

DOCKETED

Docket Number:	17-IEPR-01
Project Title:	General/Scope
TN #:	223206
Document Title:	Executive Summary of the 2017 Integrated Energy Policy Report
Description:	*** THIS DOCUMENT SUPERSEDES TN 223085 ***
Filer:	Stephanie Bailey
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	4/16/2018 4:31:11 PM
Docketed Date:	4/16/2018

2017



IEPR

INTEGRATED ENERGY POLICY REPORT

EXECUTIVE SUMMARY



The 2017 Integrated Energy Policy Report is dedicated to

JACKALYNE PFANNENSTIEL

Former California Energy Commissioner and Chair

April 2004 – December 2008

With gratitude for her leadership as the first female Chair of the Energy Commission and for her distinguished and pioneering career, during which she led advances in energy policy, including energy efficiency, demand response, and renewables.



THE CALIFORNIA ENERGY COMMISSION

Robert B. Weisenmiller, Ph.D.

Chair

Commissioners

Karen Douglas, J.D.

J. Andrew McAllister, Ph.D.

David Hochschild

Janea A. Scott, J.D.

Raquel Kravitz

Project Manager

Heather Raitt

Program Manager

Drew Bohan

Executive Director

Primary Authors

Aniss Bahreinian

Stephanie Bailey

Jim Bartridge

Leon Brathwaite

Jennifer Campagna

Noel Crisostomo

Pamela Doughman

Tom Flynn

Guido Franco

Judy Grau

Mike Gravely

Eli Harland

Elizabeth John

Melissa Jones

Chris Kavalec

Matthew Ong

Charles Smith

Michael Sokol

Lana Wong

ACKNOWLEDGEMENTS

Manjit Ahuja	Aleecia Gutierrez	Silvia Palma-Rojas
Rizaldo Aldas	Lea Haro	Mark Palmere
Meredith Alexander	Mark Hesters	George Piantka
Eileen Allen	Caryn Holmes	Fernando Piña
Al Alvarado	Yu Hou	Shawn Pittard
Grace Anderson	David Hungerford	Kiel Pratt
Dave Ashuckian	John Kato	Anitha Rednam
Kevin Barker	Michael Kenney	Ken Rider
Sylvia Bender	Sudhakar Konala	Robert Ridgley
Martha Brook	Eric Knops	Carol Robinson
Noah Silber Coats	Katharine Larson	Cynthia Rogers
Matt Coldwell	Emily Lemei	Jana Romero
Christine Collopy	Galen Lemei	Brian Samuelson
Denise Costa	Rachel MacDonald	Linda Schrupp
Rhetta DeMesa	Lynn Marshall	Sedina Sinanovic
William Dietrich	Pat McAuliffe	Courtney Smith
Bryan Early	Bob McBride	David Stoms
Ryan Eggers	Christopher McLean	Gabriel Taylor
Catherine Elder	Joseph Merrill	Laurie ten Hope
Scott Flint	Michael Murza	Chi-Chung Tsao
Sandra Fromm	Jennifer Nelson	Ysbrand van der Werf
Matthew Fung	Le-Huy Nguyen	Kourtney Vaccaro
Jesse Gage	Le-Quyen Nguyen	David Vidaver
Asish Gautam	Michael Nyberg	Misa Werner
Chuck Gentry	Tim Olson	Susan Wilhelm
Elena Giyenko	Garry O'Neill-Mariscal	Bailey Wobschall
Angela Gould	Jacob Orenberg	Angela Wuerth
Siva Gunda	Jason Orta	Sonya Ziaja

PREFACE

Senate Bill 1389 (Bowen, Chapter 568, Statutes of 2002) 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 *2017 Integrated Energy Policy Report* 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 energy reliability and controlling costs.

The *2017 Integrated Energy Policy Report* covers a broad range of topics, including implementation of Senate Bill 350, integrated resource planning, distributed energy resources, transportation electrification, solutions to increase resiliency in the electricity sector, energy efficiency, transportation electrification, barriers faced by disadvantaged communities, demand response, transmission and landscape-scale planning, the *California Energy Demand Preliminary Forecast*, the preliminary transportation energy demand forecast, renewable gas (in response to Senate Bill 1383), updates on Southern California electricity reliability, natural gas outlook, and climate adaptation and resiliency.

Keywords: California Energy Commission, Senate Bill 350, integrated resource plans, electricity demand forecast, climate adaptation and resiliency, renewable gas, energy efficiency, Southern California reliability, Aliso Canyon, integration of distributed energy resources, strategic transmission investment plan, transportation energy demand forecast, natural gas outlook, nuclear, energy storage, Alternative and Renewable Fuel and Vehicle Technology Program, resiliency

Please use the following citation for this report:

California Energy Commission staff. 2017. *2017 Integrated Energy Policy Report*. California Energy Commission. Publication Number: CEC-100-2017-001-CMF.



“

It's up to you,
*and it's up to me
and tens of
millions of other
people ... to roll
back the forces
of carbonization
and join together
to combat the
existential threat
of climate change.*

”

*Governor
Edmund G.
Brown Jr.*

EXECUTIVE SUMMARY

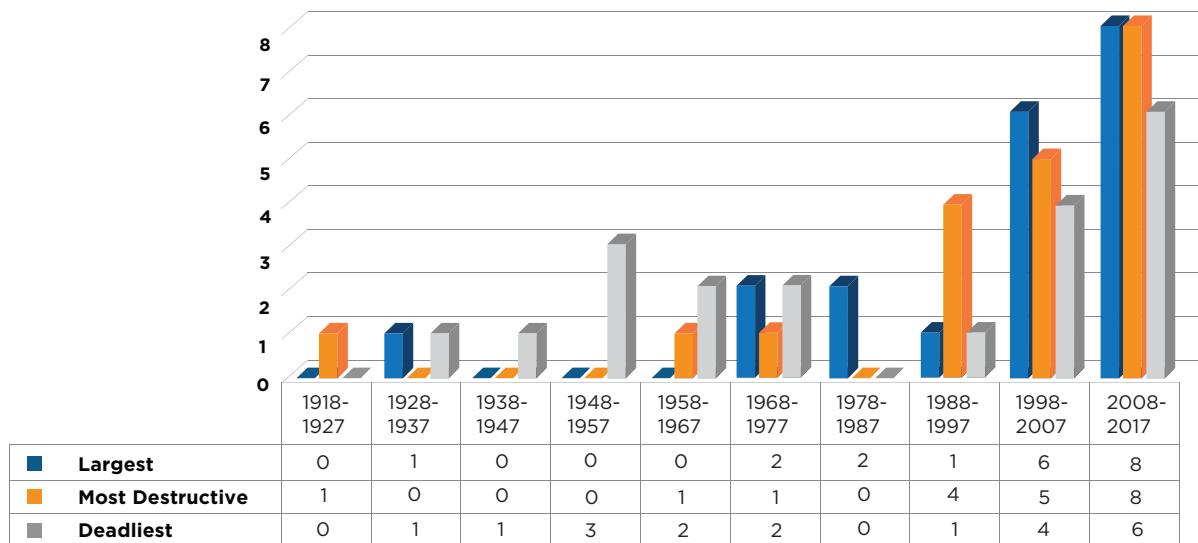
More than ever, critical action is needed to drastically reduce greenhouse gas emissions from California's energy system.

The state must further transform its energy system away from fossil fuels while maintaining the services Californians rely on at a reasonable price, including energy for lighting, heat on a cold day, air conditioning during a heat wave, and fuel to get to school, work, or vacation. California has made great progress, but the energy sector, when transportation is included, is the state's biggest source of greenhouse gas emissions.

California must continue to lower its greenhouse gas emissions to help reduce the risk of the most dangerous impacts of climate change. Because many greenhouse gases remain in circulation for decades, past emissions have already created climate change and more is unavoidable. If emissions continue on the current path, more destructive impacts are anticipated – such as continued large wildfires, additional sea-level rise, reduced snowpack, increased subsidence due to groundwater withdrawal, and more frequent heat waves, major storms, and drought. Californians are already facing the impacts of climate change. For example, about half of the 20 largest wildfires in California burned in the last decade with six of the state's largest, deadliest, and most destructive wildfires in 2017 alone. (See Figure ES-1.)

Figure E S-1:

The Largest, Most Destructive, and Deadliest California Wildfires



Source: California Energy Commission using data from http://cdfdata.fire.ca.gov/incidents/incidents_statsevents.

An open letter by prominent scientists and cosigned by Governor Edmund G. Brown Jr. in June 2017 argues that a rapid downward trend in greenhouse gas emissions must be initiated in the next three years to avoid the most extreme impacts of this unfolding global calamity. While a large task, transforming the energy sector also offers opportunity for innovation and economic growth. Governor Brown said, “It’s up to you, and it’s up to me and tens of millions of other people ... to roll back the forces of carbonization and join together to combat the existential threat of climate change.”

CALIFORNIA’S LEADERSHIP IN ADDRESSING CLIMATE CHANGE

Recognizing that California’s actions alone won’t be enough, Governor Brown continues to lead international and coordinated subnational efforts to address climate change, despite efforts by the federal administration to the contrary. Governor Brown championed the Subnational Global Climate Leadership Memorandum of Understanding (the “Under-2 MOU”), a commitment by cities, states,

and countries to help limit the rise in global average temperature to below 2 degrees Celsius. He was also a leader in achieving the Paris Agreement at the 2015 United Nations Climate Change Conference and was appointed the special advisor for States and Regions ahead of the 2017 conference.

In the Paris Agreement, nations worldwide agree to sufficiently reduce greenhouse gas emissions to avoid catastrophic climate change – but President Donald Trump has stated he intends to pull the United States out of it. The week after the President’s announcement, Governor Brown was in China discussing ways to collaborate to reduce emissions and help California’s clean technology industry grow there. The clean technology market in China is orders of magnitudes larger than the market in California and can help drive technology advancements and global greenhouse gas reductions. Partnerships with China and other nations and subnational governments committed to safeguarding their people from the challenges posed by climate can make a difference.



Governor Brown and the California Legislature remain resolute in addressing climate change. Executive Order B-30-15 set a greenhouse gas emissions reduction goal of 40 percent below 1990 levels by 2030 and established guiding principles for climate planning and funding. Senate Bill 32 (Pavley, Chapter 249, Statutes of 2016) codified the 2030 goal, and the companion bill, Assembly Bill 197 (Garcia, Chapter 250, Statutes of 2016), emphasized equitably implementing state climate change policies such that the benefits reach disadvantaged communities. The 2030 goal builds on the landmark California Global Warming Solutions Act (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006) requiring a 20 percent reduction in greenhouse gas emissions by 2020.

In Governor Brown's 2015 inaugural address, he said that California must "transform our electrical grid, our transportation system, and even our communities" to reduce greenhouse gas emissions. He set the following goals for 2030:

- Increase from one-third to 50 percent the state's electricity derived from renewable sources.
- Reduce today's petroleum use in cars and trucks by up to 50 percent.
- Double the efficiency of existing buildings and make heating fuels cleaner.

He further called on the state to:

- 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) codifies the goals for the electricity and natural gas sectors from the Governor's inaugural address. Implementation of SB 350 is a central topic of this *Integrated Energy Policy Report*.



REDUCING GREENHOUSE GAS EMISSIONS WHILE GROWING THE ECONOMY

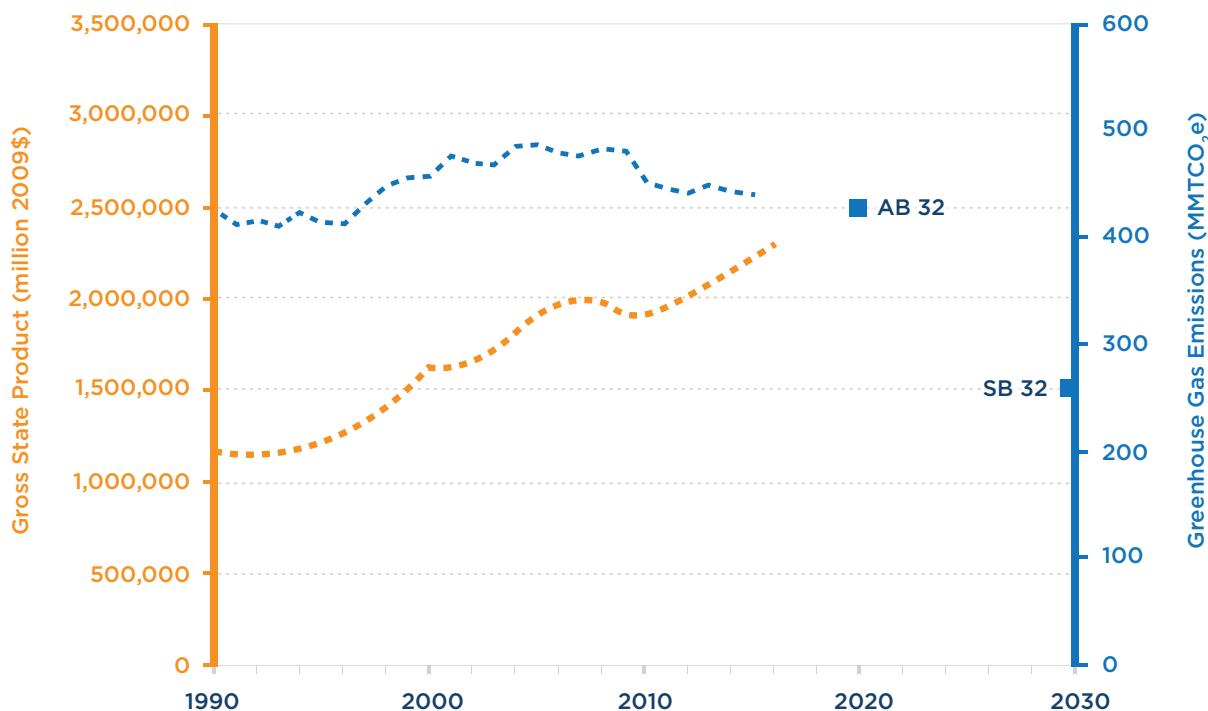
Economywide, California's 2015 carbon dioxide emissions (the most recent data available) were 1.5 million metric tons below 2014 levels – a 10 percent reduction from 2004. Since the peak in 2001, greenhouse gas emissions per gross state product have steadily declined by 33 percent, and the economy grew 37 percent. While California is making progress, this is no time to rest. Achieving a 40 percent reduction below 1990 levels by 2030 requires unprecedented reductions, as evident in Figure ES-2.

TRENDS IN GREENHOUSE GAS EMISSIONS IN THE TRANSPORTATION AND ELECTRICITY SECTORS

The transportation sector continues to dominate greenhouse gas emissions in California, accounting for 38.5 percent of the state's emissions in 2015, not including emissions from refineries that produce gasoline, which increase transportation sector emissions to about 50 percent of the statewide total. Further, motor vehicles are the largest source of air pollution that harms human health, overshadowing all other sectors

Figure ES-2:

California Has Reduced Its Greenhouse Gas Emissions While Growing Its Economy



Source: California Energy Commission staff using data from the California Air Resources Board Greenhouse Gas Inventories and gross state product data from the Bureau of Economic Analysis of the U.S. Department of Commerce. Note: Not shown is California's 2050 goal to reduce greenhouse gas emissions 80 percent below 1990 levels (Executive Order B-30-15).

and accounting for nearly 80 percent of nitrogen oxide emissions and 90 percent of diesel particulate matter emissions. (See Figure ES-3.)

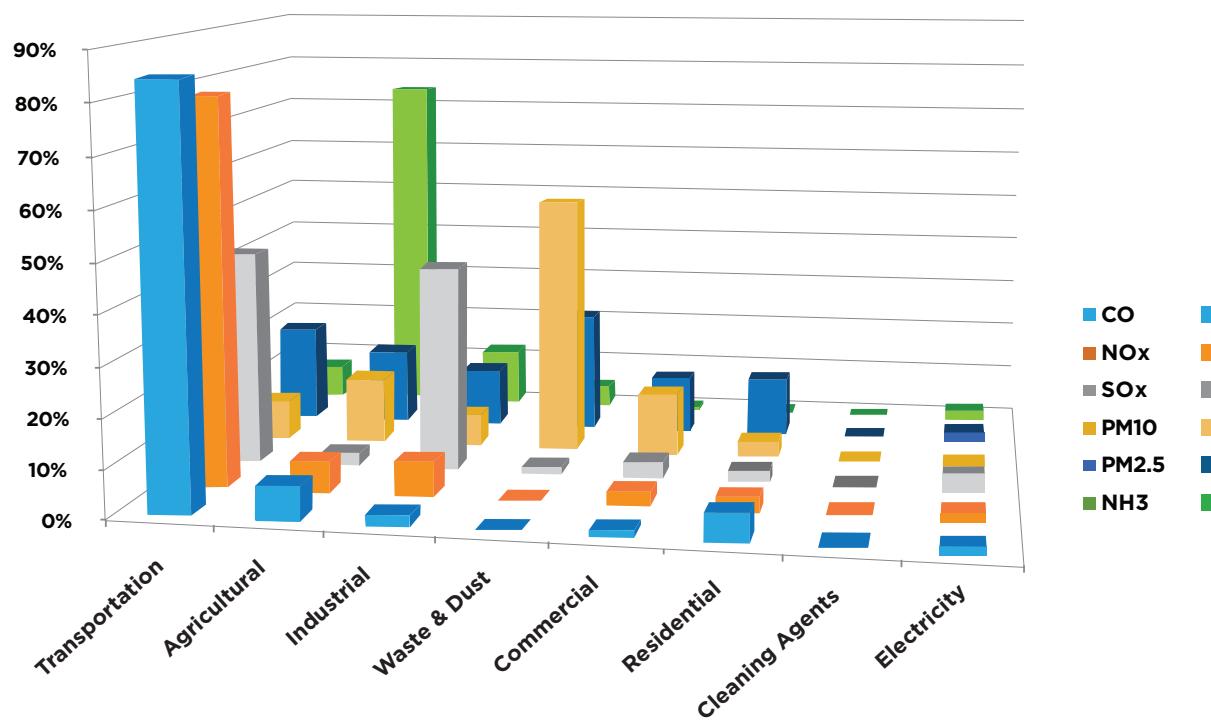
Because of these high emissions, a major push in California's energy policy is to shift from gasoline to zero-emission and near-zero-emission vehicles (ZEVs) that run on electricity from plug-in electric batteries, hydrogen fuel cells, or a combination of the two.

The electricity sector accounted for about 19 percent of the state's greenhouse gas emissions in 2015, with greenhouse gas emissions about 24 percent *below* 1990 levels in 2015. This reduction has been achieved even

with the closure of the zero-greenhouse-gas-emitting San Onofre Nuclear Generating Station in 2013 and low hydroelectricity production in 2015 due to drought. The reduced emissions in the electricity sector are in part attributable to an increase in renewable energy resources and a reduction in coal-fired electricity. Since California's Renewables Performance Standard was established in 2002, renewable-based electricity has increased by about 2.5 times. Since California's Emissions Performance Standard was enacted by Senate Bill 1368 (Perata, Chapter 598, Statutes of 2006), coal-fired electricity consumed in California has declined about 75 percent and is expected to be zero by 2026.

Figure ES-3:

California Air Quality Emissions per Sector (2012 Estimated Annual Average)



Source: California Energy Commission using California Air Resources Board data

TRANSFORMING CALIFORNIA'S ENERGY SYSTEM TO MEET THE 2030 GREENHOUSE GAS REDUCTION GOAL

As part of SB 350 requirements, the California Air Resources Board (CARB) will establish a greenhouse gas emission reduction target for the electricity sector share of economy-wide emission reductions. Through the *2017 IEP* proceeding, the Energy Commission and California Public Utilities Commission (CPUC) worked with CARB to split the target between the load-serving entities (LSEs) regulated by the CPUC (such as investor-owned utilities [IOUs] and community choice aggregators [CCAs]) and the publicly owned utilities (POUs).

SB 350 also requires a more comprehensive approach to energy planning specifically focused on meeting the 2030 greenhouse gas target. Through integrated resource plans, LSEs will identify the most cost-effective way to meet greenhouse gas reduction goals and other SB 350 goals, taking resources and customer base characteristics into account. Sixteen POUs (those that meet the threshold size requirements) will file their integrated resource plans with the Energy Commission, and the IOUs and other LSEs will file with the CPUC. In August 2017, the Energy Commission adopted guidelines for the POUs' integrated resource plans.

DOUBLE ENERGY EFFICIENCY SAVINGS BY 2030

The Energy Commission, working with the CPUC and POUs, is setting the path for doubling energy efficiency savings by 2030. SB 350 directs the Energy Commission to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a statewide cumulative doubling of energy efficiency savings in electricity and natural gas end uses by January 1, 2030. In November 2017, the Energy Commission adopted a doubling target and framework for achieving the goal. The framework includes:

- Utility-funded activities (ranging from incentives aimed at directly influencing consumer choices to those that target efficiency improvements in supply chains including manufacturers, contractors, and builders) and
- Nonutility-funded activities (such as advancing building and appliance codes, emerging technologies, innovative market solutions, progressive program designs, and public awareness).

In tandem with this work, the Energy Commission is improving its analytical capabilities to track and account for the doubling energy efficiency savings goal (as well as the increase in electric vehicles, rooftop solar, and other factors) into its electricity and natural gas forecast.



The forecast is used in energy planning efforts such as the CPUC's long-term procurement planning and the California Independent System Operator's (California ISO's) transmission planning.

ACHIEVE 50 PERCENT RPS BY 2030

The Energy Commission and CPUC have established rules for the 50 percent Renewables Portfolio Standard, and the IOUs are confident they will meet it.

As discussed in this and previous *IEPRs*, California is working to minimize the environmental and land-use impacts of new renewable energy and transmission projects needed to support its greenhouse gas goals. The Renewable Energy Transmission Initiative 2.0 (RETI 2.0), initiated in September 2015 and concluded in March 2017, brought together state and federal partners to identify constraints and opportunities for new transmission that may be needed to access and integrate new renewable energy resources to meet California's goals. As noted by Energy Commission Chair Robert B. Weisenmiller, California is "...pursuing an integrated strategy, and looking ahead at least 15 years to make sure we're doing the right things now to develop the options we'll need then. The RETI 2.0 process is helping the state's energy agencies, utilities, renewable industry, and residents narrow down our focus on where we might need new transmission." Building on the RETI 2.0 process

and supporting the needs outlined in utilities' integrated resource plans, the Energy Commission continues to develop landscape-scale planning applications that can be used by state and local planners as they consider renewable generation and infrastructure development.

ADVANCE TRANSPORTATION ELECTRIFICATION

SB 350 also emphasizes transportation electrification as a key part of California's low-carbon energy future. This emphasis builds on policies such as Governor Brown's Executive Order B-16-12, which set a target for California to have 1.5 million ZEVs on the road by 2025. In 2014, Senate Bill 1275 (De León, Chapter 530, Statutes of 2014) established the goal of placing 1 million zero-emission and near-zero-emission vehicles in service by January 1, 2023, while providing increased access to these vehicles for disadvantaged, low-income, and moderate-income communities and consumers. In 2017, CARB's proposed *Climate Change Scoping Plan Update* included a goal of 4.2 million ZEVs by 2030.

On January 26, 2018, Governor Brown issued Executive Order B-48-18, setting a new target for 5 million ZEVs on California's roads by 2030. The new executive order also sets a target of installing 200 hydrogen fueling stations and 250,000 ZEV chargers, including 10,000 direct current fast chargers, by 2025.



Planning for the growth in plug-in electric vehicles to advance “smart charging” (charging with internal controls that adjust to customer and grid needs) can help make the grid more resilient to variations in renewable generation and help reduce emissions, provided that pricing and charging infrastructure encourage charging at midday. Continued strategic investments are needed to ensure low-income customers, especially those living near heavily used freeways, also have access to the use of plug-in electric and fuel cell electric buses and vehicles and related economic and environmental benefits.

ADDRESS LOW-INCOME BARRIERS TO CLEAN ENERGY

Across the energy sector, the Energy Commission is working to ensure all Californians have an opportunity to participate in and benefit from Energy Commission programs that can lead to job creation and training, improved air quality, and energy efficiency and environmental gains. In coordination with other state agencies, the Commission is focusing on issues highlighted in the following SB 350 studies:

- Low-income barriers to energy efficiency and weatherization investments, photovoltaic energy generation investments, and small business contracting opportunities identified in the Energy Commission’s 2016 *Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income*

Customers and Small Business Contracting Opportunities in Disadvantaged Communities (Barriers Study).

- Low-income barriers to access to clean transportation technologies addressed in the companion study under development by CARB. A draft of CARB’s *Low-Income Barriers, Study Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents* was released on April 12, 2017.

In developing these studies, community meetings and public workshops provided opportunities for low-income customers and disadvantaged communities to highlight local priorities, concerns, and recommendations.

Climate change and air pollution disproportionately impact low-income and disadvantaged communities.

Local knowledge is a critical component of efforts to ensure clean energy investment enhances resilience to climate change.

The recommendations in the Energy Commission’s Barriers Study broadly address three key objectives: expand access (to products, good jobs, small business contracting opportunities, and nondebt financing); increase investment (such as in buildings, research demonstrations, infrastructure, and emergency preparedness); and improve resilience (including improving energy reliability, energy affordability, and health and safety) for California’s low income



communities and disadvantaged communities. The Energy Commission is developing indicators to measure progress implementing the recommendations in the Barriers Study and to help identify locations where further resources need to be directed.

CALIFORNIA'S EVOLVING ELECTRICITY SECTOR

As the state moves forward to achieve the goals identified in SB 350, the basic structure in which programs in the electricity sector have been implemented for decades is fundamentally changing. Traditionally, the IOUs have served about 75 percent of Californians, with POUs serving most of the rest. Energy planning has been fairly centralized; most of California's electricity planning needs have been addressed for the IOUs with CPUC oversight.

This structure is changing as consumer choice affecting both generation and consumption is proliferating, spurred by market developments, technological innovations, and policy actions. Californians are installing their own rooftop solar, numerous companies are contracting for renewable resources, and local government agencies are forming CCAs that can develop and buy electricity on behalf of their customers with relatively limited state oversight. IOU retail electric load could drop by 85 percent in the next decade.

As a result, the IOUs are not entering into long-term contracts for renewable generation or other energy products. However, there is considerable uncertainty about the ability of CCAs to secure the financing needed for long-term investments, because they are thinly capitalized shell companies. This uncertainty raises important questions about how roles traditionally filled by the IOUs will be met, including making needed investments in energy infrastructure, energy efficiency, energy services for low-income consumers, and research and development. While markets and technology innovations evolve quickly, regulatory mechanisms do not. Policy makers and regulators need to think ahead about how to ensure California's policy implementation successfully evolves with changing market conditions for IOUs and CCAs.

INCREASING RESILIENCY IN THE ELECTRICITY SECTOR

Amid this changing market structure, California's electricity grid must quickly make needed adjustments to support a low-carbon future. Unlike natural gas-fired generation, wind and solar vary depending on when the wind is blowing and the sun is shining. Integrating increasing amounts of solar and wind energy into the grid requires a greater emphasis on flexibility and resiliency. This is illustrated by the "duck curve" developed by the California ISO that shows the net load (load minus solar and wind



generation) on a typical spring day. (See Figure ES-4.) When solar electricity generation peaks at midday, the net load is low and is described as the “belly of the duck.”

When net load is lowest, the system operator works to get as many resources off the system as possible to make room for renewable generation, and sometimes has to curtail renewables. The state continues to explore beneficial uses of excess renewable energy, however, such as through storage for later use or to power desalination plants. As the system operator manages the deep drops in net load some resources need to be available to ramp up in anticipation of the evening drop in solar production

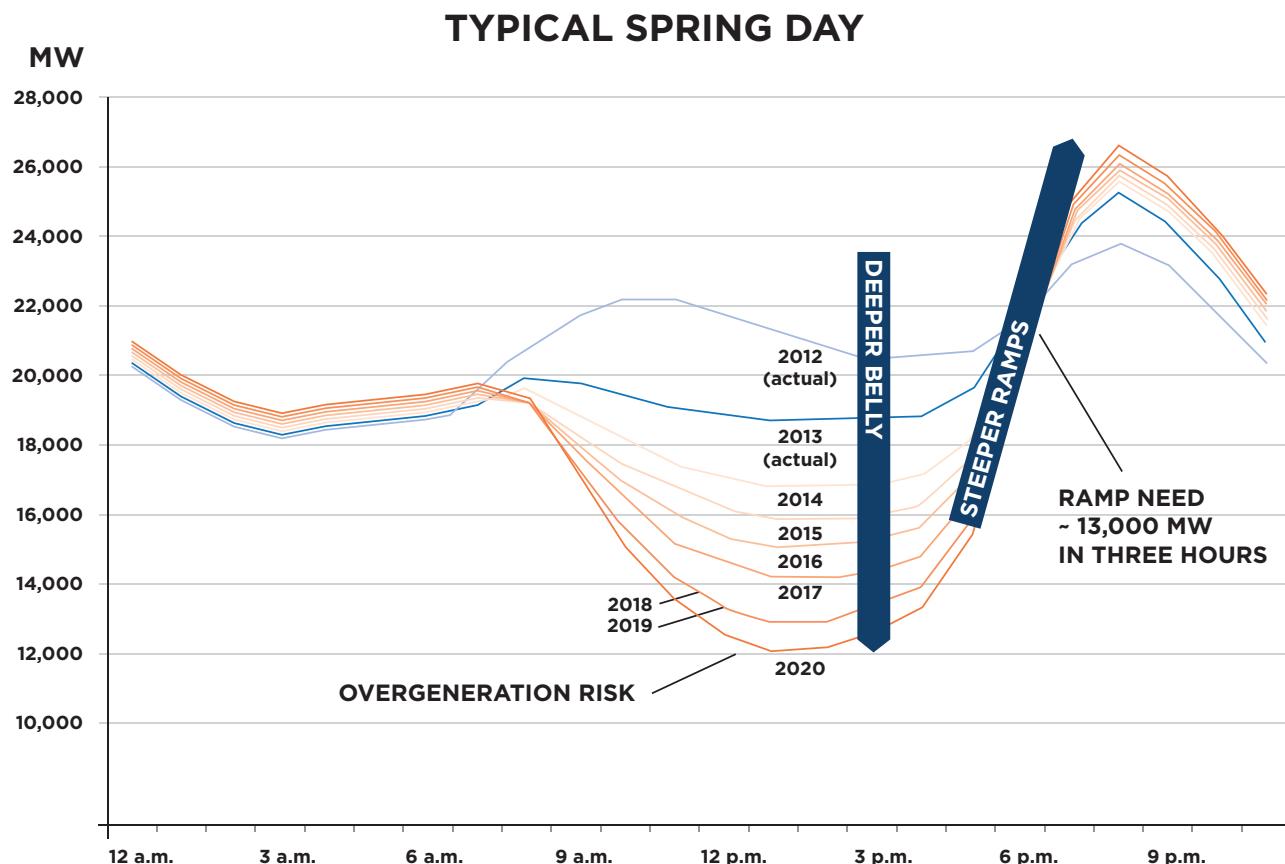
while demand remains high. The late-afternoon ramp from the belly of the duck up is approaching 13,000 MW in a three-hour period on some of the most extreme days. The duck curve illustrates the operational challenges for the California ISO but also presents opportunities for better managing the grid to maximize the benefits of renewables.

THE ROLE FOR RESPONSIVE AND STRATEGICALLY LOCATED NATURAL GAS-FIRED POWER PLANTS

Natural gas-fired power plants historically have been the workhorses of the grid and are capable of being turned up or down as needed in response to variations

Figure ES-4:

Duck Curve, Electricity Demand Minus Wind and Solar Generation on a Typical Spring Day



Source: California ISO, presentation by Mark Rothleder at May 12, 2017, IEPR workshop

in energy supply or demand. With the increase in renewables, natural gas power plants are operating less and less, and many have ceased operation or have gone bankrupt. In one sense, this is a success story in reducing greenhouse gas emissions, but some natural gas-fired power plants are important for the reliable operation of the grid, either by virtue of location or their ability to rapidly ramp up and down. The Energy Commission, CPUC, and California ISO need to work together to address how to ensure the availability of those plants that are needed to maintain the reliability and resiliency of the grid.

ZERO-GREENHOUSE GAS EMISSION SOLUTIONS

California needs to increasingly develop solutions to help integrate renewables that do not emit greenhouse gases, such as improving the operational flexibility and reliability of renewable power plants. With advanced controls, a test by the California ISO found that a utility-scale solar power plant could provide more resiliency to the grid than natural gas power plants. Improving short-term weather forecasting capabilities to better anticipate changes in renewable generation is also important. For example, monsoonal cloud cover over large solar facilities in the desert can quickly cause rapid drops of hundreds of megawatts and is difficult to predict.

Expanding the use and integration of distributed energy resources is a high priority for California to provide

customers low-greenhouse gas opportunities for meeting electricity demand, especially in the Southern California areas affected by the closure of the San Onofre Nuclear Generation Station in 2012 and the massive leakage of methane at the Aliso Canyon natural gas storage facility in 2016. Distributed energy resources include:

- Demand response, which has been used traditionally to shed load in emergencies. It also has the potential to be used as a low-greenhouse-gas, low-cost, price-responsive option to help integrate renewable energy and provide grid-stabilizing services, but California has a serious demand response underperformance problem. Solutions are available but require proactive leadership in the policy and ratemaking realms.
- Distributed renewable energy generation, primarily rooftop photovoltaic systems and also fuel cells.
- “Vehicle grid integration,” or all the ways plug-in electric vehicles can provide services to the grid, including coordinating the timing of vehicle charging with grid conditions.
- Energy storage in the electric power sector to capture electricity or heat for use at a later time to help manage fluctuations in supply and demand.

Microgrids combine distributed energy resources with a controller to manage energy use. A key feature of many microgrids is the ability to continue operating even if the surrounding electricity grid experiences an outage.



Further work is needed to make microgrids available on a commercial scale, especially in areas with vulnerable populations, disadvantaged communities, and tribes.

INCREASING RESILIENCY THROUGH GEOGRAPHIC RESOURCE DIVERSITY

Among the suite of tools available to increase the resiliency of a low-greenhouse-gas electricity system, increasing the regional scale of the electricity system provides the clearest benefits in terms of reducing costs and greenhouse gas emissions. Trading with partners across a larger footprint allows for purchases and sales between renewable power plants with differing seasonal and daily operating profiles. For example, when California has excess renewable generation, a regional electricity market can allow the generation to be sold instead of potentially curtailing operations, and when California needs more energy to meet ramping needs, more resources are available.

Initiated in 2014, the Western Energy Imbalance Market is a wholesale energy market that allows participants to buy and sell energy in real time. Its benefits have grown as more entities join and increase access to more

generation and transmission. (See Figure ES-5.) Through the fourth quarter of 2017, the Western Energy Imbalance Market has provided gross benefits of about \$288 million, avoided curtailment of more than 520 gigawatt-hours of renewable energy, and reduced greenhouse gas emissions by more than 222,600 tons of carbon dioxide equivalent emissions. In response to the Western Energy Imbalance Market, innovative market opportunities are evolving.

EXPLORING RENEWABLE GAS AS A TOOL TO REDUCE METHANE EMISSIONS

While carbon dioxide accounts for more than 80 percent of greenhouse gas emissions and is created when fuel is combusted, methane is more potent at trapping heat. It is a “short-lived climate pollutant” that accounts for about 9 percent of the state’s greenhouse gas emissions and is one of the greenhouse gases that Governor Brown called out in his 2015 inaugural address. Cattle, manure management, and landfills generate most of California’s methane emissions and emissions from California’s natural gas infrastructure account for about 10 percent.



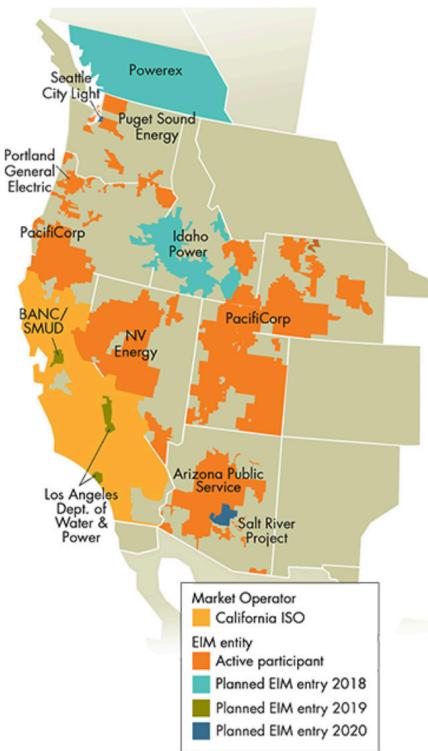
In response to Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016), CARB approved and began implementing a comprehensive short-lived climate pollutant (SLCP) strategy in March 2017 that includes strategies to reduce statewide methane emissions 40 percent below 2013 levels by 2030. SB 1383 also requires the Energy Commission, in consultation with CARB and the CPUC, to “develop recommendations for the development and use of renewable gas, including biomethane and biogas as part of its *2017 Integrated Energy Policy Report*.” Renewable gas has been used, or proposed for use, as a substitute for conventional natural gas in a variety of applications. Consistent with SB 1383, the *2017 IEPR* identifies “cost-effective strategies

that are consistent with existing state policies and climate change goals by considering priority end uses of renewable gas.” In this context, cost-effective strategies yield the lowest cost per SLCP reduction benefit in terms of greenhouse gas emissions reduced.

Two independent studies carried out by the University of California, Davis, and ICF International concluded that existing government policies (with some modifications) could support the substantial growth of renewable gas, particularly as a transportation fuel. Both studies noted that renewable gas production can generate up to four times the revenue for transportation fuel use compared to electricity from

Figure ES-5:

Existing and Future Western EIM Entities



Source: Western Energy Imbalance Market, <https://www.westerneim.com/Pages/About/default.aspx>, accessed January 2018

the same renewable gas sources because of the monetary value of credits generated from the federal Renewable Fuels Standard and California Low Carbon Fuel Standard for renewable transportation fuels. Renewable gas use in the medium- and heavy-duty vehicle sectors is an important strategy for improving air quality, and the Energy Commission's transportation forecast anticipates the growth of renewable gas use within those transportation sectors. Still, the market is constrained by a limited number of models and production volume of natural gas vehicles.

Additional policies may be needed, and agencies may also need to modify, reconfigure, and enhance existing regulations, policies, and programs to fully enable cost-effective commercialization of renewable gas and maximize methane emission reductions.

FIRST STEPS IN TRANSFORMING THE NATURAL GAS SECTOR

California's aggressive energy efficiency programs and increased renewable energy generation are reshaping its use of natural gas. In California, consumption has remained relatively flat over the last 10 years, while consumption in the United States has increased 2.4 percent per year. Although natural gas remains an important resource for heating, electricity production, and increasingly in transportation, the use of natural gas will need to decline dramatically for California to meet its long-term climate goals. In planning, utility executives are considering the use of renewable gas in the existing infrastructure, but concerns such as pipeline safety and leakage would need to be explored further and addressed.



ENERGY RELIABILITY CONCERNS IN SOUTHERN CALIFORNIA

The evolving role of natural gas is unfolding in Southern California, where ongoing reliability issues heighten the need to accelerate deployment of integrated distributed energy resources. The ability to maintain reliable electricity service in the Greater Los Angeles Area was first tested by the unexpected closure of the San Onofre Nuclear Generation Station in 2013, compounded by plans for the phased retirement of older natural gas facilities in the region that used marine water for cooling in once-through cooling systems. The Energy Commission, CPUC, and California ISO continue to work closely and take corrective action as needed to maintain

electricity system reliability. Most recently, the State Water Resources Control Board approved a request initiated by the agencies to defer the retirement of the Encina power plant temporarily to allow more time to complete the replacement facility in Carlsbad (San Diego County).

California must also consider the long-term role of natural gas as California continues ratcheting down its greenhouse gas emissions. In a letter from Energy Commission Chair Robert B. Weisenmiller to CPUC President Michael Picker dated July 19, 2017, the Chair wrote, “With the state’s climate target in mind, Governor Brown has asked me to plan for the permanent closure of the Aliso Canyon natural gas storage facility, and I urge the CPUC to do the same.”



PREPARING FOR CLIMATE CHANGE

While California works to transform its energy system, it must also prepare for the effects of climate change as discussed above including increases in wildfires (see Figure ES-1), sea-level rise, heat waves, and drought.

Several actions are underway, for example:

- As directed by Assembly Bill 2800 (Quirk, Chapter 580, Statutes of 2016), the California Natural Resources Agency announced the formation of the Climate-Safe Infrastructure Working Group. The working group will report to the Legislature by July 2018 on engineering standards that should be updated considering future climatic conditions.
- As stated in the *General Plan Guidelines: 2017 Update*, published by the Governor's Office of Planning and Research (OPR), Senate Bill 379 (Jackson, Chapter 608, Statutes of 2015) requires local governments to include a climate change vulnerability assessment, measures to address vulnerabilities, and a comprehensive hazard mitigation and emergency response strategy in the safety element of the general plan. OPR's Integrated Climate Adaptation and Resiliency Program Adaptation Clearinghouse provides access to information on funding, case studies, and tools and research (such as Cal-Adapt) to support adaptation planning by local governments.
- California's utilities are working with the Energy Commission and the CPUC to incorporate updated climate science research into utility risk assessment and infrastructure planning decisions.

Through science-based research, California is increasing its resilience to climate change. Through its implementation of SB 350, California is on a path to transform the electricity, natural gas, and transportation sectors to meet its 2030 greenhouse gas reduction goal. As Governor Brown said, "California, as it does in many areas, must show the way. We must demonstrate that reducing carbon is compatible with an abundant economy and human well-being. So far, we have been able to do that."



***California,
as it does in
many areas,
must show the
way.*** We must
demonstrate that
reducing carbon
is compatible
with an abundant
economy and
human well-
being. So far, we
have been able to
do that.

***Governor
Edmund G.
Brown Jr.***



