Integrated Resource Planning (IRP)

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California Public
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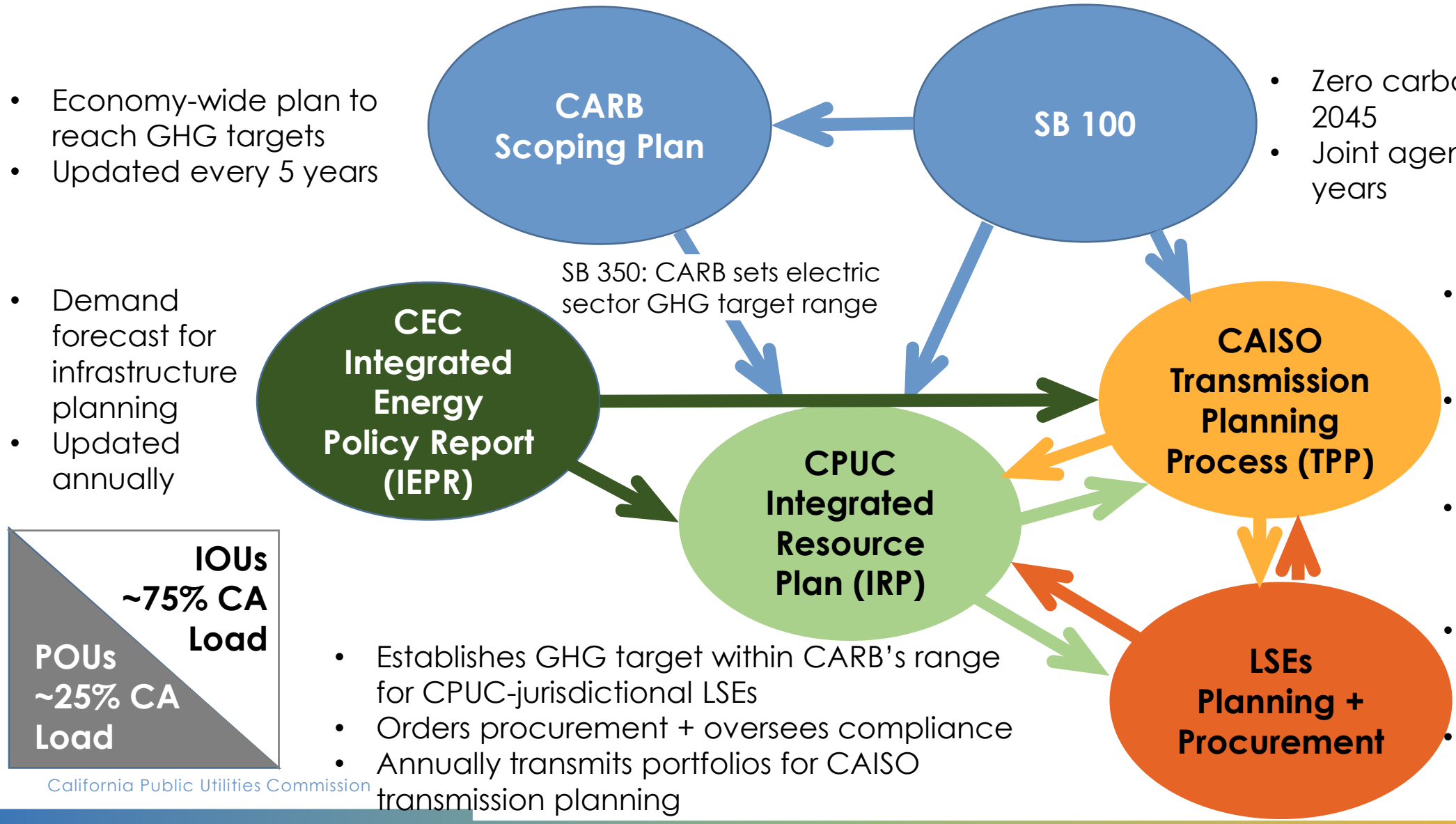
Integrated Resource Planning (IRP) in California Today

- The objective of integrated resource planning is to reduce the cost of achieving GHG reductions and other policy goals by looking across individual LSE boundaries and resource types to identify solutions to reliability, cost, or other concerns that might not otherwise be found.
- Goal of 2019-21 IRP cycle is to ensure that the electric sector is on track to help California reduce economy-wide GHG emissions 40% from 1990 levels by 2030, and to explore how achievement of SB 100 2045 goals could inform IRP resource planning in the 2020 to 2030 timeframe.

- California today is a complex landscape for resource planning:
  - Multiple Load Serving Entities (LSEs) including:
    - Investor-Owned Utilities (IOUs)
    - Community Choice Aggregators (CCAs)
    - Energy Service Providers (ESPs)
  - Multiple state agencies (CPUC, CEC, Air Resources Board) and CAISO.

California's Electricity Planning Ecosystem



- Economy-wide plan to reach GHG targets
- Updated every 5 years

- Zero carbon electricity by 2045
- Joint agency report, every 4 years

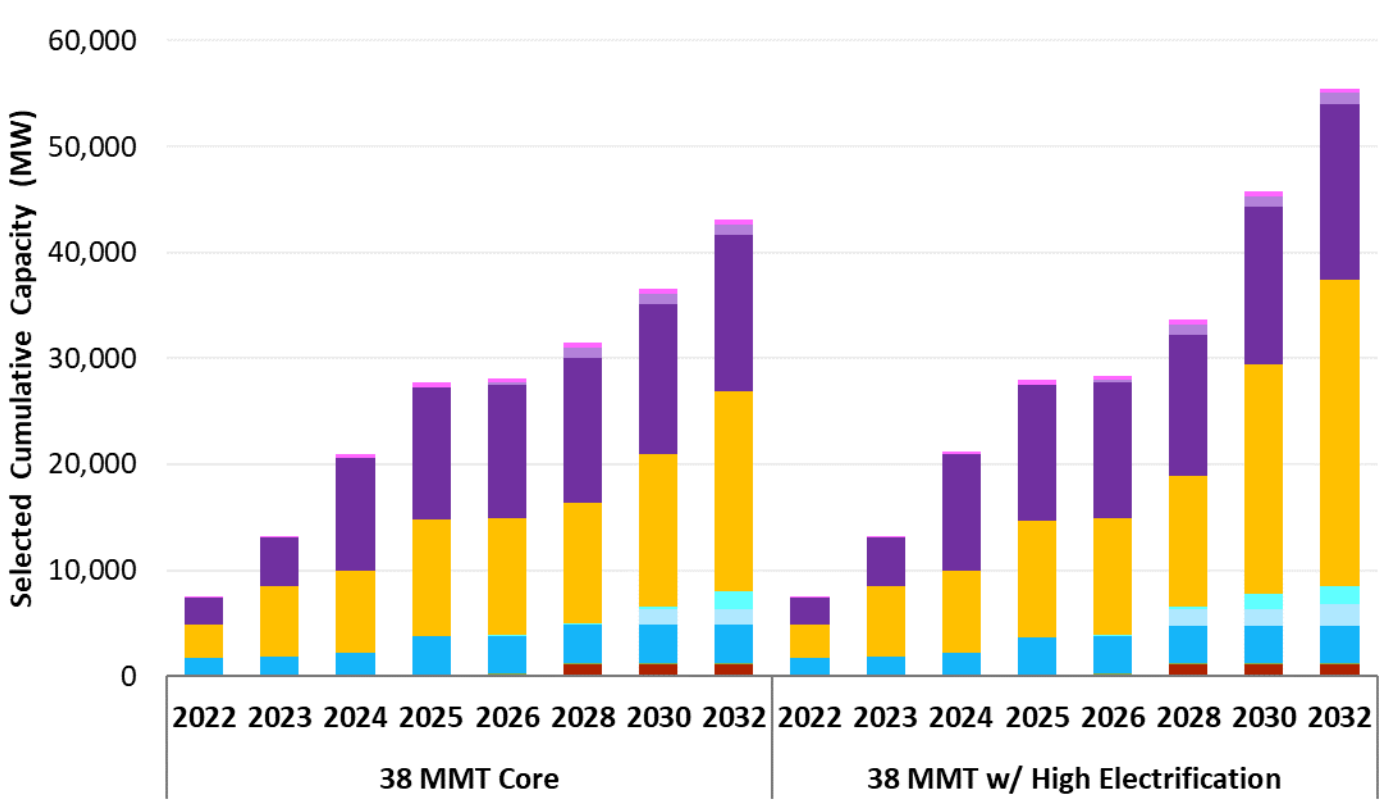
- Demand forecast for infrastructure planning
- Updated annually

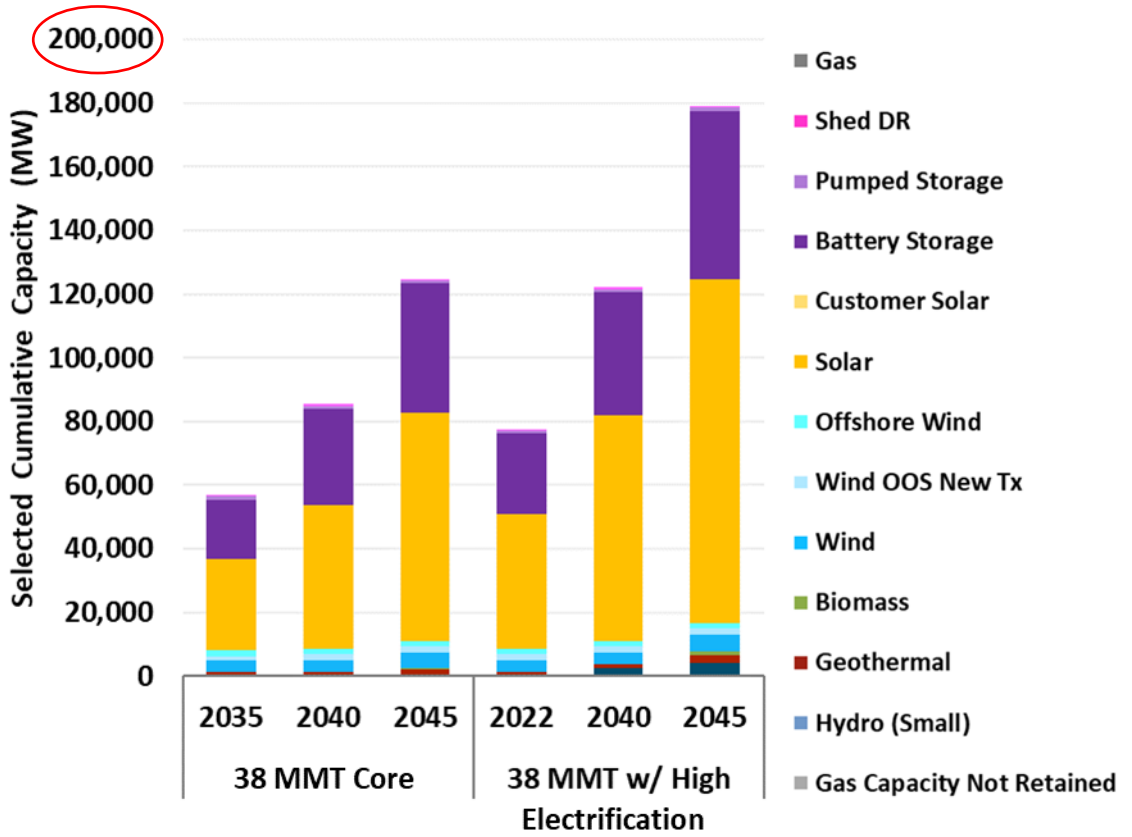
- Assess transmission needs
- Conceptually approves new projects
- Updated annually

- Establishes GHG target within CARB's range for CPUC-jurisdictional LSEs
- Orders procurement + oversees compliance
- Annually transmits portfolios for CAISO transmission planning

- Plans filed per SB 350 + CPUC guidance
- Procurement in compliance w/ CPUC directives

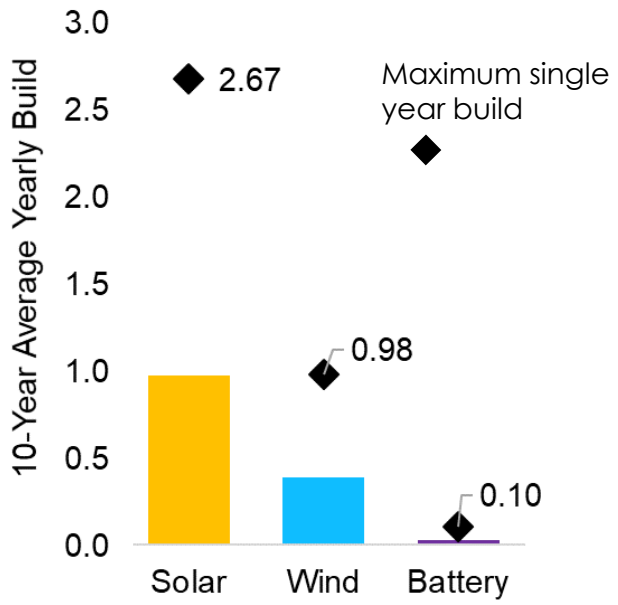
Proposed IRP Preferred System Plan (PSP) Portfolios w/ and w/out High Electrification





Record Build Rates Needed to Achieve the Proposed PSP Portfolio

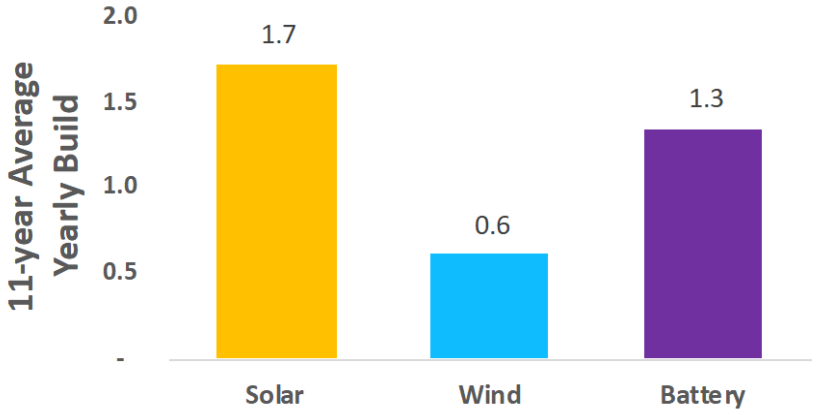
Average Build Rate to Date



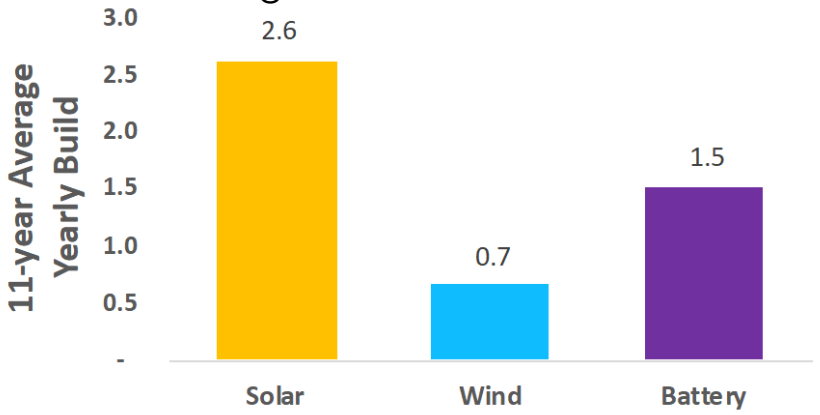
All build rates shown in "GW/year"

Average Build Rate to 2032

Reference Demand

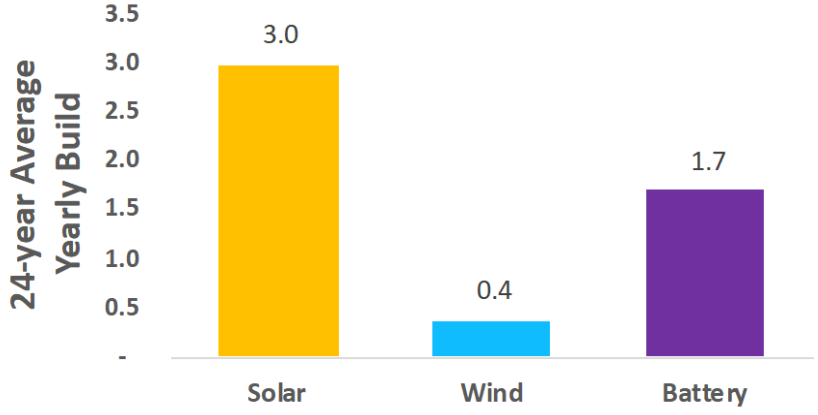


High Electrification Demand

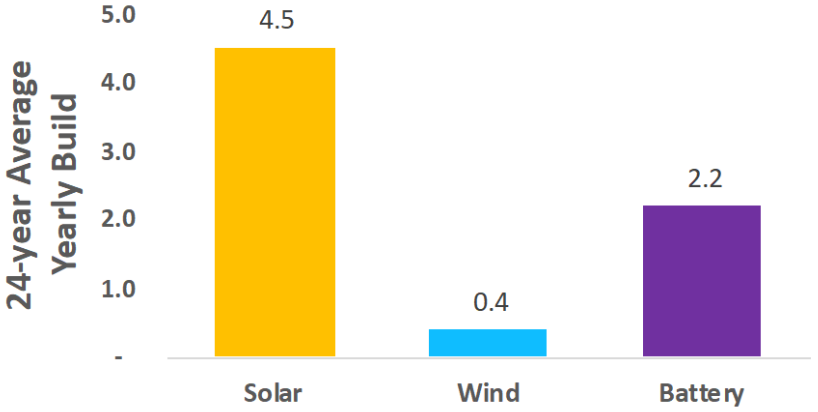


Average Build Rate to 2045

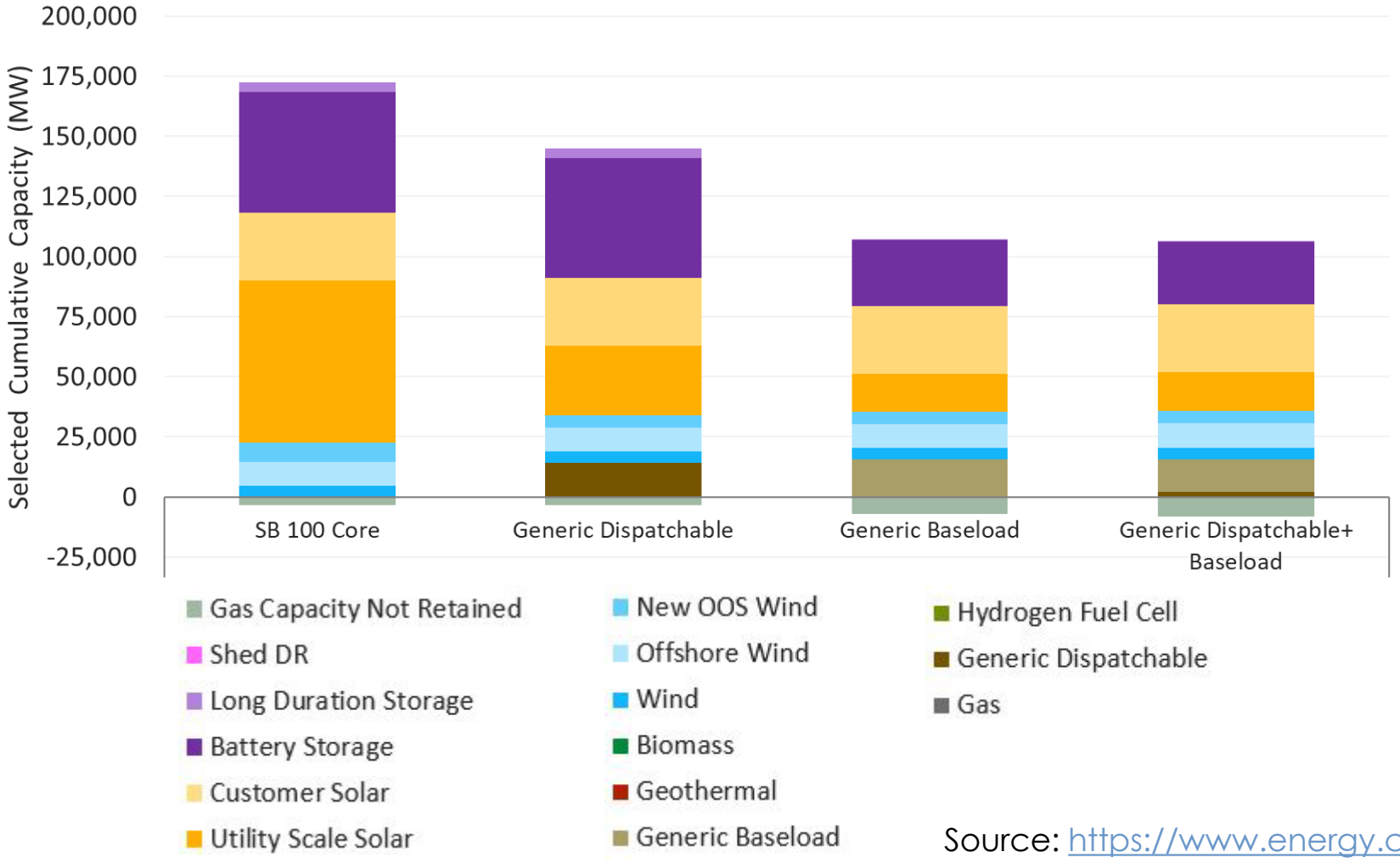
Reference Demand



High Electrification Demand



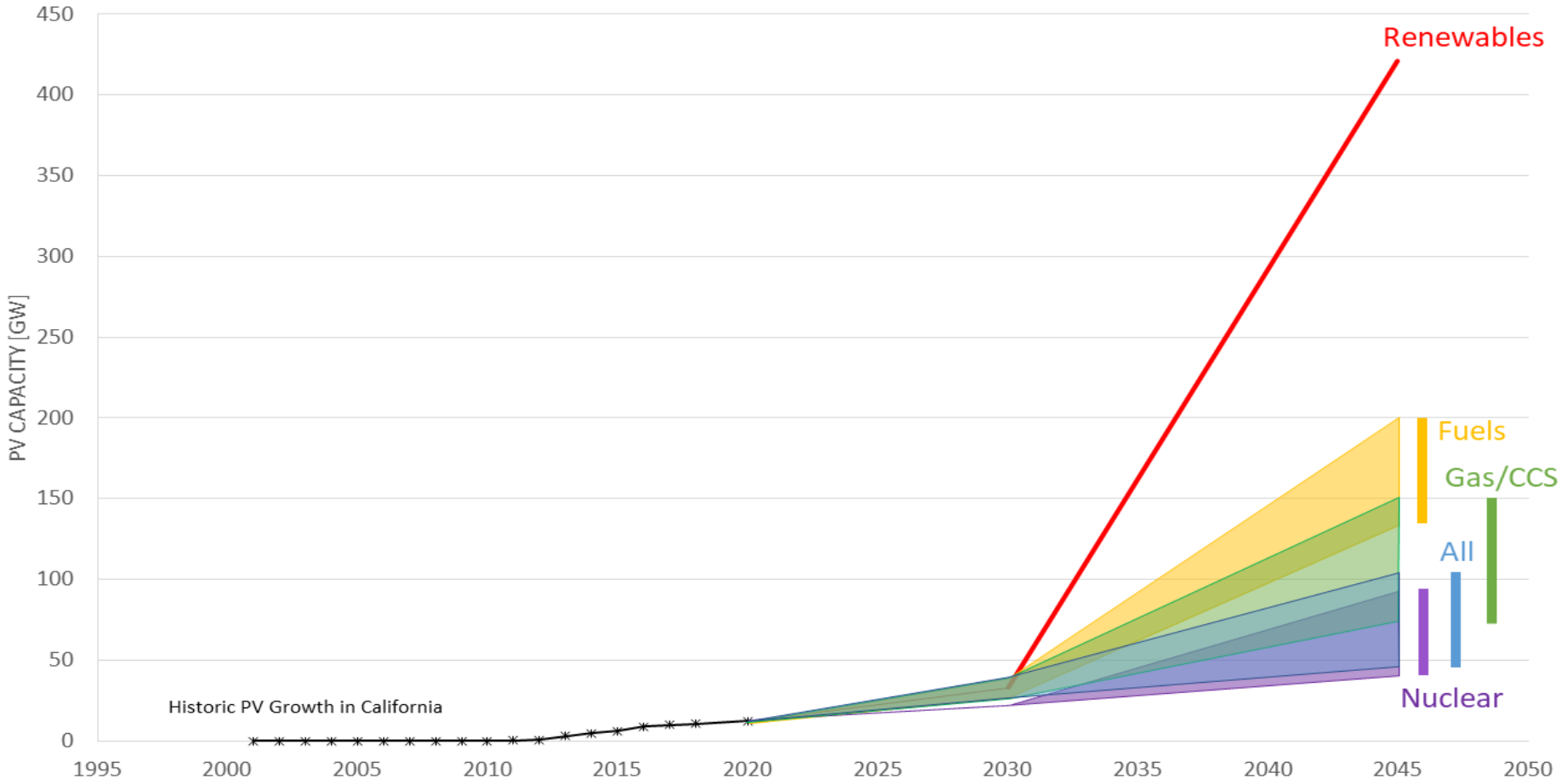
SB 100 Study: Clean firm resources reduce long-term build-out needs and enable more gas retirements



Scenario	Total Resource Cost ($B)	Average Cost (¢/kWh)
Generic Dispatchable	$64	15.4
Generic Baseload	$64	15.4
Generic Dispatch + Baseload	$64	15.4
SB 100 Core	$66	16.0

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

Getting to a zero emissions grid without "clean firm" resource types will be difficult



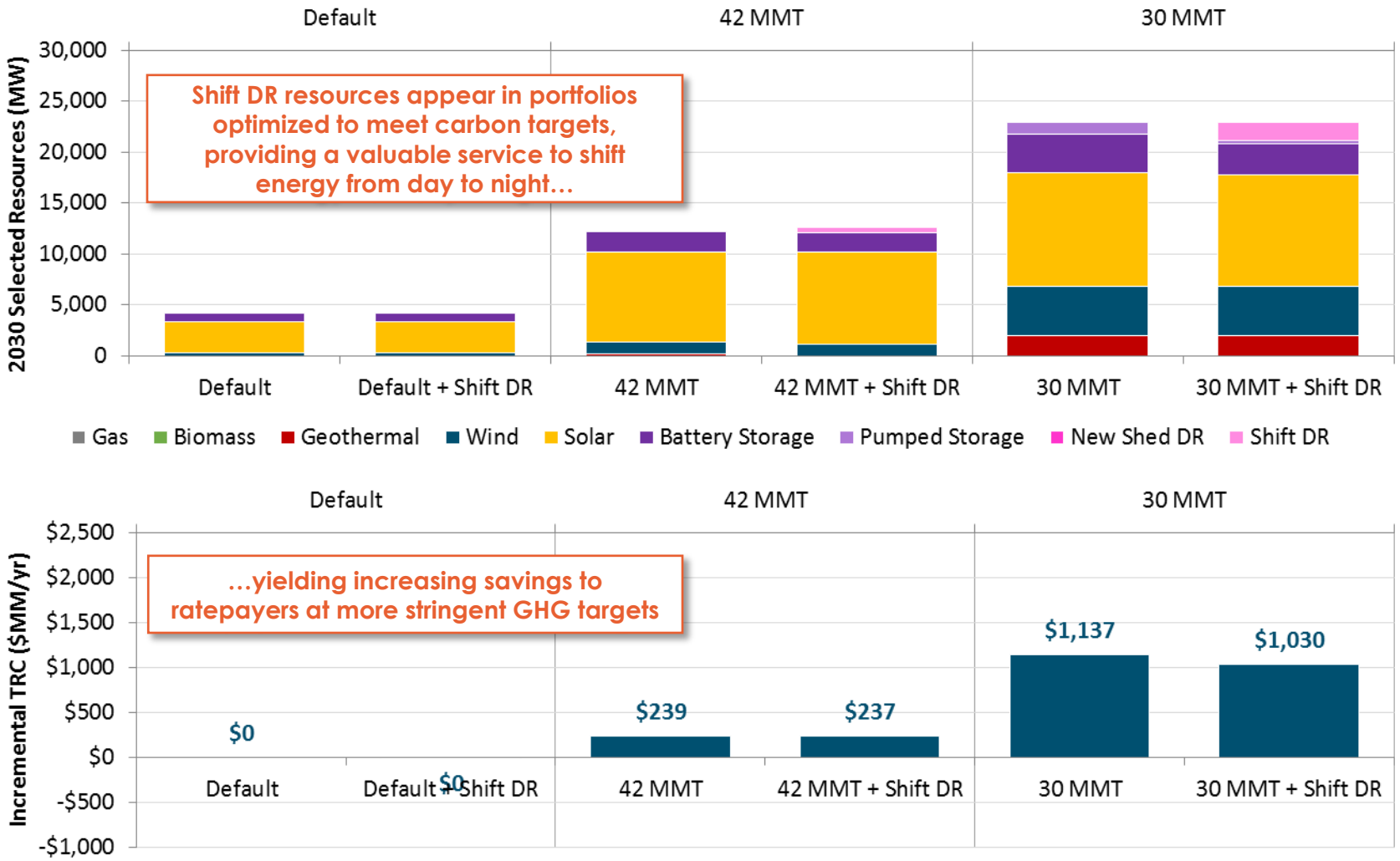
- Clean firm resources could reduce resource build-out needs by 50% or more by 2045 to fully decarbonize the grid.
- Without clean firm power, the CAISO system would need a renewables build-out equivalent to half the existing generation capacity of the entire United States.

Source: Brookings Institution, CATF, E3, EDF, Stanford University, Princeton University, UC San Diego. "California Needs Clean Firm Power, and so Does the Rest of the World." *Issues in Science and Technology*." 2021.

Promising Emerging Technology Types: Clean Firm Generation, Long-Duration Storage

- Different technology types provide different grid services, reducing need for renewables overbuild in different ways.
- Generation
  - High-capacity factor "baseload" firm resources: High capital costs, low fuel costs
    - Example: Enhanced geothermal systems, small modular nuclear reactors
  - Mid-capacity factor "load following" firm resources: Mid capital costs, mid fuel costs
    - Example: Natural gas w/ CCS, bioenergy w/ CCS,
  - Low-capacity factor "peaking" firm resources: Low capital costs, high fuel costs
    - Example: Zero carbon fuels
- Long Duration Storage
  - Multi-day storage
    - Adiabatic compressed air energy storage, long-duration iron-air battery
  - Seasonal storage
    - Examples: Hydrogen, synthetic natural gas

Promising Emerging Technology Types: Load Flexibility/Shift DR



- A 2017 IRP study found:
- At less stringent GHG targets, renewable balancing challenges are not significant enough to justify payments to flexible loads
  - Limited renewable integration challenges
- At more stringent targets, balancing challenges become significant enough to incent addition of flexible loads to the system
  - More frequent renewable curtailment creates more value to incent shifting of loads

IRP Timelines for Incorporating R&D Data

- IRP typically updates its inputs and assumptions (I&A) for modeling at the start of each IRP cycle
- Updates can include:
  - The addition of new "candidate resources" eligible for selection in capacity expansion modeling
  - Changes in the projected cost of candidate resources
  - Changes to the operational characteristics of candidate resources
  - Other
- The IRP team is collecting input data now (Q4 2021) and will continue in Q1-Q2 2022. The next I&A is projected to be finalized by May 2022
- The next juncture for updating I&A may be in early 2024

Conclusion

- The CPUC's IRP proceeding is California's key decision-making venue for long-term decarbonization planning and procurement
- California is on track for ~90% grid decarbonization, but the technological and economic barriers to full decarbonization remain high
- Key emerging technology types that can better enable a cost-effect trajectory toward full decarbonization include:
  - Clean firm generations
  - Long-duration storage
  - Shift DR/load flexibility
- IRP's modeling "inputs and assumptions" updates toward the start of each cycle are a key juncture for incorporating new data about emerging technologies
- IRP needs reliable information about resource potential, cost, and operating characteristics