The 2021 SB 100 Joint Agency Report: An Initial Assessment of Achieving 100 Percent Clean Electricity in California

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SB 100 Review

Expands RPS

60% by Dec 31, 2030

PUC 399.11(a), 454.53 (a)

Establishes 100% Policy

It is the policy of the state that **eligible renewable energy resources and zero-carbon resources supply 100 percent of all retail sales** of electricity to California end-use customers by December 31, 2045 and 100 percent of electricity procured to serve all state agencies by December 31, 2045.

SB 100 Joint Agency Report

CEC, CPUC, and CARB to issue a Joint-Agency report every four years including the following:

A. **A review of the policy** (technical, safety, affordability, reliability)

B. **Reliability benefits and impacts**

C. **Financial costs/benefits**

D. **Barriers/Benefits of achieving the policy**

E. **Alternative scenarios and costs/benefits of each**

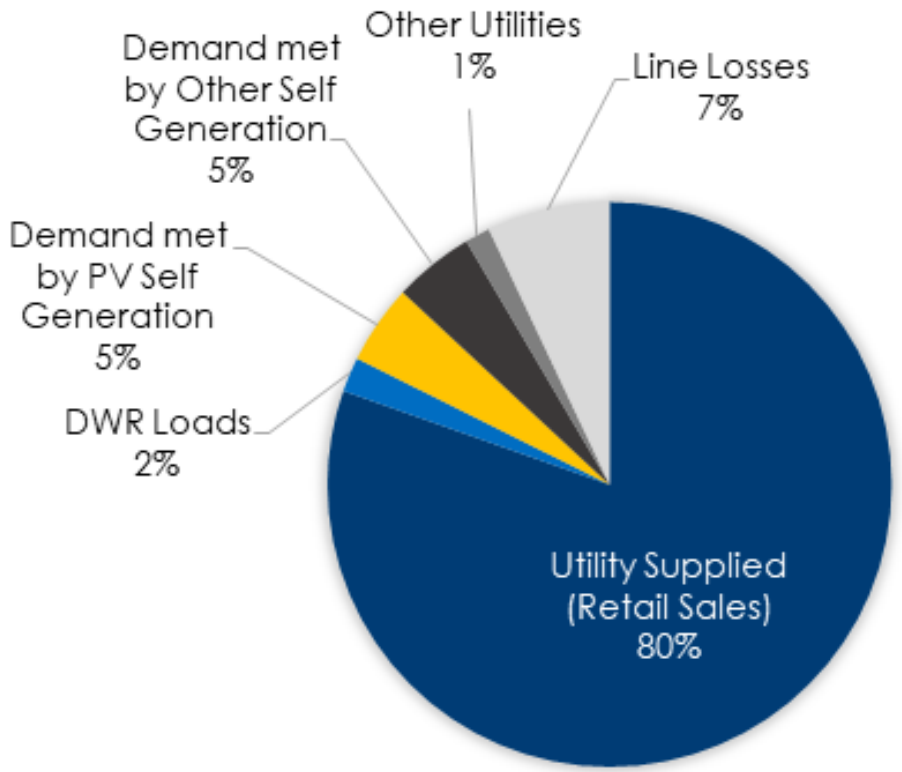
Loads Subject to SB 100

"…**eligible renewable energy resources and zero-carbon resources supply 100% of retail sales** of electricity to California end-use customers and **100% of electricity procured to serve all state agencies** by December 31, 2045"

The joint agency interpretation includes utility supplied (retail sales) and DWR loads shown in blue.

454.53 (a)

2018 California Electricity Loads



Zero-Carbon Resources Included in Modeling

Zero-Carbon Criteria ("RPS+")

1. Meets the requirements for RPS-eligibility set forth in the most recent RPS Eligibility Guidebook; and/or
2. Has zero onsite greenhouse gas emissions.

Additional Parameters for Modeling

- Are **considered viable resources** in terms of technology readiness, alignment with other state policies and public and environmental health priorities, and resource availability
- Only **commercialized technologies** with vetted and publicly available cost and performance datasets were included for Core Scenarios

Zero-Carbon Resources Included in Modeling

Technology	Eligibility Basis	Scenarios
Solar PV	RPS	Core and Study
Solar Thermal (existing only)	RPS	Core and Study
Onshore Wind	RPS	Core and Study
Offshore Wind	RPS	Core and Study
Geothermal	RPS	Core and Study
Bioenergy	RPS	Core and Study
Fuel Cells (green H2)	RPS	Core and Study
Small Hydro (existing)	RPS	Core and Study
Large Hydro (existing)	Zero-Carbon	Core and Study
Nuclear (existing)	Zero-Carbon	Core and Study
Zero-Carbon Firm Dispatchable Resource	Zero-Carbon	Study Only
Zero-Carbon Firm Baseload Resource	Zero-Carbon	Study Only

SB 100 Scope of Analysis

Inputs

Such as:

- Existing System
- Demand Forecasts/ Scenarios
- Resource Costs
- Reliability Metrics
- Policy Goals
- Resource Potential
- Land Use Screens

Portfolio Development

(Capacity Expansion Modeling)

Scope of 2021 SB 100 Analysis

Reliability Testing

Operability/ Full Dispatch	Resource Adequacy	Local Reliability
Production Cost Modeling	Probabilistic Production Cost Modeling	Power Flow Modeling

Portfolio Impacts

Rates	GHG Emissions	Land Use
Air Pollution	Workforce	Social Costs

Inputs, impacts, and tools listed are for illustrative purposes

SB 100 Modeling

All modeling was conducted by consultant E3.

- RESOLVE California model:
  - Co-optimizes NPV of investment and operational costs, given reliability and policy constraints, to develop a *least-cost resource portfolio*

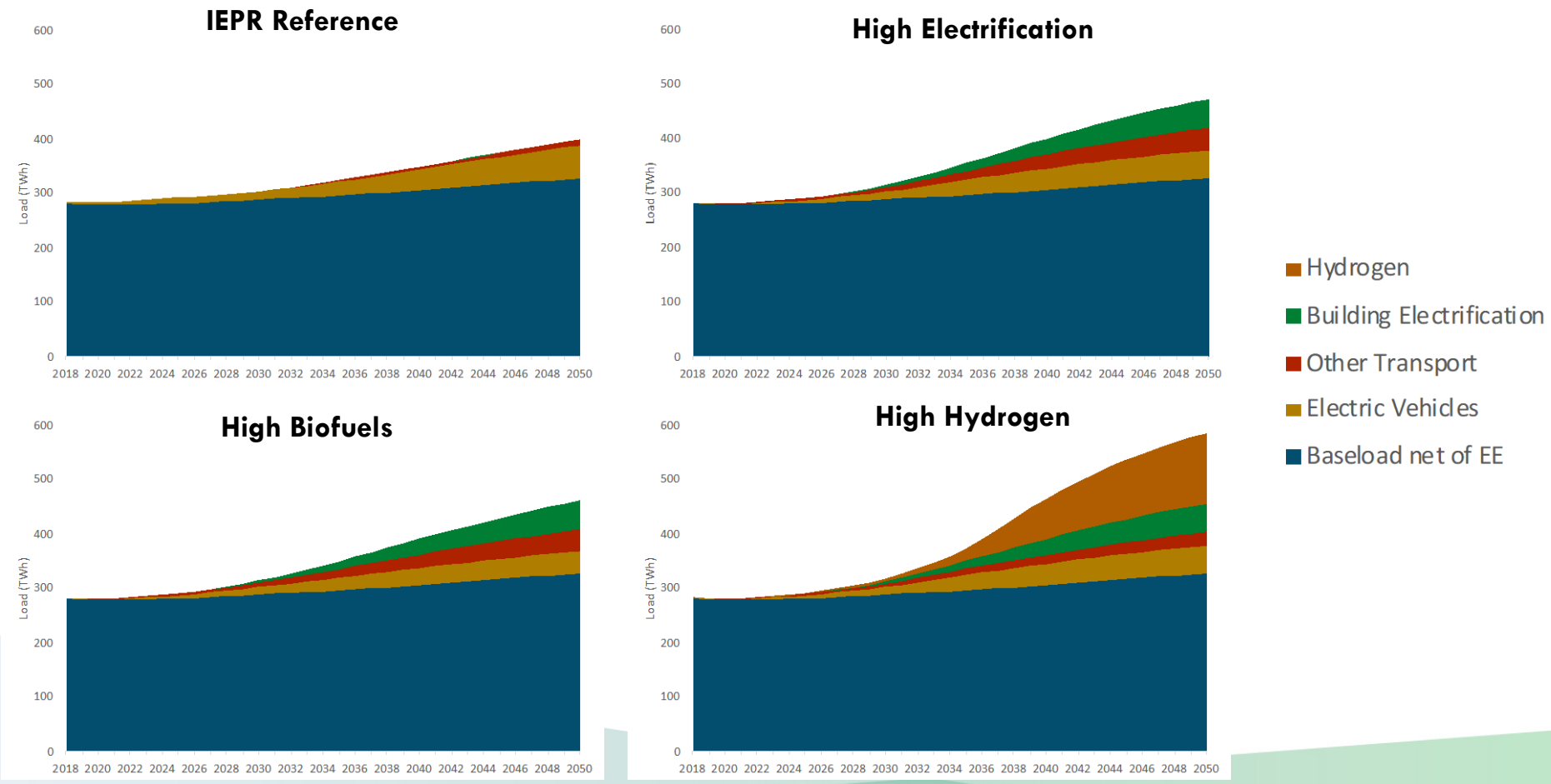
All SB 100 portfolios are *directional*.

- A reliability assessment was *not* included in the scope of work for the 2021 Report.
- Portfolios do not reflect individual BA or LSE goals or decision-making.

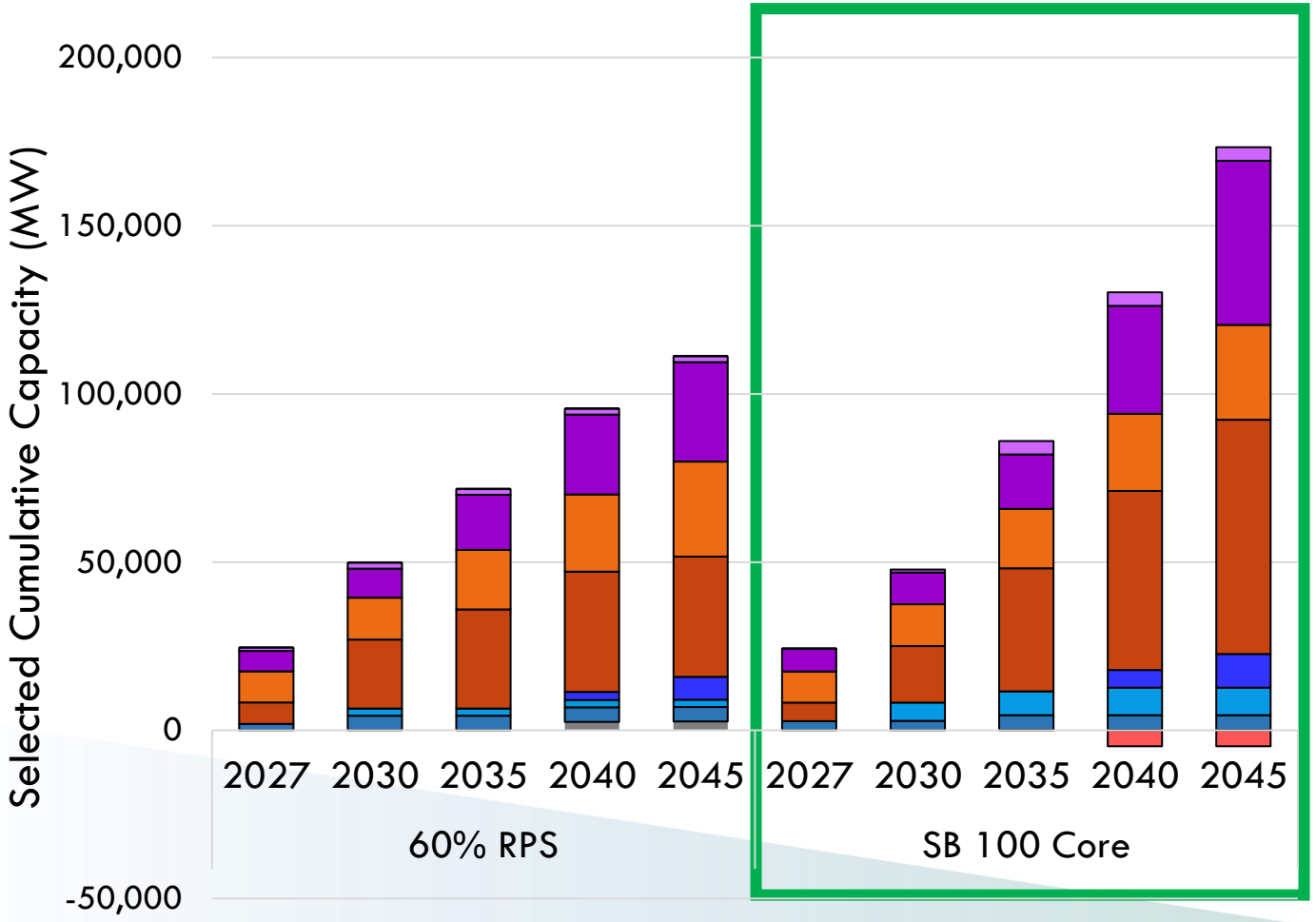
Core Assumptions: Demand Scenarios

PATHWAYS provides RESOLVE:

- Annual loads by category (GWh/yr)
- Some load shape information for load modifiers



SB 100 Requires Significant Resource Build

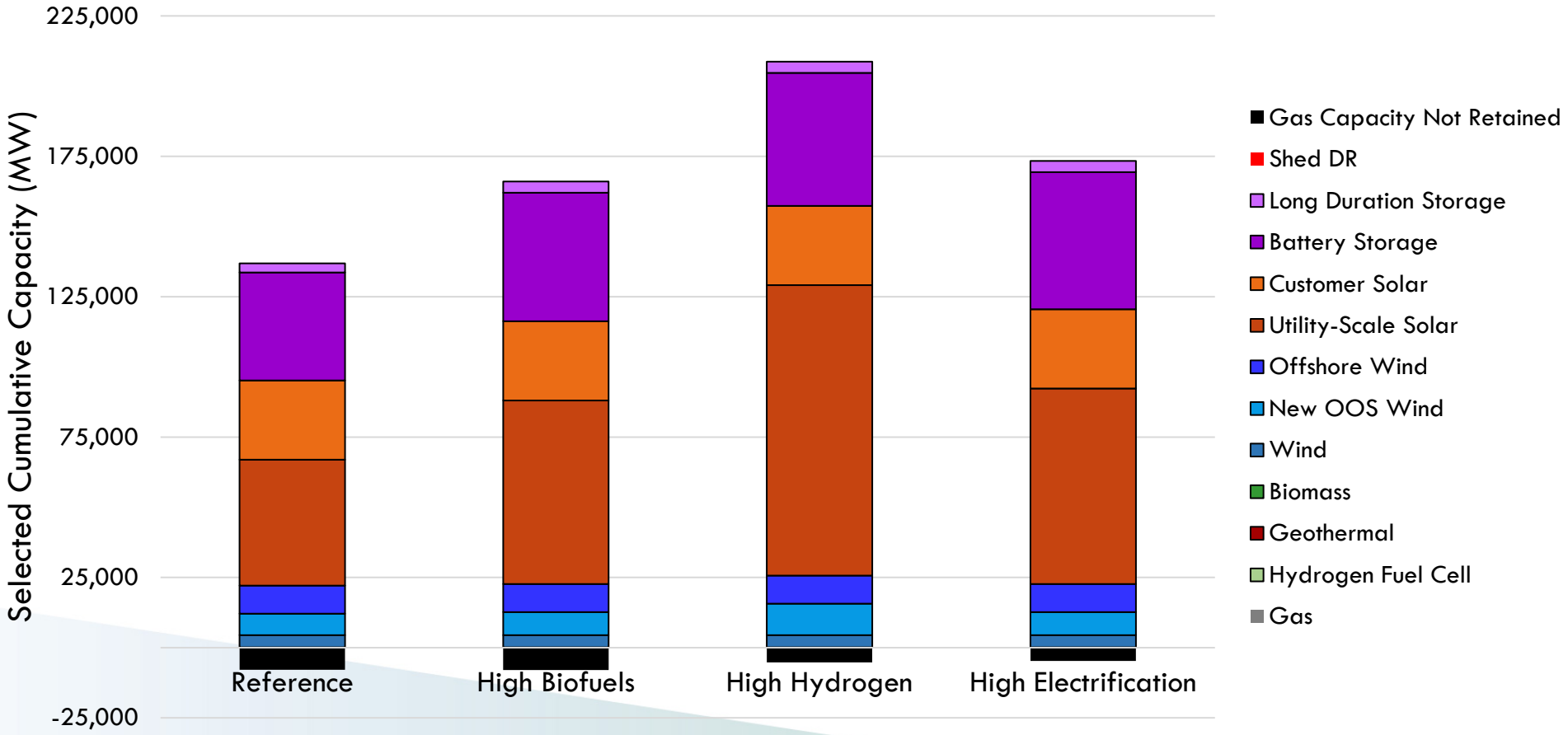


Scenario	Total Resource Cost ($B)	Average Cost (¢/kWh)
60% RPS	$62	14.8
SB 100 Core	$66	16.0

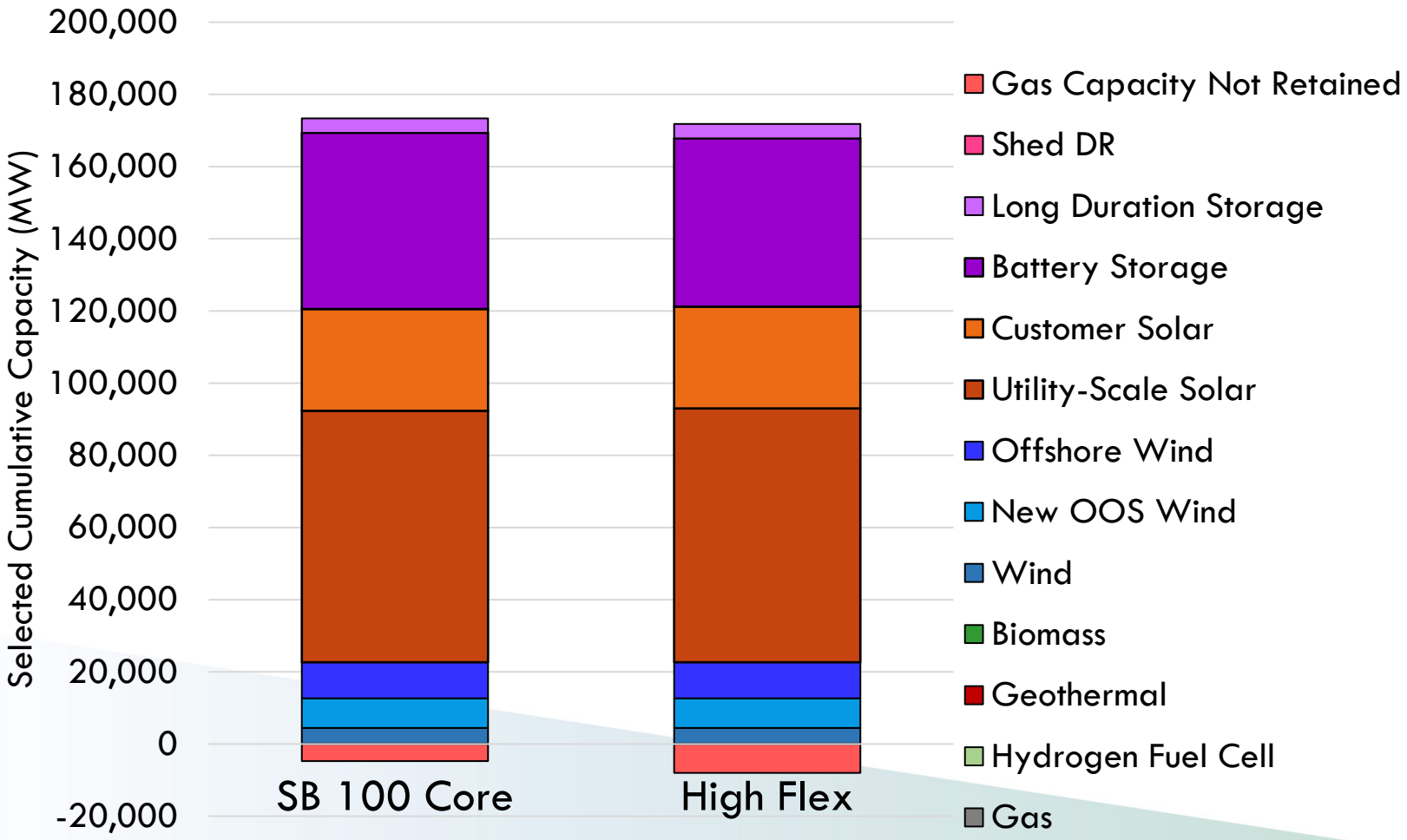
Customer solar shown here is a demand-side assumption. No additional customer solar was selected.

As of 2019, there is 80 GW of in-state capacity in California.

Economy-wide Decarbonization Impacts Resource Requirements



Load Flexibility Decreases Resource Requirements



High Flexibility Scenario

Adjusted hourly load profile for:

- EV managed charging profile
- Building end-use flexibility

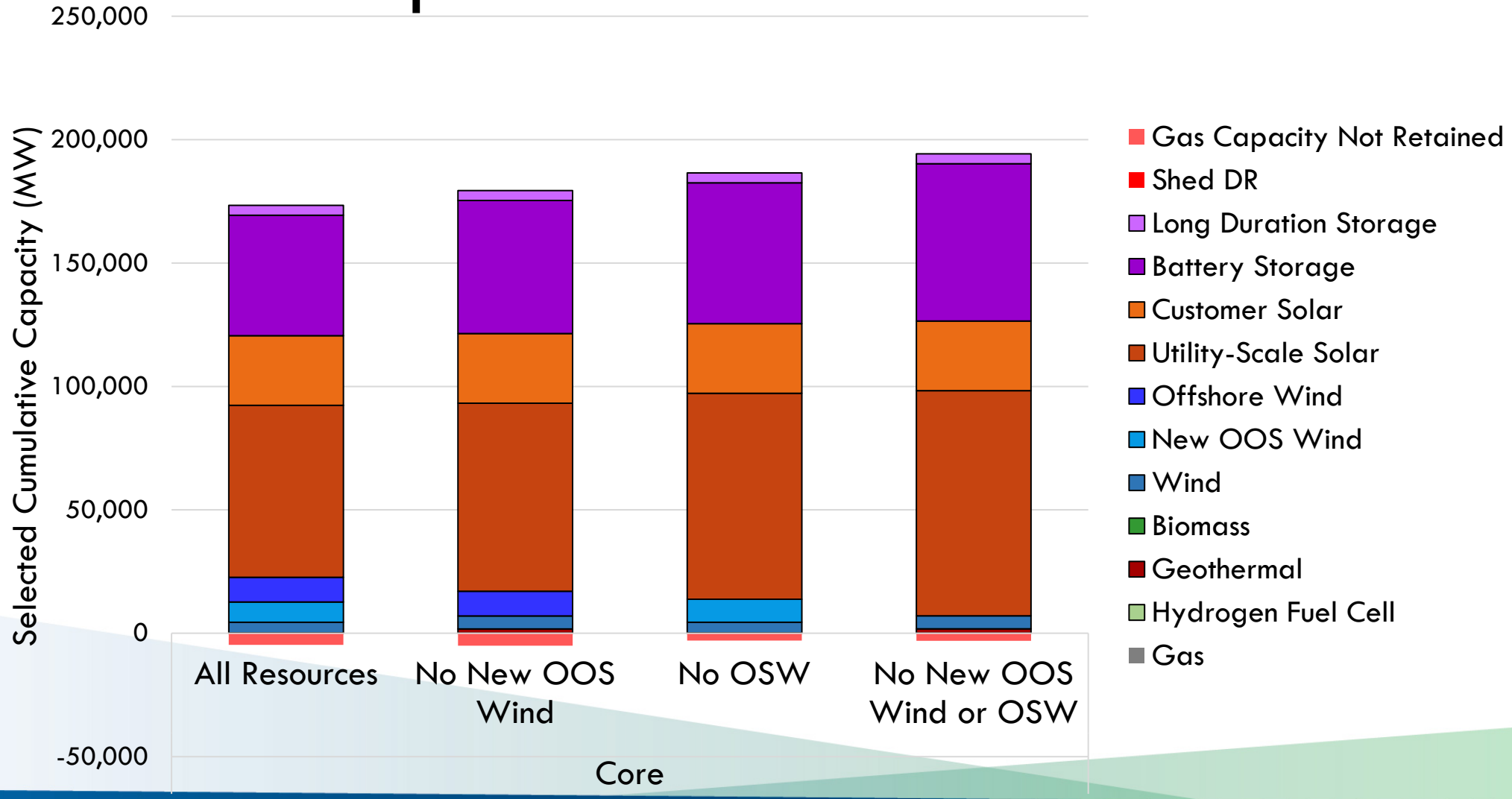
Resource Adequacy Reduction: 6 GW

Notable Change in Resource Build:

- 2.7 GW avoided battery storage
- 3.3 GW increase in economic gas retirements

Scenario	Total Resource Cost ($B)	Average Cost (¢/kWh)
SB 100 Core	$66	16.0
High Flex	$65	15.8

Resource Technology Pursued Impacts Resource Requirements



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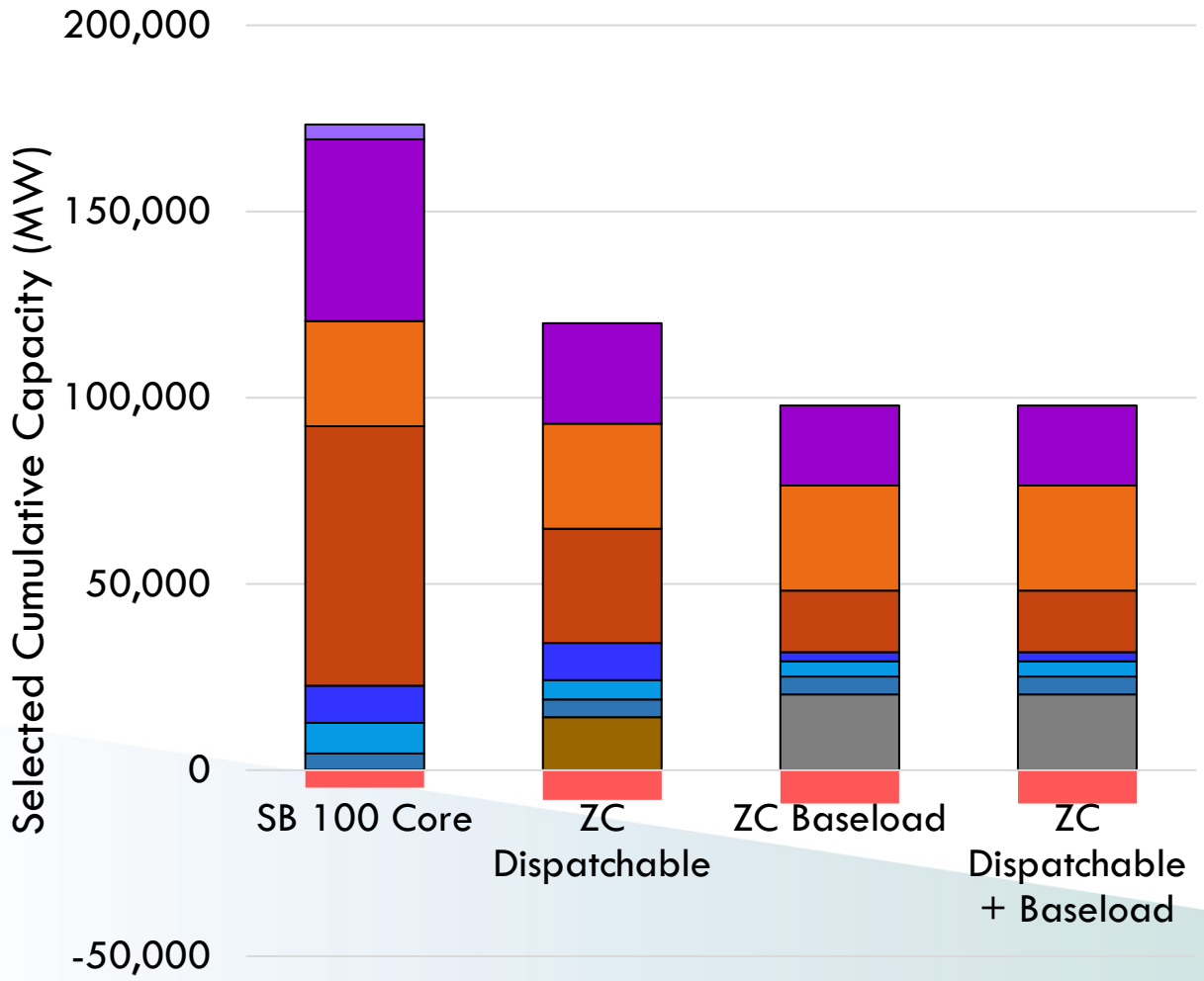
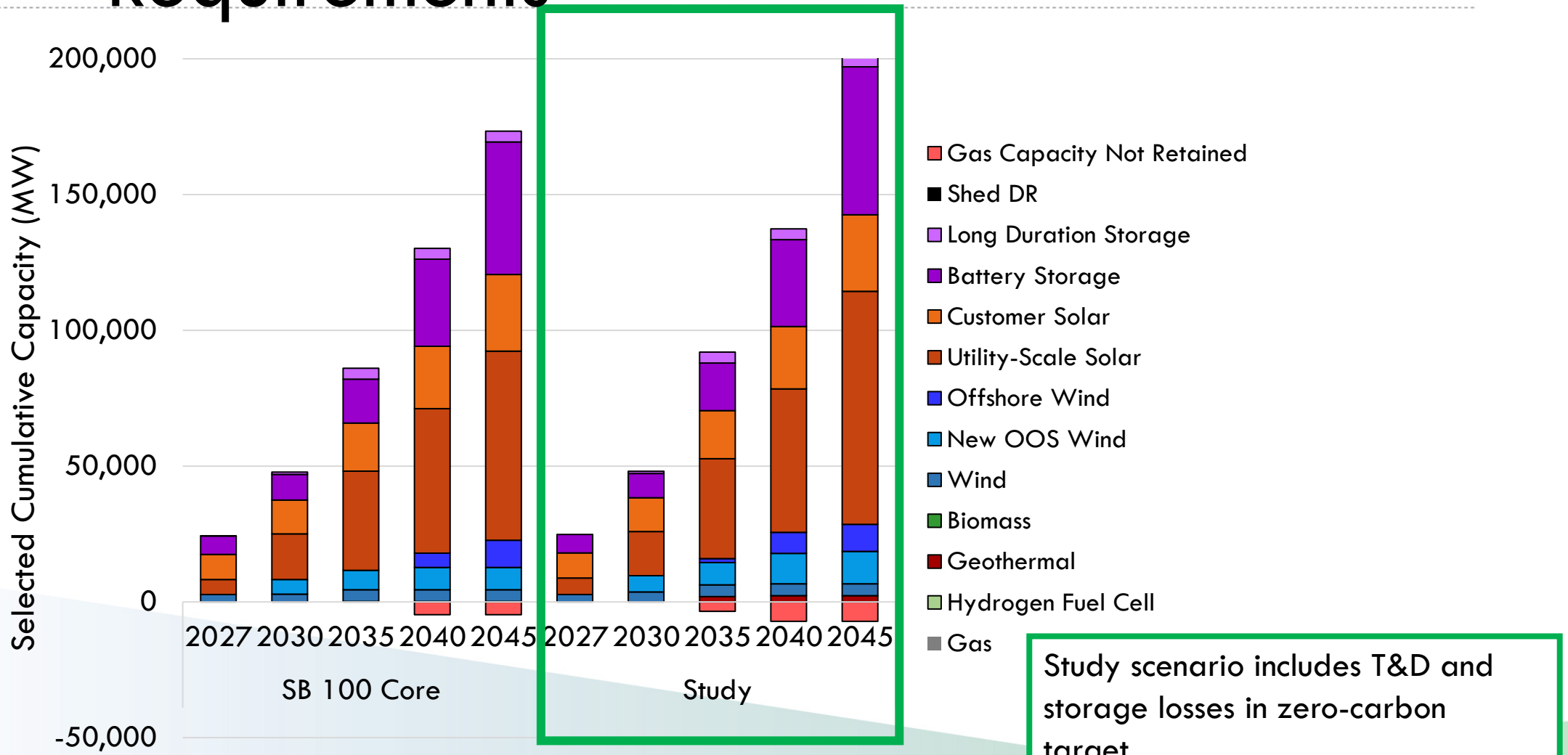


- Gas Capacity Not Retained
- Shed DR
- Long Duration Storage
- Battery Storage
- Customer Solar
- Utility-Scale Solar
- Offshore Wind
- New OOS Wind
- Wind
- Biomass
- Geothermal
- Generic Zero-Carbon Baseload
- Hydrogen Fuel Cell
- Generic Zero-Carbon Dispatchable

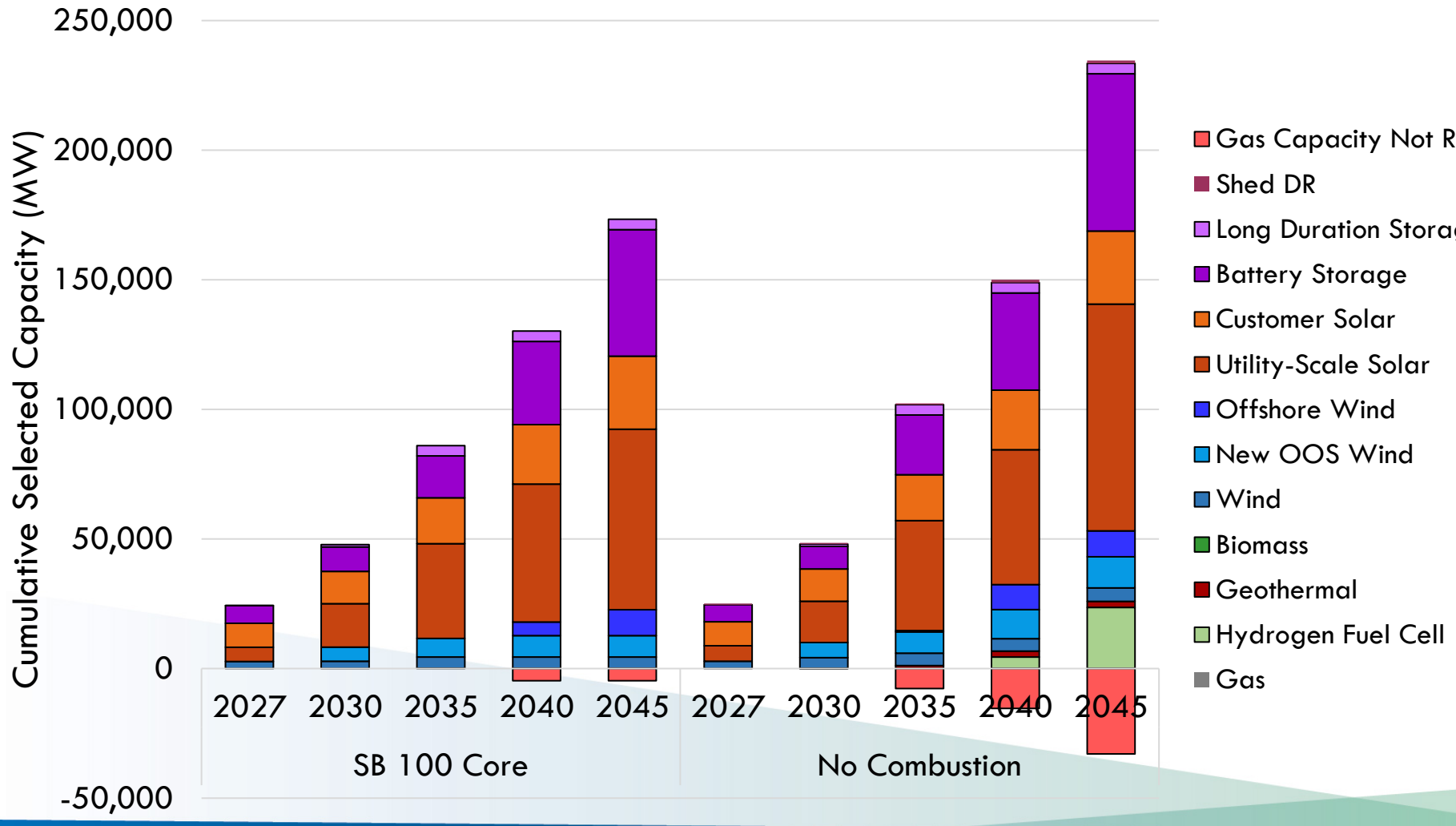
Scenario	Total Resource Cost ($B)	Average Cost (¢/kWh)
SB 100 Core	$66	16.0
ZC Dispatchable	$64	15.5
ZC Baseload	$62	15.0
ZC Baseload + Dispatchable	$62	15.0

Going Beyond SB 100 Impacts Resource Requirements



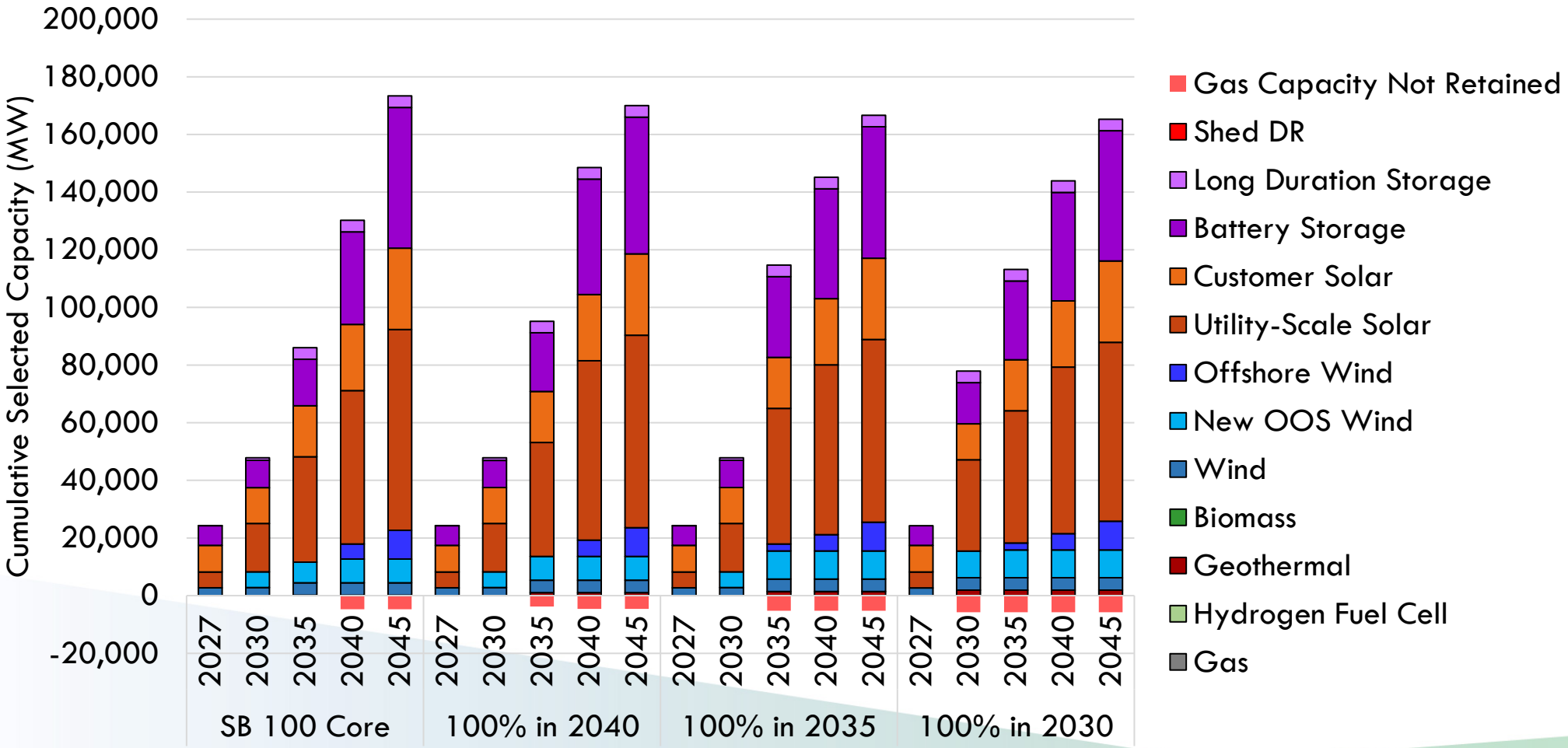
Study scenario includes T&D and storage losses in zero-carbon target.

Going Beyond SB 100 Impacts Resource Requirements



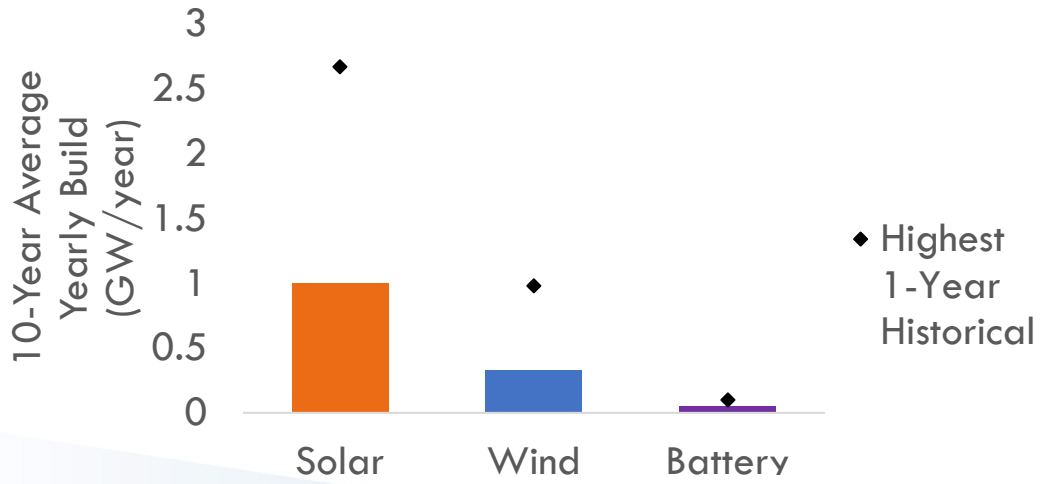
Scenario	Total Resource Cost ($B)	Average Cost (¢/kWh)
SB 100 Core	$66	16.0
No Combustion	$65	18.1

Going Beyond SB 100 Impacts Resource Requirements



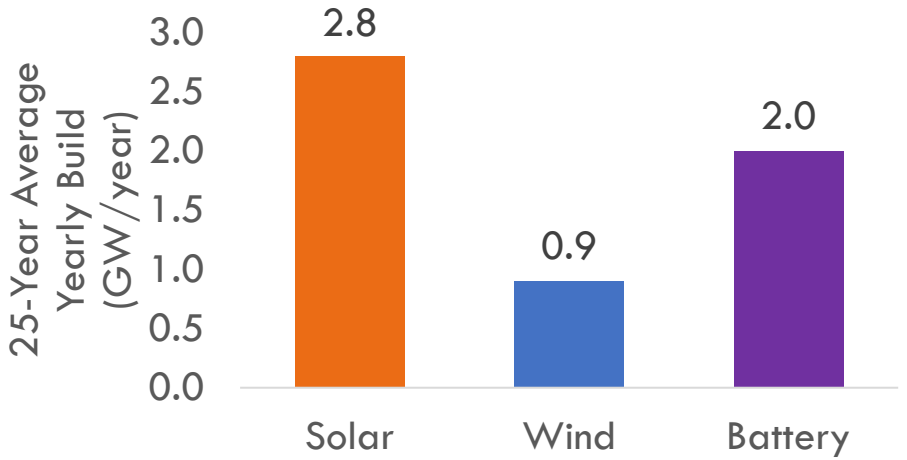
Resource Build Rates

Average Build Rate to Date



Average Build Rate to 2045

SB 100 Core
High Electrification Demand



Factors that May Impact Resource Build

- Electrification/electric demand
- Changes to gas fleet
- Portfolio diversity
  - Offshore wind, out-of-state wind, geothermal, etc
  - Clean firm resource development/deployment
  - DER deployment
  - Load flexibility
- Land-use constraints

Key Takeaways from Modeling

- The initial analysis suggests SB 100 is technically achievable though multiple pathways.
- Construction of clean electricity generation and storage resources must be sustained at record setting build rates.
- Diversity in energy resources lowers overall costs.
- Retaining some natural gas power capacity may minimize costs while ensuring an uninterrupted power supply during the transition to 100 percent clean energy.
    - Increased energy storage and advancements in zero-carbon firm resources and storage can reduce natural gas needs.
- Further analysis is needed.

Further Analysis Recommendations

- Verifying that scenario results satisfy the state's grid reliability requirements across a range of conditions.
- Continuing to evaluate the potential effects of cost-saving emerging resources, such as offshore wind, long-duration storage, green hydrogen technologies, and demand flexibility.
- Assessing environmental, social, and economic costs and benefits of the additional clean electricity generation capacity and storage needed to implement SB 100.
- Holding annual workshops to support alignment among the joint agencies and continuity between SB 100 reports.

Thank you!

The 2021 SB 100 Joint Agency Report and Summary Document can be found at:

https://www.energy.ca.gov/sb100