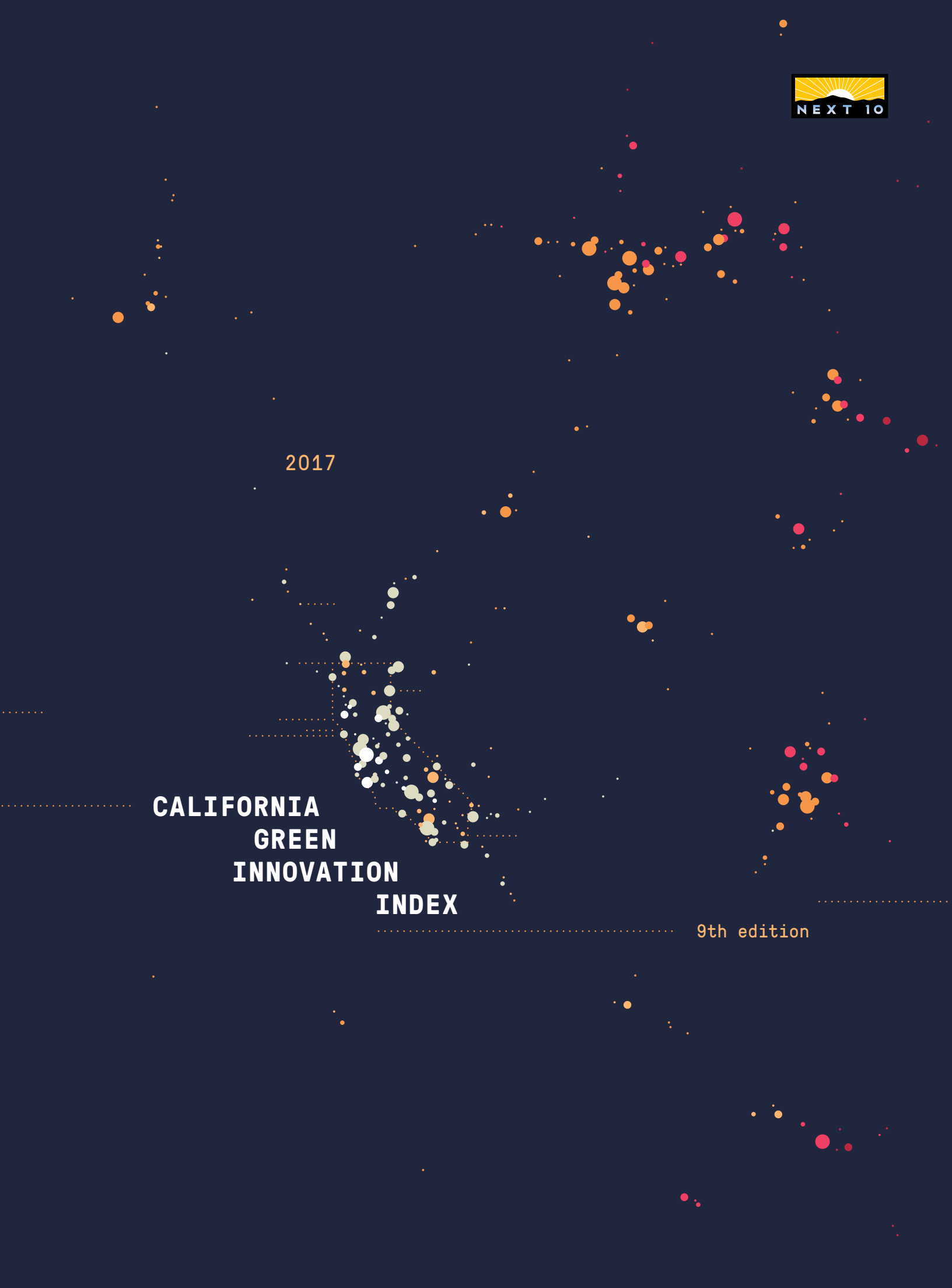
NEXT 10
2017
CALIFORNIA
GREEN
INNOVATION
INDEX
9th edition

Next 10's **CALIFORNIA GREEN INNOVATION INDEX** tracks the state's progress in reducing greenhouse gas (GHG) emissions, spurring technological and business innovation, and growing businesses and jobs that enable the transition to a more resource-efficient economy. The 2017 Index is the ninth edition published by Next 10.

Next 10 is an independent, nonpartisan organization that educates, engages and empowers Californians to improve the state's future.

Next 10 was founded in 2003 by businessman and philanthropist F. Noel Perry. Next 10 is focused on innovation and the intersection between the economy, the environment, and quality of life issues for all Californians.

For more information about the **CALIFORNIA GREEN INNOVATION INDEX**, please visit www.next10.org.

GDP GROSS DOMESTIC PRODUCT (inflation-adjusted to 2015 dollars)

2015 **$2.5** Trillion

1990–2015 **2.2%** Average annual growth

2015 **$63,898** Per capita GDP

POPULATION

2015 **39** Million

1990–2015 **1.0%** Average annual growth rate

Population Data Source: California Department of Finance.

Gross Domestic Product Data Source: Bureau of Economic Analysis.

Greenhouse Gas Data Source: California Air Resources Board, "2016 California Greenhouse Gas Inventory — by Sector and Activity." California Department of Finance.

Carbon Economy: California Air Resources Board, "2016 California Greenhouse Gas Inventory — by Sector and Activity." Bureau of Economic Analysis.

CALIFORNIA'S CARBON ECONOMY

2015 **1.77** 1990 **3.09**

Million metric tons of CO_2 equivalent / Inflation-adjusted GDP

CALIFORNIA EMISSIONS

TOTAL GHG EMISSIONS

2015 **440.4**[1] 2014 **441.5**

Million metric tons of CO_2 equivalent

1990–2015 **0.06%** Average annual growth

2014–2015 **-0.34%** One year growth

PER CAPITA GHG EMISSIONS

2015 **11.29** Metric tons of CO_2 equivalent

TARGETS: TOTAL GHG EMISSIONS

by 2020 **431** by 2030 **259** by 2050 **86**

Million metric tons of CO_2 equivalent

PRODUCED BY: NEXT 10

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Colleen Kredell
Stephanie Leonard

www.next10.org

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DESIGNED BY: CHEN DESIGN ASSOCIATES

Dear Californians,

AUGUST 2017

This year marks a turning point for our state, as we face federal inaction on climate change and the need to move beyond low-hanging emissions-reduction fruit locally if we are to hit our ambitious climate goals. The rate of decline of emissions reductions has slowed, and transportation emissions are up, at exactly the time we must be accelerating on this path. These are the results of the ninth annual California Green Innovation Index.

The first California Green Innovation Index was launched amidst a global recession, and yet California has produced consistent emissions reductions hand-in-hand with striking economic growth over the past nine years. Since the passage of AB 32 in 2006, California's GDP per capita has grown by nearly $5,000 per person — nearly double the national average — while California emissions per capita dropped by 12 percent.

It turns out that California's environmental standards aren't hurting the economy; in fact, they may be helping. Job growth in California post-AB 32 outpaced the rates of growth experienced prior to 2006, and outpaced total U.S. employment gains by 27 percent. Across the U.S., for every one job in fossil fuel generation, there are roughly 2.5 jobs in renewable generation. In California, each fossil fuel job is outnumbered by 8.5 jobs in renewable generation.

As political tides have shifted in the U.S., California remains a staunch defender of progress on climate and clean technology development. While Governor Brown has been working to promote the state's role in policy and clean tech development abroad, California legislators are working on the next generation of clean energy policies here at home. Bills recently passed by the legislature extend California's signature cap-and-trade program and another bill under consideration could increase the renewable energy portfolio standard (RPS) to 100 percent by 2050.

But even as California continues to demonstrate its policy leadership to promote clean energy innovation, challenges remain to help our state achieve its ambitious climate goals. Two of the most pressing issues include reducing transportation-related emissions and transitioning to a cleaner grid.

The transportation sector has historically been the largest source of California's emissions. While statewide emissions decreased from 2014 to 2015, transportation-related emissions increased by 2.7 percent. A more robust economy paired with falling gas prices have encouraged more driving while rising costs of living have pushed more residents further from job centers, increasing commute times by nearly 3 percent from 2014 to 2015. The state has moved to electrify transit, improve fuel efficiency, and promote greater adoption of zero-emission vehicles, but we have yet to see steep reductions in sector-wide emissions.

In order to achieve California's next RPS milestone by 2020, the state needs to increase renewable generation by 24 percent. Integrating renewables into our existing natural gas-dominated grid while ensuring reliability poses challenges. Overhauling the grid will require innovative technologies, including distributed energy and storage, while providing economic opportunity. Since the state set a target to increase storage, the industry has grown significantly in California, with energy storage providing 1 in every 6 jobs in its related sector, as compared to the U.S. average of 1 in 14.

Now, more than ever, it is critical that California maintains its leadership on clean energy innovation and collaborates with other state and national actors to reduce emissions. Solutions must create economic opportunity while minimizing costs to those most vulnerable. This year's Index takes a critical look not only at how far we have come, but also the challenges and opportunities to achieve continued success in climate change mitigation.

Sincerely,

F. Noel Perry

F. Noel Perry, *Founder*

300 BRANNAN STREET, SUITE 402 • SAN FRANCISCO, CALIFORNIA 94107

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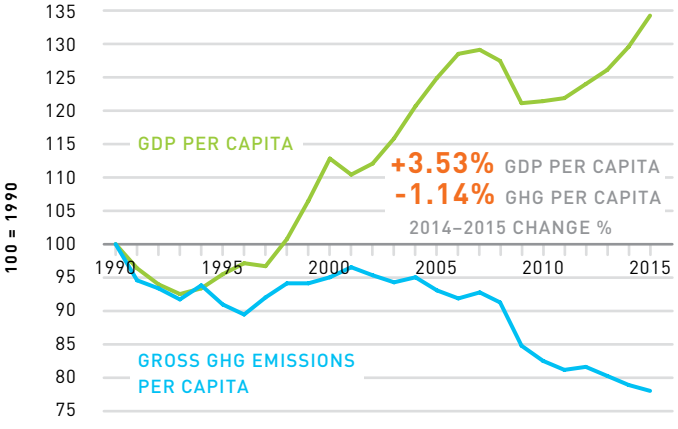
AT A GLANCE

GDP & EMISSIONS

CALIFORNIA, IN 2015 $



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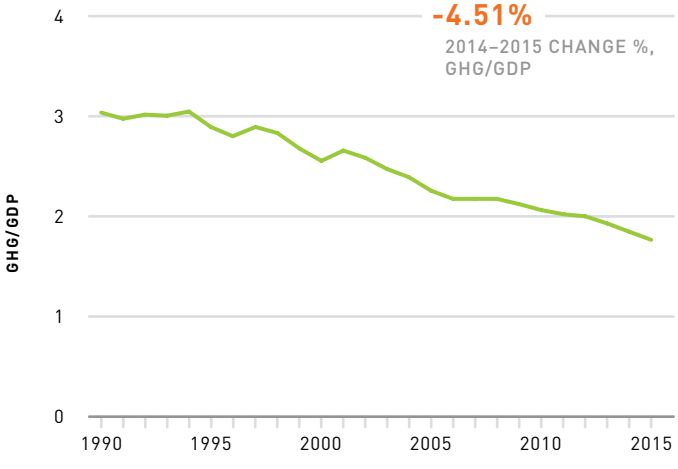
CARBON ECONOMY

CALIFORNIA, IN 2015 $



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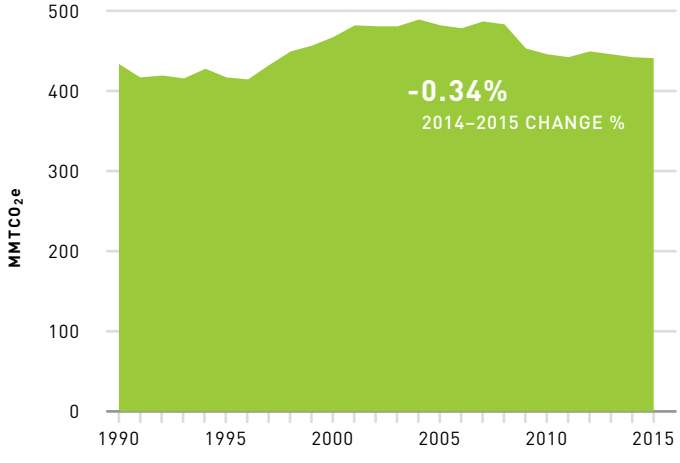
GHG EMISSIONS

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity. NEXT 10 / SF · CA · USA

ALTERNATIVE FUEL AND ZERO-EMISSION VEHICLE REGISTRATIONS

CALIFORNIA

	% CHANGE 14–15	% CHANGE 13–15
ELECTRIC	61.8%	212.9%
PLUG-IN HYBRID	33.1%	167.3%
NATURAL GAS	6.3%	20.5%
HYBRID	12.9%	30.6%
HYDROGEN	5.2%	14.4%
TOTAL ALTERNATIVE FUEL VEHICLES	14.5%	35.8%
TOTAL ZEV	45.5%	187.2%
TOTAL VEHICLES	2.7%	5.0%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Zero-Emission Vehicles include electric, plug-in hybrid, and hydrogen vehicles. Data Source: California Energy Commission.
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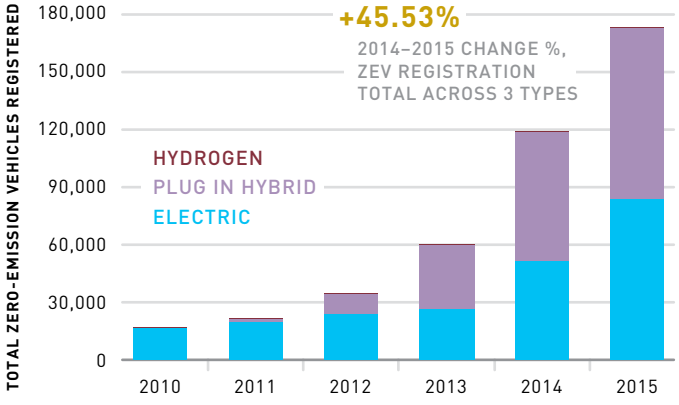
TRENDS IN TOTAL ZERO-EMISSION VEHICLE REGISTRATION

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission.
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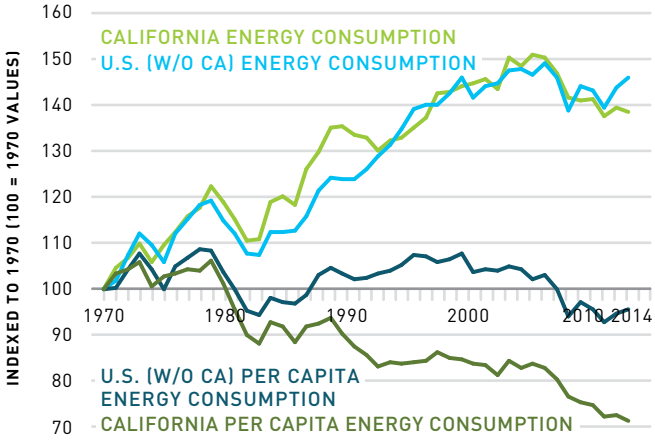
TOTAL ENERGY CONSUMPTION RELATIVE TO 1970

& PER CAPITA, CALIFORNIA & REST OF U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Census Bureau, Population Estimates Branch.
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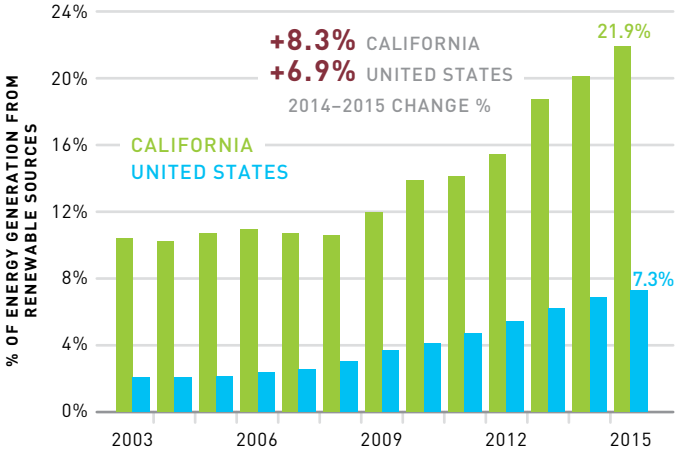
PERCENT OF TOTAL ENERGY GENERATION FROM RENEWABLE SOURCES

CALIFORNIA & U.S., 2003–2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission; U.S. Department of Energy, Energy Information Administration. NEXT 10 / SF · CA · USA

TOTAL CLEAN TECHNOLOGY PATENT RANKING

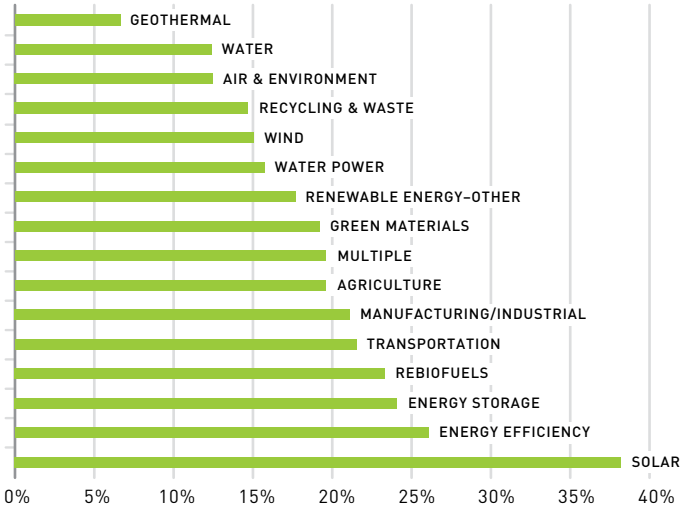
TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	5,119
2	TEXAS	1,655
3	MICHIGAN	1,526
4	NEW YORK	1,458
5	ILLINOIS	1,058
5	MASSACHUSETTS	1,034
7	WASHINGTON	908
8	FLORIDA	847
9	OHIO	839
10	PENNSYLVANIA	832

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: IP Checkups, CleanTech Patent Edge. NEXT 10 / SF · CA · USA

CALIFORNIA % OF U.S. PATENTS

2016



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: IP Checkups, CleanTech Patent Edge.
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THE CARBON ECONOMY

Why is it Important?

The global economy has traditionally been inextricably tethered to carbon-based energy sources. In the U.S., however, emissions data indicate a continuous shift away from carbon-based energy sources. In 2016, energy-related carbon dioxide emissions in the U.S. were 12.5 percent below their 2006 levels, despite continued economic growth.[2] The nationwide drop, which has persisted since the middle of the last decade, was due in large part to the electric power sector shifting away from coal and toward less carbon-intensive fuels.

Despite moves from the current federal administration to roll back policies that manage carbon-intensive energy sources, California continues to lead in implementing statewide policies that incentivize innovation in business, technology and carbon reduction. While California provides a strong template for others to follow in sustaining economic growth while pursuing climate change mitigation policies, there is still work to be done to ensure the state meets its emission reduction goals. Indicators relating to the carbon economy help track this progress and illustrate the changing relationship between economic vitality and environmental quality.

Carbon Economy Indicators

California ranks among the most efficient and least carbon-intensive economies in the world. The state's portfolio of climate policies, backstopped by its cap-and-trade program, has proven to be successful in reducing emissions, putting the state on track to meet its Assembly Bill 32 (AB 32) goal of reducing emissions to 1990 levels by 2020. The passage of AB 398 in July 2017, extending the state's cap-and-trade program to 2030, will help drive further emissions reductions required under SB 32, which seeks to reduce GHG emissions to 40 percent below 1990 levels by 2030. Between 1990 and 2014, California's emissions per dollar of gross domestic product (GDP) dropped by 40 percent, meaning that for the same amount of economic activity, the economy released significantly fewer emissions.

TABLE 1. NATIONAL CARBON ECONOMY RANKING*

LOWEST CARBON ECONOMY (EMISSIONS/GDP)

STATE	2014	2013	1990
NEW YORK	1	1	3
CALIFORNIA	4	4	4
FLORIDA	17	16	16
ILLINOIS	23	23	15
PENNSYLVANIA	29	30	32
OHIO	31	31	33
TEXAS	32	32	41

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. *All 50 U.S. states excluding D.C.
Data Source: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce. NEXT 10 / SF · CA · USA

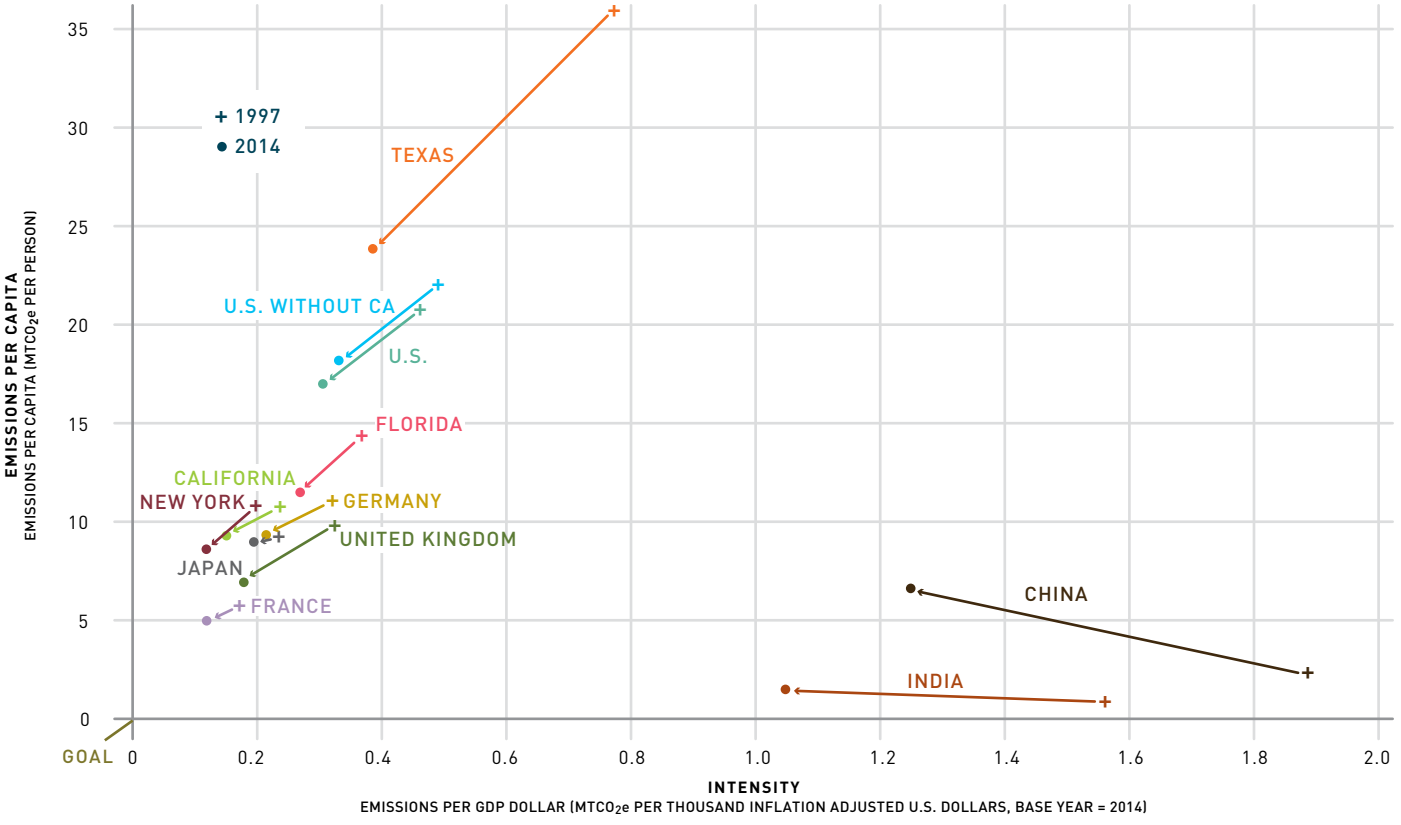
This continued trend demonstrates the state's success in decoupling emissions from economic growth.

California is relying less and less on carbon-based energy sources. In 2014 (the most recent year for which U.S. carbon emissions data is available), the state was the fourth least carbon-dependent in the U.S. behind only New York, Connecticut and Massachusetts (see Table 1).[3] That year, $10,000 of economic activity in the U.S. excluding California) resulted in 3.35 metric tons of CO_2 equivalent ($MTCO_2e$). By comparison, $10,000 of economic activity in California resulted in only 1.85 $MTCO_2e$ — roughly 55 percent less than the rest of the nation. Compared to the previous year, California's carbon-dependency improved by 3.7 percent while the U.S. (excluding California) improved by only 0.9 percent. California's economy was less carbon-dependent than the national average, as well as other large states.

When compared to countries, California performs relatively well in terms of carbon intensity (emissions per dollar of GDP, see Figure 1). California's emissions per dollar of GDP dropped 35 percent between 1997 and 2014, which was a greater improvement in carbon intensity compared to the U.S. as a whole (-32%), China (-34%), and Germany (-33%). Over the same period, California's carbon efficiency (emissions per capita) also improved, with per capita emissions decreasing 15 percent. By comparison, the U.S. as a whole decreased per capita emissions 17 percent and China's carbon efficiency rose 182 percent due to significant increases in standards of living. Texas continued to have one of the highest levels of total emissions in the U.S., but it saw a 50 percent decrease in carbon intensity and 34 percent decrease in per capita emissions from 1997 levels. In 2014, developed nations continued to trend towards a carbon-free economy while

FIGURE 1. GLOBAL FOSSIL FUEL COMBUSTION IN CALIFORNIA AND OTHER REGIONS

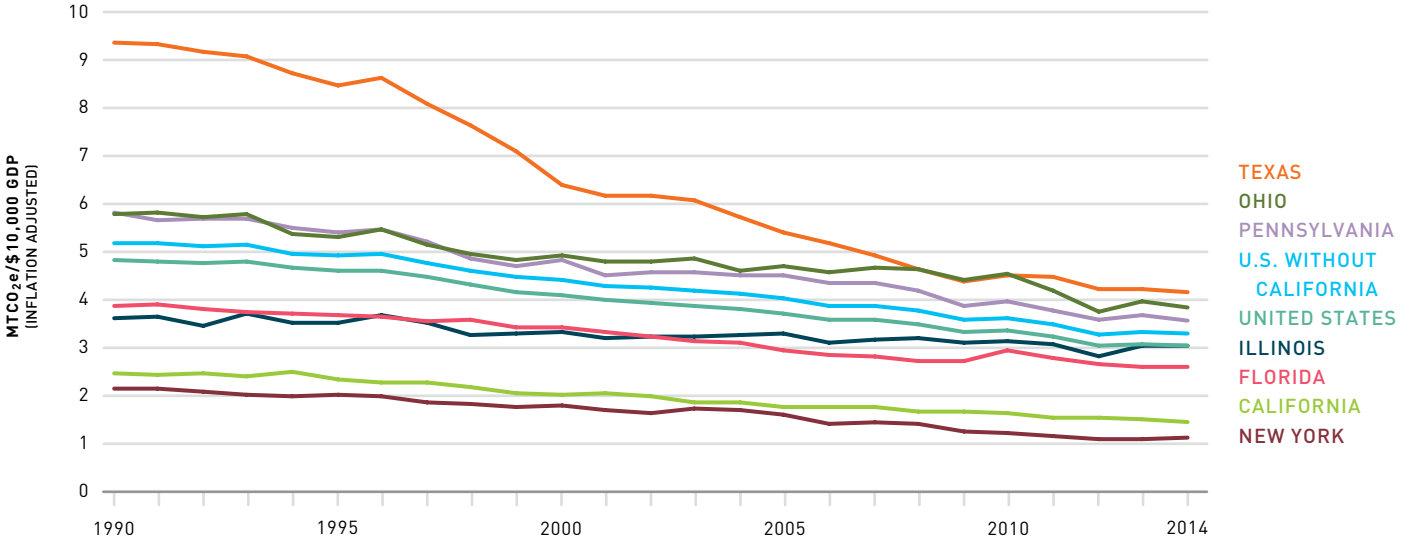
CARBON INTENSITY & EMISSIONS PER CAPITA 1997 TO 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GDP in Real 2014 U.S. Dollars. Greenhouse gas emissions are from consumption of energy. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis, USDA Economic Research Service; U.S. Census Bureau. NEXT 10 / SF · CA · USA

FIGURE 2. THE CARBON ECONOMY IN CALIFORNIA AND OTHER STATES

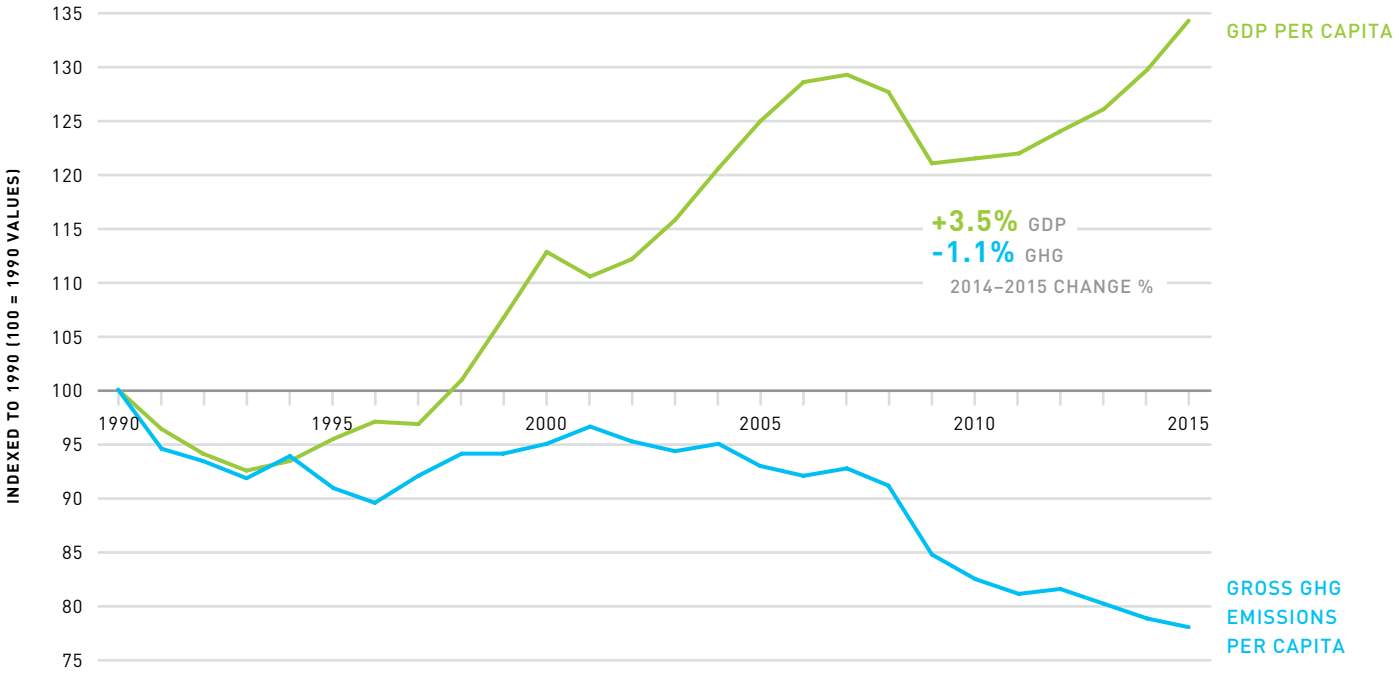
CARBON EMISSIONS (METRIC TONS) PER 10,000 DOLLARS GDP (2015 DOLLARS)



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. *GHG emissions data that allows for state-level comparison is from the Energy Information Administration and is limited to carbon emissions (fossil fuel combustion). Therefore, data represented here differs from analyses represented in other charts of total GHG emissions for California. Data Source: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce. NEXT 10 / SF · CA · USA

FIGURE 3. GREENHOUSE GAS EMISSIONS AND GROSS DOMESTIC PRODUCT

CALIFORNIA RELATIVE TRENDS SINCE 1990: GREENHOUSE GAS EMISSIONS ($MTCO_2e$) & GDP DOLLARS PER CAPITA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce; U.S. Census Bureau. NEXT 10 / SF · CA · USA

per-capita emissions rose in carbon-intensive developing economies such as China and India.

The sources of California's emissions from energy consumption were comprised of 63 percent petroleum use, 36 percent natural gas and one percent coal in 2014. The lack of coal use in California is in stark contrast to other large states where coal continues to contribute a sizable percentage of carbon emissions, such as Ohio (43%), Pennsylvania (40%), Illinois (41%), and Texas (23%).[4] States where coal makes up a higher share of carbon emissions also tend to have higher total energy consumed per capita.[5] Meanwhile, in 2014, 63 percent of energy-related emissions in California were a result of extracting, refining, and burning petroleum, compared to 48 percent in Florida, 43 percent in Texas, and 34 percent in Illinois — states that also host large populations and diverse economies.

Greenhouse gas emissions per capita in California decreased 1.1 percent in 2015 compared to 2014, with overall emissions decreasing while population increased slightly, reaching 11.3 $MTCO_2e$ per person in 2015. Greenhouse gas emissions per capita dropped 22 percent since 1990 (Figure 3). This long-term efficiency improvement has been achieved while the economy has continued to grow, as evidenced by a 34 percent jump in GDP per capita since 1990 and 3.5 percent increase since 2014.

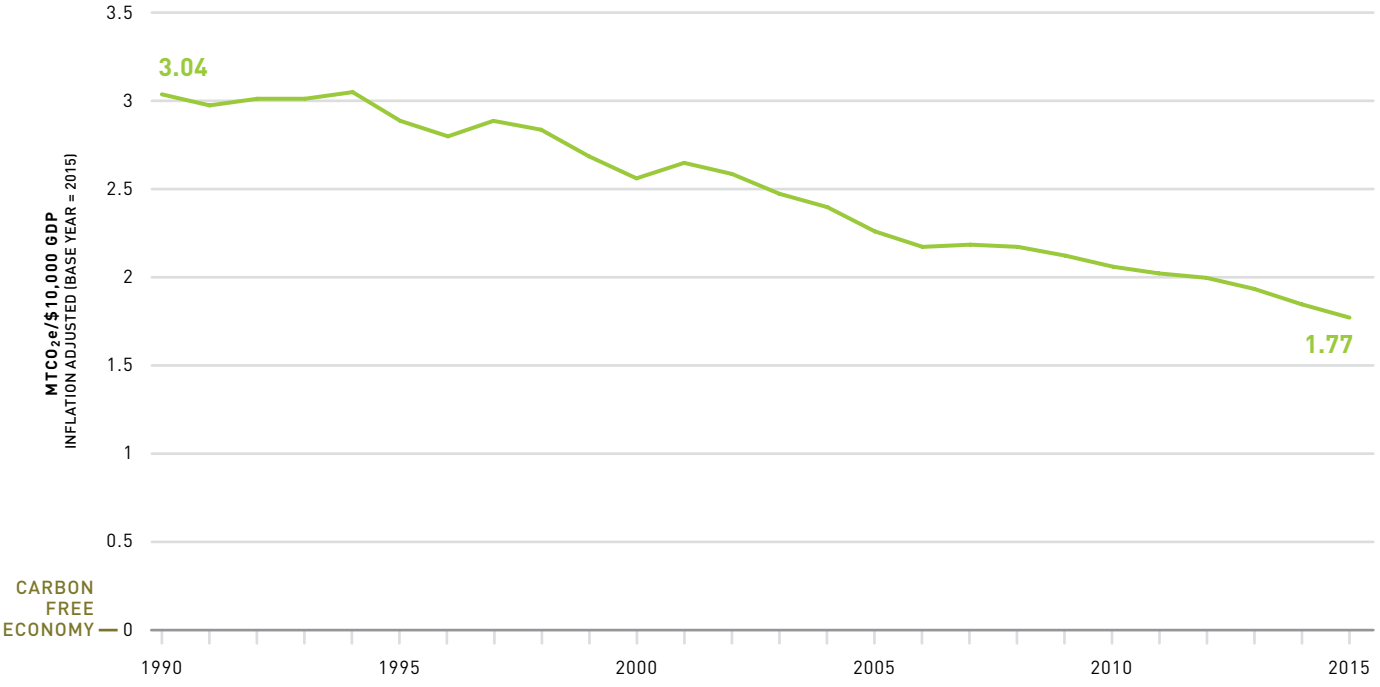
There continues to be a steady decline in the carbon intensity (emissions per GDP) of the California economy, with emissions of 1.77 $MTCO_2e$ per $10,000 of GDP generated in 2015. This marks a 4.5 percent improvement from 2014 and a 14.5 percent improvement since 2010.

Total GHG emissions in California fell slightly in 2015 compared to 2014, down 0.34 percent to 440.36 million $MTCO_2e$ — despite a 2.7 percent increase in emissions from the transportation sector, which accounts for the largest share of the state's GHG emissions.[6] Persistent drought conditions from 2011 to 2016 precipitated the continued decline of hydroelectric power generation in the state, down 18 percent in 2015 compared to 2014 and 60 percent compared to 2011. Hydropower provides an emissions-free energy source for Californians, but when there is a low availability of hydroelectric power, electricity from natural gas replaces it.

California's dependency on electricity from natural gas — a fossil fuel — is also trending down. Compared to 2014, in-state generation and total consumption of electricity generated from natural gas were down 3.6 percent and 1.8 percent, respectively, in 2015. Furthermore, the U.S. Energy Information Administration estimates that as of April 2017, with the drought now ended, increased hydroelectric generation and

FIGURE 4. THE CARBON ECONOMY

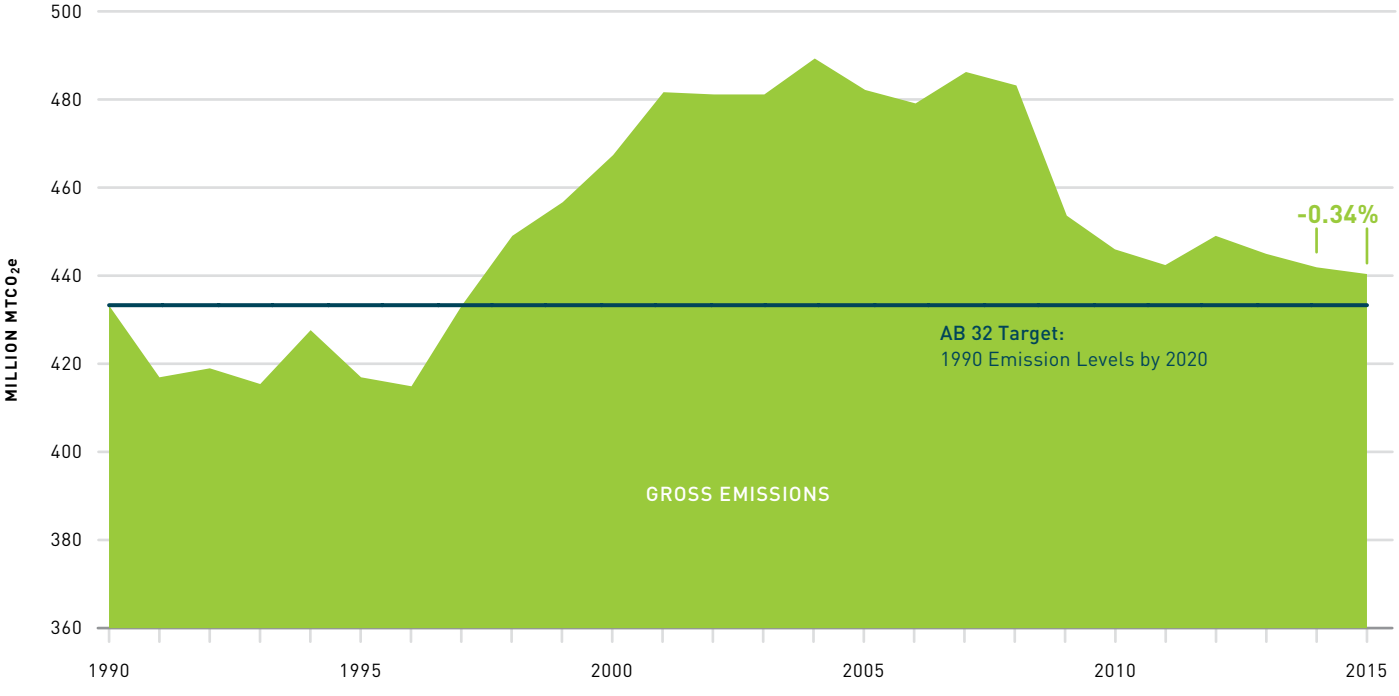
GROSS EMISSIONS RELATIVE TO GROSS DOMESTIC PRODUCT, CALIFORNIA 2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce. NEXT 10 / SF · CA · USA

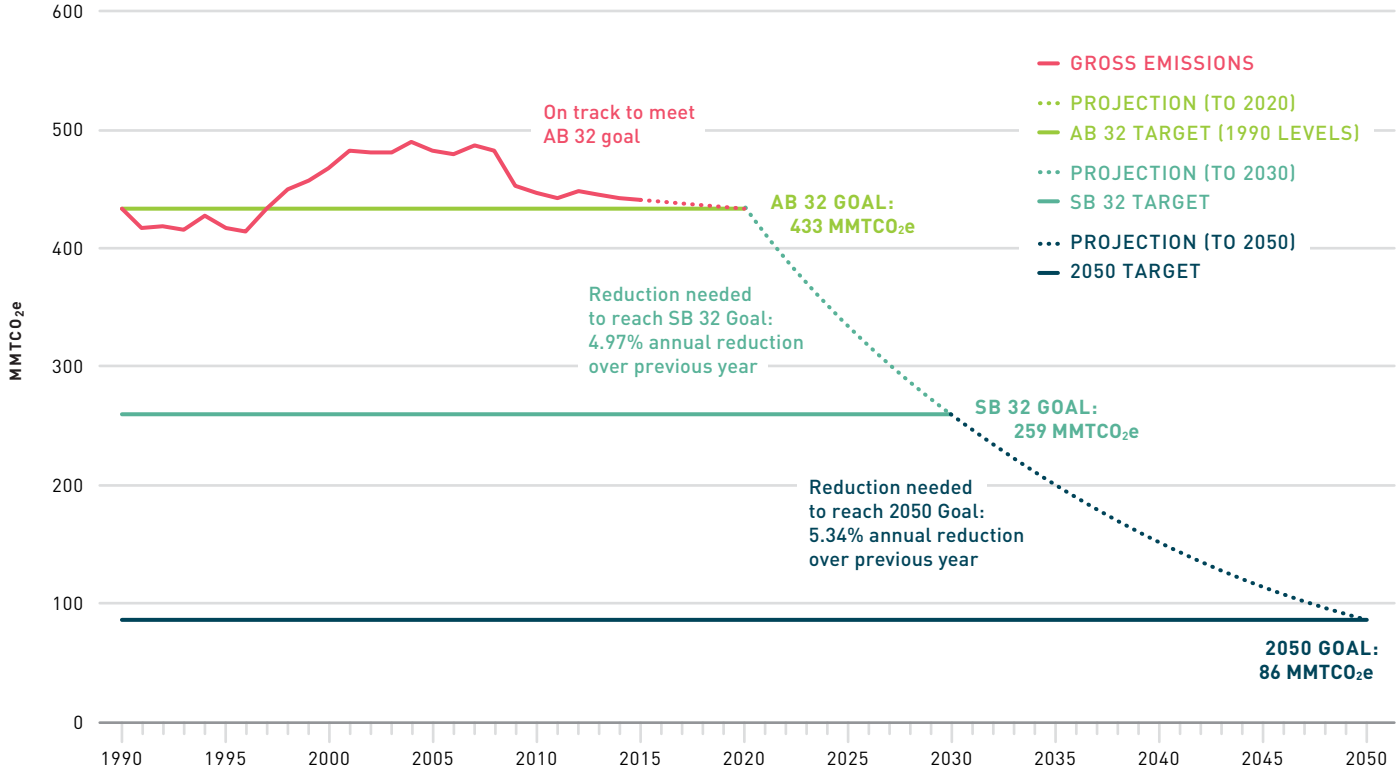
FIGURE 5. TOTAL CALIFORNIA GREENHOUSE GAS EMISSIONS

GROSS ANNUAL EMISSIONS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Gross greenhouse gas emissions (GHG) includes fossil fuel CO_2, with electric imports and international fuels (carbon dioxide equivalents) and noncarbon GHG emissions (in CO_2 equivalents). Noncarbon GHG emissions are made up of Agriculture (CH_4 and N_2O), Soils, ODS substitutes, Semi-conductor manufacture (PFCs), Electric Utilities (SF_6). Cement, Other Industrial Processes, Solid Waste Management, Landfill Gas, and Wastewater, Methane from oil and gas systems, Methane and N_2O from Fossil Fuel Combustion. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity. NEXT 10 / SF · CA · USA

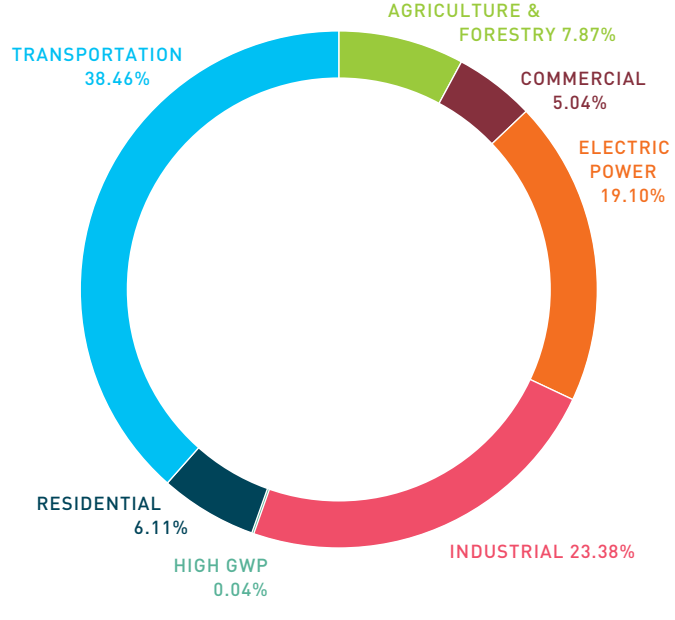
FIGURE 6. GHG EMISSIONS AND PROJECTED REDUCTION GOALS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory. NEXT 10 / SF · CA · USA

FIGURE 7. GREENHOUSE GAS EMISSIONS BY SOURCE

CALIFORNIA, 2015



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solar power generation have contributed to a recent decrease in natural gas-fired power generation.[7]

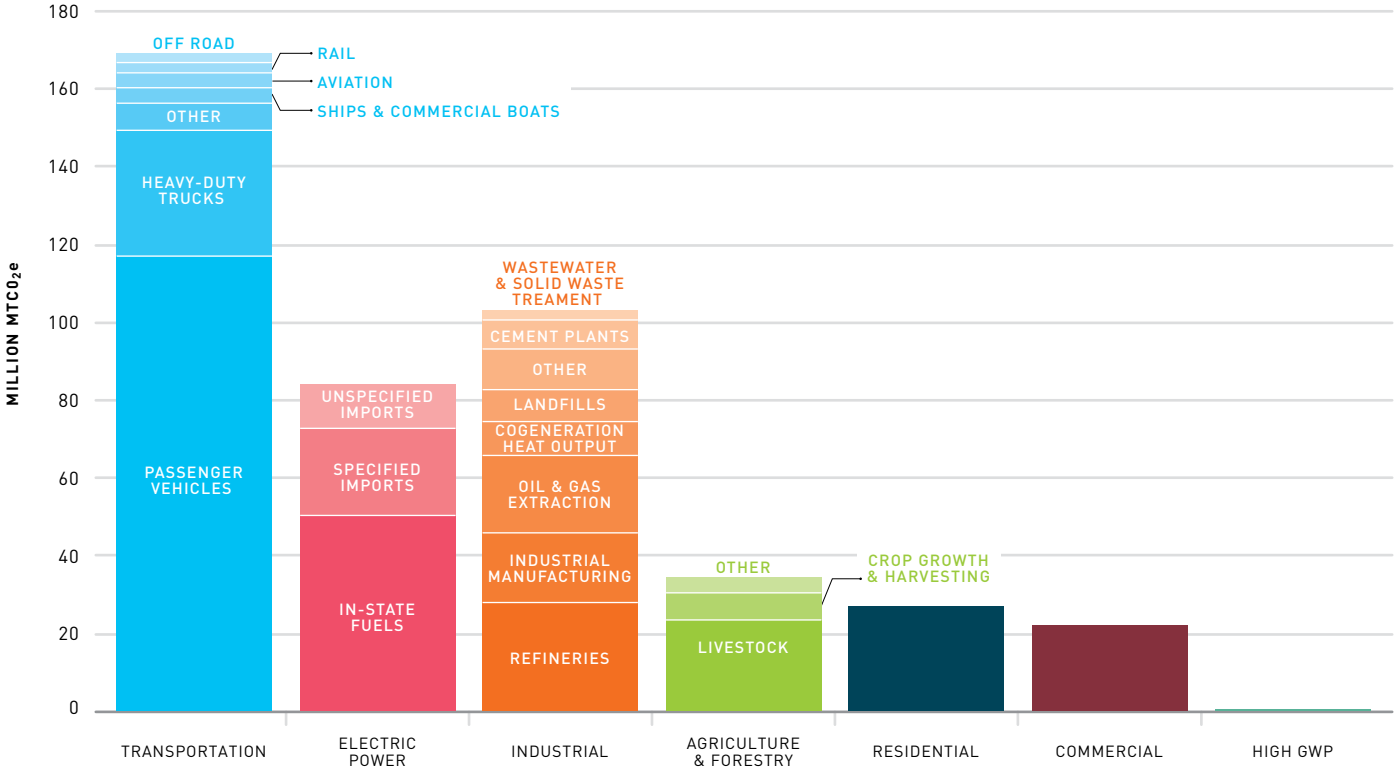
The transportation sector continued to account for the largest portion (38.5%) of California's GHG emissions, followed by the industrial (23.4%) and electric power sectors (19.1%). The California Air Resources Board collects GHG emissions data by direct source of emissions rather than by end-user.

Transportation (38.5%): Emissions from all transportation sources accounted for 38.5 percent of California's total emissions, up from 37.3 percent of the total in 2014. About 69 percent of transportation emissions came from on-road passenger vehicles and 19 percent from on-road heavy-duty trucks. Other sources, including ships and boats, locomotives, off-road vehicles, and domestic (intrastate) aviation, accounted for the remaining 12 percent of total transportation emissions.

Industrial (23.4%): Industrial activities contributed roughly 23.4 percent of California's emissions in 2015, up 0.3 percent of the total from 2014. Of these emissions, 27 percent came from petroleum refining, with oil and gas extraction (19%) and industrial manufacturing (17%) representing the next largest sources. Other emissions from industrial sources included

FIGURE 8. GREENHOUSE GAS EMISSIONS BY DETAILED SOURCE

CALIFORNIA, 2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity. NEXT 10 / SF · CA · USA

cogeneration (9%), landfills (8%), cement plants (7%), and wastewater and solid waste treatment (2%).

Electric Power (19.1%): Greenhouse gas emissions related to electricity generation contributed almost 20 percent to California's total emissions in 2015, down 0.9 percent from 2014. Of these emissions, in-state electric power generation (including from natural gas and other fuels) accounted for 60 percent, while 40 percent was derived from electric power imports.

Agriculture and Forestry (7.9%): Emissions from agriculture and forestry represented roughly eight percent of California's total emissions in 2015, down 0.3 percent from 2014. Livestock operations accounted for 66 percent of total agriculture and forestry emissions. Crop growth and harvesting accounted for 22 percent of emissions, while the remainder (12%) came from other sources such as soil cultivation and agricultural residue burning.

Residential (6.1%): The residential sector comprised 6.1 percent of total emissions in the state in 2015, up 0.2 percent compared to 2014. Residential sector emissions are largely from combustion of natural gas and other fuels to heat houses and buildings, prepare food, and heat water. The increase may be partially attributed to the emissions associated with the replacement of ozone-depleting substances (namely hydro-fluorocarbon-based pollutants used in refrigeration and air conditioning) with substitutes and the record heat wave in 2015 that caused many Californians to use air conditioning more than usual.

Commercial (5.0%): Emissions from commercial fuel combustion and cogeneration heat output accounted for five percent of emissions statewide in 2015, up 0.2 percent compared to 2014. The vast majority of these emissions were from combustion of natural gas and other fuels for uses such as heating buildings and usage of substitutes for ozone-depleting substances. While usage of substitutes for ozone-depleting substances make up a small share of total GHG emissions, its associated GHG emissions went up 257 percent compared to 2005, growing considerably faster than GHG emissions from other subsector activities.

High Global Warming Potentials (GWP) (0.04%): High GWP not incorporated into other categories, as well as unclassified fugitive greenhouse gas emissions, made up well below one quarter of one percent of California's total in 2015. These emissions came largely from evaporative losses of chemicals and solvents.

California's Challenge in Reducing Emissions from the Transportation Sector

In 2015, GHG emissions totaled 440.36 million $MTCO_2e$ in California, down 1.49 million $MTCO_2e$, 0.3 percent, from 2014. However, GHG emissions from the state's transportation sector increased by 4.49 million $MTCO_2e$, 2.7 percent, compared to 2014.

While the Golden State remains on track to achieve the statewide carbon reduction goal set in AB 32, the uptick in transportation sector emissions reinforces the importance of sustaining and ratcheting down the state's suite of clean transportation policies to deliver on the much more aggressive 2030 target.

Most of the increase was due to an increase in emissions from on-road transportation, which jumped 3.1 percent. It appears that emissions from light-duty vehicles accounted for the entire increase in GHG emissions. As gasoline prices fell starting in late 2014, motorists traveled more — an additional 2.7 billion vehicle miles traveled (VMT) in 2015 — and consumption of gasoline increased. While the percentage increase in VMT was roughly in pace with population increase, as the cost of driving went down it appears some people abandoned public transportation for driving, as evidenced in Figures 15 and 16. As shown in the following tables, both rail and bus emissions decreased during this time, due in part to the state's efforts to transition vto cleaner fuels and to electrify public transportation.

Meanwhile, emissions from heavy-duty vehicles actually dipped slightly. Despite an increase in light-duty truck and SUV sales,[8,9] these vehicle types only accounted for 1.9 million $MTCO_2e$ of the 4.9 million $MTCO_2e$ increase in GHG emissions; increase in emissions from passenger cars (+2.9 million $MTCO_2e$) actually outpaced that of light-duty trucks and SUVs. The underlying reasons for why passenger cars' emissions outpaced those of light-duty trucks and SUVs, despite the former trailing the latter in recent sales growth, are complex. Potential reasons include worsening road conditions and increased congestion.

TRANSPORTATION SECTOR GHG EMISSIONS CHANGE

	2014 MILLION $MTCO_2e$	2015 MILLION $MTCO_2e$	YoY CHANGE %
AVIATION	3.9	4.2	8.2%
NOT SPECIFIED	6.9	6.9	0.3%
OFF ROAD	2.4	2.5	4.1%
ON ROAD	145.0	149.4	3.1%
RAIL	2.7	2.4	-12.0%
WATER-BORNE	4.0	3.9	-1.6%
TRANSPORTATION	164.9	169.4	2.7%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity.
NEXT 10 / SF · CA · USA

ON ROAD TRANSPORTATION GHG EMISSIONS CHANGE BREAKDOWN

	2014	2015	YoY CHANGE %
ON ROAD	145.0	149.4	3.1%
HEAVY-DUTY VEHICLES	32.9	32.4	-1.5%
HEAVY-DUTY TRUCKS	30.3	29.9	-1.4%
BUSES	2.1	2.0	-2.6%
MOTORHOMES	0.5	0.5	-1.4%
LIGHT-DUTY VEHICLES	111.2	116.1	4.4%
LIGHT-DUTY TRUCKS & SUVS	57.9	59.9	3.4%
MOTORCYCLES	0.4	0.5	5.3%
PASSENGER CARS	52.8	55.7	5.6%
NOT SPECIFIED	6.9	6.9	0.3%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity.
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OVERVIEW

California's cap-and-trade program is one of the state's signature programs designed to meet AB 32's requirement to reduce emissions to 1990 levels by 2020. The cap-and-trade program involves setting a cap on emissions from sources responsible for 85 percent of California's GHG emissions, and issuing allowances that give entities permission to release a specified amount of emissions. Private entities may trade these allowances and can stay below their emissions limits by upgrading to more efficient technologies or can raise those limits by purchasing extra allowances from other private entities. As of May 2017, California has held nineteen quarterly auctions, eleven of which are joint auctions with Quebec. These auctions have cumulatively generated more than $4.9 billion for the Greenhouse Gas Reduction Fund (GGRF).[10]

In September 2016, the state's climate goals were strengthened under SB 32, which seeks to reduce GHG emissions to 40 percent below 1990 levels by 2030. As the state looks to expand emissions reduction programs and better target projects to serve disadvantaged communities, the cap-and-trade program and auction proceeds will continue to serve a vital role in achieving these climate goals. Approximately one-third of the funding appropriated from the GGRF is intended to benefit disadvantaged communities, exceeding the mandate in SB 535. Reductions from large GHG-emitting facilities — which are disproportionately located in disadvantaged communities[11] — will not only help continue to drive statewide emissions down but may also deliver environmental and health benefits to the communities most impacted by carbon pollution.[12]

UPDATES

After an appellate court upheld the program in April, the joint auction held on May 16, 2017, resulted in the sale of 75.3 million in current vintage allowances and 2.1 million in advanced vintage allowances. In other words, all available current vintages and just fewer than 22 percent of the future vintages were sold. The perceived legal uncertainty about the cap-and-trade program beyond 2020 may have contributed to the volatile auction proceeds over the past year or two. For example, the May 2016 and August 2016 auctions sold just 8.2 million (11 percent of all available vintages) and 30.8 million allowances (32 percent of all available vintages), respectively, while the November 2016 auction sold 78 million allowances (80 percent of all available vintages).[13] The pending court case was dismissed by the California Supreme Court in June 2017, providing a more stable future outlook for the program.

This uncertainty was laid to rest in July 2017, when the state Senate and Assembly voted to pass AB 398 (Eduardo Garcia, 2017). AB 398 extends the cap-and-trade program out to 2030, and allows the government to raise revenue from auctioning allowances without the risk of litigation. A companion bill, AB 617 (Cristina Garcia, 2017), allows for greater measures to monitor and reduce toxic air pollution, particularly in disadvantaged areas. Assembly Constitutional Amendment No. 1 (Mays, 2017) would require a two-thirds vote of the state legislature to spend cap and trade revenue.

AB 1532, SB 535, and SB 1018 serve as the framework for investing cap-and-trade auction proceeds in the GGRF, where funds are appropriated through the California budget for climate investments that maximize benefits to the state while reducing GHG emissions. Previously, SB 535 required that a minimum of 25 percent of investments be allocated to projects that benefit disadvantaged communities, and that a minimum of 10 percent of these projects be located within those disadvantaged communities. AB 1550, which was signed into law in September 2016, modified the investment minimums by requiring at least 25 percent of GGRF funds go to projects within and benefitting disadvantaged communities. The new law requires an additional minimum of five percent be invested in projects that are located within and benefiting individuals living in low-income communities or benefiting low-income households statewide, and an additional minimum of five percent that are located within a half mile of a disadvantaged community.

In FY 2016–17, the Legislature and Governor appropriated more than $1.133 billion for existing and new programs. As of December 2016, about $3.4 billion in climate investments was appropriated for GHG reduction programs, $1.2 billion of which had been implemented to date. These implemented projects are estimated to reduce GHG emissions by 15.2 million $MTCO_2e$ over the course of the projects' lifetimes.[14] Of the $1.133 billion appropriated in FY 2016–17, the largest share ($369 million) was invested in a program to help California meet its 2020 and 2025 zero-emission vehicle goals and other low carbon transportation projects. Of the new programs, $140 million were appropriated to the Transformative Climate Communities Program, which was created under AB 2722 in September 2016.

Thirty-four percent of the $1.2 billion that California Climate Investments, which funds a portfolio of state agency programs, has implemented is for projects located in disadvantaged communities, exceeding SB 535 goals. In addition, $614 million, 50 percent of funding implemented, is for projects benefitting disadvantaged communities, not including high-speed rail. Projects have been distributed across the state, covering 97 percent of disadvantaged community census tracts, up 10 percent from a year ago. For example, Los Angeles has the Green Omni Terminal Demonstration Project, which is a microgrid that enables the terminal to operate off the grid, and a fleet of new and retrofitted zero-emission battery-electric trucks, tractors, and forklifts. The San Francisco Bay Area has a pilot program to provide financial assistance to low-income Bay Area residents for zero- or near-zero-emission vehicles. The San Joaquin Valley has deployed a zero-emission truck and bus pilot project.[15] In addition, Governor Jerry Brown's proposed FY 2017–18 budget included $2.2 billion in funding from the GGRF.[16] These additional climate investments will enhance current programs, increase benefits, and further reduce GHG emissions.

TABLE 2. APPROPRIATIONS FOR CALIFORNIA CLIMATE INVESTMENTS FY 2016–17 AND CUMULATIVE

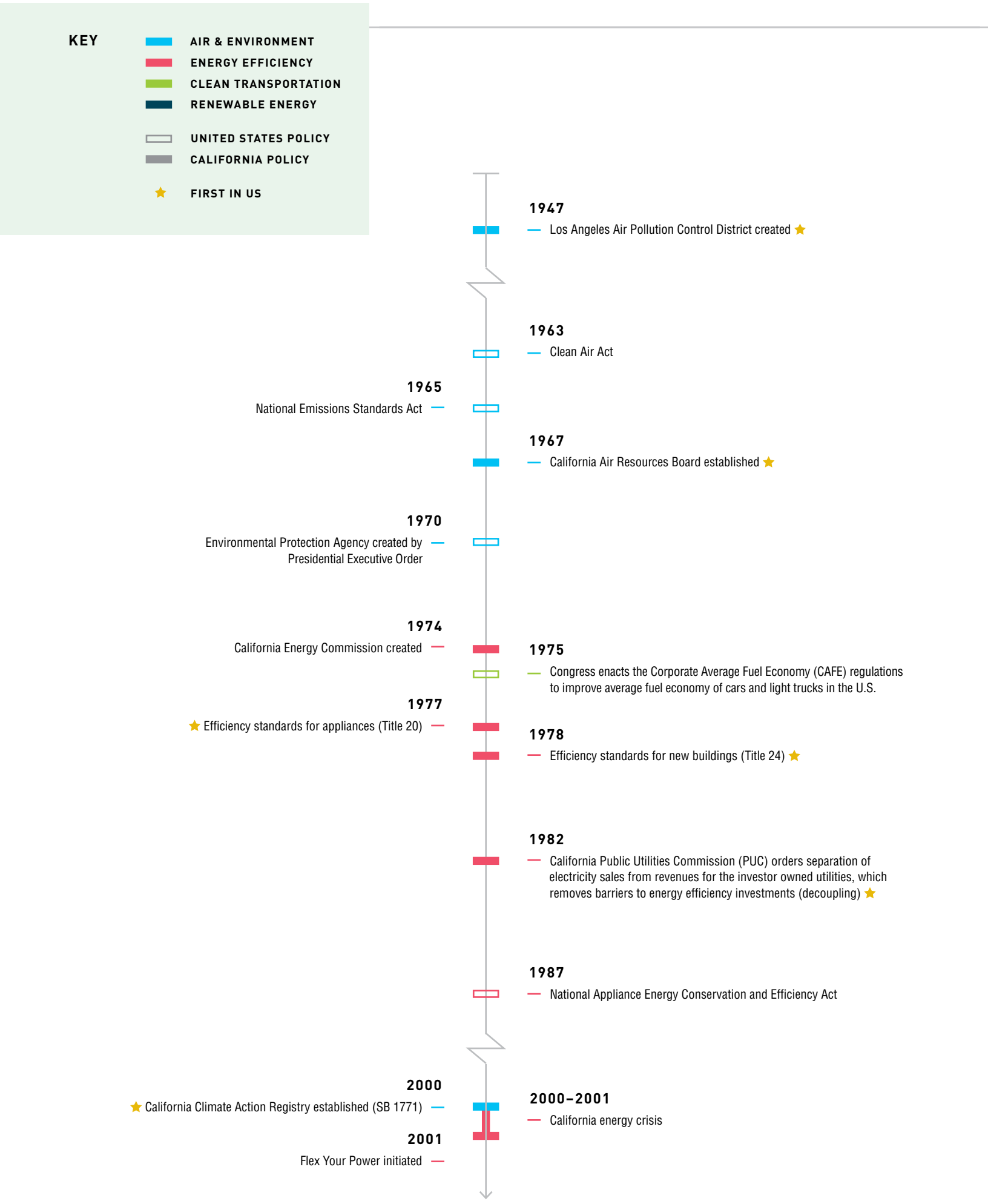
PROGRAM	APPROPRIATIONS ($ MILLIONS)	
	FY 2016–17	CUMULATIVE TOTAL
LOW CARBON TRANSPORTATION	$369	$695
ACTIVE TRANSPORTATION PROGRAM	$10	$10
LOW CARBON TRANSIT OPERATIONS PROGRAM	$19	$135
HIGH-SPEED RAIL PROJECT	$93	$800
TRANSIT AND INTERCITY RAIL CAPITAL PROGRAM	$172	$381
AFFORDABLE HOUSING AND SUSTAINABLE COMMUNITIES	$75	$570
TECHNICAL ASSISTANCE TO DISADVANTAGED COMMUNITIES	$2	$2
TRANSFORMATIVE CLIMATE COMMUNITIES	$140	$140
WOODSMOKE REDUCTION PROGRAM	$5	$5
LOW-INCOME WEATHERIZATION PROGRAM	$20	$174
BIOFUELS	$0	$3
STATE WATER EFFICIENCY AND ENHANCEMENT PROGRAM	$8	$68
STATE WATER PROJECT TURBINES	$0	$20
WATER-ENERGY GRANT PROGRAM	$0	$50
WETLANDS AND WATERSHED RESTORATION	$2	$30
DAIRY DIGESTER RESEARCH AND DEVELOPMENT PROGRAM	$50	$62
HEALTHY SOILS	$8	$8
FOREST HEALTH	$25	$49
URBAN AND COMMUNITY FORESTRY	$15	$33
WASTE DIVERSION	$41	$71
URBAN GREENING PROGRAM	$80	$80
TOTAL	$1,133	$3,385

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Notes: 1. Appropriations from previous fiscal years may be retroactively adjusted to account for Budget Control Sections or for special legislation (e.g., Trailer Bills). As a result, reported cumulative appropriations may not reflect summations of Budget Act line items. 2. SB 862 states that $400 million shall be available to the High-Speed Rail Authority beginning in FY 2015–16, as repayment of a loan from the GGRF to the General Fund. This money shall be repaid as necessary, based on the financial needs of the High-Speed Rail Project. This loan amount is not included in the reported $800 million cumulative appropriation. Data Source: California Air Resource Board. 2017, March. Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds. Retrieved from: https://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2017.pdf. NEXT 10 / SF · CA · USA

CALIFORNIA POLICY TIMELINE

For decades, California has been a national and global leader in the development of innovative environmental and energy policies. The state has led the way as an early adopter of a clean energy future, implementing standards and policies to reduce pollution, improve energy efficiency, and incentivize clean energy and technology development that have been replicated in both other states as well as nations. California's landmark climate change legislation (AB 32) in 2006 set a new standard for climate accountability and a commitment to emissions reductions that has been replicated throughout the country.

Today, as the federal government has rolled back the United States' commitment to climate action, California has shown no intention of following suit. This summer, the state passed legislation to extend its cap-and-trade program to 2030 while also addressing air quality and pollution concerns. As the Golden State continues to press for new clean energy policies and emissions reductions, its economy has experienced consistent growth. The policies in the subsequent timeline reflect decades of collaboration and innovation to address climate and pollution concerns while simultaneously developing one of the world's largest economies.


KEY
AIR & ENVIRONMENT
ENERGY EFFICIENCY
CLEAN TRANSPORTATION
RENEWABLE ENERGY
UNITED STATES POLICY
CALIFORNIA POLICY
FIRST IN US
1947
Los Angeles Air Pollution Control District created
1963
Clean Air Act
1965
National Emissions Standards Act
1967
California Air Resources Board established
1970
Environmental Protection Agency created by Presidential Executive Order
1974
California Energy Commission created
1975
Congress enacts the Corporate Average Fuel Economy (CAFE) regulations to improve average fuel economy of cars and light trucks in the U.S.
1977
Efficiency standards for appliances (Title 20)
1978
Efficiency standards for new buildings (Title 24)
1982
California Public Utilities Commission (PUC) orders separation of electricity sales from revenues for the investor owned utilities, which removes barriers to energy efficiency investments (decoupling)
1987
National Appliance Energy Conservation and Efficiency Act
2000
California Climate Action Registry established (SB 1771)
2000–2001
California energy crisis
2001
Flex Your Power initiated

2002

- California passes the state's first Renewable Portfolio Standard (RPS), requiring 20% of total electricity procured from renewables by 2017 (SB 1078)
- California sets standards for emissions of CO_2 and other greenhouse gases from autos and light duty trucks (Pavley Act) ★

2003

- West Coast Governors launch the Global Warming Initiative (CA, OR, WA)

2005

- Governor Schwarzenegger executive order set greenhouse gas emission reduction targets (S-3-05)

2006

- ★ California Global Warming Solutions Act of 2006 (AB 32)
- California greenhouse gas performance standards for power plants (SB 1368)

2007

- Governor Schwarzenegger establishes Low Carbon Fuel Standard regulations to reduce carbon intensity of transportation fuel 10% by 2020 (S-01-07)
- California legislation establishes a fund for clean vehicle and equipment projects and provides incentives to develop and deploy innovative technologies in support of the state's greenhouse gas goals (AB 118)

2008

- California PUC approves feed-in tariff to incentivize the development of small-scale solar installations (AB 1969)
- ★ California adopts green building codes
- ★ Land use strategy requirements mandated to reduce GHG emissions (SB 375)
- Green Collar Jobs Council established (AB 3018)
- California Air Resources Board adopts a Scoping Plan to reduce greenhouse gas emissions levels to 1990 level by 2020

2009

- California Air Resources Board adopts Low Carbon Fuel Standard regulations to reduce carbon intensity of transportation fuel 10% by 2020
- U.S. Environmental Protection Agency adopts more stringent tailpipe rules modeled after those of California
- California adopts efficiency standards for 23 categories of appliances including clothes washers and audio and visual products
- California legislation revises net energy metering to require utilities to reimburse customers for up to 2.5% of the excess demand from power generated from customer's solar and wind power systems (AB 920)
- California Energy Commission established regulation to increase building energy efficiency and lower operation costs (AB 758)
- The California Energy Commission set the world's most rigorous efficiency standards for televisions, cutting electricity needs for new flat-panel sets by about 50% ★
- California establishes the Clean Vehicle Rebate Project and Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project to provide rebates for zero-emission or plug-in hybrid electric vehicles

2010

- ★ California Air Resources Board finalizes regulation of Pavley Act for greenhouse gas emissions from passenger vehicles
- California raises cap on net metering from 2.5% to 5% (AB 510)
- Clean technology manufacturing equipment is exempt from sales tax (SB 71)

2011

- U.S. Department of Transportation, U.S. Environmental Protection Agency and California Air Resources Board announce a unified timeframe for CAFE and greenhouse gas standards for cars and trucks model year 2017–2025 so that automakers can work towards a single national program
- California legislation increases the state's RPS to 33% of electricity delivered to utility retail customers from renewable resources by 2020 (SB X1-2)
- California legislature passes the Renewable Energy Equity Act (SB 489), which expands the net energy metering program to all eligible forms of renewable energy, allowing small-scale renewable energy producers to participate
- Governor Brown announces the Clean Energy Jobs Plan which calls for 12,000 megawatts to come from localized energy sources and 8,000 megawatts of large scale renewable & necessary transmission lines by 2020
- The Obama administration and 13 major automakers agree to raise CAFE standards up from 27 to an average of 54.5 miles per gallon by 2025
- California legislation extends the Self-Generation Incentive Program (AB 1150), which helps customers switch to clean energy and provides a bridge for clean energy technologies to scale up and drive down costs
- California legislation aims to reduce pollution and waste by more than 15 million tons annually; establishing a new statewide goal of 75% source reduction, recycling and composting by 2020 (AB 341)
- The Western Climate Initiative Inc., a nonprofit corporation with officials from Canada and California, is formed to support the implementation of greenhouse gas emissions trading programs
- California leads the nation in solar energy installations, with a total of over 1,000 megawatts installed at homes and businesses in the state, nearly a third of total installations in 2011

2012

- California Air Resources Board passes the Advanced Clean Car Rules to be attained by 2025, including a mandate for manufacturers to produce 1.4 million zero-emission vehicles, in addition to a 75% reduction in smog-forming pollutants and a 34% reduction in greenhouse gas emissions
- Governor Brown reinforces the Air Resources Board's clean car rules by issuing an executive order for 1.5 million zero-emission vehicles and supporting infrastructure to be operating in California by 2025 (B-16-12)
- California PUC potentially doubles the amount of solar power utilities will purchase from homeowners and businesses by adjusting how electricity generation is calculated under the net metering program
- California Air Resources Board issues final regulations on the Low Carbon Fuel Standard
- California established the Greenhouse Gas Reduction Fund as a special fund to collect cap-and-trade auction revenues (SB 1018)
- U.S. Environmental Protection Agency and the National Highway Traffic Safety Administration issued a final rule that raises average CAFE standards for cars and light-duty trucks to 54.5 miles per gallon by 2025
- California passes two laws to establish a process for spending revenue generated from the cap-and-trade program, with an emphasis on improving air quality and benefiting disadvantaged communities (AB 1532 and SB 535)
- California standardizes and limits the fees city and county governments can charge on building permits for rooftop solar (SB 1222)
- Voters pass Prop 39, the Clean Energy Jobs Act, to provide an estimated $500 million annually for five years for energy efficiency and clean energy programs, such as retrofits of schools and government buildings
- California Air Resources Board conducts its first quarterly auction for emissions allowances in the cap-and-trade program as authorized by AB 32
- California PUC approves nearly $2 billion in energy efficiency program financing over the next two years
- ★ California PUC approves a plan to distribute 85% of revenue from the sale of GHG allowances from the state's three investor owned utilities to households in a semi-annual credit on their energy bill, a type of ""climate dividend""

2013

- Governor Brown releases the Zero-Emission Vehicle Action Plan that identifies specific strategies and actions that state agencies will take to meet milestones of the executive order for 1.5 million zero-emission vehicles in California by 2025
- California PUC mandates that the state's three investor owned utilities add a combined 1.3 gigawatts of energy storage by 2020 ★
- California signs three national and international agreements to cooperate on reducing greenhouse gases and align policies, with China, Quebec, and the Northwestern states/provinces of Oregon, Washington and British Columbia
- California extends to 2024 key auto emissions reductions programs, including the Alternative and Renewable Fuel and Vehicle Technology Program, Air Quality Improvement Program, and the Carl Moyer Program (AB 8)
- California PUC adopts the Efficiency Savings and Performance Incentive program for investor owned utilities to earn up to $89 million a year as a reward for helping customers achieve long-term energy savings
- California improves access to electric vehicle charging stations through two laws, requiring infrastructure for stations at new multi-family housing and non-residential developments, and simplifying access to stations (AB 1092 and SB 454)
- U.S. Environmental Protection Agency proposes a carbon emissions standard for new fossil fuel-fired electric utility power plants
- California creates a voluntary green tariff that allows utility ratepayers who cannot install their own renewable energy generation to purchase energy from shared renewable facilities and receive bill credits (SB 43)
- California joins seven other states in an initiative to put 3.3 million zero-emission vehicles on the road by 2025
- California protects net metering and removes the 33% ceiling on the RPS (AB 327)

2014

- California Energy Commission announces it will update energy efficiency standards for 15 appliances over the next two years
- California residential and small business customers start seeing a Climate Credit from utilities on their electricity bills, which can be used to help cut their energy use
- California Air Resources Board approves the first update to the 2008 Scoping Plan with key focus areas to reduce greenhouse gas emissions levels to 1990 level by 2020
- California extends the property tax exclusion for solar systems to 2025 (SB 871)
- California extends the Self-Generation Incentive Program funding to 2019, which helps customers switch to clean energy and provides a bridge for clean energy technologies to scale up and drive down costs (SB 861)
- California passes a law to streamline permitting and inspection for small solar systems to help lower soft costs of installing solar (AB 2188)
- California lawmakers pass a bundle of bills to grow the electric vehicle market, including providing a higher incentives for low-income individuals and improving access to charging stations for property renters.
- California passes law to accelerate the development and deployment of zero- and near-zero-emission trucks, buses, and freight vehicle and equipment (SB 1204)
- California holds its first joint carbon auction with the Canadian province of Quebec, creating the biggest carbon market in North America

2015

- The California cap-and-trade program starts to cover fuel distributors, including distributors of heating and transportation fuels
- Governor Brown signs an Executive Order for an interim target of reducing GHG emissions 40% below 1990 levels by 2030 (B-30-15)
- California spearheaded and signed the Under 2 MOU along with other sub-national governments that commits signatories to limit emissions to a level that would limit global warming to less than 2°C
- California passes a law to increase the RPS for renewable energy to 50% and increasing energy efficiency in buildings by 50% (SB 350)
- At the Conference of Parties (COP 21) in Paris, parties to the U.N. Framework Convention on Climate Change reached a landmark agreement to limit global warming to less than 2°C and implement programs to support that goal

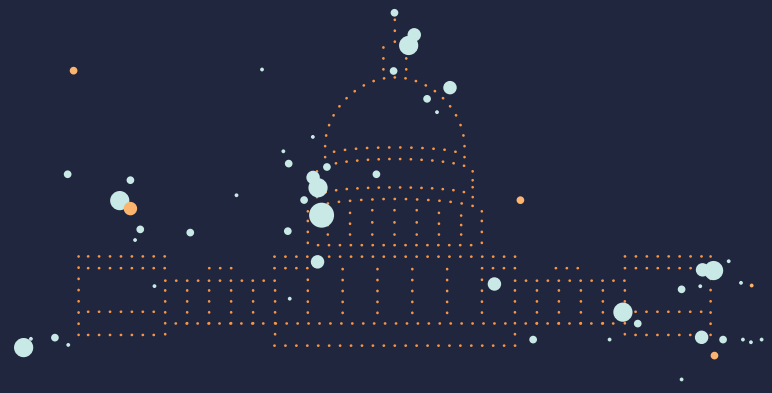
2016

- The U.S. Supreme Court ruled to support the Federal Energy Regulatory Commission's Order 745, which is expected to open the demand response market to reduce energy use
- California PUC enacted a new Net Energy Metering tariff for net-metered customers to earn retail-rate payments for their surplus solar energy and starts a move towrads time of use rates
- The U.S. Supreme Court halted the Environmental Protection Agency's implementation of the Clean Power Plan, a federal program to reduce GHG emissions, while the program is being fought in a lower court
- California extends emission limits from AB32 to mandate statewide emissions reduction equivalent to 40% below 1990 levels by 2030 and requires state board to submit annual reports on GHG mitigation progress. Becomes operative only if AB197 becomes operative this year (SB 32)
- Along with a series of other spending bills passed this year to increase funding for disadvantaged communities, the California legislature passed a bill to create the Transformative Climate Communities Program, which funds implementation of neighborhood-level climate community plans and projects to benefit disadvantaged communities (AB 2722)
- ★ California becomes the first in the world to develop a policy aimed at reducing harmful emissions of short-lived climate pollutants — which have the highest global warming potential of all GHGs — by establishing targets to achieve a reduction in methane emissions by 40%, hydrofluorocarbon gases by 40%, and anthropogenic black carbon by 50% below 2013 levels by 2030 (SB 1383)
- California PUC is granted the authority to require investor-owned utilities planning to build fossil fuel generation plants to seek bids for sites outside of highly polluted communities and to demonstrate that they have tried to meet electricity needs through cleaner options (AB-1937)
- The 2013 ZEV Action Plan is updated and expanded to establish a target of getting 1.5 million ZEVs on the road by 2025 by ensuring ZEVs are accessible to a broad range of consumers, removing barriers to future ZEV market growth, and making ZEV technologies commercially viable in targeted applications in the medium-duty, heavy-duty, and freight sectors

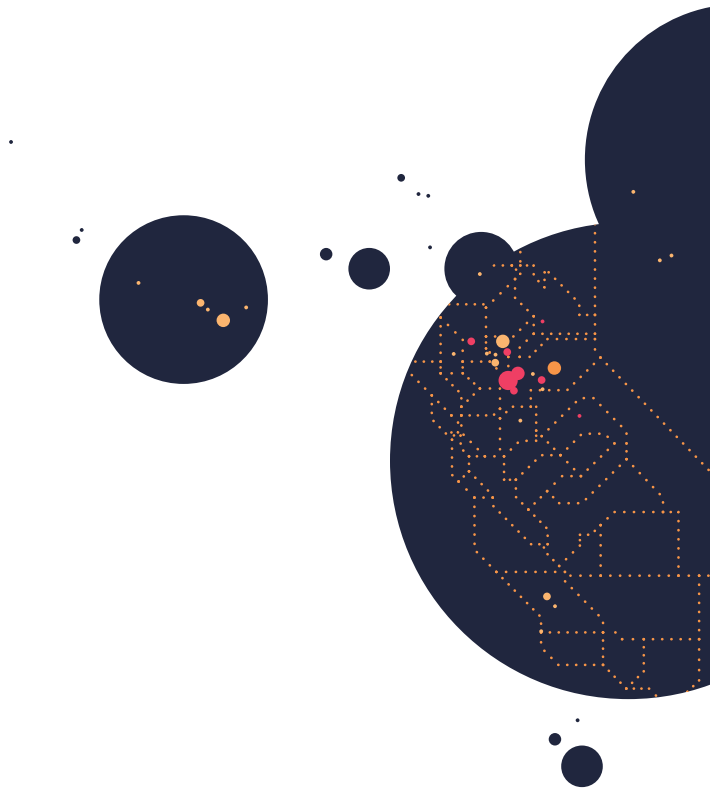
2017

- California implements new vehicle registration fees — including a $100 annual fee applicable only to zero-emission vehicles — and increases the gas tax for the first time in more than 20 years to fund a 10-year, $52 billion transportation reinvestment package to improve road conditions and build new public transit (SB 1)
- In April, the 3rd District Court ruled California's landmark system for curbing greenhouse gases can continue through at least 2020. The California Supreme Court reaffirmed the decision in June, ensuring greater stability for the program
- California legislature extends cap-and-trade program beyond 2020 to 2030 (AB 398)
- California passes air quality improvement legislation to reduce toxic and criteria emissions from mobile and stationary sources with a focus on areas most affected by pollution (AB 617)

U.S. CLIMATE ACTION POST-PARIS WITHDRAWAL



Just days after President Trump announced his intention to withdraw the United States from the Paris Agreement, California Governor Jerry Brown signed an agreement to work with China to reduce greenhouse gas emissions and promote clean technology development. While it will take the U.S. nearly four years to formally withdraw from the agreement, California and other states and cities are taking action to achieve the Paris Agreement's GHG reductions.



Several coalitions and initiatives have sprung up in the wake of Trump's decision. Most recently, Governor Brown and Former New York City Mayor Michael Bloomberg launched an initiative to uphold the U.S. pledge under the Paris Agreement and track progress of participating entities. The initiative, called America's Pledge, currently includes 227 cities, nine states, and 1,650 businesses and investors. Prior to the America's Pledge formation, the We're Still In coalition was formed to declare intent to maintain the U.S. commitment. Membership of that coalition currently includes 1,219 cities and counties, states, higher education institutions, and businesses and investors across the U.S.[17] Throughout California and around the country, states, cities, and companies are demonstrating leadership on the issue through a variety of efforts.

STATE EFFORTS

Emerging as the de facto leader of the U.S. on climate action, California has quickly moved to strengthen its role internationally, building new relationships and negotiating agreements with sub-national and national governments. For example, on April 2017, California signed a pact with Sweden to reduce GHG emissions and promote renewable energy development and another with Scotland to expand collaboration on climate initiatives. Just ahead of the G20 Summit, Governor Brown also announced that California would host the Global Climate Action Summit in September 2018, bringing together stakeholders from governments and businesses to encourage greater progress on climate action.[18]

Many other state and local governments in the U.S. have also enacted laws to uphold the Paris Agreement. On June 1, 2017, immediately after the announcement that the U.S. may withdraw from the Paris Agreement, California, New York, and Washington established the U.S. Climate Alliance to push states to adhere to the goals of the Paris Agreement. As of July 11, 2017, thirteen U.S. states[19] plus Puerto Rico had joined the alliance. On June 7, 2017, Hawaii became the first state to enact laws to align its goals with Paris Agreement.

CITY EFFORTS

Hundreds of mayors, representing a diverse group of cities large enough to collectively have a notable impact in global GHG reductions, have taken measures or intensified their commitment to fighting climate change. The Mayors National Climate Action Agenda, founded by Los Angeles Mayor Eric Garcetti, former Houston Mayor Annise Parker, and former Philadelphia Mayor Michael Nutter, seeks to establish stronger inventory standards and reporting, commit to a set of local actions to reduce GHG emissions, and grow the carbon-offset market. As of July 14, 2017, 355 mayors had pledged to adopt, honor, and uphold the commitments enshrined in the Paris Agreement.

BUSINESS EFFORTS

In the lead up to the President's decision on whether or not to remain in the Paris Agreement, many major U.S. companies voiced their commitment to federal action on climate change. Twenty-five companies with a combined market value of over $3.2 trillion wrote an open letter published as a full-page ad in *The New York Times, The Wall Street Journal,* and *New York Post* urging the President to remain committed to the Agreement.[20] Among the companies that signed on, a number are CA-based industry leaders, including Adobe, Apple, Dignity Health, Facebook, Google, Gap, Inc., Hewlett Packard Enterprise, Intel Corporation, Levi Strauss & Co., PG&E Corporation, and Salesforce.

A second business coalition formed by sustainability nonprofit Ceres has grown in size since the President's decision was announced. The Ceres Investor Network on Climate Risk and Sustainability now represents nearly 400 investors with assets totaling over $22 trillion and has urged G20 leaders to stay resolute in their commitments to climate change.[21]

UNDER2 COALITION

SUBNATIONAL GOVERNMENTS LEADING CLIMATE ACTION

On May 19, 2015, Governor Brown signed the Under2 MOU, a first-of-its-kind agreement, alongside leaders from 11 other states and provinces. Under the international agreement, signatories commit to reducing greenhouse gas emissions by 80 to 95 percent, or limiting to 2 annual metric tons per capita, by 2050. The Under2 Coalition's overarching goal is to bring together ambitious and like-minded cities, states, and nations to hold the increase in global average temperature to below 2 degrees Celsius, the tipping point scientists warn will cause catastrophic climate impacts.[22]

RECENT EVENTS

April 3, 2017: California and Scotland signed the new agreement to expand their collaboration on climate initiatives and support the Under2 Coalition of states, regions and cities committed to ambitious emissions reduction targets.[23]

April 19, 2017: California and Sweden signed the agreement to support Under2 Coalition members in sharing best practices to reduce greenhouse gas emissions and promote renewable energy development.[24]

June 10, 2017: California and Germany agreed to jointly fight climate change following the U.S.'s decision to withdraw from the Paris Agreement.[25]

UNITED KINGDOM+
City of Bristol
Greater Manchester City
Scotland
Wales*

PORTUGAL
Azores
Madeira

SPAIN
Andalusia
Basque Country
Catalonia*
Navarra

THE NETHERLANDS+
Drenthe
North Brabant
North Holland
South Holland

LUXEMBOURG+

FRANCE+
Alsace
Aquitaine
Auvergne-Rhône-Alpes
The Department of Bas-Rhin
Brittany
Midi-Pyrénées
Pays de la Loire

DENMARK+

GERMANY+
Baden-Württemberg*
Bavaria
Hesse
North Rhine-Westphalia
Schleswig-Holstein
Thuringia

SWITZERLAND
Basel-Landschaft
Basel-Stadt

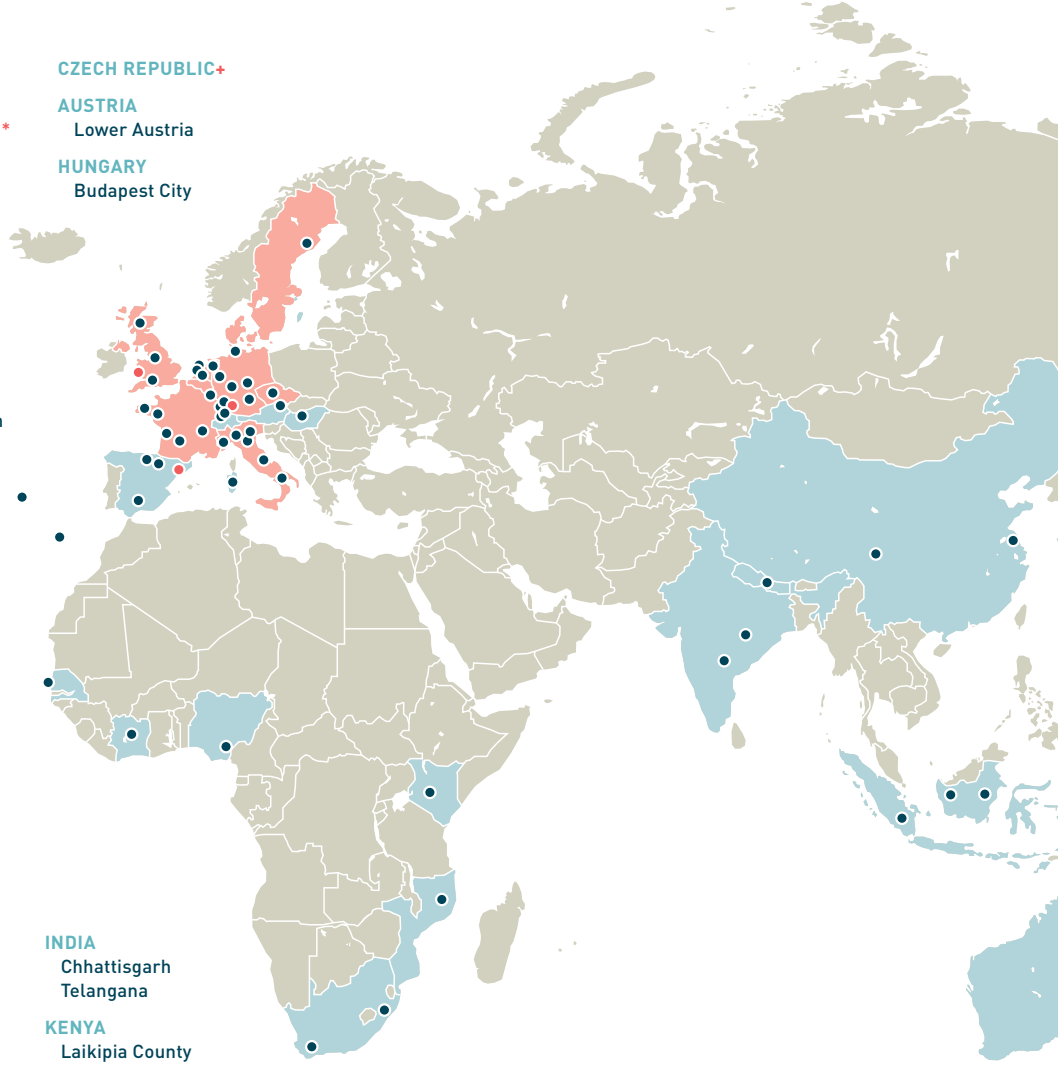
SWEDEN+
Jämtland Härjedalen

ITALY+
Abruzzo
Basilicata
Emilia-Romagna
Lombardy
Piedmont
Sardinia
Veneto

CZECH REPUBLIC+

AUSTRIA
Lower Austria

HUNGARY
Budapest City



SENEGAL
City of Guédiawaye

NIGERIA
Cross River State

IVORY COAST
Assemblée des Régions et Districts de Côte d'Ivoire

NEPAL
Kathmandu Valley

INDIA
Chhattisgarh
Telangana

KENYA
Laikipia County

MOZAMBIQUE
City of Nampula

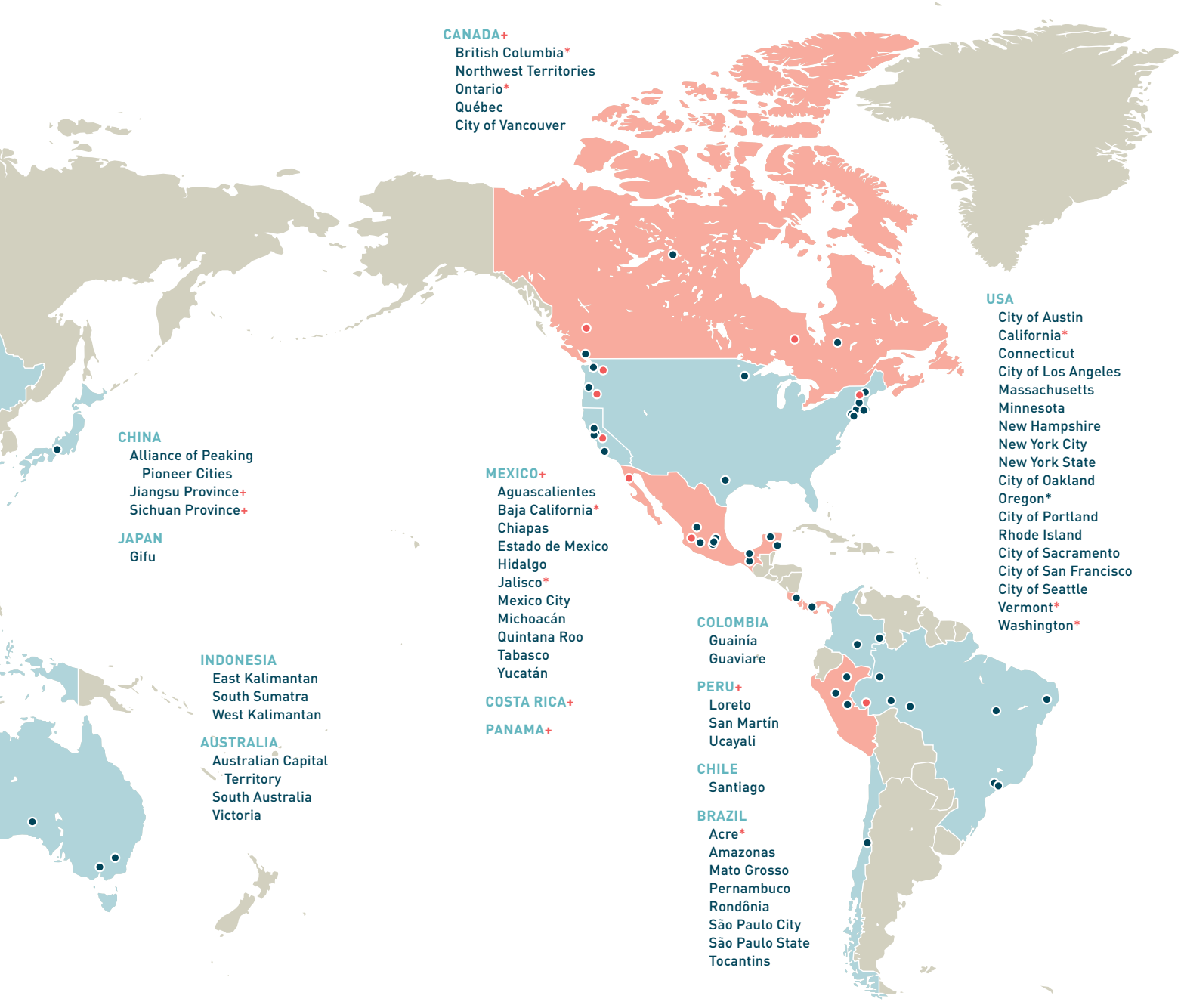
SOUTH AFRICA
KwaZulu-Natal
Western Cape

* An asterisk denotes the government is a Founding Signatory.

\+ A plus denotes the government is an endorser of the Under2 MOU and does not provide an appendix.

So far, many Under2 Coalition members are on track to deliver emissions-reduction goals ahead of their 2020 target dates.[26] Carinthia (Austria), Catalonia (Spain), Connecticut (U.S.), Lombardy (Italy), Provence-Alpes-Côte d'Azur (France), and Scotland (U.K.) have already met their 2020 reduction goals ahead of time. In addition, Blekinge (Sweden), Hesse (Germany), and Lower Austria (Austria) are very close to meeting their 2020 goals.

As of July 2017, there were a total of 176 jurisdictions, representing 36 countries and six continents that had signed or endorsed the Under2 MOU. The Under2 Coalition represents more than 1.2 billion people and $28.8 trillion in GDP — equivalent to 16 percent of the global population and 39 percent of the global economy.



TRANSPORTATION

Vehicle fuel economy improvements have long served as the foundation to emissions reduction efforts for the transportation sector. The OPEC oil embargo in the 1970s spurred the federal government to adopt the Corporate Average Fuel Economy standards (CAFE) for personal vehicles, which doubled the fuel economy of personal vehicles within roughly a ten-year period. However, those rapid advances in vehicle fuel economy began to stagnate in the mid-1980s.

This period of stagnation was only interrupted by the 2007 passage of the Energy Independence and Security Act (EISA), which required standards be set to achieve an average fuel economy of 35 miles per gallon by 2020. The rulemaking process resulted in a 2012 set of standards that require vehicles achieve 54.5 miles per gallon by 2025. Those federal standards were spurred by California's passage of GHG tailpipe standards in 2002. Since then, there have been notable and consistent increases in adjusted fuel economy. Model year 2006 vehicles averaged an adjusted fuel economy of 20.1 MPG, while model year 2016 vehicles averaged an adjusted fuel economy of 25.6 MPG, a 27.4 percent improvement compared to vehicles 10 years older.[29] A 2016 mid-term review of the standards found automakers were on-track to be able to meet the 2025 goal, but automaker lobbying of the Trump administration has prompted a review of the 2016 finding, and the fate of these targets remains to be seen. Despite possible rollback of the federal CAFE standards, in March 2017 the California Air Resources Board voted to maintain the state's 2025 limits on tailpipe greenhouse gas emissions.[30]

Fuel efficiency standards are important; however, they are only part of the solution for addressing rising transportation emissions.

Why is it Important?

California has an extensive transportation network that is vital in facilitating economic activity in the state, in the nation, and around the world. The ports of Los Angeles and Long Beach in Southern California handle 35 percent of all waterborne cargo in the U.S., serving as a major facilitator of the movement of goods in the state. With the California's population increasing and housing becoming less affordable, surface level transportation has increased as residents are commuting farther to get to work.

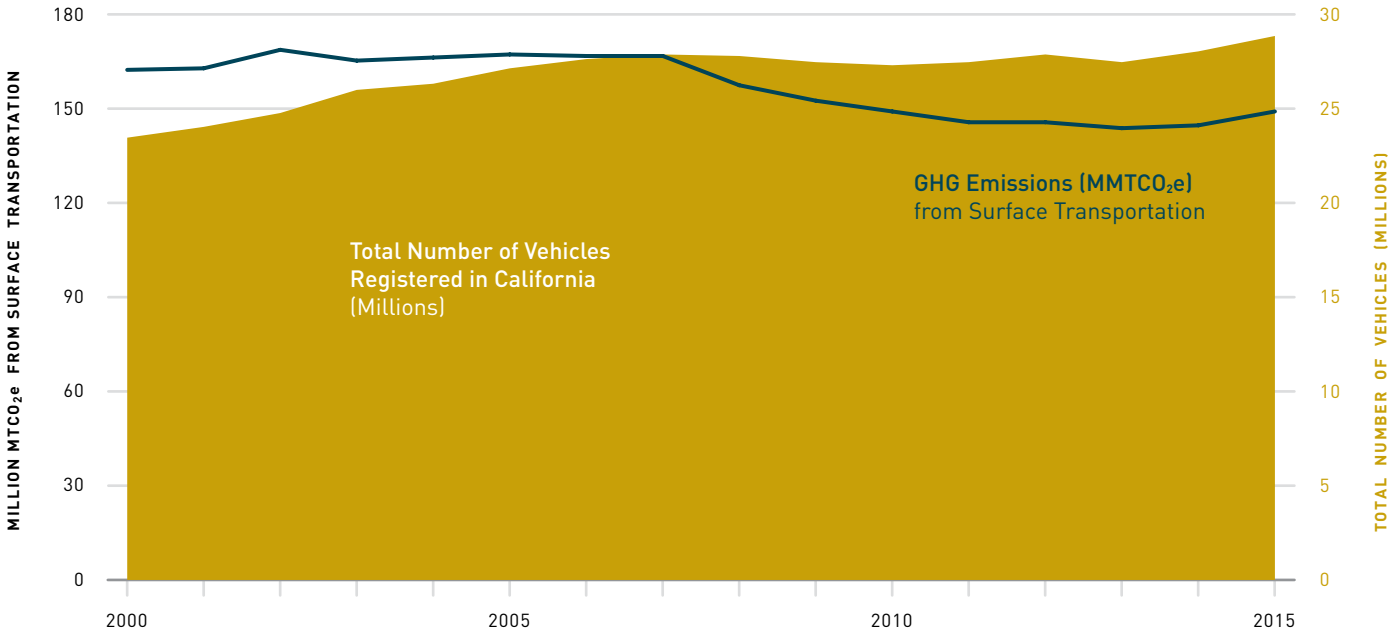
Most transportation in California, both passenger and freight, relies on burning petroleum for fuel. The transportation sector accounts for nearly 40 percent of the state's greenhouse gas emissions. In order for the state to meet its GHG reduction goals, developing cleaner ways to transport California's products and people will be critical. Measuring progress in the adoption of alternative fuel vehicles, electrification of transportation, and efforts to make trips more efficient helps to inform the ongoing development of transportation emissions reduction policies and programs.

California's efforts to reduce GHG and criteria emissions from transportation involve a variety of policies and programs targeting light-, medium-, and heavy-duty vehicles. For example, the state's Advanced Clean Cars Program seeks to meet GHG emissions reductions while advancing the zero-emission vehicle (ZEV) marketplace. California has been working to achieve its goal of 1.5 million ZEVs on the road by 2025.[27] In September 2016, the governor signed SB 859 into law, providing $133 million in funding for ZEV rebates — an amount expected to cover rebate applications through fiscal year 2016–17. Another bill to further bolster ZEV rebate programs is making its way through the state legislature. The California Air Resources Board (CARB) estimates that existing state policies will result in a 25 percent reduction in oil consumption by 2030.

With an energy grid increasingly relying on renewables, battery electric vehicles (BEVs) have the added benefit of accessing California's electricity grid that continues to be one of the cleanest in the country. A recent report estimates that, under the average U.S. electricity grid mix, a midsize and midrange BEV has 51 percent less emissions than a comparable vehicle with a gasoline engine over the lifetime of the car.[28] In California, the lifetime emissions reduction is greater due to the state's cleaner electricity power mix.

FIGURE 9. TOTAL VEHICLES AND GREENHOUSE GAS EMISSIONS

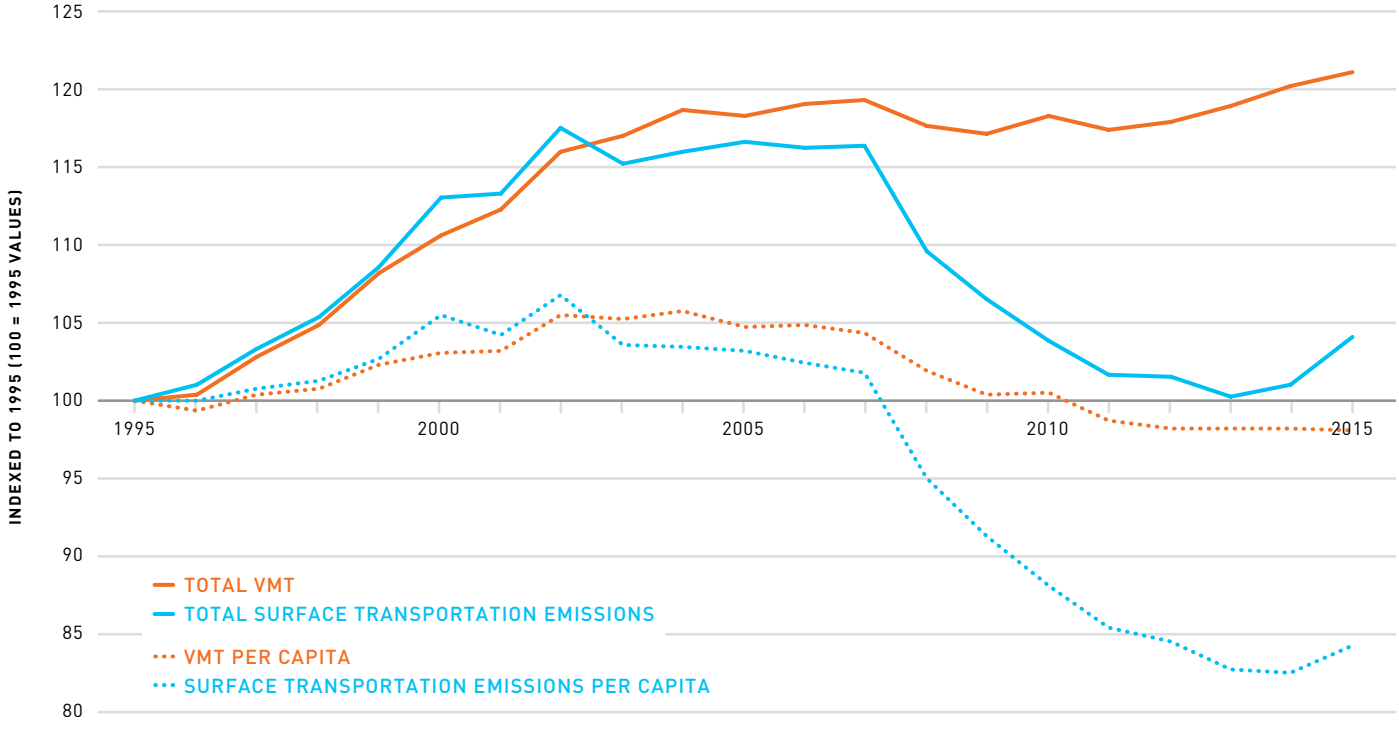
CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Total number of vehicles for all vehicles registered in California including cars and trucks. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; California Energy Commission. NEXT 10 / SF · CA · USA

FIGURE 10. VEHICLE MILES TRAVELED AND GREENHOUSE GAS EMISSIONS FROM SURFACE TRANSPORTATION

TOTAL VMT & EMISSIONS & PER CAPITA, CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; California Department of Transportation; California Department of Finance. NEXT 10 / SF · CA · USA

Transportation Indicators

Greenhouse gas emissions from surface transportation in California totaled 149.4 million $MTCO_2e$ in 2015. This represents an increase of 0.3 percent from 2010 (149.0 million $MTCO_2e$) and a 4.1 percent uptick relative to 1995 (143.5 million $MTCO_2e$). While 2014's GHG emissions from surface transportation (145.0 million $MTCO_2e$) increased only 0.8 percent compared to 2013, 2015's GHG emissions represent a 3.1 percent increase compared to 2014. This emissions increase was outpaced by the increase in total vehicle miles traveled, which increased 2.4 percent from 2010 and 21.1 percent relative to 1995. For the five-year period from 2010 to 2015, the increase in the number of vehicles registered — a rise of 5.6 percent — outpaced surface transportation emissions. These comparisons indicate that while surface transportation emissions increased, motor vehicles have actually become more efficient; the recent fall in gas prices contributed to more driving, which ultimately drove up GHG emissions from surface transportation.

Carbon dioxide emissions from surface transportation, and the fossil fuel consumption that causes them, are sensitive to multiple factors. The major factors include driving behavior, type of vehicle, type and condition of roadway, and real-time traffic conditions. Historically, the modeling of transportation emissions has been done using trip mileage, without accounting for variance in vehicle speed.[31]

Total vehicle miles traveled (VMT) increased by almost 2.7 billion in 2015 compared to 2014, an increase of 0.8 percent. On the other hand, VMT per capita decreased 0.1 percent during the same period and dropped 2.4 percent compared to 2010. In addition, U.S. Census data indicates that Californians are also facing an increasingly longer commute: average commute time was 28.9 minutes for all commuters and 27.5 minutes for those who drive alone in 2015, whereas in 2014 those average commute times were 28.1 minutes and 26.7 minutes, representing a 2.8 percent and a 3.0 percent increase, respectively.[32] A 2015 report by the Brookings Institute found that the distance between where people live and where jobs are available increased; resulting in longer commutes not only in California, but across America.[33]

In addition to longer commute times, recent research has found that if congestion reduces average vehicle speed below 45 mph on the freeway, CO_2 emissions increase. For example, an examination of average traffic conditions on a downtown

TABLE 3. VEHICLE MILES TRAVELED

CALIFORNIA, 2015

VMT (MILLIONS)	VMT PER CAPITA	2014–2015 PER CAPITA CHANGE
335,538.56	8,572	-0.102%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Department of Transportation. NEXT 10 / SF · CA · USA

TABLE 4. ALTERNATIVE FUEL AND ZERO-EMISSION VEHICLE REGISTRATIONS

CALIFORNIA

	2014	2015	YoY CHANGE
ELECTRIC	51,740	83,700	61.80%
PLUG-IN HYBRID	66,887	89,012	33.10%
HYDROGEN	174	183	5.20%
TOTAL ZEV	118,801	172,895	45.50%
HYBRID	798,751	901,885	12.90%
NATURAL GAS	28,915	30,723	6.30%
TOTAL ALTERNATIVE FUEL VEHICLES (EXCLUDING BIO-FUELS)	946,467	1,105,503	16.80%
BIOFUELS	1,102,532	1,239,910	12.50%
TOTAL ALTERNATIVE FUEL VEHICLES (INCLUDING BIO-FUELS)	2,048,999	2,345,413	14.50%
TOTAL VEHICLES	28,090,446	28,842,980	2.70%

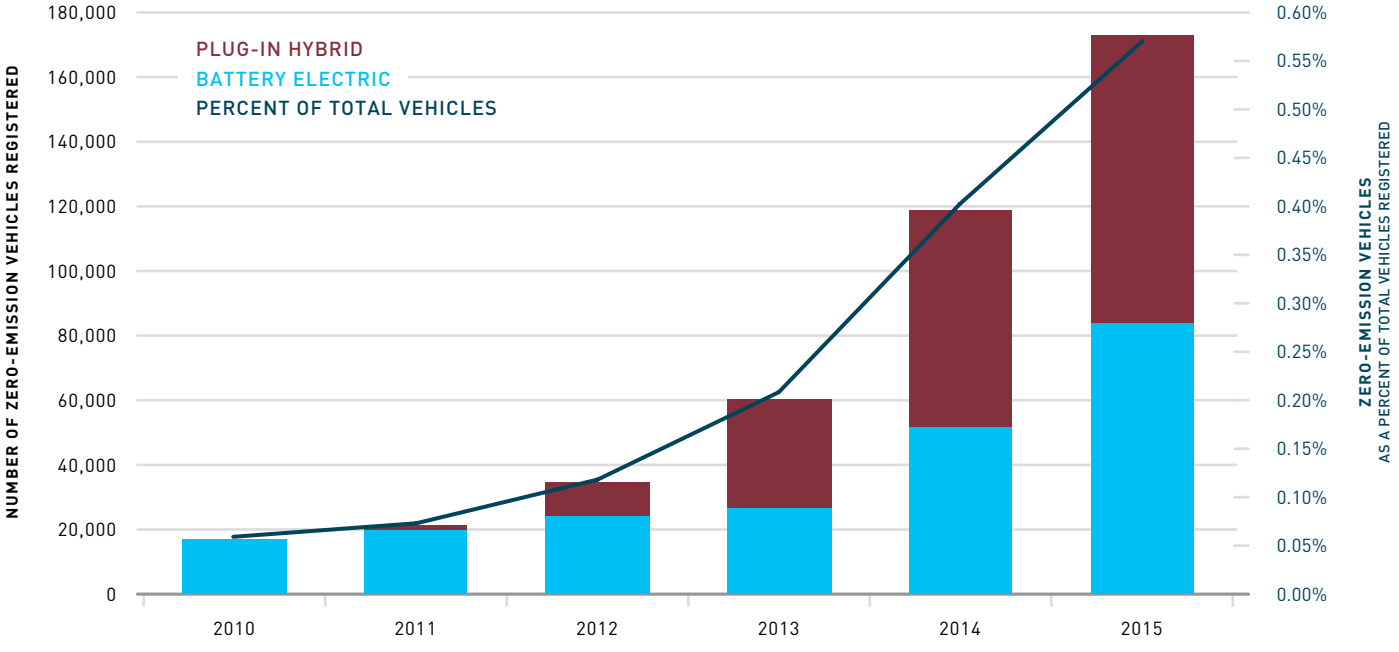
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Zero-Emission Vehicles include electric, plug-in hybrid, and hydrogen fuel cell vehicles. Data Source: California Energy Commission. NEXT 10 / SF · CA · USA

Los Angeles segment of the northbound 110 freeway found congestion reduced freeway speeds to 20 to 30 mph. If the overall average traffic speed (holding the number of vehicles constant) during a given hour could be increased 20 mph above those speeds, the emissions reduction would be 21 metric tons of CO_2, a 12 percent drop.[34]

With longer commute times, more congestion, and more people driving, reducing transportation emissions must include cleaning up transportation fuel sources. Zero-emission vehicles (ZEVs) are an important part of the state's strategy to reduce transportation emissions. California leads the nation in building out the ZEV marketplace, due in large part to the state's ZEV mandate requiring automakers to sell an increasing percentage of ZEVs in California. As of the end of 2016, about half of all ZEVs sold in the U.S. were in California. Sales of ZEVs picked up throughout 2016, and in the first quarter of 2017, accounted for nearly 5 percent of California auto sales.[25] While California has more ZEVs on the road than any other state, it is not alone

FIGURE 11. TRENDS IN TOTAL ZERO-EMISSION VEHICLE REGISTRATION

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission. NEXT 10 / SF · CA · USA

in attempting to increase the number of electric and other alternative fuel vehicles. Section 177 of the Clean Air Act permits other states to adopt California's automotive emissions standards. As of the writing of this report, 13 states and the District of Columbia have adopted California's stricter emissions standards, and nine of these states have followed California's lead in mandating an increase in sales of ZEVs.[36] The states with ZEV mandates account for nearly 30 percent of the U.S. automotive market, which will push the auto industry toward developing more ZEV options for consumers.

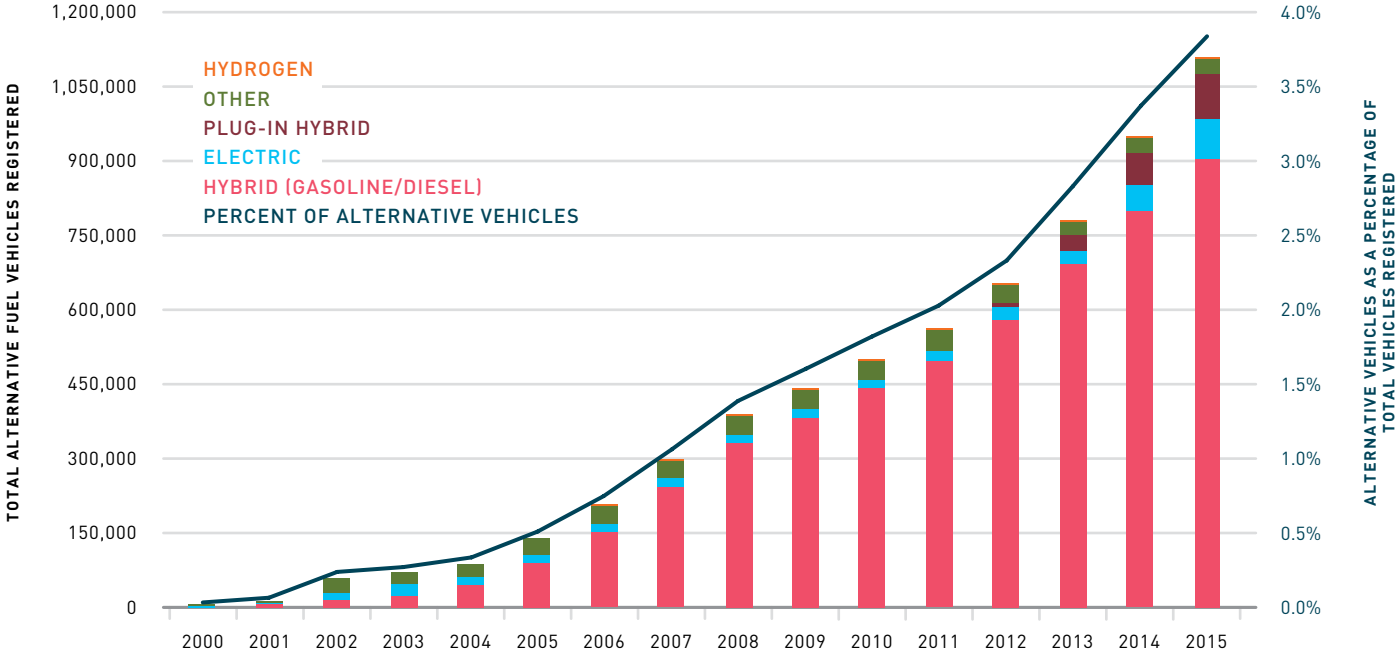
In 2015, there were 172,895 ZEVs registered in California, up 45.5 percent from the 118,801 ZEVs in 2014. This growth in ZEVs was driven by a 61.8 percent increase in battery electric vehicles and a 33.1 percent increase in plug-in hybrid vehicles. By comparison, traditional gasoline vehicle registration increased 1.7 percent between 2014 and 2015, with total vehicle registration up 2.7 percent. While there are more ZEVs on the road than ever, the 2014 to 2015 increase is smaller in magnitude, compared to the 97 percent increase from 2013 to 2014.

Despite the fact that there are more ZEVs on the road than ever before in California, the charging infrastructure required to support further growth has not quite kept up. As of July 9, there were 13,282 charging outlets in California according to the Alternative Fuels Data Center, about 30 percent of all the outlets in the United States. While this marked a notable increase over the 8,303 outlets available in November 2015, the number still falls short of providing adequate charging infrastructure for the amount of ZEVs on the road. California's share of nationwide cumulative ZEV sales was almost 50 percent at the end of 2015, but the state has a relative lack of charging outlets per ZEV compared with other states. The state's 0.05 public charging outlets-per-ZEV places California ahead of only New Jersey and Alaska. To keep up with growing adoption of ZEVs, California will have to invest in additional charging station infrastructure.

In the wake of SB 350's directive, the California investor-owned utilities (IOUs) have plans to invest over a billion dollars in charging infrastructure. All three major IOUs — Southern California Edison, San Diego Gas & Electric, and Pacific Gas & Electric — have submitted proposals that would bolster transportation electrification. For example, Southern California Edison would spend $554 million on a five-year medium/heavy-duty charging infrastructure buildout.[37] Of the $1.07 billion in funding requested, most of it ($779 million) would go toward on-road medium/heavy-duty infrastructure as medium and heavy-duty vehicles (and non-road vehicles) contribute significantly to nitrogen oxide (NOx) emissions.[38]

FIGURE 12. TRENDS IN ALTERNATIVE FUEL VEHICLE REGISTRATIONS

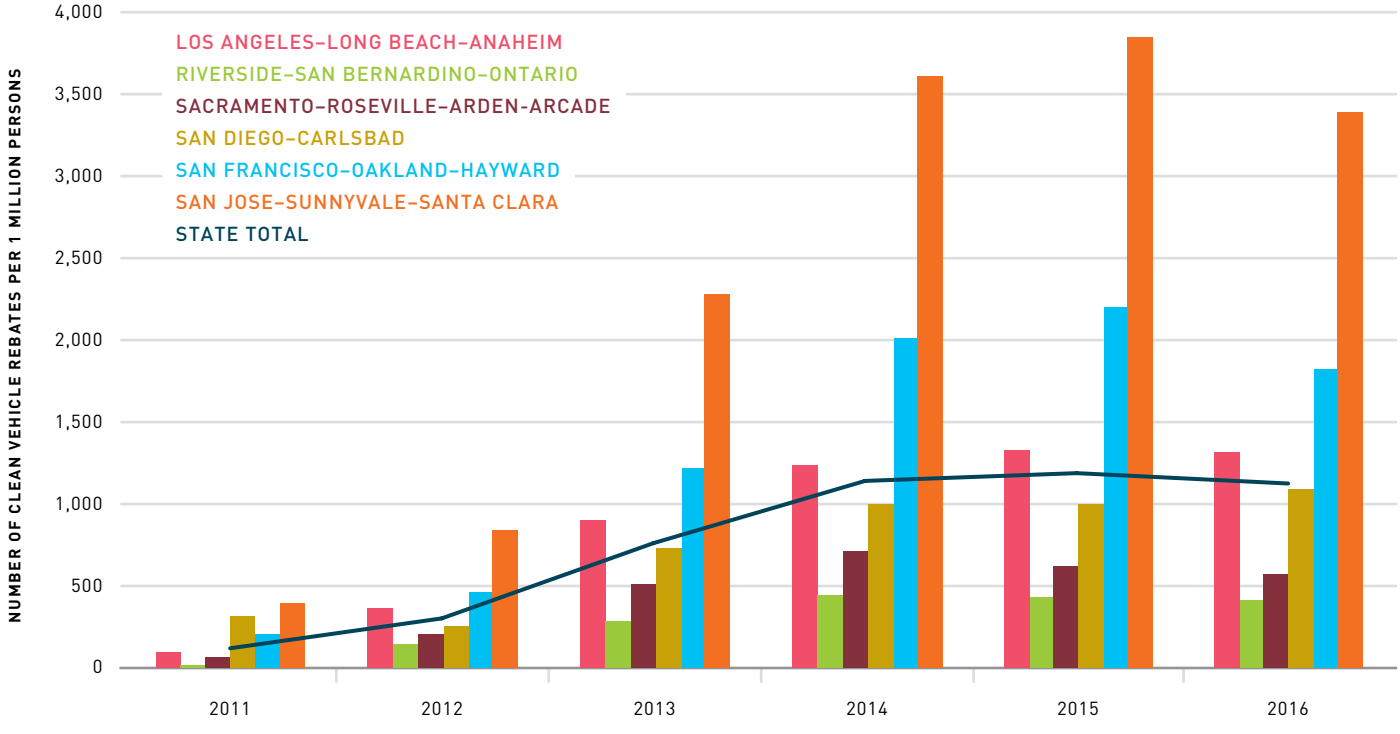
CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Other includes Natural Gas and Propane. Data Source: California Energy Commission. NEXT 10 / SF · CA · USA

FIGURE 13. CLEAN VEHICLE REBATES PER 1 MILLION PERSONS

SELECTED MSAs & CA, 2011–2016



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Center for Sustainable Energy; California Air Resource Board Clean Vehicle Rebate Project; Department of Finance. NEXT 10 / SF · CA · USA

Clean vehicle rebates are an important tool for promoting broader adoption of cleaner vehicles. As of the end of 2016, more than $388 million in rebates had been issued, though 2016 saw a lower total rebate amount compared to 2015.[39] Compared to 2015, plug-in hybrid rebates saw a 6.2 percent decline while battery electric vehicle rebates decreased 10.9 percent. While an income cap for higher-income consumers was applied beginning March 29, 2016 and then further lowered on November 1, 2016, it is unlikely that it was the major contributor to the decline. At issue was a hold-up in the distribution of ZEV rebates for several months from the state's Greenhouse Gas Reduction Fund. Despite the income cap implementation, in 2016 the San Jose – Sunnyvale – Santa Clara metro area continued to receive the highest number of clean vehicle rebates per million persons, with 3,391, followed by San Francisco – Oakland – Hayward with 1,823, and Santa Rosa – Petaluma with 1,442. Los Angeles – Long Beach – Anaheim received 1,311 and San Diego – Carlsbad claimed 1,087 rebates per million persons. Overall, the state averaged 1,132 rebates per million persons, down 5.3 percent compared to 2015, but a few rural metropolitan areas actually had substantial year-over-year growth in rebates. The number of rebates per million persons in Fresno, Visalia – Porterville, and Stockton – Lodi increased 52 percent, 40.2 percent, and 22.8 percent, respectively.

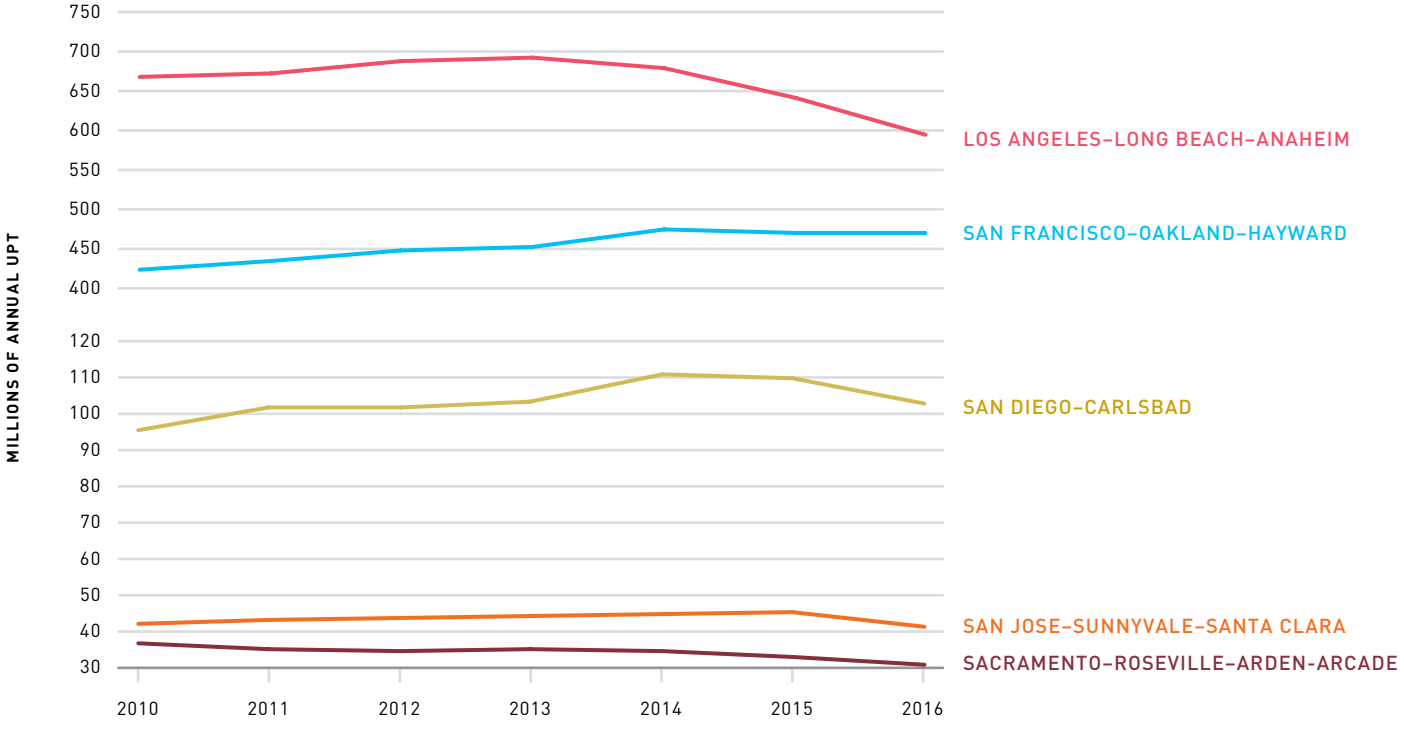
Since 2012, the types of vehicles receiving a rebate have shifted from a majority of plug-in hybrid vehicles to a majority of battery electric vehicles. This indicates a response in the market to the rapid technology improvements of BEVs. In 2016, there were 15,488 rebate applications for plug-in hybrid vehicles compared to 27,930 for battery electric vehicles.

Public Transportation Indicators

While adoption of ZEVs helps to reduce GHG emissions from surface transportation, currently the vast majority of vehicles on the road (91.9%) are still conventional internal combustion engine vehicles powered by fossil fuels (gasoline and diesel). Despite a relatively lackluster ZEV adoption rate, New York City's high public transit ridership helps the state to achieve

FIGURE 14. TOTAL ANNUAL UNLINKED PASSENGER TRIPS (IN MILLIONS)

TOP 5 CA METRO AREAS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: National Transit Database, Department of Transportation. NEXT 10 / SF · CA · USA

the nation's lowest emissions per capita. Increasing public transportation ridership plays a vital role in reducing GHG emissions from transportation.

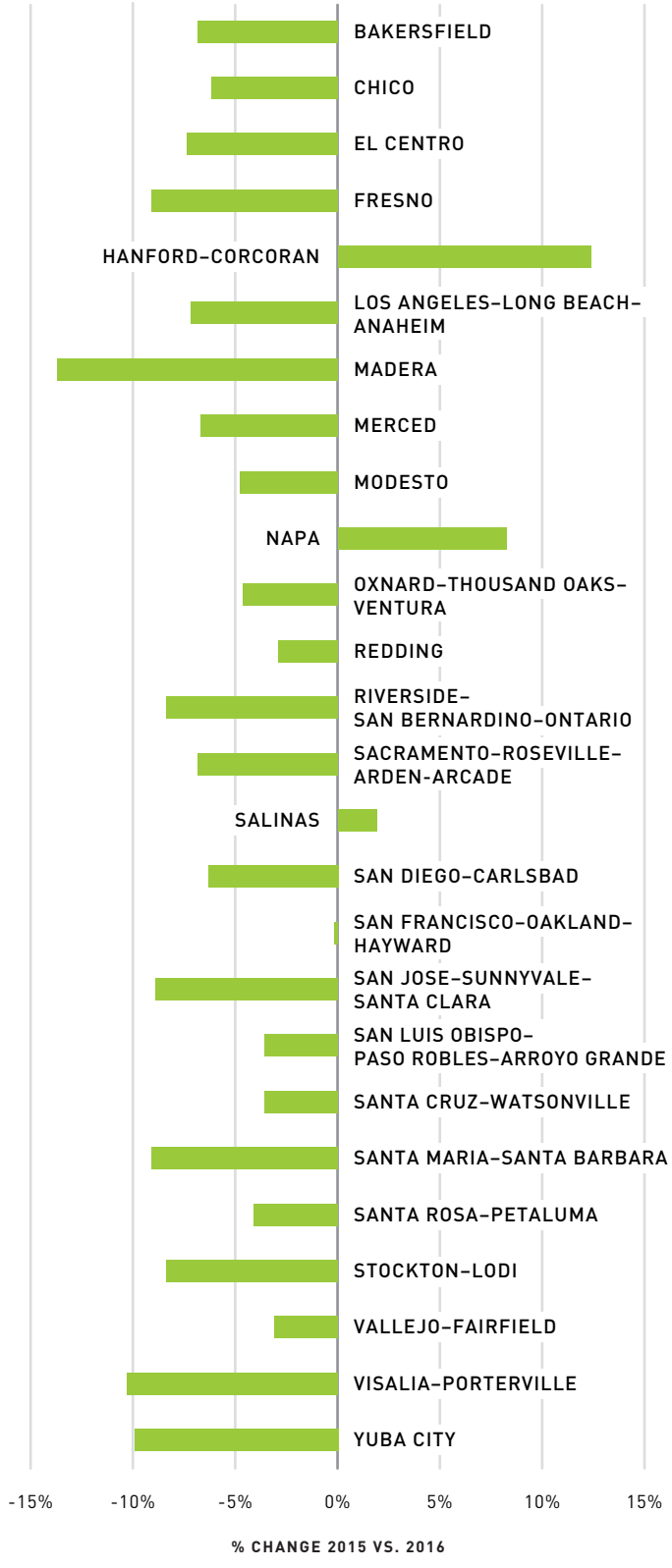
The recent decrease in gasoline prices has resulted in a surge in driving, which in turn contributed to a decrease in public transportation ridership in California and across the United States. In California, annual unlinked passenger trips fell in 2016 in all parts of the state with the exception of the Hanford – Corcoran metropolitan statistical area (MSA), Napa MSA, and Salinas MSA. Unlinked passenger trips — which are trips on one transit vehicle, not including connections (i.e. a trip with one connection would represent two unlinked passenger trips) — fell between 0.1 percent to 9 percent in the five MSAs with the busiest public transportation systems and 4.8 percent overall in California.

The San Francisco – Oakland – Hayward MSA had the most unlinked passenger trips per capita in the state in 2016 with 101.1 trips per passenger per year; more than double that of Los Angeles – Long Beach – Anaheim MSA, which had the next highest trips per capita with 44.3 trips. Overall, MSAs with large populations tend to have higher ridership per capita, as larger and denser areas tend to have more public transit options and greater amounts of traffic congestion. Surprisingly, the rural Hanford – Corcoran MSA, with a population of 150,000 people, had a relatively high public transit ridership, finishing fourth place overall in 2016.

Of the seven metro areas with the largest public transit ridership — which account for more than 90 percent of all unlinked passenger trips in the state — only Bakersfield and Fresno saw declining unlinked passenger trips per capita from 2010 to 2014 (Figure 16). From 2014 to 2016, unlinked passenger trips per capita fell relatively significantly in Los Angeles – Long Beach – Anaheim and the adjacent Riverside – San Bernardino – Ontario area, while the other major metro areas experienced only slight declines or increases or remained steady. When low gasoline prices persisted throughout 2015 and 2016, unlinked passenger trips per capita tumbled sharply in all of the major MSAs other than San Francisco – Oakland – Hayward. As gasoline prices remain low, the state will need to compensate for the increase in emissions due to increased driving by either facilitating a greater adoption of zero-emission vehicles or incentivizing public transit ridership.

FIGURE 15. CHANGE IN TOTAL UNLINKED PASSENGER TRIPS

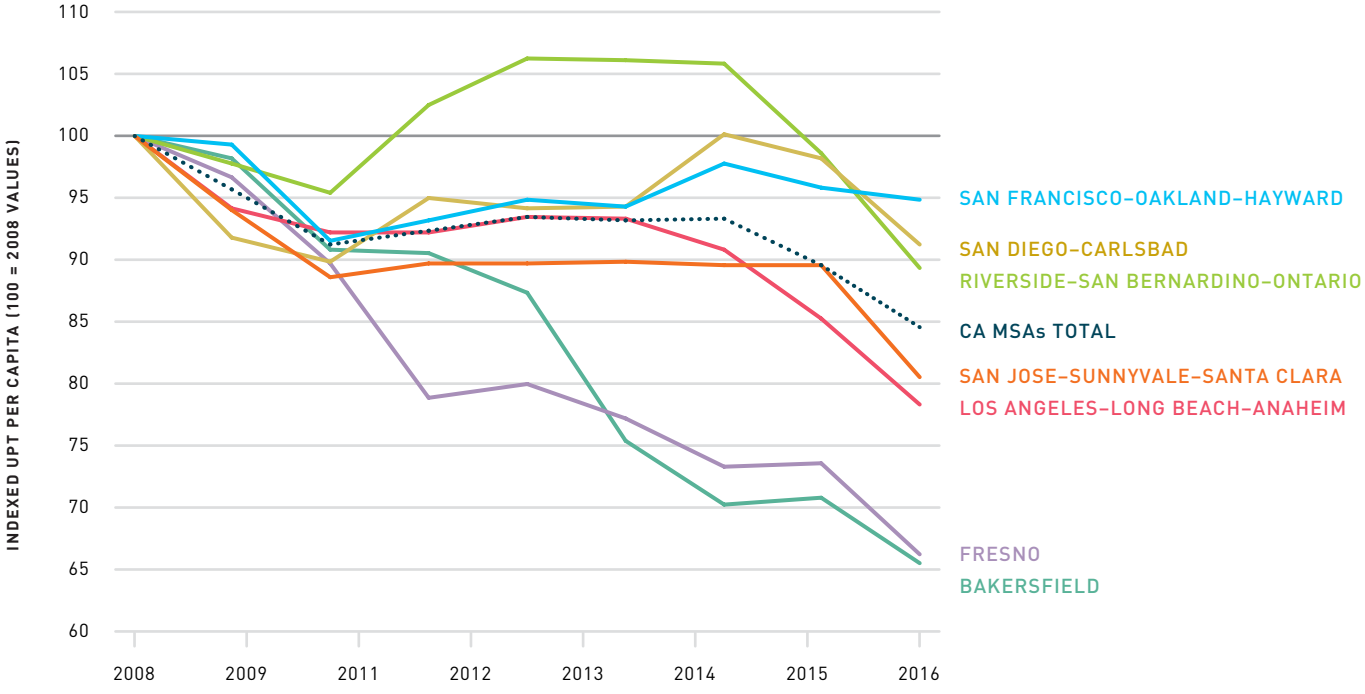
2015 VS. 2016, ALL MODES OF PUBLIC TRANSIT



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: National Transit Database, Department of Transportation. NEXT 10 / SF · CA · USA

FIGURE 16. UNLINKED PASSENGER TRIPS PER CAPITA

SELECTED LARGE CALIFORNIA MSAs, ALL MODES OF PUBLIC TRANSIT (BASE YEAR = 2008)



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: National Transit Database, Department of Transportation; Madera County Transportation Commission; Department of Finance.
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Transitioning to a Zero-Emission Public Transit Fleet

In California, clean vehicle policies such as the Transit Fleet Rule, adopted in 2000, and other, more recent CARB regulations requiring buses to be upgraded to reduce emissions have resulted in the replacement of diesel buses with fleets powered by natural gas, compressed natural gas (CNG) and liquefied petroleum gas (LPG), and have achieved significant particulate matter (PM) and NOx emissions reductions.[40]

Currently, California's bus fleet is one of the cleanest in the nation. Los Angeles County Metropolitan Transportation Authority (LACMTA), one of the largest transit agencies in California, has switched fully to natural gas, which reduced particulate matter PM by more than 80 percent compared to diesel buses.[41] Now LACMTA is going one step further, exploring alternative fuel options that are even cleaner than conventional natural gas. For example, LACMTA launched a one-year pilot program for renewable natural gas (RNG). Should LACMTA switch from CNG to RNG, the agency would reduce its GHG emissions by more than 520,000 metric tons.[42]

Statewide, California has taken several steps in order to transition to a completely zero-emission bus fleet by no later than 2040. In 2009, to incentivize and accelerate purchase of clean and more efficient trucks and buses, CARB partnered with the nonprofit CALSTART to launch the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP). Since then, there have been significant advancements for zero-emission buses. IOUs are another important driving force of transportation electrification. Although uptake is slow, the IOUs have requested over $1 billion in funding for developing and improving the state's charging infrastructure, most of which would be for medium and heavy duty fleet such as buses.[43]

As of June 12, 2016, there were 135 jurisdictions, representing 32 countries and six continents that have signed or endorsed Under 2 MOU. This group represents more than 783 million people and $21 trillion in GDP.

ENERGY EFFICIENCY

Why is it Important?

Energy is an essential component of economic stability and growth. Energy lights office buildings, provides transportation, and heats our homes. Obtaining the energy necessary for economic growth can be achieved in two ways: acquiring additional resources, or "input," or using the current input more efficiently.

Improving energy efficiency enables consumers to optimize their energy use and consume less energy for the same level of service or economic output. Energy efficiency can help businesses, governments, and consumers save money, create investment opportunities across the economy, generate jobs, and reduce the environmental impact of energy use. Indicators that measure California's change in electricity and overall energy consumption, while factoring in population and economic growth, can show how the state is progressing toward making energy more affordable and efficient.

Energy Efficiency Indicators

PRODUCTIVITY

Over the last 20 years, California's GDP has increased at a much faster rate than its energy use, leading to a continued improvement in energy productivity, the ratio of economic output to energy consumed. While energy productivity continues to climb in California, it has stagnated in the rest of the country in recent years.

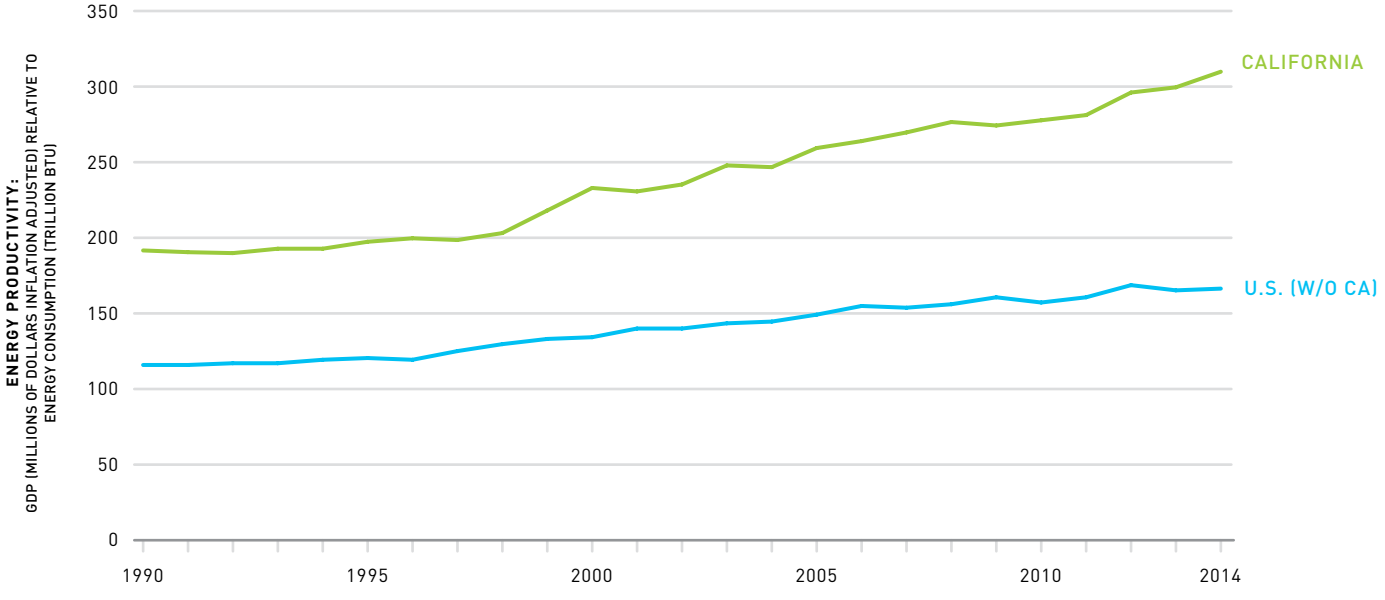
Among the top five polluting countries, Russia has the worst energy productivity, ranking 46th out of the top 50 emitters. Among this top 50, California had the highest productivity, followed by Italy, the United Kingdom, and Japan.[44]

In 2014, California generated $3.10 of GDP (inflation-adjusted) for every 10,000 British Thermal Units (BTUs) of energy consumed, while the rest of the U.S. generated $1.66 per 10,000 BTUs. This energy efficiency means that California produced 1.9 times as much economic activity with the same amount of energy.

Energy productivity in the rest of the U.S. (excluding CA) improved 5.3 percent between 2010 and 2014, while California's improvement over that time was more than double

FIGURE 17. ENERGY PRODUCTIVITY

GDP RELATIVE TO TOTAL ENERGY CONSUMPTION: CALIFORNIA & REST OF U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis.

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that, at 11.7 percent. Between 1990 and 2014, the rest of the U.S. saw a boost in energy productivity of 42.8 percent, while California saw a boost of 61.8 percent.

California leads U.S. states in energy-efficiency policy. In 2016, the American Council for an Energy-Efficient Economy ranked California the top state in the nation, tied with Massachusetts, for its energy-efficiency policy and program efforts.[45] California has long pioneered policies such as revenue decoupling and a loading order for utility resource procurement that starts with capturing all cost-effective energy efficiency, along with continuously updated energy efficiency performance standards for buildings and appliances.

EFFICIENCY

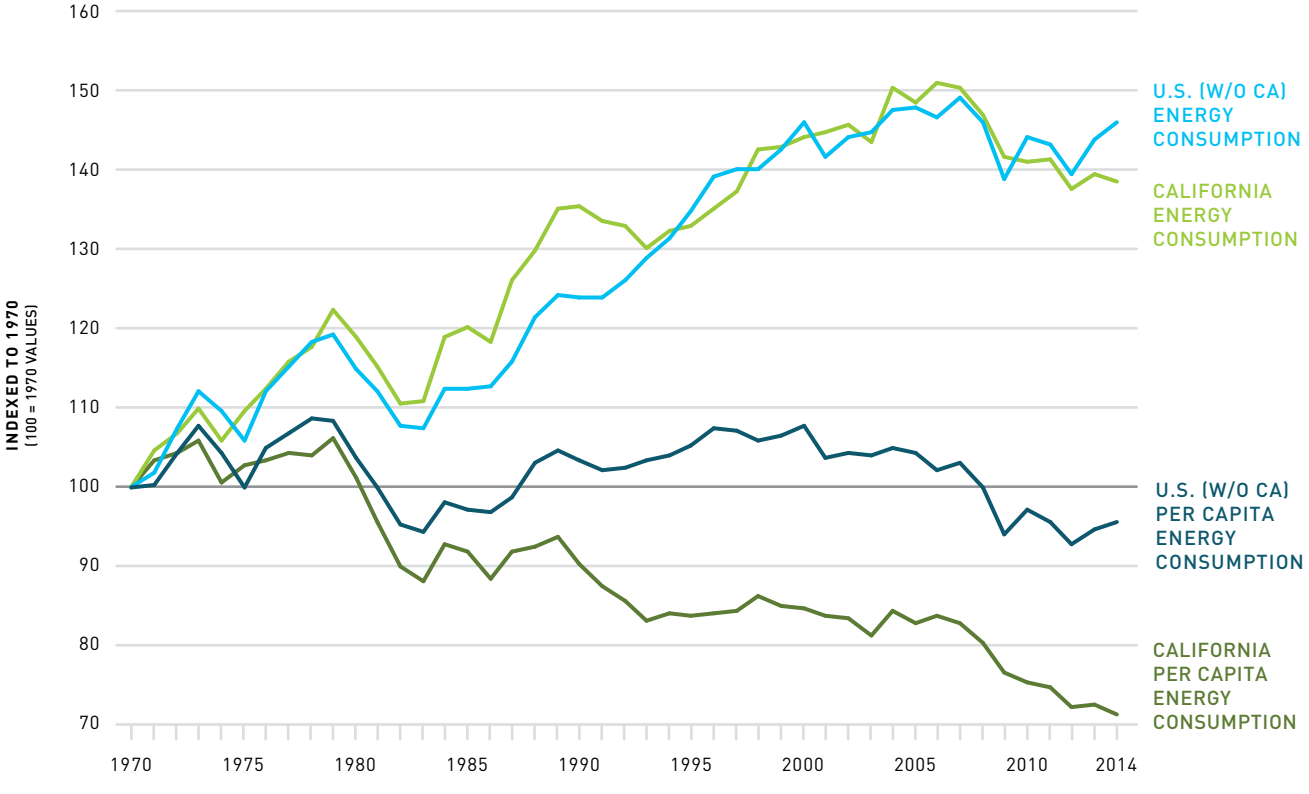
California's per capita energy consumption has declined at a much faster rate than the rest of the U.S. Per capita energy consumption in California increased through the mid- to late-1970s, and began gradually and continually declining beginning in 1980, prompted in part by the major energy efficiency policies introduced in the late 1970s. In 2014, per capita energy consumption in California was down 28.7 percent compared to 1970.

Per capita energy consumption in the rest of U.S. also increased in the 1970s at comparable rates to California's, then dipped below the 1970 level for most of 1980s before increasing again until 2000, and consumption has been decreasing since then. Since 2009, per capita energy consumption in the U.S. has remained below 1970 levels and is now 4.6 percent lower than in 1970.

Despite a consistent, gradual decline in per capita energy consumption in California, total energy consumption did not start declining until 2006, at which point it was 50.8 percent higher than 1970 levels. Since 2006, total energy consumption has declined consistently, and the state consumed 38.5 percent more total energy in 2014 relative to 1970. The rest of U.S. also exhibited a somewhat similar trend

FIGURE 18. TOTAL ENERGY CONSUMPTION RELATIVE TO 1970

TOTAL CONSUMPTION & PER CAPITA: CALIFORNIA & REST OF U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Census Bureau, Population Estimates Branch.

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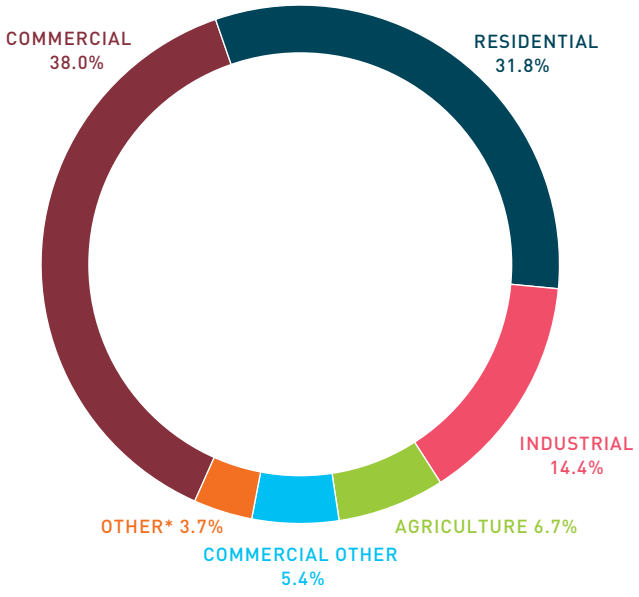
FIGURE 19. ELECTRICITY CONSUMPTION BY SECTOR

PERCENT OF TOTAL ELECTRICITY CONSUMPTION, CALIFORNIA, 2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. *Other includes Street Lighting and Mining.
Data Source: California Energy Commission. NEXT 10 / SF · CA · USA

initially: gradual increase until 2007, when energy consumption was 49 percent higher than in 1970 and slight decline since then until 2012. In 2014, the total energy consumption level was 45.8 percent higher than in 1970. The decrease between 2007 and 2012 can in part be attributed to the economic recession, as energy consumption tends to decline during periods of economic downturn.

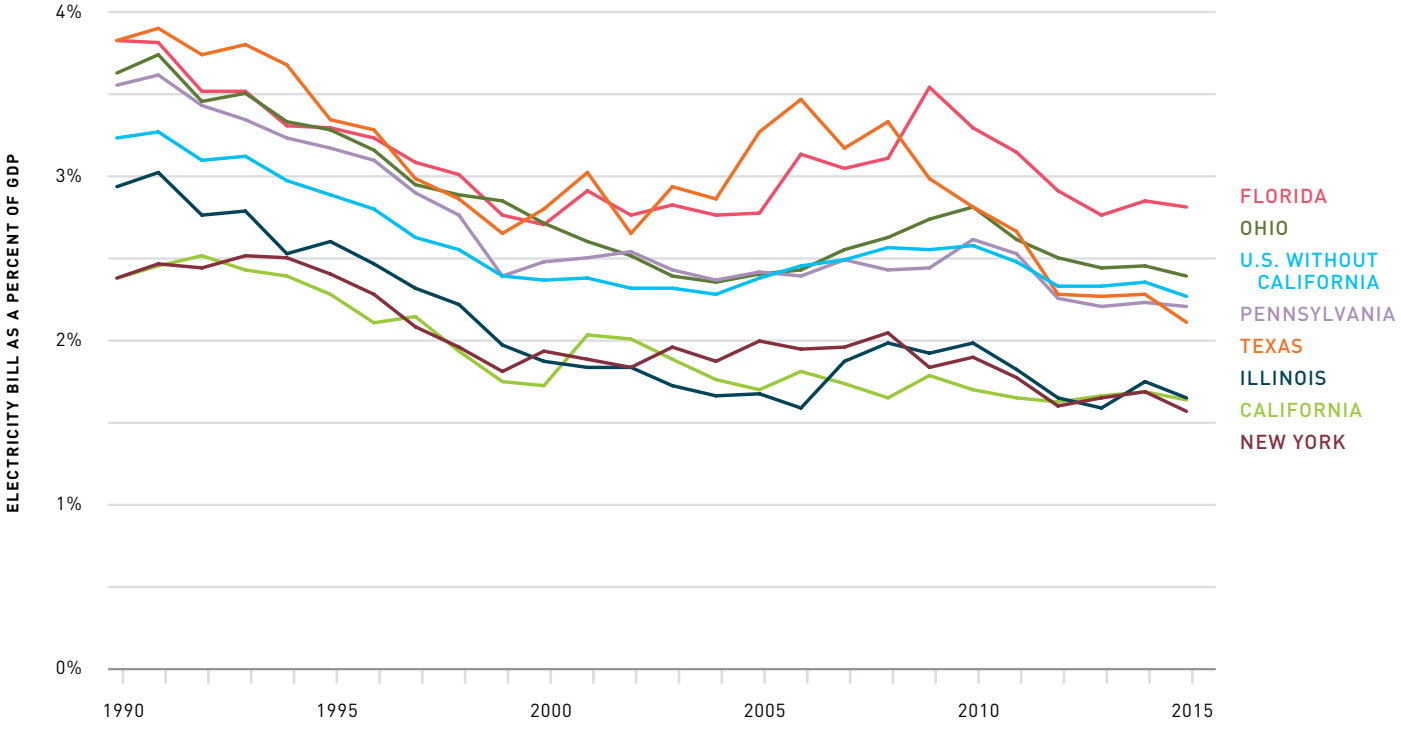
THE ELECTRICITY BILL

The electricity consumption by sector mix has remained fairly constant in recent years. Use in the commercial sector in 2015 was unchanged from 2014, accounting for 38 percent of total use. The residential sector was the next largest consumer of electricity at 31.8 percent, followed by the industrial sector at 14.4 percent.

Cost of electricity as a percent of GDP decreased between 1990 and 2015 in most U.S. states, including California. California's electricity bill (cost of electricity) was 1.63 percent of GDP in 2015, the second lowest in the U.S. and a considerable decrease compared to 2.4 percent in 1990. In

FIGURE 20. STATEWIDE ELECTRICITY BILL AS A PERCENT OF GDP

CALIFORNIA, FLORIDA, ILLINOIS, NEW YORK, OHIO, PENNSYLVANIA, TEXAS, & U.S. WITHOUT CALIFORNIA, 1990–2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy, Energy Information Administration; Bureau of Economic Analysis, U.S. Department of Commerce.
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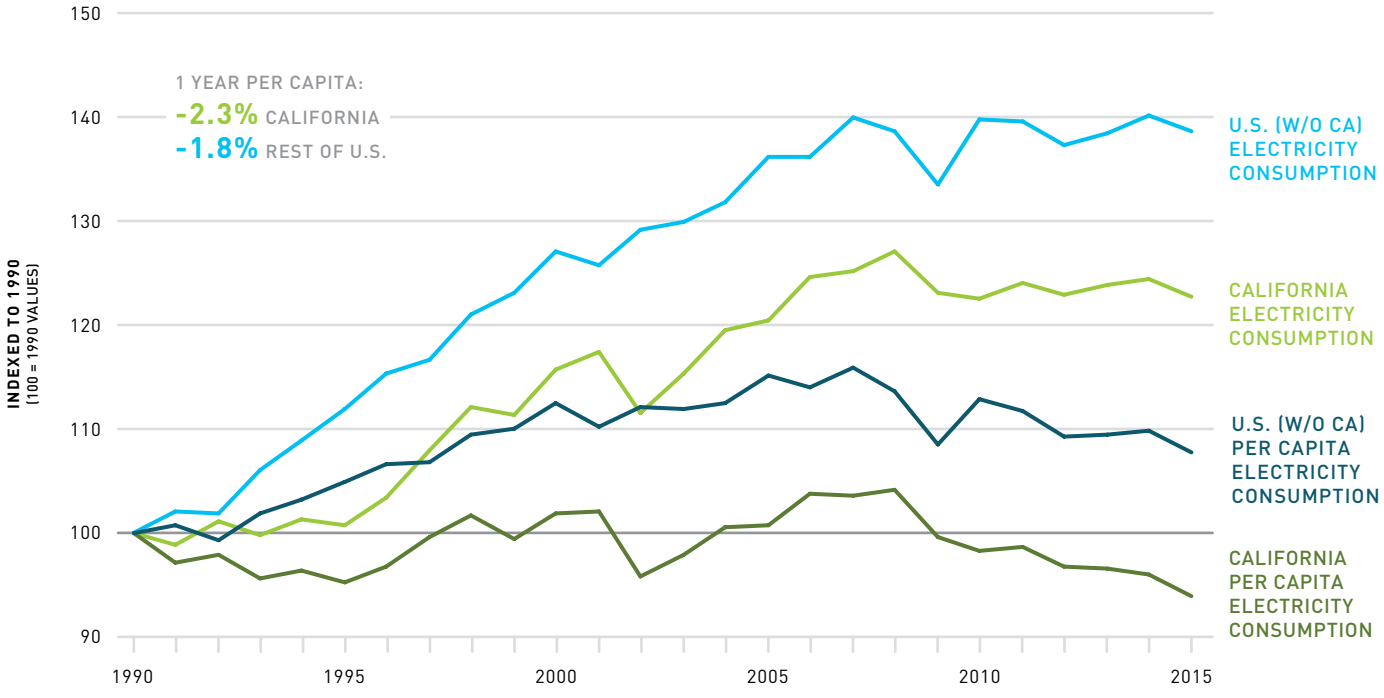
FIGURE 21. ELECTRICITY CONSUMPTION RELATIVE TO 1990

TOTAL CONSUMPTION & PER CAPITA: CALIFORNIA & REST OF U.S., 1990–2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy, Energy Information Administration; U.S. Census Bureau. NEXT 10 / SF · CA · USA

the rest of the U.S., electricity bill as a percent of GDP was 2.3 percent in 2015. Of the most populous states, New York, California, and Illinois had the lowest electricity bills as percent of GDP in 2015 (1.57, 1.63, and 1.65, respectively), while Florida and Ohio were among the highest (2.81 and 2.39 percent, respectively).

In 2015, California's electricity bill as a percent of GDP was 0.48 percentage points less than Texas's and 1.18 percentage points less than Florida's. In terms of California GDP, this equates to approximately $11.8 billion and $29 billion that Californians saved in electricity costs compared to if the state had the same efficiency as Texas and Florida, respectively.[46] However, California's Mediterranean climate — with warm to hot, dry summers and mild, moderately wet winters — means that electricity demand for air conditioning tends to be lower than in states with hot, humid summers such as Texas and Florida.

California's electric utilities outperformed the rest of the nation in efficiency. In 2015, California used 6.1 percent less electricity per capita than it did in 1990, while total electricity consumption increased 22.7 percent. The efficiency gap between California and the rest of the U.S. continues to persist. The rest of the U.S. used 7.8 percent more electricity per capita than it did in 1990, while total electricity consumption increased 38.5 percent. However, both California and the rest of the U.S. saw efficiency gains between 2014 and 2015 in terms of both total consumption and per capita consumption. In California, per capita electricity consumption decreased 2.3 percent from 2014 to 2015 and total electricity consumption decreased 1.4 percent. In the rest of the U.S., per capita electricity consumption decreased 1.8 percent and total electricity consumption decreased 1.1 percent.

AVERAGE ELECTRICITY RATES

While California's average electricity rates per kilowatt-hour are higher than the U.S. average and other large states', California had among the lowest inflation-adjusted average electricity bills in 2015 for the residential and industrial sectors. In 2015, California's average monthly residential electricity bill was 20 percent lower than the U.S. average ($94.59 versus $114.03), and average monthly industrial bills were 47.4 percent less than the U.S. average ($3,598.73 versus $6,798.62). However, in California's commercial sector, the average monthly electricity bill was 36.9 percent higher than the U.S. average ($920.84 versus $670.82).

TABLE 5. ELECTRICITY PRICES AND BILLS (INFLATION-ADJUSTED) BY SECTOR

CALIFORNIA & REST OF U.S.

	REGION	PRICE PER kWh	AVERAGE MONTHLY BILL		
		2015	2005	2015	10 YEAR % CHANGE
RESIDENTIAL	CALIFORNIA	$0.17	$86.77	$94.59	9.0%
	FLORIDA	$0.12	$139.26	$132.16	-5.1%
	ILLINOIS	$0.13	$81.89	$89.91	9.8%
	NEW YORK	$0.19	$118.38	$111.32	-6.0%
	OHIO	$0.13	$95.24	$112.25	17.9%
	PENNSYLVANIA	$0.14	$103.78	$116.62	12.4%
	TEXAS	$0.12	$158.54	$136.00	-14.2%
	UNITED STATES	$0.13	$107.53	$114.03	6.0%
INDUSTRIAL	CALIFORNIA	$0.12	$6,072.18	$3,598.73	-40.7%
	FLORIDA	$0.08	$4,332.76	$5,945.32	37.2%
	ILLINOIS	$0.07	$31,519.25	$39,956.17	26.8%
	NEW YORK	$0.06	$18,002.02	$12,457.11	-30.8%
	OHIO	$0.07	$14,046.56	$15,441.91	9.9%
	PENNSYLVANIA	$0.07	$10,775.99	$11,980.87	11.2%
	TEXAS	$0.06	$6,138.09	$4,846.50	-21.0%
	UNITED STATES	$0.07	$8,054.36	$6,798.62	-15.6%
COMMERCIAL	CALIFORNIA	$0.16	$823.54	$920.84	11.8%
	FLORIDA	$0.10	$685.74	$641.33	-6.5%
	ILLINOIS	$0.09	$691.62	$627.29	-9.3%
	NEW YORK	$0.15	$1,128.11	$930.82	-17.5%
	OHIO	$0.10	$626.12	$636.69	1.7%
	PENNSYLVANIA	$0.10	$599.98	$506.50	-15.6%
	TEXAS	$0.08	$678.81	$649.66	-4.3%
	UNITED STATES	$0.11	$662.49	$670.82	1.3%
	REGION		GDP IN MILLIONS		
			2005	2015	10 YEAR % CHANGE
GROSS DOMESTIC PRODUCT (MILLIONS OF 2015 DOLLARS)	CALIFORNIA		$2,119,214.51	$2,458,535.00	16.0%
	FLORIDA		$864,155.03	$882,798.00	2.2%
	ILLINOIS		$728,758.68	$775,007.00	6.3%
	NEW YORK		$1,272,534.97	$1,441,003.00	13.2%
	OHIO		$573,339.01	$608,109.00	6.1%
	PENNSYLVANIA		$616,119.60	$689,173.00	11.9%
	TEXAS		$1,137,616.26	$1,586,468.00	39.5%
	UNITED STATES		$15,814,238.21	$17,830,307.00	12.7%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy, Energy Information Administration; Bureau of Economic Analysis, U.S. Department of Commerce.
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Why is it Important?

Renewable energy provides an unlimited source of energy that leverages replenishable natural resources and produces significantly fewer emissions compared to fossil fuel energy. As such, renewable energy offers a way to increase or maintain an energy supply while reducing GHG emissions and environmental impacts from energy use. Indicators that track trends in renewable energy illustrate California's shift to a cleaner energy economy.

Renewable Electricity Generation

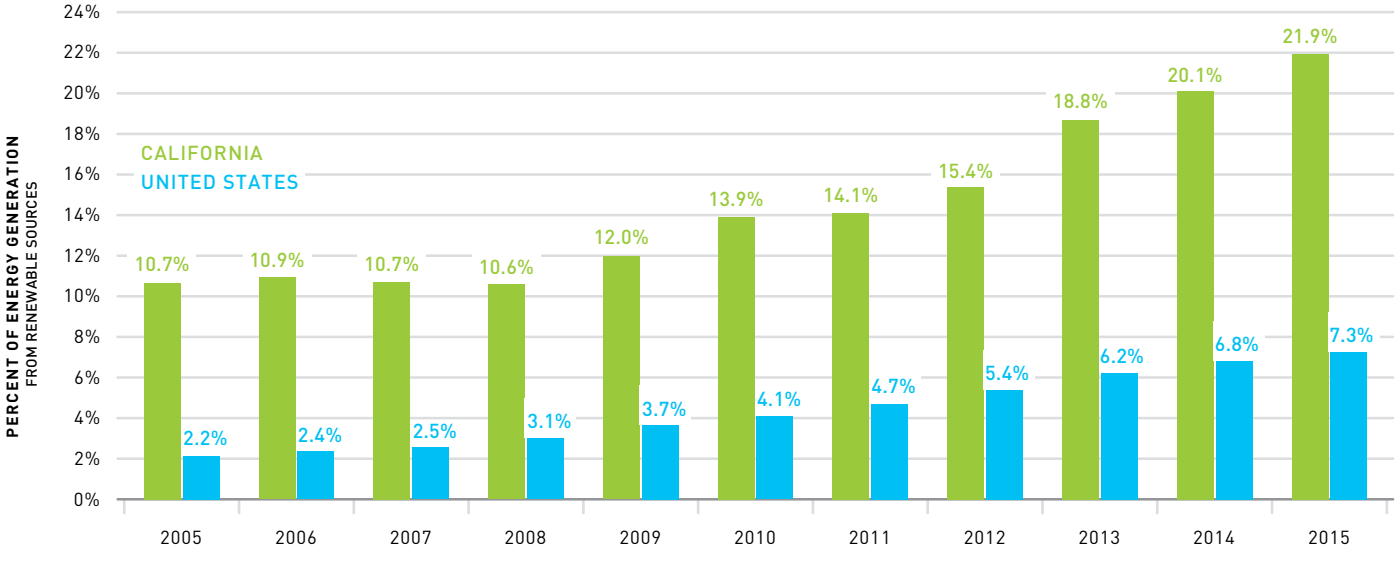
In 2015, the rapid shift of the U.S. power sector away from carbon-intensive fuels[47] continued to accelerate as a record number of coal plants — accounting for nearly 14 gigawatts of capacity — discontinued operations.[48,49] As of the first quarter of 2017, cumulative solar capacity totaled 18,963 megawatts in California, making the state number one nationally in solar capacity instillation.[50] Natural gas production and consumption hit an all-time high in the U.S., replacing more emissions-heavy energy sources.[51]

In 2002, California established a Renewable Portfolio Standard (RPS) — a state mandate on the clean-energy shares provided by utilities. The RPS began in 2002 with a requirement to source 20 percent of California's electricity from renewable sources by 2017. Since 2002, California has continued to set even more aggressive goals:

End of 2016: 25%
End of 2020: 33%
End of 2024: 40%
End of 2027: 47%
End of 2030: 50%

Twenty-nine states and Washington, D.C. now boast an RPS and collectively serve as a major driver of construction of solar and wind infrastructure, helped by incentives to spur renewable electricity generation.[52] Along with California, New York has increased its RPS to 50 percent by 2030 and Hawaii has set the most aggressive RPS requirement — a target of 100 percent by 2045. The California state legislature is currently considering a bill that would increase the state's RPS goal to 60 percent by 2030 and set a planning target of 100 percent zero-carbon resources by 2045.[53] However, while many states have continued to lead in RPS implementation,

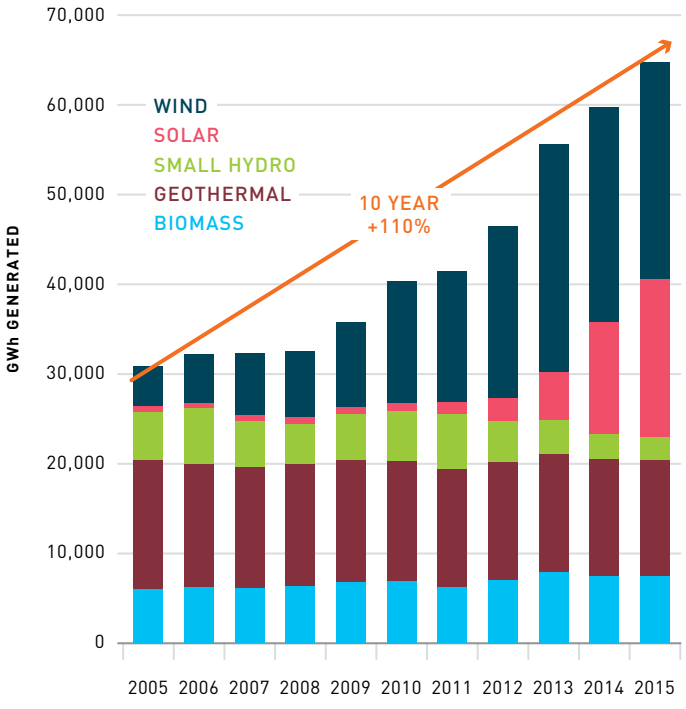
FIGURE 22. PERCENT OF TOTAL ENERGY GENERATION FROM RENEWABLE SOURCES
CALIFORNIA & U.S., 2005–2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission; U.S. Department of Energy, Energy Information Administration. NEXT 10 / SF · CA · USA

FIGURE 23. CALIFORNIA RENEWABLE ELECTRICITY GENERATION

GIGAWATT HOURS BY SOURCE, 2005–2015



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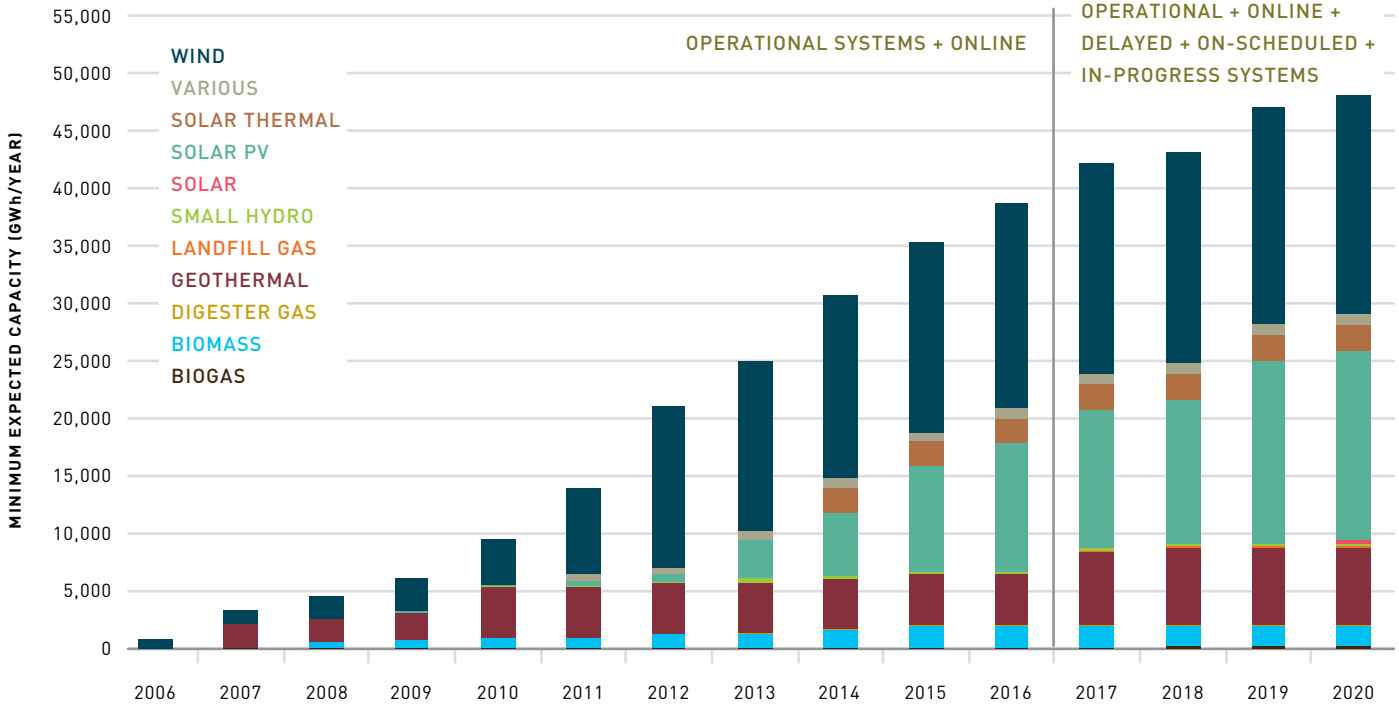
some other states are falling behind. In 2015, West Virginia repealed the state RPS enacted in 2009 that would have required 25 percent by 2025,[54] and Kansas replaced its RPS with a voluntary goal.[55]

In 2015, California increased renewable electricity to reach 21.9 percent of total electricity generation, up 1.8 percentage points compared to 2014. The U.S. as a whole experienced a slower increase of 0.5 percentage points compared to 2014, and trails California with only 7.3 percent of total electricity generation from renewable sources in 2015 (Figure 22).

California's renewable electricity generation surged 117 percent between 2002 and 2015, reaching roughly 64,800 gigawatt-hours (GWh). In 2015, it increased 8.3 percent from the year before, with the biggest jump in solar (+40.3%), while small hydropower dropped 6.1 percent, due largely to the drought. In 2015, wind comprised the largest proportion of renewable electricity generation (37%) in the state. For the first time ever, solar (27%) overtook geothermal (20%) as the second largest source of renewable electricity generation. From 2010 to 2015, total electricity from biomass increased

FIGURE 24. CUMULATIVE OPERATIONAL CAPACITY OF RENEWABLES PORTFOLIO STANDARD PROJECTS

BY INVESTOR OWNED UTILITIES, CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission. NEXT 10 / SF · CA · USA

California Energy Storage and Electric Power Grid Integration Challenge

The way that California — and the U.S. as a whole — manages its energy grid is shifting as more renewable energy is brought online, fossil fuel plants are retired, and distributed energy resources are incorporated into the grid. While federal and state policies, renewable portfolio standards, and smart grid technologies have helped to decarbonize the energy grid, more work needs to be done to incorporate energy storage so that the state can reliably manage its grid as it moves toward its renewable energy goals.

Efficient energy storage is an integral part to achieving the state's renewable energy goals. The variable nature of renewable energy poses grid-integration challenges. As renewable energy generation increases, clean energy that is produced when demand is low often has to be curtailed, shut down, or sold out of state. The U.S. Department of Energy is currently preparing a study that analyzes grid reliability concerns related to renewable energy supplies. However, California's grid-managing entity — the California Independent System Operator (CAISO) — has already found that renewables, combined with modern controls, have the ability to provide a range of grid reliability services that are comparable to, or better than, conventional resources.[57] The DOE itself has also previously found that renewables can provide as much as 80 percent of total U.S. electricity generation in 2050 while meeting electricity demand on an hourly basis in every region of the country.[58]

To better manage variable supplies and demand of renewable energy, California has developed and implemented several programs and policies, including those designed to achieve greater utilization of energy storage. In 2016, storage accounted for about one in six jobs in the entire Transmission, Distribution and Storage sector in California, compared to about one in 14 jobs for the U.S. industry average. Since the passage of Assembly Bill 2514 in 2010, which required the California Public Utilities Commission (CPUC) to adopt an energy storage system procurement target, the CPUC, California Energy Commission (CEC), and CAISO have jointly developed a roadmap that would guide the state toward reducing costs of integrating and connecting to the grid through increased storage utilization.[59]

Since the bill's passage, California has seen steady growth in the energy storage industry. As of 2016, California was on track to meeting the storage procurement target (470 MW combined from Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric), with 533 MW of procurement — 357 MW from Southern California Edison, 97 MW from Pacific Gas & Electric, and 79 MW from San Diego Gas & Electric.[60] The growth in this sector has been buoyed by policies like AB 2514 as well as the state's Self-Generation Incentive Program (SGIP). When the SGIP reopened to energy storage applicants on May 1, 2017, demand was so high for incentives to build energy storage that the application window for incentives had to be closed after just one week.[61]

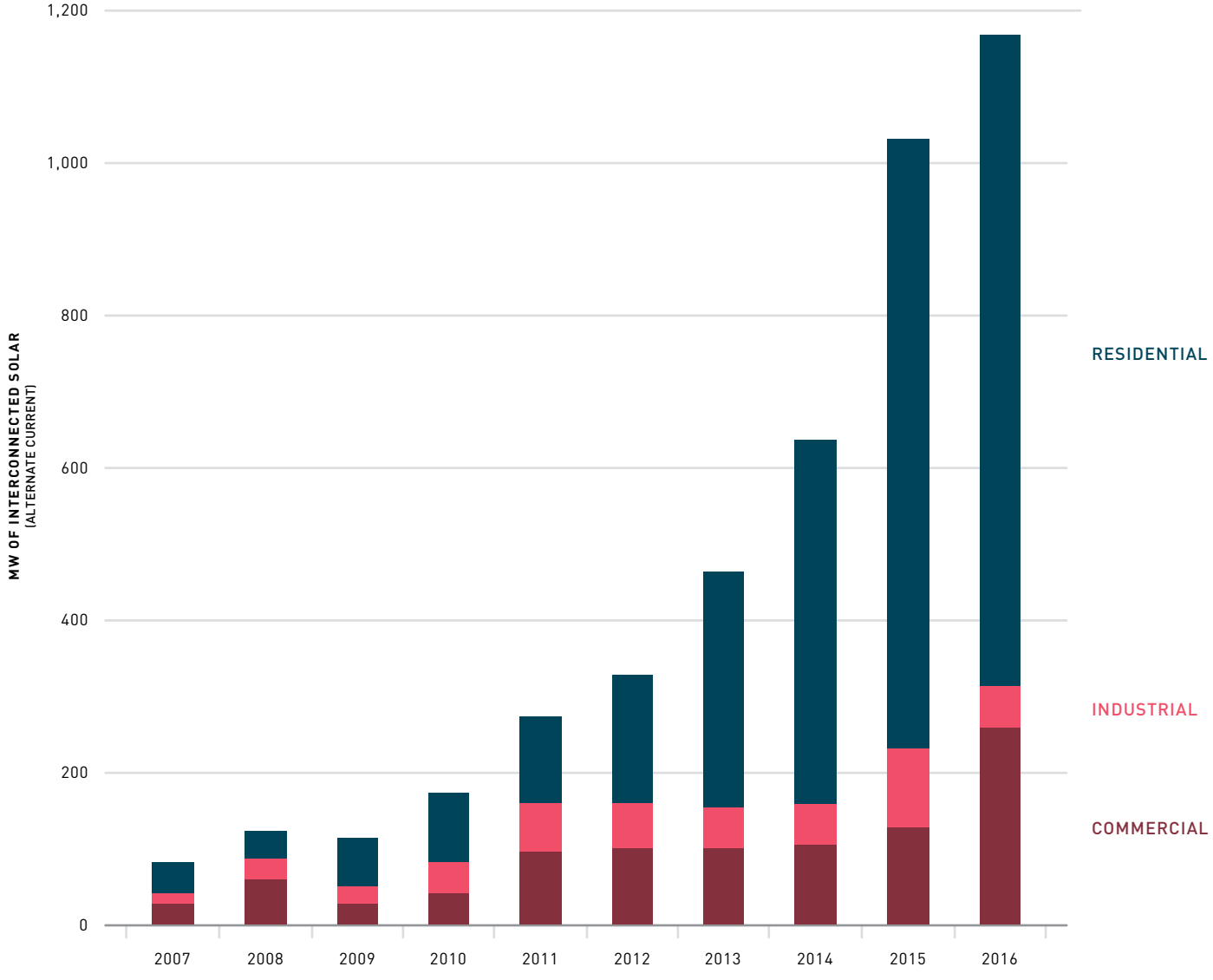
The Aliso Canyon natural gas leak in 2015 also spurred increased investment in energy storage. In spring 2016, the CPUC authorized the expedited procurement of 104.5 MW of battery-based energy storage systems for Southern California Edison and San Diego Gas & Electric service areas in an effort to ensure reliability of supply as the natural gas storage facility remained closed. In April 2017, San Diego Gas & Electric signed contracts for five storage projects that use lithium-ion batteries, totaling 83.5 megawatts, which would put the company on schedule to procure 165 megawatts of energy storage by 2020. A recent McKinsey & Company report found that there is considerable near-term potential for stationary energy storage, mainly due to falling costs of energy storage technology.[62]

8.6 percent, wind increased 78.1 percent, and solar increased an astounding 1,738.3 percent.

The California Energy Commission's progress report on renewable energy estimates that in 2016, 27 percent of the state's electricity retail sales were served by energy generated from renewable sources. This means California is ahead of schedule for meeting the RPS requirements of 25 percent by 2016.[56] In order to meet its RPS of 33 percent of electricity generation from renewables by 2020, California investor-owned utilities must increase renewable electricity generation by about 24 percent between 2016 and 2020, as illustrated in the operational and on-schedule system capacity in Figure 24. Currently, estimates place the growth at 9,236 GWh between 2016 and 2020, 24 percent of 2016's expected cumulative operational capacity.

FIGURE 25. SOLAR PV INTERCONNECTIONS IN CALIFORNIA

INTERCONNECTED SOLAR PV THROUGH NET ENERGY METERING



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: The data set only includes interconnected solar PV Net Energy Metering (NEM) projects and presents the current "state of the world" in terms of how many interconnected solar PV projects and how many megawatts are installed in a given geographic area. Calculations based on "Application Approved Date." Data Source: Currently Interconnected Data Set, California Solar Statistics. NEXT 10 / SF · CA · USA

Solar and Wind Installations

SOLAR

As the market matures, California is expanding renewable energy installations at a cost that is increasingly competitive with fossil fuel energy. In-state generation of solar jumped from 10,557 GWh in 2014 to 15,046 GWh in 2015, surpassing both in-state generation of wind and geothermal for the first time.[63] Public policies, including California's RPS and Net Energy Metering (NEM), as well as the U.S. Investment Tax Credit (ITC), have ensured that California continues to be the leading solar market in the U.S. In 2016, an additional 5,096 MW of solar capacity was installed, bringing the state's total solar capacity to 18,296 MW.[64] Total solar investments in California during 2016 were estimated to be at $8.38 billion, up 15 percent from 2015's $7.27 billion. To place California's remarkable solar boom in context, the cumulative amount of solar electricity capacity installed through 2016 in California was about six times as much as the next highest state, North Carolina (3,016 MW cumulative through 2016).[65]

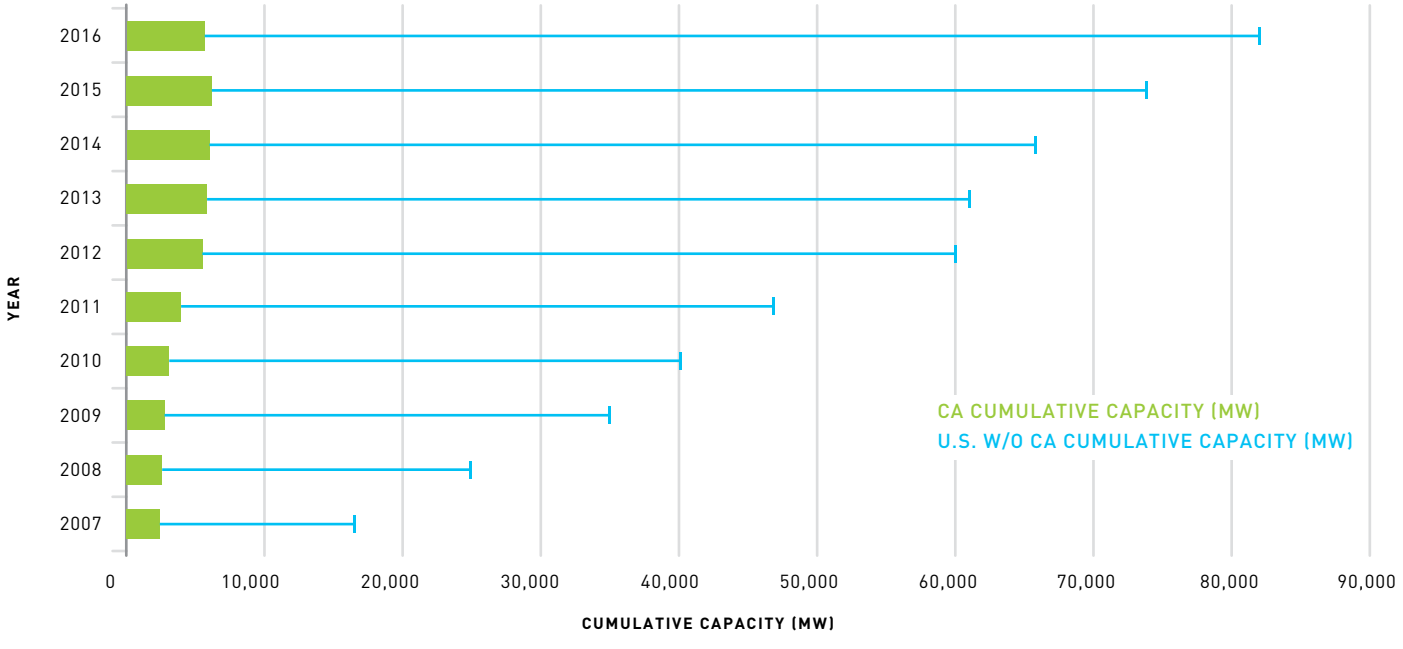
Non-utility scale solar PV interconnections continued to grow in 2016, though the magnitude of growth was not as great as 2015's growth. In 2016, new solar PV interconnections increased 13 percent, or 133 MW, from 2015. The commercial sector had the largest total MW increase with 216 additional MWs interconnected, representing a 106.5 percent increase compared to 2015. Total MWs interconnected in the residential sector increased 6.6 percent, or 53 MW. But the industrial sector had a major setback, with MWs interconnected down by 52 percent.

WIND

California wind facilities decreased their generation by 6.3 percent (down 817 GWh) in 2015, resulting in a total of 12,180 GWh generated.[66] Wind generation capacity decreased by more than 400 MW in 2016, bringing California's cumulative wind capacity down to 5,662 MW, as a number of wind capacity facilities were decommissioned.[67] However, a number of these project sites are slated for repowering and the lost capacity will be partially regained in the near future.

In 2016, the U.S. added 8,203 MW of wind capacity, increasing its cumulative capacity to 82,183 MW at the end of 2016.

FIGURE 26. WIND CAPACITY
CALIFORNIA & REST OF U.S., 2016



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: A number of wind capacity were decommissioned in 2015, primarily in California. However, a number of these project sites are slated for repowerings. One can expect the lost capacity will be regained partially in the near future. Data Source: American Wind Energy Association. NEXT 10 / SF · CA · USA

CLEAN ENERGY EMPLOYMENT

California Facts: Nine Years of Economic Growth From 2006 to 2015

The California Green Innovation Index has tracked California's economy since the 2006 passage of AB 32, a suite of regulations that reduce emissions and grow the clean energy economy. Data from 2006 to 2015 show California's climate leadership resulted in economic success, with GDP per capita growth in California of almost $5,000 per person over the time period, nearly double the growth experienced by the U.S. as a whole. At the same time, per capita emissions in California decreased by 12 percent. Total non-farm employment grew by 0.64 percent, outpacing pre-2006 growth rates and U.S. total job growth by 27 percent.

POPULATION

	POPULATION		AVERAGE ANNUAL GROWTH	
	2006	2015	2000–2006	2006–2015
CALIFORNIA	37,195,240	38,907,642	1.7%	0.5%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Department of Finance. NEXT 10 / SF · CA · USA

ECONOMY

	TOTAL GDP (MILLIONS OF INFLATION-ADJUSTED DOLLARS, 2015)		AVERAGE ANNUAL GROWTH		PER CAPITA GDP (INFLATION-ADJUSTED DOLLARS, 2015)	
	2006	2015	2000–06	2006–15	2006	2015
CALIFORNIA	2,201,849	2,491,619	2.3%	1.5%	$59,197	$64,039
U.S.	16,110,250	18,036,600	1.2%	1.3%	$53,954	$56,207

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Bureau of Economic Analysis; California Department of Finance. NEXT 10 / SF · CA · USA

GREENHOUSE GAS EMISSIONS

	TOTAL GHG EMISSIONS (MILLION METRIC TONS OF CO_2 EQUIVALENT)		AVERAGE ANNUAL GROWTH		PER CAPITA GHG EMISSIONS (METRIC TONS OF CO_2 EQUIVALENT)	
	2006	2015	2000–06	2006–15	2006	2015
CALIFORNIA	478.7	440.4	0.3%	-0.9%	12.9	11.3

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resource Board; California Department of Finance. NEXT 10 / SF · CA · USA

RENEWABLE ENERGY

	ELECTRICITY GENERATION FROM RENEWABLE SOURCES (GIGAWATT-HOURS)		AVERAGE ANNUAL GROWTH		PERCENT OF TOTAL GENERATION FROM RENEWABLE SOURCES	
	2006	2015	2000–06	2006–15	2006	2015
CALIFORNIA	32,215	64,781	0.9%	11.2%	10.9%	21.9%
U.S.	96,526	298,357	2.3%	23.2%	2.4%	7.3%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission; U.S. Department of Energy, Energy Information Administration. NEXT 10 / SF · CA · USA

EMPLOYMENT

	TOTAL NONFARM EMPLOYMENT		AVERAGE ANNUAL GROWTH	
	DEC 2006	DEC 2015	2000–2006	2006–2015
CALIFORNIA	15,391,600	16,282,000	0.44%	0.64%
U.S.	137,266,000	143,085,000	0.38%	0.47%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

The impact of regulation on employment and economic growth is a topic of national debate, and California's success indicates that smart regulations can be a boost to both while reducing GHG emissions and improving air quality.

From 2012 through 2016, California averaged 2.7 percent job growth per year, compared to 1.8 percent nationwide. These job gains occurred while the state was rolling out pioneering clean energy policies, including cap and trade, a low-carbon fuels program, an ambitious RPS and clean-car standards. California is home to some of the nation's strictest regulatory environment in terms of greenhouse gas emissions, and yet it is seeing impressive growth in employment.

From 2014 to 2015, California's real GDP per capita grew by 3.5 percent, compared to 2.0 percent for the U.S. At the same time, California's gross GHG emissions per capita decreased by 1.1 percent, and its carbon economy decreased by 4.5 percent.

In 2015, California made up 12.2 percent of the U.S. population, but accounted for 13.8 percent of U.S. GDP. California was responsible for $2.46 trillion in economic output, making it the sixth-largest economy in the world.

The growing importance of the clean energy economy is not limited to California or other coastal states. In states from Iowa to Texas, renewable energy and energy efficiency are increasingly important sources of employment and economic growth. In 2016, for the second year in a row, more renewable generation capacity than fossil-fueled generation capacity was installed across the U.S.[68] This reflects a worldwide trend as renewable generation technologies become cheaper: solar and wind generation now cost the same as or less new fossil-fueled generation in 30 countries across the globe.[69]

The U.S. energy industry covers a wide range of sectors (Figure 27), with the two largest being Electric Power Generation and Energy Efficiency. Given that they comprise so much of the industry, employment trends in these two sectors are especially important. The third-largest sector, Transmission, Distribution, and Storage, is increasingly vital to the next generation of clean energy employment as storage becomes necessary for greater expansion of renewable energy sources.

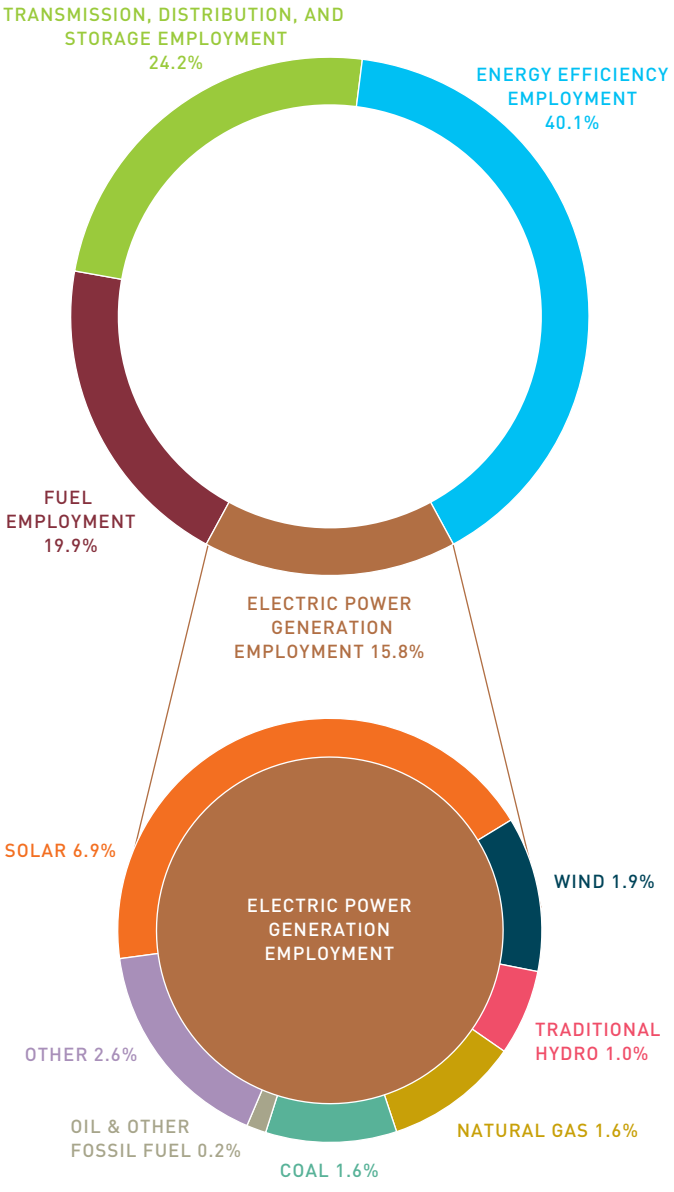
EMPLOYMENT IN ELECTRIC POWER GENERATION

In the Electric Power sector, there are far more jobs in wind and solar generation than in fossil fuel generation across the country. Total U.S. employment in electric power generation was 860,783 in 2016. Solar and wind accounted for 55 percent of employment in the sector (475,545 jobs) compared to 11.5 percent for coal and oil and 10.3 percent for natural gas.

Nationwide, solar employment increased by 25 percent in 2016, while wind jobs increased by 32 percent. In comparison, employment in fossil fuel generation energy sectors grew

FIGURE 27. U.S. ENERGY EMPLOYMENT

2016



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy.
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by eleven percent, less than the growth in total employment in electric power generation (20.7%) in 2016.[70] California employed 152,947 workers (41 percent of all U.S. solar generation jobs) in 2016, more than the next nine states combined (27.5%) (Figure 28).

Outside of California, renewable energy remains an important source of employment in the U.S. Texas is home to 24 percent of the nation's wind electric generation jobs, the largest share in the nation and almost three times as many as found in the next top state (Figure 29). In 2016, Texas employed 24,374 workers in wind electric power generation, followed by Illinois (8,321 workers), Colorado (7,124), Indiana (6,250), and California (4,635).

In 2016, 21.6 percent of California's energy jobs were in solar and wind electric power generation, surpassed only by Nevada (29.1%) and Hawaii (22.8%). In comparison, for the U.S. as a whole, 8.74 percent of all energy jobs are in solar and wind electric-power generation (Figure 30).

There are approximately 2.5 jobs in solar and wind electric power generation for every one job in fossil generation in the U.S., but this ratio varies widely across states (Table 6). Vermont has almost no employment in fossil fuel electric power generation, and therefore has 677 jobs from solar and wind for every job from fossil fuels. Idaho has a ratio of 91:1 solar and wind to fossil fuels, and Oregon, Rhode Island, Washington, Maine, South Dakota and New Mexico are all also in the double digits. Despite its clean energy leadership, California has 8.5 jobs in solar and wind electric power generation for every job in fossil fuel generation, and its lower ratio is due to the state's relatively high reliance on natural gas as a source of electricity generation.

FIGURE 28. SOLAR ELECTRIC POWER GENERATION JOBS

TOP 10 STATES, 2016

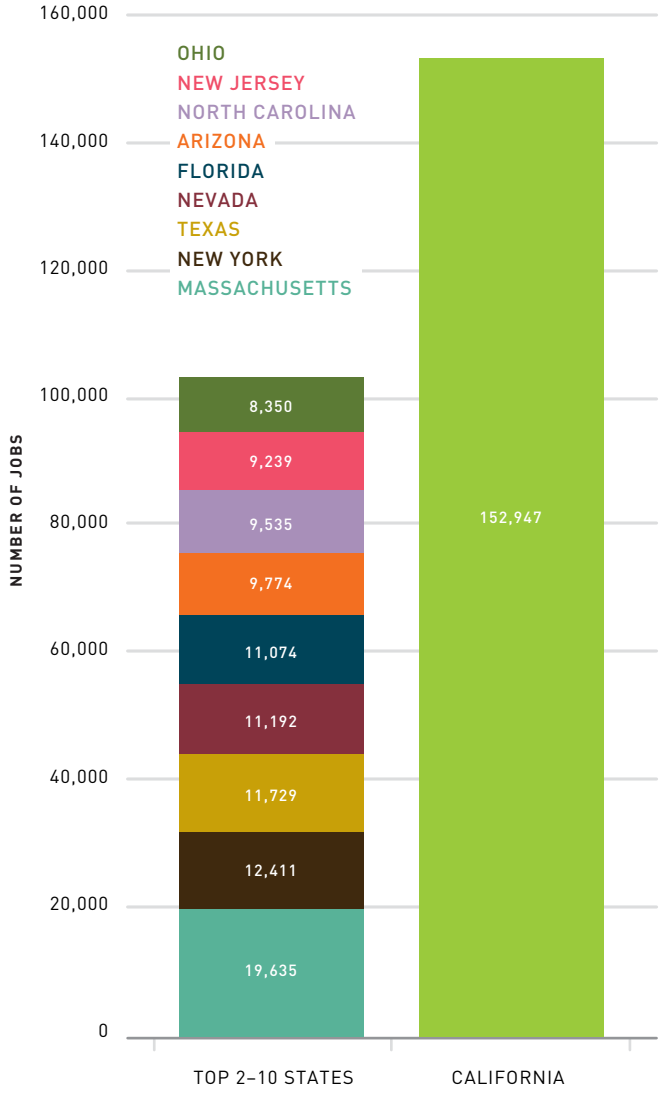

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TABLE 6. SOLAR AND WIND EMPLOYMENT TO FOSSIL FUEL EMPLOYMENT RATIO IN ELECTRIC POWER SECTOR[71]

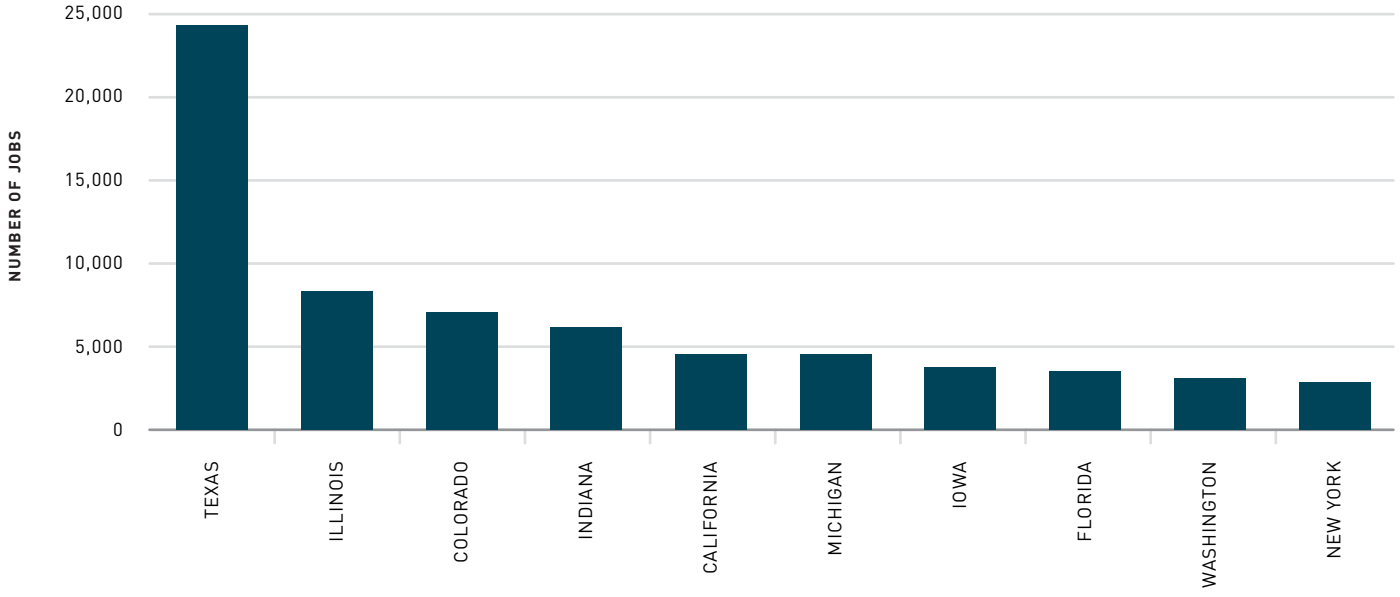
TOP 10 STATES, 2016

STATE	RATIO
VERMONT	676.8:1
IDAHO	91.4:1
OREGON	26.6:1
RHODE ISLAND	19.5:1
WASHINGTON	19.2:1
MAINE	12.2:1
SOUTH DAKOTA	11.4:1
NEW MEXICO	9.4:1
CALIFORNIA	8.5:1
NEVADA	7.5:1
UNITED STATES	2.5:1

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

FIGURE 29. WIND ELECTRIC POWER GENERATION JOBS

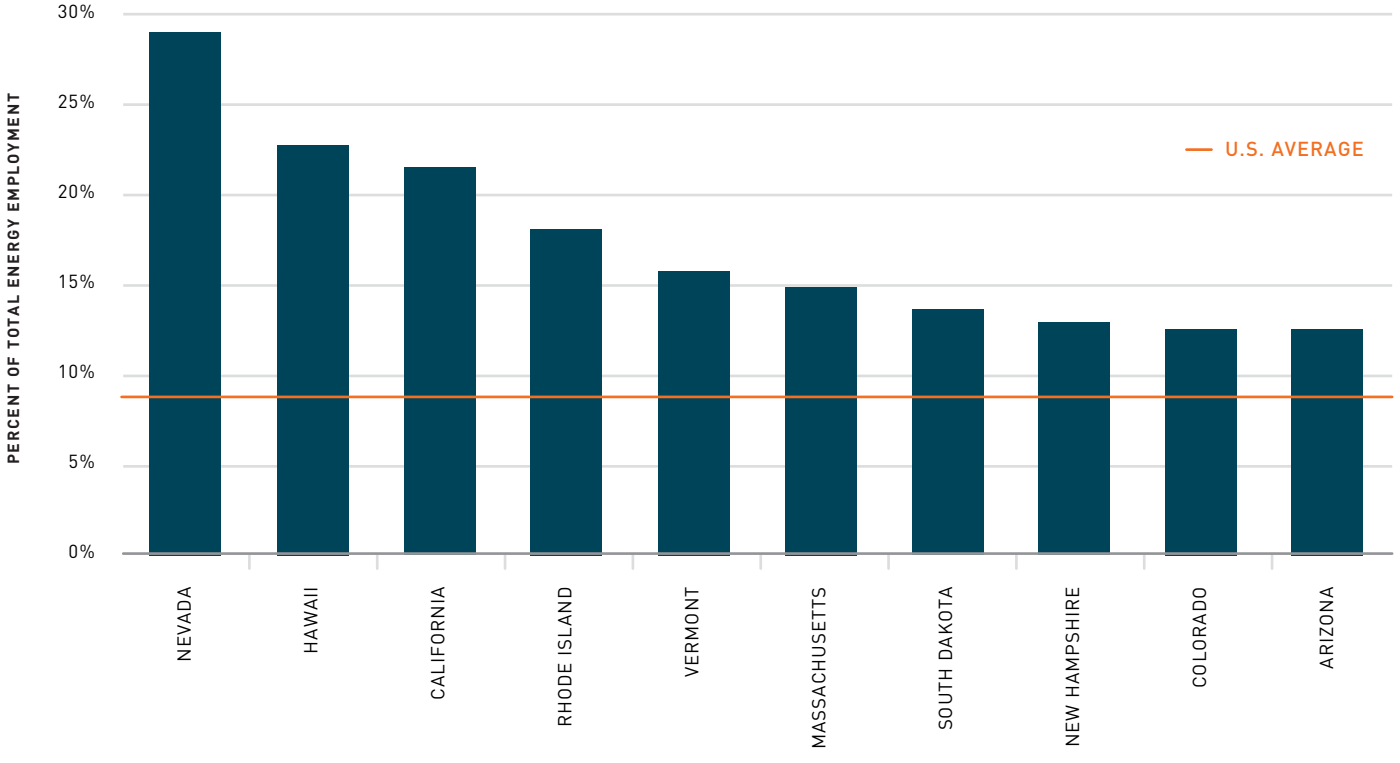
TOP 10 STATES, 2016



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy. NEXT 10 / SF · CA · USA

FIGURE 30. CLEAN ENERGY JOBS IN ELECTRIC POWER GENERATION

AS PERCENTAGE OF TOTAL ENERGY EMPLOYMENT, TOP 10 STATES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Clean Energy Jobs include electricity generation from solar and wind. Employment is the 12-month average of 2016. Data Source: U.S. Department of Energy, Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

TABLE 7. EMPLOYMENT IN ENERGY EFFICIENCY BY CATEGORY, U.S.

ENERGY EFFICIENCY CATEGORY	2016	2015	CHANGE %
ENERGY STAR APPLIANCES, INCLUDING HIGH EFFICIENCY HVAC	552,147	347,628	58.8%
ADVANCED AND RECYCLED BUILDING MATERIALS	446,796	292,667	52.7%
OTHER	217,759	145,876	49.3V
LED, CFL AND OTHER EFFICIENT LIGHTING	327,792	328,288	-0.2%
RENEWABLE HEATING AND COOLING	116,445	135,102	-13.8%
TRADITIONAL HVAC	520,572	630,537	-17.4%
TOTAL	2,181,511	1,880,098	16.0%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

TABLE 8. ENERGY EFFICIENCY EMPLOYMENT

TOP 10 STATES, 2016

STATE	NUMBER OF JOBS
CALIFORNIA	301,348
TEXAS	146,722
NEW YORK	110,582
FLORIDA	108,670
MICHIGAN	87,013
ILLINOIS	83,987
NORTH CAROLINA	80,970
MASSACHUSETTS	80,373
OHIO	78,764
VIRGINIA	75,553
U.S. TOTAL	2,181,511

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TABLE 9. ENERGY EFFICIENCY EMPLOYMENT AS A PERCENTAGE OF TOTAL STATE EMPLOYMENT

TOP 10 STATES, 2016

STATE	PERCENTAGE
VERMONT	3.3%
DELAWARE	2.7%
WYOMING	2.5%
MASSACHUSETTS	2.3%
MARYLAND	2.2%
OREGON	2.1%
UTAH	2.1%
WISCONSIN	2.1%
RHODE ISLAND	2.0%
MICHIGAN	1.9%
U.S. AVERAGE	1.4%

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ENERGY EFFICIENCY EMPLOYMENT

Energy efficiency is the largest sector, employing more than two million people (40.1%) nationwide. Energy efficiency is crucial because it helps to minimize energy waste, lowering usage and curbing energy bills, while generating more economic output from a reduced amount of energy. A recent report from the Natural Resources Defense Council found that from 2000 to 2015, the five least-efficient states saw their average electricity bill climb twice as much as the five most-efficient states.[72] Efficiency is also a cost-effective strategy for achieving carbon reductions and other environmental goals. Advances in energy-efficient policy — from building energy codes to transportation planning — help spur investment in energy efficiency, and in turn businesses, governments, and consumers benefit from having more control over their energy use.[73]

Employment in energy efficiency in the U.S. grew 16 percent in 2016. The biggest gains were in the Energy Star appliances category, an increase of 58.8 percent. The impressive growth in Energy Star appliances jobs reflects the key role the program plays in creating employment opportunities while reducing consumers' usage and electricity costs. Other gains were seen in advanced and recycled building materials (+52.7%), and in the catchall category "other energy efficiency" (+49.3%).

Meanwhile, employment in the renewable heating and cooling sector and traditional HVAC fell by 13.8 percent and 17.4 percent, respectively, as the trend toward increasing efficiency continues (Table 7). Renewable heating and cooling uses renewable technologies for end-use applications such as heating swimming pools or space heaters, which are declining

TABLE 10. TRANSMISSION, DISTRIBUTION, AND STORAGE EMPLOYMENT BY SUBSECTOR, U.S.

	2016	2015	CHANGE %
STORAGE	90,831	27,140	234.7%
MICROGRID AND OTHER	293,050	173,605	68.8%
SMART GRID	19,745	12,880	53.3%
TRADITIONAL TRANSMISSION	913,406	832,290	9.7%
TOTAL	1,317,032	1,045,915	25.9%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

in popularity as more efficient alternatives become available. Similarly, traditional HVAC is losing market share to high-efficiency HVAC systems.

With the exception of advanced materials and insulation, California leads the way on energy efficiency employment across the categories (Figure 31). Overall, the Golden State had just over 300,000 energy efficiency jobs, which is more than twice as many as the next leading state, Texas (Table 8).

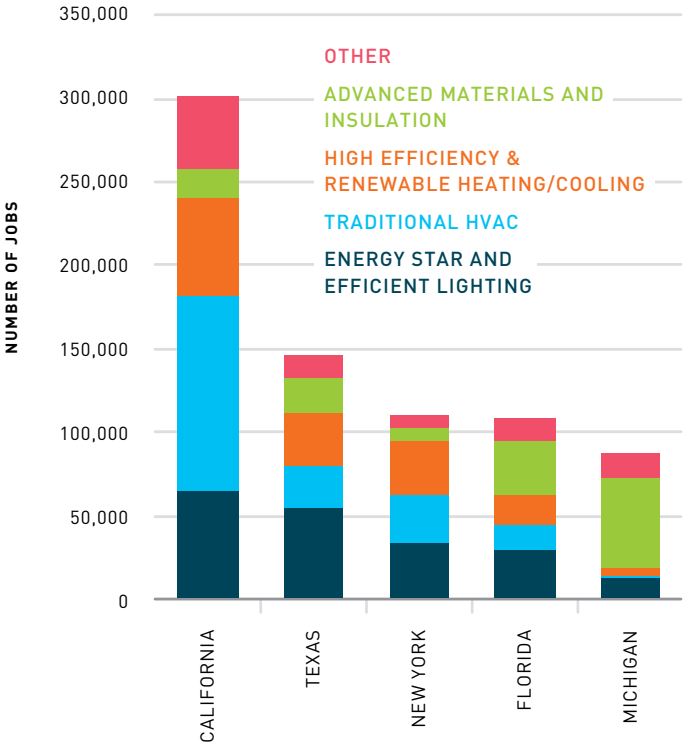
California is not the only state benefitting from energy efficiency jobs. On a percentage-of-total-employment basis, Vermont — another leader in clean energy policies — had the highest concentration of energy efficiency jobs, with energy efficiency employment accounting for 3.3 percent of total state employment (Table 9). Vermont is followed by Delaware (2.7%) and Wyoming (2.5%).[74] In California, energy efficiency employment was 1.6 percent of total state employment.

EMPLOYMENT IN ENERGY STORAGE

The transmission, distribution, and storage (TDS) industry encompasses the entire network of power lines that transmit electricity from generating stations to customers, as well as activities that support power and pipeline construction, fuel distribution and transport, and electrical transmission equipment manufacturing. The TDS industry not only includes these traditional energy transmission and distribution services, but also services in storage, smart grid, and micro grid, among others. Complementing the utility scale power supplies, the transmission, distribution and storage industry serves as a key segment of the nation's energy infrastructure and is one of the fastest growing sectors in terms of employment. 1.317 million Americans were employed in the TDS industry in 2016, up 26 percent from 1.046 million workers in 2015 (Table 10). Employment in the storage subsector in the U.S. increased 234.7 percent from 2015 to 2016, with California as a top state with 27.7 percent (25,000 jobs) of the national workforce (Table 11).

FIGURE 31. ENERGY EFFICIENCY EMPLOYMENT

TOP 5 STATES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; U.S. Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

TABLE 11. TRANSMISSION, DISTRIBUTION, AND STORAGE EMPLOYMENT BY SUBSECTOR, CALIFORNIA

	2016	AS SHARE OF U.S. TOTAL
STORAGE	25,203	27.7%
MICROGRID AND OTHER	28,285	9.7%
SMART GRID	1,908	9.7%
TRADITIONAL TRANSMISSION	99,965	10.9%
TOTAL	155,361	11.8%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; U.S. Bureau of Labor Statistics. NEXT 10 / SF · CA · USA

CLEAN TECHNOLOGY INNOVATION

Why is it Important?

As California works toward achieving increasingly ambitious climate goals, innovations in technology and business continue to serve a critical role in helping the state build a more cost- and carbon-efficient economy. Investments in companies specializing in the development of clean technology help to advance research and market adoption of new products and services for broad economic consumption. Patent registrations can highlight the incremental knowledge accumulated from previous investments in research and development. Patent filings represent future potential growth in clean technology and, together with past investment data, can help illustrate California's continued role as a leader in the shift toward a clean economy and a hub of innovation.

Clean Technology Patents

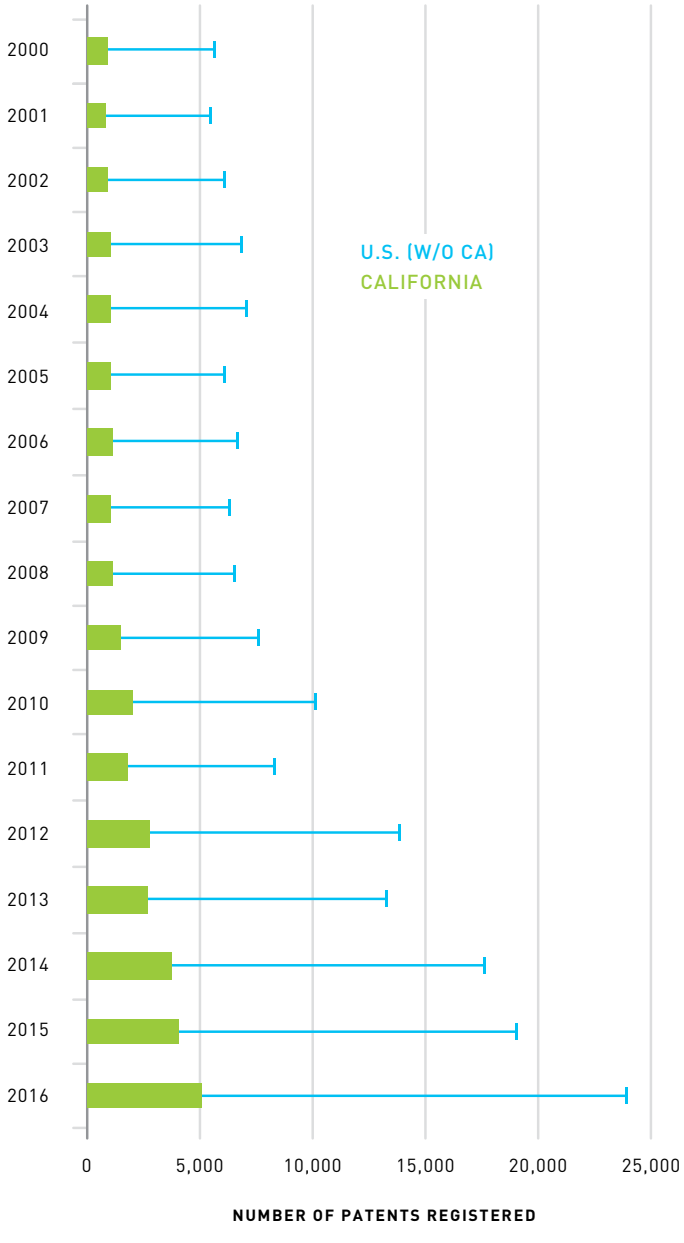
California continues to lead the U.S. in clean technology patent registrations overall and in most industry segments. After having been somewhat insulated from the decrease in venture capital in recent years — in part because a substantial portion of patent activity has come from long-established corporations, as well as research institutions that are not dependent on private venture funding — both California and the U.S. as a whole made substantial gains in clean technology patent registrations at roughly the same pace in 2016. Clean technology patent registrations rose by 25.5 percent between 2015 and 2016 in the U.S. and 26.3 percent in California.

With the exception of the wind sector (-12.0%), 2016 patent registrations were up in every clean technology category in California. Patent registrations relating to green materials had the highest growth (+55.9%), followed by transportation sector (+40.6%), those related to multiple categories (+39.8%), water (+23.8%), and energy efficiency (+19.4%). While some sectors did experience a decrease in patent registrations, overall, the state did experience a 26.3 percent increase in patent registrations.

California registered a total of 5,119 clean technology patents in 2016. The rest of the U.S. registered 18,839, bringing the 2016 total to 23,958 for the entire U.S. California was the leader in the U.S. for total clean technology patents in 2016, followed by Texas (#2), Michigan (#3), New York (#4), and Massachusetts (#5). While California secured the most patent registrations in every segment, the runner-up states fluctuated by segment.

FIGURE 32. U.S. CLEAN TECHNOLOGY PATENT REGISTRATIONS BY RESIDENCE OF FIRST INVENTOR

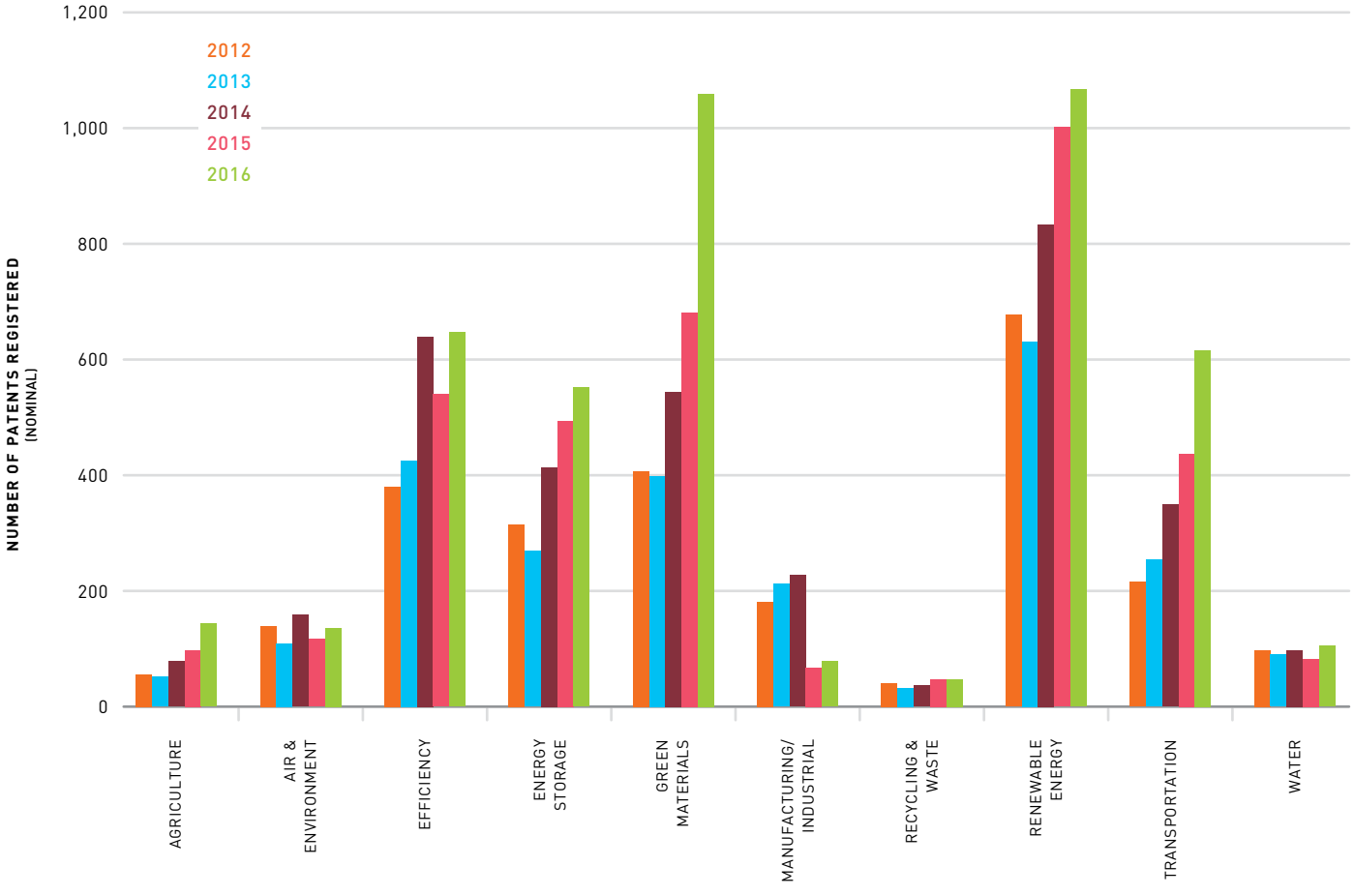
2000–2016, CALIFORNIA VS. REST OF U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: IP Checkups, CleanTech Patent Edge. NEXT 10 / SF · CA · USA

FIGURE 33. CALIFORNIA CLEAN TECHNOLOGY PATENT REGISTRATIONS BY SEGMENT

2012–2016



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PATENT REGISTRATION BY SEGMENT

Transportation

With 616 patents registered in the transportation sector in 2016, California had slightly more patents than the next two states combined (589 between Michigan and Washington).

Renewable Energy

Biofuels: California had 196 patents registered, which is more than the next three states combined (194 between Texas, Illinois, and Massachusetts). The remainder of the top 10 states each had 22 to 25 biofuels patents registered.

Solar: With 493 patents registered, California dominated the solar sector, which was more than the rest of the top 10 states combined (487 total between New York, Colorado, Michigan, Ohio, Arizona, New Jersey, Texas, Massachusetts, and Florida).

Wind: While California was king with 66 patents registered, South Carolina retained its number two spot from the previous year, with 56 patents registered, and is quickly closing the gap.

Efficiency

California had the lion's share in efficiency patents in 2016 (26.6 percent of all efficiency patents in the U.S. in 2016), with 645 patents registered — more than the next five states combined (586 efficiency patents in total between Texas, North Carolina, New York, Illinois, and New Jersey).

Green Materials

California had the largest number of green material patents registered in 2016, with 1,060 patents — slightly less than the next three states combined (1,225 patents between Texas, New York, and Massachusetts).

TABLE 12. TOTAL CLEAN TECHNOLOGY PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	5,119
2	TEXAS	1,655
3	MICHIGAN	1,526
4	NEW YORK	1,458
5	MASSACHUSETTS	1,058
6	ILLINOIS	1,034
7	WASHINGTON	908
8	OHIO	847
9	PENNSYLVANIA	839
10	FLORIDA	832

TABLE 13. EFFICIENCY PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	645
2	TEXAS	143
3	NORTH CAROLINA	124
4	NEW YORK	117
5	ILLINOIS	101
5	NEW JERSEY	101
7	MASSACHUSETTS	94
8	PENNSYLVANIA	90
9	OHIO	87
9	FLORIDA	87

TABLE 14. ENERGY STORAGE PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	550
2	MICHIGAN	277
3	NEW YORK	151
4	TEXAS	121
5	MASSACHUSETTS	101
6	CONNECTICUT	88
7	WASHINGTON	83
8	WISCONSIN	79
9	ILLINOIS	69
9	FLORIDA	69

TABLE 15. GREEN MATERIALS PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	1060
2	TEXAS	440
3	NEW YORK	437
4	MASSACHUSETTS	348
5	OHIO	262
6	MINNESOTA	259
7	PENNSYLVANIA	257
8	WASHINGTON	196
9	MICHIGAN	190
10	ILLINOIS	184

TABLE 16. BIOFUELS PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	196
2	TEXAS	79
3	ILLINOIS	74
4	MASSACHUSETTS	41
5	WASHINGTON	25
6	NEW YORK	23
6	PENNSYLVANIA	23
6	NORTH CAROLINA	23
6	IOWA	23
10	OHIO	22

TABLE 17. SOLAR PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	493
2	NEW YORK	111
3	COLORADO	65
4	MICHIGAN	56
5	OHIO	47
6	ARIZONA	45
7	NEW JERSEY	43
8	TEXAS	42
9	MASSACHUSETTS	41
10	FLORIDA	37

TABLE 18. WIND PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	66
2	SOUTH CAROLINA	56
3	NEW YORK	38
3	TEXAS	38
5	COLORADO	25
5	WASHINGTON	25
7	VIRGINIA	22
8	MASSACHUSETTS	20
9	NORTH CAROLINA	16
10	FLORIDA	12

TABLE 19. TRANSPORTATION PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	616
2	MICHIGAN	417
3	WASHINGTON	172
4	ILLINOIS	169
5	TEXAS	138
6	FLORIDA	112
7	NEW YORK	102
8	INDIANA	88
9	WISCONSIN	85
10	PENNSYLVANIA	83

TABLE 20. WATER PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	104
2	TEXAS	64
3	MICHIGAN	50
4	NEW YORK	42
5	FLORIDA	37
6	PENNSYLVANIA	35
7	MASSACHUSETTS	34
8	ILLINOIS	31
8	OHIO	31
10	KENTUCKY	30

TABLE 21. AIR & ENVIRONMENT PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	135
2	TEXAS	96
3	MICHIGAN	82
4	PENNSYLVANIA	54
5	NEW YORK	53
6	NEW JERSEY	52
7	ILLINOIS	41
7	OHIO	41
9	FLORIDA	40
10	NORTH CAROLINA	39

TABLE 22. MULTIPLE CATEGORIES PATENT RANKING

TOP RANKING STATES IN 2016

RANK	STATE	NUMBER OF PATENTS
1	CALIFORNIA	675
2	MICHIGAN	229
3	TEXAS	202
4	NEW YORK	191
5	ILLINOIS	173
6	MASSACHUSETTS	169
7	WASHINGTON	134
8	OHIO	132
9	FLORIDA	131
10	PENNSYLVANIA	120

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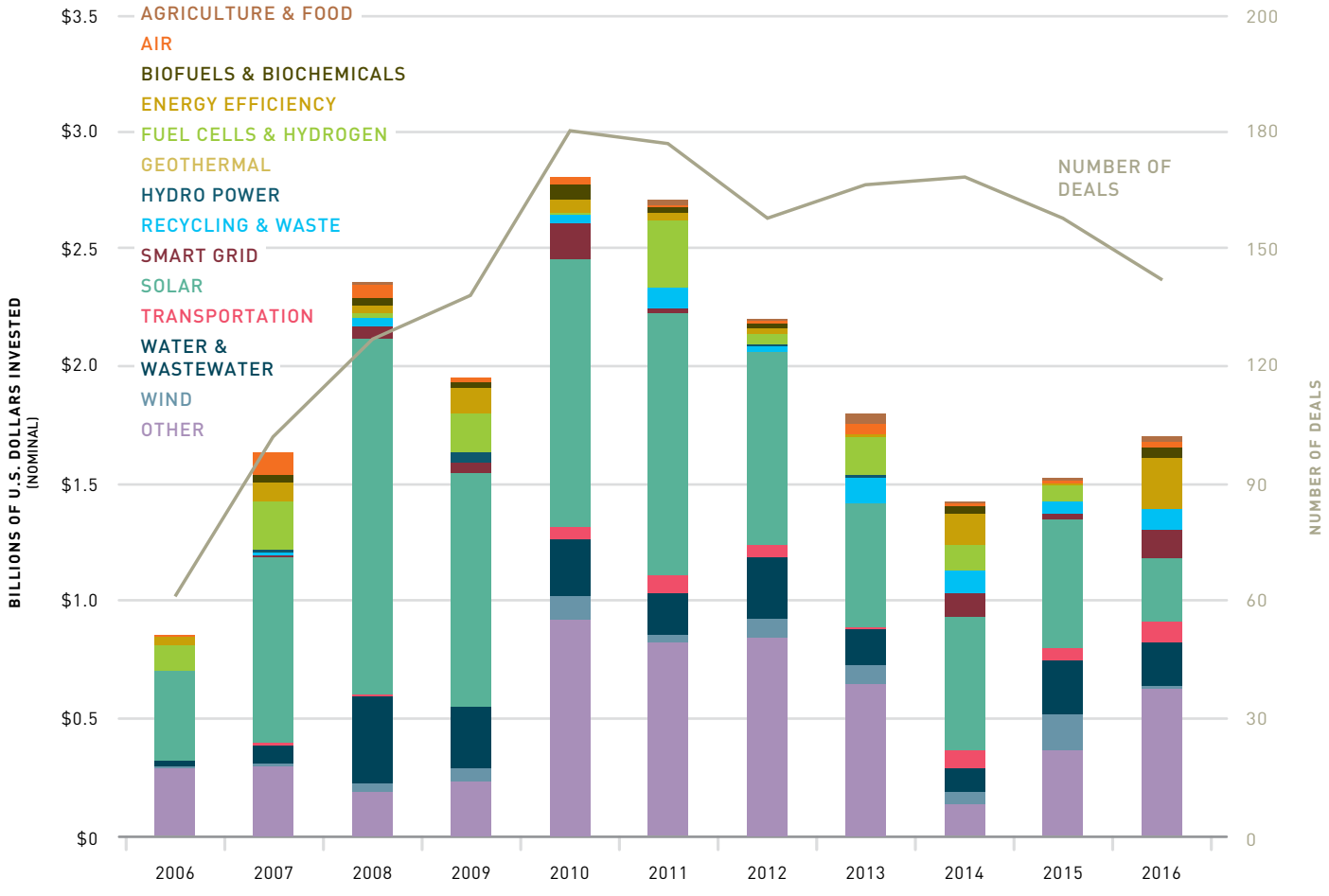
FIGURE 34. VENTURE CAPITAL INVESTMENT IN CLEAN TECHNOLOGY BY SEGMENT
CALIFORNIA, 2006–2016



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Clean Technology Investments

Investment drives clean technology innovation, allowing companies and researchers to create and improve groundbreaking products and services. These types of investments are becoming more diversified, with new types of financing emerging as more investors gain an understanding of the technologies and the value of clean technology.

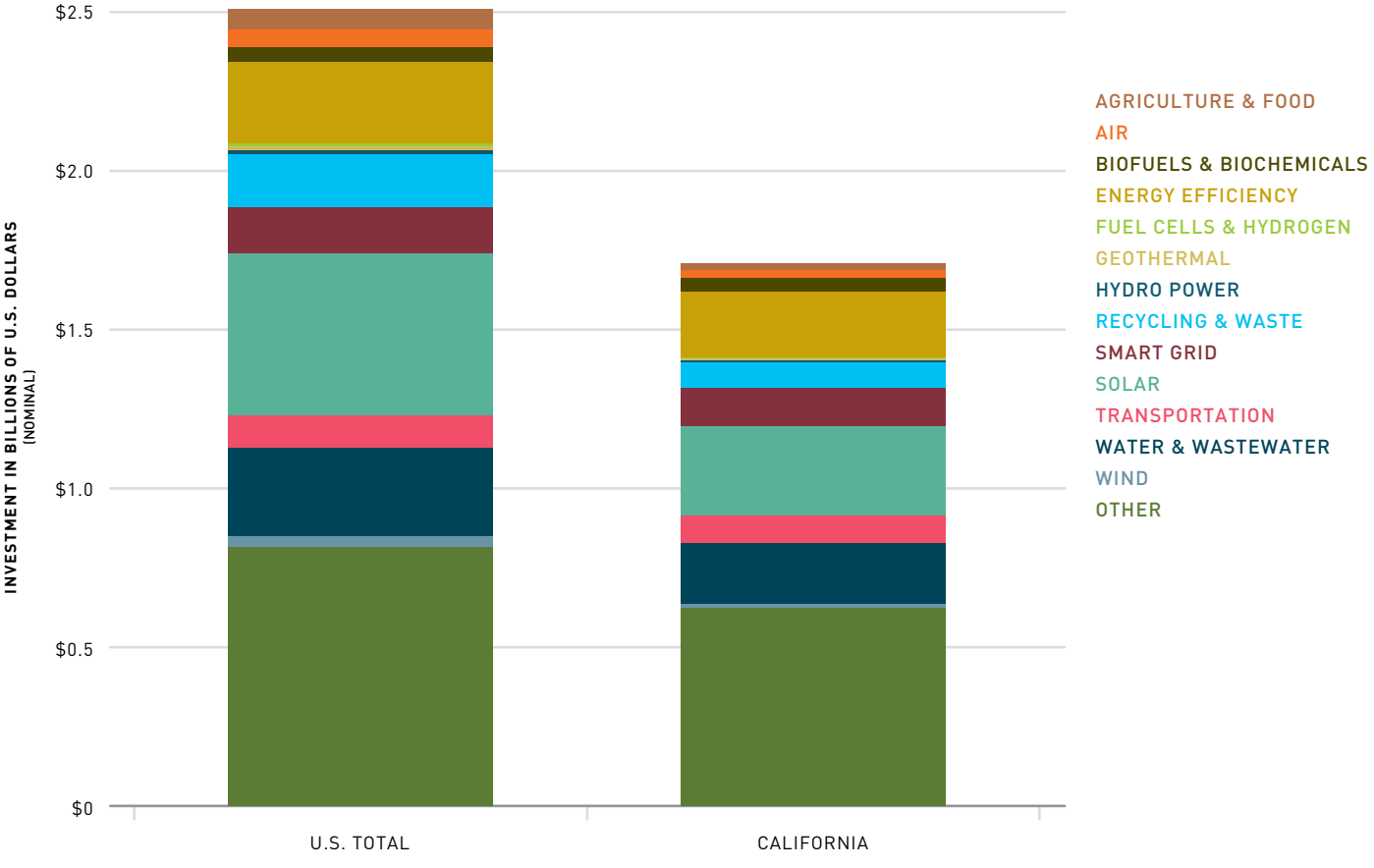
While total investment in clean technology companies continued to shrink in 2016 for the U.S. as a whole, it grew for the second year in a row in California, with the state receiving more than two-thirds (67.8%) of total U.S. venture capital investment in 2016. For the U.S., total investment in clean technology companies was $2.5 billion, down 7.4 percent compared to 2015. Total investment in clean technology in California, on the other hand, grew by 12 percent compared to 2015, totaling $1.7 billion. This investment includes venture capital, initial public offerings, private investment in public equity (PIPE) financing, loans (debt), angel investment, buyouts, and other types of financing.

Venture capital is one of the primary ways for startup companies to secure the necessary capital to create new, innovative products and services. While other types of investors are also important to the growth and expansion of the clean technology market, venture capitalists play a unique and vital role due to their tolerance of early stage, high-risk investments and their management expertise. In addition, corporations are better equipped to provide strategic market power and longer-term investment horizons as well as critical investment capital, making them extremely important investors.

In the last few years, venture funding for clean technology companies has ebbed, following an investment spike in clean technologies between 2008 and 2011. While funding amounts

FIGURE 35. TOTAL INVESTMENT IN CLEAN TECHNOLOGY

BY SEGMENT FOR U.S. & CALIFORNIA, 2016



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may be somewhat lower in recent years compared to the 2008 to 2011 spike, California did see an increase in clean tech VC funding in 2016, compared to 2015.

Just as with clean technology patents, California continues to lead the U.S. in venture capital investments, with its clean technology companies receiving more than half of all venture capital investment in the U.S. overall and in most segments in 2016. Overall, California clean technology companies received more than two-thirds of total U.S. venture capital investment in 2016.

VENTURE CAPITAL INVESTMENT BY SEGMENT

Clean Transportation: 2016 was a decent year for clean transportation, with $88.2 million invested in California and $101.3 million invested in the U.S overall. As zero-emission vehicles become increasingly popular, especially in California, there has been growing demand for charging stations and other ZEV infrastructure. A notable investment was in ChargePoint, a developer of electric vehicle charging networks, which raised $58.1 million in 2016.[75]

Biofuels & Biochemicals: After a lethargic 2015, with only $1.4 million invested in California and $9 million in the U.S., 2016 saw a surge in investment in biofuels and biochemicals, totaling $47.45 million in California. Edeniq, a biofuel tech company, has raised $12.2 million as of January 2017.[76] This investment total was comparable to the levels seen in the late 2000s, which saw VC funding reach, for example, $36.2 million in 2007 and $58.9 million in 2008.

Energy Efficiency: Historically, investment in energy efficiency has been volatile. Nevertheless, 2016 was a good year, especially compared to 2015, with $212.1 million invested in California and $253.9 million invested in the U.S. as a whole. The surge in investment in 2016 can be in part attributed to the more than $70 million in Series D funding raised by Renew Financial, which earmarked the new funds for Property Assessed Clean Energy (PACE) financing and other energy efficiency programs.[77]

Solar: Venture capital investments in solar companies remain anemic. In 2016, venture capital investments in solar declined by almost half in California, to $274.5 million, by 27.4 percent in the U.S. as a whole. As a renewable source of energy generation, solar power installations have continued to reach new highs year after year, and new solar PV interconnections have also continued to climb. There might be signs that the solar market is maturing, hence warranting less need for venture capital investments in companies. For example, the Solar Energy Industries Association (SEIA) predicted that the residential PV market would experience slower growth, similar to a maturing industry, in 2017.[78] Even though investments had been declining for the past several years, solar remains one of the largest clean technology segments.

After losing over half of the money invested during the clean technology investment boom during the economic recession, venture capital firms have remained cautious toward the clean technology segment, even as the economy recovered.[79] A recent study by the MIT Energy Initiative postulates that venture capital is not suitable for the clean technology sector due to the combination of high risk and low returns.[80] In addition, renewable projects such as solar and wind may have become less economical due to the cheap cost of natural gas and the commoditization of solar modules. This shift may have caused venture investors to be less willing to invest in solar — a sector that used to attract large shares of venture capital deals.[81] Most of the venture investments tend to be heavily clustered in a select few metropolitan areas — notably San Francisco, San Jose, Boston, and Los Angeles. The limited geographical selections could potentially limit further prospects in the future. Finally, recent venture capital investments in clean tech have shifted away from early-stage investments toward late-state investments — another sign of lack of investor confidence. This has major implications as more novel, innovative clean technologies that would otherwise reshape the clean technology industry could fail to materialize due to lack of early-stage funding, and breakthrough clean technologies would become increasingly underfunded, ultimately undermining the ability of the U.S. to remove itself from the domination of fossil fuels.

NOTABLE INVESTMENTS IN 2016

Tri Alpha Energy: Located in Orange County, California, Tri Alpha Energy is a developer of plasma fusion technologies designed to develop commercially competitive clean fusion energy. In 2016, the company raised $375 million in later-stage venture capital funding, which it intends to use to pursue nuclear fusion.[82]

Advanced Microgrid Solutions: Located in San Francisco, Advanced Microgrid Solutions is a developer of battery-powered energy systems for power-grid management. In 2016, the company raised $200 million in early-stage venture capital funding,[83] which it intends to use to design and operate facilities at commercial, industrial, and government sites.

Renew Financial: Based in Oakland, California, Renew Financial is a provider of district legislation financing for PACE programs, which offers financing to homeowners, contractors, and local government agencies for energy efficiency, renewable energy, and water efficiency improvements repayable through property taxes. The company raised more than $70 million in later-stage venture capital funding in 2016, which it intends to use for PACE and other programs.[84]

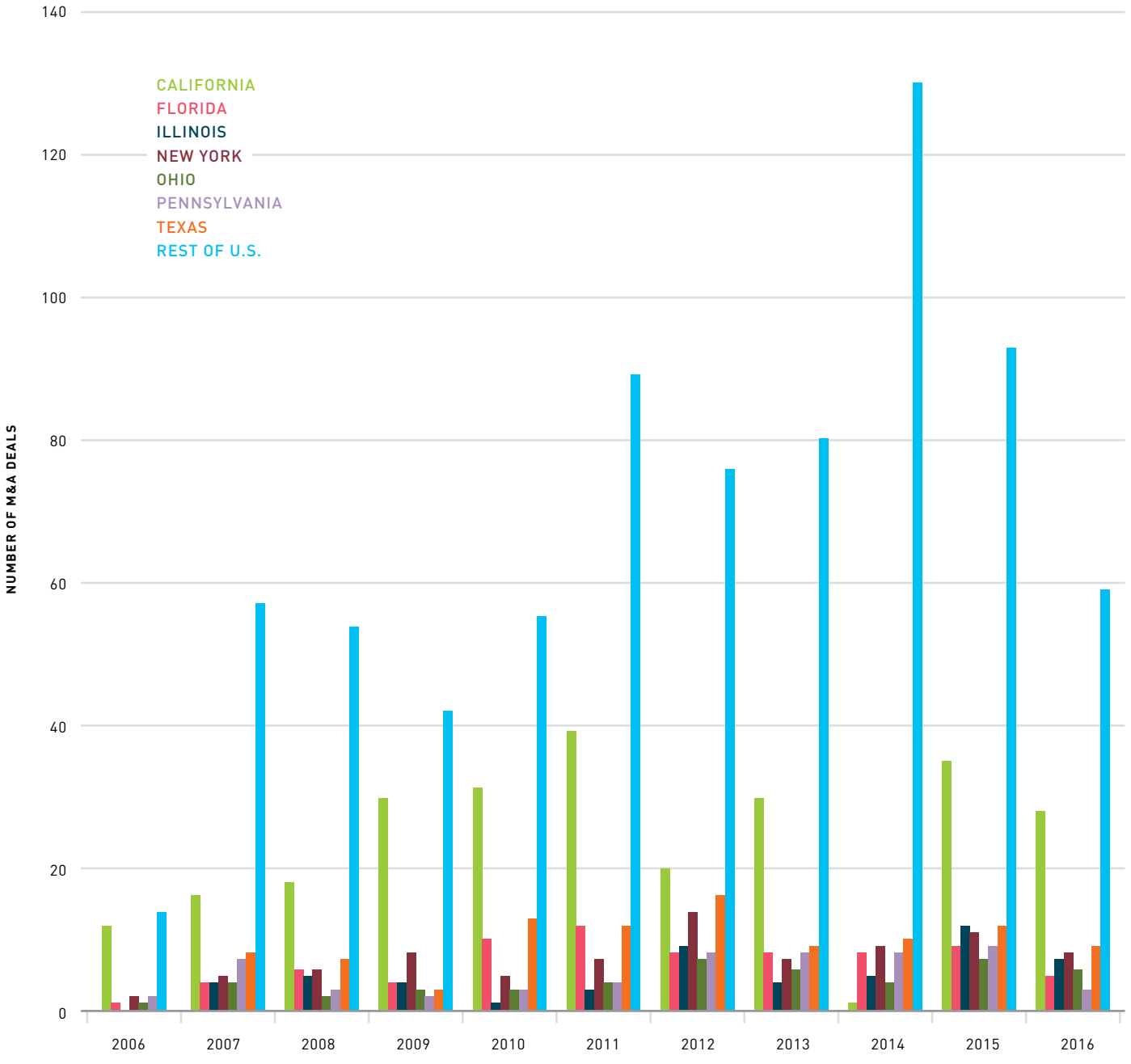
Mergers & Acquisitions

U.S. mergers and acquisitions (M&A) activities in clean technology companies continued to decline in 2016, to a total of 125 M&A deals, a 33.5 percent reduction from 2015.[85] On the other hand, the total transaction amount of all M&As increased substantially in 2016 to $26.3 billion, more than doubling the 2015 total of $12.5 billion. In California, M&A activities in clean technology companies also declined in 2016, by 20 percent, totaling just 28 deals. Similar to the national trends, the total transaction amount also increased significantly in California, from $831 million in 2015 to $4.7 billion in 2016. Notably, although there was only one M&A transaction, the District of Columbia had the highest M&A transaction amount in 2016 — Pepco Holdings, a provider of energy efficiency, renewable energy services, natural gas services, and regulated electricity services, merged with Exelon Corporation in March 2016 for $6.83 billion.[86] Sixteen states had no M&A activity in the clean technology industries in 2016.

The last year also brought a number of high profile changes to the solar industry, which may foreshadow further changes to come in the industry. The recent bankruptcies of high profile solar companies such as Sungevity and SunEdison, as well as the acquisition of SolarCity by Tesla, may signal shifts in the residential solar energy market as the industry becomes more fragmented and some firms focus on utility-scale projects.

FIGURE 36. MERGERS & ACQUISITIONS OF CLEAN TECHNOLOGY COMPANIES

BY STATE OF TARGETED COMPANY, 2006–2016



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REGIONAL SCORECARDS

Electricity Productivity

SAN FRANCISCO-OAKLAND-HAYWARD once again tops the ranking for electricity productivity, with its close neighbor San Jose-Sunnyvale-Santa Clara coming in second and San Diego-Carlsbad ranked third in 2015, the most recent year for which data is available. Bakersfield moved from the 23rd spot to the 26th (last), pushing Merced, last in 2014, up to the 25th spot.

Solar Capacity Installations

LOS ANGELES-LONG BEACH-ANAHEIM emerged as the state's top region for commercial solar power in 2016, up from number three, while San Diego-Carlsbad finished second again and Riverside-San Bernardino-Ontario ranked third. **FRESNO** maintained its first-place ranking for industrial solar power, while Madera took the number two spot. **SAN DIEGO-CARLSBAD** finished first in residential solar power, followed by Los Angeles-Long Beach-Anaheim and Riverside-San Bernardino-Ontario.

However, Los Angeles-Long Beach-Anaheim is in the bottom third of the rankings on a per capita basis for commercial, industrial, and residential solar capacities. Conversely, small metro areas tend to score well on a per capita basis. Madera finished first for per capita commercial and industrial solar capacities, while Yuba City emerged as the top region for per capita residential solar capacity.

Clean Vehicle Rebates

LOS ANGELES-LONG BEACH-ANAHEIM maintained its top spot for the number of clean vehicles rebates with 17,595 in 2016, a modest 0.2 percent decline from 2015. San Francisco-Oakland-Hayward and San Jose-Sunnyvale-Santa Clara also maintained the second and third places, respectively, but with a 16.2 percent and 10.8 percent decline compared to 2015.

On a per capita basis, large metro areas tend to perform better, likely due to a more developed EV charging infrastructure. The Bay Area — specifically San Jose-Sunnyvale-Santa Clara, San Francisco-Oakland-Hayward, and Santa Rosa-Petaluma — secured the top three spots for clean vehicle rebate per capita. Los Angeles-Long Beach-Anaheim finished fifth.

Green Technology Patents

For the first time in several years, **SAN FRANCISCO-OAKLAND-HAYWARD** emerged as the state's top region for clean technology patents with 1,684 in 2016, edging out San Jose-Sunnyvale-Santa Clara, which finished second with 1,325. Los Angeles-Long Beach-Anaheim held steady at the number three spot registering 1,128 patents, which was a 45.7 percent increase compared to 2015. The El Centro and Yuba City metro areas tied at the bottom spot as neither region had any clean technology patents in 2016.

Public Transportation

Unlinked passenger trips were down for most metro areas in 2016, except for Hanford-Corcoran, Napa, and Salinas. **LOS ANGELES-LONG BEACH-ANAHEIM** ranked first, with 594 million unlinked passenger trips, followed by San Francisco-Oakland-Hayward with 470 million. More densely populated regions tend to perform better per capita compared to sparser and more sprawling areas. On a per capita basis, San Francisco-Oakland-Hayward averaged 101.1 unlinked trips per person in 2016, which is more than double the 44.3 unlinked trips per person registered in Los Angeles-Long Beach-Anaheim, the runner up.

Natural Gas Consumption

San Diego-Carlsbad dramatically reduced its residential natural gas consumption per capita in 2015, using the third-lowest amount of gas per capita. On the other side, Riverside-San Bernardino-Oxnard increased its consumption, moving from sixth lowest in 2014 to 11th in 2015. **EL CENTRO** continued to rank first, while San Francisco-Oakland-Hayward continued to consume the most residential natural gas per capita, finishing last.

REGIONAL ECONOMIC & ENVIRONMENTAL INDICATORS: RANKINGS

REGION	REAL GDP	GDP PER CAPITA	POPULATION	HIGHEST ELECTRICITY PRODUCTIVITY	HIGHEST NATURAL GAS PRODUCTIVITY	LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL	LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL	LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL	LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL	SHORTEST COMMUTE TIME BY DRIVING	MOST GREEN TECHNOLOGY PATENTS	MOST CLEAN VEHICLE REBATES	HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL	HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL	HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL	HIGHEST PUBLIC TRANSPORTATION RIDERSHIP(UNLINKED PASSENGER TRIPS PER CAPITA)
BAKERSFIELD	9	14	8	26	24	15	26	10	24	6	12	13	5	6	5	19
CHICO	21	20	20	16	15	24	3	13	3	3	21	23	16	16	13	18
EL CENTRO	22	23	21	19	14	22	9	1	13	2	25	26	26	25	26	22
FRESNO	8	15	7	15	18	20	18	7	18	4	19	8	4	1	6	9
HANFORD–CORCORAN	25	16	25	23	25	11	25	6	23	—	23	24	10	7	21	4
LOS ANGELES–LONG BEACH–ANAHEIM	1	3	1	4	4	3	14	12	14	22	3	1	1	4	2	2
MADERA	26	24	24	24	22	19	23	2	21	14	22	20	9	2	19	26
MERCED	20	26	19	25	26	18	24	5	25	8	18	21	11	8	14	25
MODESTO	15	17	11	20	21	23	20	14	20	18	11	14	20	20	24	16
NAPA	19	5	26	6	5	17	16	25	11	9	16	18	19	21	25	11
OXNARD–THOUSAND OAKS–VENTURA	7	6	9	8	3	7	10	18	8	17	7	7	17	9	11	21
REDDING	23	22	22	21	13	26	12	4	7	—	23	22	23	24	23	23
RIVERSIDE–SAN BERNARDINO–ONTARIO	5	25	3	18	17	14	8	11	9	24	6	5	3	5	3	17
SACRAMENTO–ROSEVILLE–ARDEN-ARCADE	6	8	5	12	6	25	7	23	4	15	5	6	12	10	7	8
SALINAS	13	10	15	9	11	1	11	17	12	7	14	16	15	13	18	10
SAN DIEGO–CARLSBAD	4	4	4	3	2	8	6	3	1	12	4	4	2	15	1	3
SAN FRANCISCO–OAKLAND–HAYWARD	2	2	2	1	9	5	15	26	22	23	1	2	7	17	4	1
SAN JOSE–SUNNYVALE–SANTA CLARA	3	1	6	2	1	6	21	20	10	19	2	3	13	18	8	5
SAN LUIS OBISPO–PASO ROBLES–ARROYO GRANDE	17	11	17	11	16	9	5	21	17	5	15	17	21	22	16	12
SANTA CRUZ–WATSONVILLE	18	13	18	5	8	4	1	15	6	13	9	10	22	19	22	6
SANTA MARIA–SANTA BARBARA	11	7	14	10	10	2	19	19	15	1	8	12	25	14	20	7
SANTA ROSA–PETALUMA	10	9	12	7	7	16	2	24	5	10	10	9	18	23	17	14
STOCKTON–LODI	12	19	10	17	19	12	13	16	16	21	17	11	8	11	9	13
VALLEJO–FAIRFIELD	14	12	16	13	23	10	17	22	26	20	13	15	24	25	12	20
VISALIA–PORTERVILLE	16	18	13	22	20	13	22	8	19	11	20	19	6	3	10	24
YUBA CITY	24	21	23	14	12	21	4	9	2	16	25	25	14	12	15	15

BAKERSFIELD

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	9	$35,829	39.0%
GDP PER CAPITA	14	$40,697	6.1%
POPULATION	8	880,387	31.0%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	26	2.38	17.1%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	24	84.47	782.6%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	15	2.63	7.9%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	26	14.61	-11.3%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	10	0.10	-16.8%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	24	0.38	-90.2%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	6	21.8	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	12	27	12.5%
MOST CLEAN VEHICLE REBATES	13	231	8.5%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	5	25,072	232.2%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	6	4,246	-62.7%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	5	47,133	3.9%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	19	6.0	-7.6%

HANFORD–CORCORAN

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	25	$5,407	42.9%
GDP PER CAPITA	16	$36,110	25.1%
POPULATION	25	149,738	14.2%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	23	3.06	-25.3%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	25	80.20	24.1%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	11	2.42	12.0%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	25	9.40	92.3%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	6	0.09	-16.0%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	23	0.36	6.2%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	—	N/A*	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	23	1	
MOST CLEAN VEHICLE REBATES	24	27	285.7%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	10	7,651	154.0%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	7	3,037	-58.8%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	21	6,130	20.6%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	4	22.7	11.8%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Most Recent Year is 2015 for all metrics EXCEPT for Green Technology Patents and Clean Vehicle Rebates, where Most Recent Year is 2016. Real GDP: Inflation adjusted GDP where base year is 2015. Solar Capacity Installed: Unit based on alternate current in megawatts. *Commute time by driving data unavailable for 2015.

CHICO

RANK	2015	2001–15 %
21	$7,559	38.5%
20	$33,727	26.5%
20	224,121	9.5%
16	5.04	15.2%
15	186.97	15.1%
24	3.26	10.2%
3	3.43	9.2%
13	0.11	-1.5%
3	0.07	31.3%
3	19.5	
RANK	2016	2015–16 %
21	3	-25.0%
23	29	16.0%
16	4,813	51.0%
16	598	-53.0%
13	11,238	-7.2%
18	6.1	-6.3%

EL CENTRO

RANK	2015	2001–15 %
22	$5,947	38.5%
23	$32,233	8.1%
21	184,500	28.2%
19	4.24	34.4%
14	188.74	-37.8%
22	3.22	-7.0%
9	4.43	-26.1%
1	0.04	-11.1%
13	0.13	146.2%
2	19.1	
RANK	2016	2015–16 %
25	0	-100.0%
26	8	0.0%
26	0	N/A
25	0	-100.0%
26	18	0.9%
22	4.5	-8.0%

FRESNO

RANK	2015	2001–15 %
8	$38,830	39.8%
15	$39,831	16.0%
7	974,871	20.6%
15	5.05	12.3%
18	130.29	27.3%
20	2.81	9.0%
18	5.10	0.7%
7	0.10	-7.6%
18	0.21	-9.1%
4	20.7	
RANK	2016	2015–16 %
19	6	-45.5%
8	759	53.6%
4	25,627	246.5%
1	7,314	-49.5%
6	45,901	9.1%
9	10.4	-10.0%

LOS ANGELES–LONG BEACH–ANAHEIM

RANK	2015	2001–15 %
1	$930,817	31.4%
3	$69,950	23.1%
1	13,306,979	6.8%
4	10.29	27.2%
4	275.87	52.9%
3	2.03	6.6%
14	4.77	-6.7%
12	0.11	-31.0%
14	0.15	-8.4%
22	29.0	
RANK	2016	2015–16 %
3	1,128	45.7%
1	17,595	-0.2%
1	31,610	148.9%
4	4,440	-33.6%
2	140,917	12.8%
2	44.3	-8.1%

MADERA

RANK	2015	2001–15 %
26	$4,962	36.6%
24	$32,044	10.6%
24	154,850	23.5%
24	2.98	-9.4%
22	96.82	161.3%
19	2.76	6.5%
23	7.94	27.3%
2	0.05	8.0%
21	0.28	-62.1%
14	26.0	
RANK	2016	2015–16 %
22	2	0.0%
20	44	-4.3%
9	9,597	383.7%
2	6,552	36.7%
19	6,863	16.1%
26	1.2	-14.1%

MERCED

RANK	2015	2001–15 %
20	$8,348	35.7%
26	$31,001	7.9%
19	269,280	25.7%
25	2.85	30.0%
26	65.58	-47.2%
18	2.70	7.2%
24	8.30	-21.6%
5	0.09	-0.1%
25	0.39	175.0%
8	23.0	
RANK	2016	2015–16 %
18	7	0.0%
21	42	2.4%
11	7,609	69.1%
8	2,997	-52.3%
14	10,629	27.1%
25	3.1	-7.6%

Data Sources: Solar, California Solar Statistics: Vehicle Rebates: California Clean Vehicle Rebate Project; Patents: IPCheckups, CleanTech Patent Edge; Gas Consumption: California Energy Commission; Electric Consumption: California Energy Commission; Population: U.S. Census Bureau; Commute Time: U.S. Census Bureau, American Community Survey; GDP: U.S. Department of Commerce, Bureau of Economic Analysis.

MODESTO

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	15	$19,110	37.2%
GDP PER CAPITA	17	$35,726	17.1%
POPULATION	11	534,902	17.2%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	20	4.00	18.6%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	21	105.33	57.2%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	23	3.23	3.3%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	20	5.75	-3.0%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	14	0.11	-5.1%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	20	0.23	-31.7%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	18	26.7	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	11	49	276.9%
MOST CLEAN VEHICLE REBATES	14	214	15.1%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	20	1,243	1.4%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	20	280	-76.2%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	24	3,833	11.6%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	16	6.4	-5.8%

RIVERSIDE–SAN BERNARDINO–ONTARIO

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	5	$140,637	39.3%
GDP PER CAPITA	25	$31,682	4.5%
POPULATION	3	4,439,012	33.3%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	18	4.66	0.8%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	17	170.06	59.0%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	14	2.53	-0.1%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	8	4.66	7.0%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	11	0.10	-32.6%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	9	0.09	-35.4%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	24	30.5	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	6	113	24.2%
MOST CLEAN VEHICLE REBATES	5	1,890	0.0%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	3	25,802	109.4%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	5	4,320	-60.2%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	3	125,724	-8.2%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	17	6.3	-9.3%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Most Recent Year is 2015 for all metrics EXCEPT for Green Technology Patents and Clean Vehicle Rebates, where Most Recent Year is 2016. Real GDP: Inflation adjusted GDP where base year is 2015. Solar Capacity Installed: Unit based on alternate current in megawatts. *Commute time by driving data unavailable for 2015.

NAPA

RANK	2015	2001–15 %
19	$9,363	39.8%
5	$66,452	24.5%
26	140,898	12.4%
6	8.88	15.0%
5	269.94	63.8%
17	2.64	1.7%
16	4.87	12.9%
25	0.13	-3.2%
11	0.12	-38.5%
9	23.2	
RANK	**2016**	**2015–16 %**
16	11	57.1%
18	100	-13.0%
19	2,349	-10.3%
21	96	-85.5%
25	3,255	0.7%
11	8.3	7.4%

OXNARD–THOUSAND OAKS–VENTURA

RANK	2015	2001–15 %
7	$48,220	33.8%
6	$56,697	20.0%
9	850,491	11.5%
8	8.55	22.7%
3	293.86	107.5%
7	2.10	4.5%
10	4.55	-4.6%
18	0.11	-34.8%
8	0.08	-49.5%
17	26.6	
RANK	**2016**	**2015–16 %**
7	83	0.0%
7	820	-3.3%
17	3,810	88.4%
9	1,980	137.4%
11	14,377	-18.8%
21	5.4	-5.4%

REDDING

RANK	2015	2001–15 %
23	$5,933	41.1%
22	$33,139	30.5%
22	179,036	8.1%
21	3.80	37.9%
13	195.46	19.1%
26	4.11	6.3%
12	4.62	-13.4%
4	0.09	1.7%
7	0.08	20.1%
—	N/A*	
RANK	**2016**	**2015–16 %**
23	1	0.0%
22	36	80.0%
23	700	-14.9%
24	8	-99.2%
23	4,356	-13.1%
23	4.0	-2.7%

SACRAMENTO–ROSEVILLE–ARDEN-ARCADE

RANK	2015	2001–15 %
6	$118,822	36.2%
8	$52,890	11.4%
5	2,246,597	22.2%
12	7.18	17.9%
6	269.52	147.8%
25	3.27	-0.9%
7	4.13	-8.0%
23	0.12	-65.1%
4	0.08	-12.8%
15	26.1	
RANK	**2016**	**2015–16 %**
5	169	35.2%
6	1,312	-5.2%
12	7,132	65.0%
10	1,432	7.2%
7	40,112	10.1%
8	13.5	-7.7%

SALINAS

RANK	2015	2001–15 %
13	$21,980	37.4%
10	$50,805	28.5%
15	432,637	6.9%
9	8.26	28.9%
11	214.51	14.1%
1	1.64	-3.2%
11	4.62	3.0%
17	0.11	-4.5%
12	0.13	37.4%
7	22.5	
RANK	**2016**	**2015–16 %**
14	21	75.0%
16	172	6.8%
15	5,012	99.7%
13	948	61.0%
18	7,632	-14.2%
10	10.2	0.8%

SAN DIEGO–CARLSBAD

RANK	2015	2001–15 %
4	$220,573	33.7%
4	$67,581	16.8%
4	3,263,848	14.6%
3	11.15	13.2%
2	474.85	61.0%
8	2.14	11.0%
6	3.99	1.0%
3	0.08	-34.5%
1	0.06	-14.1%
12	25.1	
RANK	**2016**	**2015–16 %**
4	635	23.8%
4	3,576	9.3%
2	26,262	56.3%
15	683	-62.1%
1	152,873	13.1%
3	31.3	-7.1%

Data Sources: Solar, California Solar Statistics: Vehicle Rebates: California Clean Vehicle Rebate Project; Patents: IPCheckups, CleanTech Patent Edge; Gas Consumption: California Energy Commission; Electric Consumption: California Energy Commission; Population: U.S. Census Bureau; Commute Time: U.S. Census Bureau, American Community Survey; GDP: U.S. Department of Commerce, Bureau of Economic Analysis.

SAN FRANCISCO–OAKLAND–HAYWARD			
METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	2	$431,704	35.1%
GDP PER CAPITA	2	$93,841	22.1%
POPULATION	2	4,600,369	10.7%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	1	13.81	25.5%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	9	225.66	6.8%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	5	2.07	0.3%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	15	4.79	-2.6%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	26	0.14	-10.2%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	22	0.28	33.7%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	23	29.9	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	1	1,684	74.1%
MOST CLEAN VEHICLE REBATES	2	8,468	-16.2%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	7	14,802	17.0%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	17	562	-93.3%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	4	73,183	11.0%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	1	101.1	-1.1%

SANTA MARIA–SANTA BARBARA			
METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	11	$25,018	32.5%
GDP PER CAPITA	7	$56,472	20.2%
POPULATION	14	443,018	10.3%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	10	8.02	16.6%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	10	216.77	31.5%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	2	1.78	-3.0%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	19	5.35	7.0%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	19	0.11	-33.2%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	15	0.15	30.4%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	1	18.9	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	8	74	8.8%
MOST CLEAN VEHICLE REBATES	12	304	25.1%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	25	540	244.4%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	14	808	-77.9%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	20	6,310	10.3%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	7	16.5	-9.9%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Most Recent Year is 2015 for all metrics EXCEPT for Green Technology Patents and Clean Vehicle Rebates, where Most Recent Year is 2016. Real GDP: Inflation adjusted GDP where base year is 2015. Solar Capacity Installed: Unit based on alternate current in megawatts.

SAN JOSE–SUNNYVALE–SANTA CLARA

RANK	2015	2001–15 %
3	$235,222	6.1%
1	$119,986	-5.6%
6	1,960,419	12.4%
2	13.69	-3.0%
1	555.02	10.5%
6	2.08	-2.9%
21	6.74	-1.8%
20	0.11	-13.1%
10	0.10	-15.1%
19	26.8	
RANK	**2016**	**2015–16 %**
2	1,325	13.4%
3	6,730	-10.8%
13	6,384	15.0%
18	561	-77.0%
8	39,219	23.7%
5	20.8	-10.1%

SAN LUIS OBISPO–PASO ROBLES–ARROYO GRANDE

RANK	2015	2001–15 %
17	$13,705	43.4%
11	$49,588	29.6%
17	276,375	10.7%
11	7.98	24.0%
16	176.38	27.6%
9	2.36	-5.7%
5	3.90	13.3%
21	0.12	-23.1%
17	0.17	33.9%
5	21.5	
RANK	**2016**	**2015–16 %**
15	18	63.6%
17	155	-27.2%
21	925	-64.9%
22	41	-97.1%
16	9,960	-4.3%
12	7.9	-4.2%

SANTA CRUZ–WATSONVILLE

RANK	2015	2001–15 %
18	$11,908	36.1%
13	$43,524	27.3%
18	274,594	6.9%
5	9.75	63.6%
8	236.78	41.2%
4	2.06	-3.2%
1	2.43	-32.5%
15	0.11	-6.5%
6	0.08	-12.6%
13	25.8	
RANK	**2016**	**2015–16 %**
9	63	1.6%
10	362	-12.3%
22	866	-27.8%
19	445	N/A
22	4,597	-11.1%
6	20.0	-4.4%

SANTA ROSA–PETALUMA

RANK	2015	2001–15 %
10	$26,052	32.6%
9	$52,172	23.0%
12	499,352	7.9%
7	8.84	18.6%
7	256.82	31.7%
16	2.64	9.3%
2	3.30	0.7%
24	0.13	-2.4%
5	0.08	-11.6%
10	23.8	
RANK	**2016**	**2015–16 %**
10	56	27.3%
9	724	-5.0%
18	2,893	-35.5%
23	41	-94.5%
17	9,207	7.3%
14	7.3	-4.7%

STOCKTON–LODI

RANK	2015	2001–15 %
12	$24,606	38.2%
19	$33,997	10.4%
10	723,761	25.2%
17	4.76	36.3%
19	127.50	96.3%
12	2.47	1.3%
13	4.72	-26.1%
16	0.11	-5.7%
16	0.16	-55.7%
21	28.7	
RANK	**2016**	**2015–16 %**
17	9	-30.8%
11	351	24.5%
8	10,874	220.9%
11	1,226	-80.0%
9	27,578	7.6%
13	7.3	-9.7%

VALLEJO–FAIRFIELD

RANK	2015	2001–15 %
14	$19,646	49.4%
12	$46,041	39.9%
16	426,704	6.8%
13	6.11	29.6%
23	88.42	310.2%
10	2.41	9.9%
17	5.07	6.0%
22	0.12	-0.6%
26	0.40	-71.7%
20	28.6	
RANK	**2016**	**2015–16 %**
13	23	4.5%
15	205	-26.8%
24	656	-54.5%
25	0	-100.0%
12	14,174	12.6%
20	5.9	-4.1%

Data Sources: Solar, California Solar Statistics: Vehicle Rebates: California Clean Vehicle Rebate Project; Patents: IPCheckups, CleanTech Patent Edge; Gas Consumption: California Energy Commission; Electric Consumption: California Energy Commission; Population: U.S. Census Bureau; Commute Time: U.S. Census Bureau, American Community Survey; GDP: U.S. Department of Commerce, Bureau of Economic Analysis.

VISALIA–PORTERVILLE

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	16	$15,829	33.8%
GDP PER CAPITA	18	$34,292	7.7%
POPULATION	13	461,589	24.3%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	22	3.51	-2.3%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	20	105.78	-6.1%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	13	2.50	0.6%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	22	7.27	13.8%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	8	0.10	-23.6%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	19	0.22	47.9%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	11	24.0	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	20	4	-20.0%
MOST CLEAN VEHICLE REBATES	19	68	41.7%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	6	21,964	260.1%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	3	4,910	-26.9%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	10	17,083	2.7%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	24	4.0	-11.2%

YUBA CITY

METRIC	RANK	2015	2001–15 %
GDP (Real, in millions)	24	$5,765	41.6%
GDP PER CAPITA	21	$33,723	16.5%
POPULATION	23	170,951	21.6%
HIGHEST ELECTRICITY PRODUCTIVITY (GDP/kWh Consumed)	14	5.10	27.4%
HIGHEST NATURAL GAS PRODUCTIVITY (GDP/BTU Consumed)	12	199.14	240.9%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	21	2.91	11.5%
LOWEST ELECTRICITY CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	4	3.75	-19.1%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: RESIDENTIAL (kWh/1,000 Person)	9	0.10	-0.3%
LOWEST NATURAL GAS CONSUMPTION PER CAPITA: NON-RESIDENTIAL (kWh/1,000 Person)	2	0.07	-82.4%
SHORTEST COMMUTE TIME BY DRIVING (Minutes per day)	16	26.2	
METRIC	RANK	2016	2015–16 %
MOST GREEN TECHNOLOGY PATENTS	25	0	0.0%
MOST CLEAN VEHICLE REBATES	25	16	0.0%
HIGHEST SOLAR CAPACITY INSTALLED: COMMERCIAL (AC, KW)	14	6,038	202.7%
HIGHEST SOLAR CAPACITY INSTALLED: INDUSTRIAL (AC, KW)	12	1,104	-10.8%
HIGHEST SOLAR CAPACITY INSTALLED: RESIDENTIAL (AC, KW)	15	10,022	-0.3%
HIGHEST PUBLIC TRANSPORTATION RIDERSHIP (Unlinked passenger trips per capita)	15	6.6	-10.3%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Most Recent Year is 2015 for all metrics EXCEPT for Green Technology Patents and Clean Vehicle Rebates, where Most Recent Year is 2016. Real GDP: Inflation adjusted GDP where base year is 2015. Solar Capacity Installed: Unit based on alternate current in megawatts. NEXT 10 / SF · CA · USA

INTERNATIONAL SCORECARD

At the 2015 United Nations Climate Change Conference in Paris, global leaders took an unprecedented step to address climate change by agreeing to limit global temperature increase to 2 degrees Celsius. On October 5, 2016, the threshold for entry into force of the Paris Agreement was achieved and the agreement was entered into force on November 4, 2016, with all of the world's nations signing on aside from Syria and Nicaragua. Despite President Trump's June 2017 announcement that the United States would commence pulling out of the Paris Agreement, world leaders came together at the May 2017 Bonn Climate Change Conference to fine-tune the details of the agreement as they strive to move ahead with implementing the deal.[87]

The international scorecard tracks the 49 largest GHG-emitting countries, along with California, on indicators of the carbon economy, energy efficiency, and renewable energy. This scorecard demonstrates the scope of efforts in California and around the world and reveals areas of opportunity for improvement. Countries with more prosperous economies tend to have higher per capita consumptions. While developed countries do well in terms of economic-related indicators, these countries perform poorly in per capita indicators compared to less developed countries.

In 2014, China remained the largest GHG emitter, followed by the U.S. and the European Union (EU-28). Unsurprisingly, as China's economy continues to grow, so too do its total GHG emissions, which grew 3.8 percent in 2014 year-over-year, while the U.S.'s grew 0.4 percent over the same period.

When treated as a country, California moved up two places, surpassing France and Italy, to become the 18th largest emitter.

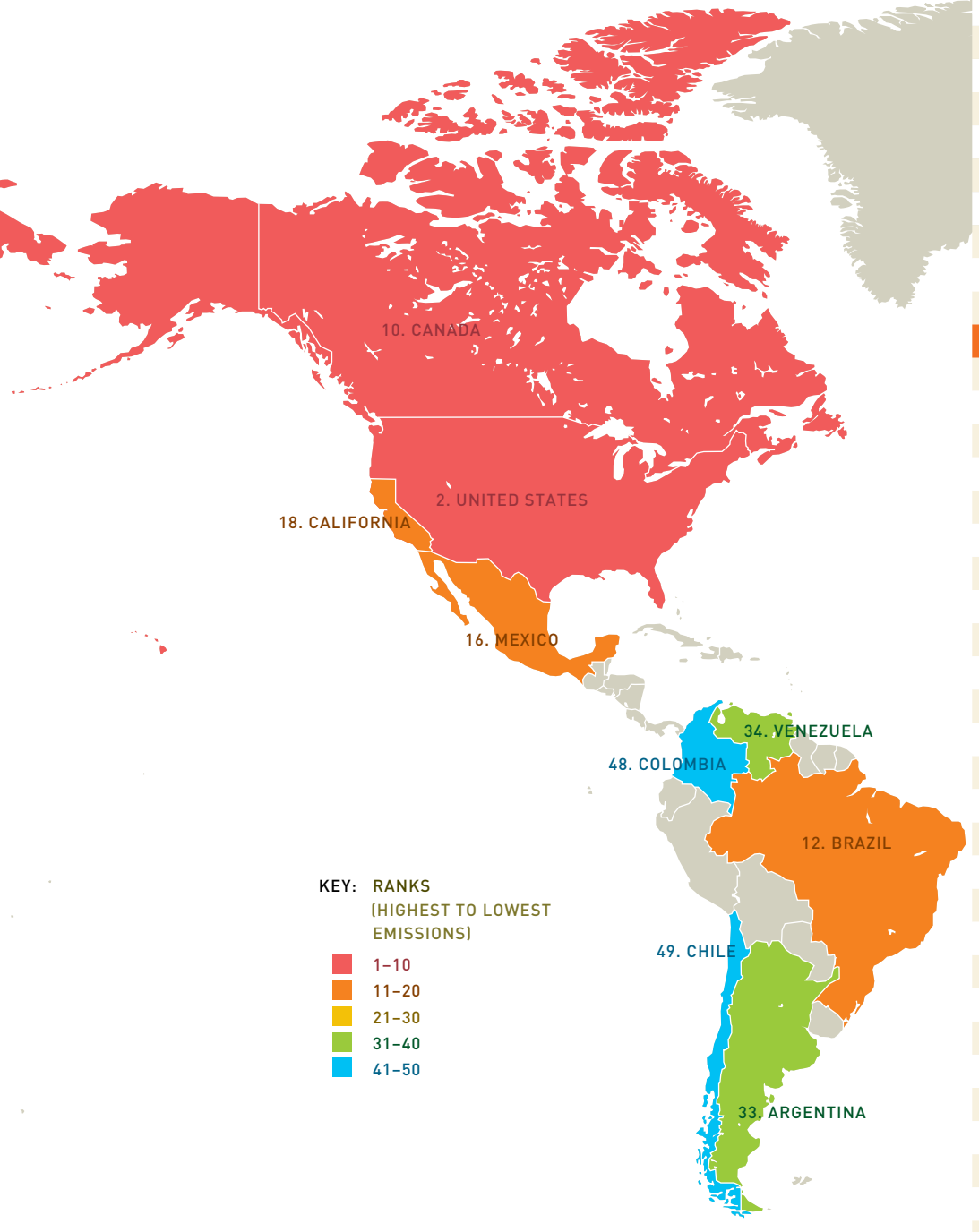
California, if treated as a country, moved up three spots to the number one spot in the international ranking of the most energy productive economies in the world in 2014. In 2013, California was fourth, behind Nigeria, the United Kingdom, and Italy, respectively. The three least carbon-intensive economies in the world — France, California, and Italy — continued to hold their spots in 2014, unchanged from 2013 and 2012. However, while France and California continued to improve their carbon economies, dropping 0.06 and 0.04 $MTCO_2e$ per $10,000 of GDP, respectively, Italy's carbon intensity ticked up slightly, by 0.06.

California also continued to reduce its GHG emissions per capita, moving from 32nd in 2013 to 34th in 2014, surpassing Japan (32nd) and Germany (33rd). Nigeria, Pakistan, and the Philippines maintained the top three spots with most GHG emissions per capita, respectively.

TOTAL GHG EMISSIONS FROM ENERGY CONSUMPTION RANKING

HIGHEST TOTAL EMISSIONS ($MMTCO_2e$) IN 2014

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: 1 = Highest Emissions from Energy Consumption.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption. NEXT 10 / SF · CA · USA



RANK	REGION	MILLION $MTCO_2e$
1	CHINA	9017.8
2	UNITED STATES*	5421.8
3	EU-28	3462.1
4	INDIA	1833.4
5	RUSSIA	1736.6
6	JAPAN*	1157.7
7	GERMANY*	742.3
8	IRAN	646.0
9	SOUTH KOREA	630.4
10	CANADA*	604.4
11	SAUDI ARABIA	575.8
12	BRAZIL	544.0
13	INDONESIA	537.7
14	SOUTH AFRICA	454.6
15	UNITED KINGDOM*	441.9
16	MEXICO*	434.2
17	AUSTRALIA*	370.4
18	CALIFORNIA	358.0
19	ITALY*	340.5
20	FRANCE*	327.7
21	THAILAND	322.5
22	TURKEY*	310.9
23	TAIWAN	297.9
24	POLAND*	279.8
25	SPAIN*	262.3
26	NETHERLANDS*	232.0
27	UNITED ARAB EMIRATES	229.4
28	UKRAINE	225.9
29	MALAYSIA	225.7
30	SINGAPORE	221.4
31	EGYPT	210.9
32	KAZAKHSTAN	209.2
33	ARGENTINA	188.9
34	VENEZUELA	180.2
35	PAKISTAN	147.2
36	IRAQ	144.2
37	ALGERIA	142.2
38	VIETNAM	138.1
39	BELGIUM*	128.5
40	QATAR	113.8
41	UZBEKISTAN	103.8
42	KUWAIT	98.7
43	NIGERIA	96.8
44	CZECH REPUBLIC*	95.4
45	PHILIPPINES	92.4
46	HONG KONG	83.9
47	TURKMENISTAN	81.6
48	COLOMBIA	79.3
49	CHILE*	75.6
50	GREECE*	70.9

RANKING SUMMARY OF THE TOP 50 POLLUTERS OF GHG EMISSIONS FROM ENERGY CONSUMPTION

RANK	TOTAL GHG EMISSIONS FROM ENERGY CONSUMPTION RANKING		CARBON ECONOMY RANKING	GHG EMISSIONS PER CAPITA RANKING	ENERGY PRODUCTIVITY RANKING
	HIGHEST TOTAL EMISSIONS IN 2014 ($MMTCO_2e$)	2014 GDP PER CAPITA, 2014 U.S.$	LOWEST CARBON INTENSITY ($MTCO_2e$/U.S.$10,000 GDP) IN 2014	LOWEST EMISSIONS PER CAPITA ($MTCO_2e$/PERSON) IN 2014	HIGHEST ENERGY PRODUCTIVITY (GDP IN 2014 USD/BTU) IN 2014
1	CHINA	$5,296	FRANCE*	NIGERIA	CALIFORNIA
2	UNITED STATES*	$47,683	CALIFORNIA	PAKISTAN	ITALY*
3	EU-28	$32,288	ITALY*	PHILIPPINES	UNITED KINGDOM*
4	INDIA	$1,412	UNITED KINGDOM*	VIETNAM	JAPAN*
5	RUSSIA	$8,393	SPAIN*	INDIA	GERMANY*
6	JAPAN*	$45,228	JAPAN*	COLOMBIA	FRANCE*
7	GERMANY*	$41,994	EU-28	INDONESIA	NIGERIA
8	IRAN	$2,474	GERMANY*	EGYPT	SPAIN*
9	SOUTH KOREA	$23,544	COLOMBIA	BRAZIL	GREECE*
10	CANADA*	$46,907	BELGIUM*	UZBEKISTAN	EU-28
11	SAUDI ARABIA	$20,469	GREECE*	MEXICO*	AUSTRALIA*
12	BRAZIL	$8,881	NIGERIA	ALGERIA	NETHERLANDS*
13	INDONESIA	$3,020	NETHERLANDS*	TURKEY*	HONG KONG
14	SOUTH AFRICA	$6,146	BRAZIL	IRAQ	BELGIUM*
15	UNITED KINGDOM*	$38,016	AUSTRALIA*	CHILE*	COLOMBIA
16	MEXICO*	$8,451	CHILE*	ARGENTINA	CHILE*
17	AUSTRALIA*	$53,681	UNITED STATES*	THAILAND	PHILIPPINES
18	CALIFORNIA	$59,590	HONG KONG	FRANCE*	UNITED STATES*
19	ITALY*	$31,363	CANADA*	UKRAINE	BRAZIL
20	FRANCE*	$39,811	PHILIPPINES	SPAIN*	MEXICO*
21	THAILAND	$5,207	MEXICO*	ITALY*	POLAND*
22	TURKEY*	$8,321	CZECH REPUBLIC*	VENEZUELA	TURKEY*
23	TAIWAN	$21,745	TURKEY*	GREECE*	CZECH REPUBLIC*
24	POLAND*	$13,000	SOUTH KOREA	CHINA	CANADA*
25	SPAIN*	$28,743	QATAR	EU-28	TAIWAN
26	NETHERLANDS*	$48,267	POLAND*	UNITED KINGDOM*	SOUTH KOREA
27	UNITED ARAB EMIRATES	$54,773	TAIWAN	POLAND*	INDONESIA
28	UKRAINE	$2,024	INDONESIA	MALAYSIA	QATAR
29	MALAYSIA	$9,564	UNITED ARAB EMIRATES	IRAN	SINGAPORE
30	SINGAPORE	$48,914	ARGENTINA	SOUTH AFRICA	MALAYSIA
31	EGYPT	$1,616	MALAYSIA	CZECH REPUBLIC*	IRAQ
32	KAZAKHSTAN	$7,191	VENEZUELA	JAPAN*	UNITED ARAB EMIRATES
33	ARGENTINA	$5,631	SINGAPORE	GERMANY*	INDIA
34	VENEZUELA	$7,599	KUWAIT	CALIFORNIA	VENEZUELA
35	PAKISTAN	$713	THAILAND	BELGIUM*	THAILAND
36	IRAQ	$3,912	ALGERIA	KAZAKHSTAN	ARGENTINA
37	ALGERIA	$3,717	IRAQ	HONG KONG	KUWAIT
38	VIETNAM	$1,061	SAUDI ARABIA	RUSSIA	ALGERIA
39	BELGIUM*	$41,880	INDIA	SOUTH KOREA	CHINA
40	QATAR	$97,131	PAKISTAN	TAIWAN	SOUTH AFRICA
41	UZBEKISTAN	$1,089	CHINA	NETHERLANDS*	SAUDI ARABIA
42	KUWAIT	$40,447	VIETNAM	TURKMENISTAN	PAKISTAN
43	NIGERIA	$1,925	SOUTH AFRICA	AUSTRALIA*	KAZAKHSTAN
44	CZECH REPUBLIC*	$18,991	EGYPT	UNITED STATES*	VIETNAM
45	PHILIPPINES	$2,258	RUSSIA	CANADA*	EGYPT
46	HONG KONG	$32,107	KAZAKHSTAN	SAUDI ARABIA	RUSSIA
47	TURKMENISTAN	$4,748	UKRAINE	KUWAIT	UKRAINE
48	COLOMBIA	$6,621	IRAN	SINGAPORE	IRAN
49	CHILE*	$13,275	UZBEKISTAN	UNITED ARAB EMIRATES	TURKMENISTAN
50	GREECE*	$23,822	TURKMENISTAN	QATAR	UZBEKISTAN

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. *OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.

RANK	ENERGY PER CAPITA RANKING	ELECTRICITY PER CAPITA RANKING	TOTAL RENEWABLE ELECTRICITY GENERATION RANKING	SHARE OF ELECTRICITY FROM RENEWABLE RANKING
	LEAST TOTAL ENERGY CONSUMPTION PER CAPITA (BTU/PERSON) IN 2014	LEAST TOTAL ELECTRICITY CONSUMPTION PER CAPITA (kWh/PERSON) IN 2014	MOST TOTAL RENEWABLE ELECTRICITY IN 2014	HIGHEST SHARE OF RENEWABLES (RENEWABLE ELECTRICITY/TOTAL ELECTRICITY) IN 2014
1	NIGERIA	NIGERIA	EU-28	SPAIN*
2	PAKISTAN	PAKISTAN	UNITED STATES*	GERMANY*
3	PHILIPPINES	PHILIPPINES	CHINA	ITALY*
4	INDIA	INDONESIA	GERMANY*	UNITED KINGDOM*
5	VIETNAM	INDIA	SPAIN*	EU-28
6	INDONESIA	IRAQ	JAPAN*	CALIFORNIA
7	COLOMBIA	ALGERIA	INDIA	BELGIUM*
8	EGYPT	COLOMBIA	ITALY*	PHILIPPINES
9	IRAQ	VIETNAM	UNITED KINGDOM*	GREECE*
10	ALGERIA	EGYPT	BRAZIL	POLAND*
11	MEXICO*	UZBEKISTAN	CALIFORNIA	NETHERLANDS*
12	BRAZIL	MEXICO*	FRANCE*	CZECH REPUBLIC*
13	TURKEY*	THAILAND	CANADA*	BRAZIL
14	UZBEKISTAN	BRAZIL	AUSTRALIA*	CHILE*
15	THAILAND	TURKMENISTAN	POLAND*	AUSTRALIA*
16	CHILE*	VENEZUELA	MEXICO*	UNITED STATES*
17	ARGENTINA	TURKEY*	NETHERLANDS*	JAPAN*
18	CHINA	ARGENTINA	BELGIUM*	FRANCE*
19	UKRAINE	IRAN	TURKEY*	INDIA
20	GREECE*	UKRAINE	INDONESIA	THAILAND
21	POLAND*	POLAND*	PHILIPPINES	MEXICO*
22	ITALY*	CHINA	THAILAND	TURKEY*
23	SOUTH AFRICA	CHILE*	GREECE*	INDONESIA
24	VENEZUELA	SOUTH AFRICA	CZECH REPUBLIC*	CANADA*
25	SPAIN*	MALAYSIA	CHILE*	CHINA
26	MALAYSIA	ITALY*	SOUTH KOREA	COLOMBIA
27	UNITED KINGDOM*	UNITED KINGDOM*	TAIWAN	SINGAPORE
28	IRAN	GREECE*	RUSSIA	ARGENTINA
29	EU-28	SPAIN*	ARGENTINA	TAIWAN
30	JAPAN*	KAZAKHSTAN	SOUTH AFRICA	SOUTH KOREA
31	KAZAKHSTAN	EU-28	COLOMBIA	UKRAINE
32	CZECH REPUBLIC*	CZECH REPUBLIC*	UKRAINE	SOUTH AFRICA
33	FRANCE*	HONG KONG	EGYPT	EGYPT
34	GERMANY*	RUSSIA	SINGAPORE	MALAYSIA
35	HONG KONG	NETHERLANDS*	MALAYSIA	PAKISTAN
36	CALIFORNIA	FRANCE*	IRAN	RUSSIA
37	TAIWAN	GERMANY*	PAKISTAN	UNITED ARAB EMIRATES
38	RUSSIA	CALIFORNIA	UNITED ARAB EMIRATES	HONG KONG
39	BELGIUM*	BELGIUM*	VIETNAM	IRAN
40	SOUTH KOREA	JAPAN*	HONG KONG	VIETNAM
41	NETHERLANDS*	SINGAPORE	SAUDI ARABIA	KAZAKHSTAN
42	AUSTRALIA*	SOUTH KOREA	KAZAKHSTAN	SAUDI ARABIA
43	TURKMENISTAN	AUSTRALIA*	VENEZUELA	VENEZUELA
44	UNITED STATES*	SAUDI ARABIA	IRAQ	IRAQ
45	SAUDI ARABIA	TAIWAN	ALGERIA	ALGERIA
46	CANADA*	UNITED STATES*	QATAR	QATAR
47	SINGAPORE	CANADA*	UZBEKISTAN	UZBEKISTAN
48	KUWAIT	QATAR	KUWAIT	KUWAIT
49	UNITED ARAB EMIRATES	UNITED ARAB EMIRATES	NIGERIA	NIGERIA
50	QATAR	KUWAIT	TURKMENISTAN	TURKMENISTAN

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ENDNOTES

[1] The California Air Resources Green House Gas Inventory provides estimates of the amount of GHGs emitted to the atmosphere by human activities within California. This project utilizes the 2016 edition of the inventory. The inventory includes estimates for carbon dioxide (CO_2), methane (CH_4, nitrous oxide (N_2), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), which are often referred to as the "six Kyoto gases," and nitrogen trifluoride (NF_3). Note: In each new edition of the inventory recalculations are made to correct errors, incorporate new methodologies or, most commonly, to reflect changes in statistical data supplied by other agencies. Emission estimates are recalculated for all previous years to maintain a consistent time-series following IPCC recommendations for developing GHG inventories. The 2016 inventory may report a different emission level for an earlier year than previous inventory versions. Energy Information Administration. "Table 12.6 Carbon Dioxide Emissions from Energy Consumption: Electric Power Sector." Monthly Energy Review. Retrieved from: https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf

[2] New York's Reforming the Energy Vision (REV) plan, which shares many of the goals of California's environmental policies, helps the state to achieve such low emissions per capita. Through REV, solar power grew 575 percent from 2012 to 2015 and up to $1.5 billion has been invested toward large-scale renewables by the New York State Energy Research and Development Authority and the New York Power Authority.

[3] State Carbon Dioxide Emissions by Fuel. Data for: 2014. November 2016. Energy Information Administration.

[4] Computing between the share of coal as share of carbon from the State Carbon Dioxide Emissions by Fuel table and Per Capita Energy-Related Carbon Dioxide Emissions by State table yields a positive correlation of 0.58.

[5] California Air Resources Board revised 2014's GHG emissions slightly upward from 441.54 million $MTCO_2e$ to 441.85 million $MTCO_2e$.

[6] Upchurch, J. and Peterson, C. 2017, May 17. California electricity mix in 2017 has involved more renewables, less natural gas. Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=31252

[7] California New Car Dealers Association's Auto Outlook stated that auto sales grew 11.1 percent in 2015 compared to 2014, of which car (light duty passenger vehicle) grew 5.8 percent while light trucks grew 19.4 percent.

[8] California New Car Dealers Association. 2016. California Auto Outlook. February 2016. Vol. 12, no. 1. Retrieved from: http://www.cncda.org/CMS/Pubs/Cal%20Covering%204Q%2015.pdf

[9] California Air Resources Board. 2017, June. California Cap-And-Trade Program Summary of Proceeds to California and Consigning Entities. Retrieved from: https://www.arb.ca.gov/cc/capandtrade/auction/proceeds_summary.pdf

[10] Office of Environmental Health Hazard Assessment. 2017, February. Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report. California Environmental Protection Agency. Retrieved from: https://oehha.ca.gov/media/downloads/environmental-justice/report/oehhaab32report020217.pdf

[11] Cushing, L. J. et al. 2016. A Preliminary Environmental Equity Assessment of California's Cap-And-Trade Program. Program for Environmental and Regional Equity, University of California. Retrieved on: http://dornsife.usc.edu/PERE/enviro-equity-CA-cap-trade

[12] In the most recent auction (May 2017), 100 percent of current vintage and 22 percent of future vintage – a composite of 91 percent of all vintage – were sold. The auction result is available at: https://www.arb.ca.gov/cc/capandtrade/auction/auction.htm#proceeds

[13] California Air Resources Board. 2017, March. Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds. Retrieved from: https://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2017.pdf

[14] Ibid.

[15] The 2017–18 Budget, Resources and Environmental Protection can be viewed at http://www.lao.ca.gov/Publications/Report/3558

[16] We're Still In can be viewed at: http://wearestillin.com/#press-release

[17] The Global Climate Action Summit announcement can be viewed at: https://globalclimateactionsummit.org/

[18] These states include California, Colorado, Connecticut, Delaware, Hawaii, Massachusetts, Minnesota, New York, Oregon, Rhode Island, Vermont, Virginia, and Washington.

[19] The letter can be viewed at: https://www.c2es.org/newsroom/releases/major-companies-sign-full-page-ad-urging-president-stay-paris-agreement

[20] The full list of the CERES Investor Network on Climate Risk and Sustainability can be viewed at: https://www.ceres.org/news-center/press-releases/over-200-global-investors-urge-g7-stand-paris-agreement-and-drive-its

[21] For example, both jurisdictions seek to cut greenhouse gases 80 percent by 2050.

[22] The Letter of Cooperation between California and Scotland can be viewed at: https://www.gov.ca.gov/docs/4.3.17_Letter_of_Cooperation.pdf

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APPENDIX

GENERAL REFERENCES

Inflation Adjustment

Inflation-adjusted figures are converted into current dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Gross Domestic Product

Nominal gross domestic product (GDP) data for California, U.S. states and the U.S. are sourced from the Bureau of Economic Analysis, U.S. Department of Commerce. Country GDP is at market prices in current 2014 dollars, expressed per U.S. dollar, from the World Bank's World Development Indicators.

Population

Population data from California used to calculate per capita figures are from the California Department of Finance's: E-4 Population Estimates for Cities, Counties and the State, with 2000 and 2010 Census Counts. U.S., state and "U.S. without California" population data are from the U.S. Census Bureau, Population Estimates Branch. Country population data are from the U.S. Department of Agriculture's Economic Research Service, calculated from the Census Bureau International Population Database.

THE CARBON ECONOMY

Global Fossil Fuel Combustion, Carbon Economy, and Emissions Per Capita in California and Other Regions

Data for carbon dioxide emissions from the consumption of energy are from the U.S. Department of Energy – Energy Information Administration (EIA), International Energy Statistics. State level emissions data come from EIA's State CO_2 Emissions. Data for carbon dioxide emissions from the consumption of energy include emissions due to the consumption of petroleum, natural gas, and coal, and also from natural gas flaring. Energy consumption data are based on the consumption of each primary energy source, and data are gathered from a variety of national and organization reports that collate data from energy users. Carbon dioxide emissions are calculated for each individual fuel by applying carbon emission coefficients to convert to million $MTCO_2e$ dioxide emitted per quadrillion BTU of fuel consumed. Calculations used GDP and Population data where applicable, as described above.

Emissions data only include energy-related emissions, and therefore do not include emissions from sources such as agriculture, waste combustion, and industrial gases, because it is the most up-to-date information available. While these other emissions are important to track and reduce, the Green Innovation Index focuses on energy emissions, given the importance of energy-related indicators and the availability of recent data. A comparison of World Resources Institute's 2011 total world emissions data shows that energy-related emissions account for about 75 percent of global emissions. In addition, the ranking for the top emitters are similar when comparing total and energy-related emissions, and the rankings of the top six emitters are identical.

GHG Emissions and Gross Domestic Product, Total California Greenhouse Emissions, Emissions by Source, Emissions by Detailed Source

Greenhouse gas (GHG) emissions data for these figures are from California Air Resources Board's "California Greenhouse Gas Inventory – by Sector and Activity" (June 2017). The 1990–1999 emissions include "gross emissions" and the 2000–2015 emissions are "included emissions" only. Calculations used GDP and Population data where applicable, as described above.

ENERGY EFFICIENCY

Energy Productivity and Energy Consumption per Capita

Energy data are from the U.S. Department of Energy – EIA, International Energy Statistics and State Energy Data System. Data is for total primary energy consumption, in British Thermal Units (BTU), of petroleum, dry natural gas, coal, and net nuclear, hydroelectric, and non-hydroelectric renewable electricity. Energy productivity divides GDP by total energy consumption. Primary energy is in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy (for example, coal is used to generate electricity). Calculations used GDP and Population data where applicable, as described above.

Electricity Consumption per Capita

Electricity consumption data are from the U.S. Department of Energy – EIA, International Energy Statistics and State Energy Data System. For the United States, total electric power consumption is equal to the data in the Total column under End Use from Table 8.1 of the EIA's Annual Energy Review. For all other countries except the United States, total electric power consumption is equal to total net electricity generation, plus electricity imports, less electricity exports

and less electricity transmission and distribution losses. Data are reported as net consumption as opposed to gross consumption. Net consumption excludes the energy consumed by the generating units. Calculations used Population data where applicable, as described above.

RENEWABLE ENERGY

Renewable Energy Generation

Data for total electricity generation and renewable electricity generation by source are from the U.S. Department of Energy – EIA, International Energy Statistics. Data are for both utility and nonutility sources, and are reported as net generation (as opposed to gross generation). Renewable electricity data are for non-hydroelectric renewable, including geothermal, solar, tide, wave, wind, biomass and waste.

California renewable energy data is from the California Energy Commission, "Net System Power Reports" 2002–2015, Total System Power in Gigawatt Hours (GWh). U.S. data in the California section on total electricity generation data is from the U.S. Department of Energy, EIA, Electric Power Monthly reports. Annual totals from "Table 1.1 Net Generation by Energy Source: Total (All Sectors)," and "Table 1.1.A. Net Generation by Other Renewables: Total (All Sectors)." Because of different renewable energy definitions between California and the U.S., data represented for the U.S. do not include any hydro.

Renewable Portfolio Standard Cumulative Operational Capacity

Data are from the California Public Utilities Commission "RPS Project Status Table" released on April 11, 2017. Projects include those Approved and Online, Approved in Development, Delayed but likely to be completed per CPUC, and those in the Renewable Auction Mechanism and Investor-Owned Utility Solar Photovoltaic programs. Projects are classified as operational, online, in progress, and on schedule. Years are based on the online date/contracted delivery date, though those with a status of in progress, delayed, or on schedule (i.e. not classified as online) with pre-2016 dates were labeled as 2016.

New Solar Installations, New Solar Installations by Sector

Solar capacity installed data are provided by Solar Energy Industries Association® (SEIA) and California Solar Initiative. SEIA data were taken from the U.S. Solar Market Insight Reports, 2007–2016. California Solar Initiative (CSI) data include municipal utility, and other utility-scale installations and Net Energy Metering (NEM) Interconnection Data.

Wind Installations

Wind capacity installed and cumulative data are provided by the American Wind Energy Association. Data is taken from quarterly and annual U.S. Wind Industry Market Reports, 2006–2016.

TRANSPORTATION

Emissions, Surface Transportation, VMT

Total Vehicles and GHG Emissions from Surface Transportation and Vehicle Miles Traveled CARB's "California Greenhouse Gas Inventory – by Sector and Activity." Surface Transportation emissions sources include passenger vehicles, motorcycles and light and heavy duty trucks. Vehicle Miles Traveled (VMT) is defined as total distance traveled by all vehicles during a selected time period in geographic segment. VMT estimates for 1995–2007 are from the California Department of Transportation's "2008 California Motor Vehicle Stock, Travel and Fuel Forecast." VMT data for 2008–2015 are from the California Department of Transportation's Highway Performance Monitoring System's "California Public Road Data." Calculations use Population data sources where applicable.

Alternative Vehicle Registrations

Data are from the California Energy Commission (CEC), compiled using vehicle registration data by fuel type from the California Department of Motor Vehicles. Alternative fuel types include all hybrid (gasoline and diesel), electric, plug-in hybrid, hydrogen, propane, biofuels, and natural gas. Zero-emission fuel-types include electric, plug-in hybrid, and hydrogen.

Public Transit Ridership

Unlinked Passenger Trips Data uses monthly American Public Transportation Association (APTA) data for the transit component of Transportation Safe Institute (TSI) for years prior to 2010, and data from FTA (Federal Transit Administration)'s NTD (National Transit Database) for 2010 and beyond. FTA is an agency of the United States Department of Transportation. The number of unlinked passenger trips is the measure used for the TSI.

Transit modes, include, among others, bus, trolleybus, vanpool, jitney, and demand response service; and heavy rail transit, light rail transit, commuter rail (including Amtrak contract commuter service), automated guideway transit, inclined plane,

cable car, monorail, aerial tramway, and ferryboat. Monthly data is reported to NTD by transit agencies.

CLEAN TECHNOLOGY INNOVATION

Investment, M&As, and IPOs in Clean Technology

Clean technology investment data are provided by PitchBook Data, Inc. and includes disclosed investment deals in private companies. Data is through December 2016. VC data includes Seed, Series A-E+, and Growth Equity series types. Debt includes loan guarantees from the federal government, as well as structured debt and loans from private investors such as banks, investment funds, and financial services groups. Totals may not be the same across charts because of different investment types included. Dollar amounts are unadjusted for inflation (nominal). M&As are by location of the targeted company (e.g. not the buyer) in the year the deal was announced. IPOs are by location of the company and in the year the IPO was listed.

Clean Technology Patents

Global Clean Technology Patents are sourced from IP Checkups through the CleanTech Patent Edge™ database, which includes clean technology patent data including both granted patents and published patent applications from the U.S. Patent and Trade Office (USPTO) and the European Patent Office (EPO), and published patent applications from the World Intellectual Property Organization (WIPO, which includes 189 member countries). Patent counts by country included in this analysis reflect the location of the first named inventor in the earliest published patent within a patent family, as defined in INPADOC (International Patent Documentation). Inventors frequently file on the same invention in multiple patent systems (such as USPTO and also EPO), and analysis at the patent family level (i.e. the set of related patents for an invention, across systems) rather than at the individual patent level reduces double-counting of the same intellectual property. If country of first inventor was unclear and could not be interpolated from other documentation, the patent family was excluded from the analysis.

IP Checkups classifies patents into clean technology segments based on patent classification codes and key word searches. Some patents fell into multiple segment and sub definitions, and if these segments were equally applicable — as defined by IP Checkups and Beacon Economics — a patent was termed "multiple." Ranking analyses by segment includes any patent families classified into that segment, including those within family members which also apply to other segments. In contrast, total clean technology analysis includes only the dominant segment category, or the "multiple" designation to reduce double-counting. Assignee companies reflect the assignee at time of patent publication.

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