BRIEF # 8

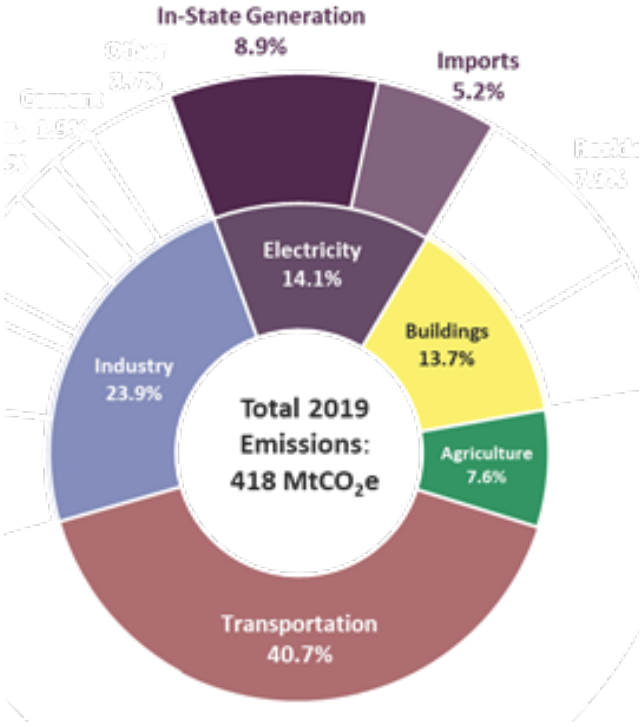
PATHWAYS TO CARBON NEUTRALITY IN CALIFORNIA

Decarbonizing the Electricity Sector

Stanford
Center for Carbon Storage
Carbon Removal Initiative

This brief discusses key findings from the following report: Ejeong Baik and Sally M. Benson, "Pathways to Carbon Neutrality in California: Decarbonizing the Electricity Sector", Stanford Center for Carbon Storage and Stanford Carbon Removal Initiative, March 2022.

California has goals to reach net-zero emissions economy-wide by 2045, and a clean grid and electrification of the transportation, industrial, residential, and commercial sectors are critical components of meeting those goals. Electrifying such a large share of the economy's energy usage has the potential to increase electricity load and the associated grid size to an unprecedented size. Several technologies including but not limited to clean firm resources, flexible loads, or negative emissions resources can help reduce the cost of decarbonization as well as the overall size of the grid. However, the challenges and costs of decarbonization do not scale linearly with the size of the grid -- larger grids are more expensive to decarbonize. If California is going to rely heavily on electrification, then planning for the decarbonization of a larger grid will be critical to ensure timely decarbonization of not only the electricity sector, but also the economy as a whole, in an affordable and reliable manner. Recognizing the challenges and preparing for them will also help California stay ahead as a leader in climate action.



Adapted from CARB GHG Emissions Inventory (2021)

KEY FINDINGS

1. The future electricity load is a significant driver of overall system costs. The size of the future grid will likely drive the total costs, regardless of the pathway chosen for decarbonization.

2. The system cost of a grid does not scale linearly with the load size, meaning larger grids are more expensive on a $/MWh basis relative to smaller ones.

3. For future systems that only expand intermittent generation resources with shorter duration energy storage (<10 hours), curtailment and overbuild will likely be a challenge, and the challenge increases with higher electricity load.

4. The choices we make in technology options and pathways have a much larger impact for systems with higher electricity loads than smaller ones.

5. Diversifying generation resources is the most effective way to reduce system generation capacity.

6. PV and energy storage will be the mainstays of California's future energy system and experience the most growth in capacity relative to all other technologies.

7. Gas generation will be needed for reliability in California's energy mix through 2040.

8. By 2045, a clean source of dispatchable generation will be needed to maintain reliability.

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