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California's Experience With Decentralized Clean Energy Systems: An Overview of State and Local Policies

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California's Experience With Decentralized Clean Energy Systems: An Overview of State and Local Policies

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Abstract: California's electricity sector is rapidly transitioning from a fossil-fuel based system to a renewable-energy based system. Decentralized clean energy systems, including distributed generation (DG) of renewable electricity, play an important role in this transition. California's goal is to install 12,000 megawatts of renewable DG capacity by 2020, of which almost 9,400 megawatts are already operating or installed. Other decentralized energy systems include energy efficiency, energy storage, electric vehicles, and demand response. This paper provides an overview of state and local policies promoting decentralized clean energy systems in the context of California's overall clean energy and climate goals.

Key words: Energy decentralization, distributed generation, renewable energy, California, microgrids, community choice aggregation

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AB Assembly Bill
CAISO California Independent System Operator
CARB California Air Resources Board
CCA Community Choice Aggregator
CEC California Energy Commission
CPUC California Public Utilities Commission
DER Distributed Energy Resources
DG Distributed Generation
DR Demand Response
GDP Gross Domestic Product
GHG Greenhouse Gas
IOU Investor Owned Utility
MCE Marin Clean Energy
MW Megawatts
NEM Net Energy Metering
NGO Nongovernmental Organization
PACE Property Assessed Clean Energy
POU Publicly Owned Utility
PV Photovoltaic
RPS Renewables Portfolio Standard
SB Senate Bill
SGIP Self-Generation Incentive Program
U.S. / USA United States of America

1.0 Introduction

California law sets a renewable electricity target of 33% by 2020, increasing to 50% by 2030, and also requires reduction in statewide greenhouse gas emissions to 40% below 1990 levels by 2030. (SB 350; SB 32) To help achieve these ambitious goals, California has established multiple laws and policies to accelerate deployment of decentralized clean energy systems, including distributed renewable energy generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies. California law refers to these decentralized clean energy systems as Distributed Energy Resources (DER). (AB 327) At the local level, counties and cities are also adopting laws and policies to accelerate the deployment of decentralized clean energy systems, or DER.

State leaders view DER as important for achieving California's clean energy, climate, and economic development goals. For example, the Clean Energy Jobs Plan released by Governor Edmund G. (Jerry) Brown, Jr. calls for the installation of 12,000 megawatts (MW) of renewable distributed generation (DG) by 2020. (Brown, 3) Renewable DG systems include solar, small hydro, biomass, wind, and geothermal projects of 20 MW or less which can operate both for self-generation and for providing energy to the market. (CEC Tracking Progress: Renewables, 4) By October 2016, almost 9,400 MW of renewable DG capacity were operating or installed in California. (Id.) Progress towards California's renewable DG goal has been achieved through a dynamic combination of state and local policy mechanisms and engagement with the private sector including energy suppliers and consumers, industry associations, university research centers, and environmental and social justice nongovernmental organizations.

In addition to helping the state achieve its clean energy and climate goals, decentralized clean energy systems support a range of economic and environmental public policy objectives

including job creation, energy security, reduction of the public health impacts of fossil fuel pollution, and avoidance of transmission and distribution line losses and infrastructure costs. In fact, distributed generation of renewable electricity is already playing a key role in the state's economy. California led the nation with 100,050 solar jobs in 2016. (Solar Foundation)

Significant achievements of California's clean energy policies include the following:

- California's three largest investor owned utilities achieved 32.3% renewable energy in 2016 (CPUC Cost Report, 8), and in May 2017, the grid achieved a new intraday record when it surpassed 67% renewable energy (Fracassa). Both of these figures exclude large hydro.

- Nearly 610,000 residential and commercial self-generation solar projects totaling almost 5,100 MW have been installed in California. (CEC 2016 IEPR Update, 23)

- Clean energy policies, including policies to promote DER, have helped reduce the electricity sector's greenhouse gas emissions to below 1990 levels while California's economy and population have grown. (Id., 2).

- Energy efficiency measures have saved Californians billions in reduced electricity bills, and California's per capita electricity use has remained flat over the last 40 years while the rest of the nation's continues to rise. (NRDC, 1)

California thus offers a model for how a subnational government can achieve ambitious clean energy goals primarily through state-level policymaking and close coordination with local governmental units (counties and cities) and the private sector.

2.0 Overview of California's Electricity System

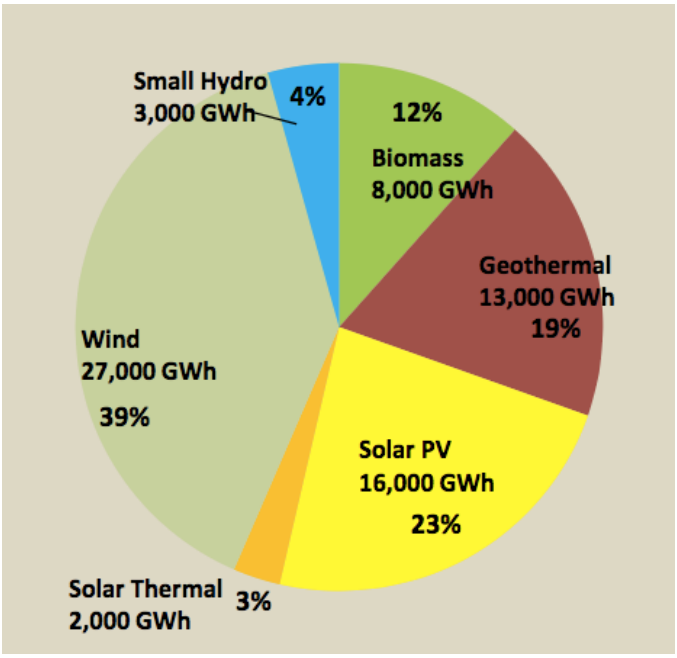
California is the most populous state in the U.S. with an estimated population of 39.3 million in 2016. (BEA, 1) Its economy as measured by gross domestic product (GDP) was $2.5 trillion in 2015, making it the largest economy in the U.S. and the sixth largest in the world. (DOF, World Bank) California's policies to promote energy efficiency have resulted in one of the lowest per capita total energy consumption levels in the country, and California is among the top states in the nation in renewable electricity generation: California ranks first in the nation in net electricity generation from solar, geothermal, and biomass and fourth in the nation in hydroelectric power and wind generation. (EIA)

2.1 Statistical Summary and Trends

California's main renewable energy law—the Renewables Portfolio Standard—sets a renewable electricity target of 33% by 2020, increasing to 50% by 2030. (SB 350) In 2015, California's electricity system totaled 295,405 gigawatt hours, of which approximately 22% came from eligible renewable resources including solar, wind, small hydro, biomass, and geothermal. (Appendix D, CEC Total System Electric Generation) Other sources of electricity included natural gas (44%), nuclear (9.2%), coal (6.0%), large hydro (5.4%), and unspecified imports (13.5%). (Id.) The 2015 data include in-state power plants with capacity greater than one MW as well as electricity imports. Since these data do not include power facilities of less than one MW, thousands of in-state DG projects are not reflected in these statistics.

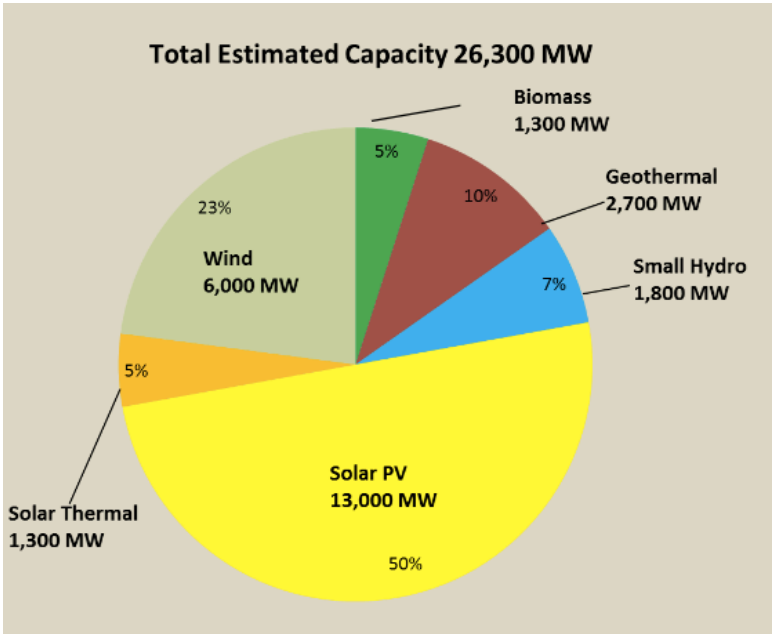
In 2016, California's three largest utilities reported that they collectively procured 32.3% of their electricity from eligible renewable resources (CPUC Cost Report, 8). Figure 2.1 shows 2016 generation from renewable facilities serving California, and Figure 2.2 shows in-state renewable capacity by resource type.

Figure 2.1:
2016 Generation From Renewable Facilities Serving California



Source: CEC Tracking Progress: Renewables, 2

Figure 2.2
2016 In-State Renewable Capacity by Resource Type, Includes Self-Generation



Source: CEC Tracking Progress: Renewables, 3

2017 has already been a record-breaking year for renewables in California. On May 13, 2017, the main California grid set a new intraday record when it achieved 67% renewable penetration from resources such as solar, wind, small hydro, biomass, and geothermal. (Fracassa) Overall on that day, 42% of California's electricity demand was served by renewables (not including large hydro) as shown on Figure 2.3. (CAISO Daily Renewables Watch)

2.2 Transmission and Distribution System

(a) ***California Independent System Operator (CAISO):*** The CAISO is a nonprofit public benefit corporation that manages the flow of electricity across a network of high-voltage, long-distance power lines that make up 80% of California's grid. This transmission system delivers wholesale electricity to utilities for distribution to 30 million customers. CAISO also operates a competitive wholesale power market. "Every five minutes, CAISO forecasts electrical demand and dispatches the lowest cost generator to meet demand while ensuring enough transmission capacity for delivery of power." (CAISO Our Business) The CAISO plays a vital role in integrating increasing amounts of renewables and other DER such as energy efficiency and demand response into the grid. Aggregators of DER can participate in the ISO market and provide energy and ancillary services. (CAISO Distributed Energy)

(b) ***Utilities:*** California's utilities include investor-owned utilities (IOUs) and publicly owned utilities (POUs). IOUs are private electricity and natural gas providers overseen by the California Public Utilities Commission (CPUC). The three largest IOUs – Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison – provide approximately three quarters of California's electricity supply. There are also more than 40 POUs in California that account for approximately a quarter of the state's electricity supply. POUs include municipal districts, city departments, irrigation districts, and rural cooperatives. (CEC Differences)

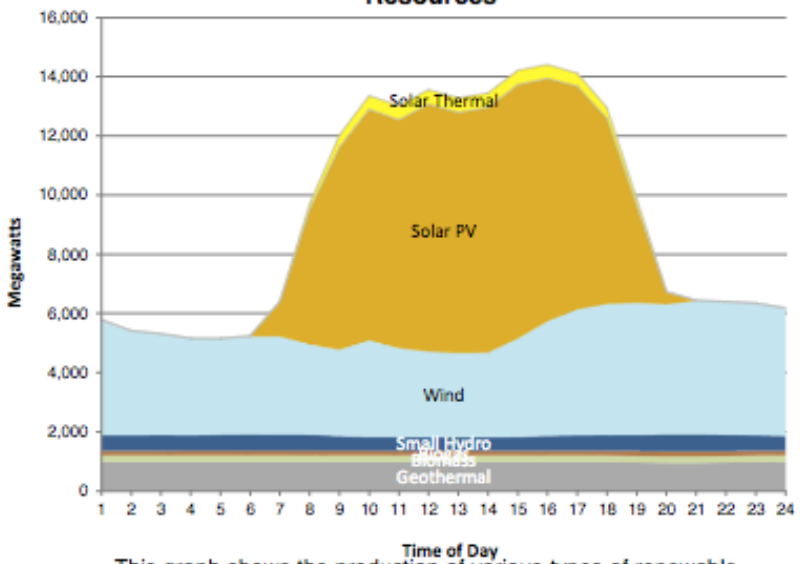
Figure 2.3:
Renewables Production (California ISO Grid)
Saturday, May 13, 2017

24-Hour Renewables Production

Renewable Resources	Peak Production Time	Peak Production (MW)	Daily Production (MWh)
Solar Thermal	12:15	494	5,032
Solar	14:45	8,669	86,902
Wind	20:27	4,576	87,068
Small Hydro	20:37	605	12,643
Biogas	19:24	154	3,575
Biomass	9:52	244	5,754
Geothermal	6:46	978	23,282
Total Renewables			**224,256**
Total 24-Hour System Demand (MWh):			*534,956*

This table gives numeric values related to the production from the various types of renewable resources for the reporting day. All values are hourly average unless otherwise stated. Peak Production is an average over one minute. The total renewable production in megawatt-hours is compared to the total energy demand for the ISO system for the day.

Hourly Average Breakdown of Renewable Resources



This graph shows the production of various types of renewable generation across the day.

System Peak Demand (MW) **26,120**
*one minute average

Time: **20:36**

Source: CAISO Daily Renewables Watch

2.3 State Energy Agencies

The state's energy agencies play an essential role in planning and developing rules and policies for integrating DER. The three main energy agencies are: (i) the California Public Utilities Commission (CPUC), which regulates investor-owned electric and gas utilities in the state; (ii) the California Energy Commission (CEC), which is the state's primary energy policy and planning agency; and (iii) the California Air Resources Board (CARB), which is the primary agency implementing AB 32, California's greenhouse gas reduction law. CARB also oversees the states Zero Emission Vehicles program.

3.0 California's Goals for Decentralized Clean Energy Systems

As noted above, California law refers to decentralized clean energy systems including energy efficiency and demand response technologies, distributed renewable energy generation resources, energy storage, and electric vehicles as Distributed Energy Resources. (AB 327) Table 3.1 shows California's goals for these technologies.

Table 3.1:
California's Distributed Energy Resource Goals

Distributed Energy Resource	Goal	Law and/or Policy Document
Energy Efficiency & Demand Response	Double statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030.	SB 350; CAISO Demand Response & Energy Efficiency Roadmap
Renewable DG	Add 12,000 MW of renewable DG in California by 2020	Governor Brown's Clean Energy Jobs Plan
Energy Storage	Add 1,325 MW of utility-scale energy storage by 2020; Provide rebates for distributed (behind-the-meter) energy storage systems	AB 2514; SGIP
Transportation Electrification	Deploy 1.5 million Zero Emission Vehicles in California by 2025	Executive Order EO-B-16-12; CARB ZEV Action Plan; CAISO VGI Roadmap

4.0 Types of Policy Mechanisms

Types of policy mechanisms employed by California state and local government entities include legislation, regulation, executive orders, job creation & economic development plans, procurement policies, industry standards, financial incentives (e.g., grants, loans, rebates, tax credits), public-private partnerships, voter referenda (ballot initiatives), utility programs, and technology roadmaps. California law generally provides that public policy making must be transparent and involve the public through notice and comment processes. In addition, many technical and policy workshops led by energy agencies are open to the public.

5.0 Overview of State Laws and Policies Relating to Decentralized Clean Energy

5.1 Loading Order – California's Energy Policy Framework

California's overarching energy policy framework is called the "Loading Order." The state's main energy agencies set forth the loading order in California's 2003 Energy Action Plan, which was developed during a severe energy crisis to guide future energy planning decisions. The loading order has two parts:

(1) Decrease electricity demand through energy efficiency and demand response, then

(2) Meet new generation needs, first, with renewable and distributed generation resources and, second, with efficient natural gas generation.

In 2012, the CPUC confirmed that utilities have an ongoing obligation to follow the Loading Order even if their renewable procurement targets have been achieved.

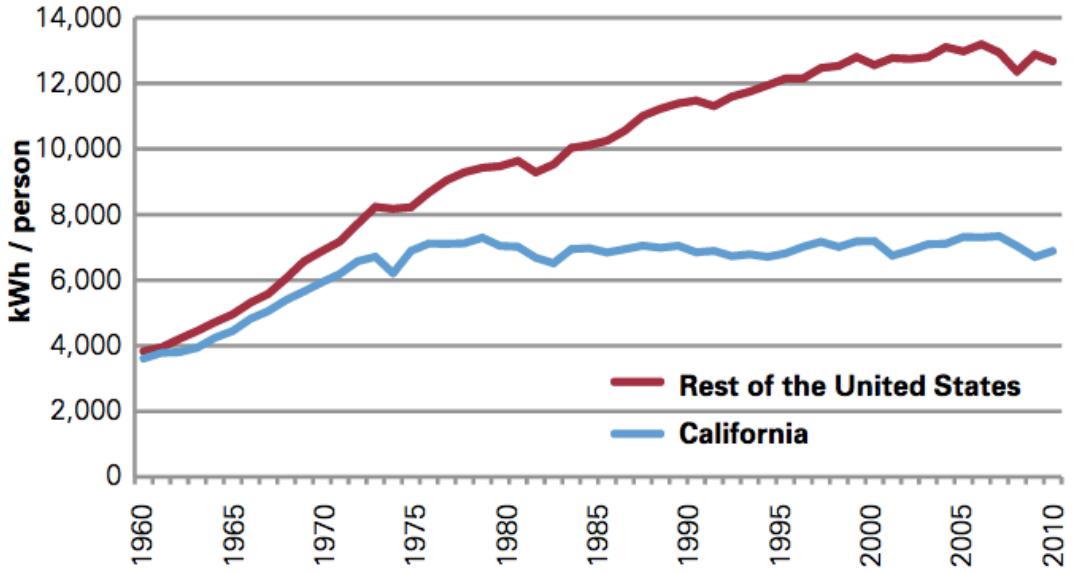
This remainder of this section summarizes state laws and policies relevant to the deployment of specific types of decentralized clean energy systems, including energy efficiency and demand response programs; renewable distributed generation programs; grid integration; and emerging decentralized clean energy technologies (storage, electric vehicles, and microgrids).

5.2 Energy Efficiency and Demand Response

The first element of the Loading Order is energy efficiency. In some markets in the U.S. and worldwide, utilities resist energy efficiency measures because they reduce sales. California addressed this issue by implementing a "decoupling" policy, which delinks utility sales from profits, thereby removing the disincentives for utilities to promote energy efficiency and conservation. Decoupling ensures that utilities retain their expected earnings even as energy efficiency programs reduce sales. By breaking the link between the utility's sales and profits, decoupling creates an incentive for utilities to focus on energy efficiency. (California's Decoupling Policy)

California's energy efficiency policies, particularly building codes and appliance standards, have saved consumers billions of dollars in electricity bills since the 1970s. (CEC Energy Efficiency, 1; NRDC, 1) By conserving electricity and natural gas, these codes and standards have also avoided the need to build more power plants. These energy efficiency policies have played a significant role in keeping California's per capita electricity use flat over the last 40 years while the rest of the country's use increased significantly. (Figure 5.1) These successful energy efficiency efforts help explain why California's average residential electricity bills are lower than other states, despite higher-than-average electricity rates. (NRDC, 1)

Figure 5.1:
California Per Capita Electricity Consumption vs. Rest of U.S.



Source: NRDC based on data from the U.S. Energy Information Agency

In 2007, the CPUC adopted the aspirational goals that all new residential construction in California will be zero net energy (ZNE) by 2020, and all new commercial construction in California will be ZNE by 2030. (CPUC California Long Term Energy Efficiency Strategic Plan, 6) Although these goals are not legally enforceable mandates, they have guided and informed state energy planning and policymaking. ZNE goals have also influenced the development of updated building codes: In 2015, the state took a major step toward ZNE by strengthening the building efficiency standards for new residential construction. (Waltner)

SB 350, which increased California's RPS to 50%, also requires relevant state and local agencies to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses by January 1, 2030. The building sector will be a major focus for achieving this energy efficiency 2030 target since commercial and residential buildings

account for nearly 70% of California's electricity end-use consumption, 55% of its natural gas end-use consumption, and over 26% of California's total greenhouse gas emissions (CEC Energy Efficiency, 3)

For more than a decade, utility demand response (DR) programs, in which consumers agree to reduce or shift their electricity usage during peak periods in response to time-based rates or other forms of financial incentives, have offset the need for additional peaking generation. DR programs also have significant potential to provide ancillary services such as regulation and load following which enables grid operators to incorporate higher amounts of intermittent, or variable, renewable energy such as wind and solar. (Mathieu et al.) CAISO envisions aggregated energy efficiency and DR systems "contributing to the low-carbon, flexible capacity needed to maintain real-time system balance and reliability supporting the integration of renewable energy." (CAISO Demand Response, "ISO Vision")

5.3 Renewable Distributed Generation

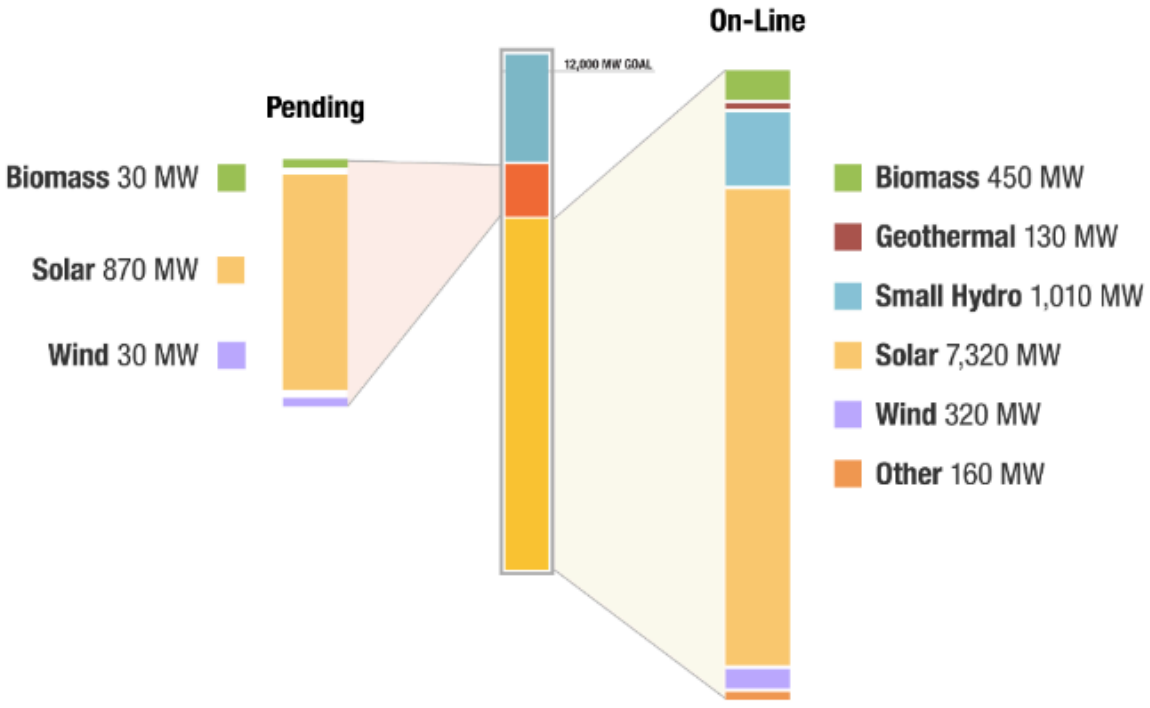
In 2011, Governor Brown's Clean Energy Jobs Plan set a goal of adding 12,000 MW of renewable DG by 2020. The CEC defines DG as "projects that are 20 MW or smaller – including both self-generation and projects that generate energy for the market." (CEC Renewable Energy, 4) As of October 2016, almost 9,400 MW of renewable DG capacity was operating or installed in the state (Figure 5.2), more than half of which consists of solar self-generation capacity. (Id.)

California leads the nation in solar DG installations. In 2016, nearly 610,000 residential and commercial self-generation solar projects totaling almost 5,100 MW were installed in California. Residential installations in California account for more than 40% of all solar PV installed in the U.S., and nonresidential installations account for 50%. (CEC 2016 IEPR Update, 23) Figure 5.3 shows the growth in solar DG installations within service territories of the three

largest IOUs. The CEC in December 2016 reported: "Assuming all pending and additional authorized capacity is successfully installed, California is already on a trajectory to exceed the 12,000 MW goal." (CEC Renewable Energy, 4)

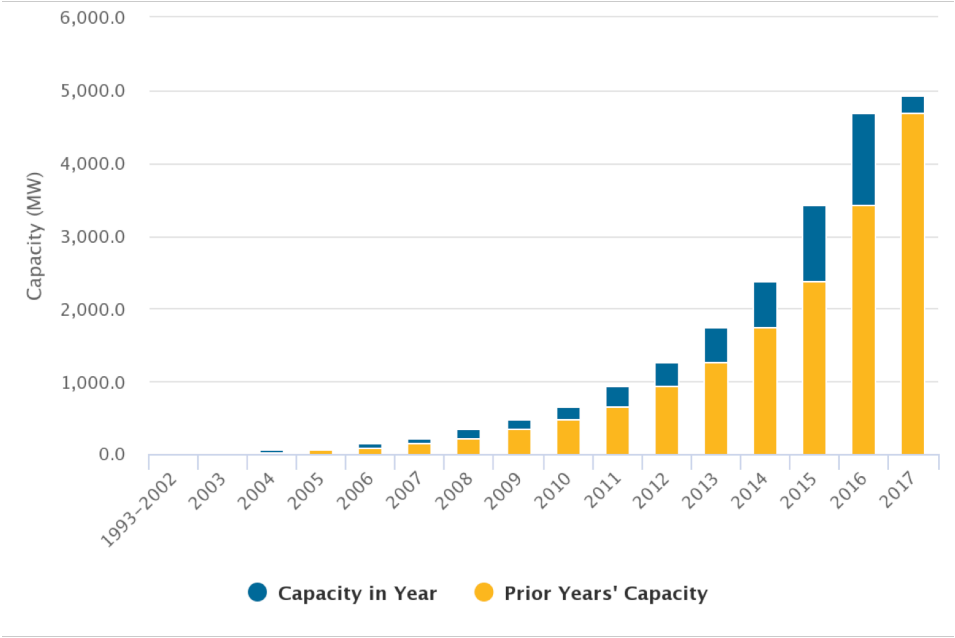
California legislators, regulators, and utilities have offered multiple incentive programs to encourage installation of DG technologies, including solar PV, solar hot water, wind, batteries, and fuel cells. The major incentive programs are summarized on Table 5.1.

Figure 5.2:
Renewable Distributed Generation in California by Fuel Type
(20 MW or Smaller, Includes Self-Generation)



Source: CEC Renewable Energy, 5

Figure 5.3:
Interconnected Solar PV Installations in California (IOU Service Areas)
As of March 31, 2017



Source: California Distributed Generation Statistics

5.4 Grid Integration of Distributed Energy Resources

As California's electricity system evolves into a more decentralized system with thousands of small-scale DER systems, policymakers have been working with CAISO and the utilities to address integration challenges and optimize the grid benefits of DERs. For example, one of the major challenges for the transmission system is managing the impact of large quantities of new intermittent renewables, particularly utility scale solar, on net loads and ramping requirements. (CAISO Duck Curve) DER technologies such as demand response and energy storage offer solutions to these challenges. "Working with the industry and policymakers, the ISO is collaborating on rules and new market mechanisms that support and encourage the development of flexible resources to ensure a reliable future grid" that incorporates 50%

renewables. (Id. 4) On the utility side, AB 327 requires CPUC to work with the IOUs to prepare distribution resources plans for a future involving diverse DERs. The plan proposals will "identify optimal locations for the deployment of distributed resources." (CPUC Distribution)

5.5 Emerging Decentralized Clean Energy Technologies

State leaders recognize that California's ambitious goals for renewable energy, energy efficiency, and DG will require working closely with the private sector to commercialize and deploy new technologies. Three technologies are particularly relevant to successful deployment of DG at scale: (a) energy storage; (b) vehicle electrification; and (c) microgrids.

(a) ***Energy Storage:*** AB 2514, passed in 2010, required the CPUC to determine targets for each utility to procure viable and cost-effective energy storage systems. In 2013, the CPUC adopted an energy storage procurement framework and established an overall energy storage target of 1,325 MW for the state's large IOUs by 2020, with installations required no later than the end of 2024. In 2014, the CAISO, the CPUC, and the CEC developed an energy storage roadmap that identifies policy, technology and process changes to address challenges faced by the storage sector. The roadmap was developed with input from more than 400 stakeholders, including utilities, energy storage developers, generators, and environmental groups. (CAISO et al., Energy Storage Roadmap)

Recognizing the importance of the distributed energy storage market, CPUC in 2017 authorized US $196 million in new rebates for onsite (behind-the-meter) energy storage systems. (Orion and Florez) The new rebates are part of California Self Generation Incentive Program ("SGIP"). SGIP provides a financial rebate to energy customers who install new qualifying technologies that meet all or a portion of the customer's on-site electricity needs.

Table 5.1
California Distributed Generation Incentive Programs

Program Name	Description
Net Energy Metering	Net Energy Metering is a utility billing arrangement that provides credit to customers with DG systems (such as solar PV) for the full retail value of the excess electricity their system generates. The customer's electric meter keeps track of how much electricity is consumed by the customer and how much excess electricity is sent back into the electric utility grid.
California Solar Initiative	Created in 2006 by SB 1, the California Solar Initiative authorized financial incentives for various solar programs: • *General Market Program* to support installation of solar PV systems on existing residential properties. • *Solar Thermal Program* to support installation of 200,000 solar thermal systems in California homes and businesses. • *Low Income Solar Incentive Programs* to provide a minimum of 10% of overall CSI funds for installing solar PV on low-income properties, including multi-family affordable housing properties. • *New Solar Homes Partnership* to encourage construction of new, energy efficient solar homes.
Self Generation Incentive Program (SGIP)	SGIP was created in 2001 to provide financial incentives to support existing, new, and emerging DER technologies that meet all or a portion of the electric energy needs of a facility. Starting in 2017, 79% of SGIP incentive funds will be allocated to behind-the-meter energy storage projects.
Renewable Feed-In Tariff Program	The Renewable Market Adjusting Tariff is a feed-in tariff program for small renewable generators less than 3 MW in size. Up to 493.6 MW of capacity are available to eligible projects through a fixed-price standard contract to export electricity to California's three large IOUs. Electricity generated as part of the program counts towards the utilities' RPS targets.
Renewable Auction Mechanism	The Renewable Auction Mechanism program is a market-based procurement mechanism for renewable DG projects greater than 3 MW and up to 20 MW. IOUS may use the program to procure RPS eligible generation. The program streamlines the procurement process for developers, utilities, and regulators. It provides a simple standard contract for each utility, and allows all projects to be submitted to the CPUC through an expedited regulatory review process.

(Sources: California Distributed Generation Statistics; Go Solar California; CPUC Self-Generation Incentive Program; CPUC Renewable Feed-in Tariff (FIT) Program; CPUC Renewable Auction Mechanism Program)

(b) ***Vehicle Electrification:*** In 2012, Governor Brown ordered state agencies to facilitate the rapid commercialization of zero-emission vehicles (ZEVs). (EO-B-16-12) The order sets a target of 1.5 million ZEVs in California by 2025. CARB has primary responsibility for charting the policy pathway for achieving this target. (CARB ZEV Action Plan). The prospect of more than a million ZEVs charging in the state creates challenges as well as opportunities for the grid. In 2014, CAISO in collaboration with state energy agencies released a Vehicle Grid Integration Roadmap focused on enabling vehicle-based grid services. "Vehicle electrification presents an unprecedented opportunity through charging strategies and aggregation, to contribute to the reliable management of the power grid." (CAISO, VGI Roadmap, 1)

(c) ***Microgrids:*** A microgrid is an electricity distribution system consisting of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid.[2] A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode. Potential benefits of microgrids include: resiliency during natural disasters which may cause the primary grid to fail, cost savings, and opportunities to integrate high levels of renewables. CEC, CPUC and CAISO are developing a roadmap for the commercialization of microgrids in California. The roadmap's purpose is to:

- Identify the barriers and describe the actions necessary to facilitate commercialization of microgrids in California.
- Assess the regulatory, market, and technical barriers that may impede the widespread development of microgrids.
- Gather lessons learned from operational microgrids.
- Identify common use cases and a business case for microgrids.
- Identify the actions that the [CEC], CPUC, [CAISO] and others can take to enable greater development of microgrids.

(Gravely, 2)

[2] For other definitions of microgrids, see https://building-microgrid.lbl.gov/microgrid-definitions.

6.0 Empowering Local Governments with Enabling Legislation

State lawmakers have passed several laws enabling, but not requiring, local governments to take action in their own cities and counties to establish decentralized clean energy programs. For example, state legislation has enabled two highly successful local programs to flourish in communities throughout the state: Property Assessed Clean Energy and Community Choice Aggregators (described below). These programs have led to innovations at the local level that are providing models for statewide action. To coordinate the state and local policy making processes, the CEC's Electric Program Investment Charge Program is funding a project to identify environmentally preferred areas for distributed generation and analytical factors that can be applied for effective local distributed generation planning. "The proposed scope of work will pilot the inclusion of DER into energy planning at the local level in parallel with ongoing planning at the state level." (CEC 2016 IEPR Update, 56)

7.0 Overview of Local Laws and Policies Relating to Decentralized Clean Energy

7.1 Property Assessed Clean Energy (PACE)

PACE is a financing mechanism that enables low-cost, long-term funding for DG improvements to existing properties, such as energy efficiency retrofits, rooftop solar installations, and electric vehicle charging infrastructure. PACE loans cover 100% of the cost of the improvement and are repaid by property owners over 20 years as an assessment on the property tax bill. Depending on local authorizing legislation, PACE can be used for commercial, nonprofit and residential properties. PACE financing may stay with the building upon sale. State and local governments typically sponsor PACE financing to create jobs, promote economic development, and protect the environment. AB 811, passed in 2007, amended the state's laws to enable PACE financing for renewable energy and energy efficiency improvements to homes and

businesses. “Residential and commercial PACE has flourished in the state since then, financing over $2 billion for clean energy improvements throughout the state.” (PACENation PACE in California)

7.2 Community Choice Aggregators (CCAs)

CCAs are new governmental entities formed by cities and counties to serve the aggregated electricity demand (or “load”) of their local residents and businesses while the existing utility remains responsible for transmission, distribution, and billing. The state legislature facilitated development of CCAs by enacting AB 117, which was signed into law in 2002. CCAs can provide many environmental, social, and economic benefits to California communities by empowering consumers with the option to choose between energy providers (i.e., their existing utility or the CCA) and various renewable energy products. (CalCCA) For example, Marin County’s CCA offers consumers options of 50% renewable energy and 100% renewable energy. CCAs are giving California communities the power to make choices about energy resource portfolios and enabling communities to invest directly in local renewable generation projects that advance complementary economic, job creation, and social goals.

7.3 Standardized Local Ordinances for Renewable DG

One of the challenges facing renewable DG developers, property owners, and advocates is navigating local building, zoning, and permitting requirements, many of which were drafted before local energy generation became a statewide priority. To address these issues, the California County Planning Directors Association developed a Model Solar Energy Facility Permit Streamlining Ordinance, Model Renewable Energy Combining Zone Ordinance, and Solar Energy Facility Permit Streamlining Guide. (CCPDA)

7.4 100% Renewable Energy Goals

Five local government entities in California have pledged to move toward 100% renewable energy: Lancaster, Marin County, Palo Alto, San Diego, San Francisco, San Jose, Santa Barbara. (Go 100%) In 2016, the Los Angeles City Council ordered the Los Angeles Department of Water & Power to study how to move to 100% renewable energy. (Kelly)

7.5 Keep It in the Ground

"Keep It in the Ground" is a global movement to keep fossil fuels – oil, coal, and natural gas – in the ground and transition to 100% clean, renewable energy. In 2016, the San Francisco Board of Supervisors approved legislation prohibiting new fossil fuel leases on city-owned property. City officials found that converting the property to a solar array could generate more revenue than oil operations. (CBD) In 2013, Marin County became the first county in California to put a moratorium on fracking until the state could guarantee public health and safety. (Welte) Most recently, in November 2016, voters in Monterey County voted 55% to 45% to approve a ballot measure to ban fracking and restrict other oil & gas development activities in the county. In total, six California counties have banned or restricted fracking. (Cama)

7.6 Case Examples

a) ***City of Lancaster:*** Lancaster has the adopted the goal of becoming the nation's first net-zero city and is working to generate more clean energy than it consumes. The city's CCA, Lancaster Choice Energy, began providing power to customers in 2015. (Lancaster)

b) ***Marin County's CCA:*** Marin Clean Energy (MCE) is a public agency and not-for-profit electricity provider that gives customers the choice of having 50% to 100% of their electricity supplied from sources such as solar, wind, bioenergy, and hydroelectric at competitive rates. MCE was the first CCA program in the State of California. MCE emphasizes that: "By

choosing MCE, electric customers help support the development of new in-state and local renewable energy generation." (Marin Clean Energy)

c) ***City of Palo Alto:*** The City of Palo Alto, at the center of Silicon Valley, operates its own energy utility. It voluntarily adopted a RPS target in 2002 and is on track to exceed the state's 50% RPS level in 2017. The City is aggressively pursuing energy efficiency measures in order to reduce its total electricity consumption, and thus reduce the volume of renewable energy purchases that are needed to satisfy its RPS requirement. (Palo Alto) In 2013, the city adopted an ordinance requiring all new homes to be pre-wired for electric vehicle charging (Buczynski), an idea that is spreading to other cities.

8.0 Role of the Federal Government

U.S. federal energy policy plays a limited, yet important, role in California's renewable DG landscape. The primary means by which national policy interfaces with California's Renewable DG initiatives is through research and development funding and federal tax incentives for renewable energy and energy efficiency technologies. These funding programs are authorized by Congress and administered by agencies including the Department of Energy, Internal Revenue Service, Environmental Protection Agency, and Department of Defense. Tax credits for solar projects in particular have been critical to enabling the solar DG industry to scale up and reduce the costs of financing and installing solar systems.

In December 2015, the U.S. Congress and President Obama extended the expiration date for tax credits for solar technologies and also introduced a gradual step down in the credit value. A U.S. taxpayer may claim a credit of 30% of qualified expenditures for a solar-electric or solar water-heating system that serves a dwelling unit located in the U.S. that is owned and used as a

residence by the taxpayer. The credits start to step down after December 31, 2019 and phase out after December 31, 2021. (DOE Residential Renewable Energy Tax Credit)

9.0 Role of Nongovernmental Stakeholders

An important feature of California's energy policymaking is significant involvement from the private sector including industry stakeholders, university researchers, and environmental and social justice nongovernmental organizations (NGOs). Industry associations have been active in developing policies to help mainstream emerging technologies such as energy storage. University research centers, such as the Center for Law Energy and Environment at the University of California, Berkeley, work with government officials, industry leaders, and NGOs to identify barriers to decentralized energy systems and propose policy solutions. (CLEE) A large number of environmental and social justice NGOs have been championing clean, locally generated renewable energy for years. Activities include publishing reports, educating policymakers, and mobilizing public support for CCAs. (See, e.g., Local Clean Energy Alliance).[3]

10.0 Linkage to Climate Policy

Current California law requires statewide reductions in greenhouse gas emissions to 40% below 1990 levels by 2030. (SB 32) In addition, California is coordinating with other states as well as with jurisdictions around the world to address climate change. California's continued leadership on these issues is particularly significant because of the Trump Administration's decision to withdraw from the Paris Agreement (Statement) and its other efforts to reverse federal climate change and clean energy policies. (Davenport and Rubin)

[3] The InterAmerican Clean Energy Institute is a member of the Local Clean Energy Alliance.

10.1 Background

In 2006, California became the first state in the U.S. to adopt legislation setting an economy-wide cap on greenhouse gas (GHG) emissions. The California Global Warming Solutions Act of 2006 (AB 32) required reduction in statewide GHG emissions to 1990 levels by 2020 and authorized a cap-and-trade program. Due in large part to the state's successful efforts to decarbonize the electricity sector, as of the end of 2016 California was on track to meet this target. (CEC IEPR, 2). GHG emissions in the electricity sector are already 20% below 1990 levels. (Id. at 4)

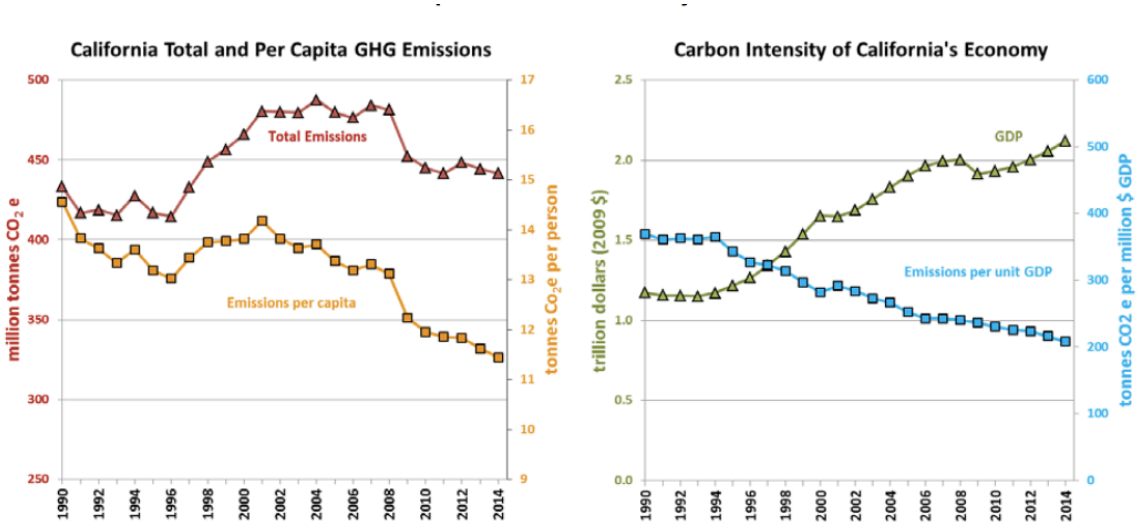
Through executive orders signed by former Governor Arnold Schwarzenegger, a Republican, and the state's current Governor, Jerry Brown, a Democrat, California has also set specific GHG reduction goals beyond 2020:

- By 2030, reduce GHG emissions to 40% below 1990 levels (recently codified into law by Senate Bill 32, described below). (Executive Order B-30-15)
- By 2050, reduce GHG emissions to 80% below 1990 levels. (Executive Order S-3-05)

10.2 Recent Developments

In the decade since AB 32's passage in 2006, California's GDP and population *increased* while its GHG emissions *decreased*. (Figure 10.1) (CEC Greenhouse Gas Emissions) And the state's strong GHG laws are highly popular: In a 2016 survey, a large majority—69%—of Californians supported AB 32's goals. (Public Policy Institute)

Figure 10.1
California Reductions in Greenhouse Gas Emissions



Source: California Energy Commission staff using data from the California Air Resources Board's *Greenhouse Gas Emissions Inventory – 2016 Edition*

In 2016, California passed SB 32, which requires the California Air Resources Board (CARB) to ensure that statewide GHG emissions are reduced to 40% below 1990 levels by 2030. A companion bill, AB 197, was passed to increase legislative oversight of CARB and to ensure that the benefits of the state's climate change policies reach disadvantaged communities. Also in 2016, California passed SB 1383 to curtail short-lived climate pollutants, such as methane. (Short-lived climate pollutants cause more climate change in a shorter time frame than carbon dioxide. Therefore, reducing these pollutants can produce faster climate benefits.) SB 1383 requires CARB to implement a strategy to reduce "statewide emissions of methane by 40 percent, hydrofluorocarbon gases by 40 percent, and anthropogenic black carbon by 50 percent below 2013 levels by 2030." (CA Health and Safety Code)

10.3 Regional and International Efforts

On the regional and international fronts, California has been working to develop alliances with other U.S. states as well as with jurisdictions outside the U.S. It is a founding signatory of the Subnational Global Climate Leadership Memorandum of Understanding (MOU), which is also known as the "Under2 MOU" in reference to the international goal of limiting warming to below 2° Celsius and the Under2 Coalition's "shared goal of limiting greenhouse gas emissions to 2 tons per capita, or 80-95% below 1990 level by 2050." (Under 2)

The Under2 Coalition consists of 170 jurisdictions representing 33 countries and six continents, which have signed or endorsed the Under2 MOU. This accounts for significant portions of the world's population and economy: more than one billion people and $27.5 trillion in GDP. (Under 2) In addition, California has entered into agreements with leaders from Mexico, China, Japan, Israel, Peru, Chile, the Netherlands and others to reduce GHG emissions. (Climate Action Team)

11. California's Response to Trump Administration Actions

On June 1, 2017, President Donald J. Trump announced his intention to withdraw the United States from the Paris Agreement. (Statement) This move was not unexpected as he had expressed skepticism about climate science and the Paris Agreement during his campaign for President. It is important to note that the American people are not in favor of this decision. Nearly 70% of Americans including majorities *all 50 states* support U.S. participation in the Paris Agreement. (Marlon et al.)

In speeches and interviews since the November 2016 U.S. Presidential election, Governor Brown has repeatedly affirmed California's commitment to its clean energy and climate policies and signaled that California will resist attempts by the Trump administration to interfere with the

state's efforts to mitigate climate change. For example, when peaking at the American Geophysical Union conference in December 2016, Governor Brown declared: "We've got the scientists, we've got the lawyers and we're ready to fight." Moreover, "if Trump turns off the satellites [collecting climate data], California will launch its own damn satellite." (Cadelago) Governor Brown and other state leaders have also said they would continue to "work directly with other nations and states to defend and strengthen [California's] aggressive policies to fight climate change." … [and] will not deviate from our leadership because of one election." (Id.)

Examples of recent state action in response to threats to climate and clean energy policy from the Trump Administration include the following.

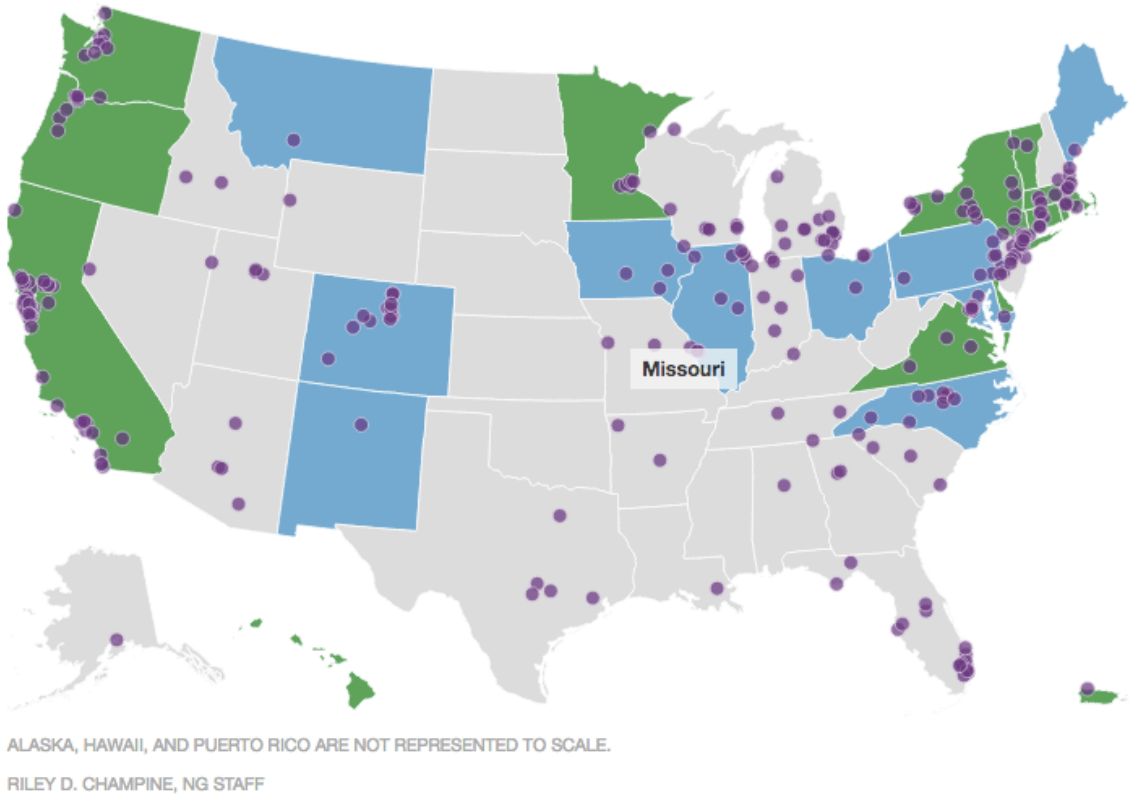
- In March 2017, the CARB voted unanimously to uphold California's strict auto admissions standards, defying the Trump administration's intention to roll back federal standards and setting up potential litigation over California's waiver under the Clean Air Act, which enables the state to set its own auto emissions standards. (Tabuchi)

- In June 2017, the states of California, Washington, and New York formed the United States Climate Alliance, which has pledged to uphold the U.S. commitments under the Paris Agreement. Nine more states and Puerto Rico have joined. The member states represent about one-third of the U.S. population, roughly 102 million people, and also about one-third of overall U.S. GDP ($6.83 trillion combined), according to the office of the Governor of Washington, Jay Inslee. (Rice)

The map at Figure 11.1 shows the growing "U.S. Climate Rebellion," which includes cities as well as states that have pledged to uphold commitments under the Paris Agreement (Greshko). Twelve states and Puerto Rico have become members of the U.S. Climate Alliance. Officials from another ten states and the District of Columbia have pledged to follow the Paris

Agreement. Mayors of hundreds of cities who have signed onto the Mayor's National Climate Action Agenda issued the following statement: "As 292 US Mayors representing 60 million Americans, we will adopt, honor, and uphold the commitments to the goals enshrined in the Paris Agreement. We will intensify efforts to meet each of our cities' current climate goals, push for new action to meet the 1.5 degrees Celsius target, and work together to create a 21st century clean energy economy." (Mayors National Climate Action Agenda)

Figure 11.1:
U.S. States and Cities Pledging to Achieve Climate Goals



Map: National Geographic

12: Conclusion: Towards 100% Renewable Energy

California's leadership on clean energy, distributed generation, and climate policy has been collaborative on multiple levels. State and local officials have worked with private sector stakeholders to develop innovative programs such as incentives for distributed energy storage.

Some of the most influential policies have been aspirational goals that inspired public and private collaboration, rather than legal mandates. Examples include Governor Brown's Clean Energy Jobs Plan, which set forth the goal of 12,000 megawatts of renewable DG, and the CPUC's Zero Net Energy goals for new construction. Cities and counties have driven progress through strong leadership at the local level.

In the author's view, the next frontier for California's energy policy is adopting a statewide target for 100% renewable energy for the electricity sector. Since it was initially passed in 2002, California's main renewable energy law—the Renewables Portfolio Standard (RPS)—has been updated multiple times to increase renewable targets and accelerate deadlines. The RPS has been driving innovation and rapid decarbonization of California's electricity matrix as California has steadily replaced in-state coal and nuclear generation assets with renewables and natural gas (Appendix C). In-state generation of electricity from coal has dropped 87% since 2002. (Id.) One of the state's two nuclear plants ceased operations in June 2013. The remaining plant will close by 2025, and the power produced by nuclear reactors will be replaced with a portfolio of energy efficiency, renewables and energy storage. (Penn and Masunaga)

In 2017, the State Senate passed legislation to increase the RPS target to 100% by 2045. (SB 100) This legislation must be passed by the Assembly and signed by the Governor before it becomes law. If approved, the law would make California the second U.S. state to adopt a 100% renewable electricity target. (The State of Hawaii passed a 100% renewable electricity target in 2015 (Governor of the State of Hawai'i).) Given the size of California's economy, such a move would be nationally significant. State energy leaders have stated that 100% renewable energy on the grid is technically feasible. For example, Michael Picker, president of the CPUC, said in remarks at the 2015 Bloomberg New Energy Finance summit that in California "We could get to

100 percent renewables" (InterAmerican), and Angelina Galiteva, one of the members of the CAISO board of governors and a founder of Renewables 100 Policy Institute, said SB 100's goals are achievable: "It can be done and it is certainly a way to go forward" (Nikolewski). While regulators, utilities, and renewables advocates acknowledge that there will be technical challenges, a number of California's energy researchers believe that 100% renewable energy is indeed within reach. For example, researchers at Stanford University have published a detailed technical roadmap for converting the state's energy system (including transportation) to renewables. (Jacobson, et al.)

In conclusion, California's experience demonstrates that strong state and local leadership on clean energy generally, and renewable distributed generation specifically, can drive progress towards sustainable energy and economic systems that benefit local communities and the planet.

APPENDIX A

Definitions of Key Energy Terms

The following terms are defined by California law and/or are commonly used by California's energy agencies, utilities, companies and other energy stakeholders in the context of decentralized energy systems.

(a) ***Behind the meter (BTM)*** refers to a clean energy system, such as a solar PV system or battery, which produces power or stores energy intended for on-site use.

(b) ***Community Choice Aggregators (CCAs)*** are governmental entities formed by cities and counties to serve the energy requirements of their local residents and businesses. AB 117 expressed the state's policy to permit and facilitate development of CCAs.

(c) ***Decoupling*** refers to a policy designed to remove the disincentives for utilities to promote energy efficiency and conservation among energy customers. Decoupling ensures that utilities retain their expected earnings even as energy efficiency programs reduce sales. By breaking the link between the utility's sales and profits, decoupling creates an incentive for utilities to sell less energy and focus on energy efficiency. (California's Decoupling Policy)

(d) ***Eligible Renewable Energy Resources:*** The California Energy Commission publishes a guidebook describing the eligibility requirements and process for certifying eligible renewable energy resources for California's Renewables Portfolio Standard (RPS) and describes the process used to verify compliance with the RPS. Currently California's RPS has a target of obtaining 50% of the state's electricity from eligible renewable energy resources by 2030. Eligible resources include solar, wind, biomass, geothermal, small hydro (capacity of 30 MW or less) and other resources as described in the guidebook. (CEC Renewables Portfolio Standard Eligibility)

(e) ***Distributed Energy Resources (DER)*** are defined in California law to include distributed renewable energy generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies. (AB 327)

(f) ***Distributed Generation (DG)*** is defined by the California Energy Commission as projects that are 20 MW or smaller – including both self-generation and projects that generate energy for the market. (CEC Tracking Progress: Renewables, 4)

(g) ***Loading Order*** refers to a policy adopted by California's energy agencies that priorities utility procurement of energy resources in the following order: energy efficiency, demand response, renewable power, distributed generation, and then efficient natural gas generation.

(h) ***Net Energy Metering*** is a billing arrangement that provides credit to customers with renewable DG systems, such as solar PV, for the full retail value of the electricity their system generates. The customer's electric meter keeps track of how much electricity is

consumed by the customer and how much excess electricity sent back into the electric utility grid. Over a 12-month period, the customer has to pay only for the net amount of electricity used from the utility over-and-above the amount of electricity generated by their solar system (in addition to monthly customer transmission, distribution, and meter service charges they incur). (Go Solar)

(i) ***Property Assessed Clean Energy (PACE)*** is a financing mechanism that enables low-cost, long-term funding for energy efficiency, renewable energy, and other distributed energy resource infrastructure projects. PACE financing is repaid as an assessment on the property tax bill. (PACENation)

(j) ***Zero Emission Vehicles (ZEV)*** are electric vehicles which generate fewer global warming emissions than gas-powered cars and which don't produce tailpipe pollution. ZEV technologies include hydrogen fuel cell electric vehicles (FCEVs) and plug-in electric vehicles (PEVs), which include both pure battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs). California's ZEV Action Plan also addresses medium- and heavy-duty vehicles, as well as zero-emission technologies for public transit and freight transport. The California Air Resources Board (CARB) manages the ZEV program, and it has also been adopted by nine other states. (UCS, CARB ZEV)

(a) ***Zero Net Energy (ZNE)*** refers to "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." (DOE Definition)

APPENDIX B

California In-State Electric Generation by Fuel Type 2001-2015 (GWh)

Primary Fuel Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Coal	4,041	4,275	4,269	4,086	4,283	4,190	4,217	3,977	3,735	3,406	3,120	1,580	1,018	1,011	538
Biomass	5,762	6,197	6,094	6,082	6,078	5,863	5,764	5,927	6,111	5,981	6,051	6,201	6,550	6,776	6,356
Geothermal	13,525	13,396	13,329	13,494	13,292	13,093	13,084	12,907	12,907	12,740	12,685	12,733	12,479	12,186	11,994
Nuclear	33,294	34,353	35,594	30,241	36,155	32,036	35,698	32,482	31,509	32,214	36,666	18,491	17,860	17,027	18,525
Natural Gas	116,341	92,697	94,428	105,222	97,161	109,176	120,466	123,037	117,287	109,886	91,221	121,884	121,067	121,975	117,482
Large Hydro	20,144	26,003	30,325	28,945	33,334	40,952	22,640	19,887	23,659	28,483	35,682	22,737	20,319	13,739	11,569
Small Hydro	4,844	5,354	5,996	5,545	6,928	7,607	4,466	4,573	4,880	5,706	7,049	4,723	3,778	2,737	2,423
Solar PV	3	2	2	2	2	2	2	3	11	82	208	962	3,653	8,949	12,571
Solar Thermal	834	848	757	739	658	614	666	730	841	879	889	867	686	1,624	2,446
Wind	3,242	3,546	3,316	4,258	4,084	4,902	5,570	5,724	6,249	6,172	7,598	9,242	11,964	13,074	11,856
Oil	379	87	103	127	148	134	103	92	67	52	36	48	38	45	54
Other	38	35	108	48	24	34	15	39	20	12	13	14	14	16	14
Grand Total	202,446	186,794	194,320	198,788	202,150	218,601	212,691	209,378	207,276	205,612	201,220	199,483	199,427	199,159	195,829

Source: CEC Electric Generation Capacity

APPENDIX C

California Installed In-State Electric Generation Capacity by Fuel Type 2001-2015 (MW)

Primary Fuel Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Coal	595	595	595	595	595	595	595	571	576	581	444	275	275	167	167
Biomass	1,143	1,139	1,083	1,075	1,080	1,085	1,093	1,082	1,095	1,104	1,153	1,182	1,214	1,296	1,297
Geothermal	2,625	2,623	2,623	2,623	2,623	2,641	2,586	2,598	2,648	2,648	2,648	2,703	2,703	2,703	2,716
Nuclear	4,456	4,456	4,456	4,456	4,456	4,456	4,456	4,456	4,456	4,577	4,577	4,577	2,323	2,323	2,323
Natural Gas	30,377	32,688	35,063	35,027	38,587	40,238	40,909	41,180	43,400	43,980	43,949	44,573	47,135	46,229	45,437
Large Hydro	11,848	11,713	11,713	11,962	11,951	12,042	11,793	12,074	12,074	12,105	12,145	12,145	12,155	12,244	12,252
Small Hydro	1,748	1,741	1,737	1,736	1,740	1,738	1,740	1,728	1,735	1,724	1,723	1,735	1,729	1,728	1,720
Solar PV	2	2	2	2	2	2	2	6	11	109	214	737	3,031	4,589	5,498
Solar Thermal	410	378	378	378	378	400	400	400	408	408	408	408	925	1,300	1,292
Wind	1,534	1,544	1,571	2,064	2,089	2,310	2,373	2,462	2,728	3,183	3,992	4,967	5,800	5,887	6,288
Oil	590	567	567	567	567	506	575	575	552	509	348	350	350	351	351
Other	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Grand Total	55,344	57,462	59,805	60,501	64,084	66,030	66,538	67,148	69,699	70,943	71,616	73,668	77,656	78,834	79,359

Source: CEC Electric Generation Capacity

APPENDIX D

California Total System Electric Generation 2015 (GWh)

Fuel Type	California In-State Generation (GWh)	Percent of California In-State Generation	Northwest Imports (GWh)	Southwest Imports (GWh)	California Energy Mix (GWh)	California Energy Mix
Coal	538	0.30%	294	16,903	17,735	6.00%
Large Hydro	11,569	5.90%	2,235	2,144	15,948	5.40%
Natural Gas	117,490	59.90%	49	12,211	129,750	44.00%
Nuclear	18,525	9.40%	0	8,726	27,251	9.20%
Oil	54	0.00%	0	0	54	0.00%
Other	14	0.00%	0	0	14	0.00%
Renewables	48,005	24.50%	12,321	4,455	64,781	21.90%
Biomass	6,362	3.20%	1,143	42	7,546	2.60%
Geothermal	11,994	6.10%	132	757	12,883	4.40%
Small Hydro	2,423	1.20%	191	2	2,616	0.90%
Solar	15,046	7.70%	0	2,583	17,629	6.00%
Wind	12,180	6.20%	10,855	1,072	24,107	8.20%
Unspecified Sources of Energy	N/A	N/A	20,901	18,972	39,873	13.50%
Total	196,195	100.0%	35,800	63,410	295,405	100.0%

Source: CEC Total System Electric Generation

APPENDIX E

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