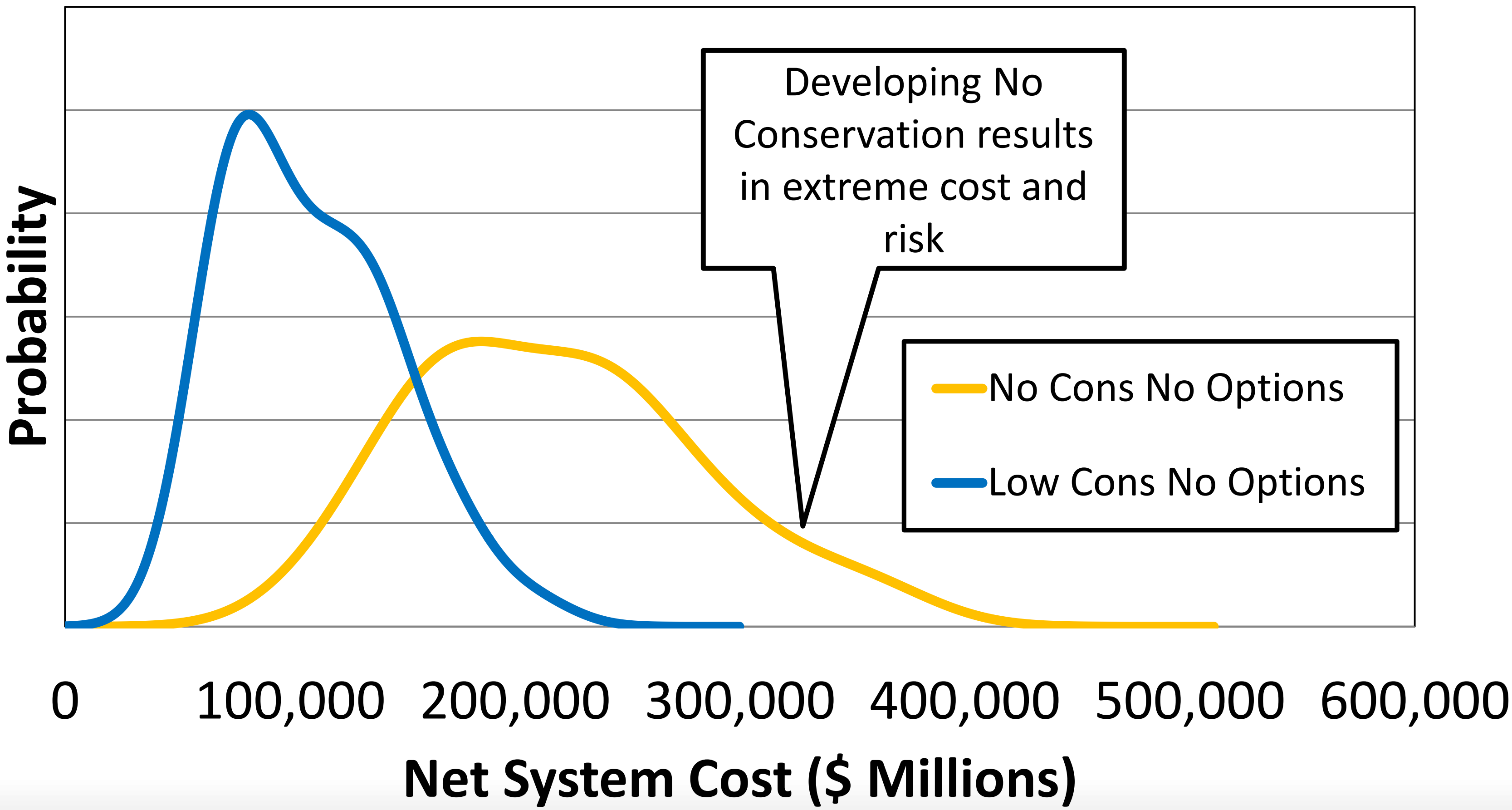
Net System Cost of Low vs. High Conservation Acquisition Resource Strategies



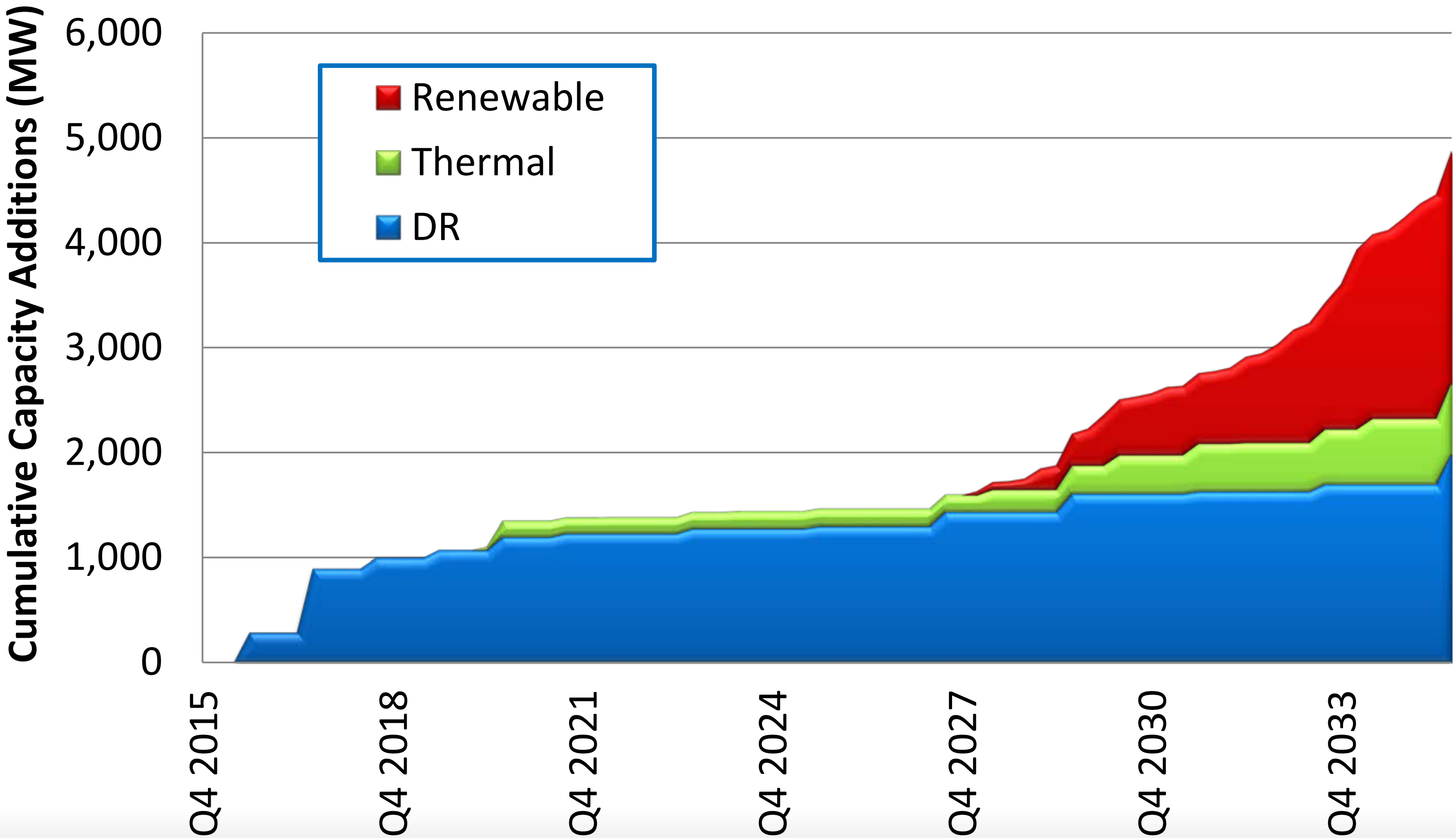
Resource Strategies with Higher Conservation Development Reduces RPS Resource Development



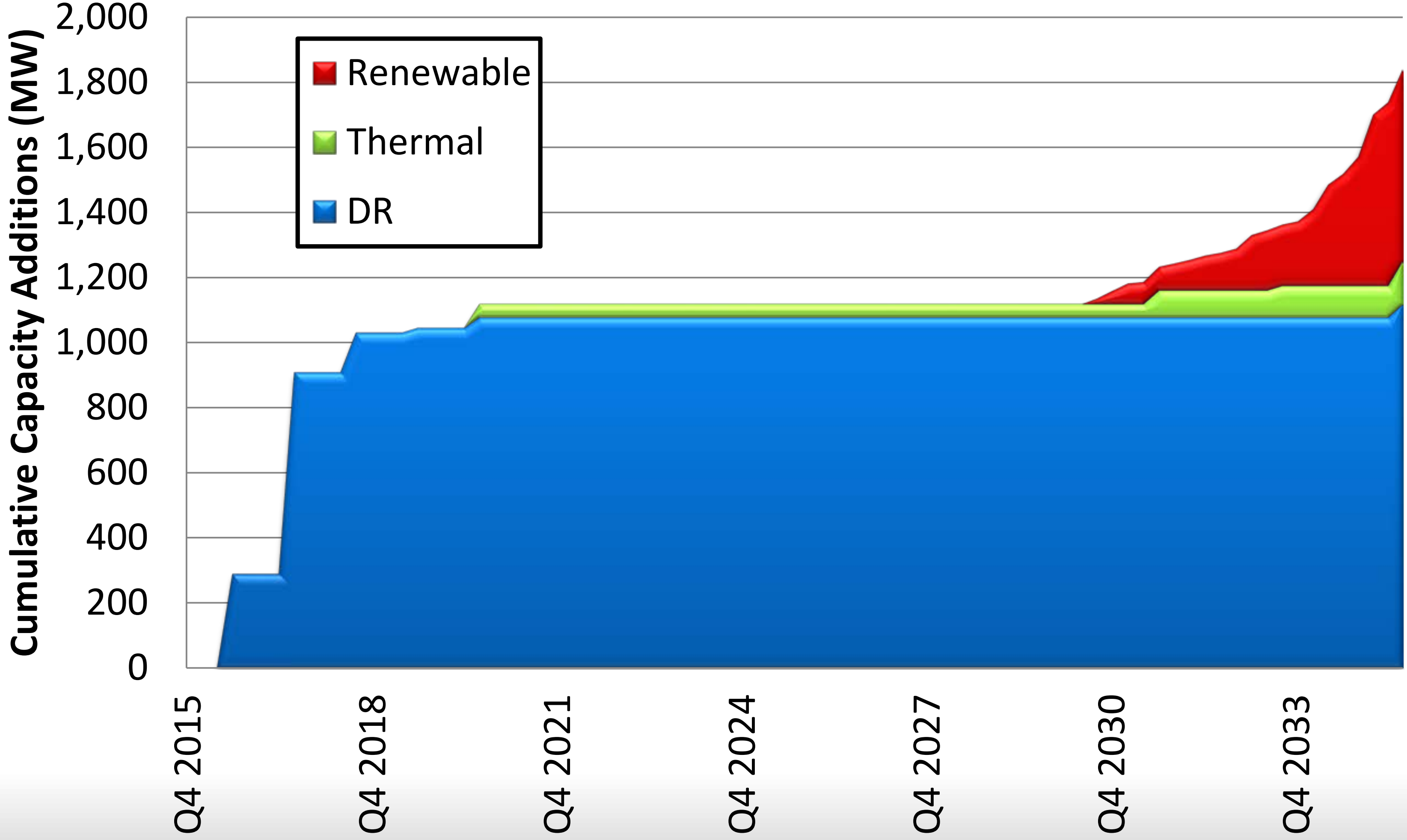
The No Conservation Resource Strategy Increases Net System Cost and Risk



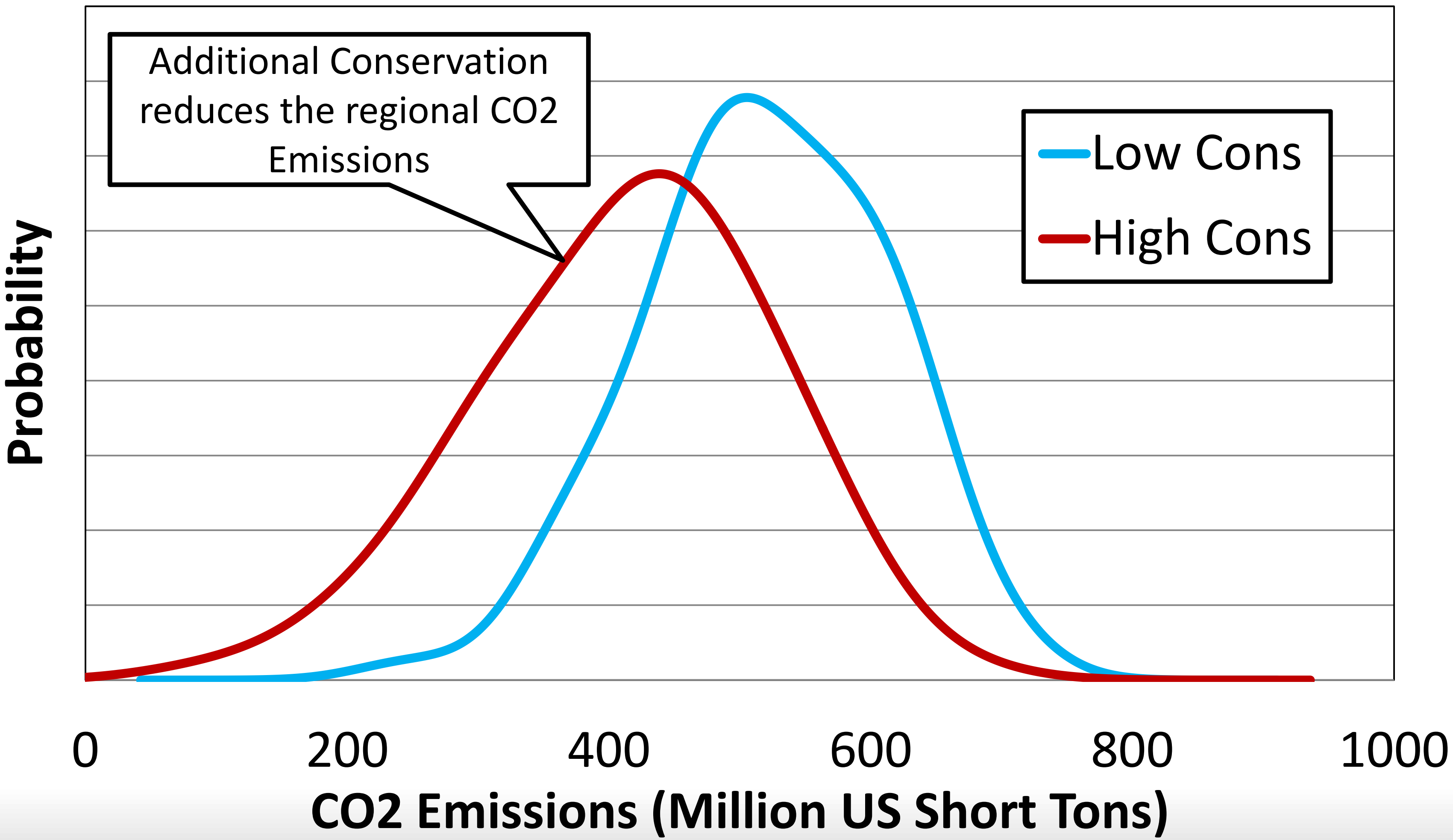
Average Generating and Demand Response Resource Building Out Under Low Conservation Development Resource Strategy



Average Generating and Demand Response Resource Building Out Under High Conservation Development Resource Strategy



Resource Strategies with Higher Conservation Development Reduce CO2 Emissions



QUESTIONS?

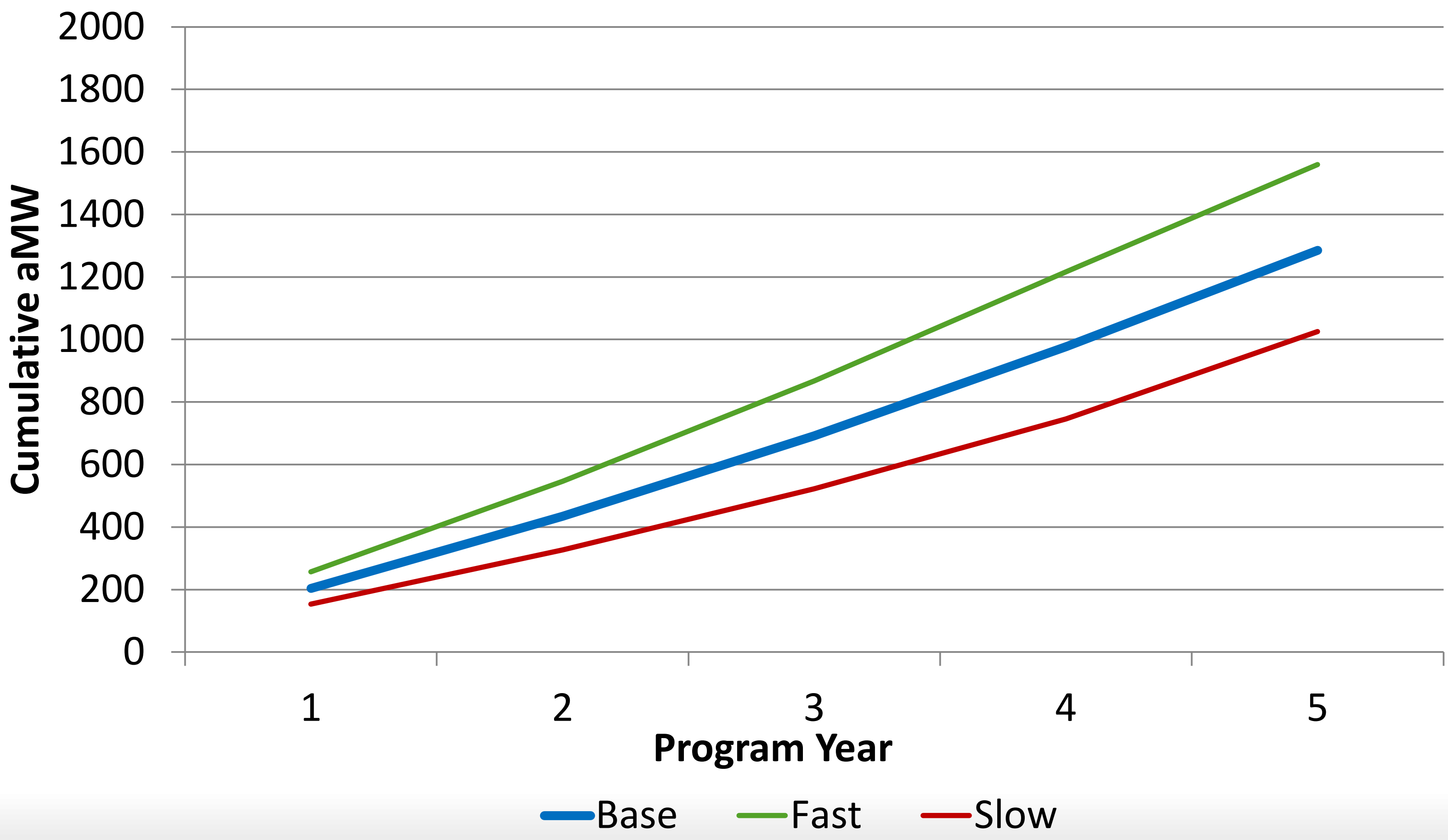
Backup

Interagency Working Groups Estimated Social Cost of CO_2, 2015-2050 and 6th Plan Carbon Risk Scenario Average (2012$/Metric Ton)

	Discount Rate and Statistic				
Year	5% Average	3% Average	2.5% Average	3% 95th Percentile	6th Plan Carbon Risk Scenario (Average Across All Futures
2015	$12	$40	$62	$118	$36
2020	$13	$47	$69	$139	$52
2025	$15	$51	$75	$156	$57
2030	$17	$56	$81	$173	$58
2035	$20	$61	$87	$190	
2040	$22	$66	$94	$208	
2045	$26	$71	$100	$224	
2050	$29	$77	$106	$239	

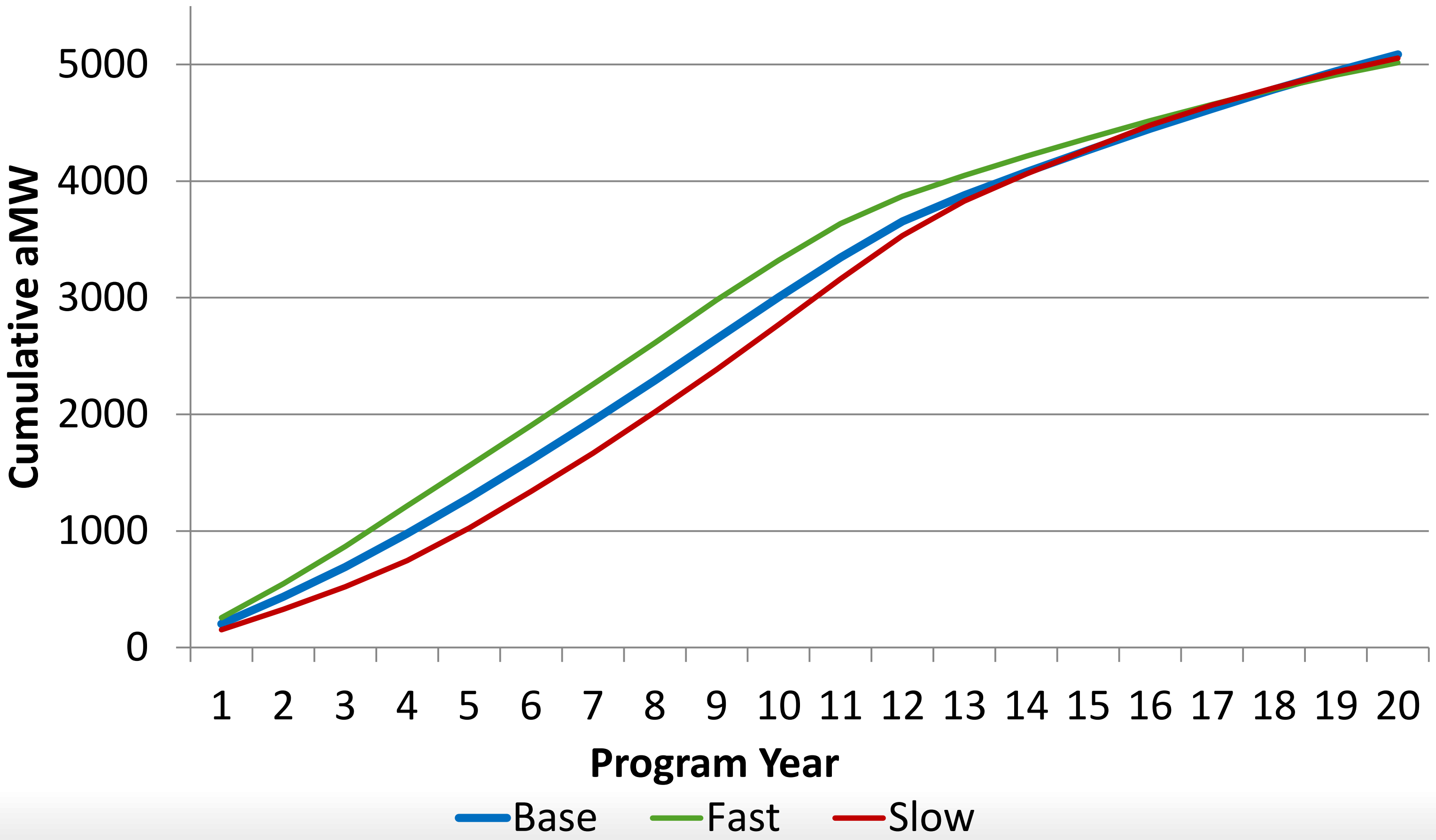
Impact of Shifts: Cumulative

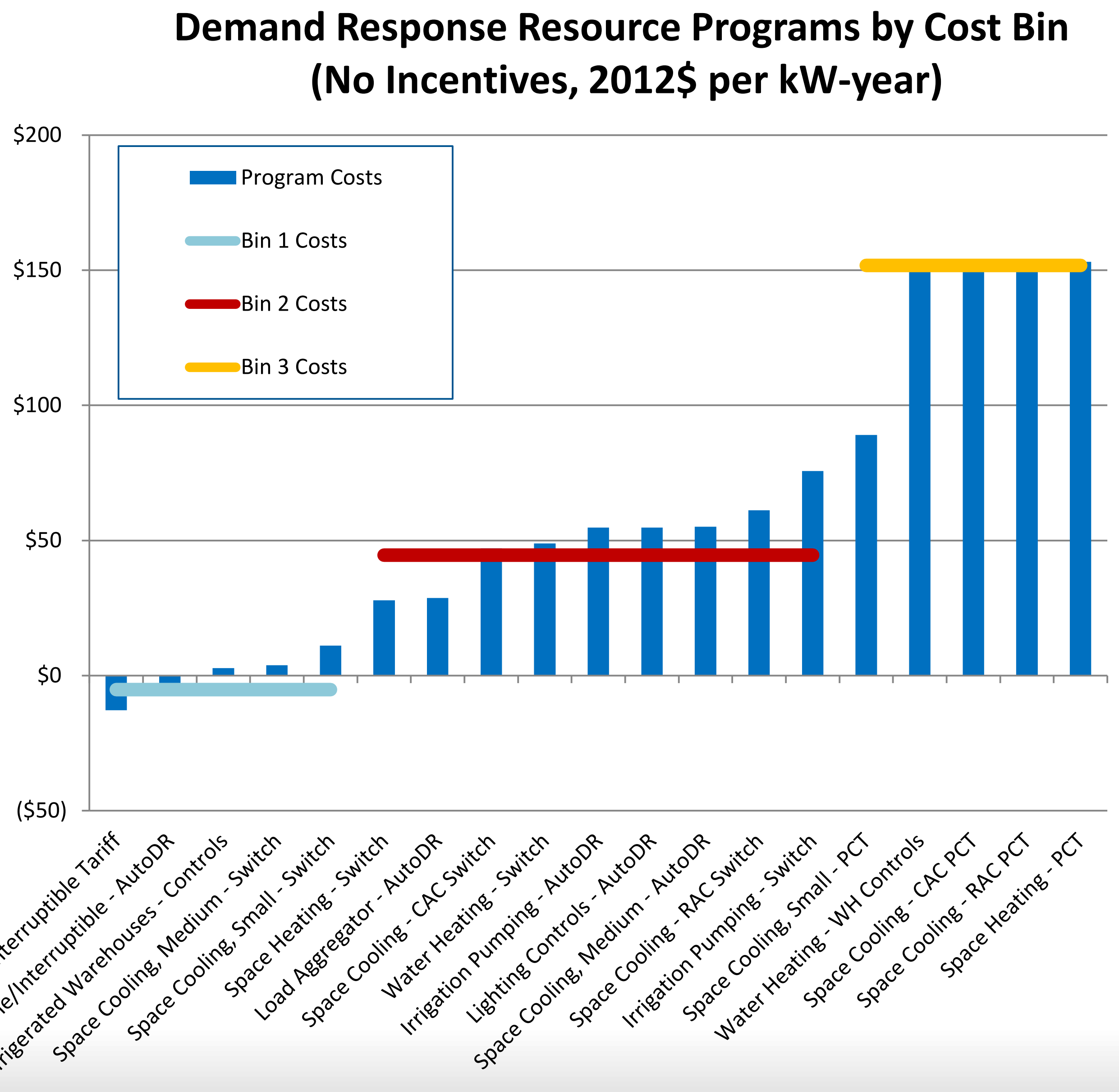
First Five Years, All Measures All Cost Bins (33% shift)



Impact of Shifts: Cumulative

20 Years, All Measures All Cost Bins (33% Shift)




Demand Response Resource Programs by Cost Bin
(No Incentives, 2012$ per kW-year)
$200
$150
$100
$50
$0
($50)
Program Costs
Bin 1 Costs
Bin 2 Costs
Bin 3 Costs
Curtailable/Interruptible Tariff
Curtailable/Interruptible - AutoDR
Refrigerated Warehouses - Controls
Space Cooling, Medium - Switch
Space Cooling, Small - Switch
Space Heating - Switch
Load Aggregator - AutoDR
Space Cooling - CAC Switch
Water Heating - Switch
Irrigation Pumping - AutoDR
Lighting Controls - AutoDR
Space Cooling, Medium - AutoDR
Space Cooling - RAC Switch
Irrigation Pumping - Switch
Space Cooling, Small - PCT
Water Heating - WH Controls
Space Cooling - CAC PCT
Space Cooling - RAC PCT
Space Heating - PCT

Demand Response Resource Programs by Cost Bin (Added Incentive Cost, 2012$ per kW-year)