Selected Findings from Scenario Analysis

Power Committee Meeting

5/26/15

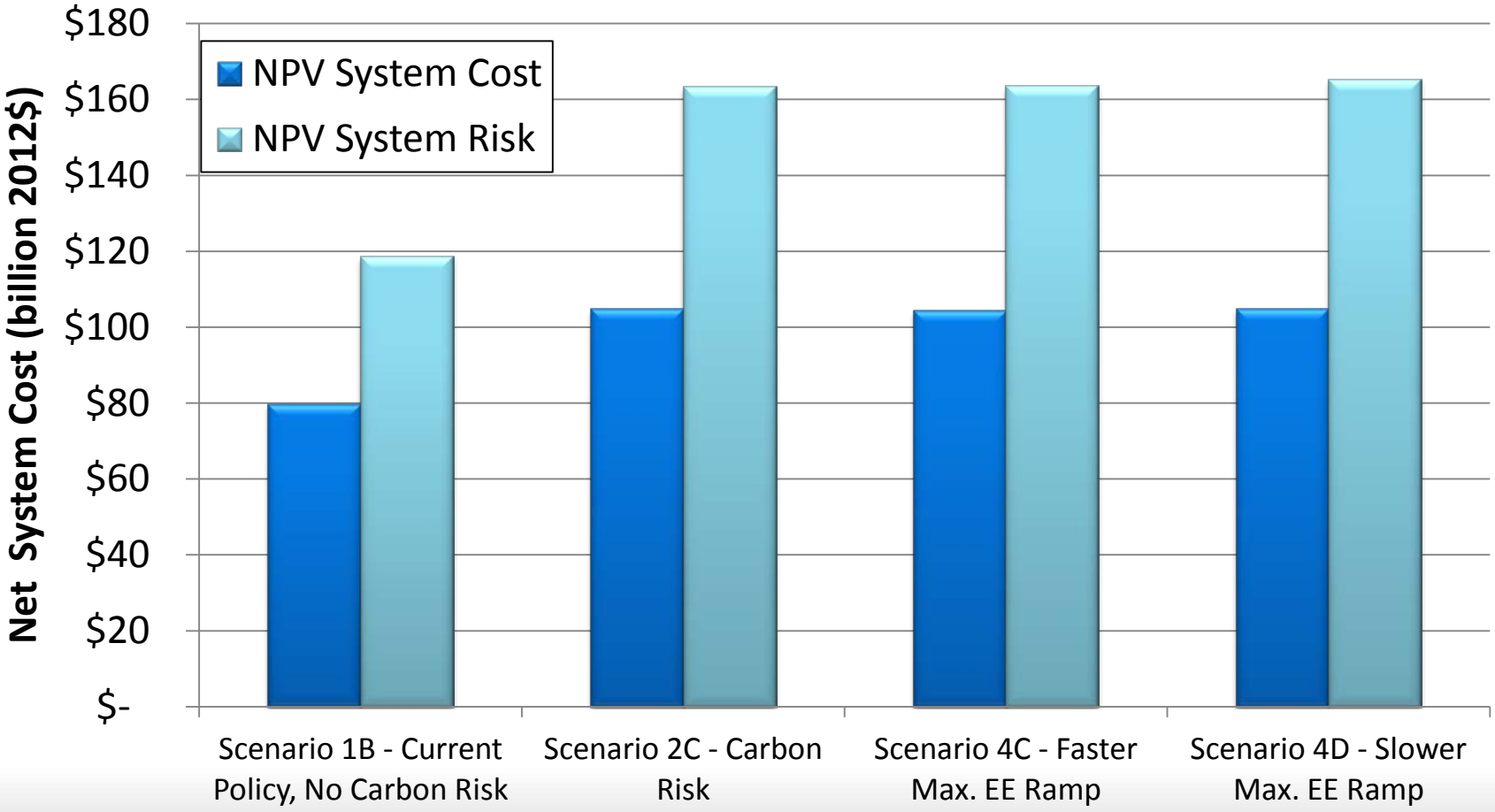
Today's Presentations

- Comparison of the Least Cost *Resource Strategies* across 800 futures for five *Scenarios:*
  - Existing Policy without Uncertainty, w/o GHG reduction risk (1A) – First Look
  - Existing Policy with Uncertainty, w/o GHG reduction risk (1B) - Update
  - Existing Policy with Uncertainty and with uncertain GHG reduction risk(2C) – Update
  - Major Resource Uncertainty – Faster Pace of Conservation Deployment (4C) – First Look
  - Major Resource Uncertainty – Slower Pace of Conservation Deployment (4D) – First Look
- Comparison Metrics
  - Distribution of Net System Cost ($)
  - Distribution of conservation development (aMW and MW)
  - Distribution of RPS resource development (aMW and MW)
  - Average Thermal Resource development (aMW and MW)
  - Distribution of Demand Response development (MW)
  - CO2 emissions for Total Regional Power System and Plants Affected by EPA's Proposed 111(d) Regulation
- Observations Regarding Emerging Resource Development Strategies

Limits of Today's Presentation

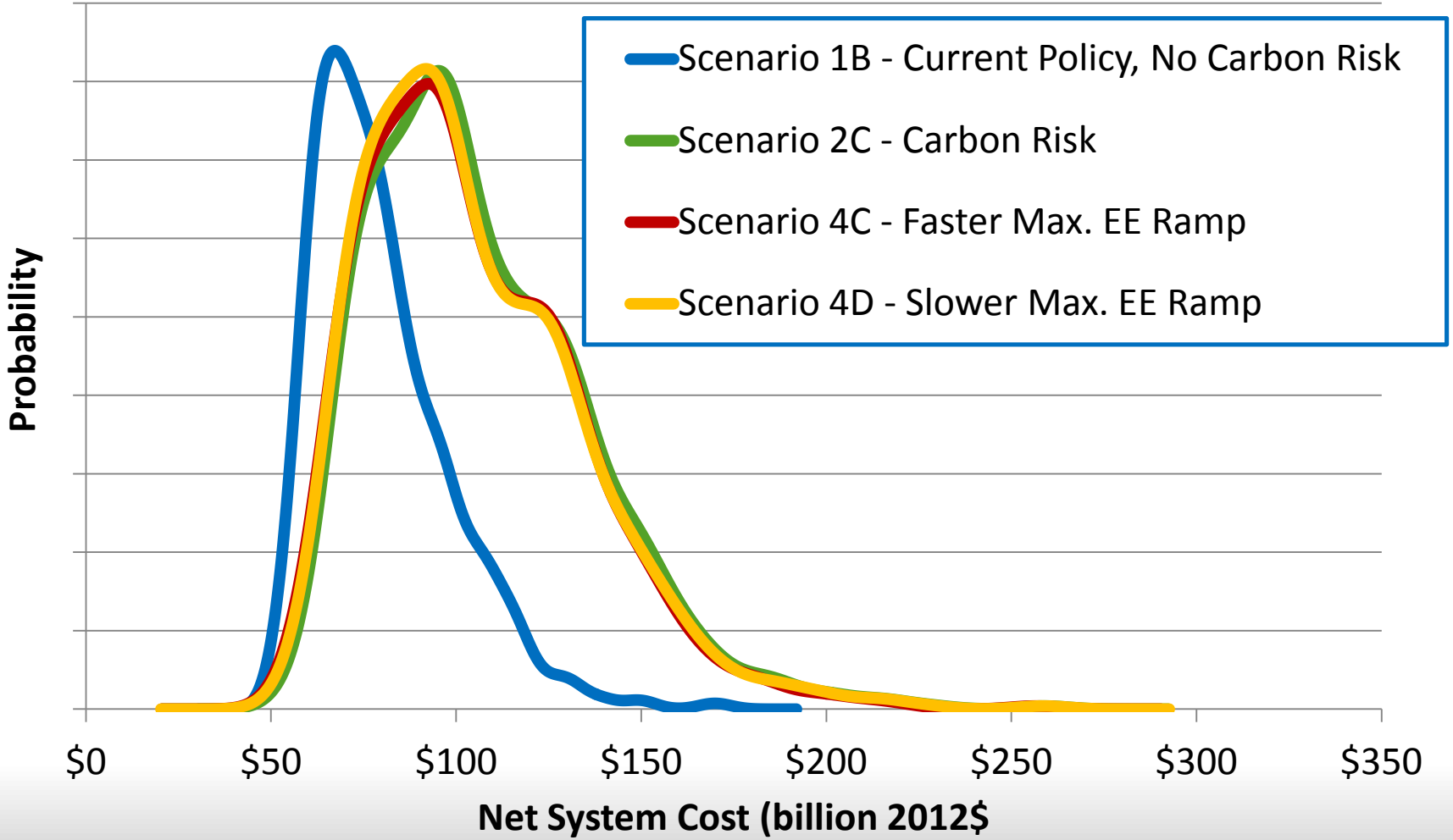
- Still fine tuning RPM input assumptions for resource adequacy
  - Revised peak load forecasting method now uses historical relationship between temperature and weather sensitive loads
    - Increases expected peak demands
    - Method consistent between GENESYS and RPM
  - Calculation of Adequacy Reserve Margins (ARMs) from GENESYS revised to isolate independent energy and capacity requirements
  - RPM input template revised to permit seasonal peak capacity values for conservation
    - This will result in lower summer conservation peak impacts
- Implication – Generalizations Okay, Details May Change

The Least Cost Strategies for Scenarios 2C, 4C and 4D Have Nearly Identical Cost and Risk

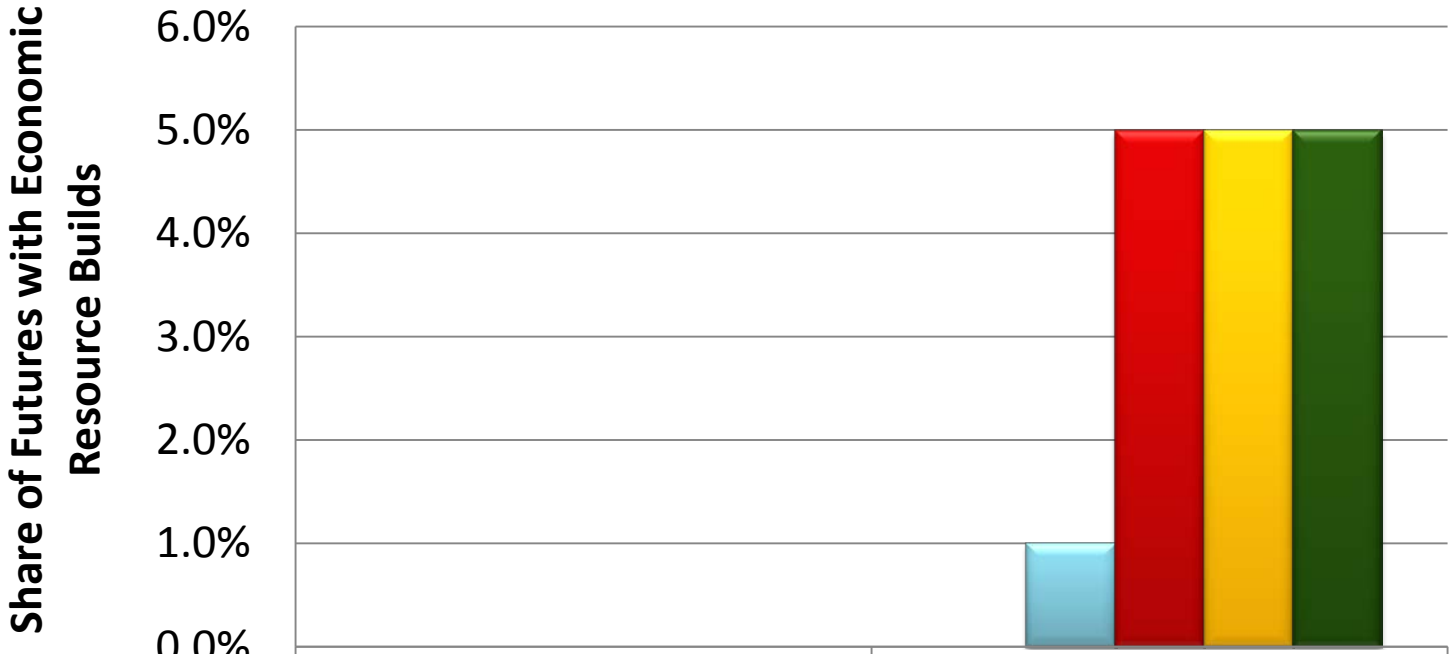


They Also Have Very Similar Distributions of Net System Cost

Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



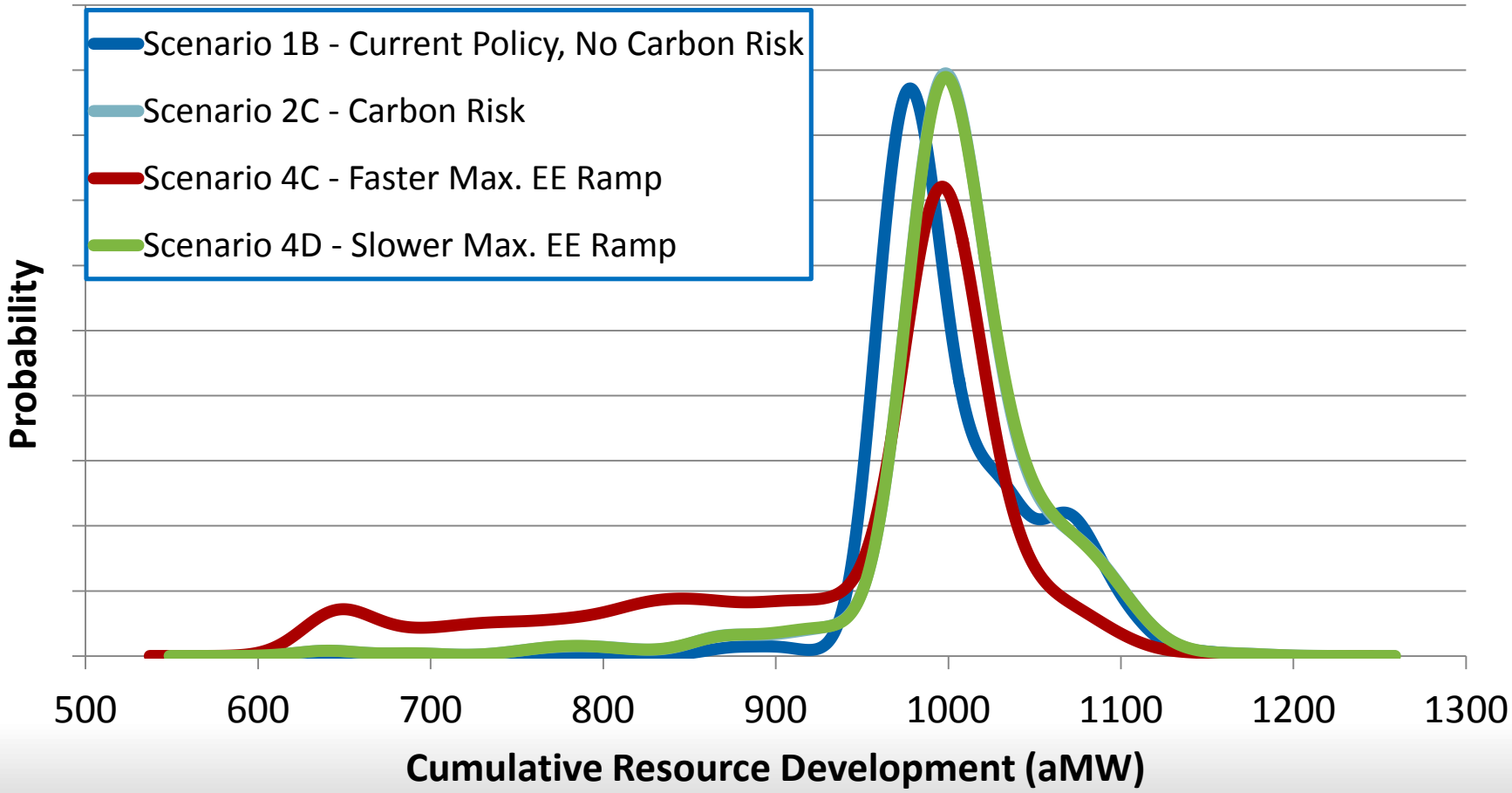
There Are Very Few Futures Where Economic Resource Builds Occur



	2020	2035
Least Cost Scenario 1A	0%	0%
Least Cost Scenario 1B	0%	1%
Least Cost Scenario 2C	0%	5%
Least Cost Scenario 4C	0%	5%
Least Cost Scenario 4D	0%	5%

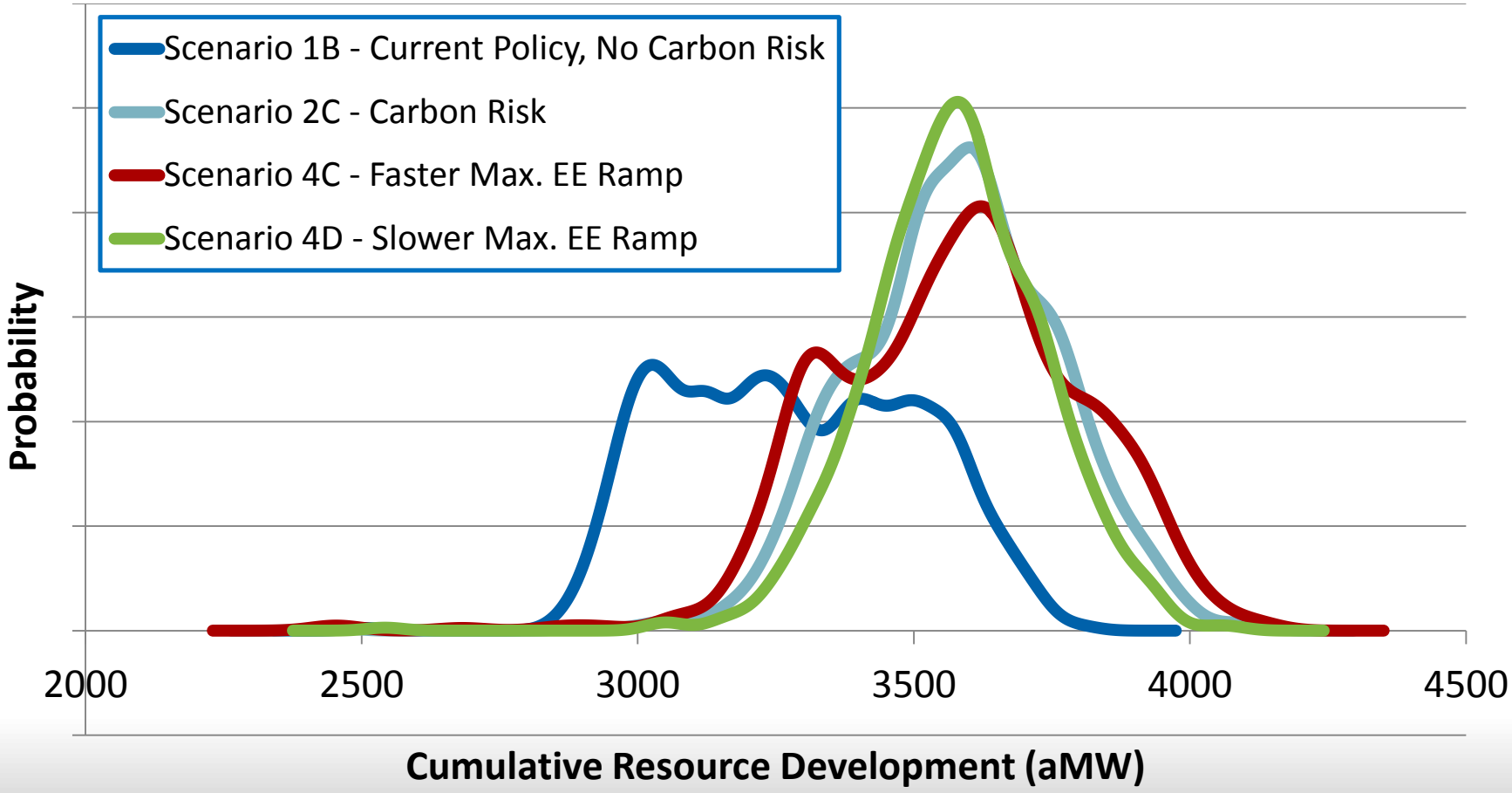
The Least Cost Strategies for Scenarios 2C, 4C and 4D Have Very Similar Distributions of Conservation Development Through 2020

Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



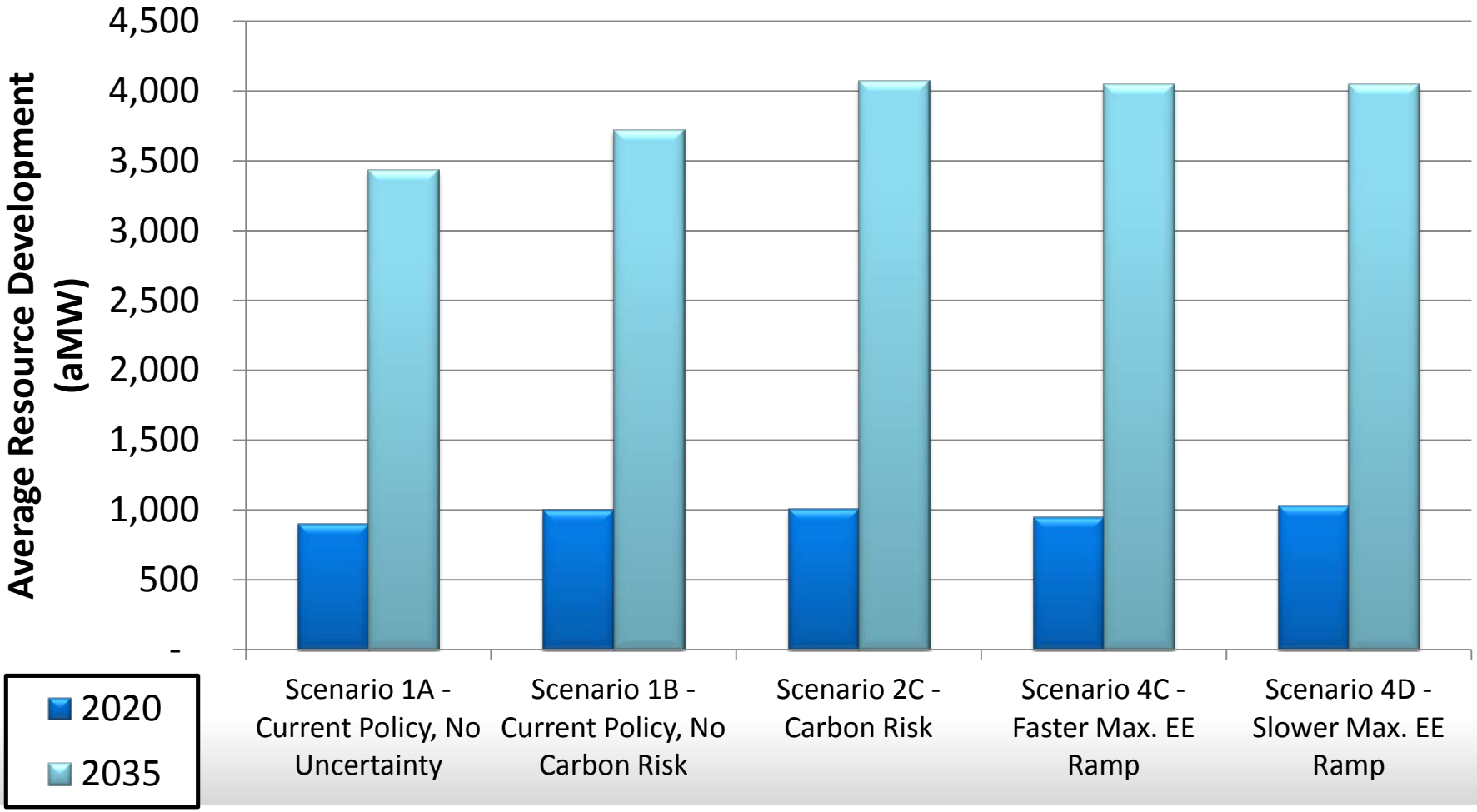
The Least Cost Strategies for Scenarios 2C, 4C and 4D Also Have Very Similar Distributions of Conservation Development Through 2035

Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



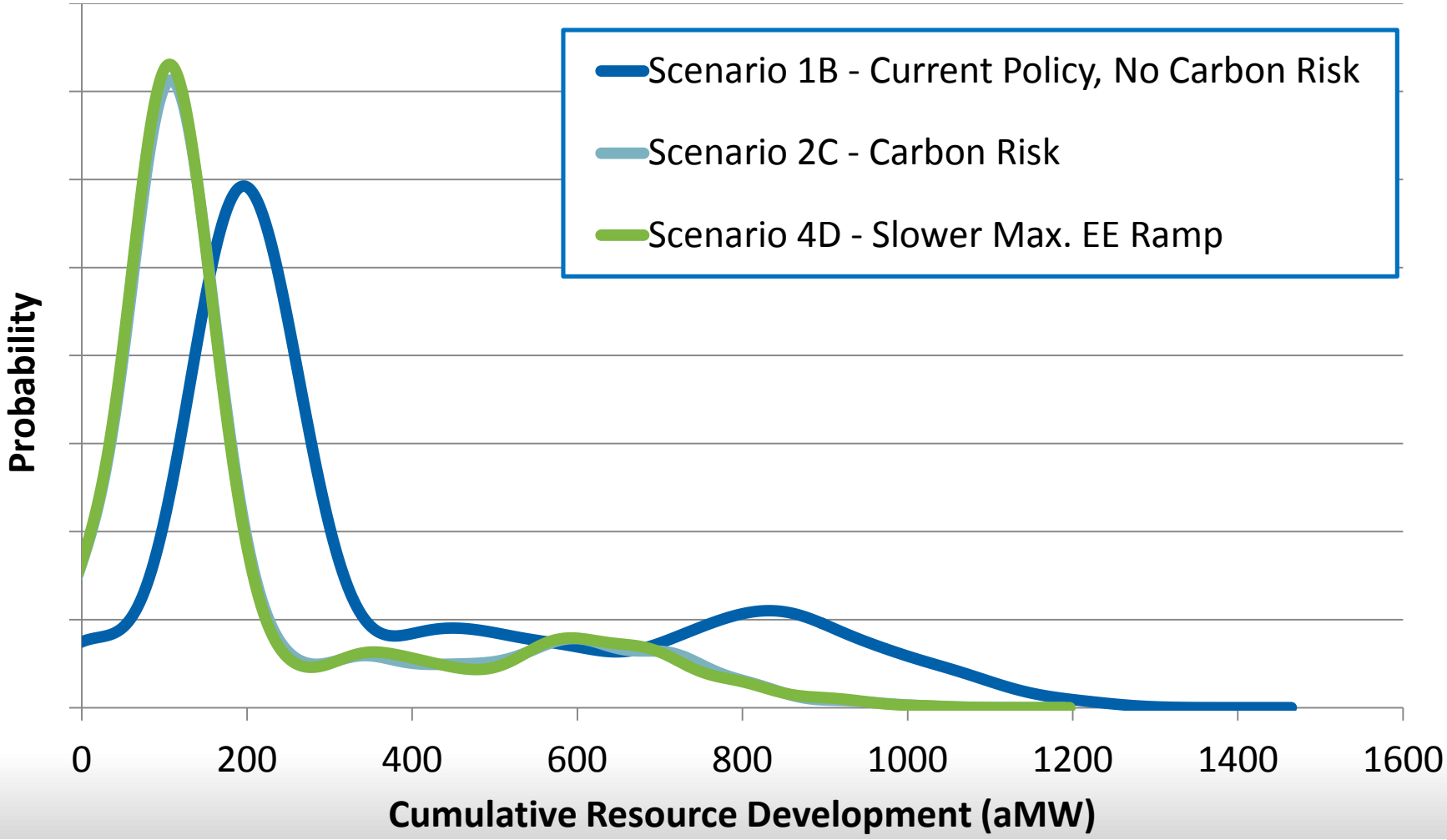
Average Conservation Development Across Scenarios is Very Similar When Carbon Risk Is Considered

Scenarios 1A,1B, 2C, 4C and 4D – Least Cost Resource Strategies

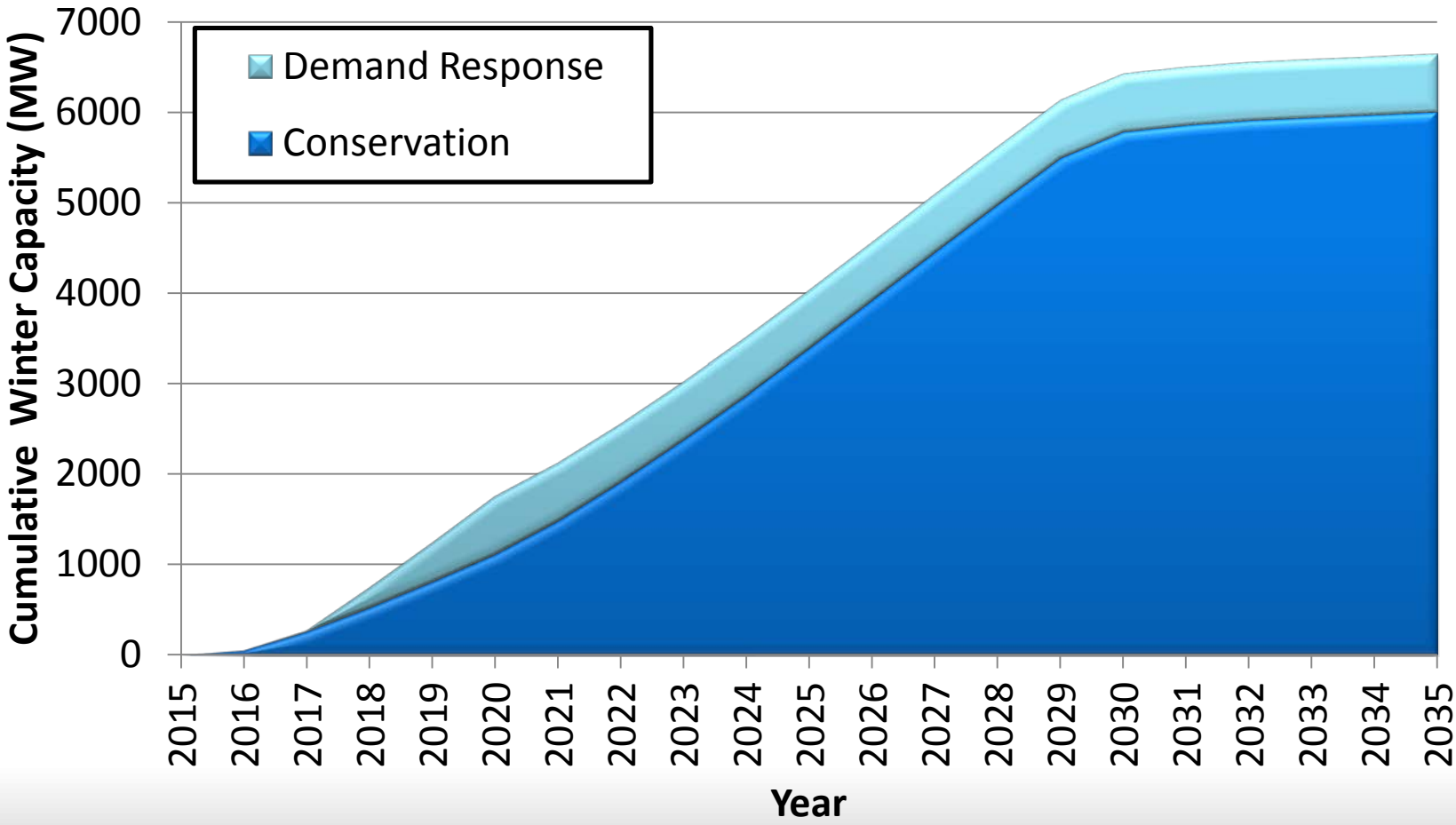


The Distribution of RPS Resource Development Through 2035 Is Affected By Conservation Development

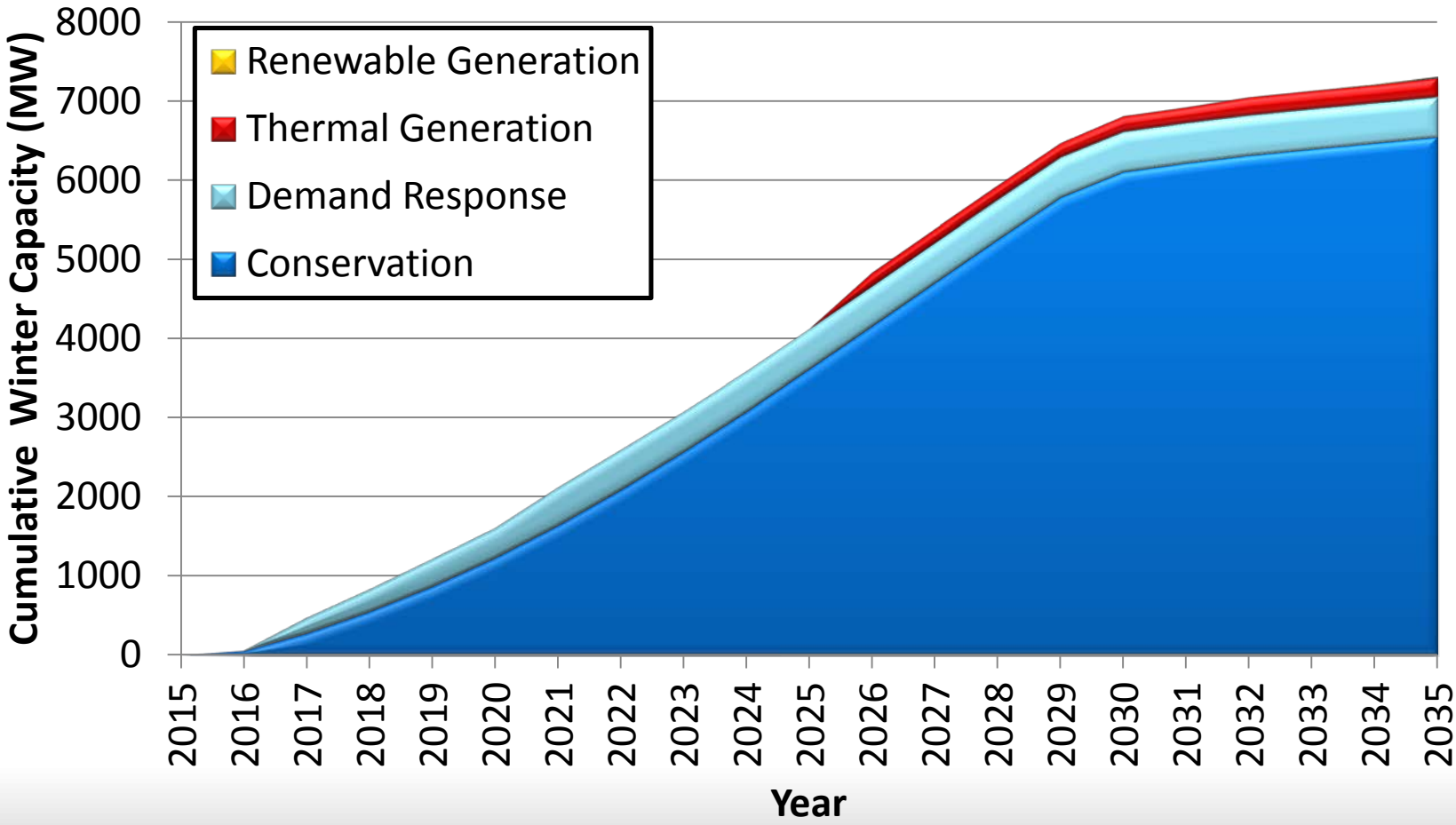
Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



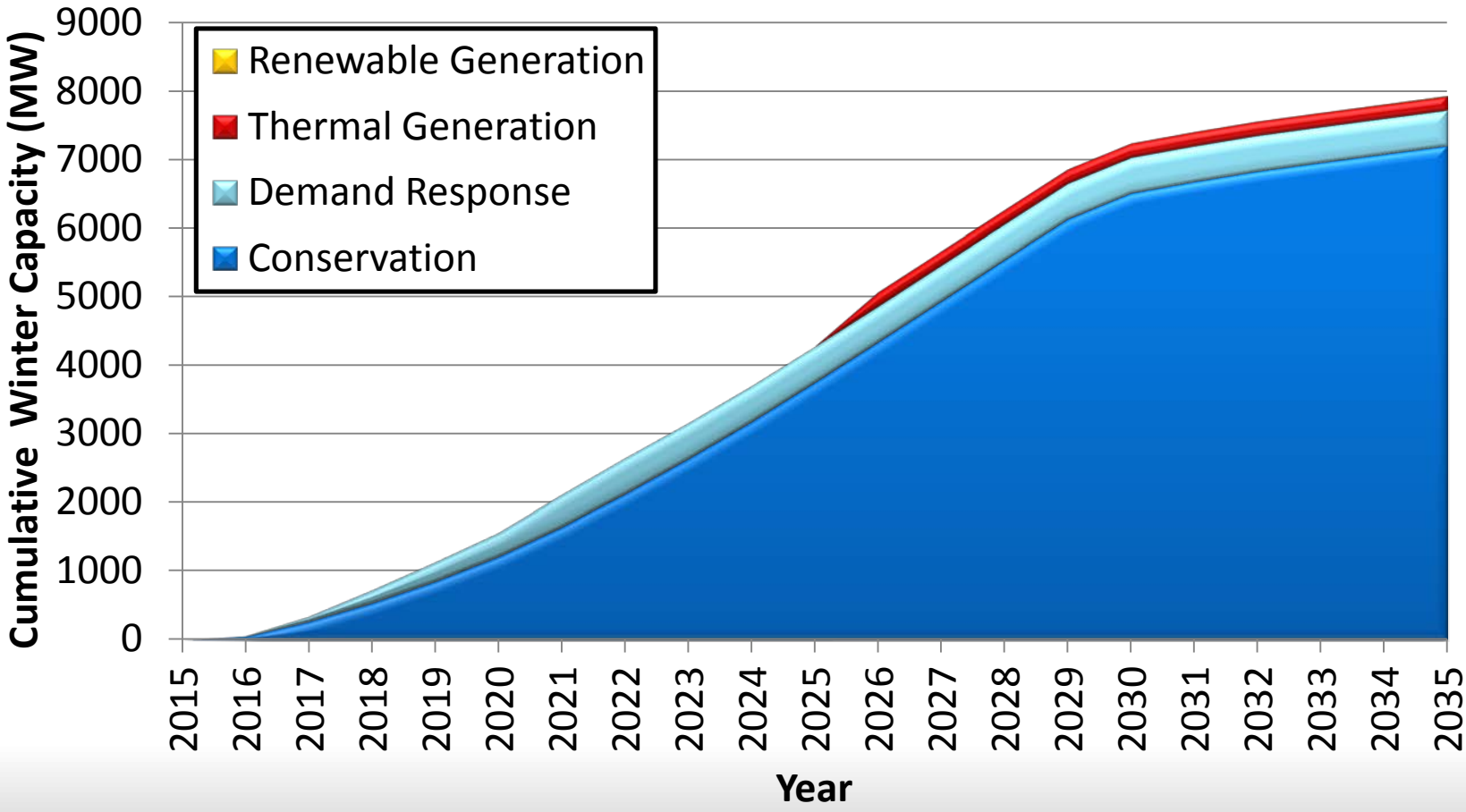
With No Uncertainty Winter Peaking Capacity Is Met with Demand Response and Conservation Scenario 1A - Least Cost Resource Strategy



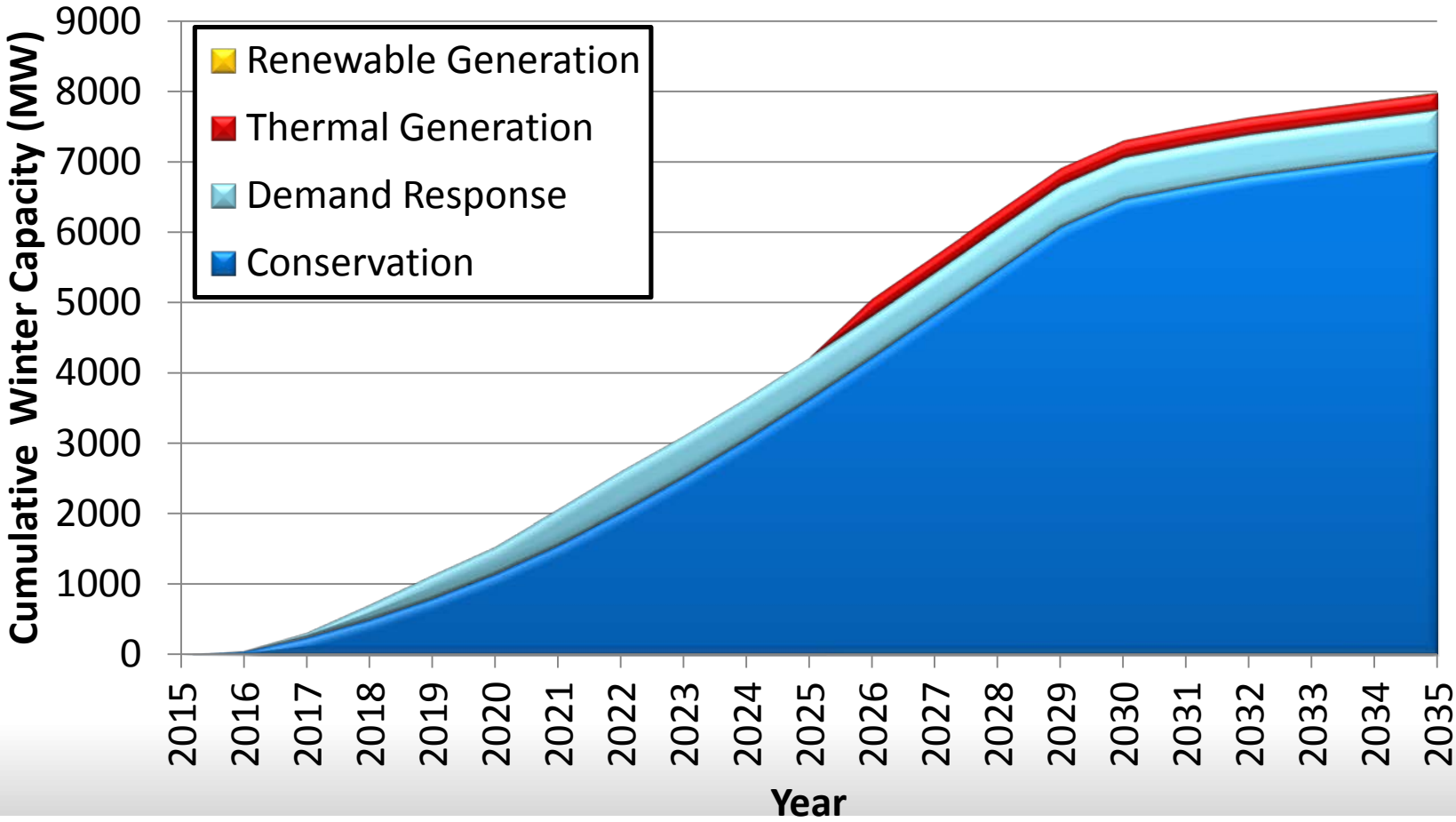
With No Carbon Risk Uncertainty Winter Peaking Capacity Is Met with Demand Response, Conservation and Limited Thermal Resource Development Scenario 1B - Least Cost Resource Strategy



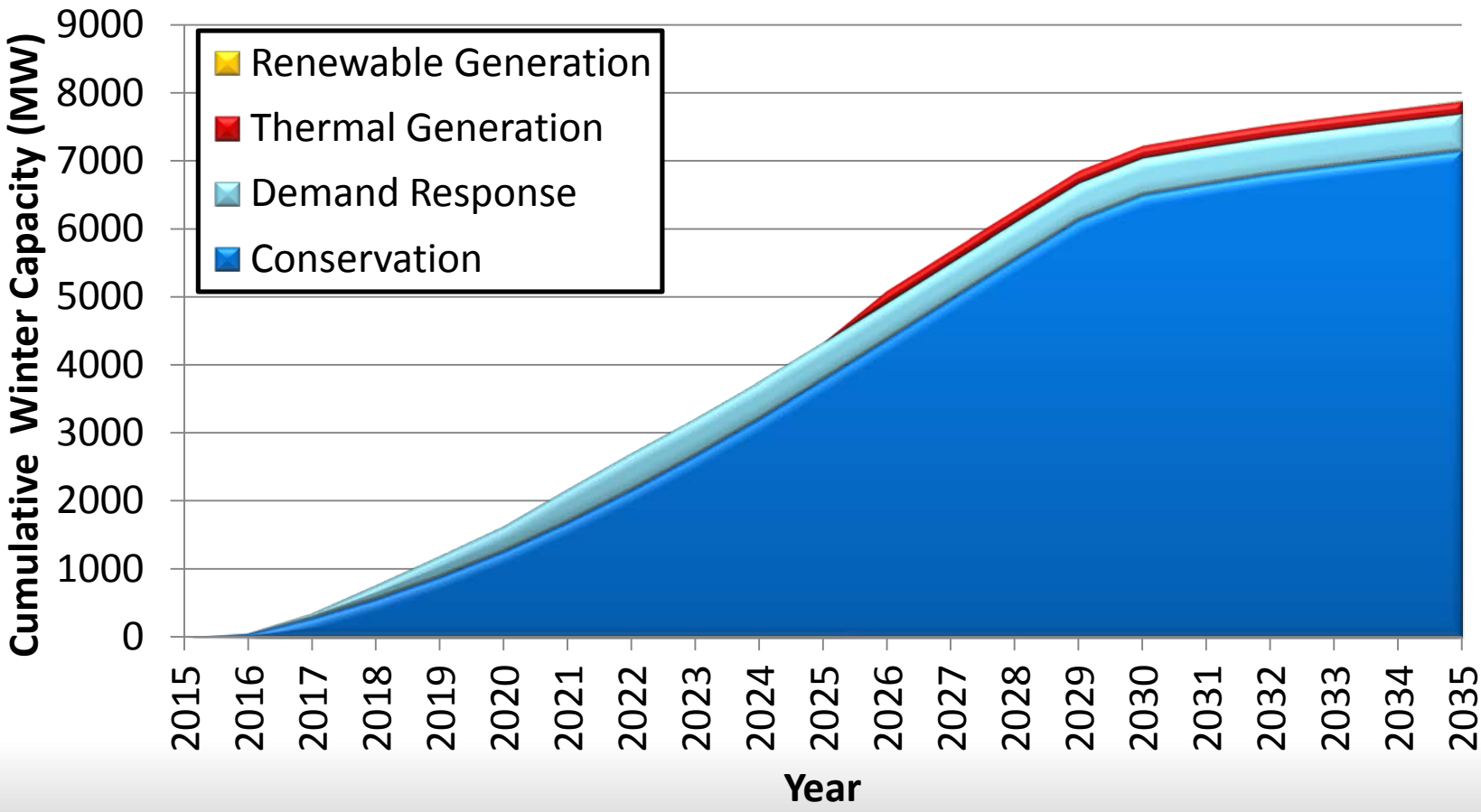
With Carbon Risk Uncertainty Winter Peaking Capacity Is Met with Demand Response, Conservation and Limited Thermal Resource Development Scenario 2C - Least Cost Resource Strategy



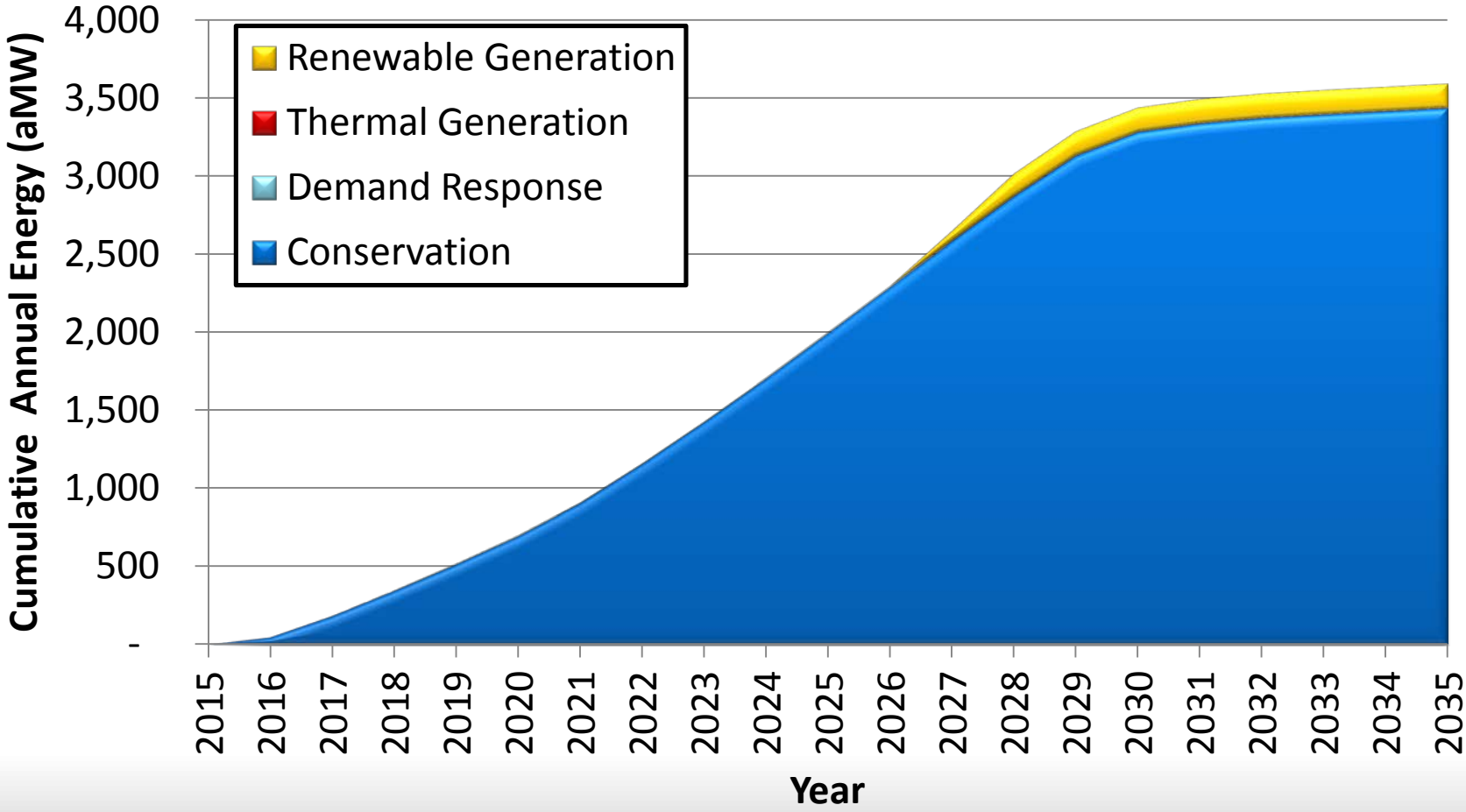
Alternative Assumptions Regarding Faster Conservation Ramp Rates Do Not Appear To Affect Resources Developed for Winter Peaking Capacity Scenario 4C - Least Cost Resource Strategy



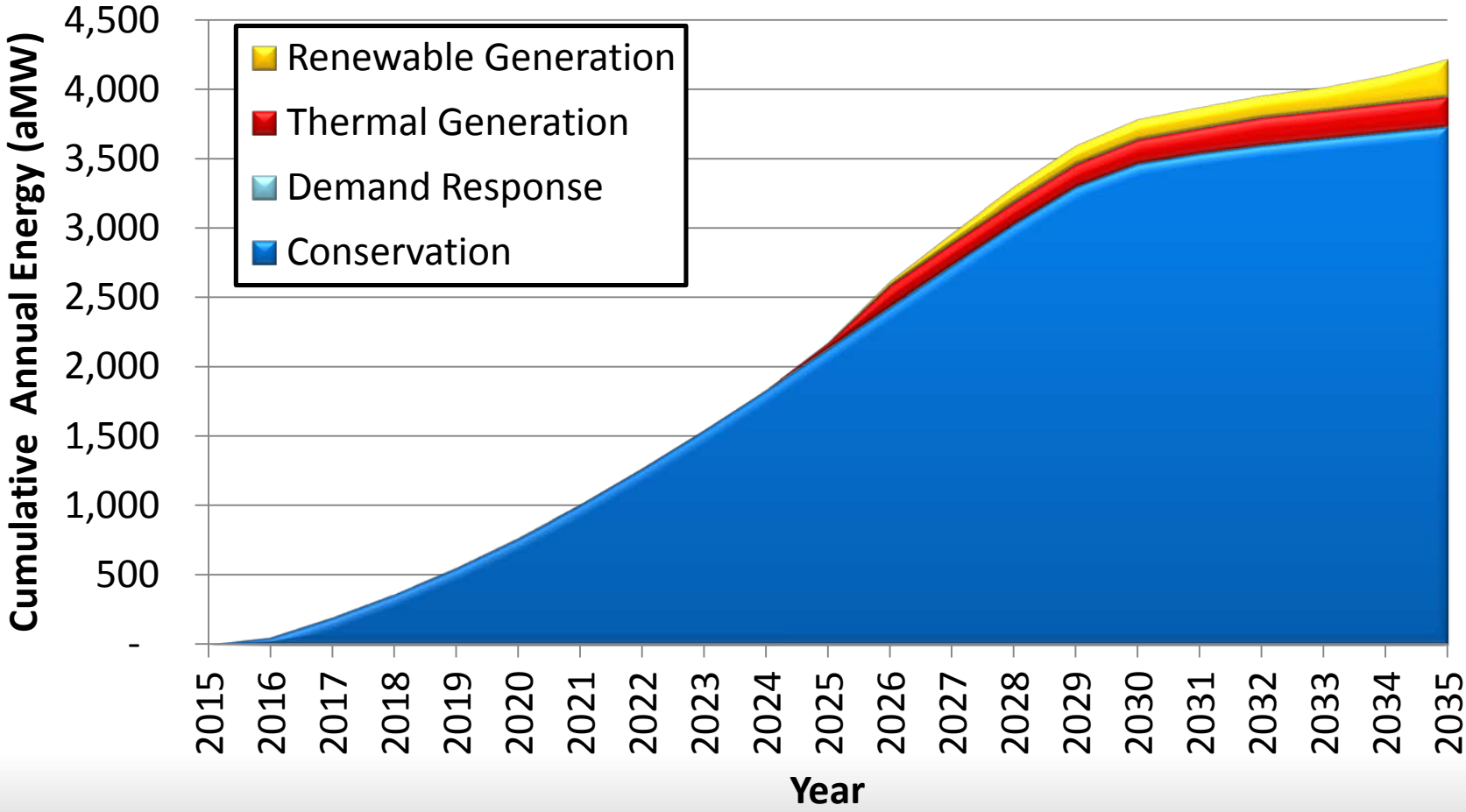
Alternative Assumptions Regarding Slower Conservation Ramp Rates Do Not Appear To Affect Resources Developed for Winter Peaking Capacity Scenario 4D - Least Cost Resource Strategy



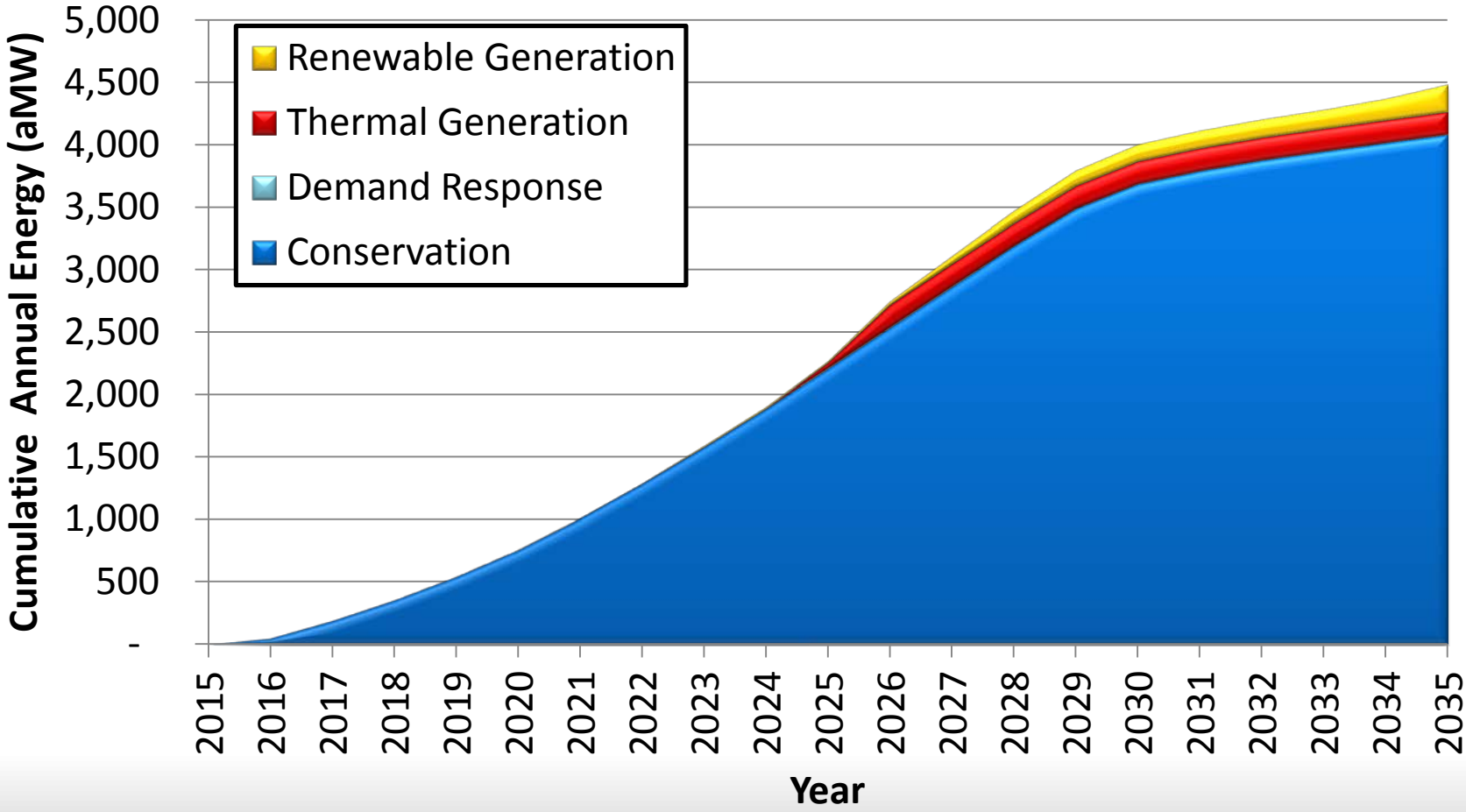
With No Uncertainty Demand for Energy Is Met with Conservation and Renewable Resources Scenario 1A - Least Cost Resource Strategy



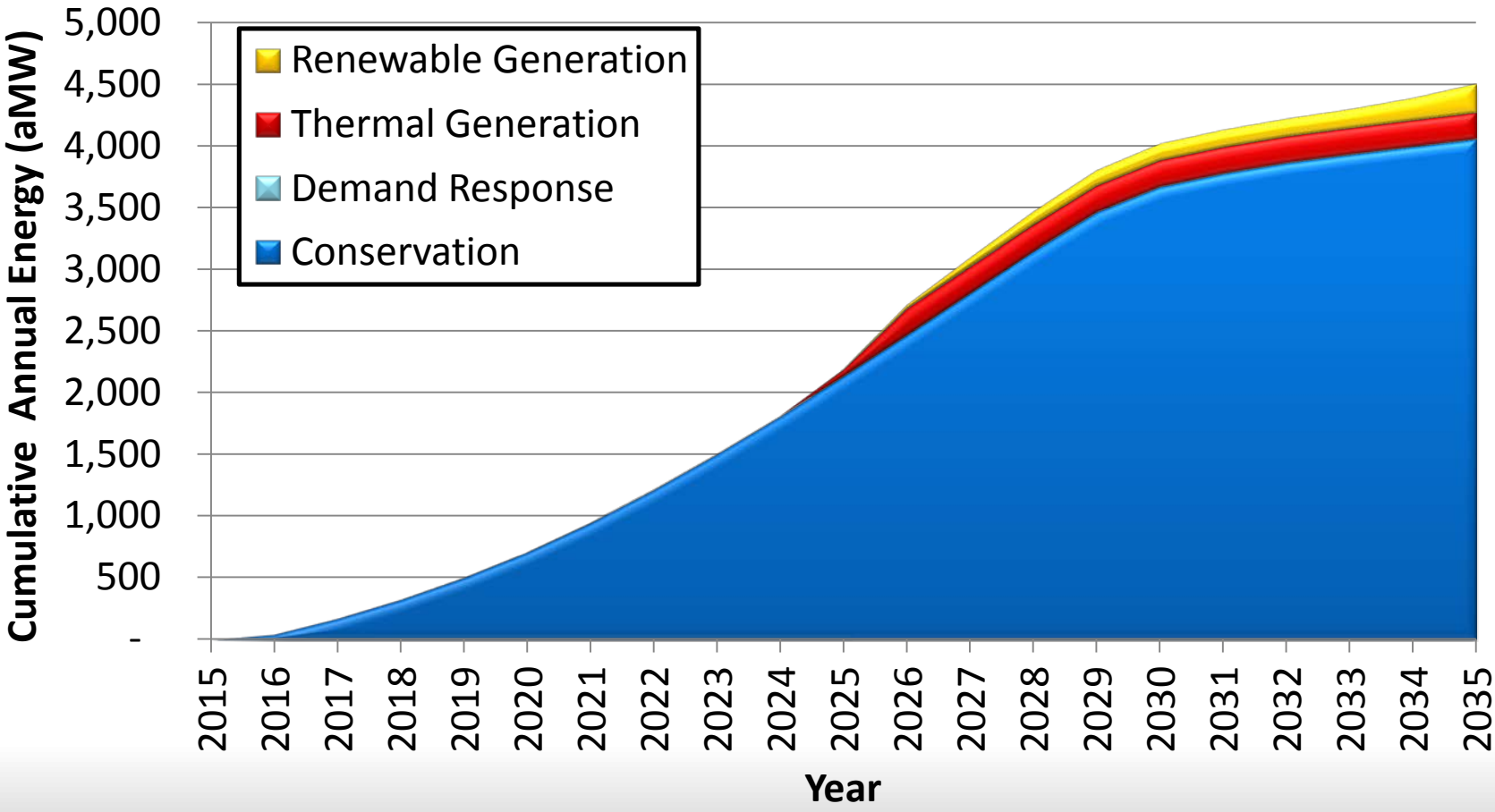
With No Carbon Risk Uncertainty Demand for Energy Is Met with Conservation, Renewable and Thermal Resources Scenario 1B - Least Cost Resource Strategy



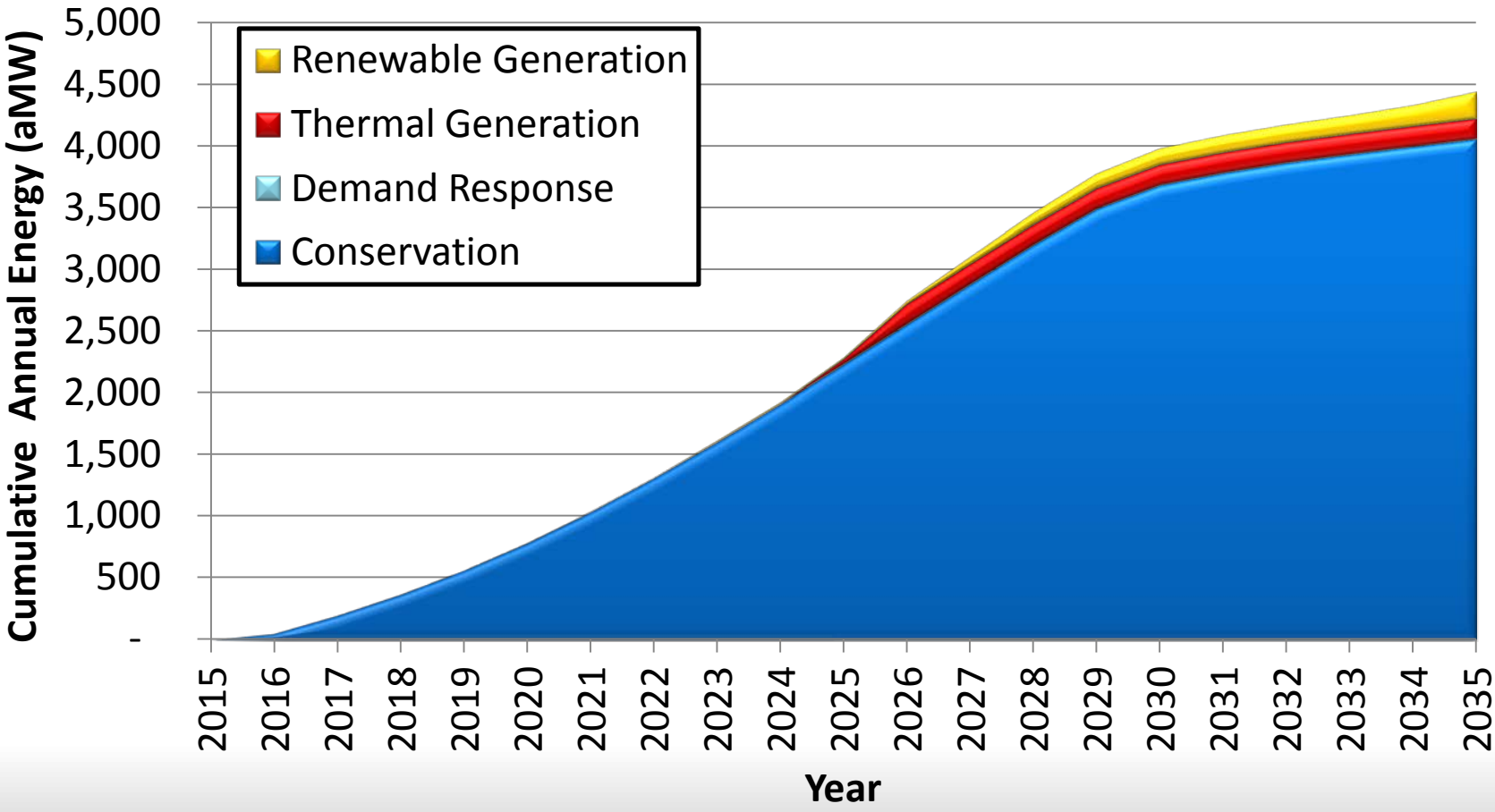
With Carbon Risk Uncertainty Demand for Energy Is Met with Conservation, Renewable and Thermal Resources Scenario 2C - Least Cost Resource Strategy



Alternative Assumptions Regarding Faster Conservation Ramp Rates Do Not Appear To Affect Resources Developed for Energy Scenario 4C - Least Cost Resource Strategy

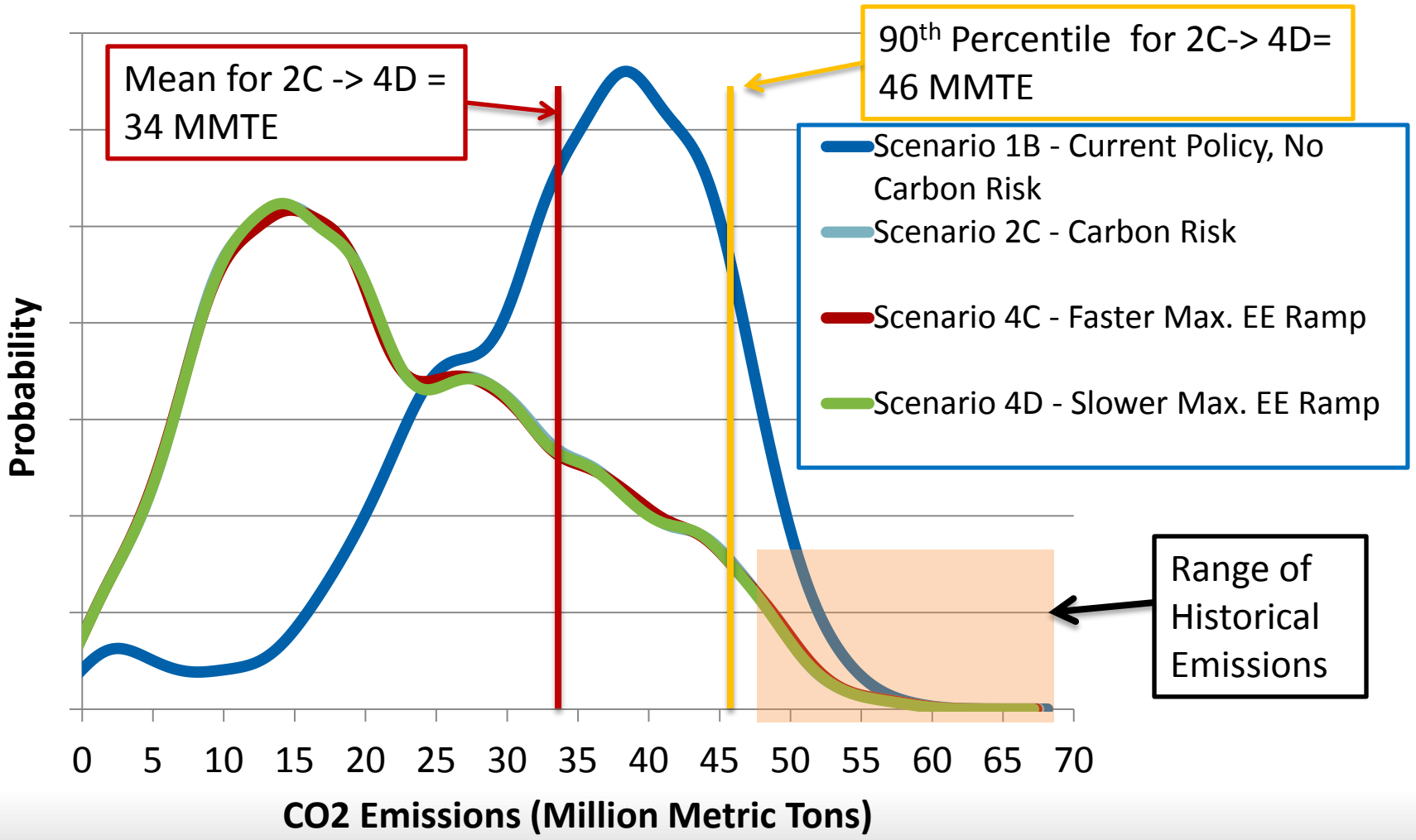


Alternative Assumptions Regarding Slower Conservation Ramp Rates Do Not Appear To Affect Resources Developed for Energy Scenario 4D - Least Cost Resource Strategy



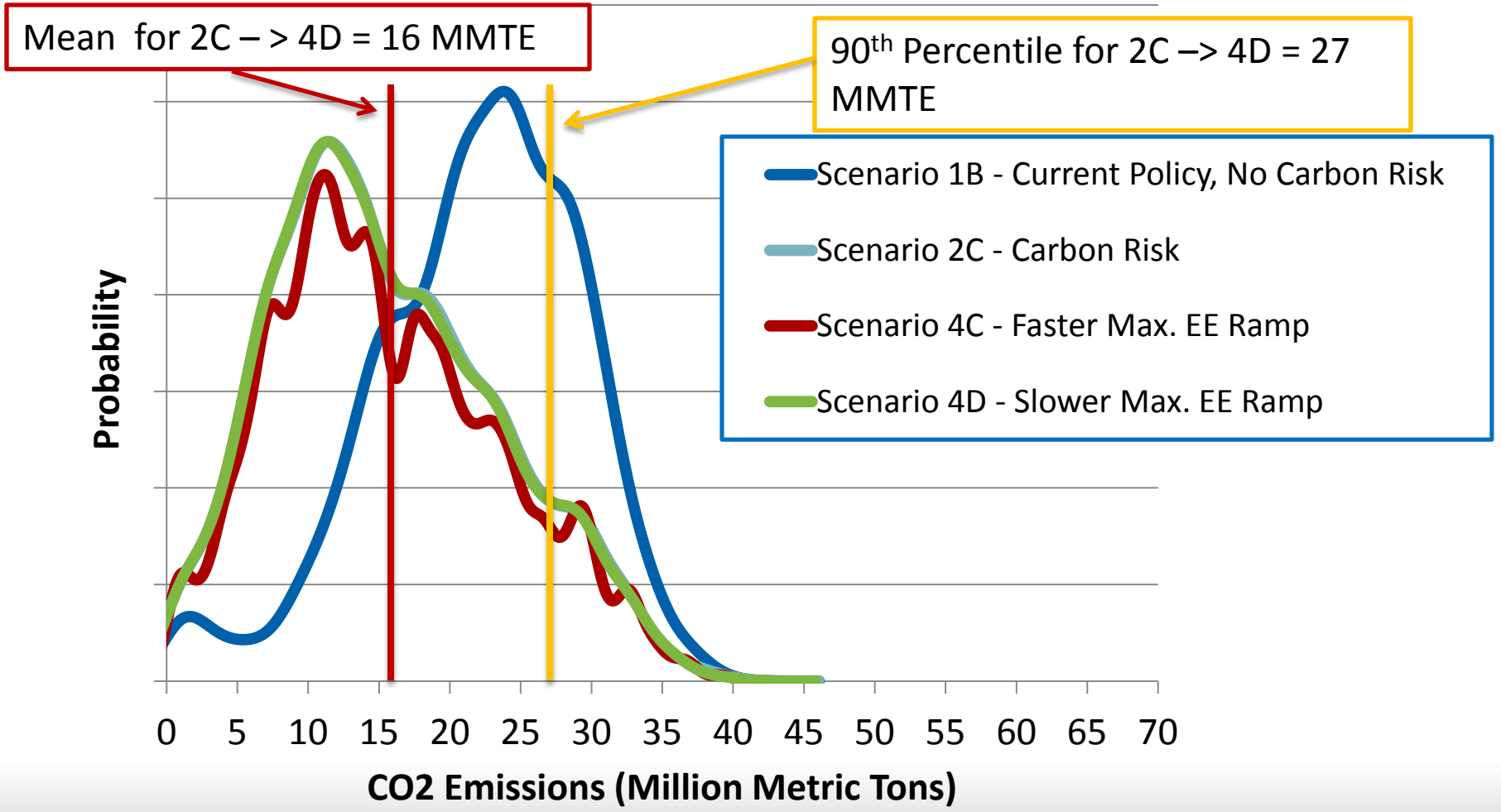
Distribution of Total Power Systems CO2 Emission in 2030

Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



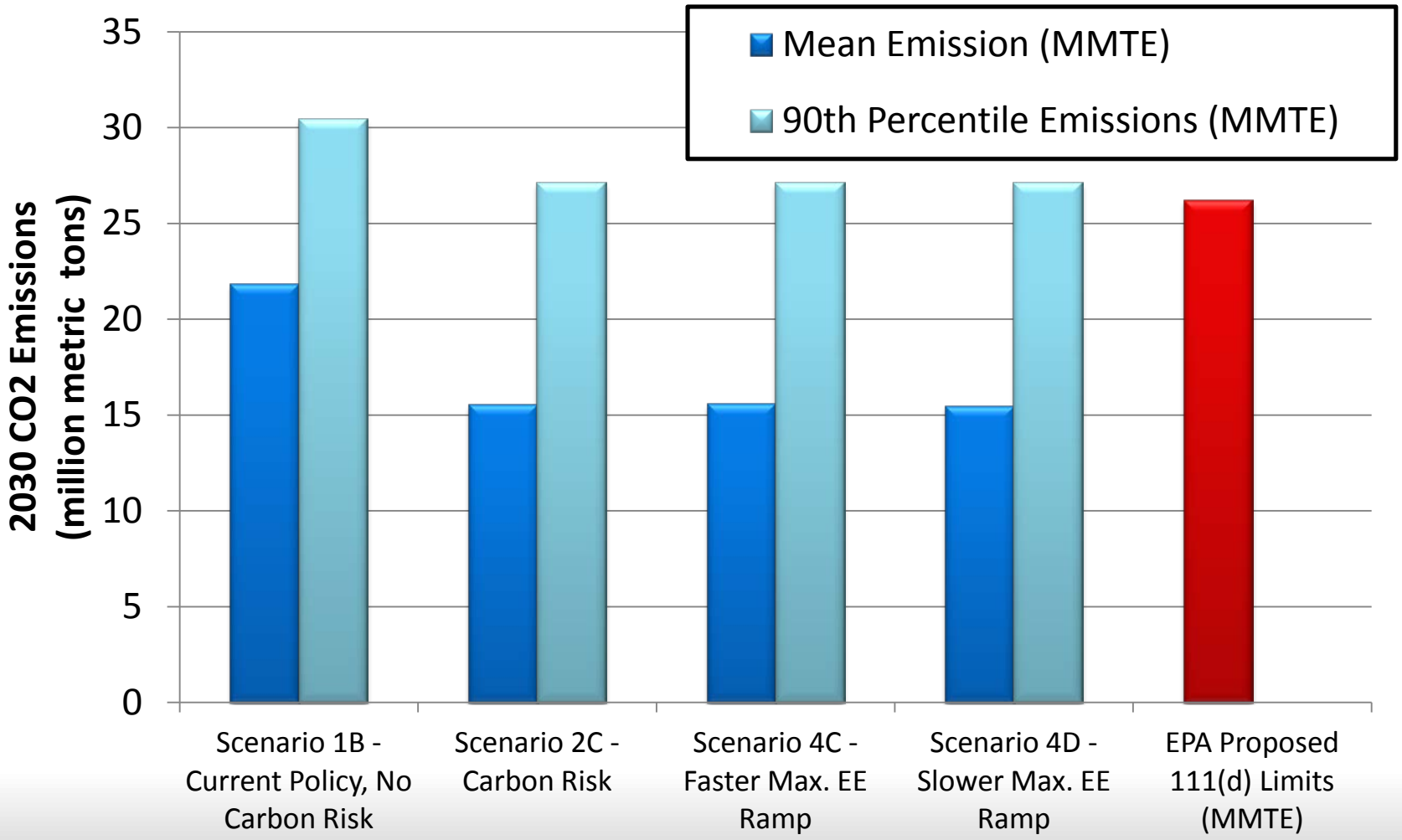
Distribution CO2 Emissions in 2030 for Resource Subject to EPA's Proposed 111(d) Regulations

Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies

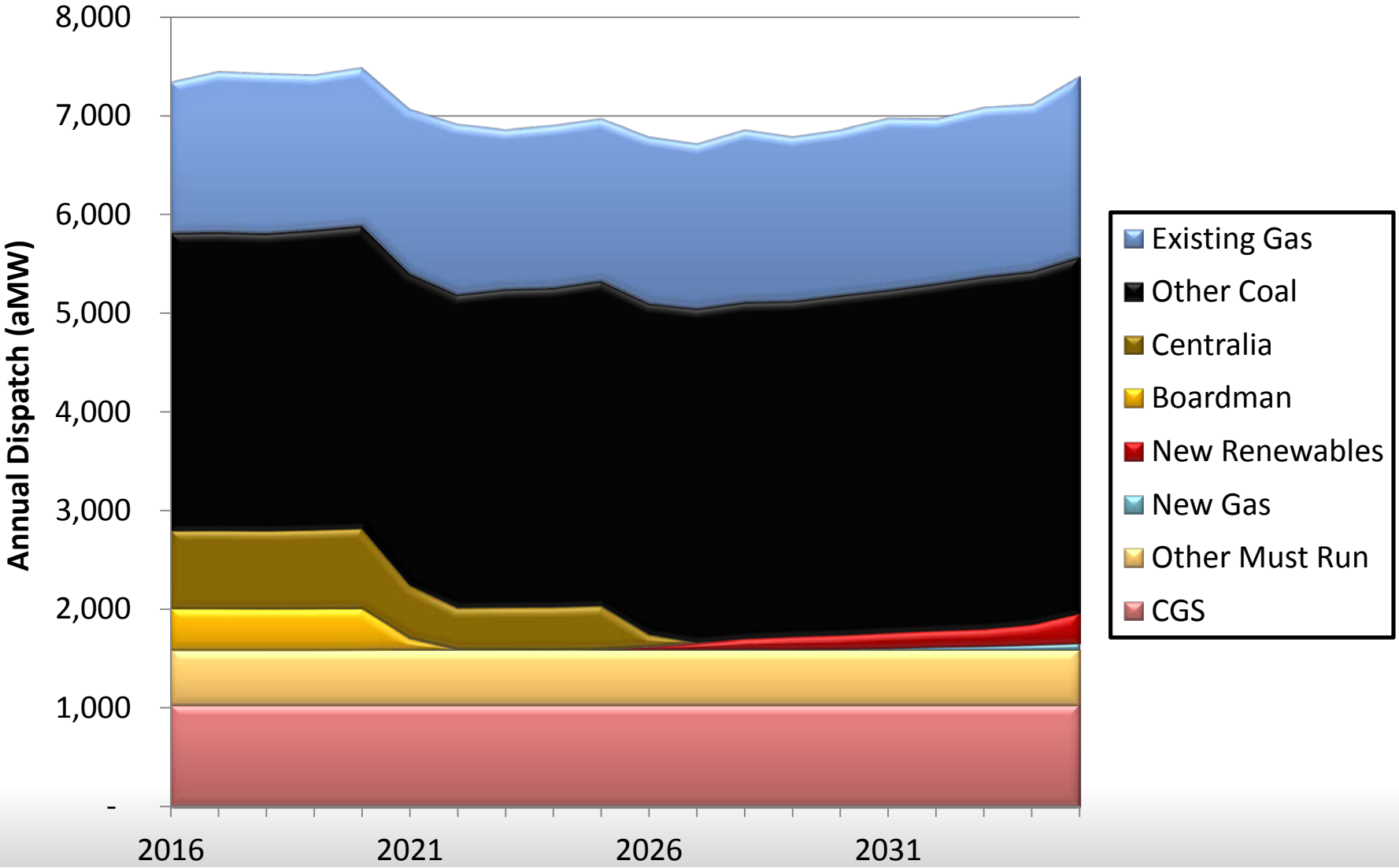


CO2 Emissions in 2030 for Resource Subject to EPA's Proposed 111(d) Regulations

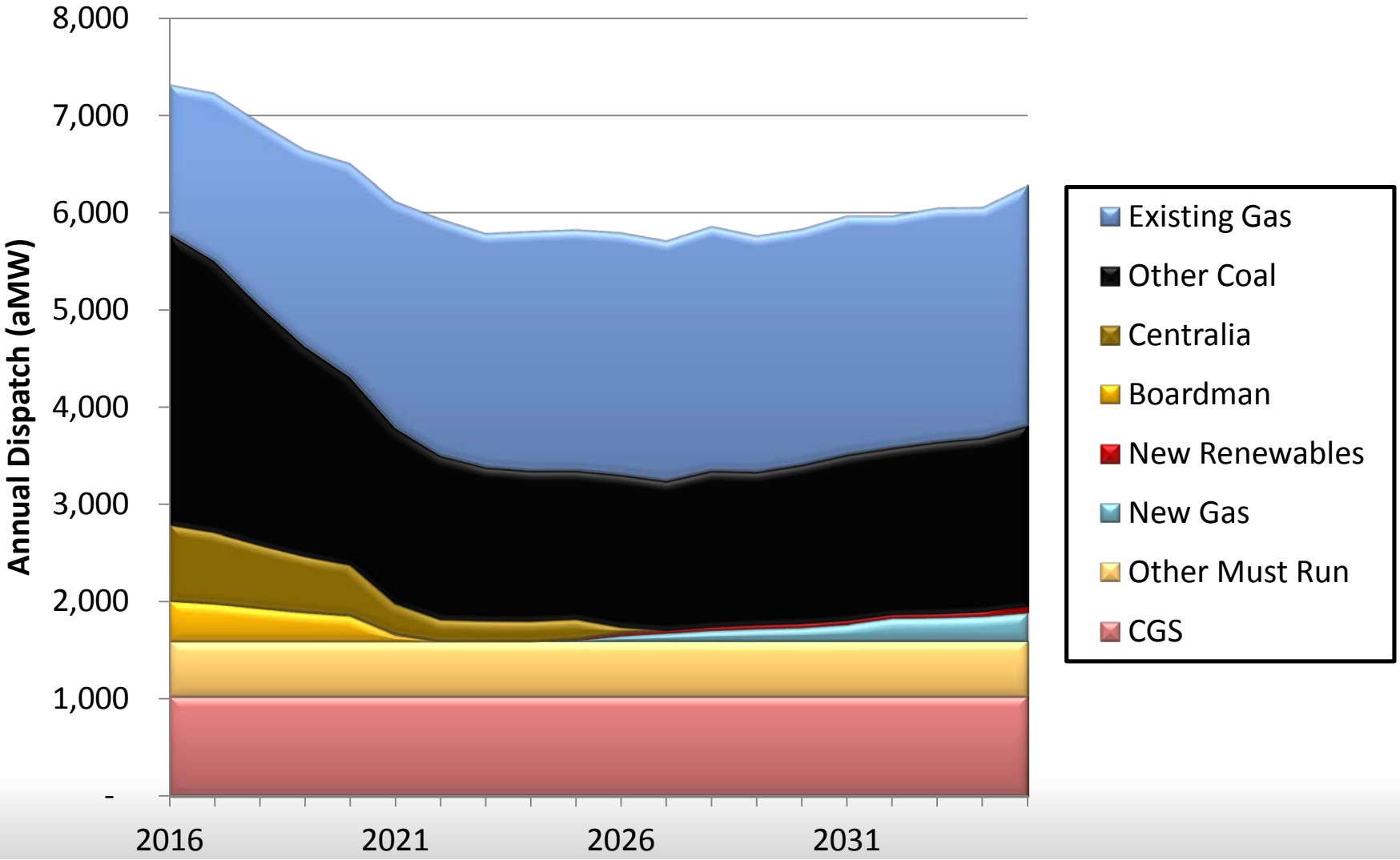
Scenarios 1B, 2C, 4C and 4D – Least Cost Resource Strategies



Thermal Resource Dispatch without Carbon Risk



Thermal Resource Dispatch with Carbon Risk



RPM Model Results

Common Elements of Least Cost Resource Strategies Across Scenarios Analyzed To Date

- In all scenarios least cost resource strategies rely heavily on conservation to meet both winter capacity and energy needs
- In all scenarios least cost resource strategies rely on only the lowest cost Demand Response options to maintain adequate capacity margins
- In all scenarios least cost resource strategies build renewable resources to satisfy state RPS requirements
  - The only exception is the “no uncertainty” Scenario

Scenario 1A – No Uncertainty Observations

- Scenario 1A was designed to assess whether the RPM would, when given a "deterministic" future, develop resources similar to those selected by other resource expansion models (e.g. Aurora).
- Nearly all other resource expansion models do not treat EE and DR as "resource options"
- That said, the RPM builds the lowest cost resources first in the amounts needed to maintain load/resource balance with adequate reserves

Scenario 1B – Current Policy Observations

- Least cost strategy already has low risk
  - Additional risk reduction comes at a high cost relative to the reduction in risk
- Adequacy requirements and RPS drives resource builds
  - The planning period starts not meeting adequacy standards in many of the futures
- Economic builds are few and far between
  - Economic builds occur in less than 1% of futures in the least cost resource strategy
- DR is optioned because it has a shorter lead time than generation options, small incremental resource size and low cost
- Thermal build options selected for adequacy seem related to retirements of Boardman and Centralia
- REC banking delays the need for constructing renewables until well past the action plan period

Scenario 2C – Carbon Risk Observations

- Least cost strategy already has low risk
  - Similar to Scenario 1B, reduction in risk comes at a relatively high cost
- In the least cost strategy the thermal options selected are all combined cycle gas plants, no gas peaking plant is selected
- DR still plays a major role in the resource strategy
- Conservation by the end of the study supplies around 80% of the capacity added to the system

Scenarios 4C and 4D Conservation Ramp Rates

- During the Action plan period the least cost resource strategy under Scenario 4C develops slightly less (950 aMW vs. 1030 aMW) conservation than under Scenario 4D

- However, under Scenario 4D the least cost resource strategy develops more expensive conservation in order to achieve total savings comparable to 4C by 2035

Renewable Resources

- Renewable resource development is driven by RPS requirements
- Additional renewable resources, beyond RPS requirements, are not developed scenario date that include carbon risk scenario
- State RPS regulations which permit banking of Renewable Energy Credits (RECs), especially in Oregon appear to delay additional development until after 2025
- Solar PV is developed to provide summer peaking capability under some futures

Thermal Resources

- Thermal Options
  - In the Carbon Risk scenario more efficient combined cycle combustion turbines are selected rather than peaking units
  - In the Carbon Risk scenarios Economic builds increase only slightly, likely as a result of higher market price impacts from CO2 costs
- Existing Dispatch
  - Existing coal-fired units with associated carbon emissions have a much lower dispatch over the planning period, while existing gas-fired unit dispatch increases

Carbon Emissions

- Under Scenarios 1B and 2C, 4C and 4D carbon emissions are significantly reduced
  - Average carbon emissions under Scenario 1B are approximately 15% below EPA 111(d) proposed 203o limits
  - Average carbon emissions under Scenario 2C, 4C and 4D are approximately 40% below EPA 111(d) proposed limits
  - However, 90th percentile emissions exceed EPA's proposed limits in under both scenarios

Sensitivity Studies and Revised Scenarios

- SAAC members have suggested the following sensitivity studies
  - Remove transmission credit for "west side" resources (DR, EE and gas turbines)
  - Remove DR as resource option
- The Oregon and Washington Chapters of the Physicians for Social Responsibility have requested that Scenario 4A – Unanticipated Loss of a Major Resource be revised to consider the "anticipated" loss of CSG

Scenario Analysis Schedule

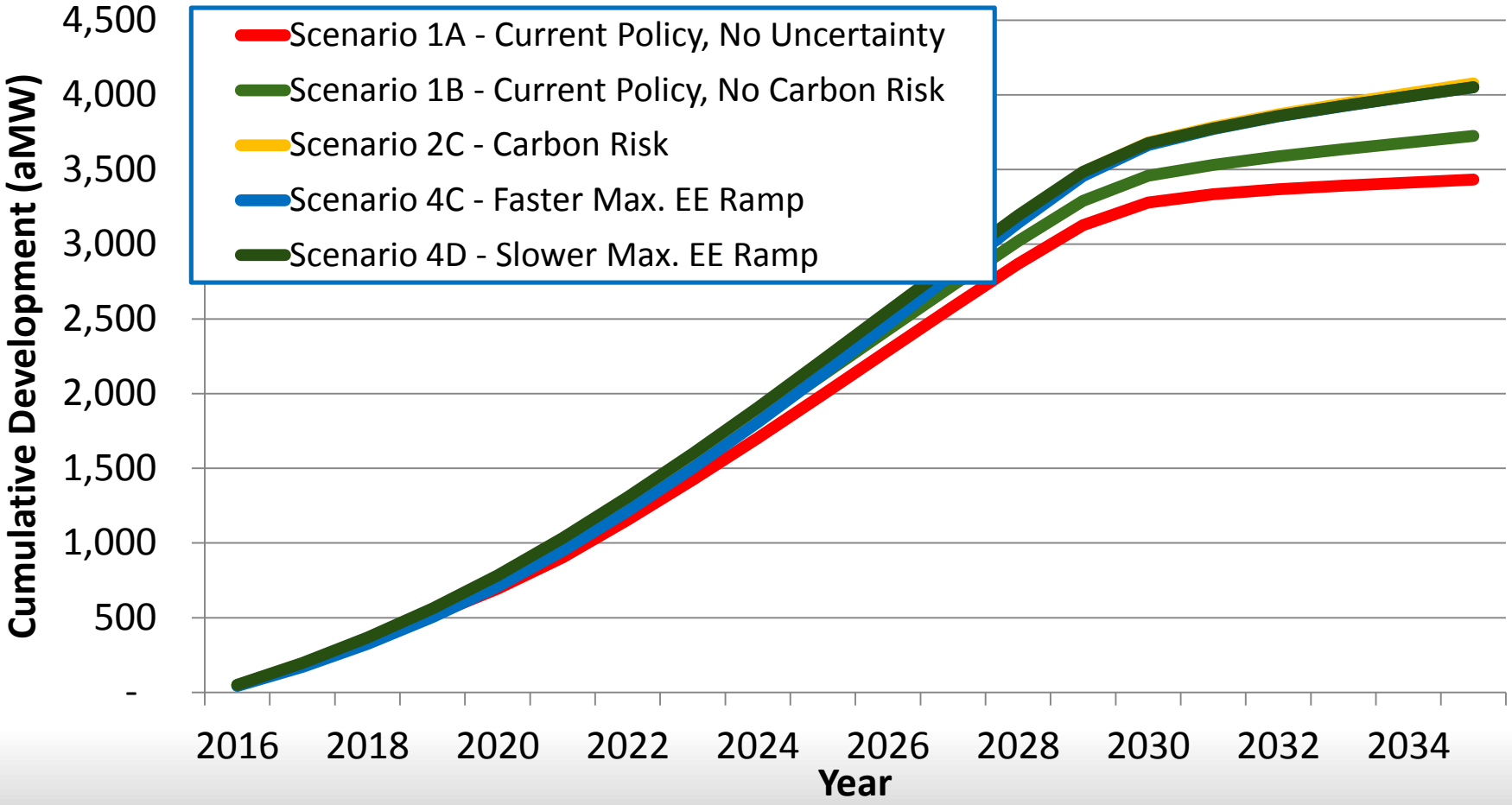
- All model enhancements needed to analyze proposed scenarios except for Scenario 4A have been completed
- Inputs needed for remaining scenarios are largely complete (with the potential exception of 4A)
- Proposed revised schedule adjusts order and schedule of analysis to accommodate consideration of revision to scope of scenario 4A

Scenario	Scenario Name	Priority	Modeling Effort	Revised Schedule
1B	Existing Policy with Uncertainty, w/o GHG reduction risk	1	Med	Early May
1A	Existing Policy without Uncertainty, w/o GHG reduction risk	2	Med	Early May
2C	Existing Policy with Uncertainty and with uncertain GHG reduction risk/target.	3	Low	Early May
4C	Major Resource Uncertainty – Faster Pace of Conservation Deployment	4	Low	Late May
4D	Major Resource Uncertainty – Slower Pace of Conservation Deployment	5	Low	Late May
2A	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	6	Med	May not need to model
2B	Existing Policy with Uncertainty and with certain GHG reduction risk/target. Example Policy Target = Mitigate to Estimated GHG Damage Cost	7	Low	Early June
6A	Climate Change Load Impacts Resulting from Direct Effects of Climate Change	8	Low	Mid-June
4B	Major Resource Uncertainty Anticipated Loss of Major Resource(s) (e.g., Snake River Dam Removal)	9	Low	Mid- June
5B	Southwest Market Liquidity Variability	11	Low	Late June
3A	Lowering carbon emissions with current technology	12	Med	Late June
4A	Major Resource Uncertainty - Unexpected Loss of Major Resource (e.g., CGS Forced Retirement)	13	Med/High	Early July or ????
3B	Lowering carbon emissions with emerging technology (e.g., storage, CO_2 heat pumps, SSL)	14	High	Not Modeled
5A	Integration of Variable Resources (i.e., Managing the NW Impact of the "Duck Curve"/50% CA RPS)	15	Med/High	Mid-July
6B	Climate Change Hydro Impacts	16	High	Mid-July

Backup Slides

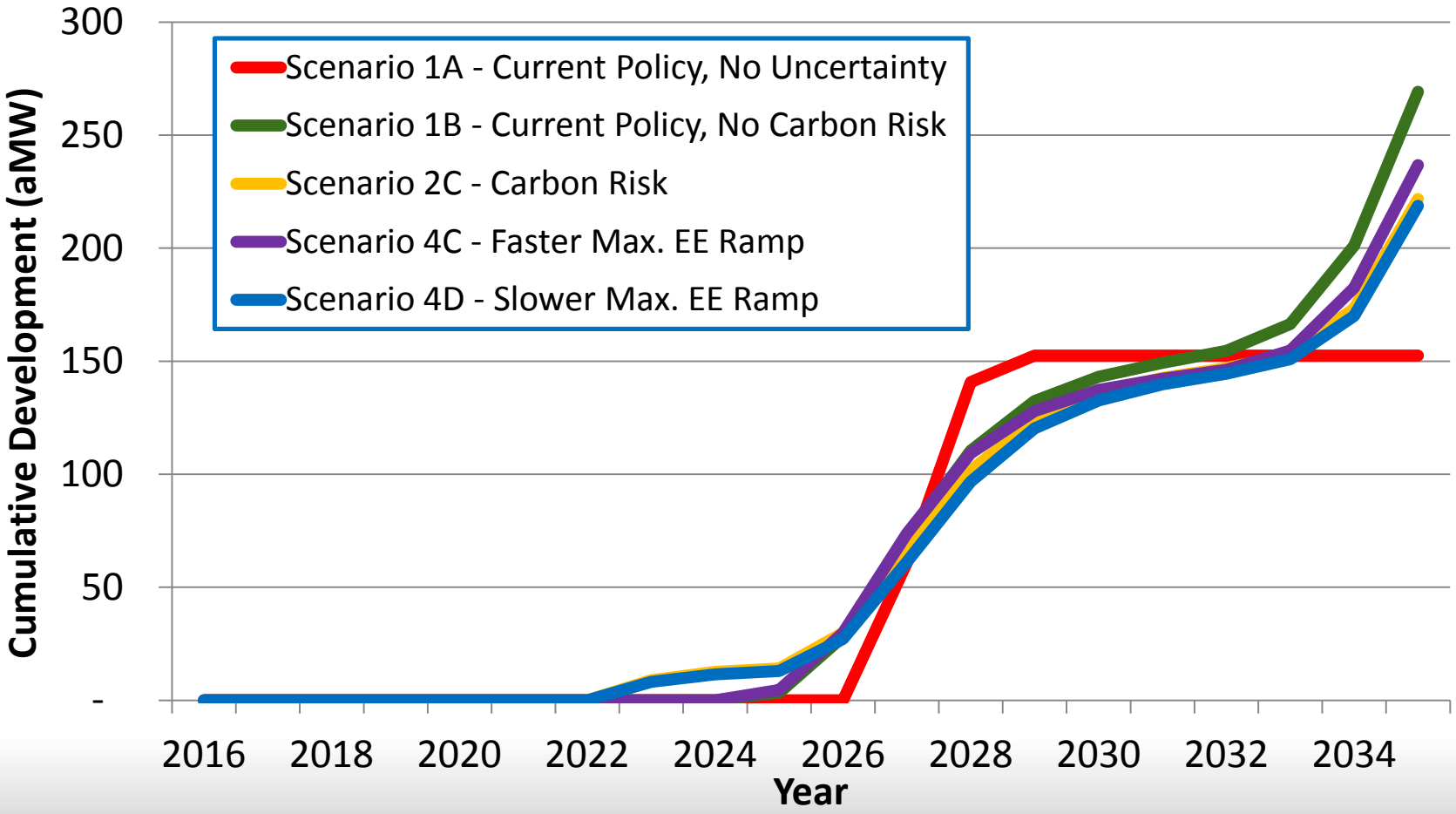
Alternative Assumptions Regarding Conservation Ramp Rates Do Not Appear To Affect The Average Conservation Development by 2035

Scenarios 1A,1B, 2C, 4C and 4D Least Cost Resource Strategies



Alternative Assumptions Regarding Conservation Ramp Rates Do Not Appear To Affect The Average RPS Development by 2035

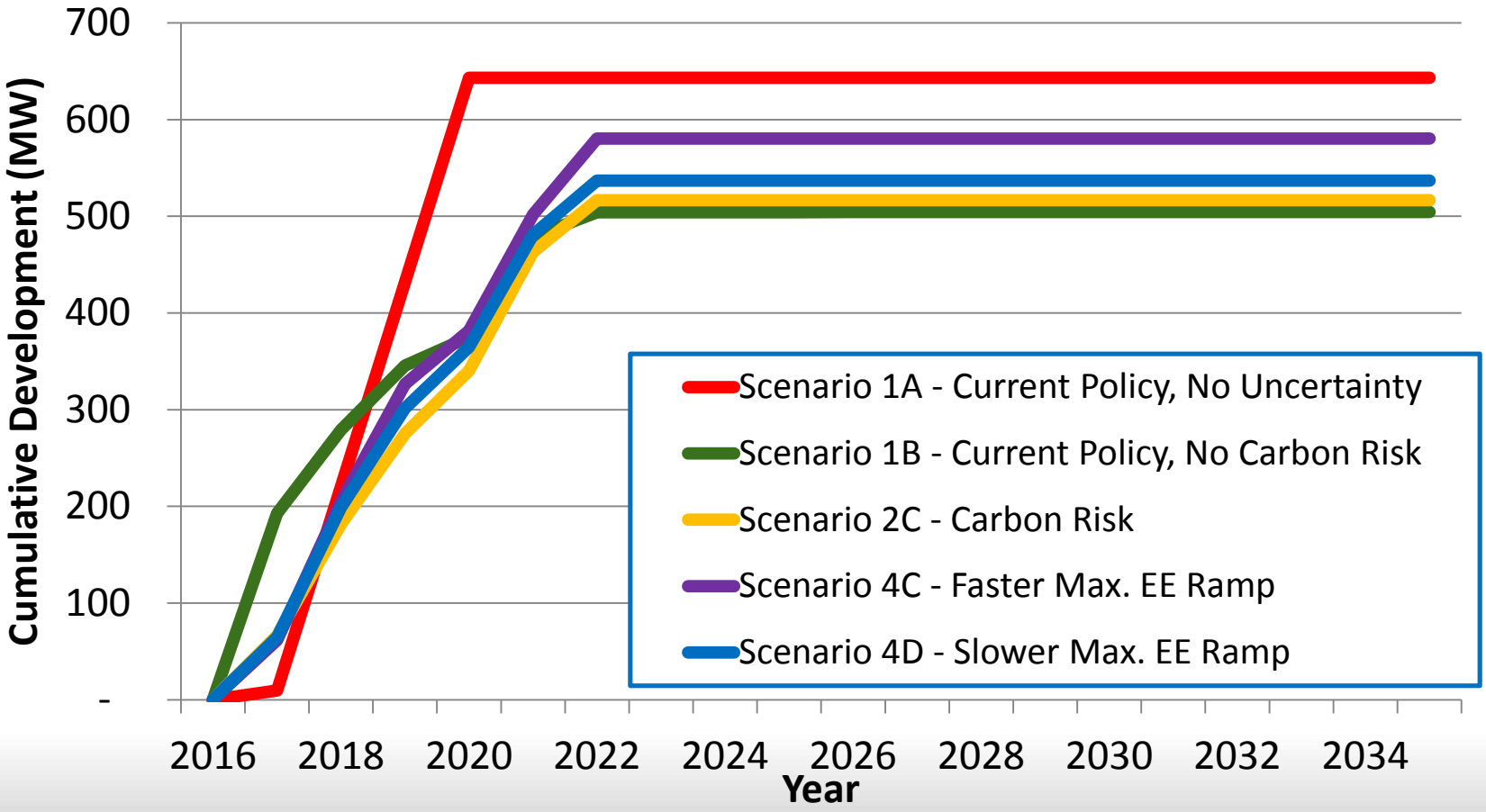
Scenarios 1A,1B, 2C, 4C and 4D Least Cost Resource Strategies



Alternative Assumptions Regarding Conservation Ramp Rates Do Not Appear To Affect The Average Demand Response Development by 2035

Scenarios 1A,1B, 2C, 4C and 4D Least Cost Resource Strategies

Winter Peak



Alternative Assumptions Regarding Conservation Ramp Rates Do Not Appear To Affect The Average Demand Response Development by 2035

Scenarios 1A,1B, 2C, 4C and 4D Least Cost Resource Strategies

Summer Peak