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# 2018 IEPR UPDATE

## VOLUME II

EXECUTIVE SUMMARY



## **NANCY MCFADDEN**

*1959–2018*

Nancy McFadden was the executive secretary to former Governor Edmund G. Brown Jr., a role comparable to chief of staff, from January 2011 to March 2018. Before that, she held positions as a senior vice president at PG&E, a senior advisor to former Governor Gray Davis, deputy chief of staff for the Office of Vice President, and general counsel for the U.S. Department of Transportation.

Former Governor Brown called her “the best chief of staff a governor could ever ask for.” He said, “She understood government and politics, she could manage, she was a diplomat, and she was fearless.”



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## PREFACE

Senate Bill 1389 (Bowen, Chapter 568, Statutes of 2002), as amended, requires the California Energy Commission to prepare a biennial integrated energy policy report that assesses major energy trends and issues facing the state's electricity, natural gas, and transportation fuel sectors and provides policy recommendations to conserve resources; protect the environment; ensure reliable, secure, and diverse energy supplies; enhance the state's economy; and protect public health and safety (Public Resources Code § 25301[a]). The Energy Commission prepares updates to these assessments and associated policy recommendations in alternate years (Public Resources Code § 25302[d]). Preparation of the Integrated Energy Policy Report involves close collaboration with federal, state, and local agencies and a wide variety of stakeholders in an extensive public process to identify critical energy issues and develop strategies to address those issues.

## ABSTRACT

The *2018 Integrated Energy Policy Report Update* provides the results of the California Energy Commission's assessments of a variety of energy issues facing California. Many of these issues will require action if the state is to meet its climate, energy, air quality, and other environmental goals while maintaining reliability and controlling costs.

The *2018 Integrated Energy Policy Report Update* covers a broad range of topics, including decarbonizing buildings, energy efficiency, energy equity, integrating renewable energy, updates on Southern California electricity reliability, climate adaptation activities for the energy sector, and the California Energy Demand Forecast.

**Keywords:** California Energy Commission, decarbonizing buildings, energy efficiency, energy equity, Senate Bill 350, electricity demand forecast, climate adaptation and resiliency, Southern California reliability, Aliso Canyon, resiliency, renewable integration

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## EXECUTIVE SUMMARY

California's energy system is instrumental to daily life — from heating and cooling homes and delivering water, to powering manufacturing and transporting goods and people. California is working to fundamentally and seamlessly change how energy is produced, delivered, and consumed to drastically reduce greenhouse gas (GHG) emissions that cause climate change. What is not changing is the commitment to safely, reliably, and affordably maintain energy services and ensure that the benefits reach all Californians, particularly those in low-income and disadvantaged communities.

California has already made progress in shifting away from fossil fuels to reduce GHGs and needs to do much more to help avoid the worst impacts of climate change. Over the last 40 years, California has implemented cost-effective appliance and building energy efficiency standards that have saved consumers well over \$100 billion. In 2018, about 34 percent of the electricity used to serve California was produced from renewable resources. Californians have purchased almost half of the zero-emission vehicles in the United States. The state has achieved these successes while growing its economy 46 percent since 2010. As former Governor Edmund G. Brown Jr. said at the Global Climate Action Summit in September 2018, “We’re getting it done but we have a very tall mountain to climb,” adding, “The metaphor I use is, we’re at the base camp of Mount Everest, and we’re looking up at the long way we still have to go.”

### Impacts of Climate Change

To help plan for the impacts of climate change, the Governor's Office of Planning and Research, the California Natural Resources Agency, and the Energy Commission released California's Fourth Climate Change Assessment (Fourth Assessment, see Figure ES-1). California's Fourth Assessment translates the global climate models into regionally relevant reports to help identify and plan for the impacts of the changing climate on a local scale. The results show a future punctuated by severe wildfires,



**Figure ES-1: California’s Fourth Climate Change Assessment  
Rigorous Science Made Accessible**

<b>KEY FINDINGS</b>	A concise summary of the Fourth Assessment’s most important findings and conclusions.
<b>STATEWIDE SUMMARY</b>	An in-depth report on how California’s people, built environment, and ecosystems will be impacted by climate change and how we can proactively adapt, based on the Fourth Assessment’s findings.
<b>SUMMARIES FOR REGIONS AND COMMUNITIES</b>	Reports summarizing Fourth Assessment findings to provide a state of the science for nine regions, the ocean and coast, tribal communities, and climate justice in California.
<b>ORIGINAL RESEARCH TO INFORM POLICY AND ACTION</b>	Academic research that provides robust and detailed results on resilience and vulnerability to climate change.
<b>ASSESSMENT FOUNDATION: UPDATED CLIMATE PROJECTIONS AND DATA</b>	A shared foundation of updated climate change projections, data and ecosystem models developed for use by Assessment authors to permit cross-comparability of results and ensure the findings consider a robust range of future climate conditions. This data is available to the public via Cal-Adapt.org.

Source: California Natural Resources Agency

rising sea levels, increased flooding, coastal erosion, extreme heat events, and more frequent and longer droughts. (Figure ES-2 shows changes in extreme heat in four regions of California.)

California is already feeling the effects of climate change with five of the deadliest, seven of the most destructive (in terms of structures destroyed), and four of the largest wildfires in California’s history occurring in 2017 and 2018 alone, preceded by a four-year drought. The Fourth Assessment provides insights on the impacts to the energy system and the needs for adaptation and resilience, particularly as a result of increases in the severity and frequency of wildfires.

More work is needed to protect the state’s most vulnerable populations and to develop flexible and adaptive strategies to increase resilience. Continued advancements in science and planning are critical to supporting California’s continued leadership on actions to address climate change and safeguard the state’s people, economy, and resources.

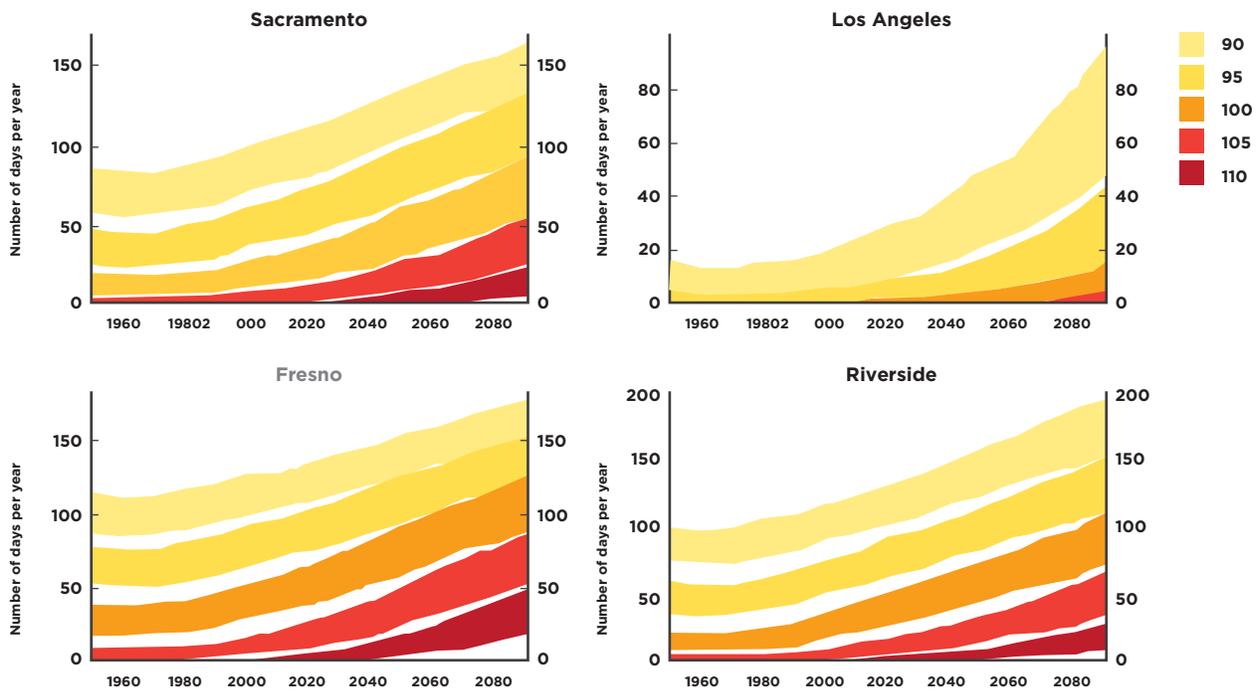
## Key Energy Policies

Former Governor Brown’s 2015 inaugural address included the following goals for 2030 to reduce GHG emissions. These goals continue to guide the state’s energy policy:

- Increase from one-third to 50 percent the state’s electricity derived from renewable sources.
- Reduce petroleum use in cars and trucks by up to 50 percent.
- Double the efficiency of existing buildings while making heating fuels cleaner.
- Reduce the relentless release of methane, black carbon, and other potent pollutants across industries.
- Manage farm and rangelands, forests, and wetlands so they can store carbon.

Senate Bill 350 (De León, Chapter 547, Statutes of 2015) codified the Governor’s renewable and energy efficiency goals. It also took steps to ensure the benefits of clean

**Figure ES-2: Heat Waves Projected to Increase:**  
*Number of Days at Extreme Heat Threshold or Above (Degrees Fahrenheit)*



Source: D. Pierce, Scripps Institute of Oceanography

energy transformation are realized by all Californians, especially those in the most vulnerable communities.

In 2016, Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016) set a statewide requirement to reduce California’s GHG emissions 40 percent below 1990 levels by 2030, building on the Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006) requirement to reduce GHG emissions to 1990 levels by 2020. Assembly Bill 197 (Garcia, Chapter 250, Statutes of 2016) emphasized equitably implementing state climate change policies such that the benefits reach disadvantaged communities. In addition, Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016) set a goal that California reduce methane and hydrofluorocarbon (HFC) refrigerants to 40 percent below 2013 levels by 2030.

Recognizing that in California the transportation sector is the largest source of GHG emissions and pollutants that directly harm human health, the state is advancing zero-

emission and near-zero-emission vehicles. The electricity sector accounted for about 16 percent of statewide GHG emissions in 2016 (the most recent data available), and the transportation sector accounted for about 50 percent when including emissions from refineries. In 2012, then-Governor Brown signed Executive Order B-16-2012 to set a long-term goal of reaching 1.5 million zero-emission vehicles on California’s roadways by 2025. In January 2018, former Governor Brown issued Executive Order B-48-18 to put at least 5 million ZEVs in California by 2030 and spur the installation and construction of 250,000 plug-in electric vehicle chargers, including 10,000 direct current fast chargers, and 200 hydrogen refueling stations by 2025.

In 2018, Senate Bill 100 (De León, Chapter 310, Statutes of 2018) set a planning target of 100 percent zero-carbon electricity resources by 2045 and increased the 2030 renewables target from 50 percent to 60 percent. On the same day of signing SB 100, then-Governor Brown signed

Executive Order B-55-18 with a new statewide goal to achieve carbon neutrality (zero-net GHG emissions) by 2045 and to maintain net negative emissions thereafter. The executive order covers all sectors of the economy and includes consideration of carbon sequestration in natural and working lands. Executive Order B-55-18 follows the spirit of what is required at a global scale to achieve the climate goals of the Paris Agreement, in which signatory nations worldwide agree to sufficiently reduce GHG emissions to avoid catastrophic climate change. This is also consistent with a special report by the Intergovernmental Panel on Climate Change, which found that to avoid catastrophic climate change, global carbon dioxide emissions must decline by about 45 percent below 2010 levels by 2030 and reach net zero by about 2050.

In September 2018, then-Governor Brown signed a comprehensive package of new climate-related bills into law, including bills to advance zero-emission transportation (see box), as well as two bills to block new offshore oil drilling off California's coast: Senate Bill 834 (Jackson, Chapter 309, Statutes of 2018) and Assembly Bill 1775 (Muratsuchi, Chapter 310, Statutes of 2018). Also, the Global Climate Action Summit, cochaired by former Governor Brown, showcased actions underway by states, regions, cities, businesses, investors, and non-governmental organizations to address climate change and resulted in bold new commitments, building momentum to accelerate action on this critical issue.

## California's Electricity Sector Leads the Way

The electricity sector is leading the state's efforts to reduce GHG emissions. Although AB 32 and SB 32 goals are economywide, in 2016, the electricity sector surpassed the 2020 goal and nearly met the 2030 goal. In 2016, GHG emissions from the electricity sector were 37.6 percent below 1990 levels. (See Figure ES-3.) These gains are largely attributable to advancements in energy efficiency, increased use of renewable energy resources, and reduced use of coal-fired electricity. To

## 2018 Legislation to Reduce Carbon Emissions From the Transportation Sector and Other Climate-Related Bills

**AB 2127** (Ting) supports the state's goal of achieving 5 million ZEVs on the road by 2030 by affirming the Energy Commission's authority to assess the need for charging infrastructure to support adoption of zero-emission vehicles, including freight and off road vehicles.

**AB 2885** (Rodriguez) continues the legislative priority of ensuring that California's incentive programs serve all communities, by extending the requirement that the California Air Resources Board (CARB) conduct outreach to low-income households and communities as part of the Clean Vehicle Rebate Project and continue to prioritize rebates to low-income applicants until January 1, 2022.

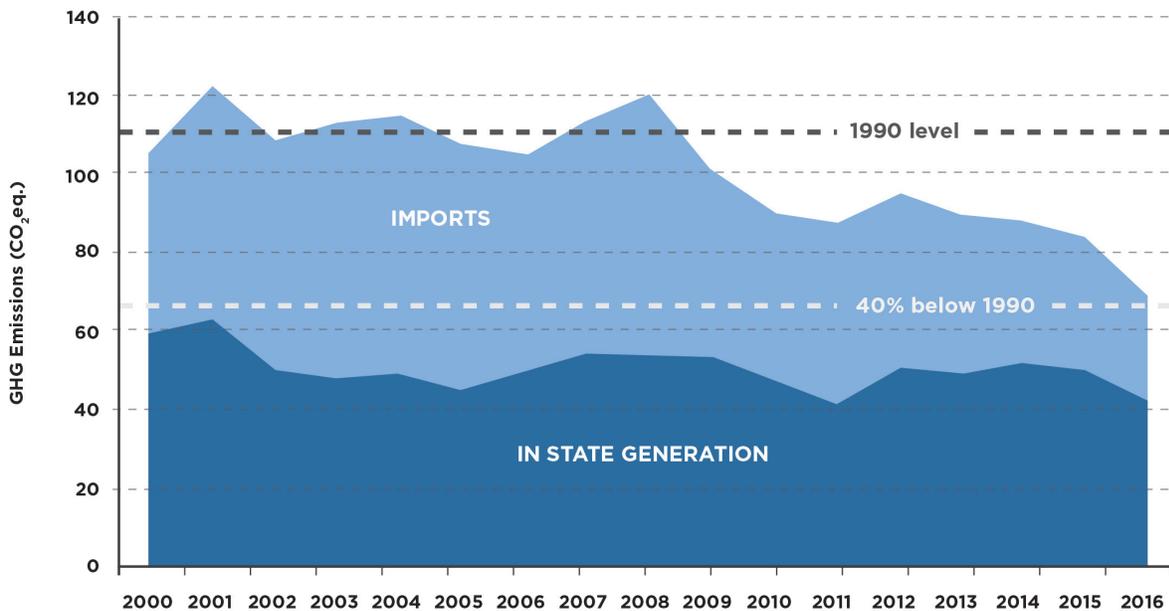
**SB 1000** (Lara) requires the state to assess whether vehicle-charging infrastructure is sufficient to encourage the purchase of electric vehicles, and ensures that plug-in electric vehicles and zero-emission vehicles have equal access to charging infrastructure.

**SB 1072** (Leyva) establishes a regional climate collaborative program to assist under resourced communities with accessing statewide public and other grant money for climate change mitigation and adaptation related projects. The bill also requires the Strategic Growth Council to develop technical assistance best practices that state agencies may use and identify state grants that could benefit from technical assistance best practices.

**SB 1477** (Stern) establishes two incentive programs aimed at reducing emissions from buildings – one to provide financial incentives for the deployment of near-zero emission building technologies and a second to offer incentives for installing low emission space and water heating equipment for new and existing buildings.

For a more complete listing of these and other bills signed by the Governor to address climate change, see <https://www.gov.ca.gov/2018/09/13/aboard-hybrid-electric-ferry-on-the-san-francisco-bay-governor-brown-signs-bills-to-promote-zero-emission-vehicles-reduce-carbon-emissions>

**Figure ES-3: GHG Emissions From California’s Electricity Sector Continue to Decline** (*Million Metric Tons*)



Source: California Energy Commission using data from the California Air Resources Board

further reduce GHG emissions, California is increasingly using renewable resources to produce electricity while planning for increased demand from transportation electrification and other opportunities for electrification.

In 2017, solar outstripped all other renewable resources in California for the first time, accounting for 36 percent of the state’s renewable generation. (See Figure ES-4.) The increase in solar and other renewables is a success story in reducing GHG emissions but also creates operational challenges. Grid operators must manage the ramp-up of solar generation as it peaks midday and then ramps down at sunset while electricity demand remains high.

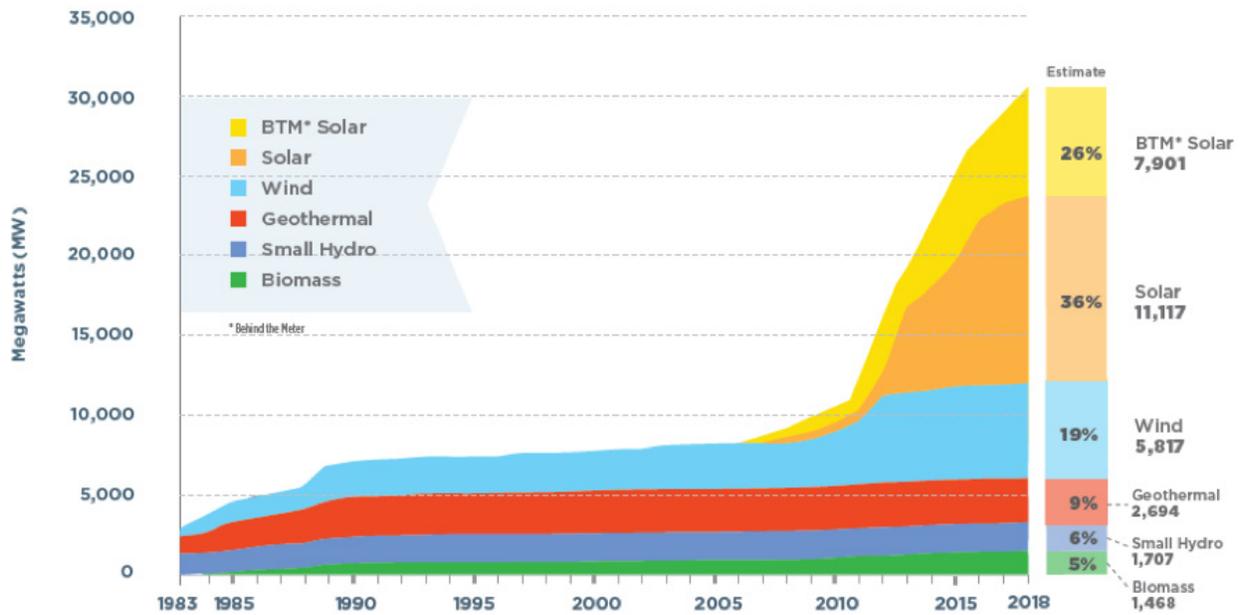
*Increasing Flexibility to Integrate More Renewable Energy*

Some progress has been made in deploying the supply-side and demand-side tools available to help manage the daily and minute-to-minute changes in solar

generation. For example, the North American Electric Reliability Corporation and the California Independent System Operator (California ISO) have made progress in developing performance standards for inverter-connected solar and wind power plants that will help improve reliability and increase services to the grid. There are also a greater understanding and ability to plan for the performance of older inverter-connected power plants.

The need for energy storage that can absorb excess energy and reinject it into the grid when needed continues to increase. As the global market for electric vehicles expands, there is a growing opportunity to take advantage of vehicle batteries for energy storage in the electricity sector. Grid regionalization is a promising solution that has not yet been fully realized, but the Western Energy Imbalance Market (EIM) continues to grow (the Western EIM allows for real-time energy transfers in the West), and further opportunities to exchange power with the Bonneville Power Administration are being explored.

**Figure ES-4: Annual Cumulative Installed Renewable Capacity Since 1983**  
*(Including Behind-the-Meter Solar)*



Source: California Energy Commission, Tracking Progress, Renewable Energy, updated December 2018

Increasing the flexibility of loads is also important, and options include implementing time-of-use rates (to encourage better alignment of energy use with resource availability) and expanding the participation of demand response in energy markets (to reliably and quickly ramp energy load up or down in response to price signals). As these low- and zero-GHG solutions continue to be developed, some strategically located natural gas power plants that can quickly ramp up and down to compensate for changes in renewable energy production are still needed.

### *The Changing Market Structure*

Increasingly, Californians are making household choices about how and from where they get their electricity. Large numbers of Californians are deciding to generate and possibly store their own electricity or purchase energy services from sources other than their utility, such as from local providers called community choice aggregators. Historically, California has had a fairly centralized

electricity market. Policies to advance energy efficiency, renewables, and research and development, for example, have been implemented largely by the utilities as directed by the state. This changing model provides new opportunities and raises questions about how the state's energy and climate policies will be realized.

### *California's Energy Demand Forecast*

The Energy Commission's update to its electricity demand forecast is aimed to reflect the changes to and help meet the evolving planning needs of the electricity market. The forecast is used in various proceedings, including the California Public Utilities Commission's (CPUC's) Integrated Resource Plan process and resource adequacy proceeding, as well as the California ISO's annual Transmission Planning Process.

Consistent with previous updates, the analysis refreshes economic and demographic drivers used in the prior Integrated Energy Policy Report (IEPR) forecast with the most current projections and adds a year of historical

data. As a reflection of the changing electricity system, the *2018 IEPR Update* is the first to include refreshed projections of solar photovoltaic system adoptions, plug-in electric vehicle adoptions, community choice aggregators, and time-of-use rate impacts. This update improves upon the hourly load model that was developed in 2017, allowing for a forecast of monthly peak loads to be adopted by the Energy Commission alongside its standard forecasts of consumption and annual peak load. The forecast extends to 2030, comparing across mid demand scenarios. Updated forecasts for consumption remain relatively unchanged from the previous *2017 IEPR* forecast. Managed sales are declining, but at a slower rate than the previous analysis, and managed net peak demand, driven up by a shifting peak hour, remains relatively flat over the forecast horizon.

## **Decarbonizing Buildings Is the Next Innovation**

In California, building GHG emissions are second only to transportation, when accounting for electricity use, water use, and wastewater treatment. The focus over the past decade has been on advancing zero-net-energy buildings, and this must pivot to zero-emission buildings as the state mobilizes to meet its 2030 and 2050 climate goals. This change from zero-net energy to zero-emission buildings focuses squarely on reducing GHG emissions from the entire building, including from the use of electricity, natural gas, other fuels, as well as cooling systems that typically use highly potent GHGs.

Electrification of space and water heating using highly efficient technologies is a key strategy to reduce or eliminate GHG emissions from buildings. With electrification, achieving zero-emission buildings requires a recognition that emissions from the electricity system are not the same each hour of the day. For example, emissions are lowest midafternoon during peak solar production. Electrification needs to be coupled with strategies such as time-of-use rates and demand response to shift the timing of energy consumption to maximize the use of renewable energy and achieve zero-

emission buildings. The future of zero-emission buildings is not only about energy efficiency and transitioning to zero-carbon performance, but about creating healthy and sustainable buildings sited in smart locations where people can travel via transit and active transportation modes. A lower carbon future will require higher-performing and healthier buildings and communities.

Investments in new construction, retrofitting existing buildings, and replacing appliances and other energy-consuming equipment essentially lock in energy system infrastructure for many years and can be longer-term commitments than even investments in transmission or power plants. As a result, each new opportunity for investment in energy efficiency is precious and has long-term implications on the state's ability to meet its climate goals. Increasingly integrating buildings with the grid to better take advantage of the growth in zero-emission energy sources is needed to achieve California's climate goals.

## **Doubling Energy Efficiency Remains Key**

At sufficient scale, increases in energy efficiency can reduce the need for new power plants and new or upgraded transmission and distribution lines and will continue to create headroom for load growth associated with electrification of transportation and buildings. To meet its energy efficiency goals, the state will need to expand energy efficiency efforts and harness emerging technologies, progressive program designs, and innovative market solutions across all sectors of the economy.

For example, manufacturing and agriculture account for about a quarter of total state energy consumption, with about 85 percent of the energy consumed by the industrial sector and the remaining 15 percent by the agricultural sector. Additional savings in these sectors can help fill the gap in meeting SB 350 doubling targets. Energy infrastructure can also benefit from efficiency advancements, and conservation voltage reduction is a proven technology that reduces energy use and peak demand by optimizing voltages on the distribution system.

## *California Adopts First-in-Nation Standards Requiring Solar on New Homes*

The Energy Commission took a bold step in 2018 toward reducing emissions from buildings and increasing efficiency. The new standards require high levels of wall and attic insulation to reduce heating and cooling needs, which is a continuation of the Energy Commission's four-decade long work establishing cost-effective efficiency requirements in statewide building design and construction standards. Moreover, the Energy Commission adopted and the California Building Standards Commission in December approved the first in the nation building standards that require solar on new homes starting in 2020, following a rigorous assessment of homeowner financial benefits of rooftop PV systems. Six cities have already chosen to require solar in new construction.

## **Increasing Access to Clean Energy Benefits**

While California's renewable and energy efficiency goals are ambitious, meeting them will not be truly successful unless the benefits from the clean energy economy reach all Californians. The state is committed to increasing the equitable distribution of clean energy benefits and creating an inclusive clean energy economy.

As directed by SB 350, the Energy Commission examined the barriers to energy efficiency and weatherization investments, renewable energy generation, and contracting opportunities for local small businesses in low-income and disadvantaged communities. Likewise, the California Air Resources Board (CARB) reported on barriers faced by low-income residents, including those in disadvantaged communities, to accessing zero-emission and near-zero-emission transportation and mobility options. The Energy Commission adopted its report in December 2016, and CARB released its study in February 2018 (termed the *Barriers Study Part A* and the *Barriers Study Part B*, respectively).

Multi-agency efforts to implement the recommendations in the two-part barriers study are underway. For example,

in June 2018, the Energy Commission launched the Energy Equity Indicators to identify opportunities for improving clean energy access, investment, and resilience in California's low-income and disadvantaged communities. The report is paired with an interactive mapping tool to visualize different mapping layers and focus on different regions of the state.

Also, the Energy Commission developed the *Draft Clean Energy in Low-Income Multifamily Buildings Action Plan*. The report identifies existing programs and policies, remaining challenges, and actions the state can take to accelerate the use of distributed energy resources within California's multifamily housing stock.

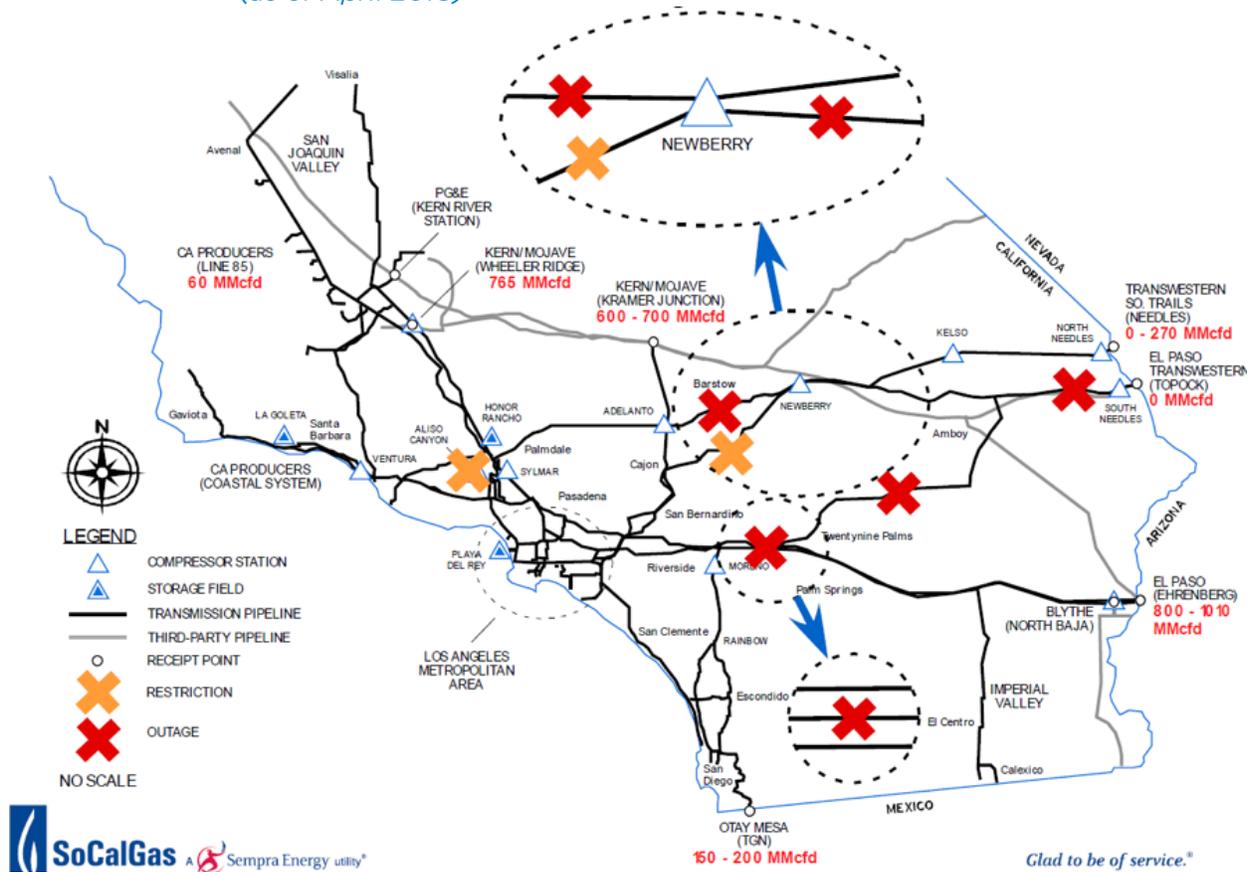
CARB is leading efforts to increase access to, and awareness about, clean transportation and mobility options for low-income residents. CARB's efforts concentrate on expanding education and outreach and developing a One-Stop-Shop Pilot Project for CARB's Low-Carbon Transportation Equity Projects.

## **Continued Efforts Needed to Maintain Energy Reliability in Southern California**

While pursuing a cleaner energy system with benefits for all Californians, the state continues to grapple with making sure energy supplies are reliable in the near term, particularly in Southern California. This region has been the focus of electric reliability concerns beginning with the outage of the two San Onofre Nuclear Generating Station units (San Onofre) in January 2012, followed by the decision to retire San Onofre in June 2013 and the massive gas leak discovered on October 23, 2015, at the Aliso Canyon natural gas storage facility. These events, coupled with the expected compliance-related closure of several Southern California coastal power plants that use ocean water for cooling, as well as long-term outages on major natural gas pipelines in the Southern California Gas (SoCalGas) system, place the regional energy supply in a tight situation.

The Energy Commission, CPUC, and the California ISO continue to work together to address reliability issues first

**Figure ES-5: Southern California Gas System Outages**  
(as of April 2018)



Source: SoCalGas presentation at the May 8, 2018, IEPR joint agency workshop on Southern California Energy Reliability, [http://www.energy.ca.gov/2018\\_energypolicy/documents/#05082018](http://www.energy.ca.gov/2018_energypolicy/documents/#05082018).

with the closure of San Onofre and, with the additional partnership of the Los Angeles Department of Water and Power, to address reliability issues related to Aliso Canyon. This year marks the third year of analysis by the joint agency team of the natural gas and electricity systems, this time for summer 2018 (see Figure ES-5) and winter 2018–2019. For all scenarios studied, the analysis finds that pipeline capacity is more constrained in 2018 than in the previous year, meaning there is a greater risk of service interruptions than last year or solely due to restricted use of Aliso Canyon. The summer 2018 study identified five new mitigation measures, including steps to increase local gas and electricity supply, to help

improve the short-term reliability concerns. Reliability risks remain the same in winter 2018–2019, with the possibility of multiple cold days late in winter posing the greatest risk to energy reliability in the region.

Looking further ahead, planning is underway to phase out Aliso Canyon within 10 years, as former Governor Brown has directed former Energy Commission Chair Robert B. Weisenmiller. Then-Chair Weisenmiller and CPUC President Michael Picker requested that California ISO President and Chief Executive Officer Stephen Berberich evaluate expanded transmission capability of low-carbon supplies to and from the Northwest to support phasing out Aliso Canyon. The study is underway.

For reliability issues related to San Onofre and the closure of coastal power plants, the agencies are periodically reviewing progress on preferred resources (local energy efficiency, demand response, renewable generation, storage, and combined heat and power), conventional generation, and transmission projects to determine whether further actions are needed. Delays of a large transmission project to increase capability to import electricity into the region, the Mesa Loop-in project, bear watching. The joint agencies will continue to evaluate actions to take in 2019, as needed.

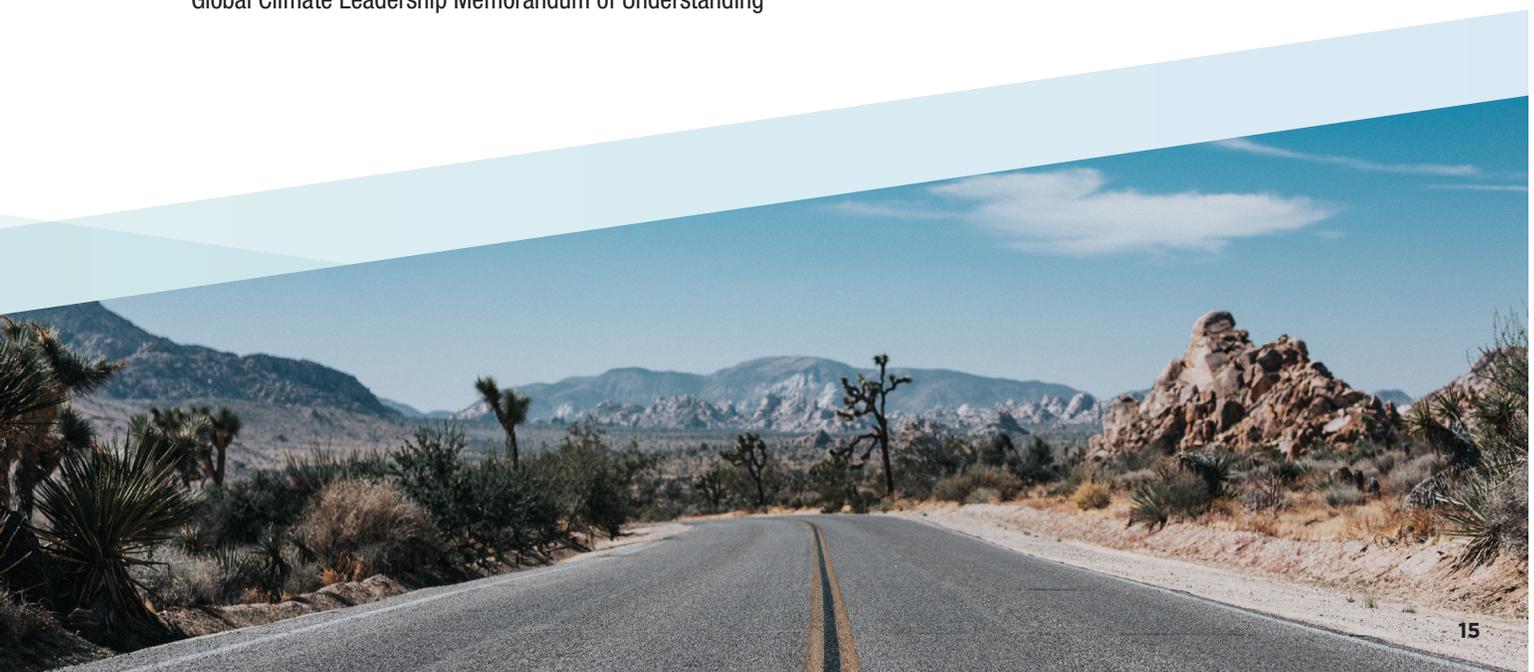
## California's Leadership to Address Climate Change Remains Strong

The effects of climate change pose serious risks to the state, and the level of risk is contingent upon global emission trends. California leads by example, demonstrating strategies to reduce emissions while stimulating economic growth.

Under the leadership of former Governor Brown, the state has forged partnerships with nations and subnational governments worldwide to help limit the rise in global average temperature to below 2 degrees Celsius to avoid catastrophic climate change. Former Governor Brown's achievements include spearheading the Subnational Global Climate Leadership Memorandum of Understanding

(the "Under-2 MOU"), being a leader in achieving the Paris Agreement at the 2015 United Nations Climate Change Conference, and being appointed the special advisor for States and Regions ahead of the 2017 conference. In September 2018, California hosted the Global Climate Action Summit in San Francisco to strengthen the push for greater emissions reductions internationally.

In signing California's goal for 100 percent clean energy by 2045 into law, former Governor Brown stated, "To truly stop global warming, cleaning up our electricity grid is not enough. We must transition to carbon neutrality and that will not be easy. It will require large investments across all sectors — energy, transportation, industrial, commercial and residential buildings, agriculture, and various forms of sequestration, including natural and working lands. California is committed to doing whatever is necessary to meet the existential threat of climate change." Former Governor Brown also signed an executive order setting a new statewide goal to achieve carbon neutrality "as soon as possible, and no later than 2045, and achieve and maintain net negative emissions thereafter." The executive order notes that "scientists agree that worldwide carbon pollution must start trending downward by 2020, and carbon neutrality — the point at which the removal of carbon pollution from the atmosphere meets or exceeds emissions — must be achieved by midcentury."





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