Climate, Here and There, Pt 1, California SB 100 Progress

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1. Introduction

It is very important to most Californians (including your author) that we meet our environmental progress goals. I believe the reasons that we typically exceed our goals is that we monitor them closely, and a large majority of stake-holders are heavily involved. An example of this is section 2 in a recent post described and linked below:

PV and Storage Late Spring 2022: *Section 2 of this post presented a roadmap to decarbonization composed by a major California Utility and others.*

https://energycentral.com/c/cp/pv-and-storage-late-spring-2022

This paper is a summary of the report referenced at the end of this paragraph. *The 100 Percent Clean Energy Act of 2018 (Senate Bill 100, 2018) is a landmark policy that establishes a target for renewable and zero-carbon resources to supply 100 percent of retail sales and electricity procured to serve all state agencies by 2045. The bill also increases the state's Renewables Portfolio Standard (RPS) to 60 percent of retail sales by December 31, 2030 and requires all state agencies to incorporate these targets into their relevant planning.*[1]

The statute calls upon the California Public Utilities Commission (CPUC), California Energy Commission (CEC), and the California Air Resources Board (CARB) to use programs under existing statutes to achieve this policy and issue a joint policy report to the Legislature by January 1, 2021, and every four years thereafter.

Near zero-greenhouse gas (GHG) electric power is central to decarbonizing any modern economy. Since California has a head-start in moving to near-zero carbon power (in 2020 55% of our power came from near-zero carbon sources[2]), we should be the first to move to net-zero for our electric generation, and then move on to decarbonize the rest of our economy. This would provide other economies with methods to repeat this process.

2. Benefits of 100 Percent Clean Electricity

In addition to serving as a central policy in the state's efforts to address climate change, successful implementation of SB 100 can benefit residents across the state by:

2.1. Improving Public Health

Implementing SB 100 is expected to reduce criteria air pollution emissions as renewable and zero-carbon resources replace fossil fuel in generating electricity. Today, more than 28 million Californians live in areas that exceed the federal health-based standards for ozone and fine particulate matter (PM2.5). Disadvantaged communities will reap the highest health benefits from the phase out of fossil fuels in generating electricity; half of the state's natural gas power plants are in communities that rank among the 25 percent most disadvantaged.

[1] Liz Gill, Aleecia Gutierrez and Terra Weeks, California Energy Commission, "2021 SB 100 Joint Agency Report," March 2021, https://www.energy.ca.gov/sb100

[2] "Intermittency Compatibility Toolkit, Part 1," Dec 2021, https://energycentral.com/c/gr/intermittency-compatibility-toolkit-part-1

The public health benefits are expected to grow substantially throughout the state as the transition from fossil fuels to clean electricity accelerates in transportation and buildings. Increased conversion of cars, trucks, and buses, as well as home appliances to electric technologies can improve health and reduce mortalities associated with air pollution across the state.

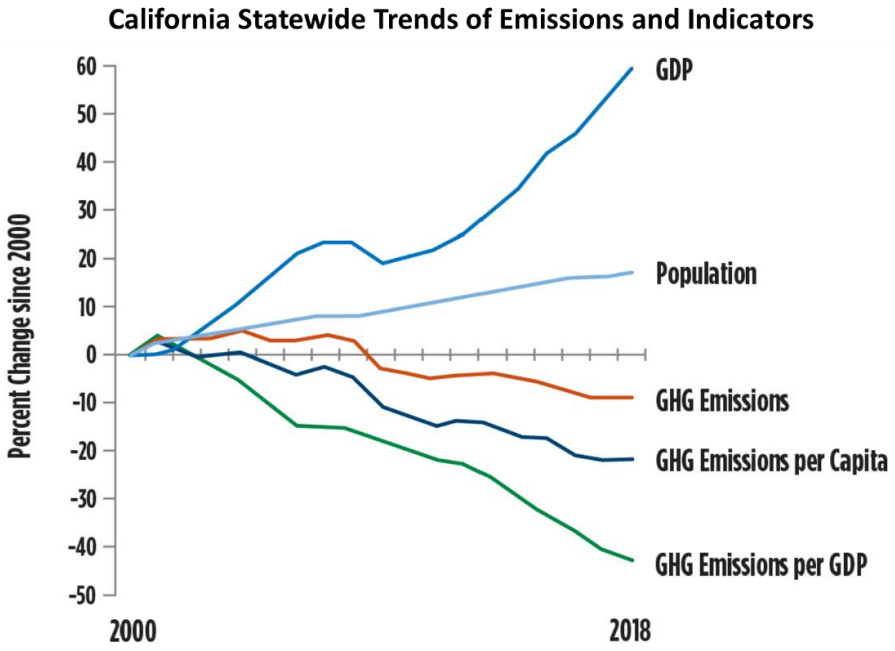
2.2. Advancing Energy Equity

The joint agencies are committed to ensuring the benefits of cleaner, more efficient energy are enjoyed by all Californians, including those in low-income and disadvantaged communities, as well as tribal and rural communities. To ensure equitable outcomes, SB 100 will need to be implemented in ways that help these communities overcome barriers to clean energy, including:

- *Keeping electricity affordable, with an emphasis on vulnerable populations and households that pay a disproportionately high share of their household income on energy.*
- *Reducing air pollution from local power plants, particularly in communities that experience a disproportionate amount of air pollution.*
- *Strengthening communities' ability to function during power outages and enjoy reliable energy in a changing climate.*
- *Funding of training for high-quality jobs and careers in the growing clean energy industry.*

2.3. Supporting a Clean Energy Economy

As a clean energy leader boasting one of the world's largest economies, California has shown that economic growth and environmental protection are not mutually exclusive. For decades, the state has reduced GHG emissions while growing its economy at a rate that has consistently outpaced the U.S. national average (see chart below).

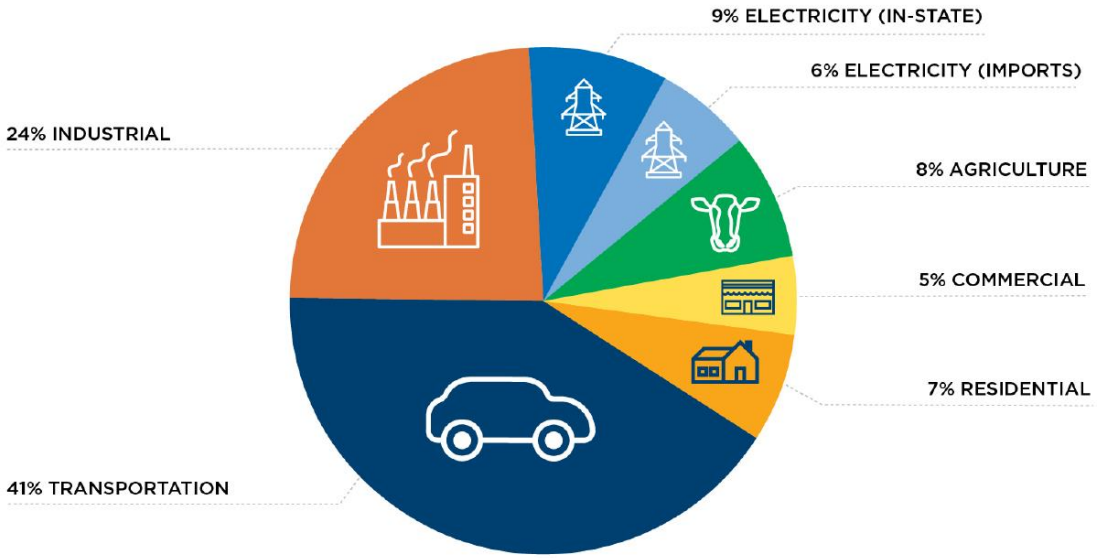


California's policies have spurred innovation and created markets for renewable energy, energy efficiency, energy storage, low-carbon fuels, and zero-emission vehicles. The state is a leader in patent registrations across all major clean technology (cleantech) categories and California's companies have received more than 50 percent of all U.S. venture capital investment in cleantech.

3. Electric Power First

Successful implementation of SB 100 alone will not achieve statewide carbon neutrality, but it is pivotal to the success of California's climate-fighting efforts that collectively can reach the target. A clean electricity grid can serve as a backbone to support the decarbonization of transportation, buildings, and some industries. Together, with the electricity sector, these sectors account for 92 percent of the state's GHG emissions.

California GHG Emissions by Sector



SB 100 sits within a portfolio of related key clean energy efforts to reduce climate and air pollution emissions while maintaining a reliable and affordable electric grid. These efforts include:

3.1. Transportation Electrification

While the transportation sector remains among the state's biggest decarbonization challenges, California has already positioned itself as a leader in clean transportation with more than 566,000 zero-emission vehicles (ZEVs) on the road and nearly half of the total U.S. ZEV sales. Building on this success, Governor Gavin Newsom issued an executive order in September 2020 requiring all new passenger car and truck sales to be zero-emission by 2035. This transformation will require close coordination and planning across the electric and transportation sectors.

3.2. Building Decarbonization

The construction of and conversion to zero-emission buildings has rapidly emerged as a key decarbonization strategy in recent years. State agencies are assessing pathways to

reduce emissions from this important sector and considering implications of migrating more building energy uses, such as space and water heating, to the electric grid.

3.3. Energy Efficiency

Prioritizing cost-effective energy efficiency measures remains critical as the state moves toward 100 percent clean electricity. Taking steps to reduce energy demand can offset the need for additional generation capacity, saving customers money while reducing land-use and other environmental impacts associated with the construction of new generation facilities.

3.4. Load Flexibility

Load flexibility — the ability to shift electricity consumption to other parts of the day — is critical to supporting grid reliability, especially in a high-renewables future, and reducing the total cost of the electric system. The state has efforts underway to research and implement a variety of load flexibility applications.

3.5. Research and Innovation

Given the urgency of achieving an electricity system powered by renewable and carbon-free electricity, continued prioritization of research and development of new and more cost-effective solutions is imperative. State agencies are also working to ensure these investments benefit all Californians.

4. Report Findings

The analysis for this report used the RESOLVE California model, a capacity expansion model developed by Energy and Environmental Economics, Inc. (E3). The RESOLVE model produces a least-cost resource portfolio, given policy and reliability constraints. The modeling inputs and assumptions build upon previous state efforts, including the CPUC's Integrated Resource Planning (IRP) 2045 Framing Study, and were informed through public and stakeholder comments.

The analysis examines estimated resource requirements and cost impacts of various SB 100 implementation pathways. Although capacity expansion is an important tool, it is just the first step in a series of modeling phases to develop reliable portfolios that meet all applicable policy objectives. Further analysis is needed to evaluate topics such as reliability and land use and better reflect equity, workforce, and additional planning and implementation considerations.

4.1. Zero Carbon Resources

SB 100 does not define "zero-carbon resources," and the state had no legal definition prior to the bill becoming law. For modeling, the joint agencies interpreted "zero-carbon resources" to mean energy resources that either qualify as "renewable" in the most recent Renewables Portfolio Standard (RPS) Eligibility Guidebook[3] or generate zero greenhouse gas emissions on site.

[3] Christina Crume and Lynette Green, California Energy Commission, "Renewables Portfolio Standard Eligibility Guidebook, Ninth Edition Revised," Jan 2017, https://www.energy.ca.gov/programs-and-topics/programs/renewables-portfolio-standard

Only commercialized technologies with vetted and publicly available cost and performance data and an anticipated pipeline of development were included for the core scenarios. Moreover, the joint agencies excluded energy resources from some or all scenarios if the use of these resources would have significant negative effects on public health or the environment or were otherwise at odds with state policies and priorities. Excluded technologies may be included in future SB 100 analyses if assessments change. Staff will update modeling as emerging technologies become commercialized.

The generation resources used in the model are defined in the table below. The core scenario includes retail sales and state loads; high electrification demand; all candidate resources available. The study scenarios are exploratory analyses that examine outcomes outside the scope of the joint agencies' interpretation of the SB 100 policy.

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 (using green hydrogen)	RPS	Core and Study
Small Hydro (existing only)	RPS	Core and Study
Large Hydro (existing only)	Zero-Carbon	Core and Study
Nuclear (existing only)	Zero-Carbon	Core and Study
Generic Firm Dispatchable Resource	Zero-Carbon	Study Only
Generic Firm Baseload Resource	Zero-Carbon	Study Only

The Report goes into much detail on the modeling process with many charts, etc. If these are important to a particular reader, it is suggested that they upload the full report (Reference 1), and review these.

4.2. Key Takeaways from Modeling

4.2.1. SB 100 Is Achievable

Initial analysis demonstrates that SB 100 is technically achievable, though additional analysis is needed to evaluate reliability and other factors more comprehensively. The preliminary modeling in this report suggests the total resource cost of achieving SB 100 is about 6 percent higher than a 60 percent RPS future in 2045. This cost may be lower if the cost trends for renewables continue to fall faster than projections. Cost reductions and innovation in zero-carbon technologies, as well as load flexibility and energy storage development, can further reduce implementation costs.

4.2.2. Very High Build Rates Will Be Required to Meet SB 100

The need for a significant amount of new electric generation resources is driven by the 100% clean electricity target and increasing electricity demand to achieve economy-wide decarbonization. The projected record-setting resource development rates needed, have implications for workforce needs, land-use planning, technology supply chains, and regulatory and permitting processes that must be considered for implementing SB 100 successfully.