2020

California Green Innovation Index

12th edition

NEXT 10

GDP

Gross Domestic Product (inflation-adjusted to 2018 dollars)

$3.0 Trillion
2018

2.9% Average annual growth
1990–2018

$75,215 Per capita GDP
2018

Population

39.5 Million
2018

1.0%
Average annual growth rate
1990–2018

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 2020 Index is the 12th 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.

California's Carbon Economy

0.143
2018

0.323
1990

Million metric tons of CO_2 equivalent / inflation-adjusted GDP

California Emissions

Total GHG Emissions

425.3
2018

424.5
2017

Million metric tons of CO_2 equivalent

-0.05% Average annual growth
1990–2018

+0.20% One year growth
2017–2018

Targets: Total GHG Emissions

259
by 2030

431
2020 target met in 2016

86
by 2050

Million metric tons of CO_2 equivalent

Per Capita GHG Emissions

10.78
2018

Metric tons of CO_2 equivalent

Population Data Source: California Department of Finance.
Gross Domestic Product Data Source: Bureau of Economic Analysis.
Greenhouse Gas Data Source: California Air Resources Board, "2020 California Greenhouse Gas Inventory – by Sector and Activity." California Department of Finance.
Carbon Economy: California Air Resources Board, "2020 California Greenhouse Gas Inventory – by Sector and Activity." Bureau of Economic Analysis.

www.next10.org

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Dear Californians,

As we near a full year of limited mobility and restrictions to help slow the spread of the COVID-19 virus, there is much to reflect upon.

Our economy has suffered from the pandemic-induced recession, but this experience has also shed light on some of the most critical challenges we face—as well as important opportunities in addressing those challenges. For example, we have seen first-hand the impact our commutes have on air quality. In the first few weeks of shelter-in-place, cities around California saw a marked decrease in air pollution, providing us with a brief glimpse of what communities could look like with cleaner transportation choices abundantly available. Yet historically marginalized communities continue to suffer environmental and social injustices on multiple fronts, with communities in high air pollution zones suffering inequitably from COVID-19.

In light of these sobering revelations, stakeholders and governments throughout the world have mobilized to not only address the COVID-19 challenge, but to address the environmental and economic challenges that could limit our ability to thrive in a post-pandemic world, as well. Some, like the European Union, have chosen to strengthen their climate plans and investments. In California, our governor has made new commitments to climate action through executive orders to advance electric vehicles and carbon storage in natural and working lands. As the world looks to recover from the global challenge that COVID-19 presents, there is hope that this experience may also be applied to helping solve our global climate challenge, as well. The world now watches California as we examine our unique position in this recovery to accelerate progress toward an equitable and clean energy economy.

In 2018—the last year for which data are available—California's statewide greenhouse gas emissions increased for the first time since 2012. This upward growth in emissions is troubling as the state looks to achieve its 2030 climate goal and ultimately reach carbon neutrality by 2045. The good news is that California's most polluting sector—transportation—saw emissions decline for the first time in six years. That drop was driven largely by a decline in emissions from the heavy-duty sector, including larger trucks that run primarily on diesel fuel. As the economy improves, ensuring that goods movement and heavy-duty vehicles can rapidly transition to cleaner fuels could go a long way toward meeting our climate goals and reducing harmful air pollution from diesel vehicles.

But vehicles are not the only source of harmful air pollution. This year brought another unprecedented wildfire season for California and the West. Aside from the tragic losses that can come with this challenge, wildfires emitted nearly the same amount of greenhouse gases in 2020 as the combined emissions of the residential, commercial, and agriculture and forestry sectors combined. In order to minimize greenhouse gas emissions and particulate pollution from wildfires, we must scale our efforts to mitigate our fire risk.

While this year has been challenging, our recovery will be more successful if we are able to learn from the past. Since 2008, Next 10 has published the *California Green Innovation Index* to track environmental and economic progress through multiple state and federal administrations—as well as recessions. We are at a critical crossroads and the direction we take now will impact the viability and health of our economy, environment, and people.

With this moment in mind, we are proud to share the latest data and insights from the *California Green Innovation Index*. California has demonstrated that it is possible to reduce emissions while growing the economy. As we look toward a global economic recovery post-COVID-19, I am hopeful that we may all learn from the events of this year to help build a more equitable and clean energy economy for our future.

Sincerely,
F. Noel Perry, Founder

F. Noel Perry

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Carbon Economy

Key Findings

While California's greenhouse gas emissions continued to **stay below the 1990 levels,** 2018 marked the first year where greenhouse gas (GHG) emissions increased year-over-year since 2012. Despite the slight increase in GHG emissions of 0.2 percent, the state has continued to reduce its carbon intensity—emissions relative to GDP— by **3.2 percent from 2017 to 2018** thanks to a strong growth in real GDP.

Nevertheless, the slight increase in GHG emissions indicates that while the state has made good progress on the relatively easier-to-achieve GHG reductions, **further work will be needed to reduce emissions in harder-to-reach sectors** such as transportation and buildings. Looking ahead, significant challenges remain in order to meet the state's next climate goal in 2030, but there are key opportunities to scale emissions reductions in challenging sectors.

California's Greenhouse Gas Emissions

- Total California greenhouse gas (GHG) emissions **rose 0.83 million metric tons of carbon dioxide equivalent** ($MMTCO_2e$) to 425.3 $MMTCO_2e$ (+0.2%) in 2018 compared to 2017. This is still below the AB 32 GHG emissions goal of 431 $MMTCO_2e$.
- By top-level economic sector, only the **transportation sector saw a reduction in GHG emissions** from 2017 to 2018 (-0.9%). GHG emissions rose in all other economic sectors in 2018: Agriculture & Forestry (+0.8%), Commercial (+2.1%), Electricity Power (+1.5%), Industrial (+0.7%), and Residential (+0.3%).
- At the current trajectory, the state will take **significantly more time to reach the 2030 and 2050 emissions goals** than it did to reach the 2020 goal. California will need to quadruple its average reduction rate from 2015 to 2018 in order to meet the 2030 goal.
- California's energy-related carbon dioxide emissions per capita were **9.1 $MTCO_2e$ per person** in 2017–the third-lowest among the 50 states, behind New York and Maryland.

California's Carbon Economy

- From 2017 to 2018, California's inflation-adjusted **GDP per capita grew 3.2 percent** while **per capita GHG emissions decreased 0.1 percent.** Since 2008, California's per capita GDP grew 17.6 percent while per capita GHG emissions fell by 18.6 percent.
- From 2013 to 2018, California's carbon intensity relative to economic output **declined at a rate of 4.7 percent per year**—faster than the 10-year average of 3.6 percent from 2008 to 2018.
- From 2007 to 2017, California's energy intensity **decreased by 24 percent**—ahead of states with high energy intensity such as Texas (-20.3%) and Florida (-15.4%). Internationally, among the developed countries that are major economic powerhouses, only France had a lower carbon intensity (0.123 $MTCO_2e$ per $1,000 inflation-adjusted GDP) in 2017.
- California's carbon intensity of the energy supply **declined 2.3 percent** in 2017 compared to 2016—which is greater than the reduction in the U.S. excluding California (-1.2%).

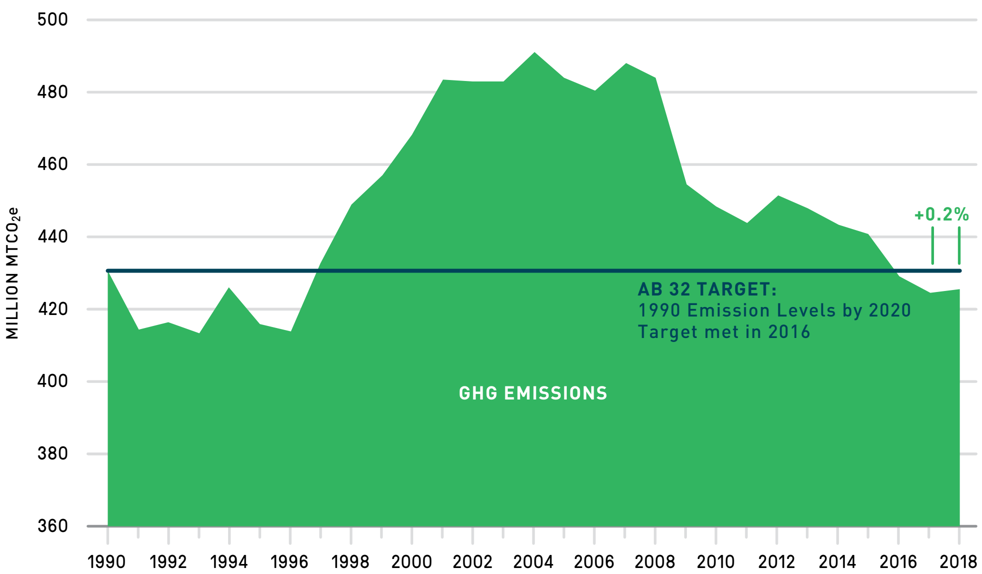
Emissions by Sector: Challenges and Opportunities

- The Transportation sector remains by far the largest-emitting sector in California, but its share of GHG emissions dropped from an **all-time high of 41.3 percent in 2017 to 40.9 percent in 2018.** Within the transportation sector, GHG emissions dropped 1.3 percent from the on-road vehicles subsector, but increased 3.6 percent from off-road vehicles.
- While the amount of transportation fuel consumed in 2018 was similar to levels from ten and fifteen years prior, GHG emissions from transportation fuel in 2018 were **3.3 percent lower and 8.3 percent lower** than 2008 and 2003, respectively. This is the result of policies promoting cleaner vehicle fuels and higher corporate average fuel economy (CAFE) standards.
- After years of increasing GHG emissions, GHG emissions from aviation-related subsectors **dropped 1.2 percent** from 2017 to 2018. The drop is due to the international flights subsector, which declined 4.3 percent compared to 2017. GHG emissions from domestic intrastate flights (+1.0%) and domestic interstate flights (+1.9%) both edged up slightly in 2018.
- Californians are disposing of an increasing amount of waste in landfills since the Great Recession. As landfills are burdened with an increasing amount of waste, landfill emissions have gone up almost every year. GHG emissions from the Landfill subsector within the Industrial sector totaled 16.9 $MMTCO_2e$ in 2018—**up 0.9 percent from 2017.**
- Emissions from Substitutes for Ozone-Depleting Substances (substitutes for ODS) **continue to increase,** as they replace Ozone-Depleting Substances (ODS) being phased out under the 1987 Montreal Protocol. In 2018, GHG emissions from ODS substitutes from all economic sectors accounted for 4.7 percent of total included emissions—a considerably larger share compared to 2008 (2.3%) and 2000 (1.2%).
- Wildfires have been producing more GHG emissions than ever. As of September 13, 2020, emissions from wildfires reached 83 $MMTCO_2e$—**82.4 percent above the 45.5 $MMTCO_2e$ recorded for wildfire emissions in 2018.** While the state's forests also serve as a carbon sink, the increasing threat of wildfires does continue to pose an emissions challenge.

California's Greenhouse Gas Emissions

Figure 1. Total California Greenhouse Gas Emissions

GROSS ANNUAL EMISSIONS, 1990–2018



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

HIGHLIGHT:

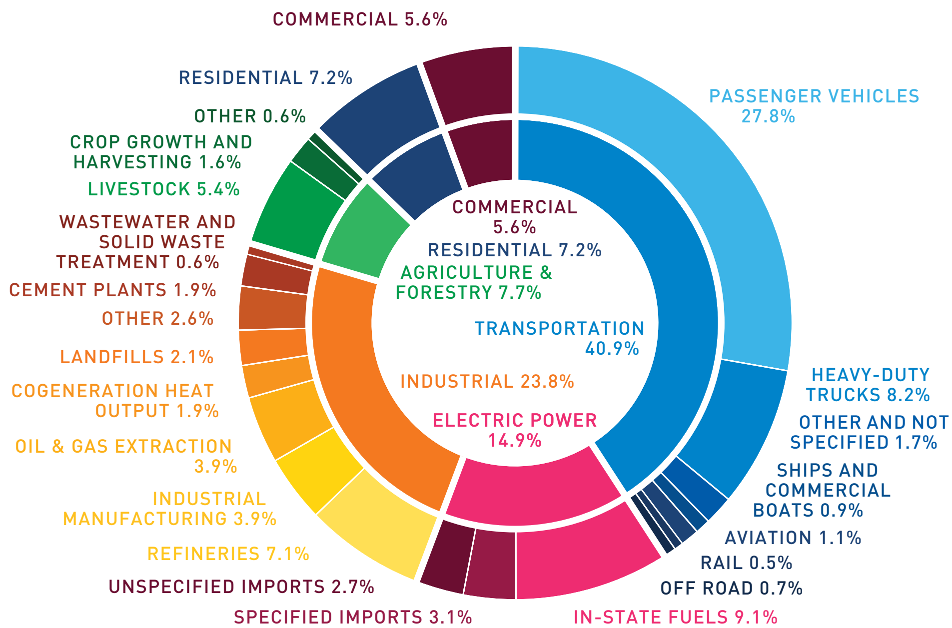
After meeting the AB 32 goal in 2016, total included greenhouse gas emissions[1] were 425.3 $MMTCO_2e$ in 2018, remaining below the 1990 level of 431 $MMTCO_2e$.

CHALLENGE:

For the first time since 2012, GHG emissions actually increased slightly (+0.2%) in 2018 compared to the previous year. If the state continued reducing emissions at the current pace (averaging just slightly over one percent in reduction annually), California would not be on track to meet its Senate Bill 32 (SB 32) goal of 259 $MMTCO_2e$ by 2030.

Figure 2. Greenhouse Gas Emissions by Source

CALIFORNIA, 2018



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

HIGHLIGHT:

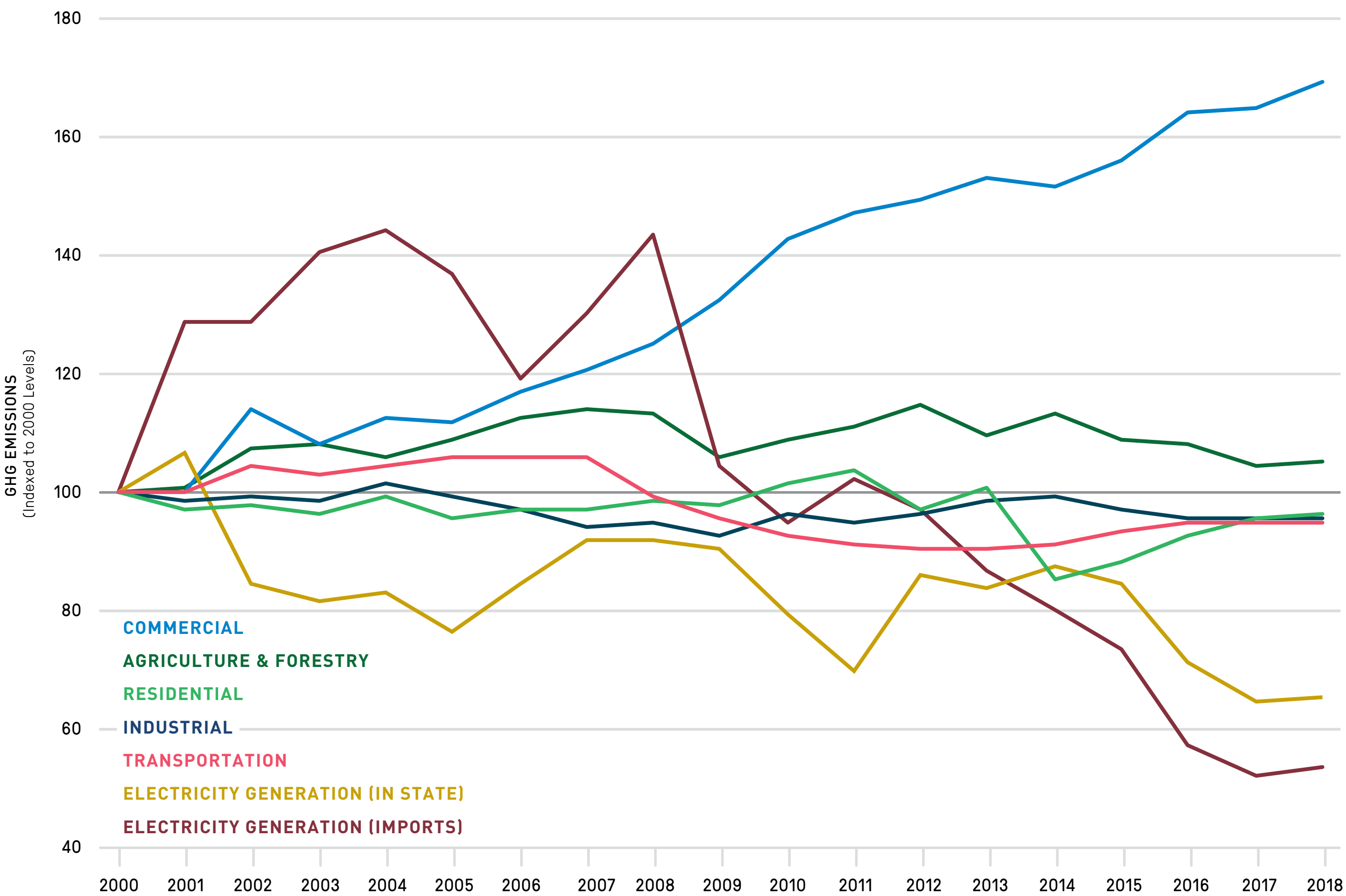
The transportation sector remains the largest-emitting sector at 40.9 percent of total 2018 emissions—down slightly (-0.4%) from 2017. On-road passenger vehicles accounted for 27.8 percent of the state's total GHG emissions in 2018, with heavy-duty vehicles (-4.0%) driving the drop.

CHALLENGE:

Emissions from the electric power sectors increased for the first time in ten years. For in-state generation, merchant-owned[2] electricity generation accounted for the increase, as generation from natural gas increased and generation from renewable sources such as large hydroelectric decreased from 2017 to 2018.[3] Imported generation from unspecified sources accounted for an even greater increase in GHG emissions—increasing by 31 percent in 2018.

Figure 3. GHG Emissions (Indexed to 2000 Levels)

BY SECTOR, CALIFORNIA



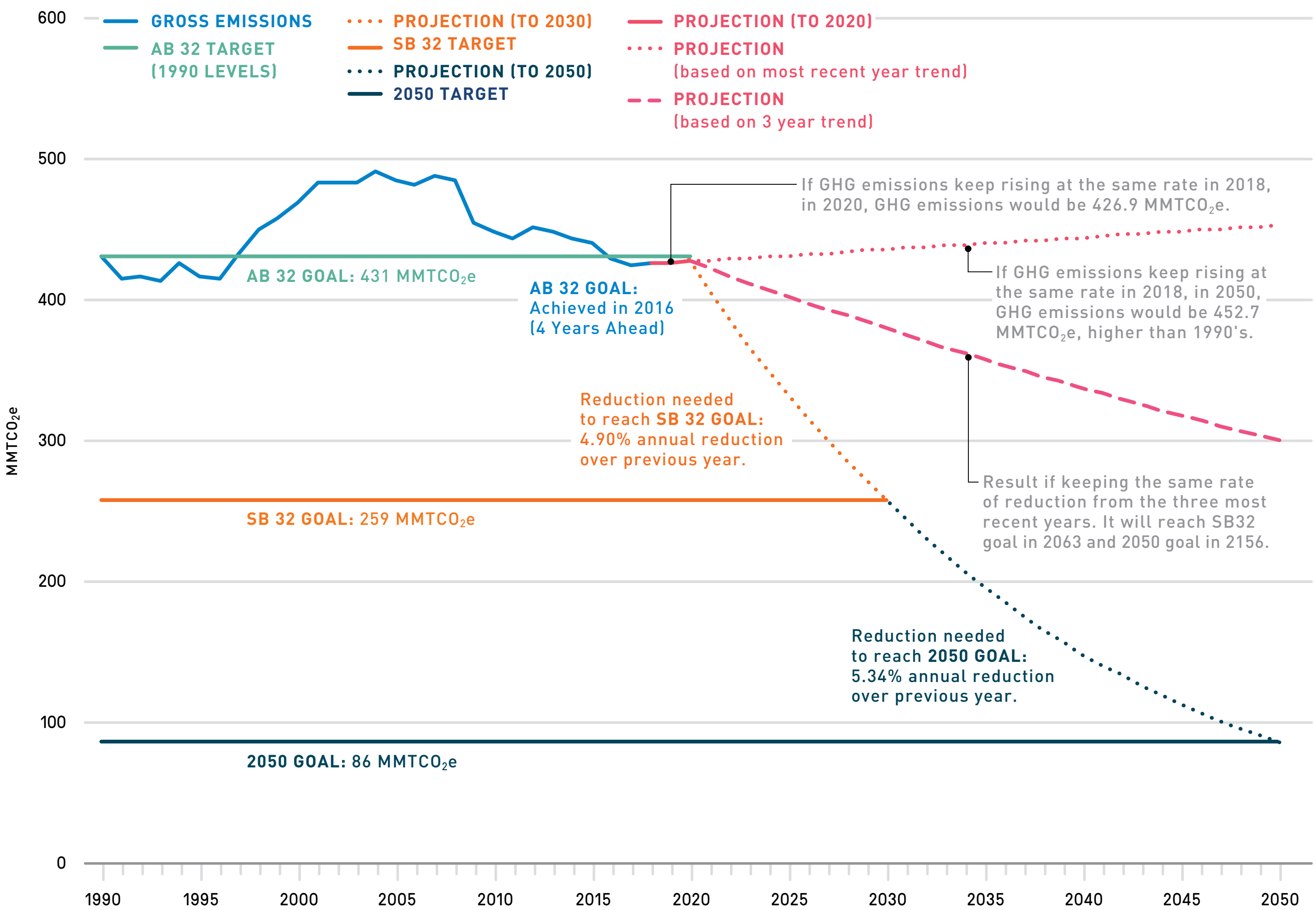
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas inventory - by Sector and Activity. NEXT 10 / SF · CA · USA

CHALLENGES:

❶ So far, only the electric power sectors have seen dramatic reductions since 2000, which are down 34.9 percent for in-state generation and down 46.5 percent for imports. As the grid becomes cleaner, further emission cuts from other sectors will become more critical. The Industrial (-4.3%), Residential (-3.9%), and Transportation (-5.1%) sectors have seen only marginal decreases compared to 2000. Of all of the economic sectors, only Transportation saw a year-over-year decrease (-0.3%); all other sectors' GHG emissions increased in 2018 compared to 2017. ❷ GHG emissions in the Commercial sector keep increasing (+69.3% relative to 2000) with no sign of slowing down. The continuous increase is primarily due to an increase in high global warming potential (GWP) gases stemming from the use of substitutes for ozone-depleting substances (substitutes for ODS). These substitutes for ODS are primarily used for refrigerants and air conditioning. Compared to 2017, the Commercial sector also had the largest one-year increase (+2.7%) in GHG emissions.

Figure 4. GHG Emissions and Projected Reduction Goals

CALIFORNIA, 1990–2050



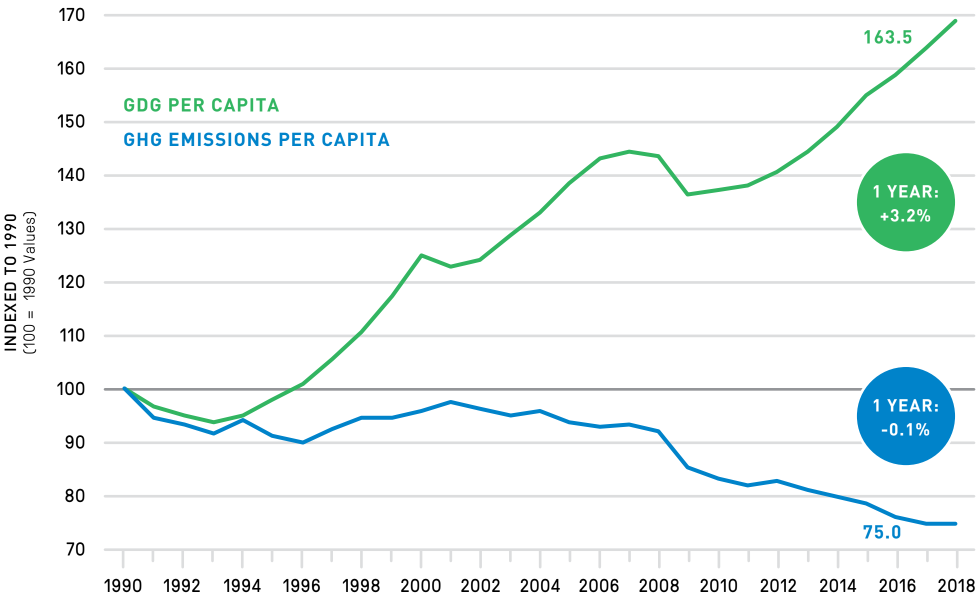
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory. NEXT 10 / SF · CA · USA

CHALLENGES:

❶ From 2018 to 2030, the state would need to reduce GHG emissions by 4.1 percent each year in order to meet the SB 32 goal by 2030. This represents a larger hurdle compared to 2016 (when the AB 32 goal was met), which required an annual reduction of 3.6 percent to reach the SB 32 goal. Furthermore, if statewide GHG emissions were to continue with the same rate of change from 2017 to 2018 (+0.2 %), a 4.9 percent reduction would have to be achieved each year from 2020 to 2030 to reach the SB 32 goal in 2030. ❷ At the current trajectory, the state will take significantly more time to reach its SB 32 and 2050 goals than it did to reach the 2020 goal. Assuming the same rate of change (+0.2%) from 2017 to 2018, GHG emissions would exceed 1990 levels by 2025. Using the average rate of decline from the three most recent years (-1.18%), the state would meet the SB 32 and 2050 goals in 2063 and 2156, respectively.

Figure 5. Greenhouse Gas Emissions and Gross Domestic Product, California Relative Trends Since 1990

GREENHOUSE GAS EMISSIONS ($MTCO_2e$) AND GDP DOLLARS PER CAPITA



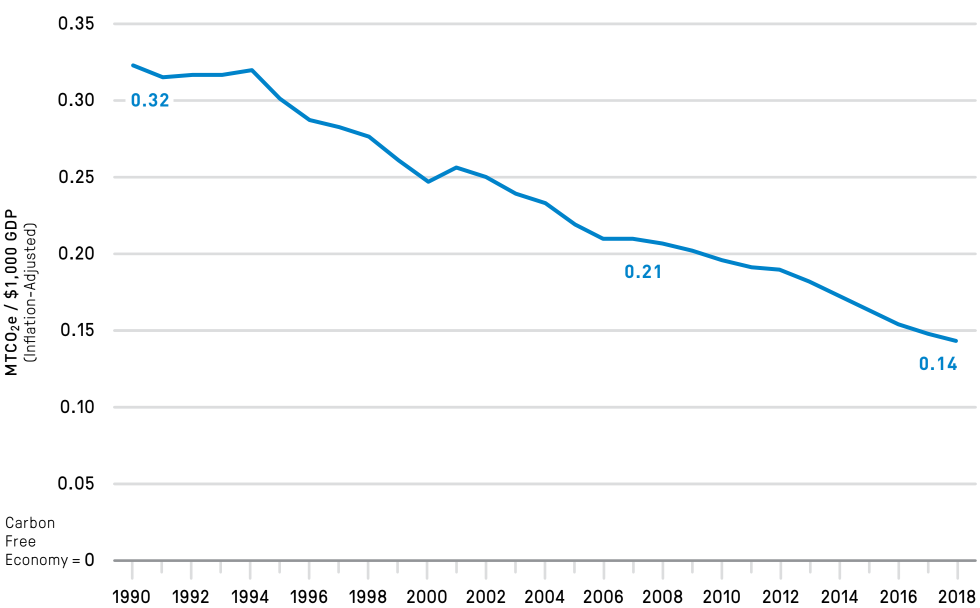
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce; U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Despite the slight uptick in total GHG emissions, GHG emissions per capita declined 0.1 percent from 2017 to 2018. Meanwhile, the state's inflation-adjusted GDP per capita grew 3.2 percent year-over-year over the same time period.

Figure 6. Gross Emissions Relative to Gross Domestic Product

CALIFORNIA, 1990–2018



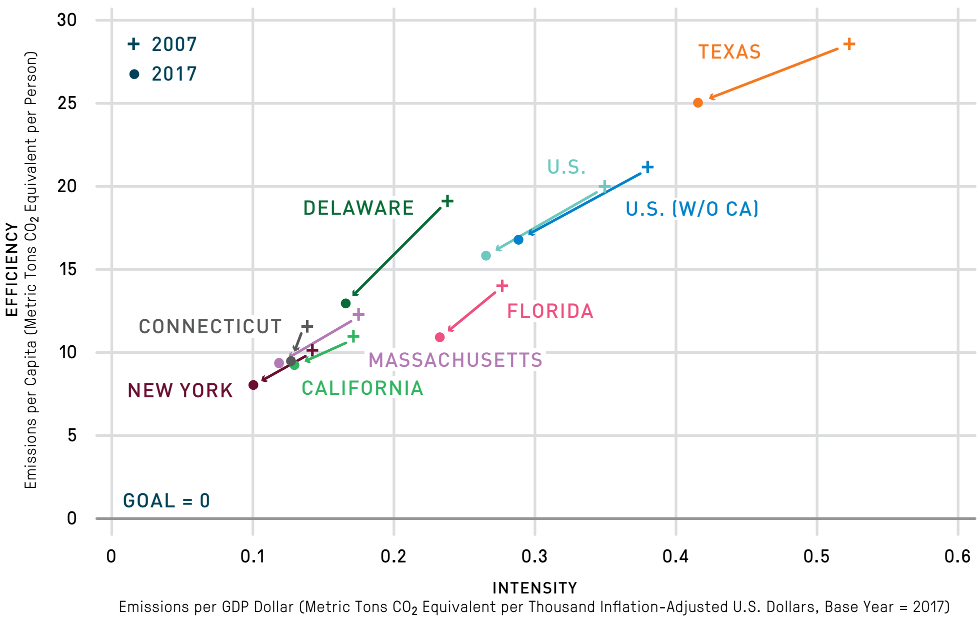
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ The carbon intensity (emissions relative to GDP) of the California economy continues to decline, with emissions of 0.14 $MTCO_2e$ per $1,000 of GDP (inflation-adjusted 2018 dollars) generated in 2018—a 3.2 percent improvement compared to 2017. However, this decline was smaller than the declines recorded each year from 2013 to 2017. ❷ From 2008 to 2018, California's carbon intensity declined by 30.8 percent total—greater than the reduction over the previous ten-year period (-24.9%). The rate of carbon intensity reduction was faster after the Great Recession than before. Although real GDP grew slightly slower after the Great Recession than before, the greater reduction in carbon intensity was due in large part to the climate policies that the state has implemented since the passage of AB 32 in 2006.

Figure 7. Carbon Intensity and Efficiency

SELECTED U.S. STATES, 2007 v. 2017



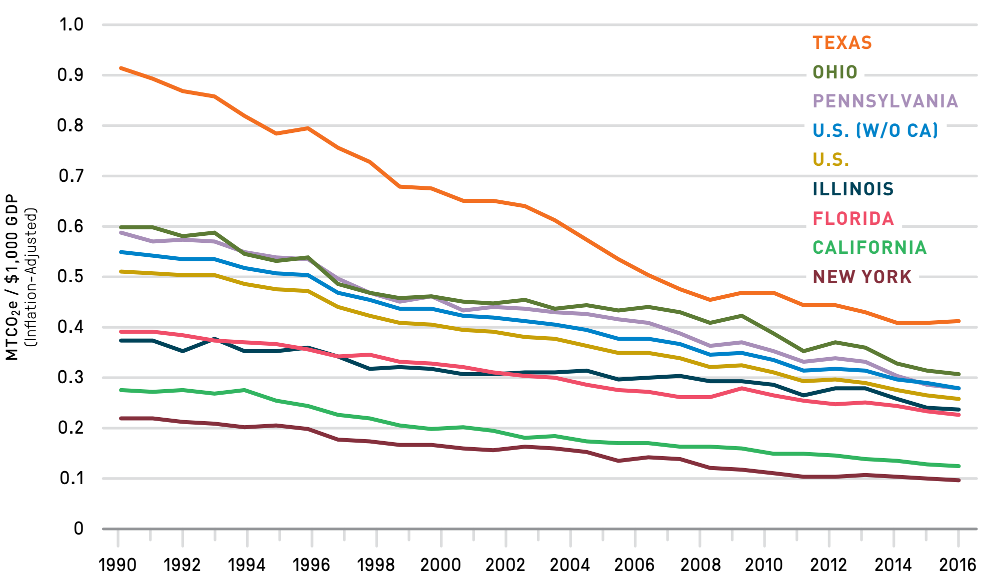
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GDP in Real 2017 U.S. Dollars. Greenhouse gas emissions are from consumption of energy. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis, USDA Economic Research Service; U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ In 2017 (the latest year for which nationally comparable data are available), $1,000 of economic activity[4] in California resulted in 0.131 $MTCO_2e$ produced. In comparison, the same $1,000 of economic activity in the U.S. (excluding California) resulted in 0.289 $MTCO_2e$ produced—more than double that of California. From 2007 to 2017, California's energy intensity decreased by 24 percent, ahead of states with high energy intensity such as Texas (-20.3%) and Florida (-15.4%). ❷ In addition to performing well in terms of carbon intensity, California also has one of the lowest energy-related GHG emissions per capita levels (9.11 $MTCO_2e$ per person), ranking third-lowest in the U.S. in 2017. The U.S. excluding California had a per capita emissions of 16.77 $MTCO_2e$.

Figure 8. The Carbon Economy in California and Other States

ENERGY-RELATED CARBON EMISSIONS (METRIC TONS) PER 1,000 DOLLARS GDP (2018 DOLLARS)



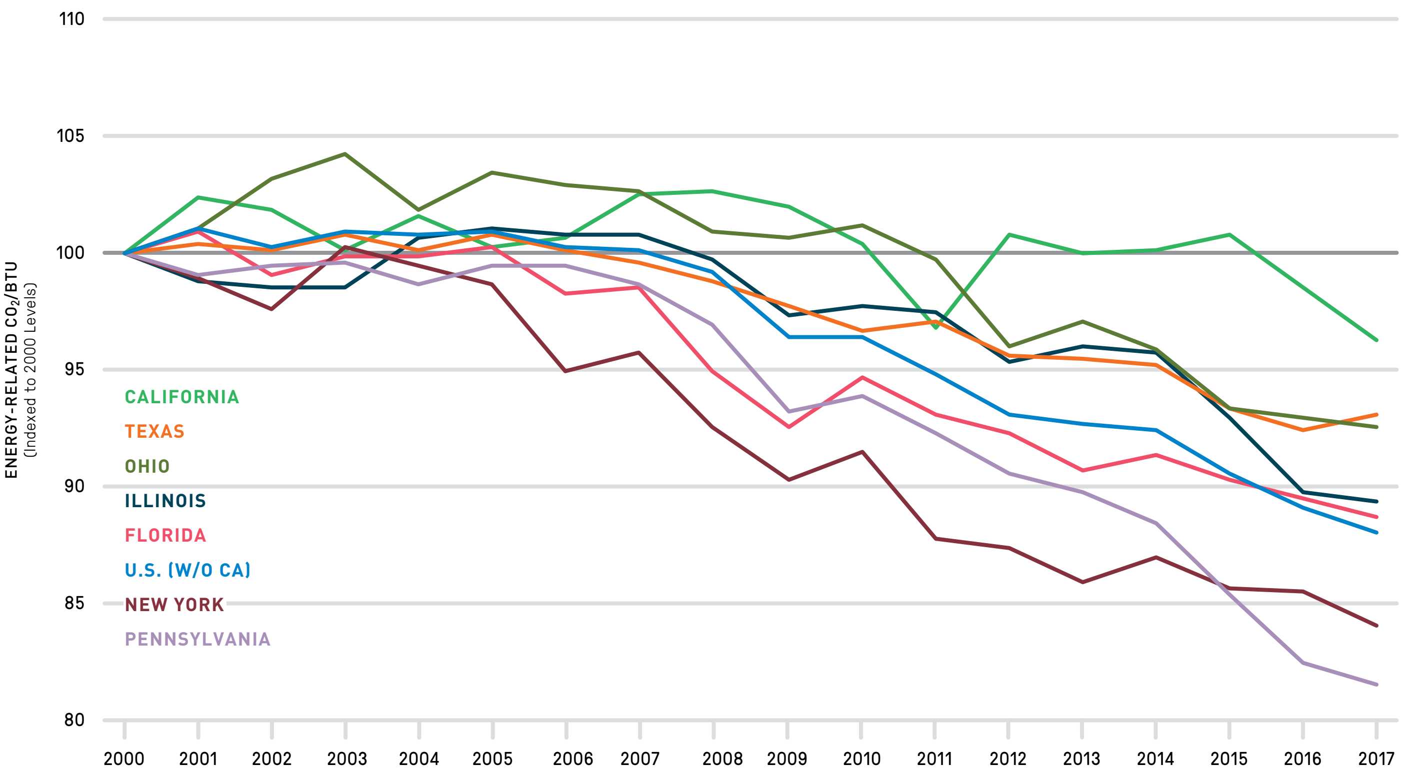
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GHG emissions data that allows for state-level comparison is from the Energy Information Administration and is limited to carbon emissions (fossil fuel combustion). Therefore, data represented here differs from analyses represented in other charts of total 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

HIGHLIGHTS:

❶ In 2017, California's carbon intensity was 55.3 percent lower than that of the rest of the U.S. (excluding California). Among the most populous U.S. states, California had the second-lowest carbon intensity, behind only New York (0.10 $MTCO_2e$/$1,000).[5] Compared to 2016, California's carbon intensity dropped 3.1 percent, greater than the 2.8 percent decline recorded for the rest of the U.S. ❷ Among the fifty states (excluding the District of Columbia), California maintained its position as the fourth-most carbon-efficient state ($MTCO_2e$ relative to inflation-adjusted GDP) in 2017, behind New York, Massachusetts (0.11 $MTCO_2e$/$1,000), and Connecticut (0.12 $MTCO_2e$/$1,000).

Figure 9. Carbon Intensity of the Energy Supply in California and Other States

INDEXED TO 2000 LEVELS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: The carbon intensity of energy supply (CO_2/BTU) reflects the energy fuel mix within a state. Data Source: Energy Information Administration, U.S. Department of Energy. NEXT 10 / SF · CA · USA

HIGHLIGHT:

The carbon intensity of California's energy supply (CO_2 relative to British thermal unit) declined 2.3 percent in 2017, more than other most populous U.S. states (which ranged from a decline of 1.8 percent in New York to an increase of 0.6 percent in Texas). The drop also outpaced that of U.S. excluding California (-1.2%).

CHALLENGE:

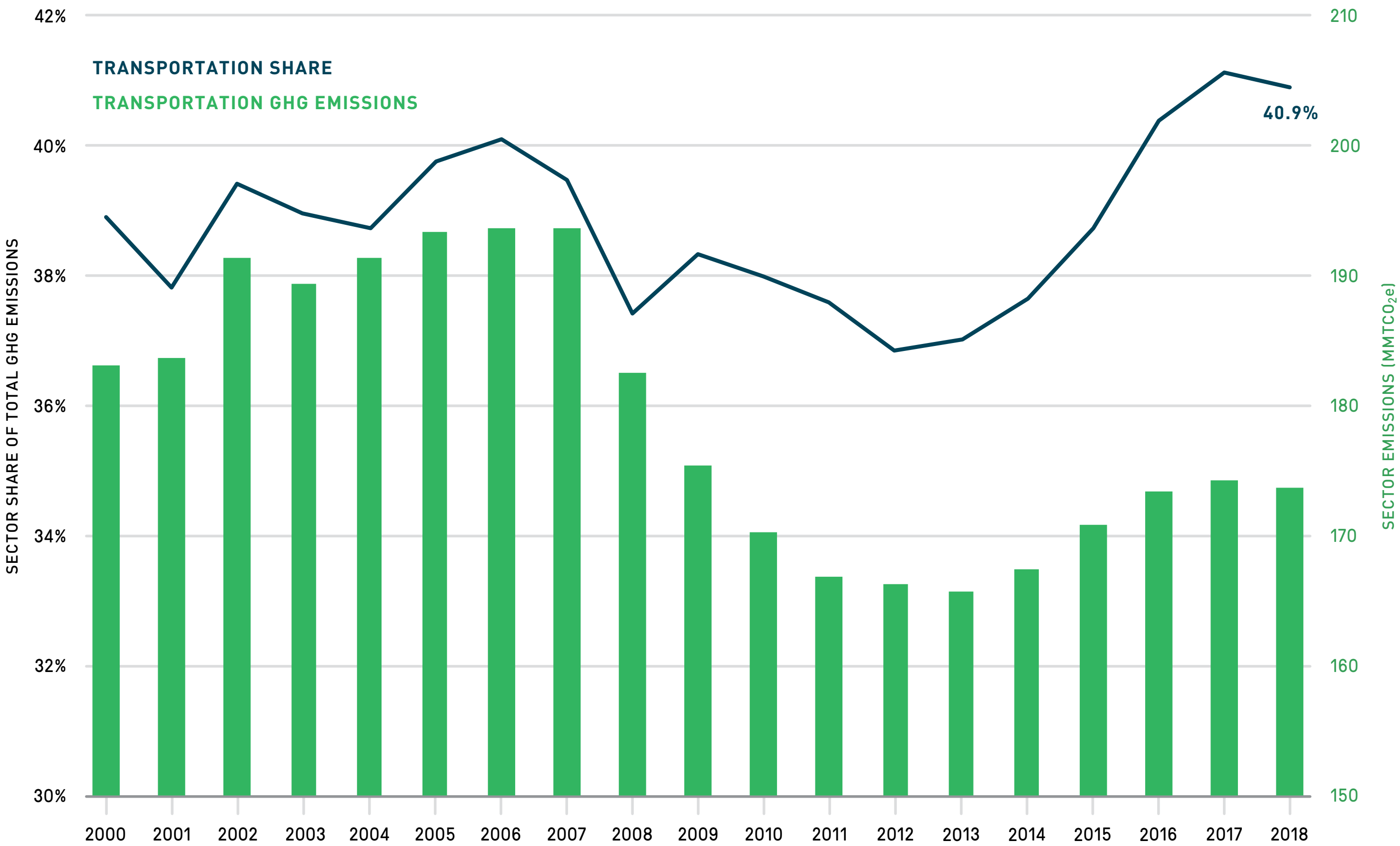
Over time, as California has moved away from natural gas and toward more renewables, the state's remaining fossil fuel consumption mix (coal, petroleum, and natural gas) shifted slightly toward more petroleum (less polluting than coal but more polluting than natural gas) and less natural gas. As a result of these shifting energy source trends, energy supply carbon intensity decreased more slowly in California (-3.7%) compared to the rest of the U.S. (-11.9%) from 2000 to 2018. In 2018, California's carbon intensity of its energy supply was 50.0 kilogram CO_2e/million BTU, or 6.1 percent less than the rest of the U.S. (53.2 kilogram CO_2e/million BTU), but 13.2 percent higher than New York (44.2 kilogram CO_2e/million BTU).

OPPORTUNITY:

Petroleum is the main source of emissions from fuel, which underscores California's need to reduce emissions from transportation. As zero-emission vehicles become more commonplace, the transportation sector should become increasingly electrified and the state should move away from fossil fuels as a significant source of emissions.

Figure 10. GHG Emissions from Transportation Sector and as Share of Total GHG Emissions

CALIFORNIA, 2000–2018



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

HIGHLIGHT:

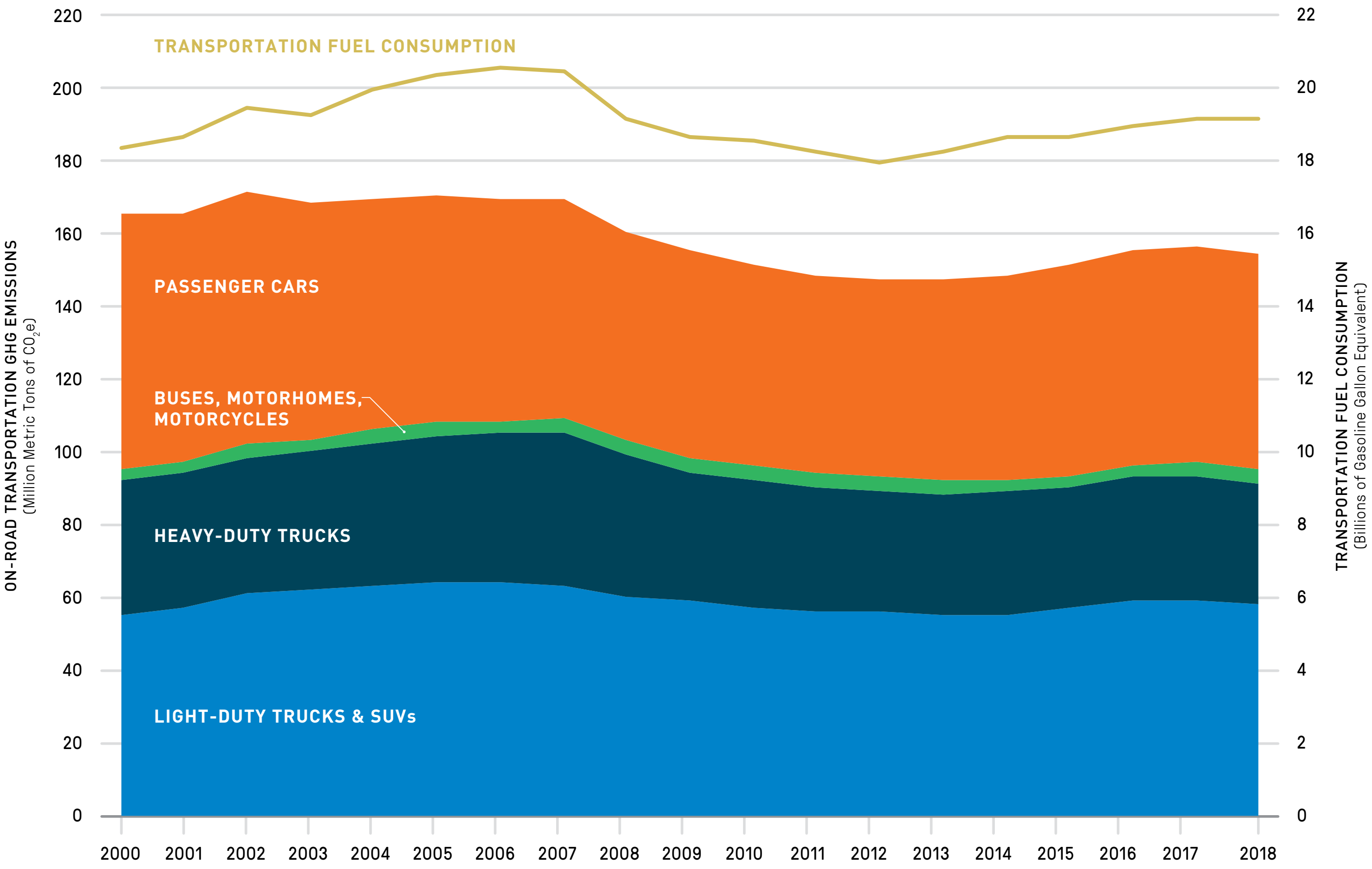
The share of GHG emissions from the transportation sector was 40.9 percent in 2018—down from 41.3 percent in 2017, but still very high. The sector's GHG emissions totaled 173.83 $MMTCO_2e$ in 2018, down 1.64 $MMTCO_2e$ (-0.9%) from 2017. Within the transportation sector, GHG emissions dropped 1.3 percent from on-road vehicles but increased 3.6 percent from off-road vehicles.[6]

OPPORTUNITY:

On-road heavy-duty vehicles accounted for the majority of the reduced emissions (-1.45 $MMTCO_2e$) from 2017 to 2018. Furthermore, all three subsectors of on-road heavy-duty vehicles had reductions in GHG emissions: Heavy-duty Trucks (-4.0%), Buses (-4.6%), and Motorhomes (-3.6%). Notably, GHG emissions from buses decreased from 2017 to 2018 despite a slight uptick in the vehicle revenue miles[7] of buses[8] (+0.5%). This is plausibly due to bus fleets becoming cleaner or electrified. Likewise, there exists vast opportunities to electrify heavy-duty trucks. Moving forward, further emissions reductions from the heavy-duty sector may be helped along by California's recently passed Clean Trucks Rule. Passed in July 2020, the new rule requires that manufacturers of heavy-duty trucks meet certain targets for sales of zero-emission trucks by 2035 (zero-emission truck sales would need to be 55% of Class 2b-3 truck sales, 75% of Class 4-8 of truck sales, and 40% of tractor sales).[9]

Figure 11. On-Road Transportation Subsector GHG Emissions

CALIFORNIA, 2000–2018



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

HIGHLIGHT:

On-road light-duty vehicles (passenger cars, light-duty trucks & SUVs, and motorcycles) accounted for the lion's share of the transportation sector's emissions with 118.11 $MMTCO_2e$ altogether—or 68 percent of the sector's total emissions—in 2018. While 84 percent of Californians drove or carpooled to work in 2018, there was a clear divergence between transportation fuel consumption and emissions over time. The amount of transportation fuel consumed in 2018 was similar to 2008 and 2003, yet GHG emissions in 2018 were 3.3 percent lower compared to 2008 and 8.3 percent lower compared to 2003. This is largely the result of the state's Low Carbon Fuel Standard and higher corporate average fuel economy (CAFE) standards.

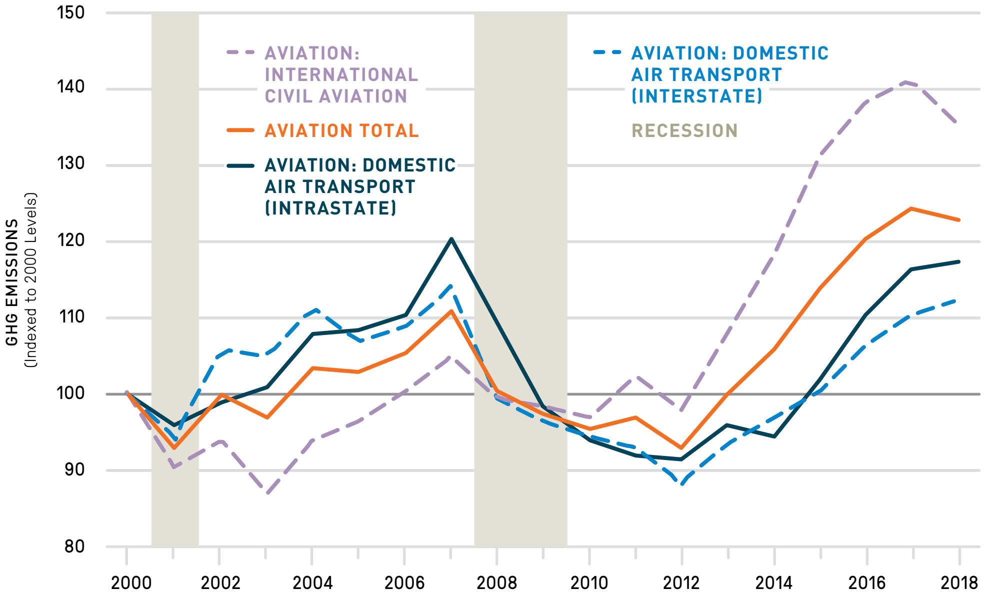
OPPORTUNITIES:

❶ California has a long way to go in terms of incentivizing people to use alternative modes of transportation to driving. Accelerating the electrification of passenger vehicles and light-duty trucks and SUVs would reduce GHG emissions from light-duty vehicles significantly, but requires a relatively long time horizon to deliver meaningful GHG reductions. In the meantime, it is imperative that the state maintains its high fuel economy standards in order to drive emissions reductions in this sector.

❷ The COVID-19 pandemic has upended many aspects of people's lives—from commuting to socializing to other activities. The pandemic has accelerated remote working, while bicycling as a form of transportation has surged.[10] Therefore, it can be reasonably expected that California's GHG emissions from transportation will decline in 2020. Even after the pandemic is over, remote work is expected to remain significantly higher than pre-pandemic levels. While maintaining the new, lower level of GHG emissions from transportation would be welcome news for the state, emissions tend to rebound to some extent after a recession ends. Whether this new normal can be sustained is yet to be seen, but some regions in the state are hoping to encourage reduced or cleaner commutes in the future. For example, as part of their regional plan through 2050, the Bay Area initially approved a proposal to mandate that employers keep 60 percent of their employees home for work each day by 2050, though this was later amended to instead require businesses with more than 50 employees to limit the number of employees who drive to work to 40 percent by 2035.[11]

Figure 12. Transportation: Aviation Subsector-Related GHG Emissions

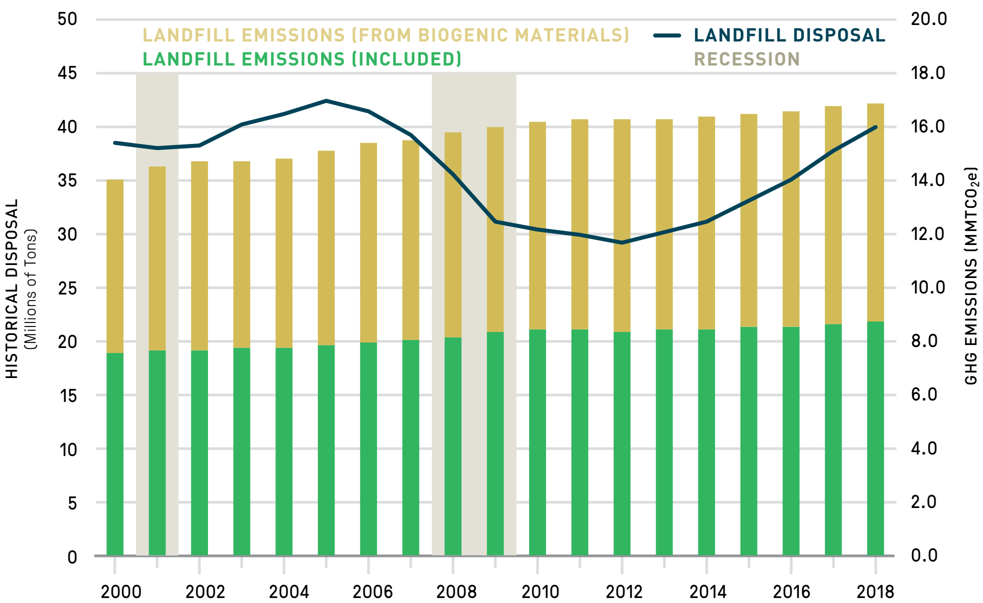
CALIFORNIA, INDEXED TO 2000 LEVELS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Dashed lines denote emission items not part of the included emissions inventory. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity. NEXT 10 / SF · CA · USA

Figure 13. Landfill Emissions and Waste Disposed in Landfill

CALIFORNIA, 2000–2018



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Disposal includes total landfilled in state and total exported tons reported at the time but does not include transformation. Data Source: CalRecycle and CARB. NEXT 10 / SF · CA · USA

HIGHLIGHT:

After years of increasing, emissions from aviation dropped 1.2 percent in 2018. Emissions from these subsectors are well correlated with the economy overall; the only periods when they declined were during the 2001 recession and the 2007–08 Great Recession. GHG emissions from international flights (not included in the emissions inventory)[12] declined 4.3 percent year-over-year while emissions from domestic intrastate flights (+1.0%) and domestic interstate flights (+1.9%) increased from 2017 to 2018.

OPPORTUNITY:

Emissions from aviation are likely to decline significantly in 2020 due to the pandemic, but it remains unclear to what extent such trends may persist.

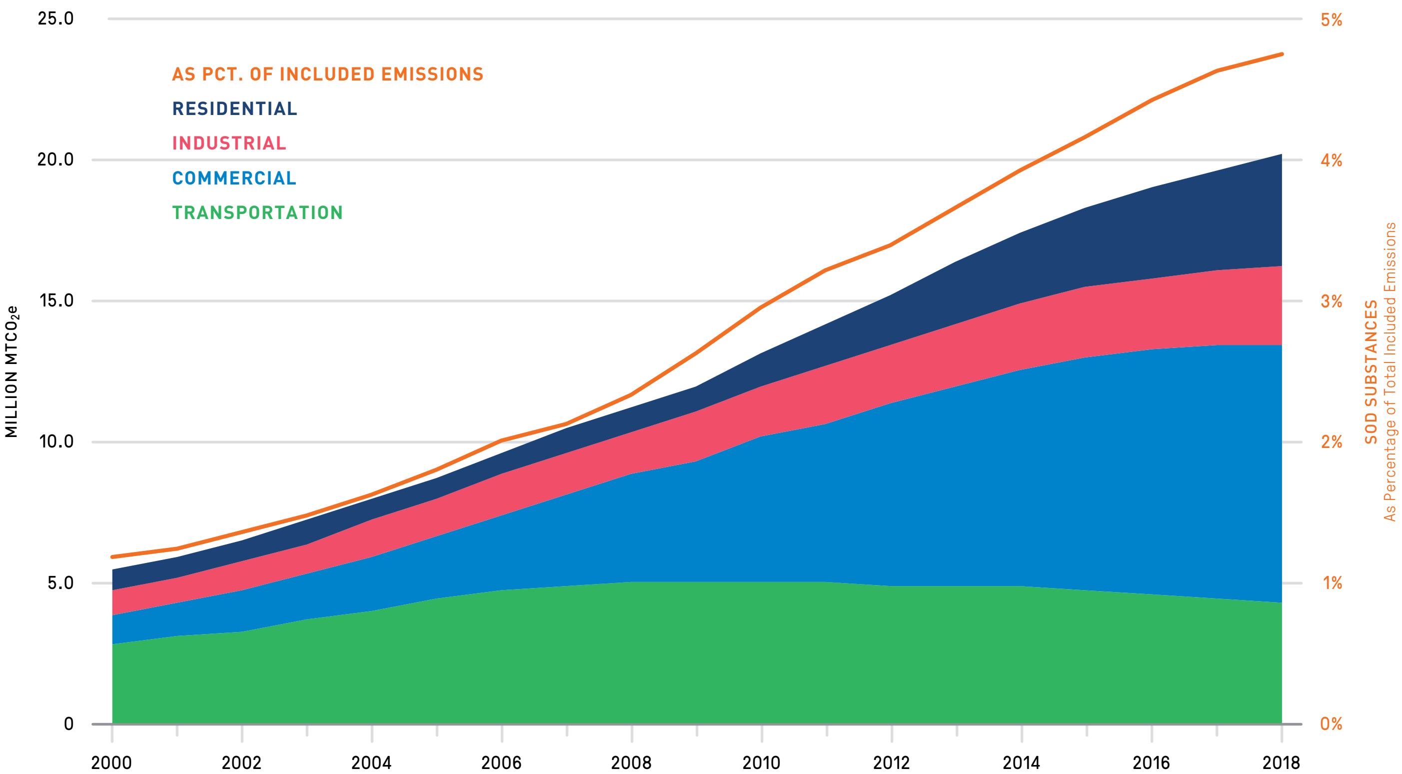
CHALLENGES:

❶ Californians exported or sent to landfills 37.8 million tons of waste in 2018, up 5.6 percent compared to 2017. As the economy continues to grow, people consume more and solid waste generation generally increases. The increase in landfill disposal has also outpaced population growth in recent years. In 2018, 5.54 pounds of waste per capita was sent to a landfill every day, up 5.3 percent compared to 2017. Although the per capita amount in 2018 is less than the amounts recorded during the early- to mid-2000s, the rate of increase has hovered around about five percent each year since 2015.[13]

❷ As landfills are burdened with an increasing amount of waste, landfill emissions have gone up almost every year. From 2007 to 2017, emissions from landfills have increased by 1.0 percent every year on average.

Figure 14. Use of Substitutes for Ozone-Depleting Substances by Sector

CALIFORNIA, 2000–2018



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

CHALLENGE:

Emissions from the use of Substitutes for Ozone-Depleting Substances (substitutes for ODS),[14] which emit high global warming potential (GWP) gases such as hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), are the fastest-growing source of GHG emissions in California—especially within the Commercial sector. In 2018, GHG emissions from substitutes for ODS from all economic sectors accounted for 4.7 percent of total included statewide emissions, a considerably larger share compared to 2008 (2.3%) and 2000 (1.2%). Worldwide, emissions of high GWP gases from substitutes for ODS are rising, as they are used for purposes such as refrigeration and air conditioning.[15] A global environmental treaty may have played a role in this trend: the 1987 Montreal Protocol aimed to protect the Earth's ozone layer by phasing out Ozone-Depleting Substances, but increased utilization of substitutes for ODS have resulted in an unintentional growth in GHG emissions.[16]

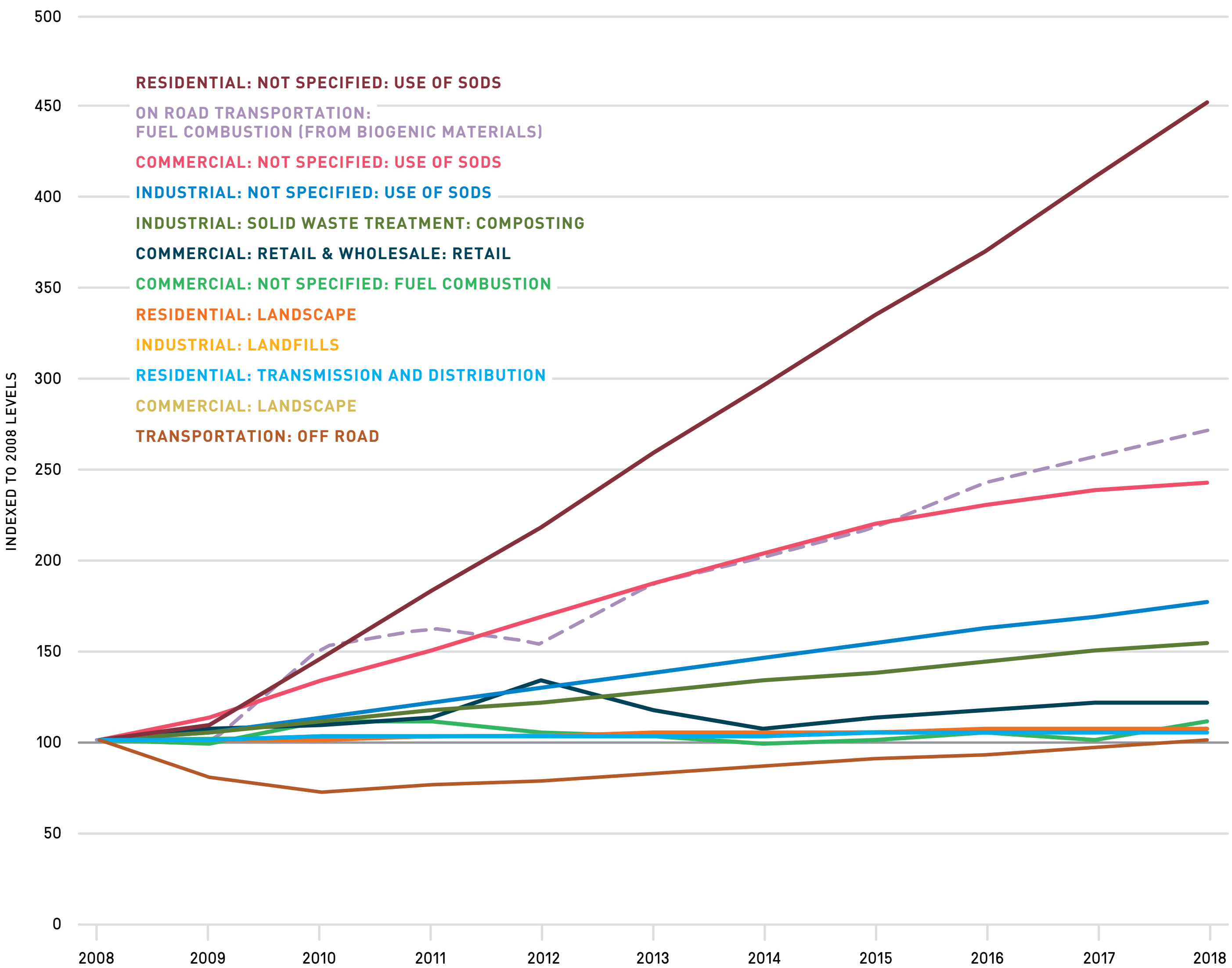
OPPORTUNITY:

For the Commercial and Industrial sectors, emissions from substitutes for ODS are associated with aerosols, fire protection, foams, solvents, and refrigeration and air conditioning activities. But activities associated with refrigeration and air conditioning alone accounted for the majority of the increase in GHG emissions from substitutes of ODS. In 2018, GHG emissions from refrigeration and air conditioning activities in the Commercial and Industrial sectors were 10.92 $MMTCO_2e$—up 1.2 percent from 2017 and 122.8 percent from 2008. The Residential sector saw emissions increase 10.7 percent compared to 2017 and 1,114.5 percent compared to 2008. Internationally, there have been efforts to address this emissions problem (via the Kigali Amendment to the Montreal Protocol, which entered into force in January 2019) by creating market certainty to allow for growth of more environmentally friendly alternatives.

The U.S. has not yet ratified that agreement, but President-Elect Biden has indicated plans to do so. And at the state level, California has implemented a number of programs and policies to help transition away from these "super pollutant" refrigerants—including a recently announced rule that will require all new facilities to use refrigerants that can reduce their emissions by up to 90 percent beginning in 2022. While the California Air Resources Board had recently warned that the state may not be able to meet its 40 percent below 2013 levels reduction goal for these substances by 2030, this new rule could go a significant way in reducing emissions from refrigeration and commercial sector emissions overall.

Figure 15. Subsectors with Increasing GHG Emissions Over Time

INDEXED TO 2008 LEVELS

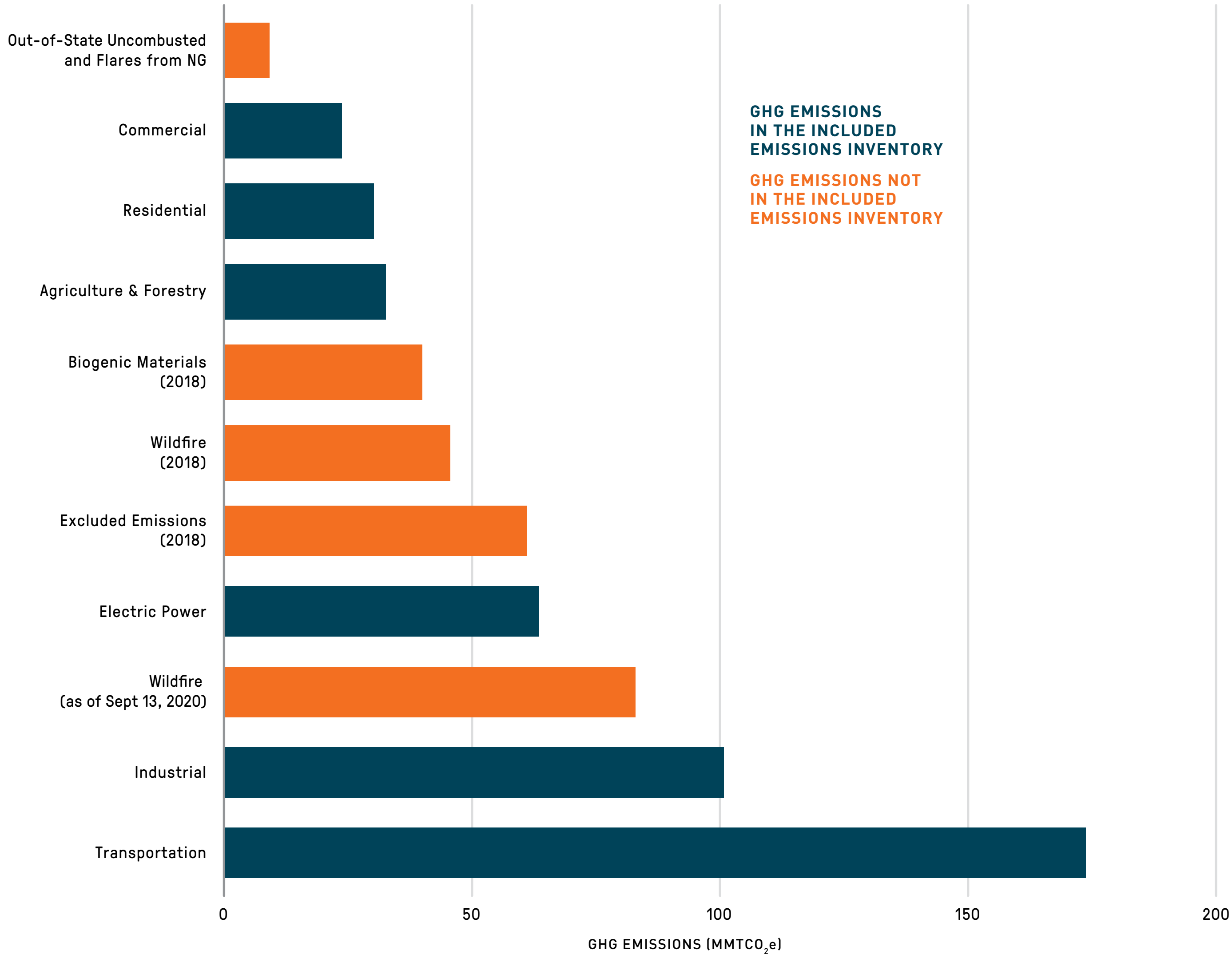


NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Dashed line denotes emission items not part of the included emissions inventory; SODS = substitutes for ozone depletion substances, which emit hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ The state has made tremendous progress reducing its GHG emissions, but there are a few subsectors and activities where GHG emissions have generally risen. In addition to the use of substitutes for ODS and landfills, GHG emissions associated with landscaping (the use of nitrogen fertilizer on turf) from the Commercial and Residential sectors have risen gradually. From 2008 to 2018, GHG emissions were up 8.1 percent for both Commercial and Residential sectors and were in line with population growth, which increased by 7.9 percent during the same period. ❷ While GHG emissions from fuel combustion of biogenic materials (including biofuels and other biogenic energy sources) for on-road transportation were up 171 percent in 2018 compared to 2008, this is not necessarily bad as emissions from biogenic materials do not permanently and irreversibly increase atmospheric concentration of greenhouse gases. Specifically, these emissions, which are not part of the included emissions inventory, result from combustion of biodiesel, ethanol, and renewable diesel. While these fuel sources do result in some emissions of greenhouse gases, it would be an improvement if these fuels could displace the combustion of gasoline.

Figure 16. GHG Emissions Not in the Included Emissions Inventory Comparison



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GHG Emission estimates for all items are expressed as MMTCO$_2$e under 100-year global warming potential time horizon, except for wildfire estimates. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector (for Included, Excluded, and Biogenic Materials GHG Emissions); California Air Resources Board (for 2018 Wildfire GHG Emission Estimates and GHG Out-of-state emission estimates from releases of uncombusted gas and flaring associated with natural gas consumed in California, pursuant to AB 2195); the European Centre for Medium-Range Weather Forecasts (for 2020 Wildfire GHG Emission Estimates). NEXT 10 / SF · CA · USA

HIGHLIGHT:

Assembly Bill 2195, enacted in 2018, requires the California Air Resources Board to "quantify and publish annually the amount of greenhouse gas emissions resulting from the loss or release of uncombusted natural gas to the atmosphere and emissions from natural gas flares during all processes associated with the production, processing, and transporting of natural gas imported into the state from out-of-state sources," beginning January 1, 2020.[17] The amount for 2018 is estimated to be 9.4 MMTCO$_2$e,[18] or 2.2 percent of the state's included emissions. Emissions from biogenic materials totaled 40.4 MMTCO$_2$e in 2018, or slightly more than the emissions from the Agriculture & Forestry sector (32.6 MMTCO$_2$e) within the included emissions inventory.

CHALLENGE:

Emissions stemming from wildfires are producing more GHGs than ever. From the start of 2020 through September 13, 2020, emissions from wildfires in California reached 83 MMTCO$_2$e, or 82.4 percent above the 45.5 MMTCO$_2$e recorded emissions from wildfires in all of 2018. This also represents slightly fewer emissions than the Agriculture & Forestry, Commercial, and Residential sectors combined (87.0 MMTCO$_2$e). However, the wildfire season is not yet over, and emissions from wildfires in 2020 are expected to increase still.

FEATURE:

COVID-19 and Clean Economy Recovery

As California nears the one-year mark since the onset of the novel coronavirus (COVID-19) pandemic, policymakers continue to grapple with how to effectively mitigate the public health crisis while also seeking ways to stimulate an economy still in the midst of a protracted shutdown. The pandemic has also forced Californians to view the intersection between the state's environment and economy in a new light. In the weeks immediately following Governor Newsom's stay-at-home order, there were numerous accounts of how decreased economic activity contributed to as much as a 40 percent reduction in air pollution in some areas, largely due to an 80 percent drop in traffic statewide.[19, 20, 21, 22] As certain sectors of the economy have come back online, such an improvement in air quality has not been sustained, but residents were able to catch a glimpse of what a cleaner California may look like as the state continues to work towards reducing pollution and meeting its climate goals.

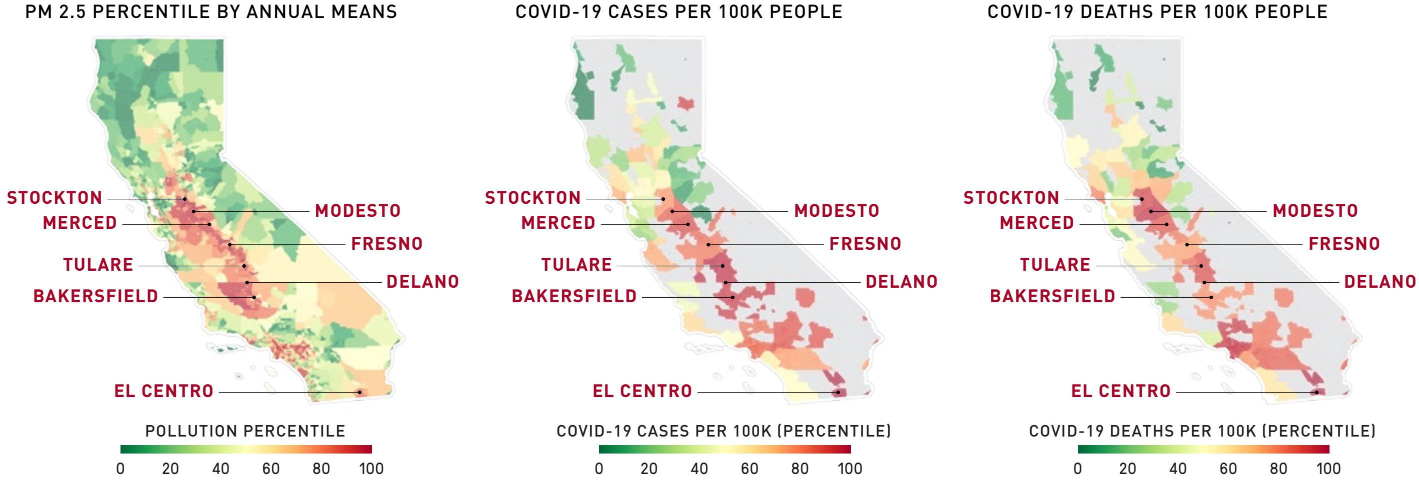
The pandemic has also revealed how communities chronically exposed to high air pollution levels are also the ones most vulnerable to more serious health issues. Recent studies have found that not only are residents in these areas more at risk for contracting COVID-19, they are also less likely to survive once infected.[23, 24] Although air pollution is one of many risk factors for COVID-19, it is clear that a cleaner California will be a key determinant for improving the health of communities and reducing comorbidities—as well as associated economic costs.

Health care costs in California associated with treating COVID-19 patients—at least those who are able to access care[25]—are estimated to be as high as $2.4 billion (based on a prevalence rate of 5 percent), placing a further strain on the state's revised 2020–21 budget. Investing in better air quality is not just a concern for environmental equity, but an economic consideration as well. As one recent study notes, California may be able to save as many as 14,000 lives and net $109 billion annually if it were to reach net-zero greenhouse gas (GHG) emissions by 2050.[26]

California has been a global leader in advancing solutions to the climate crisis, driving the nation toward a clean energy economy and future. As the state looks to meet the next climate goals and reinvest in the economy to recover from this pandemic-induced recession, it is critical that it rebuilds with the future clean energy economy in mind. Although a number of initiatives addressing GHG emission reductions were shelved in the wake of the COVID-19 outbreak, investing in a clean energy stimulus now can play an instrumental role jumpstarting California's economy in the short- to medium-term. And not only would such an investment help restore many of the nearly 20,000 "green jobs" lost at the recession's nadir in March, 2020,[27] but it could also serve as the first step towards a reimagined future rather than simply the next step in a recovery to the pre-pandemic status quo.

California has a proven track record of reducing emissions while growing the economy. As the state works on economic recovery in the months and years ahead, focusing investment on key emissions areas can help deliver both economic and environmental benefits while improving the health of the state. This chapter provides an overview both of the scale of the COVID-19 challenge in California, as well as the scale of benefits that can be delivered through clean energy economy investments.

Figure 17. Prevalence of Air Pollution, COVID-19 Cases, and COVID-19 Deaths in California Counties

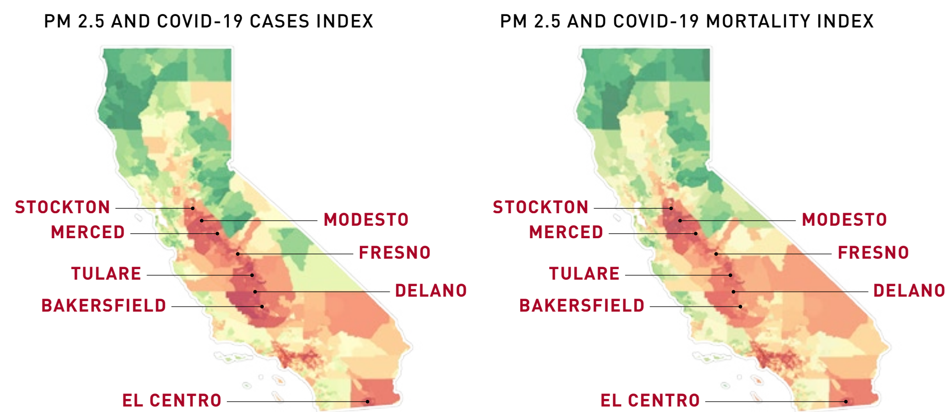


NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: CalEnviroScreen 3.0 (2018 data), New York Times (COVID-19 cases and deaths through November 3, 2020). NEXT 10 / SF · CA · USA

HIGHLIGHT:

Of the U.S. metropolitan areas deemed most polluted by the American Lung Association, the top four are located in California (Bakersfield, Fresno–Madera–Hanford, Visalia, and Los Angeles–Long Beach, respectively) with 10 of the nation's top 25 most at-risk counties in terms of pollution located in the state.[28] The California counties that had the highest average annual PM 2.5 levels tended to be in the Central Valley and pockets of Southern California. Not coincidentally, these same regions have also seen the highest rates of COVID-19 cases, led by Imperial County (7,558 cases per 100,000 people through November 3, 2020), Kings (5,955), Tulare (3,992), Kern (3,979), and Merced (3,387). Imperial also had by far the highest number of COVID-19 deaths (188 per 100,000 people); by comparison, Stanislaus had a COVID-19 mortality rate of 74 per 100,000 people and Los Angeles had 72.

Figure 18. Composite Pollution/COVID-19 Vulnerability Index, California



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: CalEnviroScreen 3.0 (2018 data), New York Times (COVID-19 cases and deaths through November 3, 2020). NEXT 10 / SF · CA · USA

CHALLENGE:

There are a variety of socioeconomic factors—in addition to air quality—that make certain communities more vulnerable than others to COVID-19, yet the link between the prevalence of air pollution and poor health outcomes in California is apparent. Over 15 percent of Imperial's population suffers from asthma,[29] compared to less than 10 percent for the state,[30] which is largely attributed to agricultural burning, airborne toxins from the Salton Sea, and idling traffic at the U.S.-Mexico border (in the case of El Centro). The situation in the San Joaquin Valley is even more dire, where lifetime asthma prevalence rates among the populations in Kings, Kern, and Stanislaus counties have been as high as 26 percent, 23 percent, and 18 percent, respectively.[31] Funding efforts to mitigate these risks can be challenging—even in the absence of a recession. Despite concerted efforts to improve air quality during the most recent economic expansion, Los Angeles remains one of the "dirtiest" cities in the nation due to transportation and industrial production pollution.[32]

The Economic Benefits of Green Investment

California has historically relied on the Greenhouse Gas Reduction Fund (GGRF) to make investments in climate change and pollution reduction efforts through the California Climate Investment program.[33] The GGRF, since its inception in 2013, has contributed over $3.5 billion to projects benefiting priority populations and disadvantaged communities;[34] during Fiscal Year (FY) 2019–2020 alone, the GGRF was able to invest over $1.5 billion into 27,983 projects that yielded 6,626 new jobs in California.[35] Due in part to the pandemic and resulting economic shutdown, cap-and-trade auctions have not raised sufficient funds to provide the same level of support in FY 2020–21. Indeed, the auctions were never intended to be reliable long-term funding streams for climate resilience programs, and the impact of COVID-19 has only emphasized the importance of diversifying revenue sources.

What the state needs now is a greater commitment to increased, sustained funding for initiatives that do not just mitigate GHG emissions but also support emerging industries and job growth. As the cases in this section show, clean energy economy spending is in fact economy-wide stimulus spending.[36] If targeted towards specific emissions challenges and opportunities—such as moving towards cleaner transportation and fewer vehicle miles traveled (VMT), investing in working lands, and extending building energy-efficiency initiatives into vulnerable communities—California can provide an immediate boost to the economy while continuing to reduce GHG emissions and air pollution.

METHODOLOGY

To conduct the economic impact analysis, IMPLAN software was utilized with 2018 data for local, regional, and statewide analyses to assess the employment, labor income, and economic output gains of a given project. IMPLAN contains an input-output model that measures the inter-industry relationships within an economy. Input-output analysis is a means of measuring the market transactions among businesses and between businesses and consumers as well as the ripple effects of an initial impact of a given project to downstream industries. These ripple effects are known as multipliers. The overall multipliers are based on direct, indirect, and induced effects:

- The **direct effect** is the initial impact: a spending or employment change in directly affected industries. In this particular analysis, the direct impacts are both the direct costs of complying with cap and trade as well as the investment of cap-and-trade auction proceeds.
- **Indirect effects** are the supply chain effects of the activities undertaken by the directly affected industries. Indirect effects measure the jobs and economic activities of industries that supply goods and services directly to the affected industries. The indirect effects capture increases and decreases in demand for supplies, like construction materials, caused by the initial impact.
- **Induced effects** are the outer ripples resulting from changes in the income and spending of employees and proprietors of industries directly affected by the policy. These changes in spending re-circulate in the economy affecting industries that are not directly involved in the cap-and-trade program (such as retail, services, and restaurants, etc.). These effects are measured over the time period needed for all of the ripples to work through the regional economy.

Table 1. Impacts of BlueLA Expansion Project in City of Los Angeles, 2017–22

GGRF AND MATCHING FUNDS

IMPACT	EMPLOYMENT	LABOR INCOME (THOUSANDS)	ECONOMIC OUTPUT (THOUSANDS)	STATE AND LOCAL TAX REVENUE (THOUSANDS)
DIRECT	99	$6,460.18	$23,128.86	$1,479.03
INDIRECT	7	$533.98	$1,392.90	$85.08
INDUCED	2	$115.20	$333.93	$21.39
TOTAL	**108**	**$7,109.36**	**$24,855.69**	**$1,585.50**

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: City of Los Angeles application for GGRF funding for the Los Angeles EV Carsharing Serving Disadvantaged Communities: Phase 2. Retrieved from: https://clkrep.lacity.org/onlinedocs/2019/19-0131_rpt_DOT_02-08-2019.pdf. NEXT 10 / SF · CA · USA

HIGHLIGHT:

In an effort to reduce its GHG emissions and improve local air quality, the City of Los Angeles has instituted a number of transportation projects in recent years to reduce single passenger vehicles and VMT. The BlueLA carshare program aims to reduce GHG emissions by extending access to electric vehicles (through carshares, vanpools, and shuttle services) in disadvantaged communities most affected by pollutants—airborne and otherwise. During the FY 2014–15, the City of Los Angeles received $1.7 million in GGRF funding for a zero-emission carshare pilot project to operate in four such communities. An additional $3 million was awarded during FY 2017–2018 to expand the program by an additional 300 EV charge points, 200 new EVs, and at least 600 electric bicycles and/or scooters. The $3 million grant was matched by an additional $20.1 million in funding from other sources (including cash and in-kind matching by the applicant, the City of Los Angeles Department of Transportation; investments by Blue Solutions/BlueLA; and in-kind contributions by community organizations) for a total of $23.1 million in project funding. By 2022, the BlueLA expansion project is expected to generate $7.1 million in labor income, $24.9 million in economic output, $1.6 million in state and local tax revenue, and support 108 jobs in the City of Los Angeles.

Table 2. Impacts of Our Community Carshare Sacramento Pilot Project, 2016–20

GGRF AND MATCHING FUNDS

IMPACT	EMPLOYMENT	LABOR INCOME (THOUSANDS)	ECONOMIC OUTPUT (THOUSANDS)	STATE AND LOCAL TAX REVENUE (THOUSANDS)
DIRECT	15	$995.83	$4,150.61	$350.15
INDIRECT	7	$425.57	$1,134.45	$76.84
INDUCED	6	$344.30	$1,040.87	$77.00
TOTAL	**28**	**$1,765.70**	**$6,325.93**	**$503.99**

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source:Detailed budget information could not be located. Given the similarities between this project and the BlueLA project, the same methodology (i.e. input shares) is applied here to estimate employment, income, output, and tax revenue. Data retrieved from: https://ww3.arb.ca.gov/msprog/lct/pdfs/ourcommunity.pdf
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HIGHLIGHT:

In Sacramento, the Our Community Carshare program provides residents in select low-income housing communities with limited mobility options free access to electric vehicles. In 2017, the GGRF awarded $4.4 million to the Sacramento Metropolitan Air Quality Management District to launch Phase 3 of the Community CarShare Sacramento Pilot Project for electric car/bike sharing services (among other transit-oriented services) in disadvantaged communities. The project received an additional $1.5 million in matching funds (mostly in the form of in-kind services from housing agencies and other grant programs such as the Carl Moyer Memorial Air Protection Program),[37] for a total of $5.8 million in project funding. The total $5.8 million in funding for the Our Community CarShare project will generate $1.8 million in labor income, $6.3 million in output, $503,990 in state and local tax revenue, and support 28 jobs in the Sacramento metropolitan area.

Table 3. Impacts of California Energy Commission Electric Vehicle Charging Infrastructure in California, FY 2020–21

IMPACT	EMPLOYMENT	LABOR INCOME (MILLIONS)	ECONOMIC OUTPUT (MILLIONS)	STATE AND LOCAL TAX REVENUE (MILLIONS)
DIRECT	246	$18.95	$51.00	$1.24
INDIRECT	79	$6.32	$19.29	$1.29
INDUCED	121	$7.47	$22.12	$1.47
TOTAL	**447**	**$32.74**	**$92.43**	**$4.01**

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Source: Budget Change Proposal: One-Time Expenditure Authority for Unspent ARFVTF Funds. California Department of Finance. Fiscal Year 2020–21. Retrieved from: https://esd.dof.ca.gov/Documents/bcp/2021/FY2021_ORG3360_BCP3787.pdf. NEXT 10 / SF · CA · USA

OPPORTUNITY:

Expanding EV infrastructure is critical to helping increase clean vehicle adoption across the state. While the state has a goal of getting 1.5 million zero-emission vehicles on the road by 2025, there is currently a 81,000 shortfall in the number of charging stations to meet the demand of those vehicles.[38] Prior to the COVID-19 outbreak, the California Energy Commission awarded a one-time $51 million payment (and up to $200 million over time) to the California Electric Vehicle Infrastructure Project (CALeVIP) to fund four large-scale EV charging infrastructure projects in Northern California (Humboldt, Shasta, and Tehama counties), Sacramento County, Fresno County, and Southern California (Los Angeles, Orange, Riverside, and San Bernardino counties).[39] These projects are projected to add nearly 3,900 EV charging stations, the construction of which would support 447 jobs, and generate $32.7 million in labor income, $92.4 million in economic output, and $4.1 million in state and local tax revenue.

WORKING LANDS

Table 4. Impacts of Sustainable Agricultural Lands Conservation Program (SALC) in California, 2018–19

GGRF AND MATCHING FUNDS

IMPACT	EMPLOYMENT	LABOR INCOME (THOUSANDS)	ECONOMIC OUTPUT (THOUSANDS)	STATE AND LOCAL TAX REVENUE (THOUSANDS)
DIRECT	16	$1,318.25	$2,292.12	$79.91
INDIRECT	5	$349.17	$895.39	$37.43
INDUCED	493	$29,998.24	$90,798.88	$6,041.80
TOTAL	**514**	**$31,665.66**	**$93,986.39**	**$6,159.15**

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Most of the impacts are generated through the induced effect. This is because easement grants compensate landowners for the development rights to their lands, which leads to additional spending by landowners on various goods and services. Data Source: SALC Planning and Easement Grants Awarded FY 2018–19 Funding. Retrieved from: https://www.conservation.ca.gov/dlrp/grant-programs/SALCP/Documents/FY%202018-19%20Awarded%20Projects%20List.pdf. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Natural and working lands offer a valuable solution to helping reduce GHG emissions through improved land use decisions and conservation—while providing the added benefit of reducing greater risks from climate impacts like flooding and wildfires. The Sustainable Agricultural Lands Conservation (SALC) Program aims to reduce GHG emissions by protecting agricultural lands against conversion to more GHG-intensive uses through conservation easement and planning grants. By providing annual incentives to discourage sprawl through denser development and preserving working lands, the program helps to avoid GHG emissions by minimizing VMT and also reduces emissions currently in the atmosphere by improving the land's ability to naturally capture and store carbon. In FY 2018–19, SALC easement grants funded by the GGRF totaled $55.5 million,[40] with an additional $13.9 million in matching funds from other sources (including the landowners themselves, land trusts, and Federal agencies such as the USDA's Natural Resources Conservation Services). In FY 2018–19, planning grants totaled $1.4 million, with 50 percent of total spending occurring in the Central Valley. The total $70.8 million in SALC funding is expected to generate $31.7 million in labor income, $94.0 million in output, $6.2 million in state and local tax revenue, and support 514 jobs in California.[41]

ENERGY EFFICIENCY

Table 5. Impacts of the Low-Income Weatherization Program (LIWP) Multi-Family Energy Efficiency and Renewables Component in California, 2018–19

GGRF AND MATCHING FUNDS

IMPACT	EMPLOYMENT	LABOR INCOME (THOUSANDS)	ECONOMIC OUTPUT (THOUSANDS)	STATE AND LOCAL TAX REVENUE (THOUSANDS)
DIRECT	58	$4,996.58	$11,448.00	$300.66
INDIRECT	25	$1,880.79	$5,360.99	$328.65
INDUCED	34	$2,044.48	$6,054.32	$404.45
TOTAL	**116**	**$8,921.85**	**$22,863.31**	**$1,033.76**

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Annual Report to the Legislature on Climate Investments Using Cap-and-Trade Auction Proceeds. (2020, March) California Climate Investments. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/classic/cc/capandtrade/auctionproceeds/2020_cci_annual_report.pdf. NEXT 10 / SF · CA · USA

HIGHLIGHT:

While the state has ambitious goals to transition to 100 percent clean energy and around 40 cities and counties have mandated that new buildings transition away from natural gas entirely, the vast majority of Californians will continue to live in existing building stock for years to come. Programs designed to improve the efficiency of existing building stock help deliver critical emissions reductions to minimize the building sector's contributions to statewide emissions. The Low-Income Weatherization Program (LIWP) provides low-income households (located in either multi-family, community, or farmworker housing) with energy efficiency upgrades and solar photovoltaic systems to help reduce residential GHG emissions. The Multi-Family Energy Efficiency and Renewables Program is a component of LIWP which serves multi-family households throughout California. In 2019, the GGRF awarded $9.6 million to support LIWP's Multi-Family Energy Efficiency and Renewables Program,[42] with an additional $1.8 million in matching funds from community partner organizations.[43] The total $11.4 million in funding for the Multi-Family Energy Efficiency and Renewables Program is expected to generate $8.9 million in labor income, $22.9 million in output, $1.0 million in state and local tax revenue, and support 116 jobs in California.

Investing in California's Clean Energy Economy

Although the California Climate Investments program continues to administer GGRF funding to climate resiliency projects, relying solely on cap-and-trade revenue is unsustainable in the long-run and an insufficient source of short-term stimulus funding given budget shortfalls in 2020. Therefore, it is important for California to pursue broader green stimulus opportunities to foster employment, income, and output growth. Policymakers should promote and embrace the opportunities listed here and make every attempt to move towards implementation in the coming months.

OPPORTUNITY:

Governor Newsom issued two landmark executive orders in September and October that aim to make up for climate spending cuts in the 2020–21 revised budget. Executive Order N-79-20 requires 100 percent of new passenger vehicle sales in the state to be zero emission by 2035. California will also fostering the expansion of EV charging infrastructure across the state,[44] which will be implemented by the California Energy Commission through a three-year $384 million investment plan.[45] Executive Order N-82-20 seeks to conserve 30 percent of the state's lands and coastal waters and create a natural and working lands climate strategy,[46] which in turn will likely require the expansion of current sustainable agriculture programs.

OPPORTUNITY:

Public-private collaborations may offer an alternative path to GHG reduction funding. The Transportation Electrification Partnership in Los Angeles—which includes the Mayor's Office, Southern California Edison, the Los Angeles Department of Water and Power, and the Los Angeles Cleantech Incubator—proposed a $185 billion plan to the U.S. Congress that would build upon existing local initiatives aimed at mitigating emissions.[49] Proposed aid would contribute to the manufacturing, assembly, and adoption of EVs ($25 billion), zero-emission infrastructure projects ($85 billion), public transit and reductions in vehicle miles traveled ($25 billion), workforce development and training ($12.5 billion), and the fostering of innovation ecosystems and small businesses ($2.5 billion).

OPPORTUNITY:

In 2019, Governor Newsom proposed creating a $1 billion Climate Catalyst Revolving Loan Fund, with an initial $250 million deposit in FY 2020–21, which would offer "low-interest lending to small businesses and organizations that have green ideas but may not be established or connected enough to compete for venture capital funding."[47] Although the California Assembly passed AB 78[48] in June, which calls for the establishment of the fund, it is unclear how soon or how quickly loans will be processed, or when funds would be made available given current budget deficits as a result of the pandemic and recession.

OPPORTUNITY:

Led by Los Angeles environmental organization MoveLA and Bay Area urban planning organization SPUR, the California Climate and Clean Air Initiative is considering calling for a 2022 statewide ballot measure that would, if approved, impose a statewide half-cent sales tax increase to help fund ongoing climate investments throughout California. Based on a similar initiative that had been under development in the LA region, this statewide effort could provide a significant source of revenue for climate investments—up to $140 billion over 30 years, based on the initiative's estimates.[50]

CHALLENGES

The vast majority[51] of climate resilience-oriented bills failed to pass this year due to budget cuts, but as the economy improves in the coming months, policymakers could continue pushing for some of the following initiatives:

- **AB 326:** This bill would have created a new electric mobility manufacturer vehicle membership program that would allow electric vehicle manufacturers to offer vehicles directly to customers on a month-to-month basis through a membership or subscription model.[52]
- **AB 1071:** This bill would have created an Agricultural Climate Adaptation Tools Program (ACATP) grant program to help the agricultural sector adapt to climate change.[53]
- **AB 2954:** This bill would have required the Air Resources Board (ARB) to set—as part of the next Scoping Plan Update—an overall climate goal for the state's natural and working lands, which would support the state's efforts to achieve carbon neutrality and climate resilience.[54]
- **AB 3030:** This bill would have set new land, water, and ocean protection goals for California, including to conserve at least 30 percent of the state's land areas and water by 2030.[55, 56]
- **AB 2789:** This bill would have appropriated $1.5 million to require the CPUC, in consultation with the CEC, to request that the California Council on Science and Technology (CCST) undertake and complete a study relative to electrical grid outages and cost avoidance resulting from deployment of eligible renewable energy resources, battery storage systems, and demand response technologies.[57]
- **AB 3021:** This bill would have appropriated $300 million from the General Fund per fiscal year in the 2020–21, 2021–22, and 2022–23 to the CEC to administer a program to provide resiliency grant funding and technical assistance to local educational agencies and school districts for the installation of energy storage systems.[58]
- **SB 1323:** This bill would have created the California Carbon Sequestration and Climate Resilience Project Registry, in order to maintain a list of unfunded but eligible projects, many of which would likely involve natural and working lands.[59]
- **SB 1363:** This bill would have required regions around the state, in conjunction with the ARB, to set a VMT reduction target—in addition to the GHG reduction target—for 2035, 2040, and 2050 by the end of 2022.[60]
- **AB 1942:** This bill would have appropriated $330 million for the 2021–22 fiscal year from the GGRF for healthy forest and fire prevention programs.[61]
- **SB 1329:** This bill would have allowed an individual to specify on their tax returns that a specified amount in excess of their personal tax liability be transferred to the Climate Innovation Voluntary Contribution Account, a new account that would award grants for the development and research of new innovations that either reduce GHG emissions or address the impacts caused by climate change.[62]

California Policy Timeline

California has long been a leader in innovative energy and climate policies—from the creation of the Los Angeles Air Pollution Control District in 1947 to the passage of the state's landmark Global Warming Solutions Act (AB 32) in 2006 and the 2018 commitment to transition to 100 percent clean energy sources by 2045 (SB 100). The state has led the way as an early adopter of a clean energy future, implementing policies to reduce pollution, improve energy efficiency, and incentivize clean energy and clean technology innovation that have been replicated in both other states and nations. To meet its climate goals moving forward, California will need to build upon this foundation with policies that tackle harder-to-reach emissions reductions, including those from the transportation sector and buildings.

While the events of this year—including the COVID-19 pandemic and another unprecedented wildfire season—have taken center stage in terms of policy priorities, these challenges have also created a new sense of urgency around environmental policy. As the world has been forced to understand and address the links between public health, the environment, and the economy, there has been a marked increase in commitment to address climate change. The current federal administration worked to roll back the nation's climate progress, but the incoming administration has made clear its intention to prioritize global cooperation and accelerate the transition to a sustainable clean energy economy. As California and the nation look ahead to prospects for policies that help strengthen our economy while protecting our environment, it is worth highlighting how far the state has come. 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.

- Air & Environment
- Energy Efficiency
- Clean Transportation
- Renewable Energy
- Climate

★ 1st in U.S.
U.S.: United States Policy

1947

★ Los Angeles Air Pollution Control District created

1963

- **U.S.:** Clean Air Act

1967

★ California Air Resources Board established

1970

- **U.S.:** Environmental Protection Agency created by Presidential Executive Order

1974

- California Energy Commission created

1975

- **U.S.:** 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)

2002

- California passes the state's first Renewable Portfolio Standard (RPS), requiring 20% of total electricity procured from renewables by 2017 (SB 1078)

2005

- Governor Schwarzenegger's Executive Order set greenhouse gas emission reduction targets (S-3-05)

2006

★ California Global Warming Solutions Act of 2006 (AB 32)

2007

- Governor Schwarzenegger establishes Low Carbon Fuel Standard regulations to reduce carbon intensity of transportation fuel 10% by 2020 (S-01-07)

2008

★ California passes the Sustainable Communities and Climate Protection Act (SB 375), targeting greenhouse gas emissions reductions from passenger vehicles through planning and land use strategy

2009

- **U.S.:** U.S. Environmental Protection Agency adopts more stringent tailpipe rules modeled after those of California

2011

- California increases the state's RPS to require at least 33% of electricity procured from renewable resources by 2020, the most ambitious standard in the country at the time (SB X1-2)
- **U.S.:** 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

2012

- California established the Greenhouse Gas Reduction Fund as a special fund to collect cap-and-trade auction revenues (SB 1018)
- California Air Resources Board conducts its first quarterly auction for emissions allowances in the cap-and-trade program as authorized by AB 32

Notable Policy Developments

SEPTEMBER 2019

- California—plus 22 other states, Washington D.C., and the cities of Los Angeles and New York—sue the U.S. Department of Transportation over the revocation of the state's waiver that allows California to set its own GHG and auto emissions requirements under the Clean Air Act
- California passes legislation requiring the Air Resources Board to adopt and implement regulations for a Heavy-Duty Vehicle Inspection and Maintenance program for non-gasoline, heavy-duty, on-road vehicles (SB 210)

OCTOBER 2019

- To support resiliency during a deenergizing event, a law is passed requiring the CPUC to allocate a certain percent of the self-generation incentive program (SGIP) funding to projects that install community energy storage systems and associated renewable energy resources in high fire threat communities (AB 1144)

MARCH 2020

- The Trump administration finalizes new fuel economy standards for passenger vehicles and light trucks, loosening the Obama-era requirements that manufacturers increase fuel economy between 2021 and 2026 in order to reduce emissions

JUNE 2020

- The California Air Resources Board adopts the Advanced Clean Trucks rule, the first statewide zero-emission commercial truck standard requiring that manufacturers sell an increasing percentage of zero-emission trucks in California from 2024 to 2035 and requiring 100% zero-emission truck sales in the state by 2045

AUGUST 2020

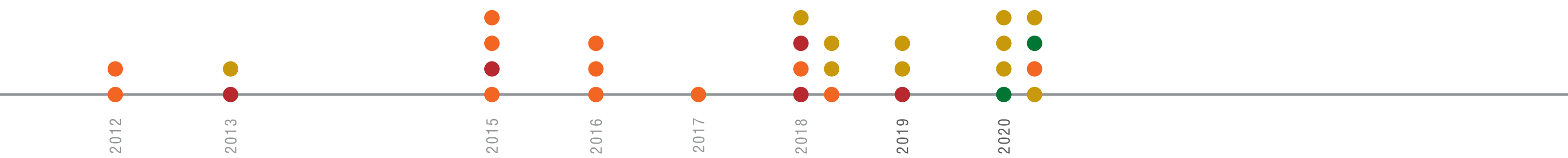
- The California Air Resources Board approves the Omnibus Low-NO_x Rule requiring NO_x emissions from heavy-duty trucks to be cut to approximately 75% below current standards beginning in 2024 and 90% below current standards in 2027

SEPTEMBER 2020

- California legislature passes bill directing the Governor's Office of Planning and Research (OPR) to complete a California-specific climate assessment no less frequently than every five years to assess the impacts and risks of climate change and identify potential solutions to inform policy (SB 1320)
- Governor Newsom signs an Executive Order (N-79-20) directing the California Air Resources Board to develop regulations to mandate that 100% of in-state sales of new passenger cars and trucks are zero-emission by 2035
- ★ Governor Newsom announces the creation of the California Climate Action Corps, the nation's first statewide corps dedicated supporting climate action projects

OCTOBER 2020

- ★ Governor Newsom issues a new Executive Order (N-82-20) committing to increase carbon sequestration in the state's natural and working lands, and establishing the first-in-the-nation goal to conserve 30 percent of the state's land and coastal water by 2030
- The California Energy Commission approves a $384 million plan for clean transportation investments to boost the adoption of zero-emission cars and trucks by closing the gaps in zero-emission fuels and infrastructure



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

2015

- 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 2ºC
- California passes a law to increase the RPS for renewable energy to 50% and double energy efficiency in buildings (SB 350)
- **U.S.:** 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 2ºC and implement programs to support that goal

2016

- **U.S.:** 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 (SB 32)
- ★ California develops a first-in-the-world policy to reduce harmful emissions of short-lived climate pollutants—which have the highest global warming potential of all GHGs—and establishes targets to significantly reduce their emissions by 2030 (SB 1383)

2017

- **U.S.:** The Trump administration announces its intention to withdraw from the Paris Climate Agreement

2018

- California updates its ZEV Action Plan goal from 1.5 million EVs on the road by 2025 to 5 million on the road by 2030
- ★ California approves mandate to require rooftop solar on all new homes under three stories as part of its 2019 update to Title 24 Building Energy Efficiency Standards
- CARB announces that the state has surpassed the 2020 emissions goal of 431 $MMTCO_2e$ four years ahead of schedule
- California passes a law increasing the RPS requirement from 50 percent by 2030 to 60 percent and setting a target to meet all of the state's retail electricity supply with a mix of RPS-eligible and zero-carbon resources by 2045 (SB 100)
- ★ The California Clean Miles Standard and Incentive Program is created to increase the use of zero-emission vehicles by ride-hailing companies, requiring GHG reduction targets to be set for such companies by ARB (SB 1014)
- California and a consortium of automanufacturers agree to a voluntary framework to ensure improved vehicle emissions standards through 2026 for light-duty cars and trucks—in line with goals set under the Obama administration, despite efforts from the Trump administration to freeze emission standards at 2020 levels through 2026
- The Wildfire Fund—to be jointly funded at $21 billion by electrical corporations and ratepayers—is authorized to address future damages from the increasing amount of wildfires in the state (AB 1054)

Transportation

Key Findings

Transportation makes up slightly more than **40 percent of the state's greenhouse-gas emissions and is by far the largest energy-consuming and greenhouse-gas-emitting sector** in California. While emissions from on-road passenger vehicles have ticked up continuously since 2013, emissions from the transportation sector decreased between 2017 and 2018.

The state faces many challenges in reducing emissions from the transportation sector—from increasing car ownership rates and declining public transit usage, to shifting consumer preferences away from more fuel-efficient sedans and compact cars to pickup trucks and SUVs. It remains to be seen whether or not these trends will be helped or hindered by changes to how Californians move around the state during or after the COVID-19 pandemic. Either way, at the current trajectory of transportation trends, **California is not on track to achieve the GHG emissions reduction targets for 2030 and beyond.**[63]

Transportation Emissions and Vehicle Ownership

- Greenhouse gas emissions from surface transportation in California totaled 154.4 $MMTCO_2e$ in 2018, a **1.3 percent reduction from 2017**–and the first reduction in these emissions since 2013.
- The total number of vehicles registered in California **increased 3.3 percent** to 32 million vehicles between 2017 and 2018–nearly triple the 1.2 percent increase between 2016 and 2017.
- By vehicle class, registrations for SUVs (+12.2%) and crossover utility vehicles (+9.1%) **increased the fastest year-over-year** while registration for cars/sedans fell 1.6 percent. In the fourth quarter of 2019, light-duty pickup trucks, mini-vans, and SUVs made up 61.8 percent of new vehicle registrations, up from 57.2 percent from one year ago and 40.1 percent from five years ago.
- In 2019, ZEVs and hybrids (HEVs) accounted for about 4.3 vehicles registered per 100 persons–**slightly more than in 2018** when ZEVs and HEVs accounted for 4.0 vehicles per 100 persons.
- Vehicle miles traveled (VMT) **rose 1.4 percent** between 2017 and 2018 to 348.8 billion miles. While the state population increased only 0.3 percent from 2017 to 2018–the smallest it has been since 1970–VMT per capita increased by 1.2 percent during the same period to 8,839 miles per person.
- In 2018, **just 0.8 percent** of VMTs by transportation network companies (TNCs) were generated by electric vehicles. To reach the state-mandated Clean Vehicle Miles Standard of a 60 percent share by 2040, TNCs would have to achieve a 2.7 percent increase in EV VMT linearly each year from 2019 to 2040.

Zero-Emission Vehicles (ZEVs)

- In 2019, battery electric, plug-in hybrid, and hydrogen vehicles accounted for **1.9 percent of all registered on-road vehicles** in California, up from 1.5 percent in 2018 and 1.1 percent in 2017.
- The number of ZEVs on the road surpassed half a million as of the end of 2019, **increasing by over 100,000 ZEVs,** or 22.8 percent, in 2019 compared to 2018. However, sales and registration of new ZEVs actually decreased in 2019 compared to 2018. The decrease in new vehicle sales accounted for a small portion of the drop, but the lion's share of the decrease is due to the retirement of older model year vehicles.
- Although the state is in good shape to meet its 2025 goal of 1.5 million ZEVs on the road, it is **not on track to meet the 2030 goal of five million ZEVs** at current trajectory. In addition to obstacles such as waning federal subsidies and lack of charging stations, lower automobile sales in 2020 due to COVID-19 may impede more widespread ZEV adoption as automakers seek to make up for profit losses by focusing on SUVs and pickup trucks.
- Electric light-duty pickups and SUVs is the fastest-increasing vehicle class segment on a percentage basis. In 2019, registrations of electric pickups and SUVs **increased 39.8 percent** compared to 2018 compared to a 20.7 percent increase for cars.
- Since new ZEVs sales were lower in 2019 than in 2018, clean vehicle rebates were also lower in 2019 than in 2018. In 2019, there were a total of 70,642 rebates statewide, **down 3.7 percent** compared to 2018.

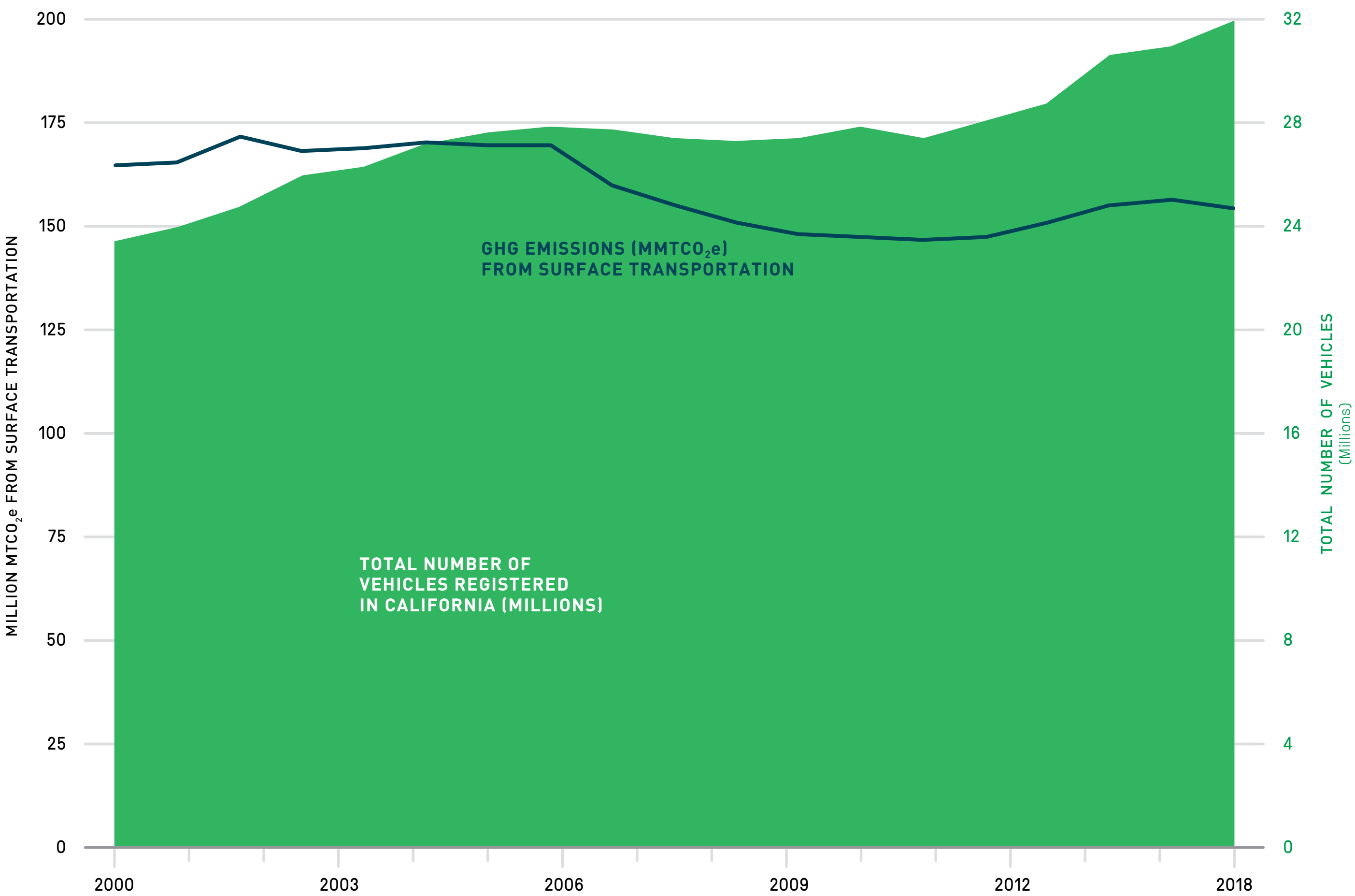
Public Transportation and Active Transportation

- In 2019, among the five largest metro areas in California, unlinked passenger trips (UTPs)[64] totaled 1.15 billion, **down 1.8 percent** from 2018 and down 12.7 percent from 2009. The Los Angeles–Long Beach–Anaheim metropolitan statistical area (MSA), which had the highest UPTs among all of the MSAs in California, also had the largest year-over-year decline (-3.7%) between 2018 and 2019.
- Of the 26 MSAs in California, **only seven recorded higher UPTs** in 2019 than in 2018, all of which are in more rural areas with the exception of Sacramento–Roseville–Arden-Arcade MSA.
- From 2005 to 2018, the percentage growth of commuters who used active transportation such as walking and bicycling (+29.9%), and public transportation (+22.9%) have **both outpaced the growth in commuters who drive** (+15.4%).
- The overall uptick in active transportation is primarily due to having gradually more commuters who walk to work, but from 2013 to 2018, the number of commuters using active transportation actually **declined 1.6 percent.** There were about 161,000 commuters who biked to work in 2018–down over 20 percent compared to the 2014 peak of 205,000 commuters.

Transportation Emissions and Vehicle Ownership

Figure 19. Total Vehicles and Greenhouse Gas Emissions

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity; California Energy Commission.

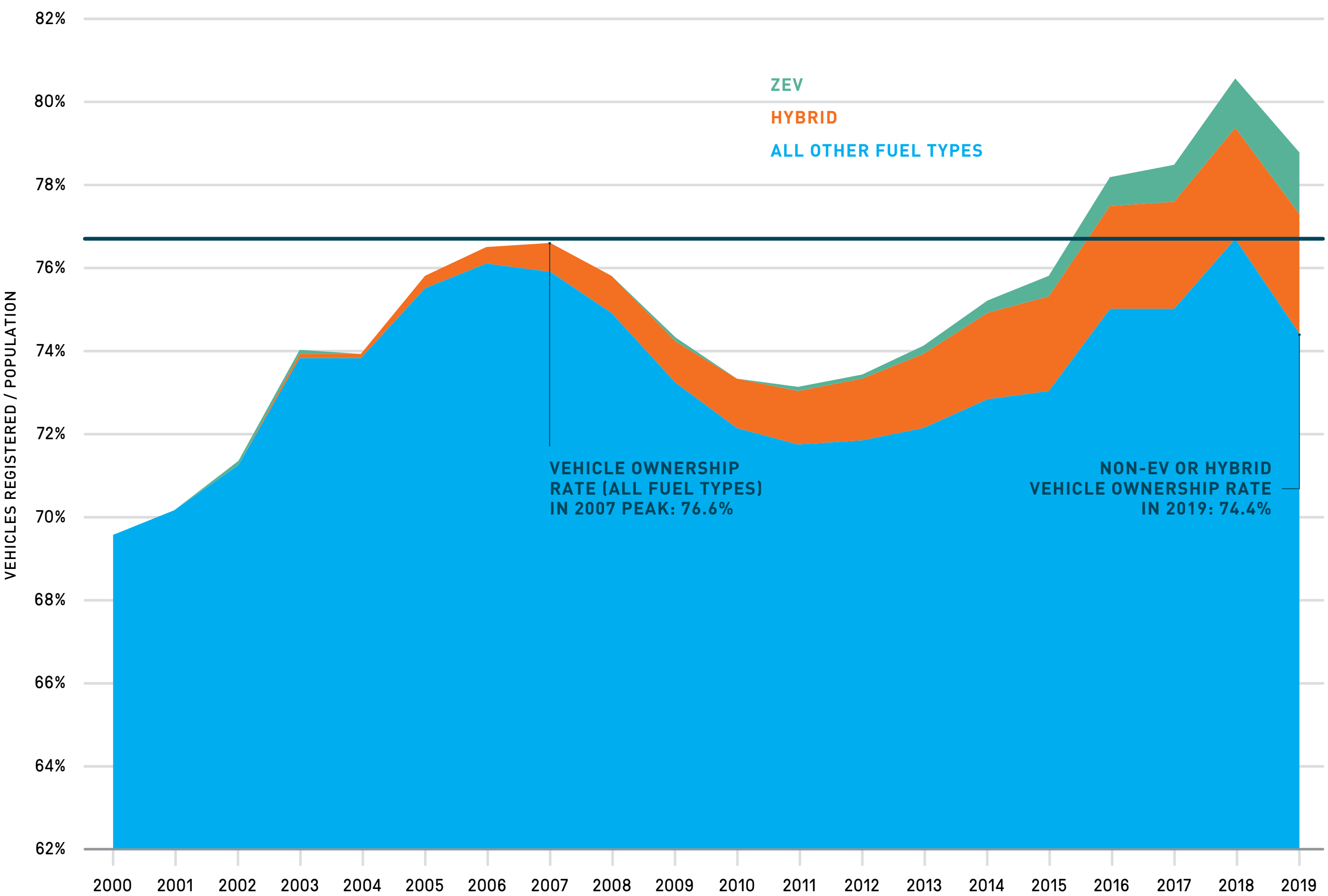
NEXT 10 / SF · CA · USA

CHALLENGES:

❶ After only a modest increase in the total number of vehicles registered from 2016 to 2017 (+1.2%), the total number of vehicles registered increased 3.3 percent to 32 million vehicles between 2017 and 2018. By vehicle class, registrations for crossover utility vehicles (+9.1%) and sports utility vehicles (+12.2%) increased the fastest year-over-year while registrations for cars and sedans fell 1.6 percent—marking a continuous consumer preference shift away from smaller (more fuel-efficient) vehicles for larger (less fuel-efficient) vehicles. ❷ The increase in vehicle ownership has resulted in a steady increase in related emissions. Greenhouse gas emissions from surface transportation in California were 154.4 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) in 2018. Although this represents a 1.3 percent decrease from 2017, it also represents a 5.0 percent increase from five years prior, as GHG emissions from transportation increased every year from 2013 to 2017. Heavy-duty vehicles accounted for most of the decrease in GHG emissions from surface transportation, dropping 4.0 percent year-over-year, while GHG emissions from light-duty vehicles declined 0.5 percent from 2017 to 2018.

Figure 20. Vehicle Ownership Rate by Fuel Type

CALIFORNIA, 2000–2018



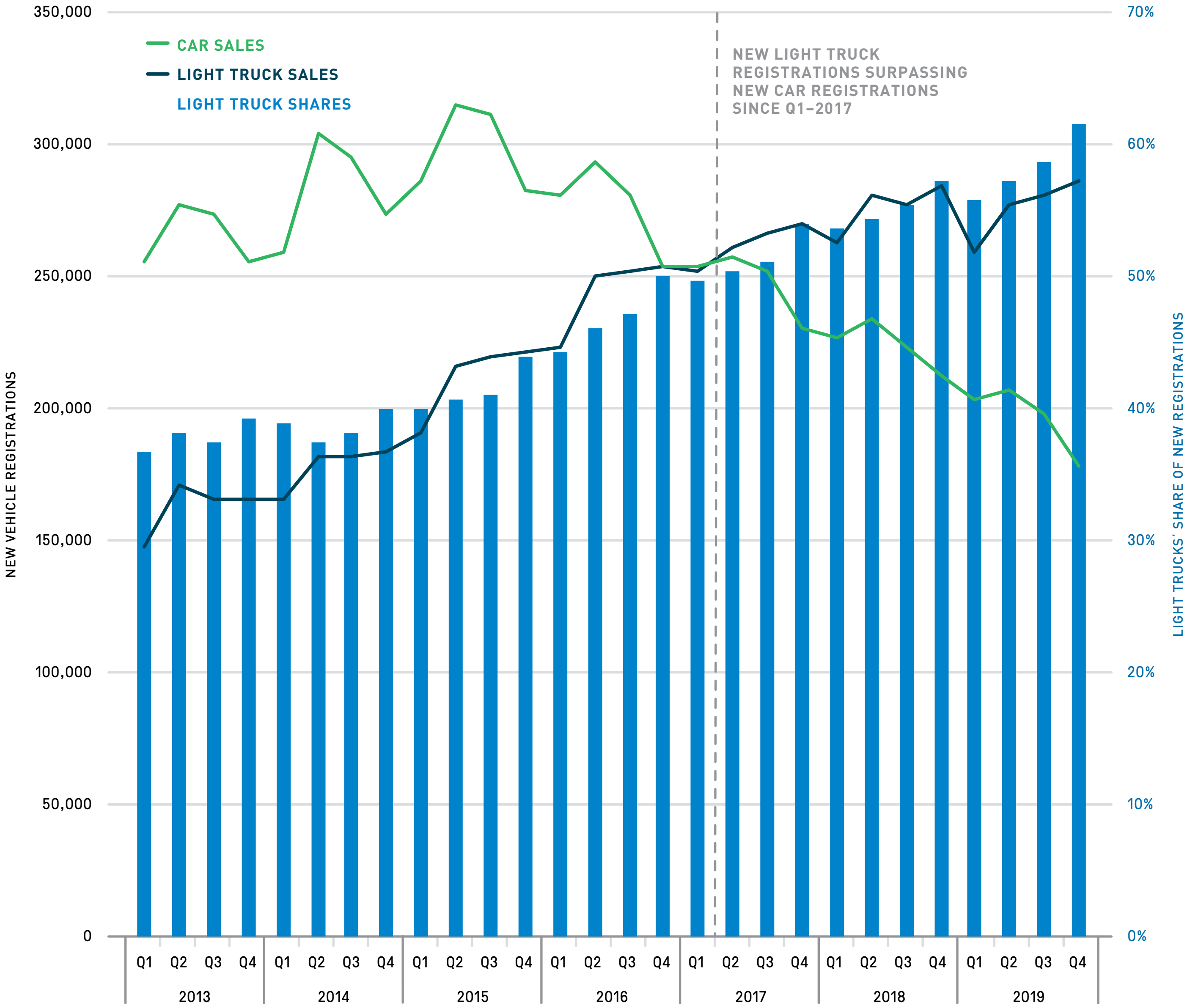
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission; California Department of Finance. NEXT 10 / SF · CA · USA

HIGHLIGHT:

For the first time since 2012, the vehicle ownership rate took a downward turn in 2019. In 2019, the vehicle ownership rate was 78.8 per 100 persons, falling 1.8 percentage points from 2018. ZEVs and hybrids (HEVs) accounted for about 4.3 vehicles per 100 persons, slightly more than in 2018 when ZEVs and HEVs accounted for 4.0 vehicles per 100 persons. The increased share of ZEVs and HEVs is matched by a decreased share in the non-zero-emission vehicle rate, which reached 74.4 vehicles per 100 persons in 2019 (solid black line above, which represents non-ZEV or HEV vehicles registered per capita in 2019)—down from 76.7 in 2018. Given that the ownership rate for non-EV or hybrid vehicles has declined from 2018, and the share of ZEVs and HEVs has risen, people may be substituting their internal combustion vehicles with zero- or lower-emission alternatives.

Figure 21. New Light Truck Registrations as a Percentage of Total New Light Vehicle Registrations

CALIFORNIA, 2013–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: New light vehicles only and does not include used vehicles and vehicles coming off lease. Cars include subcompact, compact, mid-size, large sedans, and sports cars. Light trucks include pickup trucks, mini vans, large vans, and SUVs. Data Source: IHS Automotive, California New Car Dealers Association. NEXT 10 / SF · CA · USA

HIGHLIGHT:

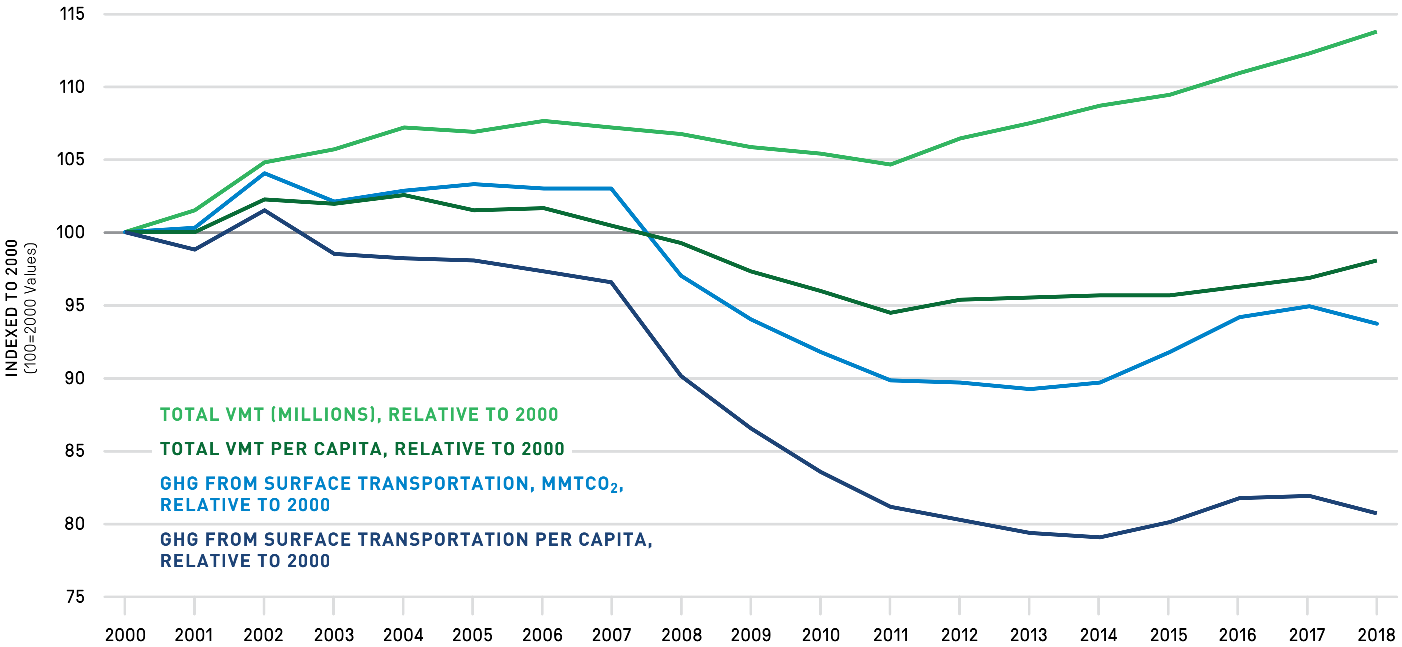
Vehicle ownership is rising and consumers continue to prefer more larger and inefficient vehicles, instead of sedans with better fuel economy. By the fourth quarter of 2019, light-duty pickup trucks, mini-vans, and SUVs made up 61.8 percent of new vehicle registrations—up from 57.2 percent in 2018 and up from 40.1 percent five years prior. The fourth quarter of 2019 saw the largest difference between car and light truck sales, with light truck sales exceeding car sales by 109,480 vehicles—or 23.5 percent more of total sales for the quarter.

OPPORTUNITY:

Until zero-emission vehicles become truly mainstream, most GHG reductions from the transportation sector will need to come from the Low Fuel Carbon Standard and reducing vehicle miles traveled. However, with offerings such as Tesla's Cybertruck, lineups from Rivian, and Ford F-150 becoming commercially available soon, there could also be an opportunity to incentivize purchases of electric light-duty trucks.

Figure 22. Vehicle Miles Traveled and Greenhouse Gas Emissions from Surface Transportation

TOTAL VMT AND EMISSIONS AND 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

HIGHLIGHT:

Vehicle miles traveled (VMT) in California rose 1.4 percent between 2017 and 2018 to 348.8 billion miles. Annual VMT continues to outpace population growth: from 2017 to 2018, California's population increased 0.3 percent—the lowest it has been during the time period observed—but VMT per capita increased by 1.2 percent during the same period to 8,839 miles per person. From 2010 to 2018, VMT increased on average 1.0 percent per year—slightly faster than population's average increase of 0.7 percent per year—implying that people are traveling in on-road vehicles more.

CHALLENGE:

VMT has risen faster than population since 2011, resulting in an increasing VMT per capita over time. Population and VMT per capita increased 0.3 percent and 1.4 percent, respectively, while per capita GHG emissions from surface transportation decreased 1.5 percent from 2017 to 2018. Although per capita GHG emissions from surface transportation have somewhat stabilized in recent years at around 19.3 percent below 2000 level, total GHG emissions from surface transportation have been increasing steadily since 2013 to a mere 6.3 percent below 2000 level. Transitioning more drivers to cleaner vehicles and ensuring that future land use decisions minimize VMT will be critical to reducing emissions from this sector.

Vehicle Miles Traveled

CALIFORNIA, 2018

VMT (MILLIONS)	VMT PER CAPITA	2017–2018 PER CAPITA CHANGE	VMT PER REGISTERED VEHICLE	2017–2018 PER VEHICLE CHANGE
348,795.71	8,839	1.170%	10,888	-1.79%

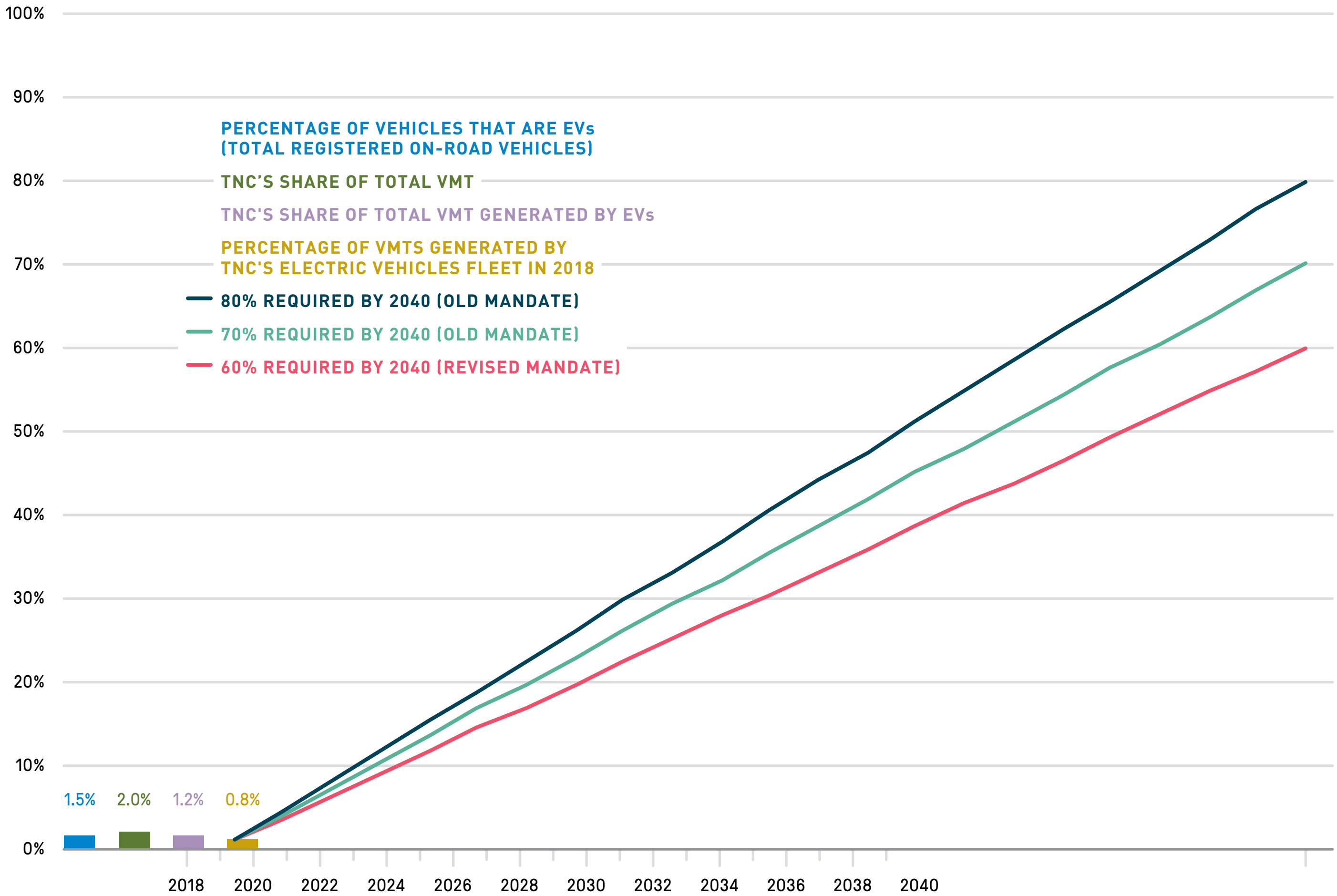
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Department of Transportation. NEXT 10 / SF · CA · USA

HIGHLIGHT:

From 2017 to 2018, VMT increased 1.4 percent to 348.8 billion miles, relatively modest compared to the 3.3 percent increase in on-road vehicles registered. While VMT increase outpaced population growth, resulting in a 1.17 percent increase in VMT per capita year-over-year, VMT per registered vehicle declined 1.79 percent. Overall, VMT per registered vehicle has been on a sustained downward trend since 2000, due to the number of vehicles registered far outpacing both population growth and VMT.

Figure 23. TNC Summary Statistics for 2018 Baseline Inventory

AS REQUIRED BY SB 1014



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

HIGHLIGHT:

In 2018, just 0.8 percent of the VMT generated by transportation network companies (TNCs) fleets were from electric vehicles—much lower than the 1.5 percent share of total registered vehicles on road that are electric vehicles.

OPPORTUNITY:

California's Clean Miles Standard program requires TNCs to establish a baseline VMT for their operations and then meet targets to increase the ratio of VMT driven in electric vehicles.[65] The initial proposed target for the program was to require that TNCs have 70 to 80 percent of all VMT be in electric vehicles by 2040, but in 2020, that goal was revised downward to 60 percent. To meet the revised target, TNCs will need to increase ZEV VMT by 2.7 percent linearly from 2019 to 2040. Recent commitments from both Lyft[66] and Uber[67] targeted at increasing ZEV adoption and reducing emissions across their platforms should help drive progress toward this mandate.

Zero-Emission Vehicles (ZEVs)

Table 6. Alternative Fuel and Zero-Emission Vehicle Registrations

CALIFORNIA

	% CHANGE 19-18	2019	2018
ELECTRIC	28.5%	330,249	257,018
PLUG-IN HYBRID	16.2%	252,037	216,974
NATURAL GAS	-8.2%	30,728	33,457
HYBRID	4.4%	1,139,124	1,091,200
HYDROGEN	20.1%	6,669	5,552
TOTAL ALTERNATIVE FUEL VEHICLES	9.6%	1,758,807	1,604,201
TOTAL ZEV	22.8%	588,955	479,544
TOTAL VEHICLES	-1.8%	31,450,641	32,035,366

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

HIGHLIGHT:

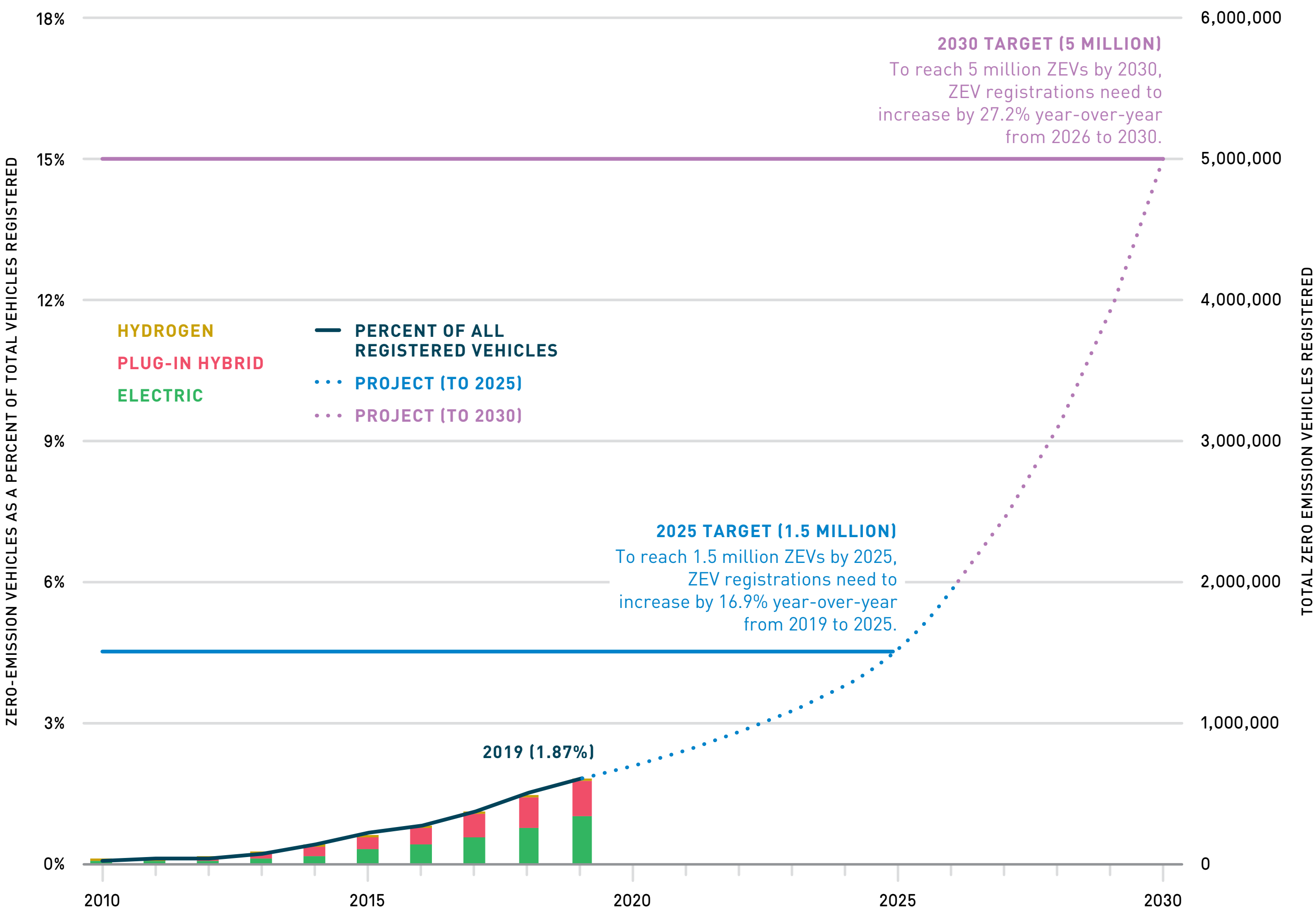
The number of ZEVs on-road surpassed half a million as of the end of 2019, increasing by over 100,000 ZEVs or 22.8 percent in 2019 compared to 2018.

CHALLENGE:

Sales and registrations of new ZEVs actually decreased in 2019 compared to 2018. In 2019, the state registered a total of 145,864 new ZEVs—7.5 percent less than the 157,648 new ZEVs registered in 2018.[68] As a result, after holding the percentage increases of ZEVs on-road steady from 2016 to 2018, when the number of total ZEVs registered on road increased by over 35 percent, in 2019, the figure increased just 22.8 percent compared to 2018.

Figure 24. Trends in Total Zero-Emission Vehicle Registrations

CALIFORNIA



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

HIGHLIGHT:

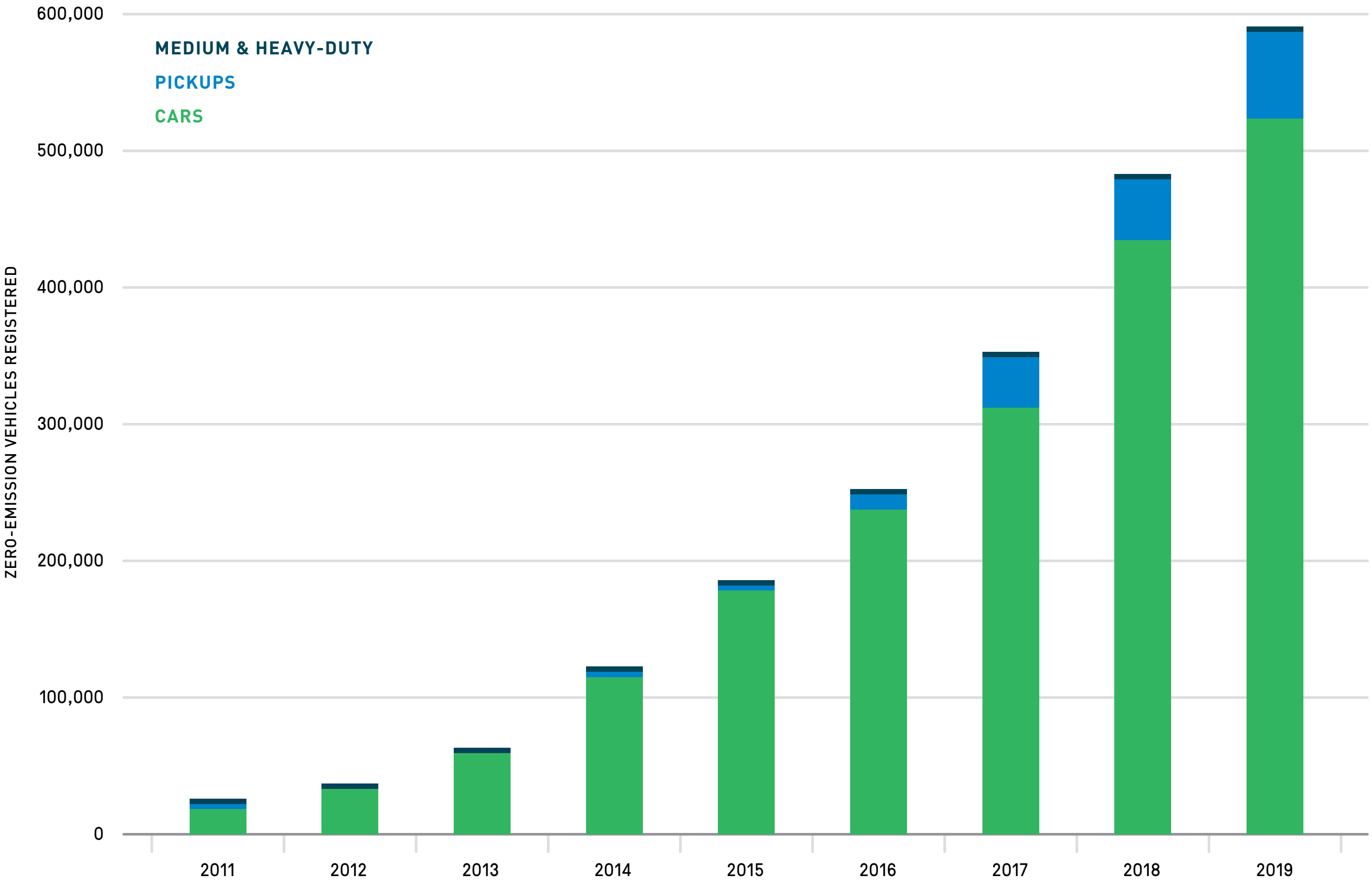
To reach California's goal of 1.5 million ZEVs on the road by 2025,[69] the number will need to increase by 16.9 percent annually, revised downward from 17.7 percent previously, which itself was a downward revision from 20.0 percent the year before. These continuous downward revisions indicate that the state is on track to meet the 2025 goal at current trajectory.

CHALLENGE:

Although the state is in good shape to meet the 2025 goal, it is not on track to meet the 2030 goal of five million ZEVs at the current trajectory. In addition to obstacles such as waning federal subsidies and lack of charging stations,[70] reduced automobile sales in 2020 as a result of the COVID-19 pandemic may impede widespread ZEV adoption as automakers seek to make up for profit losses by focusing on SUVs and pickup trucks.[71]

Figure 25. Zero-Emission Vehicle Registrations by Vehicle Class

CALIFORNIA, 2011–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: New light vehicles only and does not include used vehicles and vehicles coming off lease. Cars include subcompact, compact, mid-size, large sedans, and sports cars. Light trucks include pickup trucks, mini vans, large vans, and SUVs. ZEVs include battery-electric vehicles, plug-in hybrid vehicles, and fuel-cell electric vehicles.
Data Source: California Energy Commission. NEXT 10 / SF · CA · USA

HIGHLIGHT:

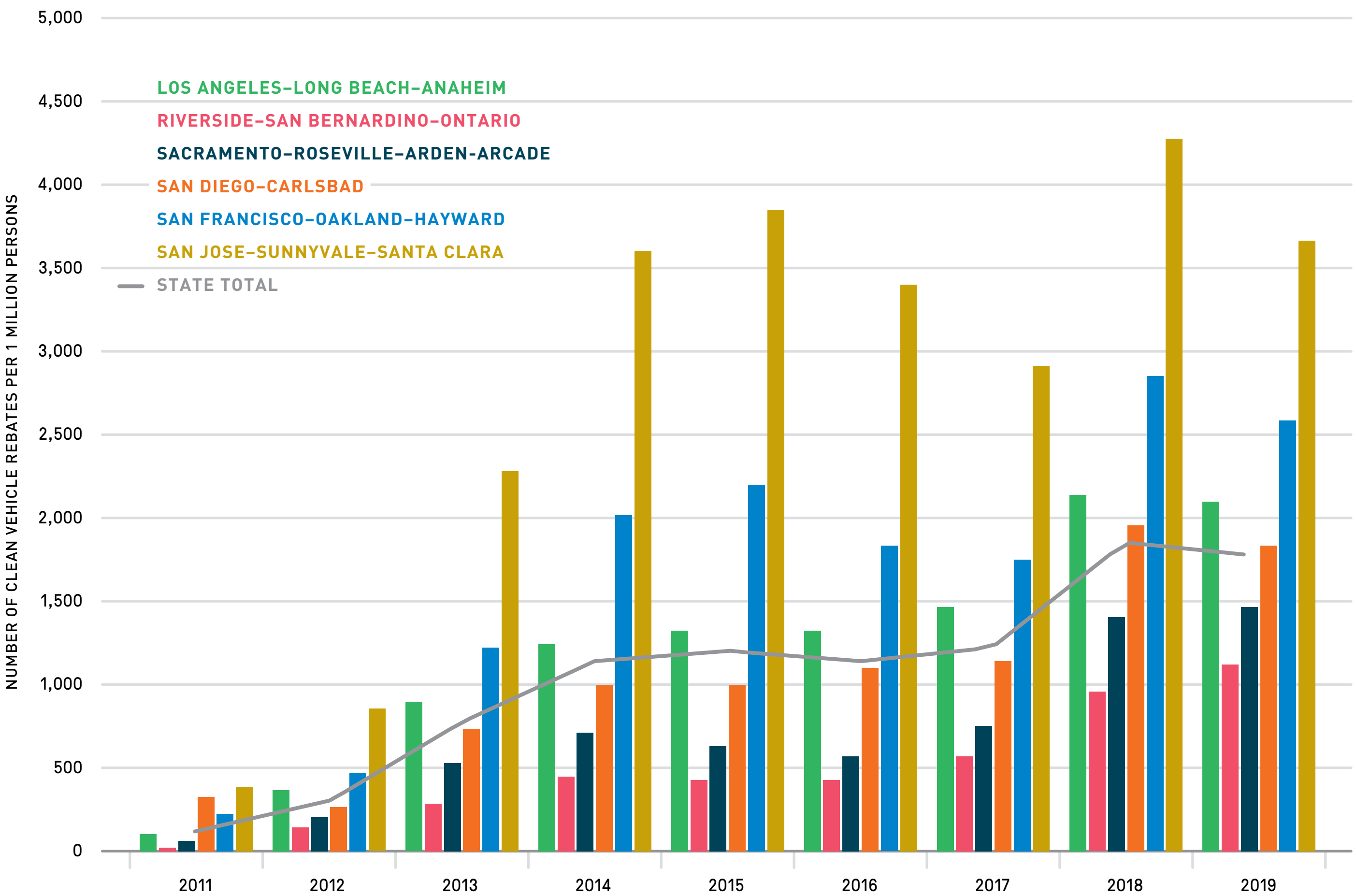
Although most of the ZEVs on the road are still light-duty cars, electric light-duty pickups and SUVs is the fastest-growing segment on a percentage basis. In 2019, registrations of electric pickups and SUVs increased 39.8 percent, while those of cars increased 20.7 percent, compared to 2018. Overall, ZEVs represent 1.9 percent of all vehicles and, within the pickup and SUV segment, ZEVs represent 0.42 of all pickups and SUVs.

OPPORTUNITY:

Electrification of medium and heavy-duty vehicles remains slow. The number of electric medium and heavy-duty vehicles registered on road increased just 3.7 percent in 2019 compared to 2018. However, adoption of electric medium and heavy-duty vehicles is expected to pick up in the near future as the California Air Resources Board has recently issued an accelerated plan to require five to nine percent (depending on vehicle class) of medium and heavy-duty vehicles to be electric zero-emission vehicles beginning in 2024, with increasing mandates through 2035. By 2035, zero-emission truck/chassis sales would need to be 55 to 75 percent of medium and heavy duty vehicle sales, depending on vehicle class.[72]

Figure 26. Clean Vehicle Rebates Per 1 Million Persons

SELECTED MSAs AND CALIFORNIA, 2011–2019



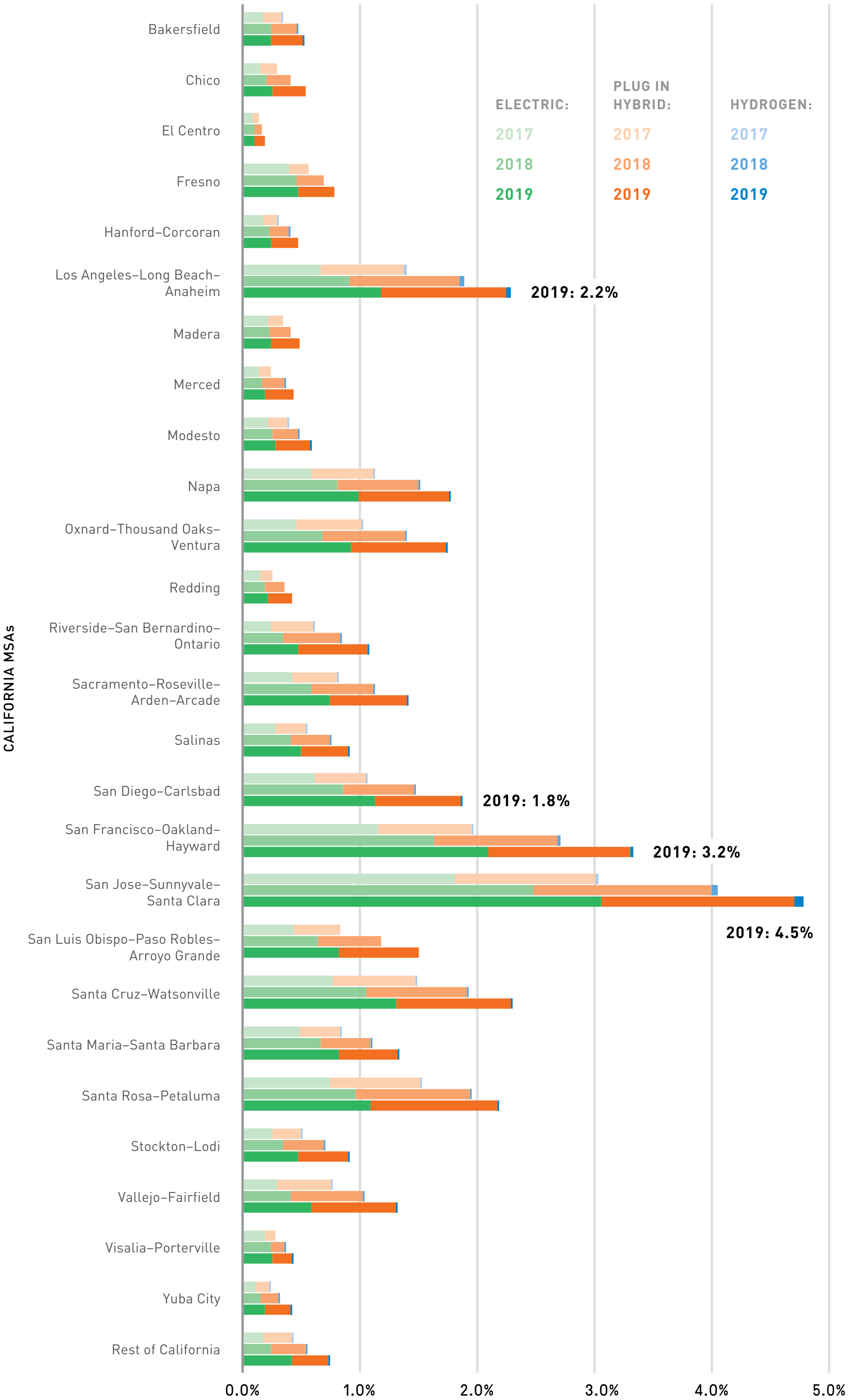
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: The 2018 surge in rebates are driven by Tesla Model 3. without Tesla M3, the rebate numbers for BEVs would be lower in 2018. Clean vehicle rebates refers to the state of California rebates. Data Source: Center for Sustainable Energy; California Air Resource Board Clean Vehicle Rebate Project; Department of Finance. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ Since new ZEVs sales were lower in 2019 than in 2018, clean vehicle rebates were also lower in 2019 than in 2018. In 2019, there were a total of 70,642 rebates statewide, down 3.7 percent compared to 2018. This is not a sign of slowing ZEV adoption but rather an expected outcome given 2018 was a strong growth year in terms of new ZEVs registration and rebates. ❷ Among the metro areas with the highest ZEV adoption rates adjusted for population, the Santa Rosa–Petaluma MSA experienced the largest year-over-year drop, with 1,623.8 rebates per one million residents in 2019, down 32.3 percent from 2018. In general, rebates per capita are down in the Bay Area, which has the highest per capita ZEV adoption. While San Jose–Sunnyvale–Santa Clara MSA and San Francisco–Oakland–Hayward MSA still have the highest ZEV adoption rates per capita, the 2019 rate was 13.9 percent and 9.4 percent lower, respectively, than in 2018. On the other hand, Southern California held steady and even saw an increase in per capita clean vehicle rebates, with Los Angeles–Long Beach–Anaheim MSA (-1.8%) holding relatively steady and growing in Riverside–San Bernardino–Ontario MSA (+17.0%). Finally, per capita rebates grew 3.1 percent to 1,455.5 rebates per 1 million persons in Sacramento–Roseville–Arden-Arcade MSA in 2019 compared to 2018.

Figure 27. Zero-Emission Vehicles Registered as Percent of Total Vehicles Registered

CALIFORNIA MSAs, 2017 - 2019



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

HIGHLIGHT:

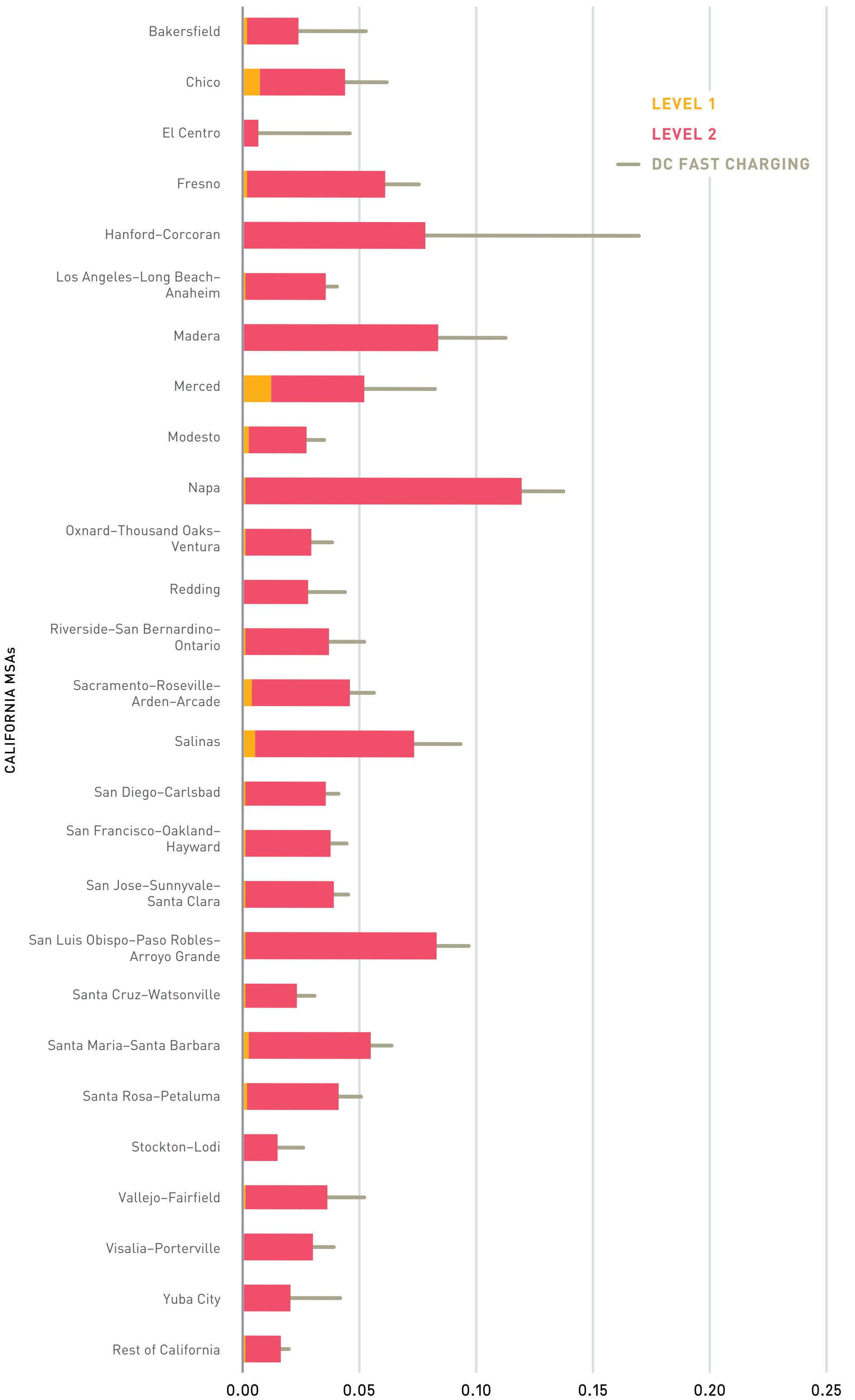
The share of ZEVs on-road as percentage of total vehicles registered in large urban areas continues to increase. The percent of registered vehicles that are ZEVs reached 4.5 percent in Sunnyvale–Santa Clara MSA, 3.2 percent in San Francisco–Oakland–Hayward MSA, and 2.2 percent in Los Angeles–Long Beach–Anaheim MSA in 2019—up from 3.8 percent, 2.5 percent, and 1.7 percent, respectively, in 2018.

CHALLENGE:

The presence of ZEVs varies across the state; ZEV adoption continues to be significantly higher in large Bay Area metro areas than in large Southern California metro areas, which in turn have higher rates than the rest of California. El Centro MSA had the lowest ZEV adoption rate (0.2%) in 2019, which represents a marginal increase of 0.033 percent from 2018. Bakersfield MSA and Visalia–Porterville, both located in south Central California, have some of the lowest ZEVs on-road as percentage of total vehicles registered (0.5% and 0.4%, respectively) and the next-lowest percentage increases from 2018 to 2019 (0.082% and 0.083%, respectively).

Figure 28. Charging Stations Per Electric Vehicle Registered

BY MSA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Vehicle registration as of end of 2019 and charging station data as of June 30, 2020. Not all electric vehicles can handle L3 fast charging (e.g., many plug-in hybrids). Data Source: Alternative Fuel Data Center, U.S. Department of Energy.

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HIGHLIGHT:

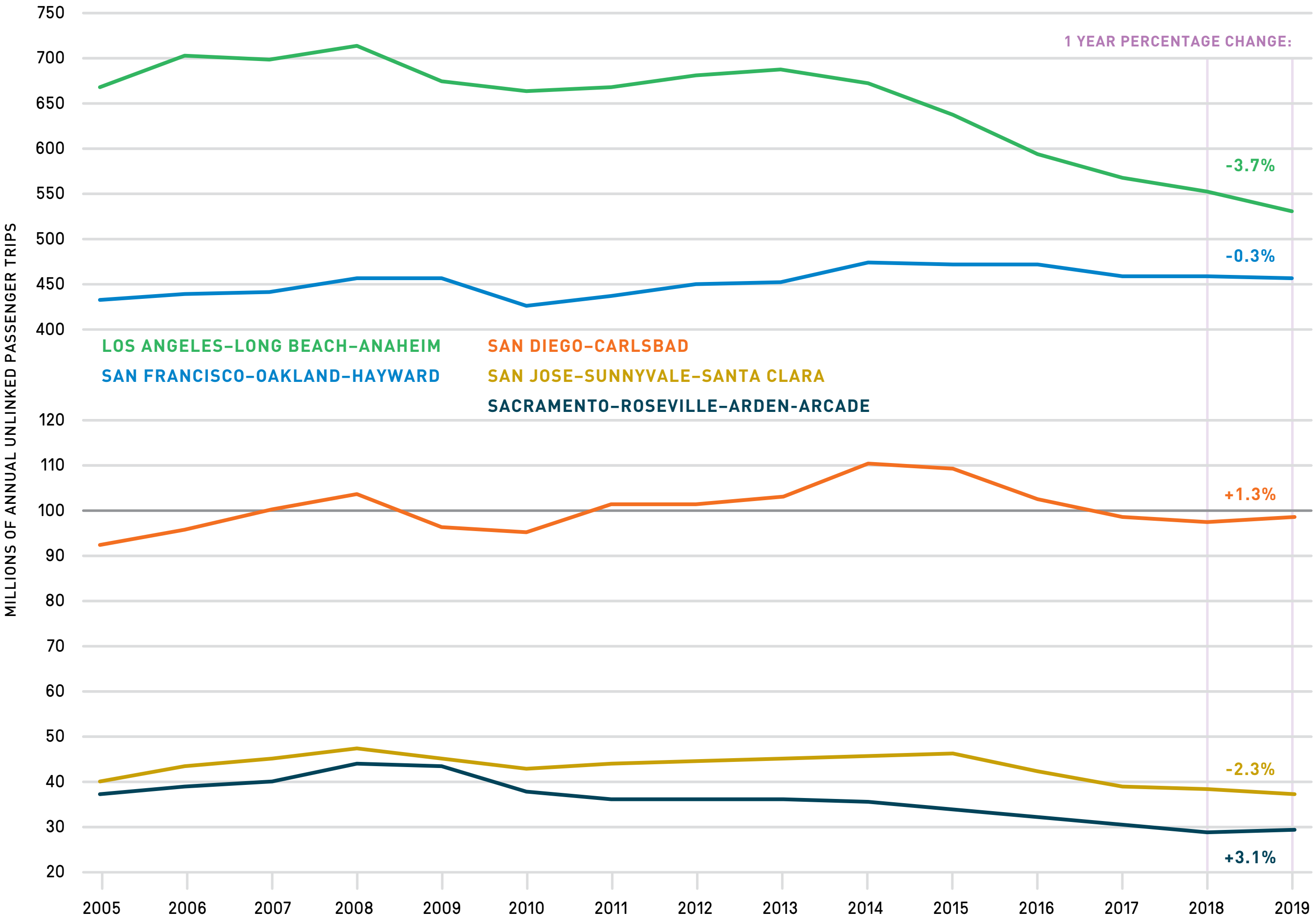
Statewide, charging infrastructure is gradually expanding. There are now under 22.8 ZEVs per charging station, down slightly from 23.3 compared to a year ago. Since ZEV penetration is far lower in more rural and less-populous metro areas, these areas also tend to have a greater number of charging stations per electric vehicle. Still, there are exceptions such as Modesto MSA, Redding MSA, Stockton–Lodi MSA, and Visalia–Porterville MSA, where ZEV adoption and ZEV per charging station are both low.

OPPORTUNITY:

In August of this year, the CPUC approved Southern California Edison's (SCE) Charge Ready 2 infrastructure program which provides $436 million for a program to install an additional nearly 38,000 electric vehicle charging ports in the SCE territory—making it the largest single-utility EV charging program in the country.[73] This program would significantly expand charging infrastructure in Southern California. According to the Atlas Public Policy EV Hub, this brings total utility investment in EV charging infrastructure in the state to over $1.5 billion.

Figure 29. Total Annual Unlinked Passenger Trips (in Millions)

TOP 5 CALIFORNIA METRO AREAS BY TOTAL UNLINKED PASSENGER TRIPS



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

HIGHLIGHT:

Among the five largest metro areas, total unlinked passenger trips (UPTs, or trips on one transit vehicle, not including connections) fell in all metro areas in 2019 except for San Diego–Carlsbad MSA and Sacramento–Roseville–Arden-Arcade MSA, which experienced a 1.3 percent and 3.1 percent increase, respectively. The largest decline in UPTs in 2019 took place in Los Angeles–Long Beach–Anaheim MSA (-3.7%), followed by San Jose–Sunnyvale–Santa Clara MSA (-2.3%), and San Francisco–Oakland–Hayward MSA (-0.3%). Across all five metro areas, UPTs totaled 1.15 billion, down 1.8 percent from 2018 and down 12.7 percent from 2009.

CHALLENGE:

In 2020, public transit ridership plummeted nationwide as movements were restricted or constrained by the COVID-19 pandemic. While some studies[74] have indicated that there is little risk that public transit might pose a risk of causing a coronavirus outbreak, it remains unclear how soon ridership levels could return to normal levels—let alone increase. Beyond the challenge of getting riders to return, public transit systems and authorities are also facing significant budget shortfalls[75] as a result of the recession.

Figure 30. Change in Total Unlinked Passenger Trips

ALL MODES OF PUBLIC TRANSIT, ANNUAL CHANGES: 2017 VS. 2018 AND 2018 VS. 2019

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Data for Madera MSA not available. Data Source: National Transit Database, Department of Transportation. NEXT 10 / SF · CA · USA

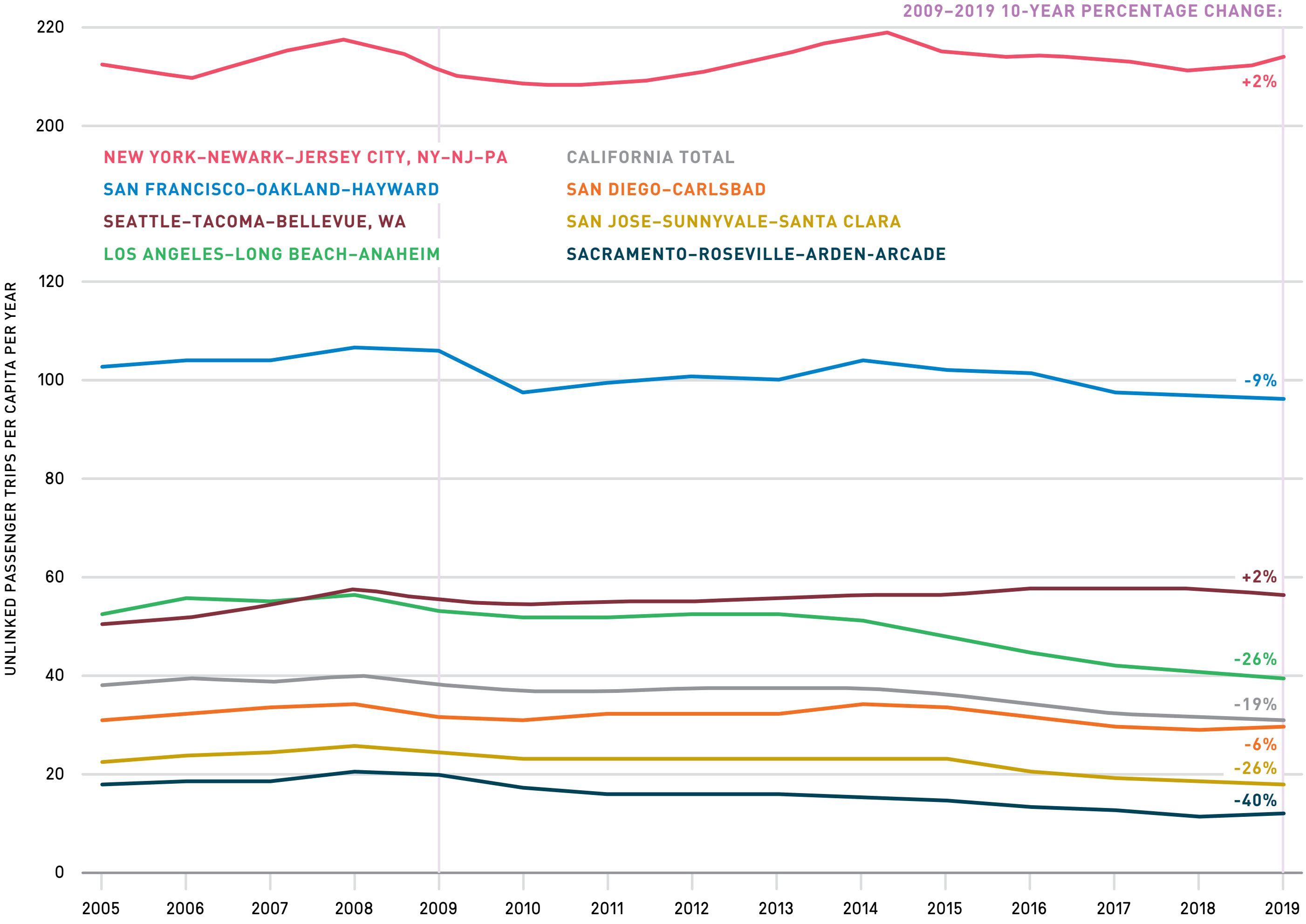
CHALLENGE:

Of the 26 MSAs in California, only seven recorded higher UPTs in 2019 than in 2018, all of which are in more rural areas with the exception of the Sacramento–Roseville–Arden-Arcade MSA. In the Sacramento metro, change in UPT ridership increased 8.9-percentage points in 2018–19 from 2017–18—the largest percentage point increase across all MSAs. This result follows a multitude of regional efforts to increase public transit ridership, which included doubling scheduled light rail service and lowering transit fares.[76, 77]

While Hanford–Corcoran (+5.0%), Stockton–Lodi (+4.9%), and Fresno (4.4%) saw the largest yearly ridership growth in 2018–19, the increases were not as significant as in 2017–18, as the chart indicates.

Figure 31. Unlinked Passenger Trip Per Capita, All Modes of Public Transit

SELECTED LARGE CALIFORNIA MSAs, SEATTLE, AND NEW YORK CITY MSAs, 2005–2019



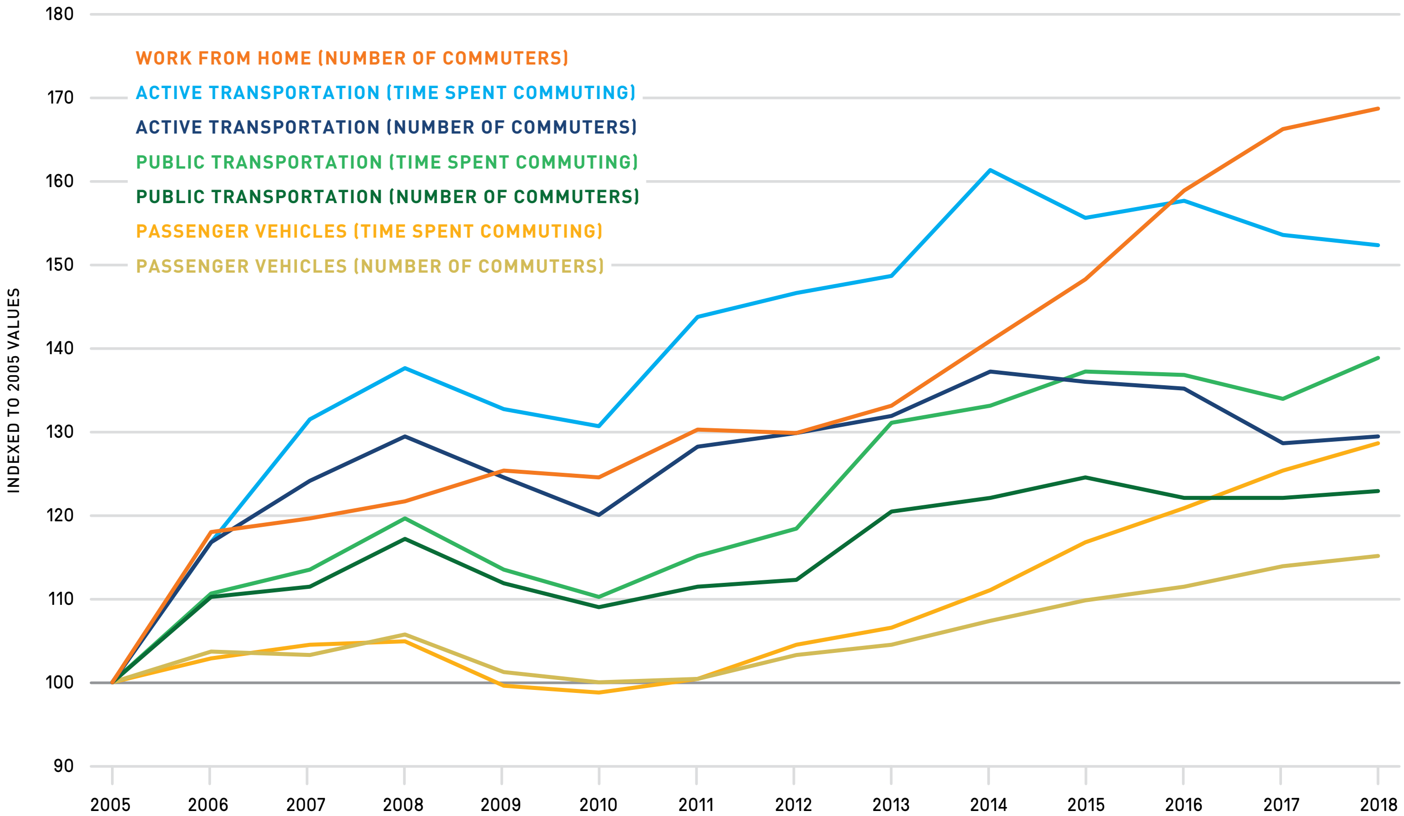
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: National Transit Database, Department of Transportation; California Department of Finance; U.S. Census Bureau. NEXT 10 / SF · CA · USA

CHALLENGE:

Over the last decade, public transportation ridership fell in MSAs across California and increased in other major areas in the U.S. While California saw ridership declined statewide by 19 percent between 2009 and 2019, the New York and Seattle metro areas each saw a two percent increase. In particular, ridership in the New York metro increased two percent between 2018 and 2019 as well, which is largely attributable to the region's major infrastructure and performance developments that have improved transit quality and reliability.[78] In contrast, the Los Angeles metro area—the largest in California by population—saw ridership per capita decline 26 percent between 2009 and 2019. A combination of factors contributed to the decline in public transportation ridership, including increases in automobile ownership. In Southern California specifically, car ownership has grown fastest among its most frequent transit riders, who are typically lower-income, foreign-born residents.[79] The decline, which has been more pronounced in recent years, also coincides with the rise of ride-hailing services such as Uber and Lyft.[80] Furthermore, rising rents are pushing transit patrons into outlying areas where public transit is no longer feasible.

Figure 32. Time Spent Commuting and Number of Commuters by Mode of Transportation

CALIFORNIA, 2005–2018



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: American Community Survey Public Use Microdata Samples, U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHT:

From 2005 to 2018, the percentage growth of commuters who used active transportation, such as walking and bicycling (+29.9%), and public transportation (+22.9%) have both outpaced the share of commuters who drive (+15.4%). Likewise, the total time spent commuting using active transportation (+52.9%) and public transportation (+39.3%) have outpaced driving (+28.9%) during the same period. However, people who work from home has been the fastest rising group, increasing 69.3 percent between 2005 and 2018.

CHALLENGE:

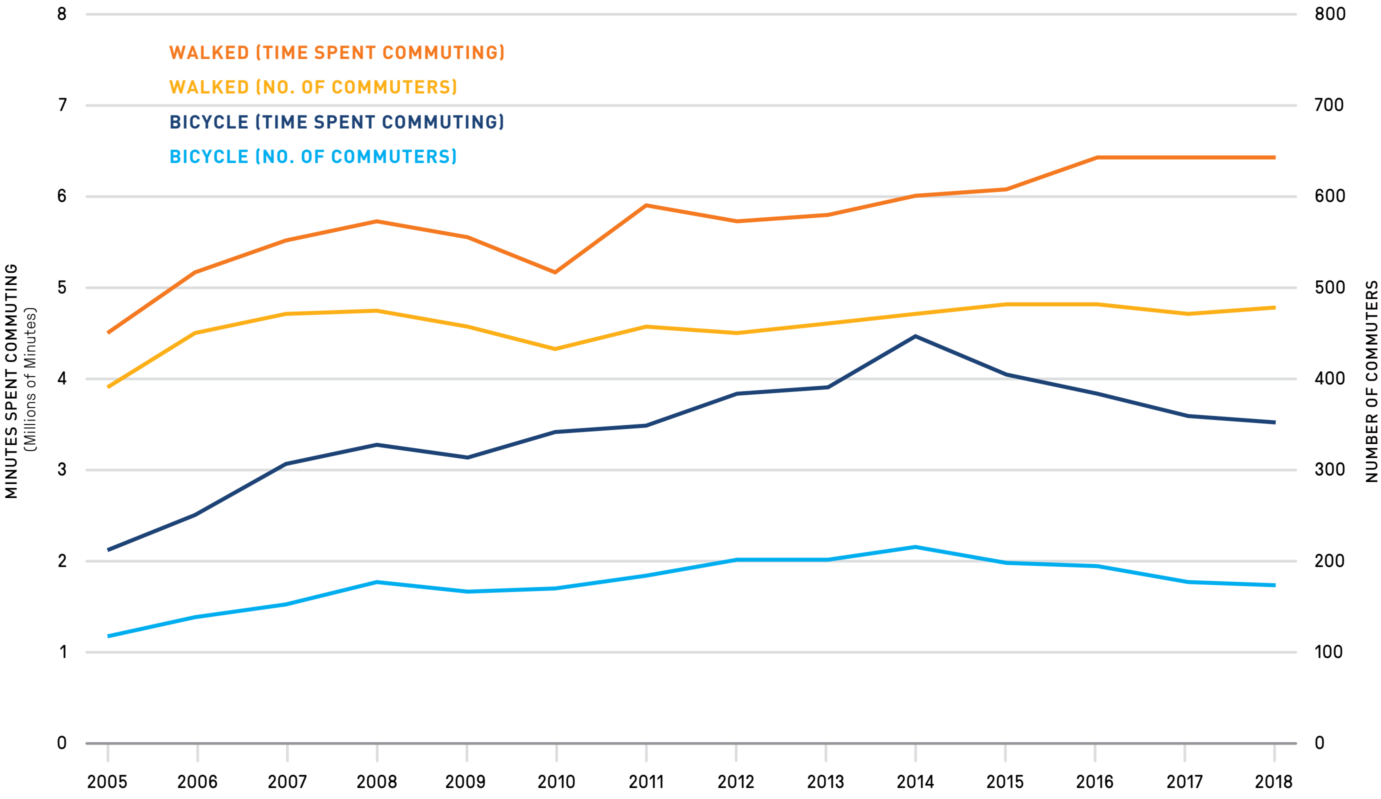
The number of commuters who drive to work have been increasing gradually while the number of commuters using active transportation or public transit have been stagnating since 2014 and 2015, respectively. In fact, from 2013 to 2018, the number of commuters using active transportation actually declined 1.6 percent and the number of commuters using public transit rose only 1.8 percent. Meanwhile, the number of car commuters increased 10.3 percent during the same period.

OPPORTUNITY:

Over the same period, the number of people who work from home increased 69 percent, though still represented a small (near zero) overall percentage of commuters overall. In 2020, the number of Californians working from home skyrocketed as the state and nation responded to the COVID-19 pandemic. Months into working from home, a number of large employers in California committed to allowing employees to continue to work from home indefinitely, including tech companies like Facebook, Twitter, and Square.

Figure 33. Time Spent Commuting by Active Transportation and Number of Commuters

CALIFORNIA, 2005–2018



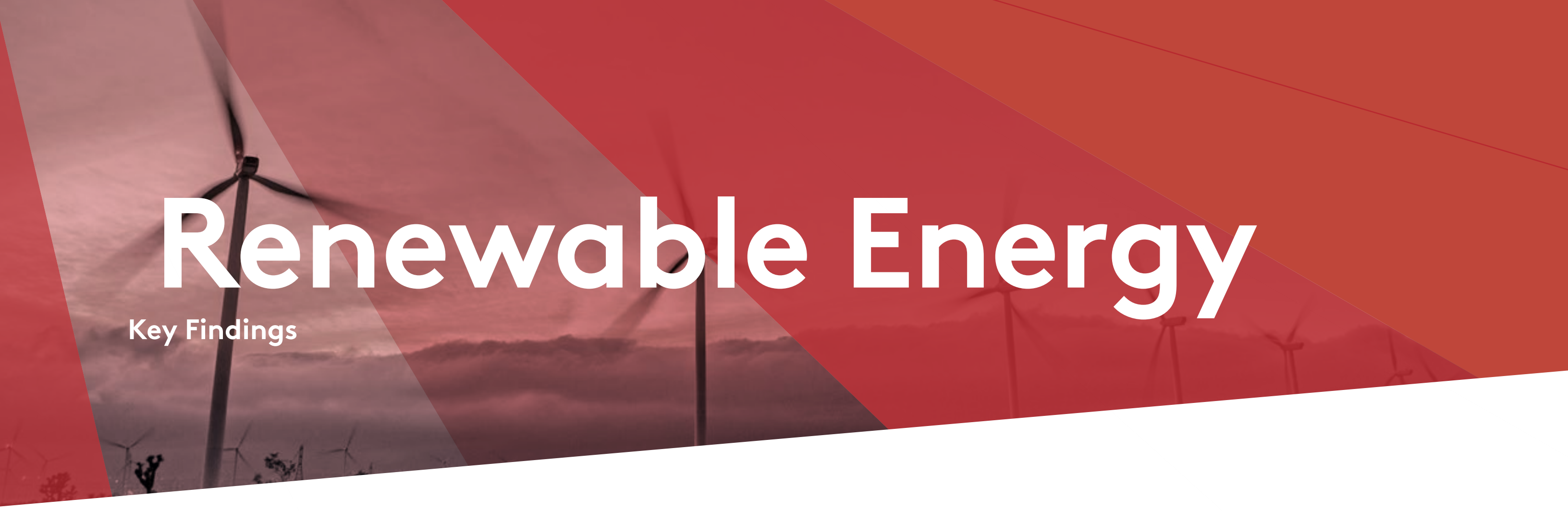
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: American Community Survey Public Use Microdata Samples, U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHT:

The overall uptick in active transportation is primarily due to having gradually more commuters who walk to work. There are slightly under half of a million commuters in California who walk to work 2018. The figure has held steady for the past few years.

CHALLENGE:

There has been a notable decline in the number of commuters who bike to work since 2014. There were about 161,000 commuters who biked to work in 2018, down over 20 percent compared to the 2014 peak of 205,000 commuters. Lower gasoline prices and traffic safety concerns are cited as the major obstacles to biking to work.[81]



Renewable Energy

Key Findings

California has set ambitious goals for increasing its share of electricity from renewable sources, including a target set in 2018 to supply 100 percent of retail sales from zero-carbon sources by 2045, and **the state is poised to meet or exceed its renewable and clean energy goals for the next few years.** However, the March 2020 California Public Utilities Commission decision for the 2019-2020 Integrated Resource Plan (IRP), which sets a target reduction of greenhouse gases from the electric sector to 46 $MMTCO_2e$ by 2030, could impede the state's decarbonization goals. Since the IRP process also requires planning for resource adequacy, the recent CPUC decision reflects a certain degree of concern over the grid's reliability, resiliency, affordability, and safety concerns, relying more on natural gas through 2030 than the state would otherwise, absent the March decision.

Renewable Electricity Generation and Power Mix

- The share of the state's total energy generation from renewable sources **increased slightly from 31.4 percent in 2018 to 31.7 percent in 2019.**
- Between 2014 and 2019, solar accounted for almost **80 percent of the growth** in electricity generation from renewable sources, while generation from wind increased more modestly (+18%).
- In 2019, the share of renewables, including large hydroelectric (46%), **collectively made up a greater share of the state's power mix than that of fossil fuels** (37%), which includes coal, oil, and natural gas. Just ten years prior, in 2009, fossil fuels accounted for 50 percent of the state's power mix while renewables (14%), plus large hydroelectric (1%), accounted for only 25 percent in total.
- Between 2009 and 2019, the power mix from coal and natural gas **decreased 65.8 percent and 24.2 percent,** respectively, while solar **increased by almost 4,000 percent.** In-state generation for coal and natural gas decreased 93.4 percent and 26.2 percent, respectively.
- In 2019, **29.2 percent** of California's net in-state generation came from renewable sources, excluding hydroelectric (down slightly from 30.0 percent in 2018), maintaining its position as the 6th-highest in the nation. California has the largest share of generation coming from solar (14.0%) and geothermal (5.4%), while Kansas has the largest share of wind (41.7%).

Renewable Portfolio Standards (RPS)

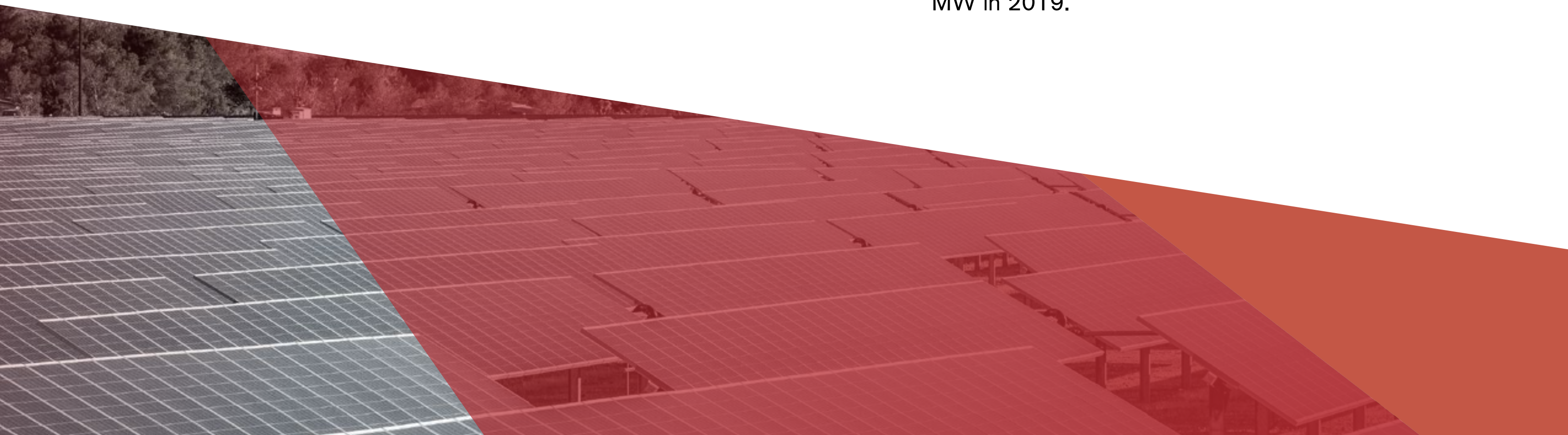
- All retail sellers in California either **met or exceeded the interim RPS target** of 31 percent by December 31, 2019 and most are on track to achieve their 2020 requirements.[82]
- Community Choice Aggregators (CCAs) achieved an average RPS position of **47 percent** in 2019, above the average RPS position of the investor-owned utilities. But while CCAs fared better on RPS position in 2019, **they are not on track to meet long-term renewable procurement targets**—only five of the 29 CCAs that plan to operate from 2021–24 have met the 65 percent target for long-term procurement contracts.
- Although currently the three investor-owned utility (IOU) companies have comfortably exceeded their interim RPS goals, the March CPUC ruling on the Integrated Resource Plan could **pose a challenge** for California to meet its long-term goals under SB 100.[83]

Integrated Resource Plan and Resource Adequacy

- This March, the CPUC approved a planning scenario for the state's 2019–2020 Integrated Resource Plan[84] cycle that looks to reduce emissions from the electricity sector to 46 $MMTCO_2e$ by 2030, but the scenario chosen puts the majority of the burden of meeting the 2045 carbon zero goals on the 2030–2045 period, allowing more natural gas on the grid between now and 2030. Two other scenarios would have called for reductions to either 38 or 30 $MMTCO_2e$ by 2030.
- In the 46 MMT scenario, the California Independent System Operator (CAISO) grid region will substantially and increasingly depend on battery storage to meet future GHG reduction needs, which is crucial **to address capacity shortfall and provide operational flexibility.**

Solar and Wind Installations

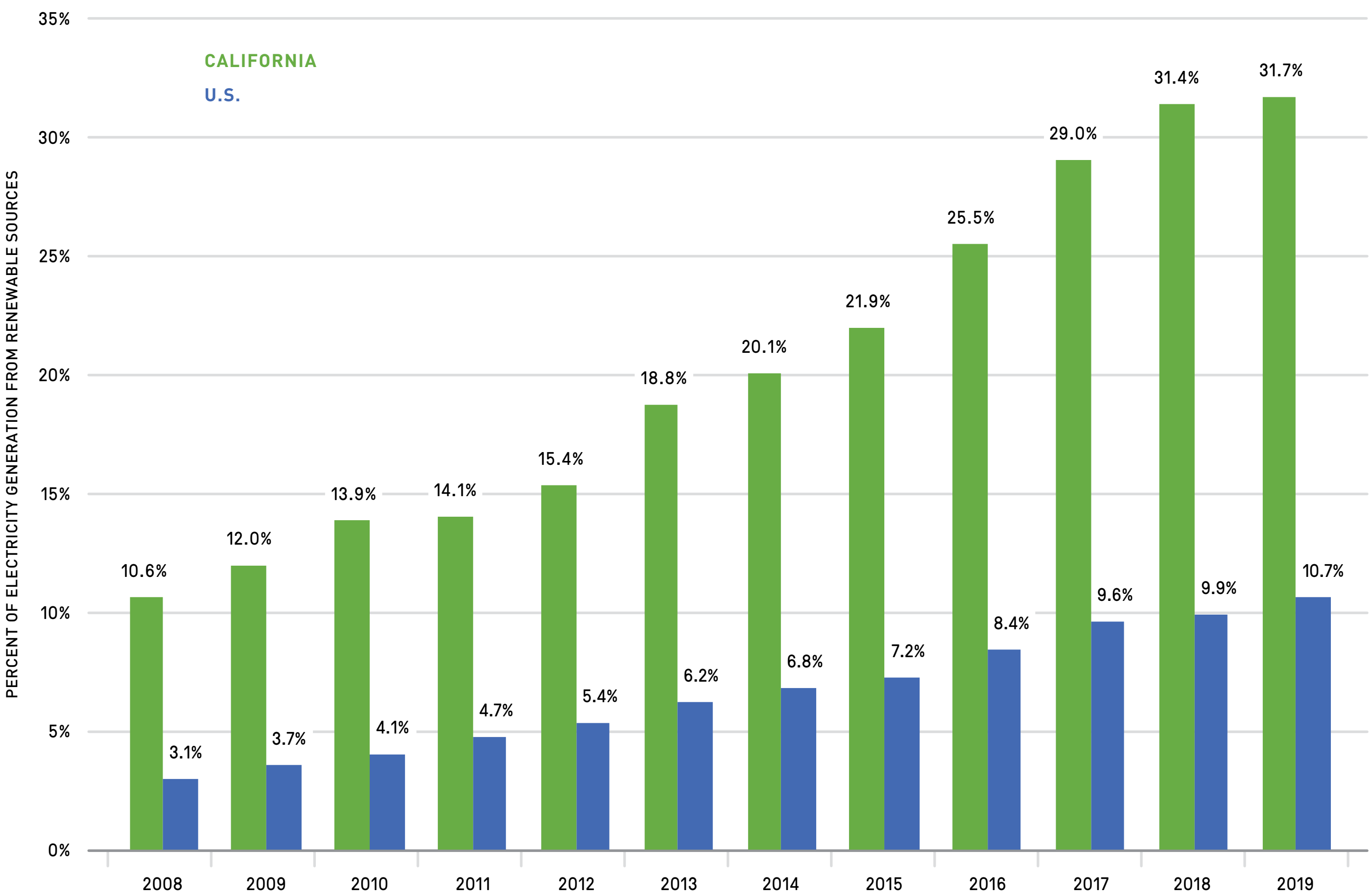
- Annual interconnected solar installations totaled 1,186 MW in 2019—**almost unchanged** from the 1,189 MW installed in 2018. As the solar market reaches maturity, annual installations from all sectors stabilized at just below 1,200 MW after peaking in 2016. Cumulative capacity totaled 8,157 megawatts (MW).
- As of the end of 2019, California accounted for 43 percent of all small-scale solar photovoltaic (PV) net generation in the U.S. From 2018 to 2019, small scale-solar PV generation **increased 16.1 percent** in California and 20.6 percent in the rest of U.S.
- In California, cumulative installed wind capacity totaled 5,973 MW in 2019 and has remained **largely stagnant** since 2012. Nationwide, cumulative installed wind capacity topped 100,000 MW in 2019.



Renewable Electricity Generation and Power Mix

Figure 34. Percent of Total Electricity Generation from Renewable Sources

CALIFORNIA & THE REST OF THE U.S., 2008–2019



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

HIGHLIGHT:

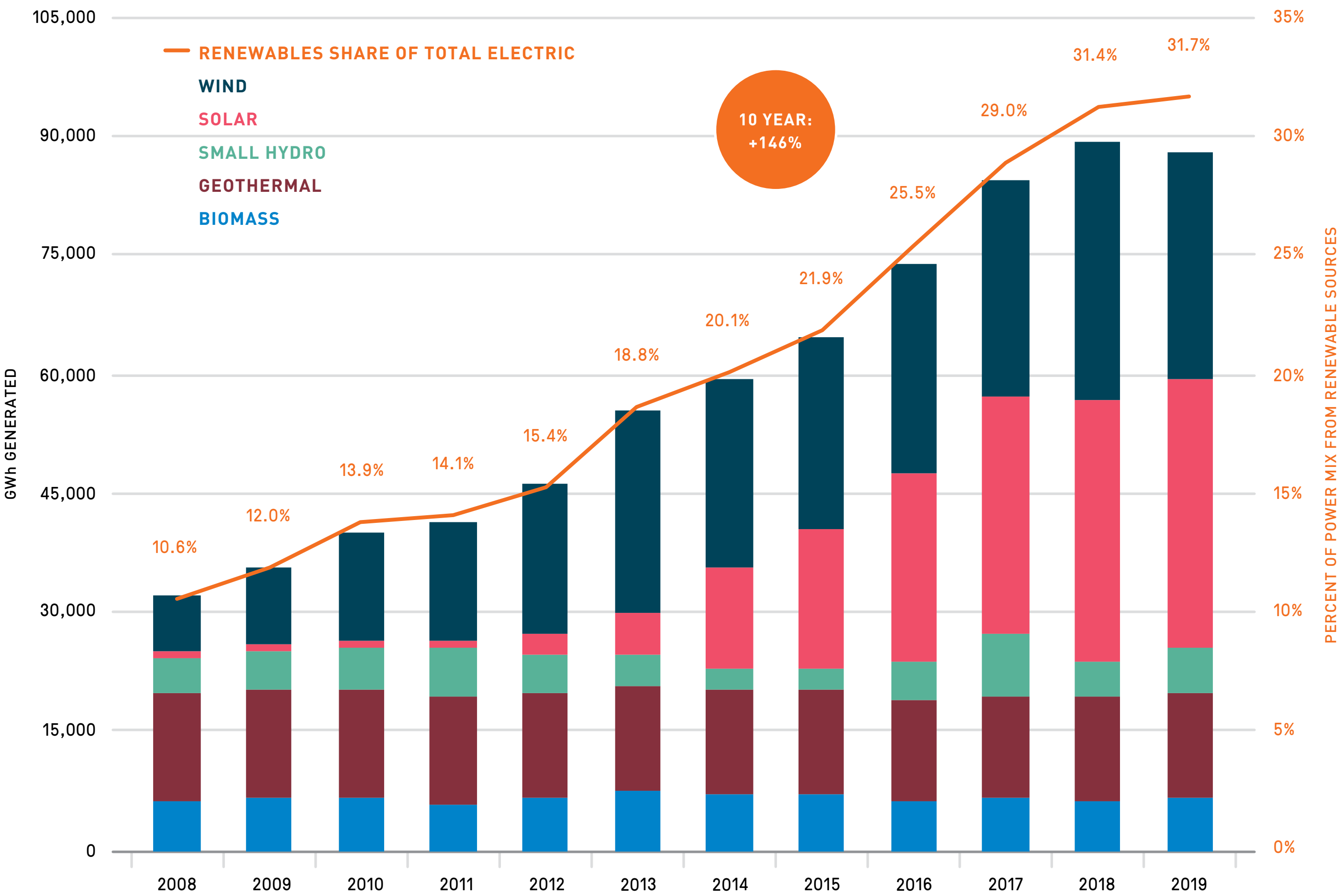
The percentage of utility-scale total power mix from renewable sources in California increased just 0.3 percent to 31.7 percent in 2019, whereas the U.S. recorded a 0.8 percent increase.[85] Renewables' share of generation as a percent of total generation holds steady at three times as large in California than in the U.S. The slowdown in generation from renewable sources in 2019 is primarily due to a decrease in generation from wind, which decreased (for the first time since 2014) 4,462 gigawatt-hours—or 13.6 percent—compared to 2018. Nonetheless, California is on track to meet the 2020 RPS goal. Looking forward, there is a need for enhanced western grid integration and to ensure that renewable energy additions are fully used.[86]

CHALLENGE:

Although currently renewable generation exceeds the interim RPS goals (31 percent by the end of 2019 and 33 percent by the end of 2020), the CPUC forecasted a physical deficit beginning in 2028 at the current trajectory[87] as more generation associated with facilities becomes expired and they no longer have a Power Purchase Agreement with the IOUs.

Figure 35. California Renewable Electricity Generation

GIGAWATT-HOURS BY SOURCE, 2008–2019



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

HIGHLIGHT:

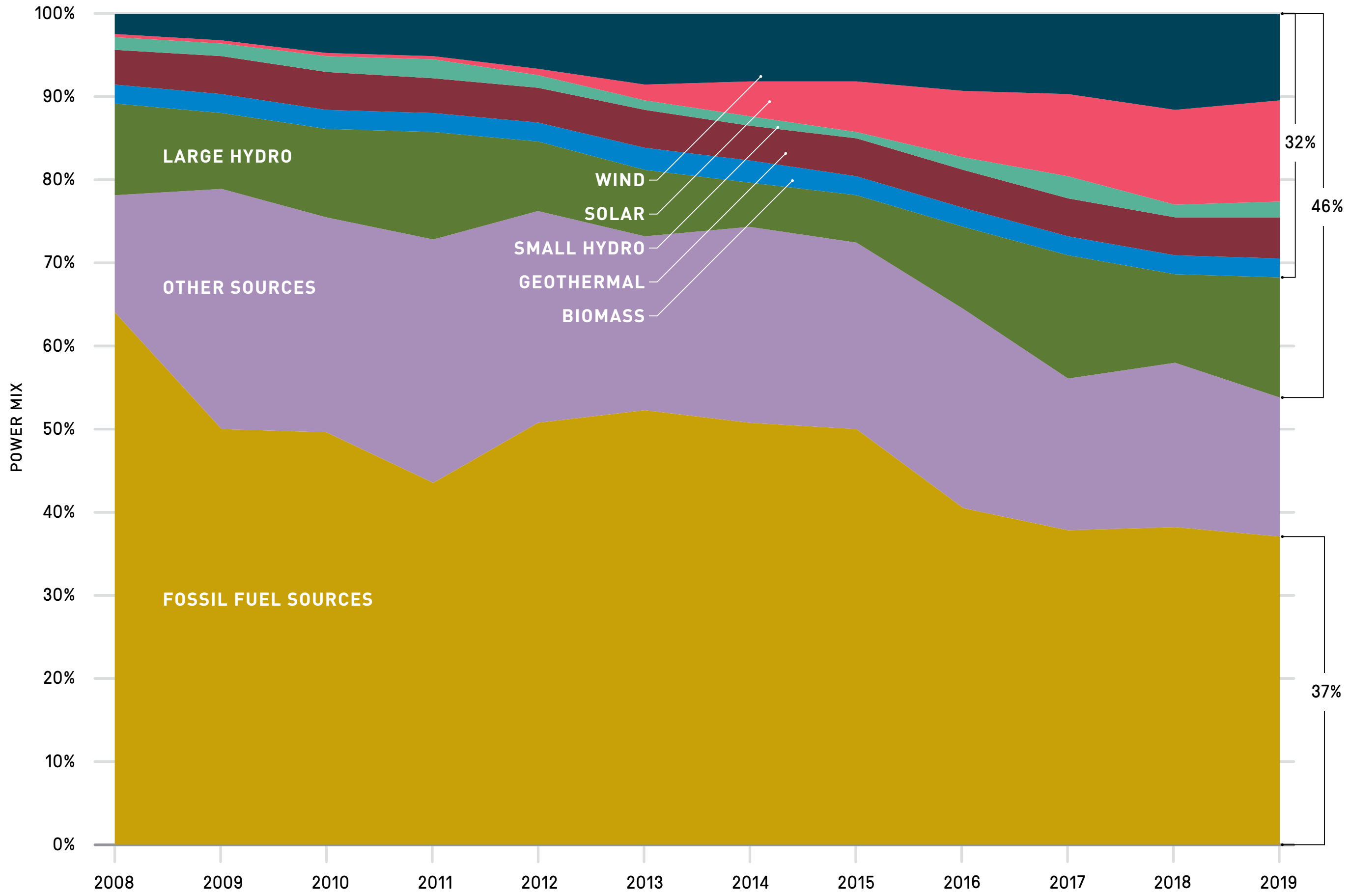
For the first time, California's renewable energy mix surpassed 30 percent in 2018. Although total generation from renewable sources declined in 2019 relative to 2018, 2019's share trended up slightly due to the overall lower generation from all sources. Solar and wind are the largest renewable sources, making up 12.3 percent and 10.2 percent, respectively, of the state's total power mix.

CHALLENGE:

Although California has a relatively diverse mix of renewables, solar accounted for almost 80 percent of the state's increased renewable energy generation from 2014 to 2019. Generation from biomass, geothermal, and small hydro remain stagnant, while there was a smaller increase in wind generation (+18%).

Figure 36. Power Mix Percentage by Source

CALIFORNIA, 2008–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Fossil Fuel Sources = Coal, Oil, and Natural Gas; Other Sources = Nuclear, Unspecified, and Other. Data Source: California Energy Commission.

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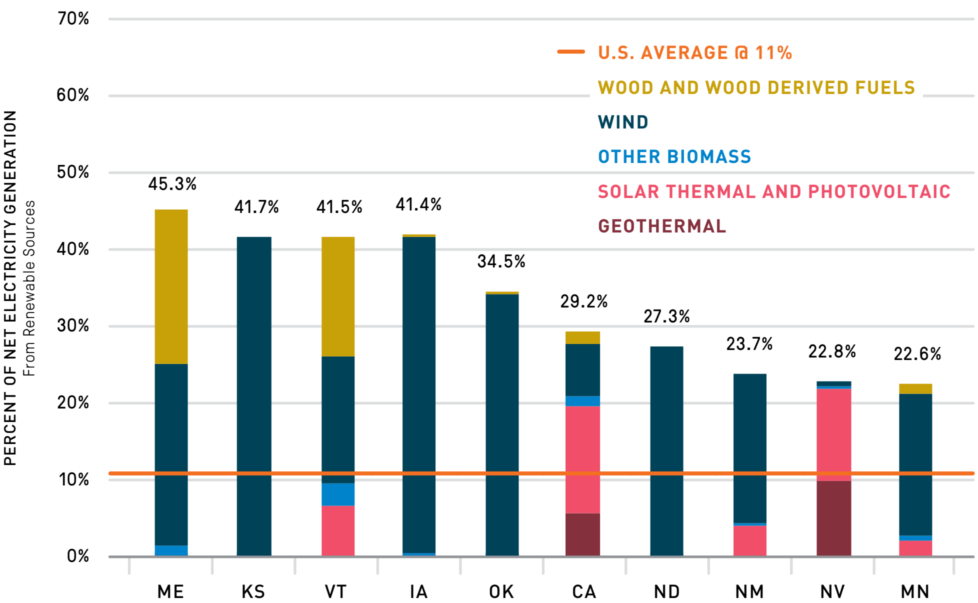
HIGHLIGHT:

Hydroelectric, solar, and wind generation are continuing to displace natural gas in California. 2017 was the first year that the share from fossil fuel sources—coal, oil and natural gas—fell below 40 percent, and the share remained below 40 percent of California's power mix in 2019. The share of renewables including large hydroelectric (46.3%) continued to surpass the combined share of fossil fuels (37.2%).

Figure 37. Renewable Sources as Percentage of Net In-State Generation

TOP 10 STATES & U.S., 2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Excludes Small Hydro, as generation on small hydro is unavailable for outside of California. Data Source: U.S. Department of Energy, Energy Information Administration. NEXT 10 / SF · CA · USA

HIGHLIGHT:

In 2019, 29.2 percent of California's net in-state generation came from renewable sources (down slightly from 30.0% in 2018), making the state the 6th-highest in the nation for renewable generation's market share (unchanged from 2018). While California doesn't have the largest share of in-state generation from renewables, its sources are cleaner than some of the top states; Maine and Vermont have some of the highest shares, but 20.3 percent and 15.7 percent of their generation, respectively, come from burning wood for biomass energy, which releases CO_2 emissions. California has the greatest share of renewable in-state generation from solar energy (14%), followed by Nevada (12%) and Vermont (6%).

Table 7. Recent Renewable Portfolio Standards Revisions

SINCE JANUARY 2019

STATE	RPS REVISION
CALIFORNIA	Increased RPS to 60% by 2030 and added goal of 100% zero-carbon electricity by 2045 (SB 100)
COLORADO	Utilities serving half a million or more customers are required to supply 100% of retail sales with clean energy sources by 2050 as long as it is technically and economically feasible and in the public interest (SB 236, 2019)
DISTRICT OF COLUMBIA	Increased RPS to 100% by 2032 with 10% solar by 2041
MAINE	50% from new renewable sources (Class I) by 2030
MARYLAND	50% Tier 1 by 2030. Also reduced Alternative Compliance Payment (ACP)
MASSACHUSETTS	Increased Class I growth rate to 2% of retail sales per year over 2020–2029 period and added a clean peak standard. The Massachusetts Department of Energy Resources determined that 1.5% of sales by retail electricity suppliers in the Commonwealth shall be met with Clean Peak Energy Certificates in the 2020 compliance year
NEVADA	50% RPS by 2030 and 100% carbon-free by 2050
NEW MEXICO	Increased RPS to 80% by 2040 and 100% carbon-free by 2045
NEW YORK	Created offshore wind procurement program with a target of 2,400 MW by 2030. Its RPS has been increased from 50% to 70% by 2030
OHIO	Reduced RPS to 8.5% from 12.5% by 2026, exempted large commercial and industrial customers, and eliminated solar carve out
VIRGINIA	Became the first southern state and seventh in the U.S. to commit to providing 100% carbon-free electricity by 2045 with the passage of the Virginia Clean Economy Act (SB 851). Phase I utilities and Phase II utilities are to achieve 100% RPS by 2050 and 2045, respectively

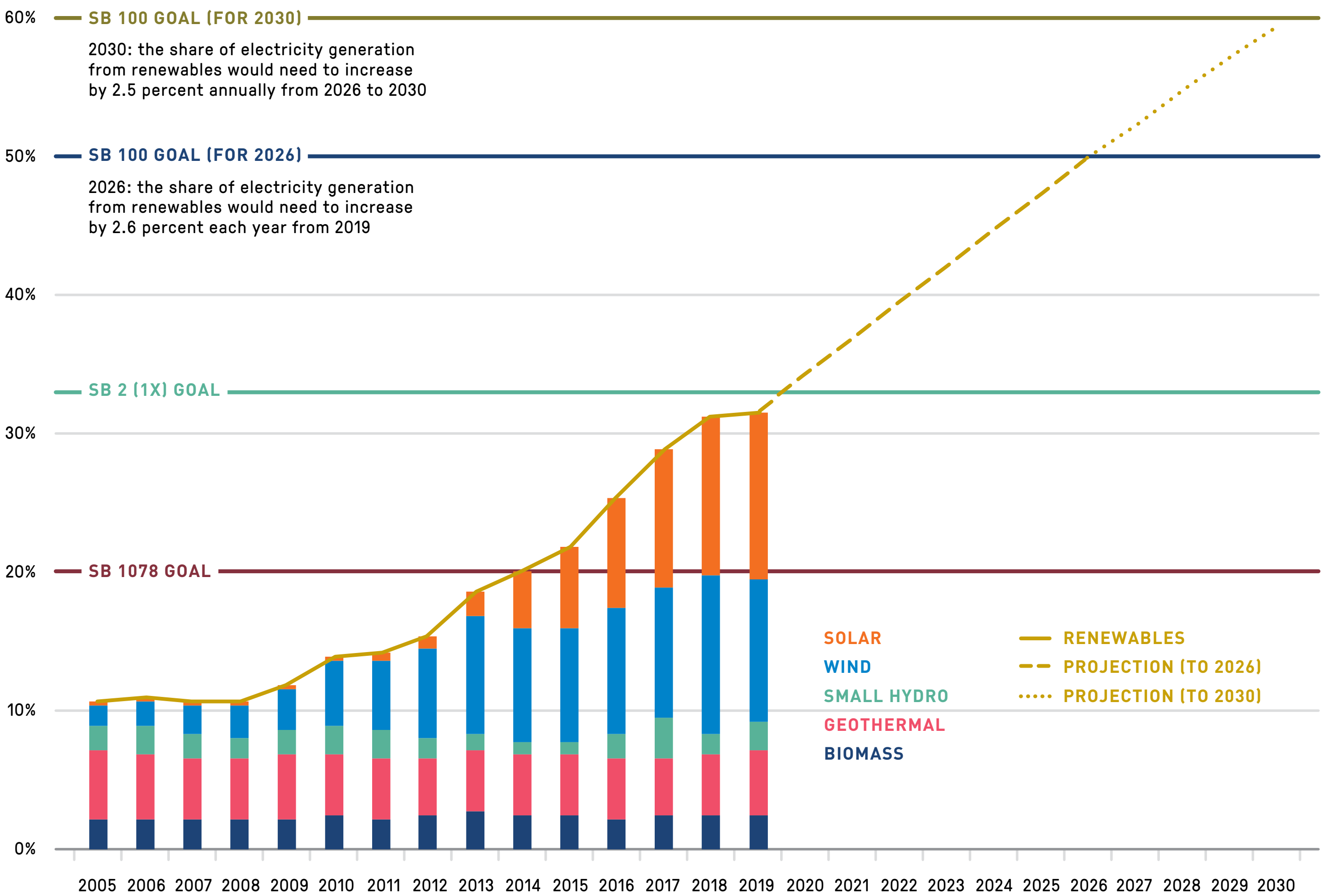
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Current as of May 2020. Data Source: Lawrence Berkeley National Laboratory; Database of State Incentives for Renewable Energy; National Conference of State Legislatures; Virginia's Legislative Information System 2020 Session. NEXT 10 / SF · CA · USA

HIGHLIGHT:

The Virginia Clean Economy Act became law and Virginia became the seventh state in the U.S. to target 100 percent carbon-free electricity in March 2020.[88] Virginia previously had a voluntary RPS goal of 15 percent by 2025.[89] The new law means Virginia now has a mandatory RPS. In addition, Phase I utilities and Phase II utilities are to achieve 100 percent RPS by 2050 and 2045, respectively.

Figure 38. California's Path to 60% RPS Goal by 2030

ASSUMING LINEAR GROWTH



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Renewables do not include large hydros. Data Source: California Energy Commission; U.S. Department of Energy, Energy Information Administration.
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Targets

LEGISLATION	GOAL	TIME HORIZON
SB 1078 (SHER, 2002)	Established RPS program with initial requirement of 20% of electricity retail sales served by renewable resources	2017
SB 2 (1X) (SIMITIAN, 2011)	Requires both public- and investor-owned utilities to procure 33% of the electricity delivered to retail customers from renewable sources	2020
SB 350 (DE LEÓN, 2015)	Increased RPS goals: 50% of state's electricity from renewables; required all LSEs and POUs to hit GHG planning targets set by ARB as part of IRP	2030
SB 100 (DE LEÓN, 2018)	Increased RPS to 60% renewables by 2030 and 100% fossil-fuel free electricity by 2045	2030, 2045

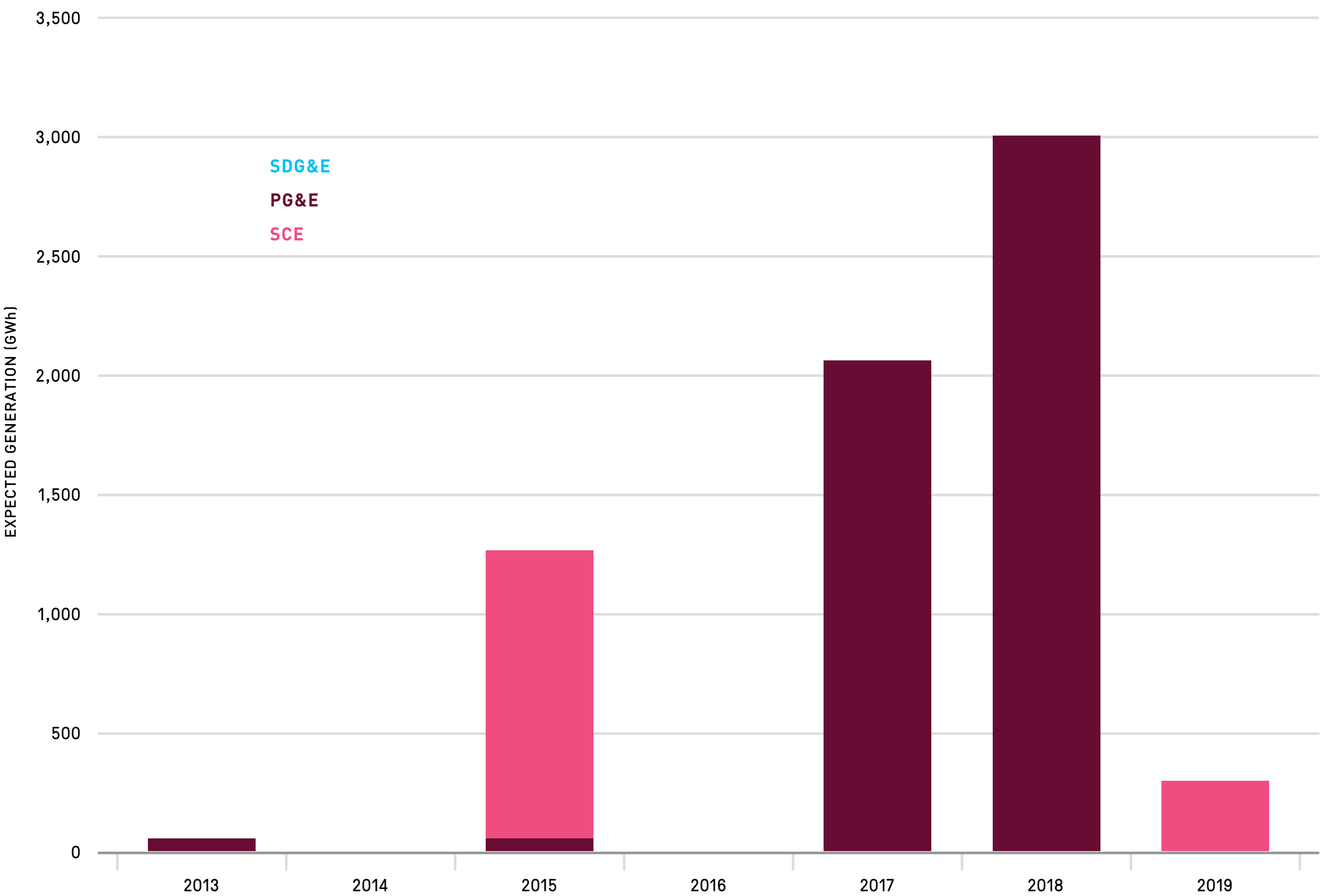
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission. NEXT 10 / SF · CA · USA

HIGHLIGHT:

At the current pace, California should meet the 50 percent and 60 percent RPS goals by 2026 and 2030, respectively. To meet the 2026 and 2030 goals, the share of electricity generation from renewables would need to increase by 2.6 percent each year from 2019 to 2026 and by 2.5 percent annually from 2026 to 2030.

Figure 39. Sale of Renewable Energy Credits

CALIFORNIA, 2013–2019



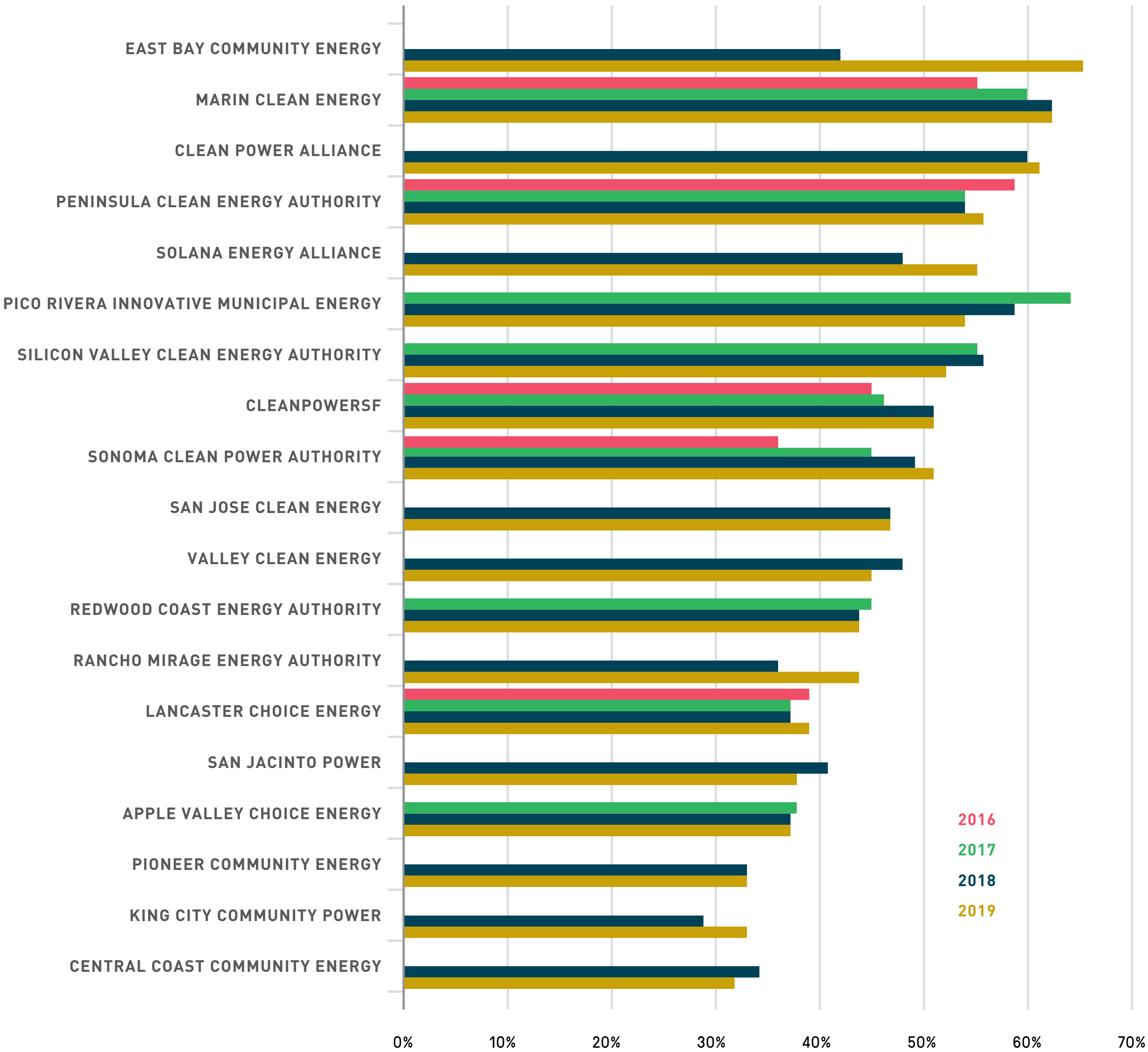
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: As of end of 2019. Data Source: California Public Utilities Commission. NEXT 10 / SF · CA · USA

HIGHLIGHT:

A utility may buy, sell, and trade renewable energy credits (RECs, or certificates of proof that a unit of energy was generated and delivered by an RPS-eligible renewable energy source) at any time, as long as it obtains and retires sufficient levels of RECs to comply with RPS requirements. Since the three investor-owned utilities (IOUs) are ahead of schedule in meeting their RPS goals, these IOUs have elected to sell their RECs to other parties and have stopped acquiring any additional RECs. After a spike in sales in 2017 and 2018, Pacific Gas & Electric (PG&E) did not sell any RECs in 2019. On the other hand, Southern California Edison (SCE) sold RECs totaling an expected annual generation of 300 GWh to Clean Power San Francisco. Many of the sales of RECs are to community choice aggregators (CCAs), which have grown considerably in recent years.[90] In 2019, nineteen CCAs provided approximately 25 percent of the electric load.

Figure 40. Annual RPS Position of Community Choice Aggregations

2016–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission compilation of CCA Draft RPS Procurement Plans 2017, 2018, 2019, and 2020.

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HIGHLIGHT:

In 2019, the 19 CCAs operating in California had an average RPS position of 47 percent, higher than the RPS positions of the state's three large IOUs—Pacific Gas & Electric (31%), Southern California Edison (38%), and San Diego Gas & Electric (39%).[91] The CPUC forecasts a decrease in the CCAs' out-of-state RPS procurement due to falling contract pricing.

CHALLENGE:

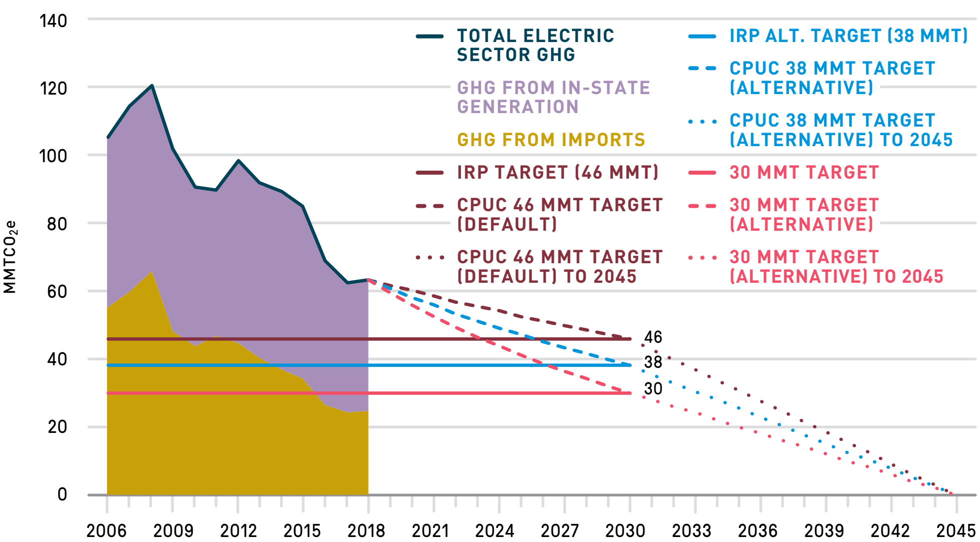
To help ensure long-term stability of the state's clean energy supply, Senate Bill 350—which created the state's 50 percent RPS target by 2030—mandates that, starting in 2021, 65 percent of RPS procurement must derive from long-term contracts (10 years or more). While the state's three investor-owned utilities (IOUs) are on track to meet the long-term procurement requirement, only five of the 29 CCAs in the state are on track to do so. Ensuring that CCAs are able to reliably meet long-term energy demands will be critical to their viability and the state's RPS target.[92]

Integrated Resource Plan and Resource Adequacy

In March 2020, the California Public Utilities Commission voted to approve a target to reduce emissions for the electric sector to 46 million metric tons of carbon dioxide-equivalent ($MMTCO_2e$) by 2030, with an alternative scenario of a 38 MMTCO2e reduction target by the same year.[93] Per the CPUC's Integrated Resource Plan (IRP) for the 2019-2020 cycle, the CPUC has studied the electric system operational and reliability and arrived at the current decision, after giving considerations for balancing GHG emissions reductions, ratepayer costs, and system reliability. In California, each load-serving entity (including IOUs, CCAs, and others) is required to submit an IRP. An IRP is important as it determines where electricity will come from, the cleanliness of the power mix, and whether California will meet its clean energy goals. The CPUC voted to limit GHG emissions to 46 $MMTCO_2e$ by 2030, which is at the high end of the 30 $MMTCO_2e$ to 53 $MMTCO_2e$ range provided by the California Air Resources Board.

Figure 41. Electric Sector GHG Emissions

CALIFORNIA, CPUC INTEGRATED RESOURCE PLAN SCENARIOS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board GHG Inventory; California Public Utilities Commission.
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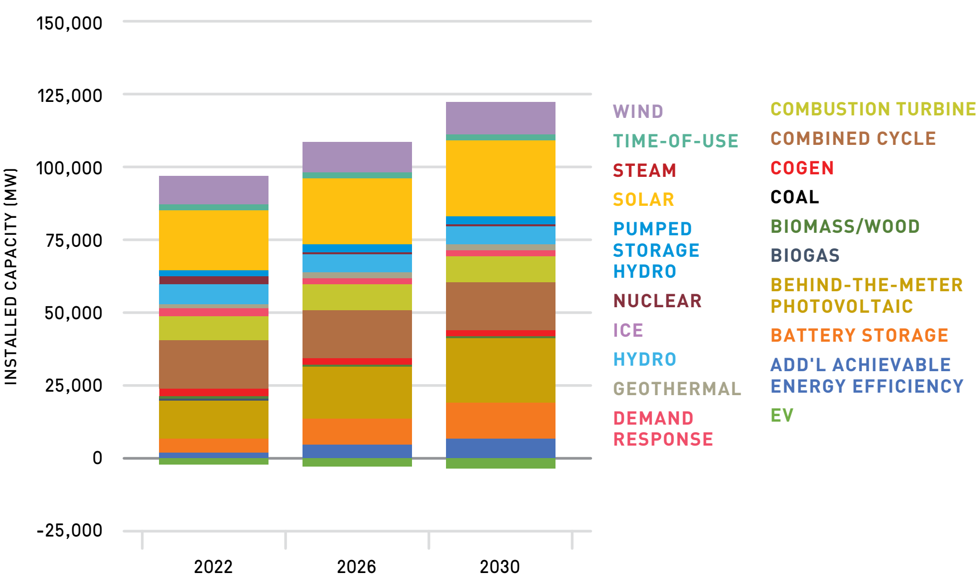
CHALLENGE:

From 2006 to 2018, GHG emissions from the electric sector decreased on a compounded average basis of 4.1 percent per year. Under the 46 $MMTCO_2e$ scenario, however, from 2018 to 2030, emissions from the state's electric sector would only need to decrease by 2.6 percent per year on a compounded average basis, or 1.4 $MMTCO_2e$ on a linear basis. While California's electricity providers are still subject to the 60 percent RPS requirement by 2030 under this scenario, proceeding with the current target could make it substantially more difficult to achieve carbon neutrality by 2045, as it would require an annual reduction of 3.1 $MMTCO_2e$ linearly from 2030 to 2045.[94]

Figure 42. CAISO Region: 46 $MMTCO_2e$ IRP Scenario



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: CAISO footprint is modeled as the following four regions: PG&E Valley, PG&E Bay, Southern California Edison, and San Diego Gas & Electric. Data Source: California Public Utilities Commission. NEXT 10 / SF · CA · USA

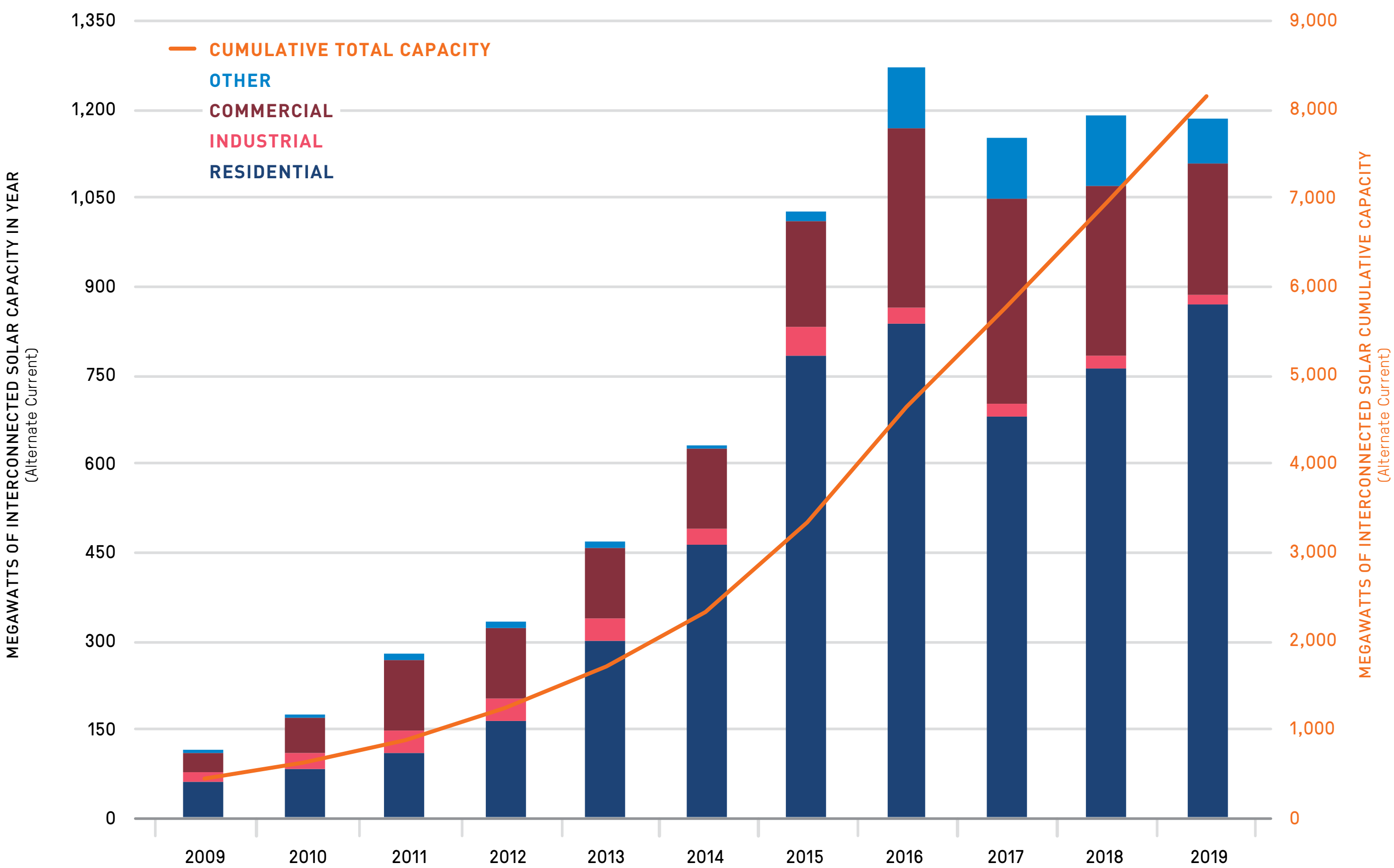
HIGHLIGHT:

In the 46 $MMTCO_2e$ scenario, the CAISO region will increasingly depend on battery-storage to meet future GHG reduction needs. Additional battery capacity is crucial to address capacity shortfall and provide operational flexibility. Between 2022 to 2030, the CAISO region is expected to increase battery storage by 152 percent, solar (not including behind-the-meter photovoltaic) by 23 percent, and wind by 16 percent. The plan also calls for a reduction of coal to zero by 2026.

SOLAR

Figure 43. Interconnected Solar in California

2009–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: The data set only includes interconnected solar PV Net Energy Metering (NEM) systems within PG&E, SCE, and SDG&E service territories 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." Other includes the educational, military, non-profit, and government sectors. Data Source: Currently Interconnected Data Set, California Solar Statistics. NEXT 10 / SF · CA · USA

HIGHLIGHT:

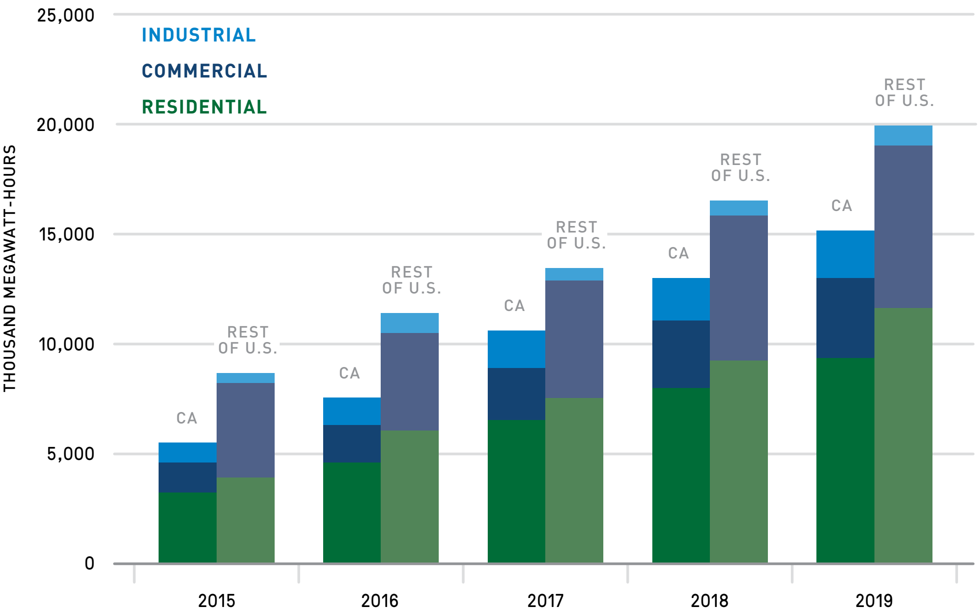
Interconnected solar photovoltaic (PV) Net Energy Metering (NEM) systems installations[95] within the three investor-owned utilities service territories totaled 1,186 megawatts (in alternate current) in 2019, a 0.2 percent decrease from 2018, and a seven percent decrease since peak capacity in 2016. Declines in the commercial sector (-23.5%), industrial sector (-0.9%), and other sector (-34.2%) contributed to the total decrease in 2019. However, the residential sector increased by 13.9 percent, and as a share of total capacity, it increased by nine percentage points—from 64 percent of total capacity in 2018 to 73 percent in 2019. This boost may be a reflection of developments responding to the state's home solar mandate—requiring most new residential buildings to have solar panels—which took effect January 1, 2020.

CHALLENGE:

2019 reveals a potential start of a rising trend in solar installation in the residential sector in response to California's home solar mandate. However, shortly after the mandate came into effect in 2020, its credibility was tested. In February, California regulators approved a proposal in Sacramento that would allow some new homes to be powered by the Sacramento Municipal Utility District's new off-site solar farm instead of individual rooftop solar panels, allowing developers to build new homes without solar.[96] This outcome may inspire other regions to follow suit, undermining possible increases in solar installation in the residential sector across the state.

Figure 44. Small Scale Net Generation from Solar PV

CALIFORNIA AND U.S. (W/O CA), 2015–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Small scale usually refers to system that is less than 1 megawatt in size. So this would typically be residential rooftop solar and some commercial rooftop solar. Data Source: U.S. Energy Information Administration. NEXT 10 / SF · CA · USA

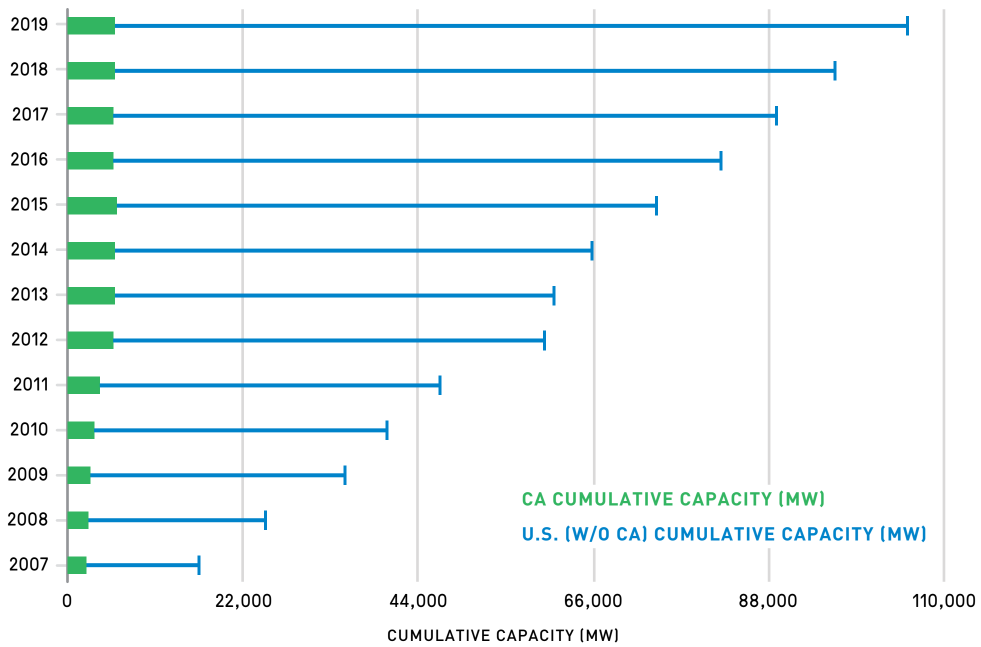
HIGHLIGHT:

As of 2019, California accounted for 43 percent of small scale solar PV net generation in the U.S., including a staggering 71 percent of industrial sector small-scale solar PV generation. Small-scale solar PV generation increased by 16 percent from 2018 to 2019 for California, and by 21 percent for the rest of U.S. By sector, small-scale solar PV generation grew 15 percent in the commercial sector, 18 percent in the residential sector, and 12 percent in the industrial sector in California from 2018 to 2019. Another notable trend is that small-scale solar PV generation in the industrial sector is higher in California than the rest of the U.S. every year.

WIND

Figure 45. Cumulative Wind Capacity

CALIFORNIA VS. U.S., 2007–2019



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Utility-scale wind capacity includes installations of wind turbines larger than 100-KW. Data Source: American Wind Energy Association. NEXT 10 / SF · CA · USA

HIGHLIGHT:

California's cumulative wind capacity was 5,973 MW in 2019 (+133 MW). The rest of the U.S. added 9,010 MW of wind capacity in 2019, reaching a total U.S. cumulative capacity of 105,583 MW. Total wind capacity has remained largely stagnant in California since 2012, but it continues to expand in the rest of U.S.

OPPORTUNITY:

California has lower than average wind speed, constraining its ability to generate wind energy. The state could import wind energy from other western states to complement the state's daytime solar generation or could develop offshore wind. One study estimates that the state's coastline has the potential to generate about 1.5 times California's energy consumption in offshore wind each year.[97]

Energy Efficiency

Key Findings

California has a long history of leading on energy efficiency—from adopting the first-in-the-nation appliance efficiency standards (Title 20) in the 1970s to the first standards on battery chargers in 2012. And while energy efficiency has long-been prioritized in the state, as California looks to transition away from fossil fuels and toward greater utilization of clean electricity sources, there is also increasing momentum to electrify buildings, homes, and transportation.

Efficient use of electricity in particular will become increasingly important as the state looks to meet climate and clean energy goals. Since 1990, California has slightly more than doubled its energy efficiency. In 2015, the state passed Senate Bill 350 (SB 350), which sets a target for the state to double energy efficiency by 2030 compared to 2015.[98] However, despite this history of action and the long-term efficiency gains, **the state is not on track to meet the SB 350 target of doubling its energy efficiency by 2030** at the current rate of improvement.

Energy Productivity

- In 2017, California generated $3.64 of GDP (inflation-adjusted) for every 10,000 British Thermal Units (BTU) of energy consumed, almost **double the national average** of $1.90/10,000 BTU of energy consumed.
- California has outperformed the U.S. overall (without California) in terms of energy efficiency gains as a share of GDP produced over the last 20 years–**improving 80 percent** in California compared to 48 percent in the U.S. from 1997 to 2017.
- Despite these efficiency gains, California is not on track to doubling energy efficiency savings by 2030 on either electricity efficiency or natural gas efficiency, **falling 44 percent and 28 percent short,** respectively.

Energy Consumption

- California's total statewide energy consumption was 5.9 percent higher in 2017 than in 1990, but energy consumption per capita **declined 19.8 percent,** indicating more efficient use of the energy the state does consume.
- Natural gas consumption in the residential sector saw the **greatest decline (-12.6%)** from 2008 to 2018, while electricity consumption in the same sector increased 2.1 percent during the same period.
- Since 2000, per capita natural gas consumption has gradually decreased while per capita electricity consumption has held steady. However, natural gas consumption is still higher than electricity consumption, indicating that the state has **a long way to go** in terms of electrification, especially in the residential sector.

Energy Intensity

- Energy intensity (energy consumption relative to GDP) **decreased by 2.7 percent** from 2017 to 2016—a marked improvement over the previous year's 1.1 percent decrease from 2015 to 2016.
- Overall, energy intensity in the transportation sector **fell 23.1 percent** from 2007 to 2017—roughly in line with all other sectors.

Electricity Consumption

- In 2018, California's electricity consumption per capita of 6.47 megawatt-hours (MWh) was significantly lower than in the other most populous states. Between 2008 and 2018, electricity consumption per capita **declined 11.7 percent** in California.
- California was the only populous state where electricity consumption per capita fell between 2017 and 2018, **declining 1.0 percent.** On average, consumption in the U.S. without California increased 3.4 percent over the same period.

Electricity Bill

- Though California and New York have some of the highest electricity cost per kilowatt-hour among populous states, they also have the lowest electricity bill as percentage of GDP—**1.4 percent and 1.3 percent** in 2018, respectively. By comparison, the U.S. without California's electricity bill was 2.1 percent of its GDP in 2018.
- In 2018, California's average monthly residential and industrial electricity bills were **12.5 percent and 46.5 percent lower** than those in the U.S., respectively. However, California's average monthly commercial electricity bill was **39.3 percent higher** than in the U.S.

Energy Transition in Residential Fueling

- Natural gas consumption in California is still higher than electricity consumption—indicating that the state has a long way to go in terms of electrification, especially in the residential sector, where natural gas consumption was almost **40 percent higher** than electricity consumption in 2018.
- Of the major fueling sources used in residential buildings, the share of utility gas has decreased gradually over time, from 67.7 percent in 2008 to **63.9 percent** in 2018. On the other hand, electricity's share has gradually increased, from 23.6 percent in 2008 to **26.7 percent** in 2018.
- Electricity and solar energy together saw the greatest growth as a percent (+24.5%) from 2007 to 2018. Residential units with no heating fuel have also grown over the period, **increasing 33.6 percent** from 2007 to 2018.

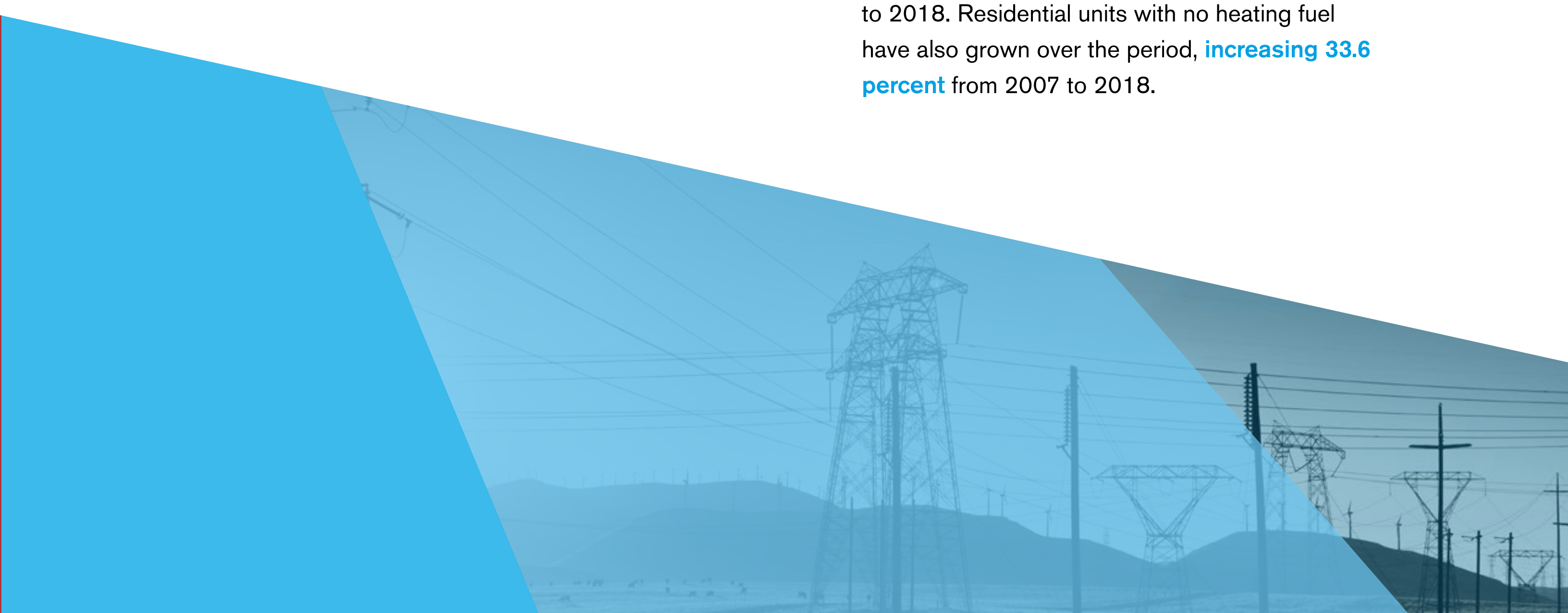
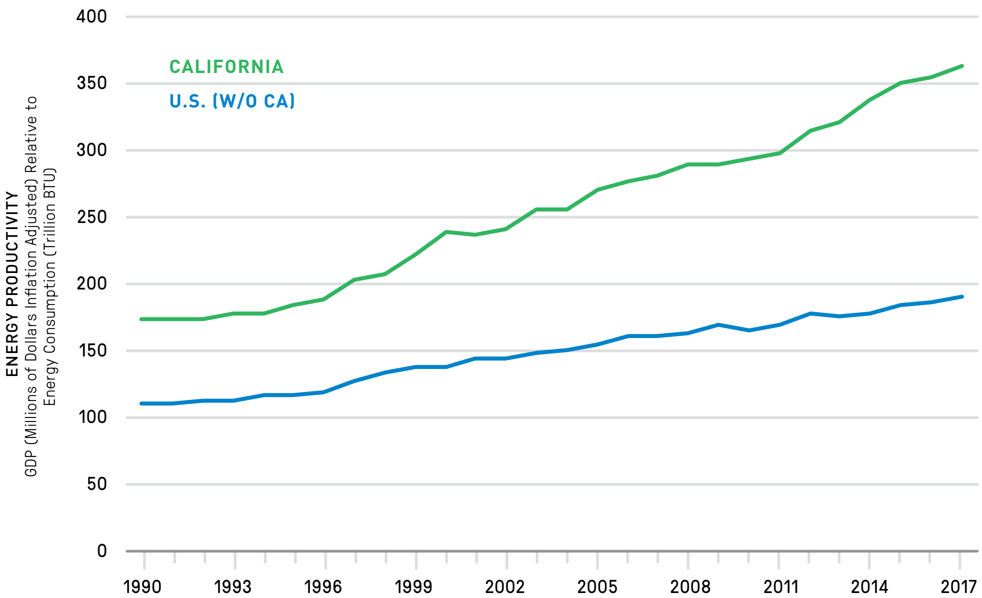


Figure 46. Energy Productivity (GDP Relative to Total Energy Consumption)

CALIFORNIA & THE REST OF THE U.S., 1990–2017



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. NEXT 10 / SF · CA · USA

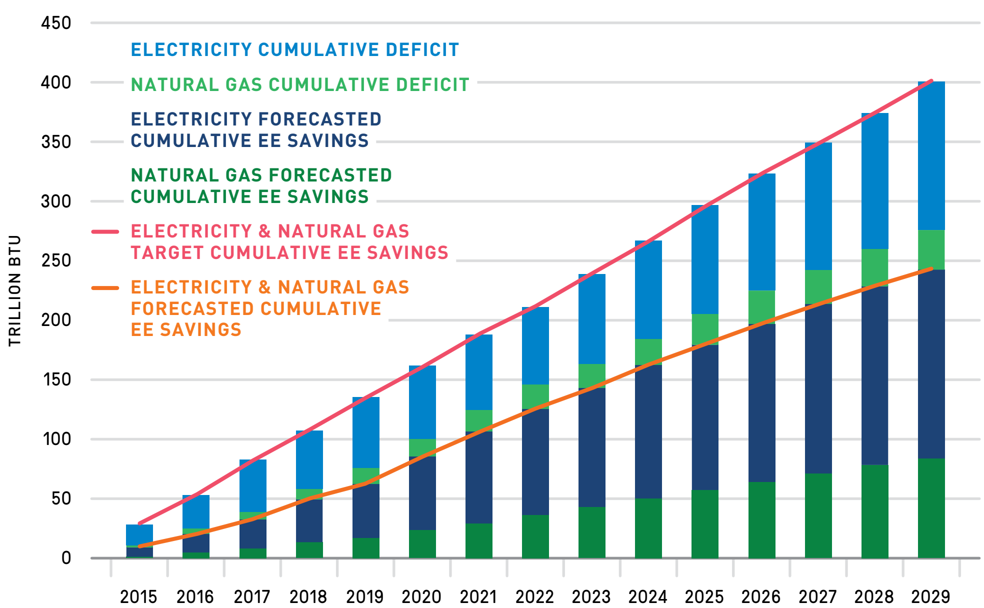
HIGHLIGHTS:

❶ California continues to spring ahead of the U.S. in energy productivity. In absolute terms, California generated $3.64 of GDP in 2017 (inflation-adjusted in 2018 U.S. dollars) for every 10,000 British Thermal Units (BTU) of energy consumed. The U.S. generated just $1.90 of economic output for the same amount of energy consumed.

❷ In relative terms, California outperformed the U.S. in energy efficiency gains over the last 20 years. Energy productivity in California and the U.S. grew 79.5 percent and 48.0 percent, respectively, between 1997 and 2017, and by 28.9 percent and 18.0 percent, respectively, from 2007 to 2017. Even over the five-year period from 2012 to 2017, it grew 15.6 percent in California and 6.4 percent in the U.S.

Figure 47. Targeted vs. Forecasted Cumulative SB 350 Energy Efficiency Savings

CALIFORNIA, 2015–2029



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

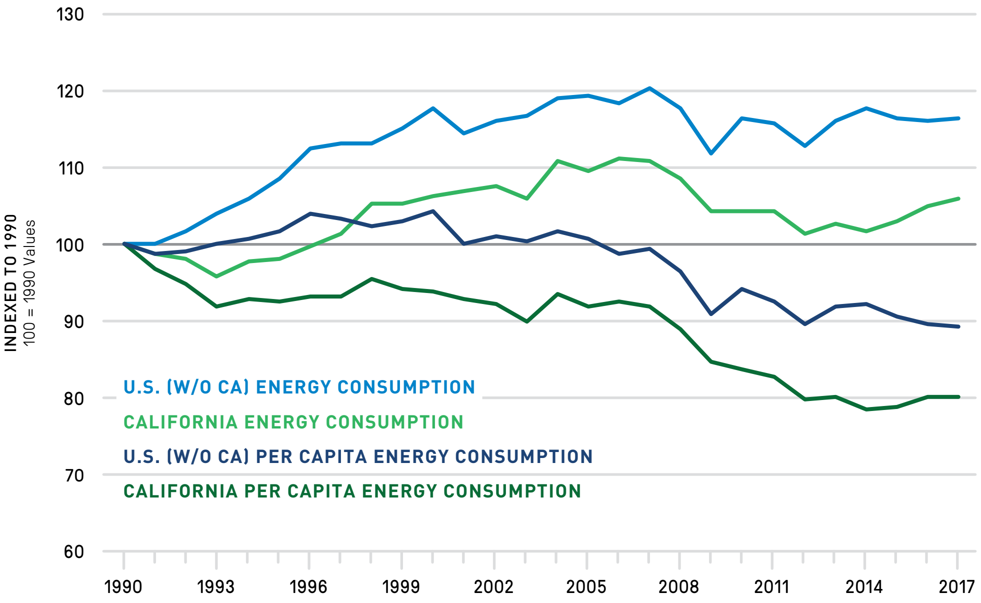
CHALLENGE:

Based on current savings projections, California is not on track to doubling energy efficiency savings by 2030 on either electricity efficiency or natural gas efficiency. Electricity and natural gas savings are forecasted to be 44 percent and 28 percent short of the 2030 goals, respectively. For electricity, the residential and commercial sectors will be where most of the energy savings come from. Whereas, for natural gas, the residential sector followed by the industrial sector will derive most of the energy savings.

Energy Consumption

Figure 48. Total and Per Capita Energy Consumption Relative to 1990

CALIFORNIA & THE REST OF THE U.S., 1990–2017



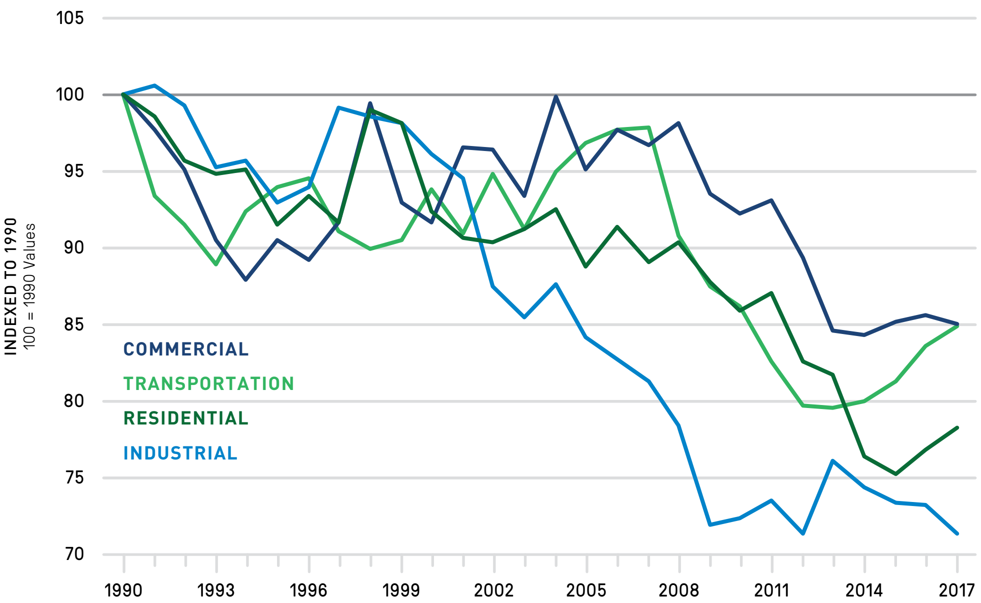
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Census Bureau, Population Estimates Branch. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Although California's total statewide energy consumption was 5.9 percent higher in 2017 than in 1990, energy consumption per capita declined 19.8 percent. Overall, California is doing significantly better than the rest of the U.S. from an energy efficiency standpoint; between 1990 and 2017, total energy consumption in the rest of the U.S. grew almost three times as much as in California (16.5% vs. 5.9%). Meanwhile consumption per capita in the U.S. fell by only about half as much as California's rate with a 10.6 percent reduction.

Figure 49. Energy Consumption Per Capita by Sector Relative to 1990

CALIFORNIA, 1990–2017



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

HIGHLIGHT:

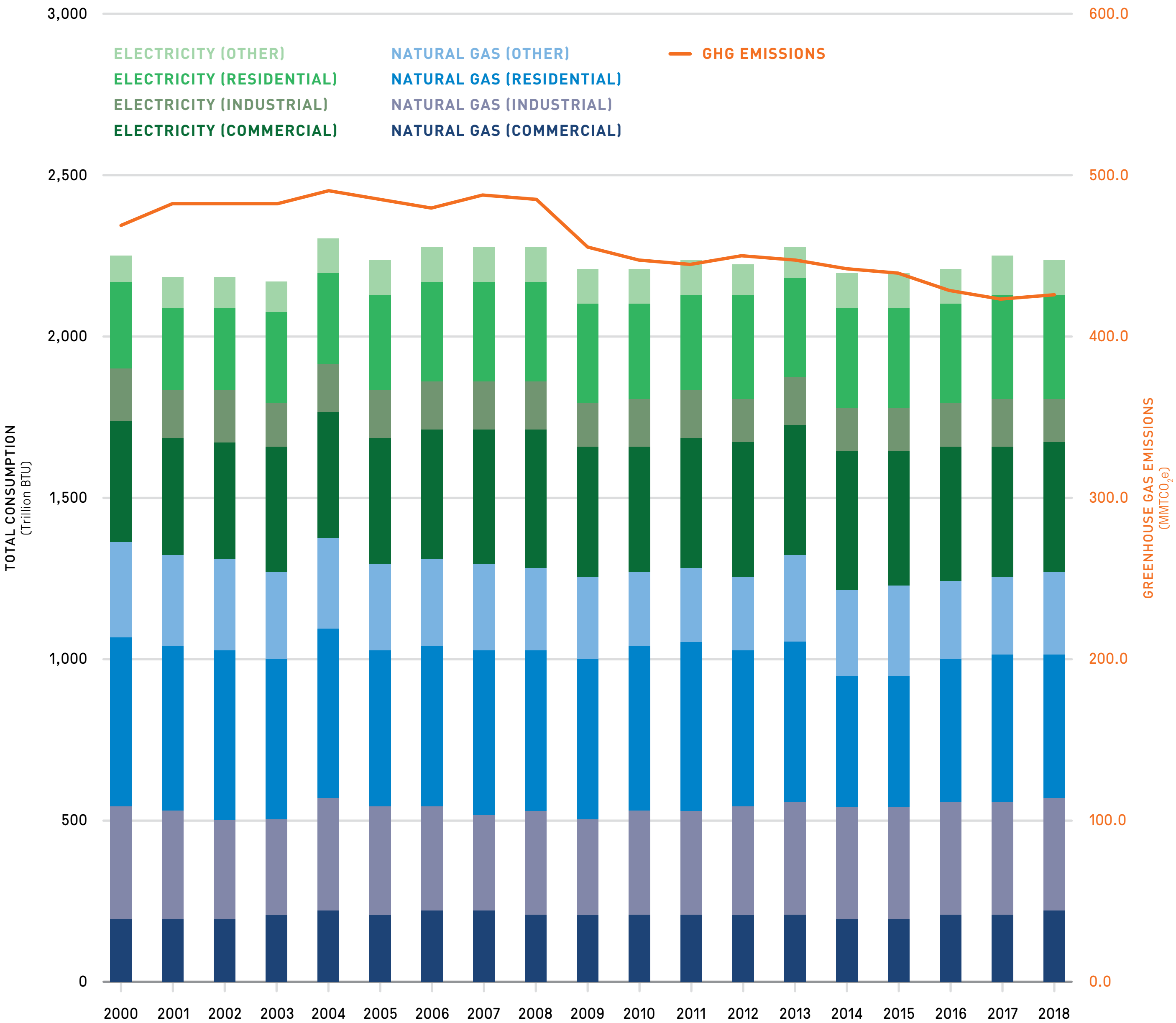
Energy consumption per capita in 2017 was substantially lower across all sectors in California than in 1990. In particular, energy consumption per capita in the industrial sector has declined extraordinarily and is the only sector where consumption has fallen consecutively year-over-year since 2014.

CHALLENGE:

While energy consumption in the industrial sector has been declining in recent years, the opposite is true for the residential and the transportation sectors—it rose 2.0 percent and 1.4 percent, respectively, from 2016 to 2017. In the transportation sector in particular, energy consumption increased 6.3 percent from 2012 to 2017—the largest increase from any sector.

Figure 50. Natural Gas and Electricity Consumption by Sector

CALIFORNIA, 2000–2018



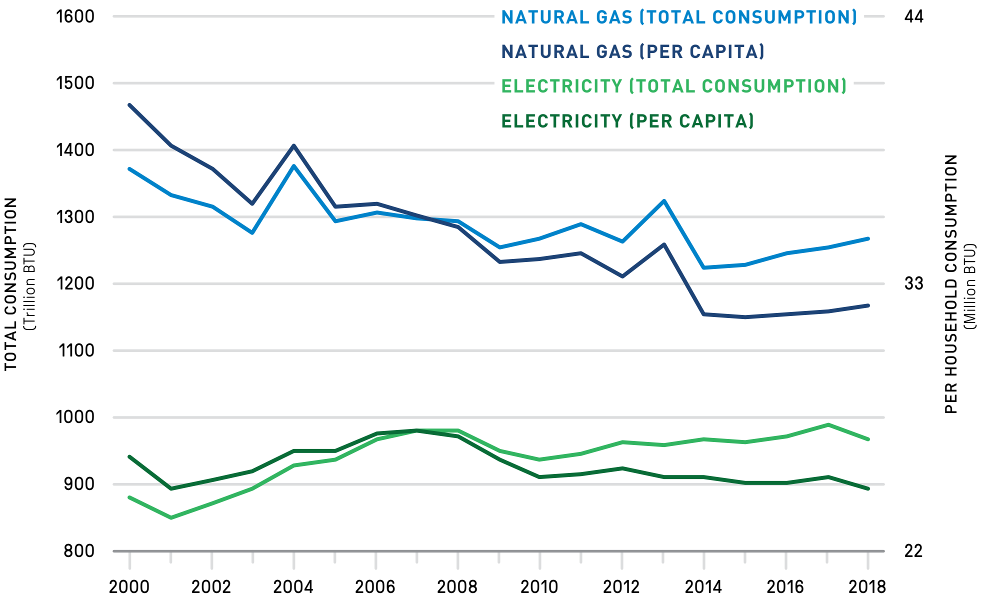
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Other Sectors include Agriculture, Mining & Construction, and Streetlights. Data Source: California Energy Consumption Database, California Energy Commission. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ Natural gas and electricity consumption combined has held steady in California since 2000—even as the statewide population increased by 16 percent from 2000 to 2018. Within the total combined consumption, natural gas consumption has steadily decreased while electricity consumption has gradually increased. Given that natural gas is a greenhouse gas-emitting fossil fuel, this is encouraging news and indicates that the state's electricity grid has truly become cleaner over time with the addition of more renewable energy. ❷ Over the 10 years from 2008 to 2018, natural gas consumption in the residential sector—the largest natural gas-consuming sector—saw the greatest decline (-12.6%), while electricity consumption in the same sector increased 2.1 percent during the same period. The industrial sector is the second-largest natural gas-consuming sector. After bottoming out in 2008, consumption of natural gas in this sector grew 11.7 percent by 2018. Meanwhile, electricity consumption in the industrial sector declined 6.3 percent during the same 10-year period.

Figure 51. Natural Gas and Electricity Consumption, All Sectors

CALIFORNIA, 2000–2018



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

HIGHLIGHT:

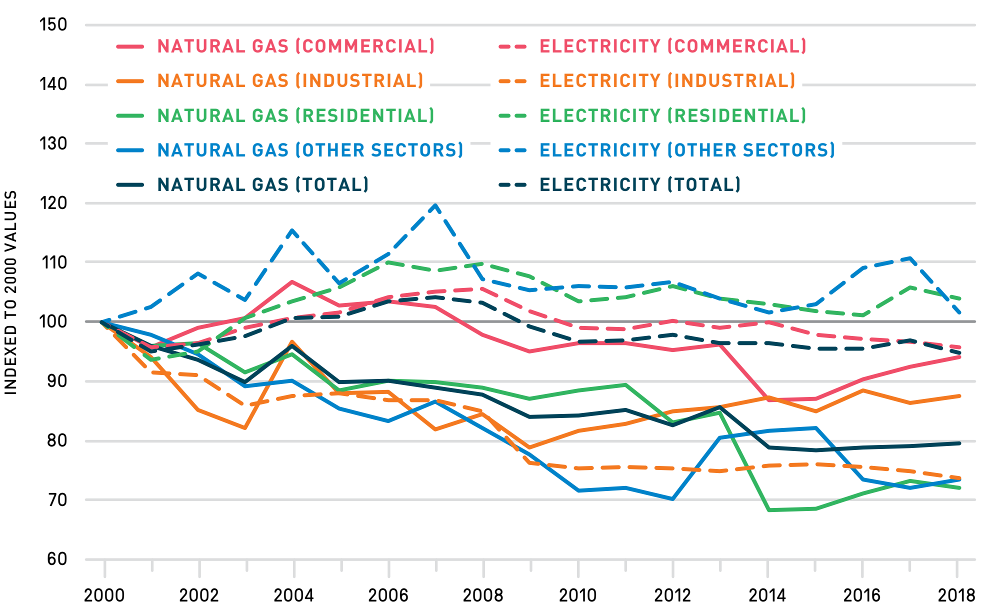
Natural gas consumption per capita has gradually decreased since 2000, while per capita electricity consumption has held steady. In 2018, total natural gas and electricity consumption per capita across all sectors was 32.1 million BTU and 24.6 million BTU, respectively.

CHALLENGE:

Natural gas consumption in California is still higher than electricity consumption—indicating that the state has a long way to go in terms of electrification, especially in the residential sector, where natural gas consumption is almost 40 percent higher than electricity consumption in 2018. The commercial sector is the only major sector where electricity consumption is higher than natural gas consumption.

Figure 52. Natural Gas and Electricity Consumption Per Capita by Sector

CALIFORNIA, 2000–2018



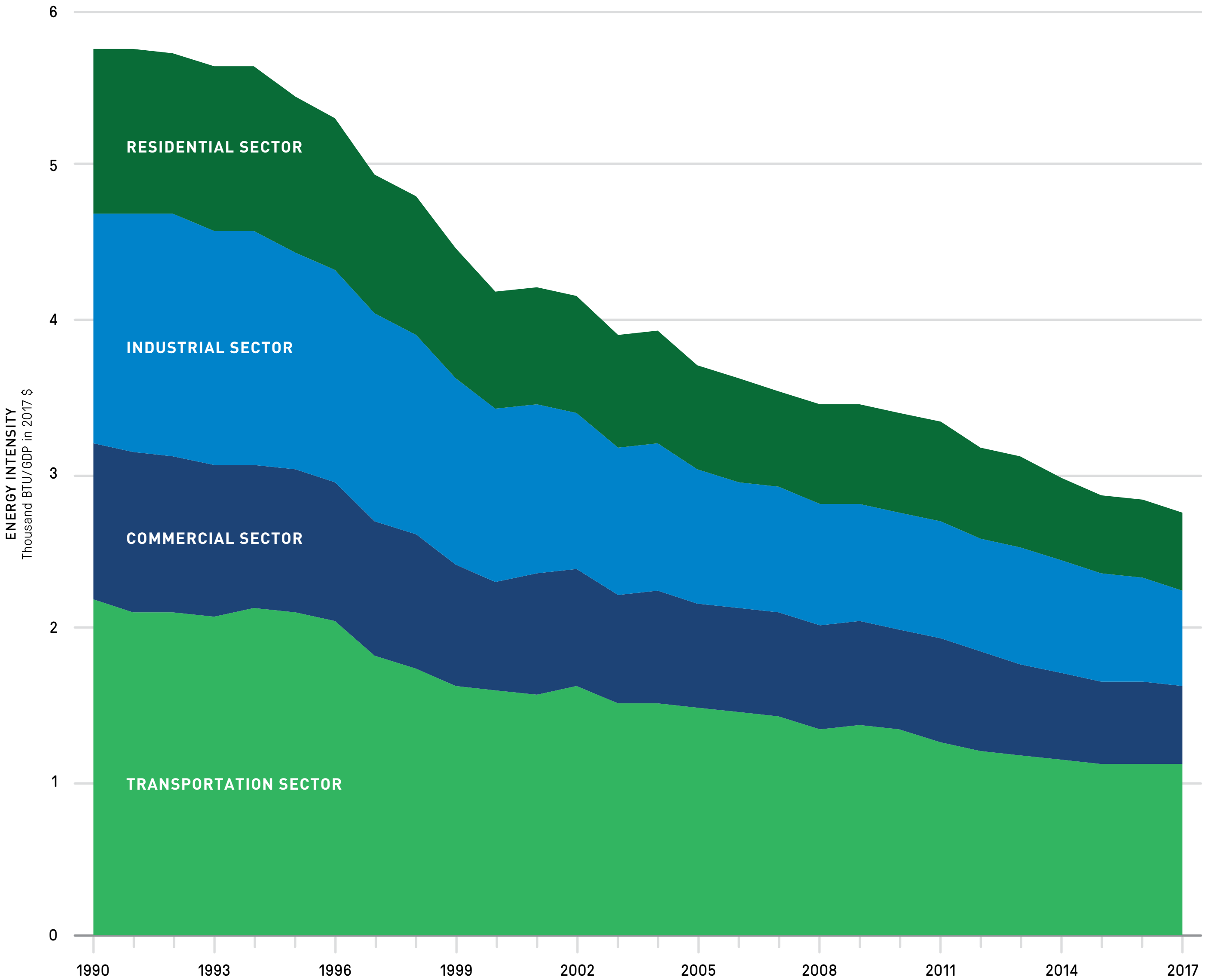
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Other Sectors include Agriculture, Mining & Construction, and Streetlights. Data Source: California Energy Consumption Database, California Energy Commission. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Per capita natural gas consumption across all sectors was about 20 percent lower in 2018 than in 2000. The downward trend holds true for every sector, though there has been a small uptick in per capita natural gas consumption in the commercial sector. On the other hand, per capita electricity consumption (all sectors) was only five percent lower in 2018 than in 2000. Overall, per capita electricity consumption has increased (residential and other sectors) or stayed relatively the same (commercial sector) over the time period. The only sector that saw a gradual decrease in per capita electricity consumption was industrial. The fact that both per capita natural gas and electricity consumption have been decreasing indicates that the state's energy efficiency has improved over time.

Figure 53. Energy Intensity

TOTAL ENERGY CONSUMPTION BY SECTOR RELATIVE TO GDP, CALIFORNIA, 1990–2017



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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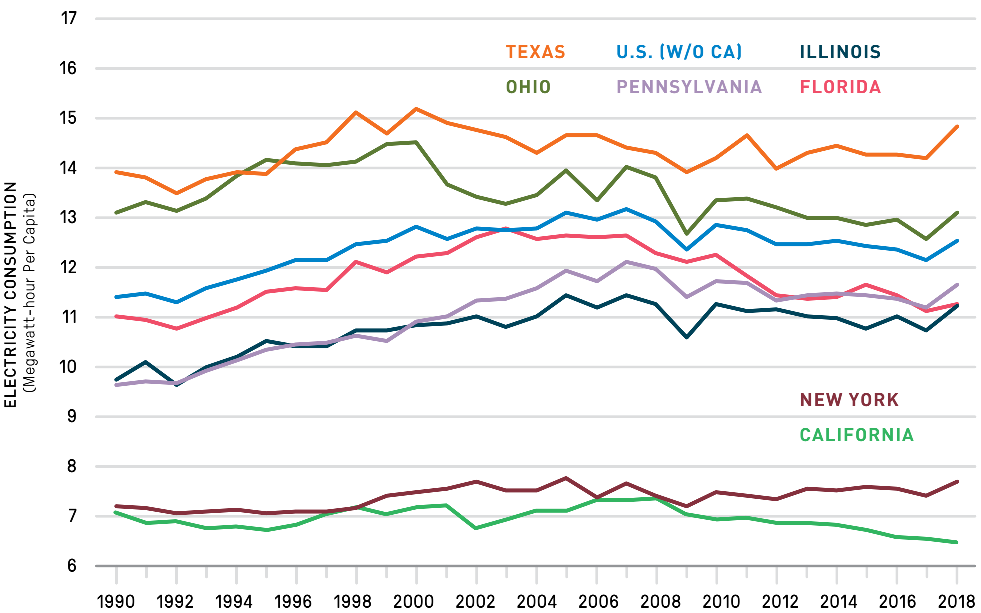
HIGHLIGHTS:

❶ In 2017, energy intensity (energy input relative to GDP output) decreased by 2.7 percent compared to 2016, more than double the previous year's decrease of 1.1 percent. The drop was once again led by a 5.2 percent reduction in the industrial sector followed by a 3.5 percent decrease in the commercial sector. ❷ Although energy intensity for the transportation sector decreased by only 1.5 percent year-over-year in 2017, energy intensity overall in the transportation sector fell 23.1 percent from 2007 to 2017—which is in line with the other sectors: commercial (-22.0%), industrial (-22.0%), and residential (-21.4%).

Electricity Consumption

Figure 54. Statewide Electricity Consumption Per Capita

CALIFORNIA, FLORIDA, ILLINOIS, NEW YORK, OHIO, PENNSYLVANIA, TEXAS, & U.S. WITHOUT CALIFORNIA, 1990–2018



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

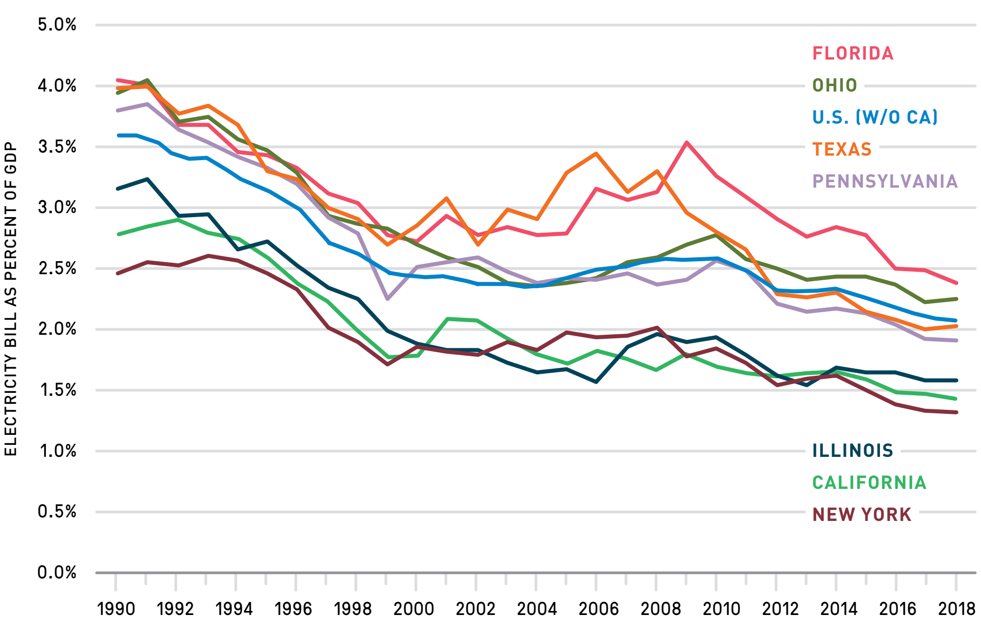
HIGHLIGHT:

California's electricity consumption per capita in 2018 (6.47MW) was significantly lower than other large states in the nation. Electricity consumption per capita in California and New York has remained below 10 MWh since 1993, but between 2008 and 2018, electricity consumption per capita declined 11.7 percent in California and increased 3.7 percent in New York. Between 2017 and 2018, California was the only large state where electricity consumption per capita fell (-1.0%). The average consumption in all other states (U.S. without California) increased 3.4 percent over the same time period.

Electricity Bill

Figure 55. Statewide Electricity Bill as a Percent of GDP

CALIFORNIA, FLORIDA, ILLINOIS, NEW YORK, OHIO, PENNSYLVANIA, TEXAS, & U.S. WITHOUT CALIFORNIA, 1990–2018



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. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Over the last decade, statewide electricity bills as a percent of GDP have been declining across the U.S. California, Illinois, and New York are the states with the lowest electricity costs as a share of state GDP. While California has the highest average electricity retail price among the large states (16.58 cents/kWh, compared to 14.83 cents/kWh in New York and 9.60 cents/kWh in Illinois),[99] the state's electricity bill as a share of GDP is among the lowest, driven by extensive energy efficiency programs and policies that have decreased per capita growth in electricity demand.

Table 8. Electricity Prices and Bills (Inflation-Adjusted) by Sector

CALIFORNIA & THE REST OF THE U.S.

	REGION	PRICE PER kWh	AVERAGE MONTHLY BILL		
		2018	2008	2018	10YR % CHANGE
RESIDENTIAL	CALIFORNIA	$0.19	$94.59	$102.90	8.8%
	FLORIDA	$0.12	$152.22	$128.10	-15.8%
	ILLINOIS	$0.13	$98.70	$94.98	-3.8%
	NEW YORK	$0.19	$126.52	$111.93	-11.5%
	OHIO	$0.13	$106.72	$114.80	7.6%
	PENNSYLVANIA	$0.14	$114.01	$120.04	5.3%
	TEXAS	$0.11	$171.67	$131.63	-23.3%
	UNITED STATES	$0.13	$120.87	$117.65	-2.7%
INDUSTRIAL	CALIFORNIA	$0.13	$6,469.41	$3,670.05	-43.3%
	FLORIDA	$0.08	$6,782.89	$4,987.19	-26.5%
	ILLINOIS	$0.07	$53,942.17	$43,713.76	-19.0%
	NEW YORK	$0.06	$15,271.34	$13,168.56	-13.8%
	OHIO	$0.07	$16,651.36	$15,993.00	-4.0%
	PENNSYLVANIA	$0.07	$11,942.79	$23,855.24	99.7%
	TEXAS	$0.05	$5,614.12	$4,410.96	-21.4%
	UNITED STATES	$0.07	$8,809.71	$6,864.28	-22.1%
COMMERCIAL	CALIFORNIA	$0.16	$843.47	$919.62	9.0%
	FLORIDA	$0.09	$813.13	$599.48	-26.3%
	ILLINOIS	$0.09	$793.03	$626.35	-21.0%
	NEW YORK	$0.15	$1,224.17	$837.96	-31.5%
	OHIO	$0.10	$693.03	$630.59	-9.0%
	PENNSYLVANIA	$0.09	$638.58	$449.17	-29.7%
	TEXAS	$0.08	$836.83	$613.53	-26.7%
	UNITED STATES	$0.11	$757.50	$660.32	-12.8%

	REGION	GDP IN MILLIONS		
		2008	2018	10YR % CHANGE
GROSS DOMESTIC PRODUCT (MILLIONS OF 2018 DOLLARS)	CALIFORNIA	$2,339,899	$2,968,118	26.8%
	FLORIDA	$907,760	$1,036,323	14.2%
	ILLINOIS	$791,296	$864,587	9.3%
	NEW YORK	$1,371,301	$1,676,350	22.2%
	OHIO	$603,912	$676,193	12.0%
	PENNSYLVANIA	$690,782	$788,538	14.2%
	TEXAS	$1,351,192	$1,775,797	31.4%
	UNITED STATES	$17,224,824	$20,494,079	19.0%

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. NEXT 10 / SF · CA · USA

HIGHLIGHT:

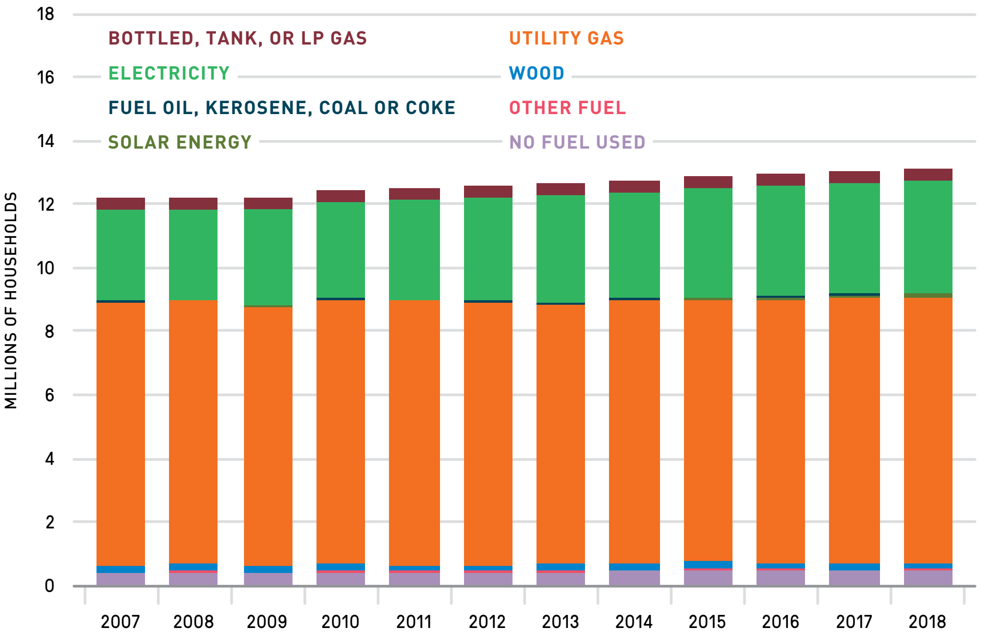
In 2018, California's average monthly residential and industrial electricity bills were 12.5 percent and 46.5 percent lower than in the U.S., respectively. However, the comparative advantage is waning. In recent years, wildfires had posed significant threats to California's grid resiliency and reliability, and California's unique wildfire doctrines are threatening the affordability of electricity.[100] On the other hand, California's average monthly commercial electricity bill was 39.3 percent higher than the U.S.

CHALLENGE:

California's edge over the U.S. in having a lower average residential sector electricity bill has diminished notably—from 21.7 percent lower in 2008 to 12.5 percent lower in 2018. On the other hand, the electricity bill in the commercial sector has gotten more expensive relative to the U.S., from 11.3 percent higher to 39.3 percent higher. Given that the residential and commercial sectors have the largest electricity consumption, to achieve its goals of greater electrification, California will need to ensure more affordable electricity bills moving forward. Increased emphasis on energy efficiency and demand response could help contain costs.

Figure 56. House Heating Fuel by Major Source

CALIFORNIA, 2007–2018



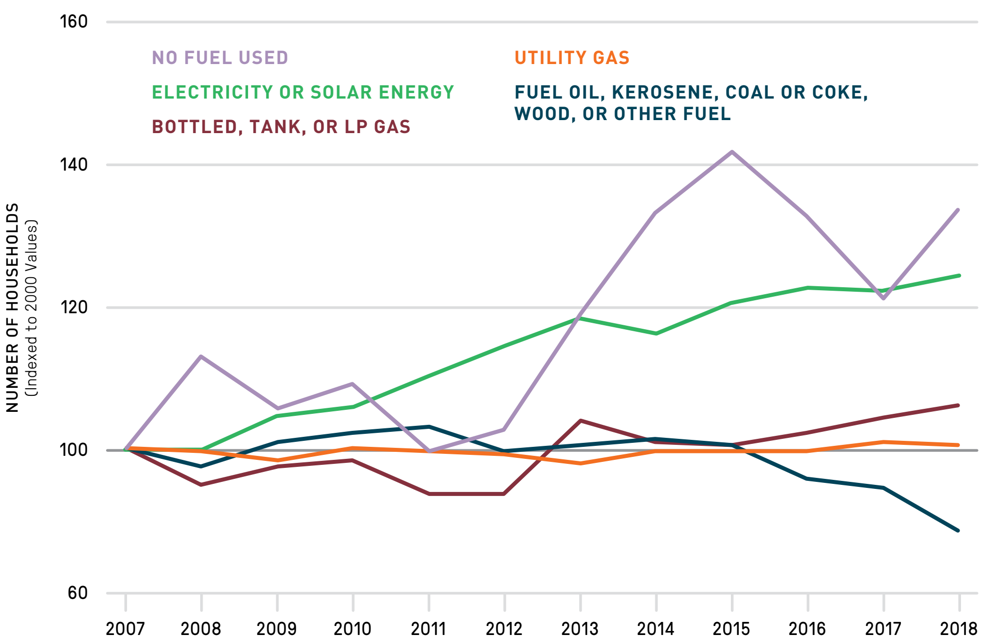
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: American Community Survey Public Use Microdata Samples, U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ Utility gas was the most common residential heating fuel source in 2018, comprising 63.8 percent of all occupied households in California. The relative share of utility gas usage has decreased gradually over time from 67.7 percent in 2008. On the other hand, the share of electricity as the house heating fuel source has gradually increased—from 23.6 percent in 2008 to 26.7 percent in 2018. ❷ The number of residential units in California where solar is the heating fuel has increased more than ten-fold from just 8,000 households in 2008 to slightly under 100,000 in 2018.

Figure 57. Change in House Heating Fuel by Major Source

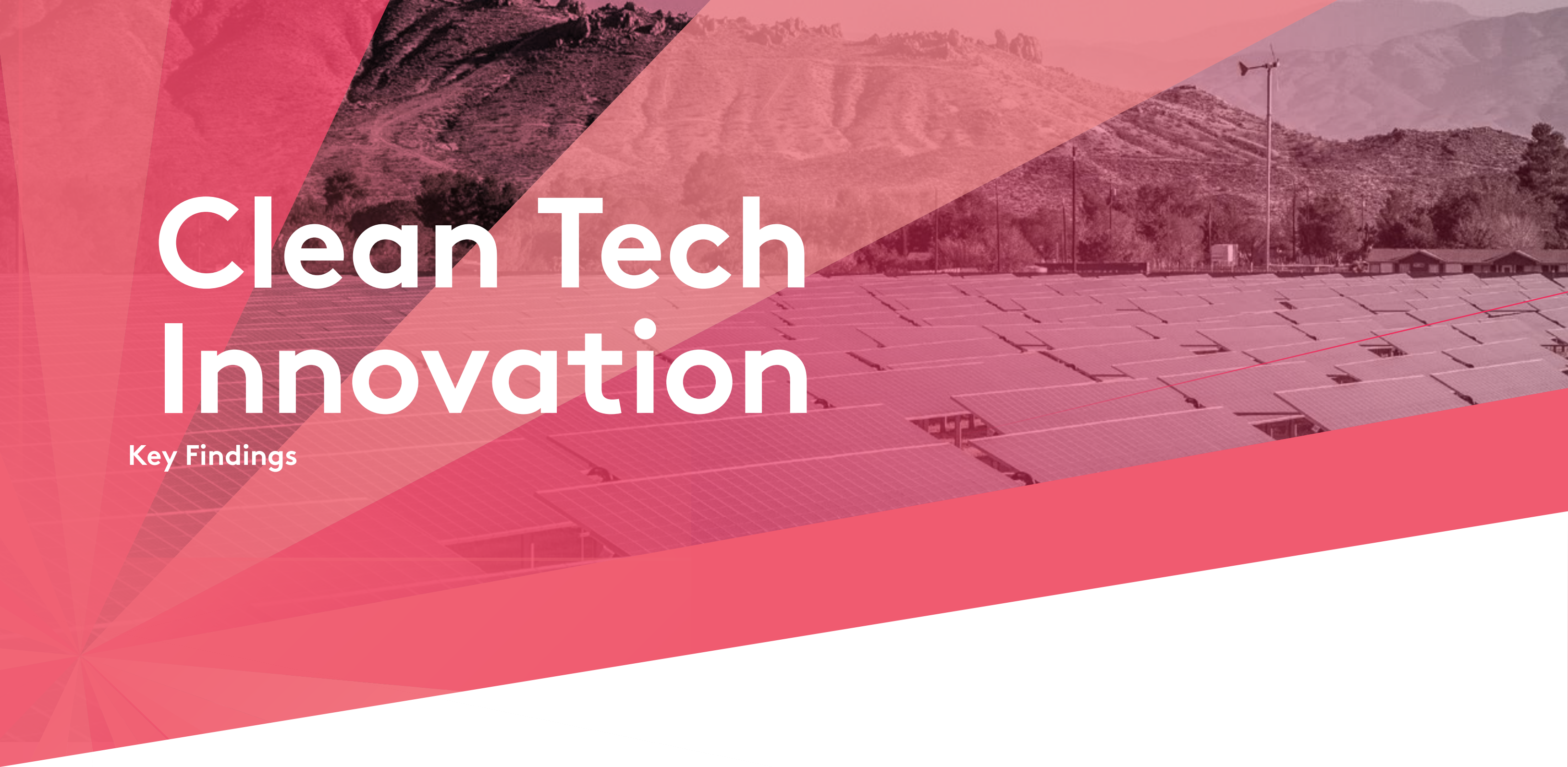
CALIFORNIA, 2007–2018



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: American Community Survey Public Use Microdata Samples, U.S. Census Bureau. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Electricity and solar energy—cleaner heating fuel sources than utility gas, bottled, tank or liquid propane gas, or kerosene fuel—saw the fastest increase (+24.5%) since 2007. Residential units with no heating fuel are also another fast-rising category, increasing 33.6 percent since 2007. The number of residential units where utility gas is the heating fuel remains unchanged compared to 2007 (+0.7%), while the number of households where fuel oil, kerosene, coal or coke, wood, or other fuel as the heating fuel declined 11.2 percent during the same period.



Clean Tech Innovation

Key Findings

Sustained investment into Californian clean tech companies has solidified the Golden State's position as the leader in American clean tech innovation. Though sectors like transportation and wind power have seen notable decreases in investment, **companies that focus on geothermal, smart grid, and hydroelectric technologies have seen large gains**—even amidst the economic turmoil brought on by the COVID-19 pandemic. Additionally, new frontiers in sectors like energy storage indicate that California's front-runner status in clean tech will hold for the foreseeable future.

Clean Technology Investment

- In 2019, clean tech venture capital (VC) investment totaled $6 billion in the U.S., with **51 percent** of those funds invested in California.
- Compared to 2018, the dollar amount investment in California clean tech firms **decreased significantly in 2019 (-39%), totaling $3.1 billion**–with $1.25 billion of that total investment attributed to a single deal from Faraday Future, a leading electric vehicles company.
- The average investment amount has gone down. In 2019, the average deal in California was **$18.5 million** (down from $27 million in 2018) compared to $11 million in the U.S. overall (down from $15 million in 2018).
- Despite the economic impacts induced by the COVID-19 pandemic, total clean tech investment through mid-August 2020 **($2.8 billion)** was close to the total amount of clean tech VC investment through all of 2019 ($3.1 billion).

California Clean Technology Mergers and Acquisitions

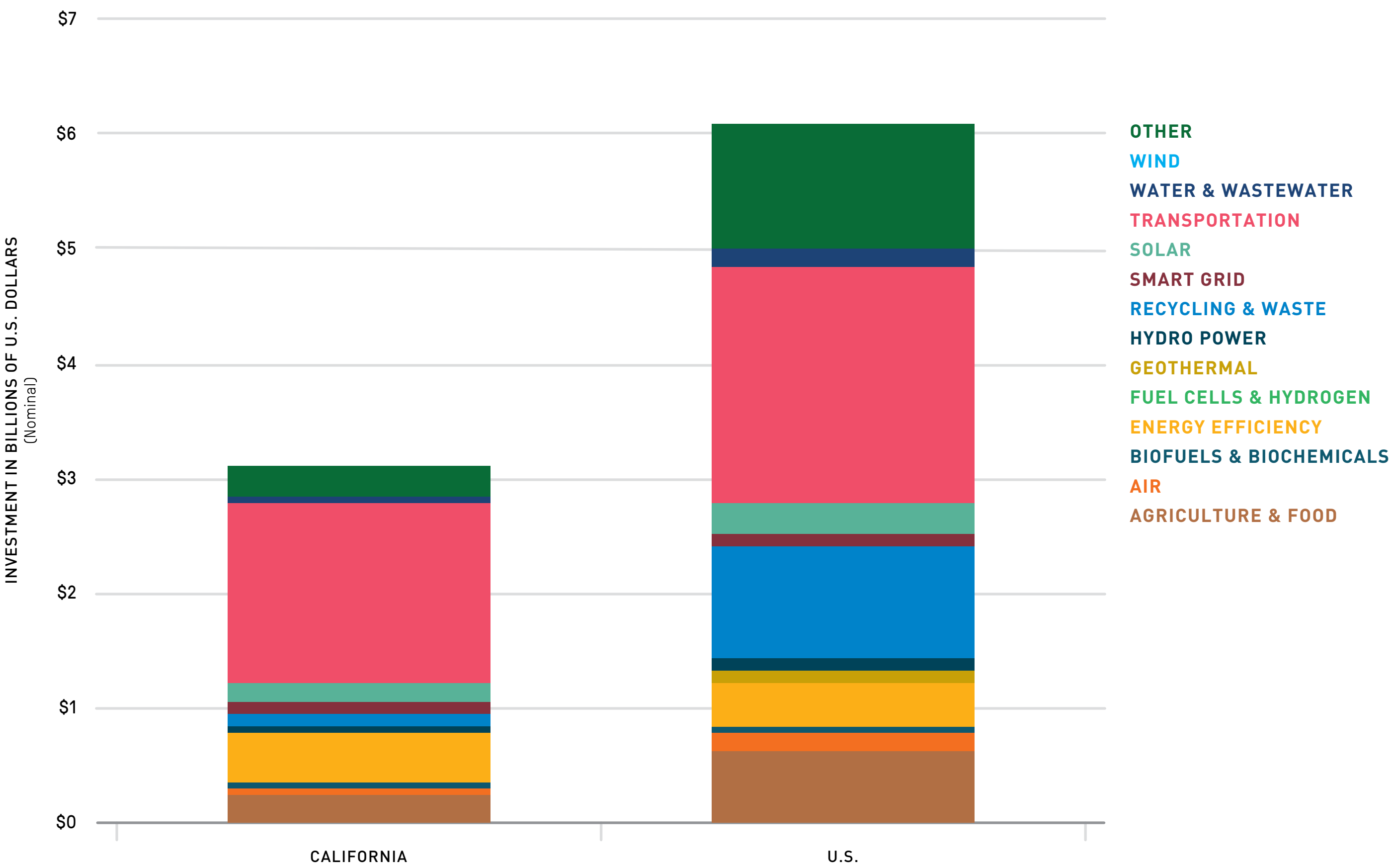
- California leads all other states in mergers and acquisitions (M&A) deals, with a quarter (**24.3 percent**) of all M&A deals having taken place in the state in 2019—up slightly compared to 22.6 percent in 2018.
- There were **three times** more deals in California than in the next runner-up, Texas and New York (tied), in 2019.
- In terms of the size of the M&As, California also led the U.S., with M&A deals totaling **$4.2 billion** in 2019. Colorado ($1.7 billion) and Maryland ($1.2 billion) followed.
- Just as the total amount of clean tech VC investment decreased year-over-year in 2019, the number of M&A deals also declined, from 36 M&A deals in 2018 to only **25 M&A deals in 2019.** This reflects a broader trend of a slight decline in M&A deals across the U.S., which saw 136 deals in 2018, but only 103 deals in 2019.

California Clean Technology Investment by Stage and by Segment

- Over **85 percent** of all venture capital investment in Californian clean tech companies in 2019 was funneled into companies considered in the "Later Stages" of the venture capital life cycle—higher than the shares seen in any other year over the past decade.
- While only nine percent of all of the transportation-related venture capital investment reported in 2018 was directed towards companies in the later stages of VC funding, this proportion skyrocketed to over **90 percent** in 2019.
- The maturing solar market is seeing early stage VC investment decline over time: **75.4 percent** of all 2019 solar investment went to companies in the later stages of the venture capital lifespan. One solar company in the later stages of funding—Solaria—received about 35 percent of all capital invested into the solar segment in 2019.
- The largest increase in dollars between 2018 and 2019 invested was in Geothermal, which saw an increase from nothing in 2018 to over **$11 million** in 2019. This was followed by Smart Grid, which saw a 360 percent increase, and Hydropower, which saw an 81 percent increase.
- Though two transportation companies—Faraday Future and Joey Aviation—each represent the largest clean tech deals of 2019 and 2020 respectively, there has been an overall **decline in investment** in companies that specialize in transportation.
- Despite some decline in transportation clean tech VC investment, the three largest clean tech deals in 2019 were all **transportation-related:** Faraday Future ($1.25 billion), RomeoPower ($92 million), and Proterra ($75 million).

Figure 58. Venture Capital Investment in Clean Technology by Segment

CALIFORNIA VS. U.S., 2019



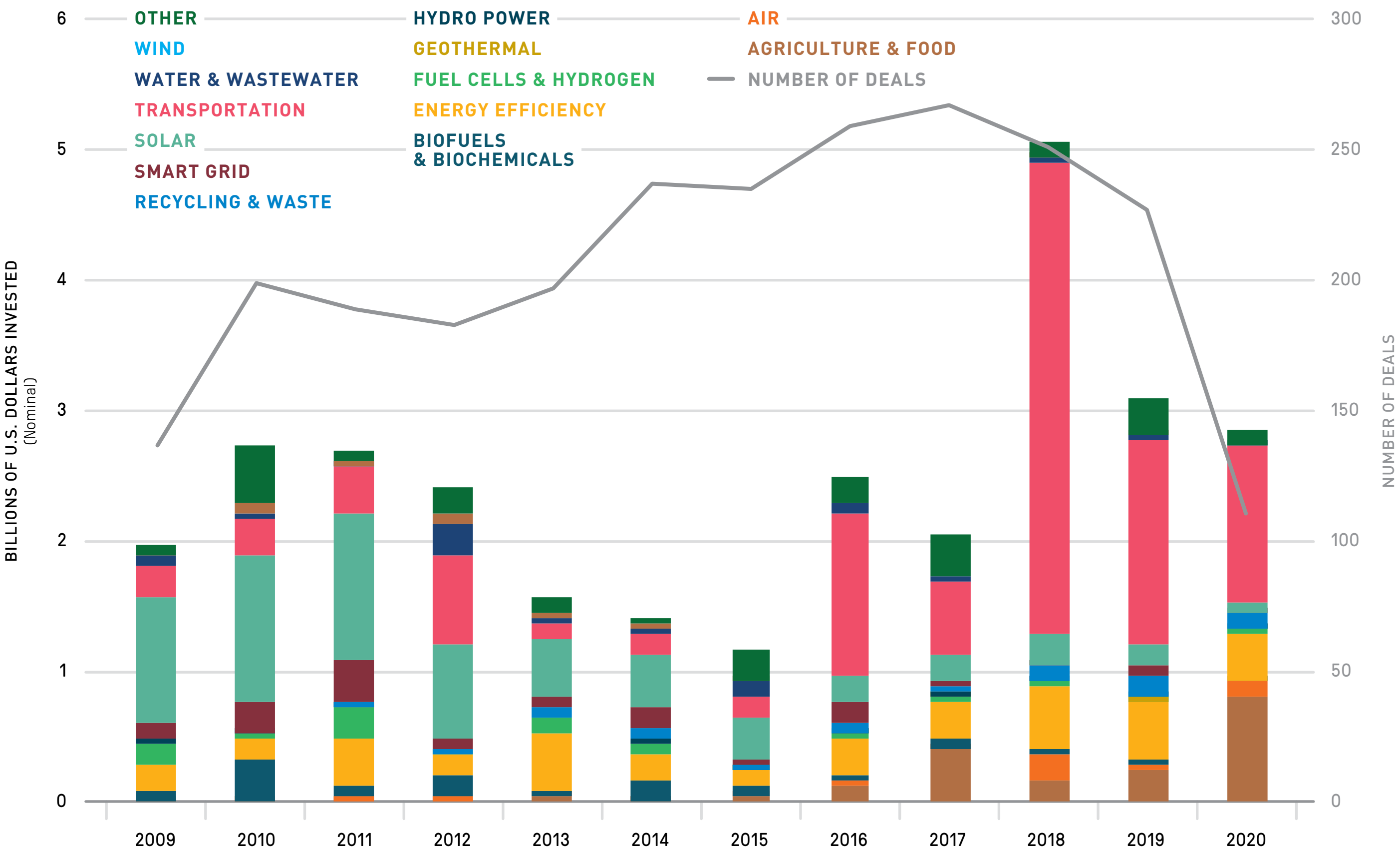
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation. Data Source: Pitchbook, LLC NEXT 10 / SF · CA · USA

HIGHLIGHT:

California traditionally receives about half or more of total VC investment into clean technology across the U.S., and 2019 was no exception. Whereas California represented 58 percent of the share in 2018, this share was 51 percent in 2019. Three of the five largest deals—totaling $1.6 billion, all of which were in the later stages of VC funding—in the U.S. took place in California and the state had the most clean tech VC deals with 235 deals reported in 2019. The next three states with the most deals were Massachusetts (84 deals), New York (72), and Texas (60).

Figure 59. Venture Capital Investment in Clean Technology by Segment

CALIFORNIA, 2009–2020



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation. Analysis of deals in 2020 only represents the investments reported on Pitchbook as of August 19, 2020. Data may have been updated since the time of publication. Data Source: PitchBook, LLC. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ The last couple of years have seen a sustained interest in clean technology companies based in California, with a few large investments going to just a handful of companies. In 2019, clean technology VC investments in California totaled $3.1 billion. Transportation once again emerged as the preferred industry among venture capitalists in the state, with $1.6 billion invested in these firms. Meanwhile, interest in clean technology firms that specialize in Agriculture and Food held steady, with over $249 million invested—not as much as in 2017 ($415 million), but still much more than the $155 million invested in Agriculture & Food through the first five years of the 2010s combined. Total VC investment in solar continued to lag through the first eight months of 2020. ❷ Even with the COVID-19 pandemic bringing much of the global economy to a standstill, there was still over $2.8 billion invested in clean tech in California through mid-August 2020—very close to the total number of investments in all of 2019. Key drivers of this sustained investment through 2020 comes from clean tech companies in the Transportation and Agriculture & Food sectors, with large investments into companies such as Joby Aviation ($590 million), which specializes in creating electric aircrafts, and Apeel Sciences ($275 million), which specializes in using natural plant extracts to eliminate food spoilage. Yet while investment held strong in 2020, the sharp decline in the number of clean tech deals suggests an unequal distribution in the amount of total VC investment in 2020 compared to 2019. There have only been 111 deals through August 2020, a 30 percent drop compared to the 157 deals seen at the same point in 2019.

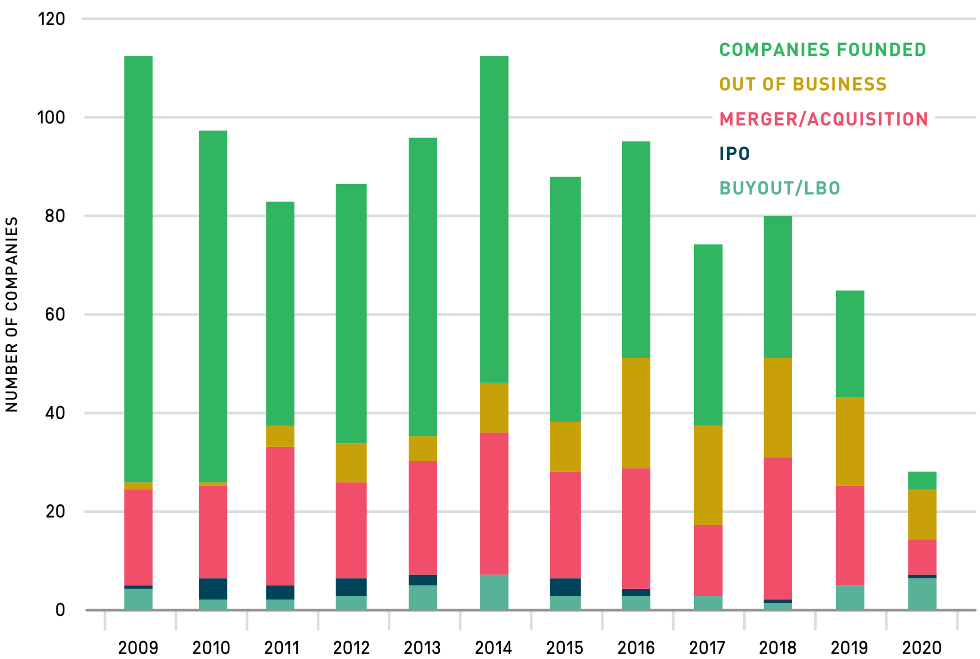
CHALLENGE:

The $3.1 billion invested in clean technology in 2019 is roughly $2 billion short of the amount invested in 2018.[101] The high number of investments in 2018, however, was rather anomalous, as a few large firms like Tesla and Faraday Future skewed the aggregate amount of investments in clean tech upwards. The fact that the total amount invested in 2019 is still above all of the other years represented in our data remains a positive sign that investments into clean technology remain a deep interest to venture capitalists everywhere.

California Clean Technology Mergers and Acquisitions

Figure 60. Clean Technology Entrances/Exits Over Time

CALIFORNIA, 2009–2020



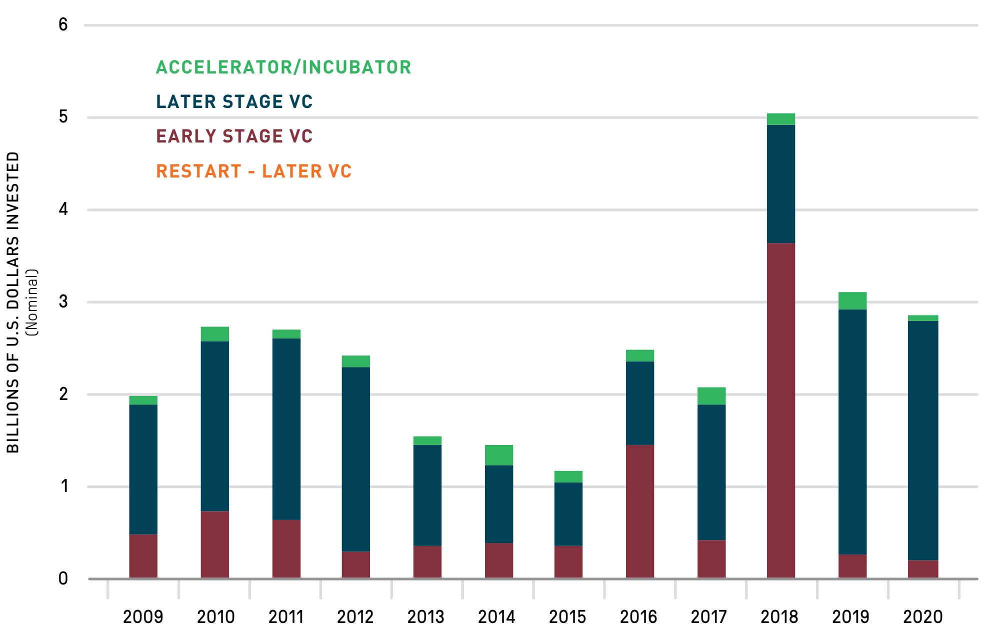
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Pitchbook, LLC. NEXT 10 / SF · CA · USA

HIGHLIGHT:

Buyouts, Leveraged Buyouts (LBOs), and Mergers & Acquisitions held steady in 2019. The largest M&A in 2019 ($23.75 million) was Pristine Environments. The number of new companies founded in the last five years has remained relatively stable, and the slow decline in the number of new companies founded over time might be less suggestive of a slowdown and instead reflect a lack of complete data, as some companies founded more recently might not have made any notable deals yet to be represented in the Pitchbook dataset analyzed.

Figure 61. Clean Technology Investments Over Time by Deal Type

CALIFORNIA, 2009–2020



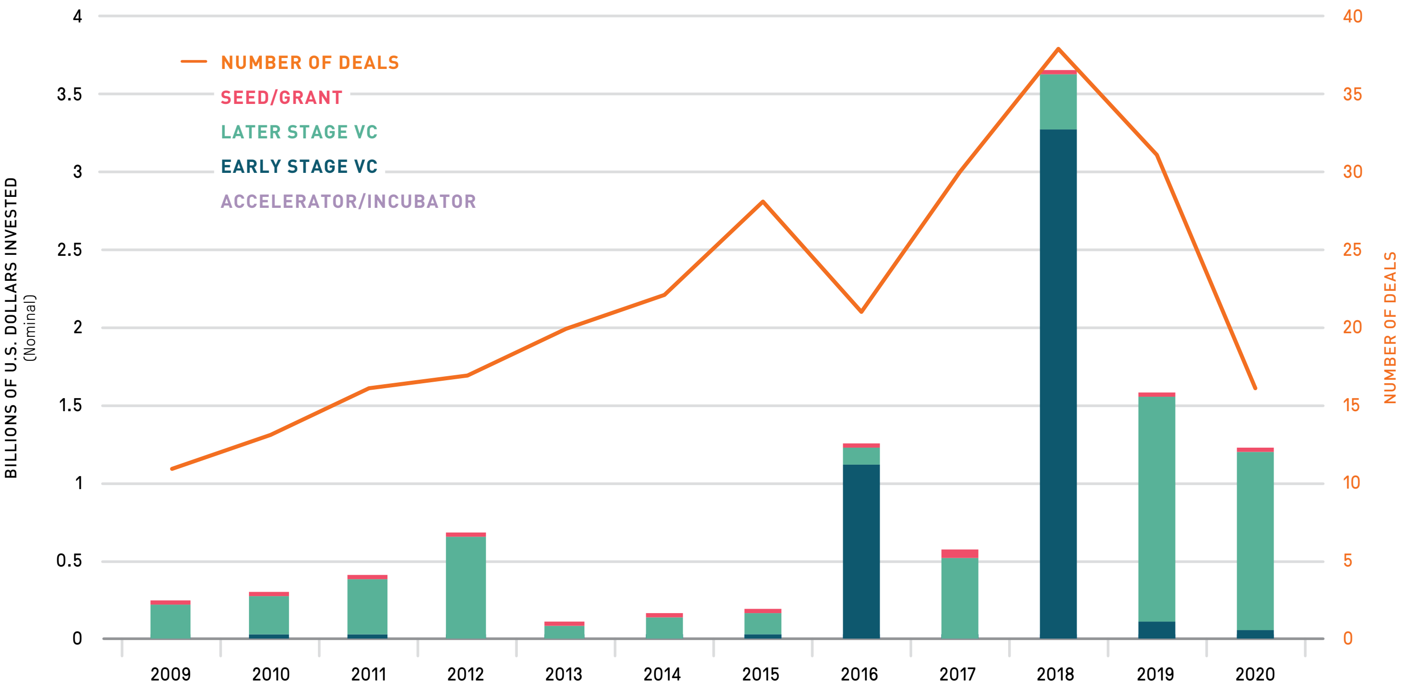
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Pitchbook, LLC. NEXT 10 / SF · CA · USA

HIGHLIGHT:

About $2.6 billion of the total $3.1 billion—over 85 percent—of all VC investment in Californian clean tech companies was funneled into companies considered in the "later stages" of the venture capital life cycle. This share is much higher than any other year in the past decade; between 2009 and 2018, there was an average of about 60 percent of capital invested in late-stage VC deals each year. This broader trend of investments into later-stage VC deals has remained virtually unchanged through the first eight months of 2020. As the amount of total investment is getting very close to the total amount invested in all of 2019, one could reasonably expect the total investment at the end of 2020 to surpass that of 2019.

Figure 62. Clean Technology Investments in Transportation by Deal Type

CALIFORNIA, 2009–2020



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Analysis of deals in 2020 only represents the investments reported on Pitchbook as of August 19, 2020. Data may have been updated since the time of publication. Data Source: Pitchbook, LLC. NEXT 10 / SF · CA · USA

HIGHLIGHT:

2019 saw a sharp reversal in the number of later-stage deals in Transportation compared to 2018. Whereas only nine percent of all venture capital invested in Transportation was directed to companies in the later stages of VC funding in 2018, this proportion skyrocketed to over 90 percent in 2019.

This is less suggestive of a broader shift within the clean tech space and more indicative of a few clean transportation companies maturing over time. Namely, Faraday Future—a company headquartered in Los Angeles that specializes in electric vehicles (EVs)—reported a $2 billion corporate-backed deal in 2018 that was still classified as being in the earlier stage of capital fundraising. In 2019, Faraday Future completed another $1.25 billion deal that was identified as later-state VC. RomeoPower, another Los Angeles company that specializes in improving the durability of batteries used for electric vehicles, saw a $92 million, early-stage VC deal in 2019—the second-largest deal of the year. The third-largest belonged to Proterra, a manufacturer of zero-emissions buses that completed a $75 million, later-stage VC deal.

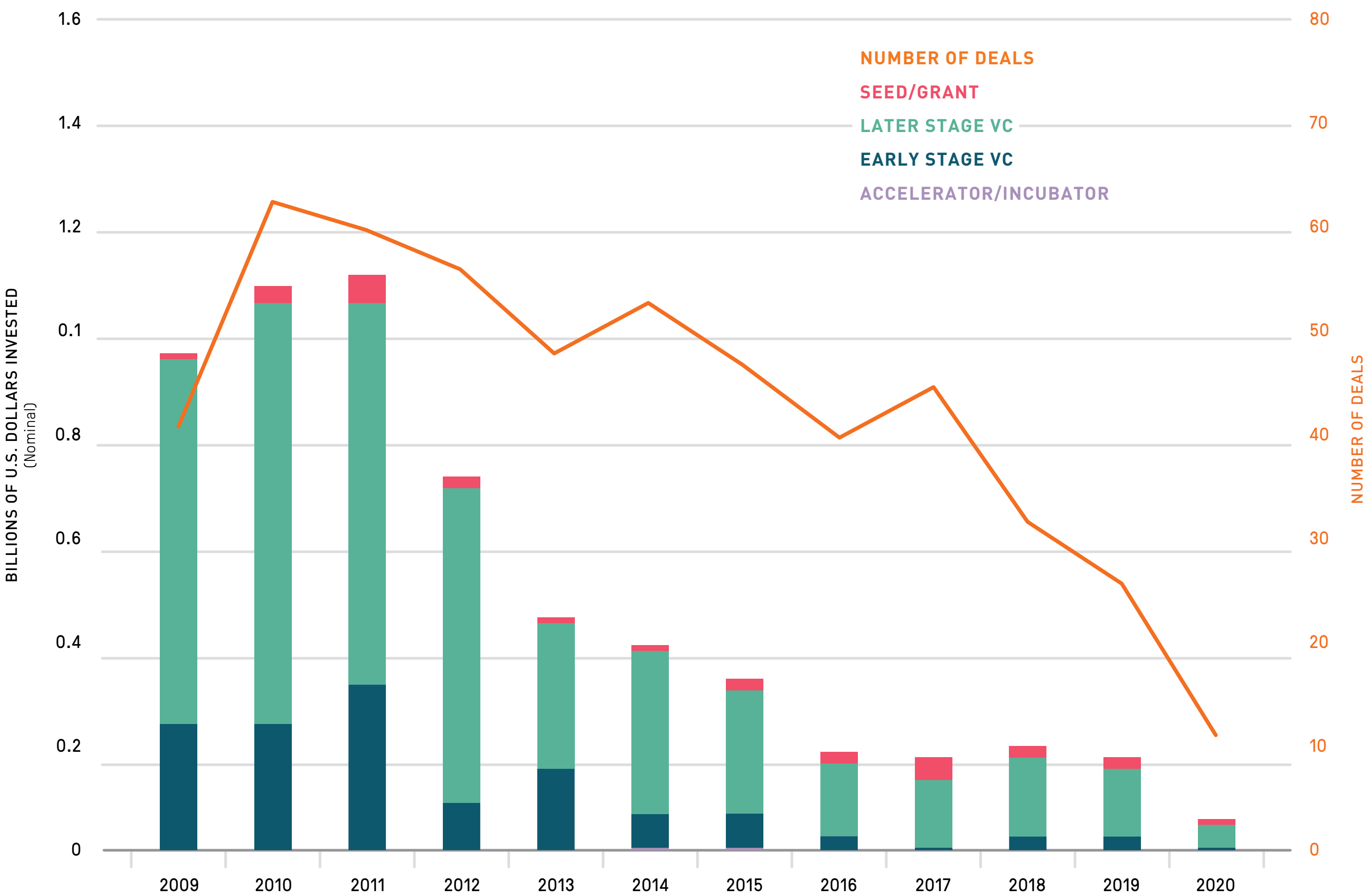
Large later-stage VC deals in 2020 were ChargePoint ($367 million), Karma Automotive ($100 million), and Fisker ($50 million)—all of which are focused primarily in the electric vehicles (EVs) space. The largest deal went to Joby Aviation ($590 million), which specializes in building electric personal aircrafts.

CHALLENGE:

While $3.5 billion was invested in Transportation in 2018, only $1.5 billion was invested in the sector in 2019, a $2 billion decrease. This may be for a number of reasons: First, some of the largest movers in Transportation failed to receive as much venture capital funding in the last few years compared to 2018. Second, some of these companies that weren't represented in the last few years of data, like Maxwell Technologies, have exited the VC space as they either merged with larger companies or went public on their own. And third, the overall decline in Transportation investment can also be explained by a decreasing interest among investors due to concerns about a lack of profitability—especially among investors of some large transportation network companies (TNCs), such as Uber and Lyft, who have begun to doubt whether investments in autonomous vehicles will actually yield the kind of rewards they initially believed.[102]

Figure 63. Clean Technology Investments in Solar

CALIFORNIA, 2009–2020



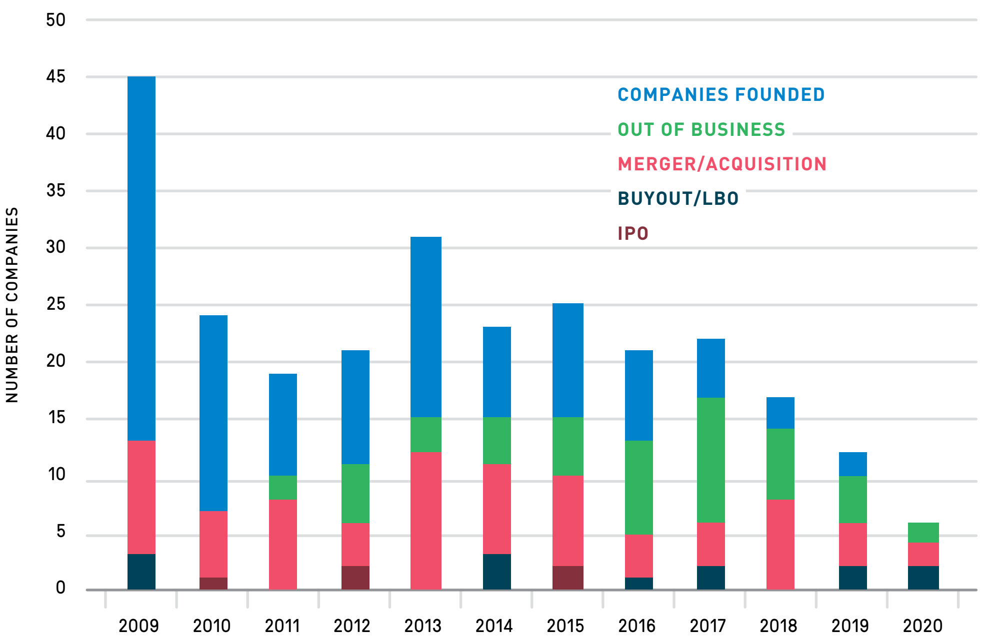
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Analysis of deals in 2020 only represents the investments reported on Pitchbook as of August 19, 2020. Data may have been updated since the time of publication. Data Source: Pitchbook, LLC. NEXT 10 / SF · CA · USA

HIGHLIGHTS:

❶ The share of dollars invested in clean tech companies that focus on solar energy held steady from 2016 to 2019, with 75.4 percent of all investment in solar energy in 2019 going to companies in the later-stages of the venture capital lifecycle. Solaria, a provider of solar technology, had the largest number of deals and investment with over $63 million received in later-stage VC funding in 2019—about 35 percent of all of the capital invested into the solar segment. Sunfolding, based in San Francisco and specializing in the tracking and monitoring of solar power, was the company with the second-largest number of total deals, with $38 million. Other notable investments in solar companies in 2019 included Aurora Solar ($23.4 million) and Swiftmile ($15 million), which focus on automating solar power installation and deploying solar-powered charging stations for electric scooters and bicycles, respectively. Of the three largest solar deals seen in 2020, only one deal (valued at $11 million) went to an early-stage company, Swiftmile. ❷ VC investment in solar has continued to decline in recent years, with a total of $179 million invested in solar in 2019—a $27 million drop from the year before. Last year was the first time in the past decade that the total number of solar deals reported fell below 30. The data analyzed shows only 26 deals taking place in the solar segment in 2019. Given that so much of the investment in solar continues to go to companies in later stages of the VC lifecycle, this could potentially be a positive sign that maturation is taking place in the solar sector. Once companies are successfully bought out and/or merged with bigger firms, they are no longer represented in the VC investment data—so what looks like an overall decline in firms specializing in solar is actually continued growth and maturation of solar technology in California overall.

Figure 64. Entrances/Exits of Solar Companies

CALIFORNIA, 2009–2020



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HIGHLIGHT:

The story of exits in the solar space is largely a microcosm of what is happening in clean tech overall: a stable number of M&As and buyouts, combined with a decreasing number of companies being founded and an increase in the number of firms going out of business. As the solar industry has matured, consolidation has increased and creation of new firms has slowed. Two Californian companies in solar clean tech were bought out in 2019: SunSystem Technology, which specializes in installing large-scale solar panels as well as systems that analyze energy metrics; and 8Minute Solar Energy, which owns a 67-megawatt solar farm located in Madera County, California.

LITHIUM VALLEY: POWERING ENERGY STORAGE AND THE CALIFORNIA ECONOMY

For several years, firms around the world have been racing to find alternative sources for lithium extraction. The mineral is essential to powering batteries for electric vehicles and energy storage, yet the vast majority that is used in the U.S. is produced outside the country.

California's Salton Sea is rich with the resource: deep beneath the declining body of water, lithium can be found in and extracted from geothermal brine. What's more: the methods for recovering lithium from the Salton Sea are less damaging to the environment than production means used outside the state. If the mineral could be cost-effectively extracted from the Salton Sea brine, it could provide a significant new source for lithium development within California—providing up to a third of the world's current lithium demand, according to some estimates,[103] and up to $860 million annually in revenues.[104]

In October 2020, a bill was signed into law to create a Blue Ribbon Commission on Lithium Extraction in the state in order to explore how best the state can expand the emerging industry.[105] Notable investments in lithium recovery in California this year included:

Lilac Solutions: A lithium start-up based in California's Imperial Valley announced a $20 million round of funding in February 2020,[106] followed by a March announcement of a new partnership with Australian firm Controlled Thermal Resources to develop a lithium extraction facility at the Salton Sea.[107]

Berkshire Hathaway Energy: Warren Buffet's firm is seeking funding from the CEC to build a lithium extraction demonstration plant—using Lilac's technology. Berkshire Hathaway owns 10 of the 11 geothermal plants operating in the Salton Sea region.[108]

California Energy Commission (CEC): In May 2020, the CEC awarded nearly $10 million in grants to three geothermal-related projects that could help boost the state's lithium recovery sector.[109]

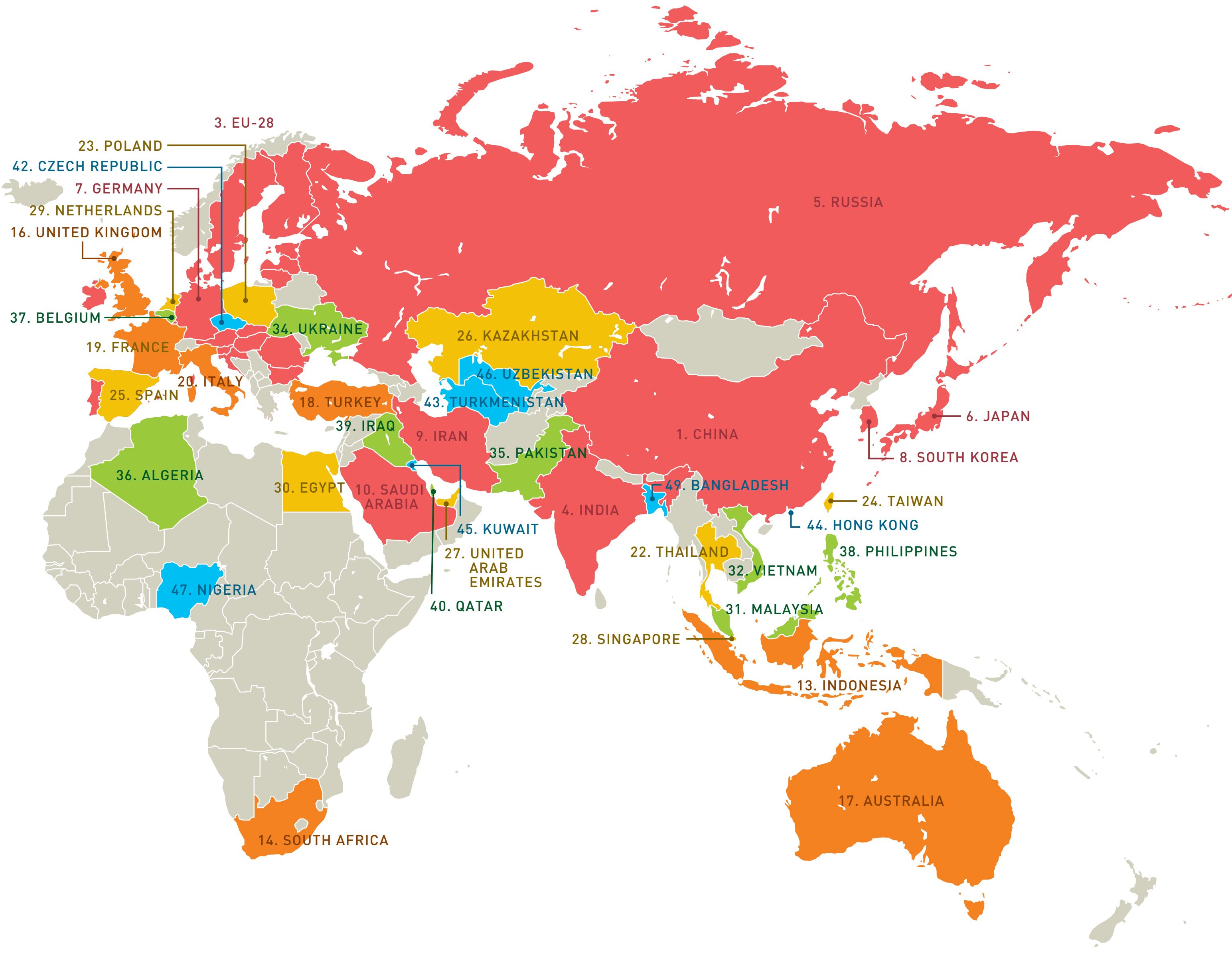
Rio Tinto: In October 2019, Rio Tinto announced the launch of a $10 million lithium pilot to produce the mineral from the firm's boron mine in the California desert. If successful, Rio Tinto will consider expanding to a $50 million industrial-scale plant.[110]

International Scorecards

HIGHLIGHTS ON RANKING SUMMARY OF TOP 50 POLLUTERS (2017)

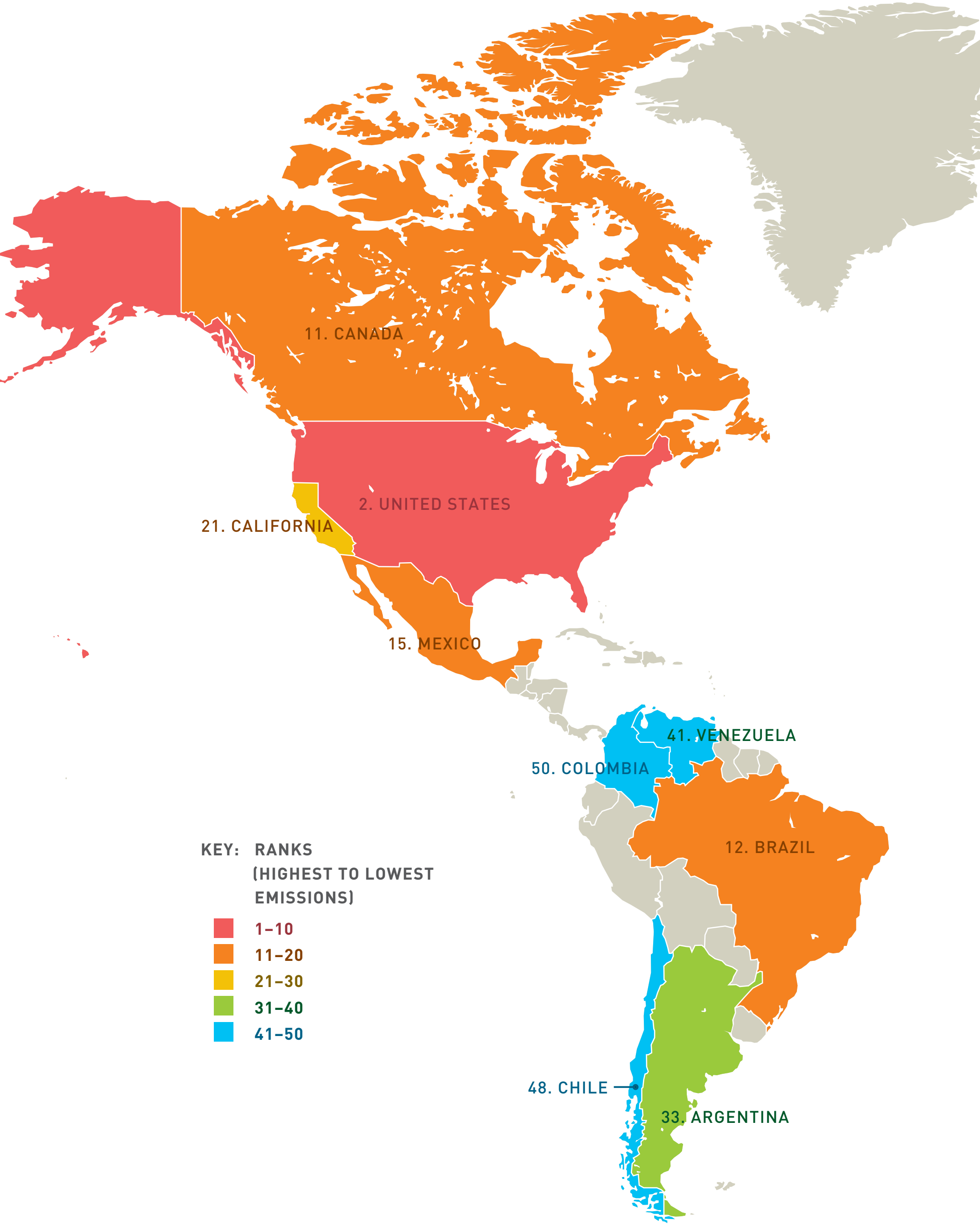
Relative to the other top 50 polluters across the globe, California's carbon economy profile improved in many areas in 2017—the latest year for which internationally comparable data were available. California had the 21st-highest level of energy-related carbon emissions in 2017, down two places from the previous year. This shift was due to increases in energy-related carbon emissions in France and Italy, while at the same time California's energy-related carbon emissions decreased, from 2016 to 2017. In addition to improving in its emissions ranking, California also improved in terms of energy productivity (GDP relative to energy consumption). The state jumped two places to have the 4th-highest energy productivity ranking. Meanwhile, the U.S. came in with the 23rd-highest energy productivity among the top 50 polluters.

On the other hand, California's rankings slipped on some of the per capita metrics. While California's ranking on energy consumption per capita stayed the same compared to 2016, the state's electricity consumption per capita went down three places from 36th to 39th, reversing the improvement posted in 2016 (compared to 2015). California's ranking on emissions per capita (where one is the lowest) dropped one place from 30th to 31st.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: *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

California continues to gain a higher share of electricity generation from renewable sources (excluding hydroelectric) each year. In 2017, among the top 50 polluters, California had the 9th-highest amount of renewable electricity generated, up one place compared to 2016. On the per-capita basis, California placed 4th in 2017—on par with several Western European countries—and ahead of the EU-28 average. At the same time, other nations are also investing in renewable energy. Hopefully, these nations will continue to transition to having more renewable energy together.



RANK	REGION	MILLION $MTCO_2e$
1	CHINA	10487.0
2	UNITED STATES*	5133.4
3	EU-28	3773.5
4	INDIA	2312.1
5	RUSSIA	1782.2
6	JAPAN*	1272.3
7	GERMANY*	826.0
8	SOUTH KOREA	820.5
9	IRAN	676.5
10	SAUDI ARABIA	630.8
11	CANADA*	624.8
12	BRAZIL	532.5
13	INDONESIA	530.9
14	SOUTH AFRICA	476.9
15	MEXICO*	473.2
16	UNITED KINGDOM*	420.4
17	AUSTRALIA*	411.1
18	TURKEY*	408.8
19	FRANCE*	376.9
20	ITALY*	362.5
21	CALIFORNIA	358.6
22	THAILAND	342.8
23	POLAND*	324.8
24	TAIWAN	324.7
25	SPAIN*	300.4
26	KAZAKHSTAN	295.5
27	UNITED ARAB EMIRATES	289.1
28	SINGAPORE	256.5
29	NETHERLANDS*	240.9
30	EGYPT	238.2
31	MALAYSIA	228.2
32	VIETNAM	221.1
33	ARGENTINA	210.1
34	UKRAINE	204.5
35	PAKISTAN	197.1
36	ALGERIA	142.3
37	BELGIUM*	137.8
38	PHILIPPINES	129.9
39	IRAQ	127.6
40	QATAR	124.7
41	VENEZUELA	117.6
42	CZECH REPUBLIC*	110.8
43	TURKMENISTAN	99.5
44	HONG KONG	97.5
45	KUWAIT	96.4
46	UZBEKISTAN	95.7
47	NIGERIA	93.8
48	CHILE*	87.3
49	BANGLADESH	82.1
50	COLOMBIA	75.9

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 2017 ($MMTCO_2e$)	2017 GDP per Capita, 2017 U.S. $	Lowest Carbon Intensity ($MTCO_2e$/U.S. $10,000 GDP) in 2017	Lowest Emissions Per Capita ($MTCO_2e$/Person) in 2017	Highest Energy Productivity (GDP in 2017 USD/BTU) in 2017
1	CHINA	$8,812	NIGERIA	NIGERIA	NIGERIA
2	UNITED STATES*	$54,865	FRANCE*	BANGLADESH	UNITED KINGDOM*
3	EU-28	$40,113	CALIFORNIA	PAKISTAN	ITALY*
4	INDIA	$2,769	UNITED KINGDOM*	PHILIPPINES	CALIFORNIA
5	RUSSIA	$20,995	ITALY*	COLOMBIA	TURKEY*
6	JAPAN*	$49,113	BRAZIL	INDIA	JAPAN*
7	GERMANY*	$52,534	COLOMBIA	INDONESIA	GERMANY*
8	SOUTH KOREA	$29,142	EU-28	VIETNAM	BRAZIL
9	IRAN	$17,830	GERMANY*	EGYPT	FRANCE*
10	SAUDI ARABIA	$20,635	SPAIN*	BRAZIL	COLOMBIA
11	CANADA*	$56,985	TURKEY*	UZBEKISTAN	EU-28
12	BRAZIL	$17,982	JAPAN*	IRAQ	SPAIN*
13	INDONESIA	$5,648	VENEZUELA	ALGERIA	AUSTRALIA*
14	SOUTH AFRICA	$11,147	BELGIUM*	MEXICO*	HONG KONG
15	MEXICO*	$13,801	NETHERLANDS*	VENEZUELA	NETHERLANDS*
16	UNITED KINGDOM*	$47,862	CHILE*	UKRAINE	CHILE*
17	AUSTRALIA*	$65,426	AUSTRALIA*	CHILE*	BELGIUM*
18	TURKEY*	$25,480	MEXICO*	ARGENTINA	MEXICO*
19	FRANCE*	$45,673	HONG KONG	THAILAND	INDONESIA
20	ITALY*	$42,362	UNITED STATES*	TURKEY*	VENEZUELA
21	CALIFORNIA	$69,477	BANGLADESH	FRANCE*	BANGLADESH
22	THAILAND	$7,046	CANADA*	ITALY*	PHILIPPINES
23	POLAND*	$17,392	ARGENTINA	UNITED KINGDOM*	UNITED STATES*
24	TAIWAN	$22,890	INDONESIA	SPAIN*	ARGENTINA
25	SPAIN*	$33,089	PHILIPPINES	MALAYSIA	EGYPT
26	KAZAKHSTAN	$19,570	EGYPT	EU-28	POLAND
27	UNITED ARAB EMIRATES	$40,325	CZECH REPUBLIC*	CHINA	CZECH REPUBLIC*
28	SINGAPORE	$58,450	IRAN	SOUTH AFRICA	CANADA*
29	NETHERLANDS*	$57,017	POLAND*	IRAN	IRAN
30	EGYPT	$6,400	PAKISTAN	POLAND*	INDIA
31	MALAYSIA	$13,507	UKRAINE	CALIFORNIA	SOUTH KOREA
32	VIETNAM	$2,844	MALAYSIA	GERMANY*	MALAYSIA
33	ARGENTINA	$14,592	SOUTH KOREA	JAPAN*	TAIWAN
34	UKRAINE	$8,397	ALGERIA	CZECH REPUBLIC*	SOUTH AFRICA
35	PAKISTAN	$1,805	RUSSIA	BELGIUM*	PAKISTAN
36	ALGERIA	$6,135	TAIWAN	RUSSIA	ALGERIA
37	BELGIUM*	$51,050	UZBEKISTAN	HONG KONG	IRAQ
38	PHILIPPINES	$3,332	INDIA	TAIWAN	UKRAINE
39	IRAQ	$5,227	IRAQ	NETHERLANDS*	KAZAKHSTAN
40	QATAR	$61,264	THAILAND	UNITED STATES*	RUSSIA
41	VENEZUELA	$16,923	QATAR	SOUTH KOREA	SINGAPORE
42	CZECH REPUBLIC*	$24,904	SOUTH AFRICA	KAZAKHSTAN	THAILAND
43	TURKMENISTAN	$9,034	UNITED ARAB EMIRATES	AUSTRALIA*	CHINA
44	HONG KONG	$46,337	KUWAIT	CANADA*	UZBEKISTAN
45	KUWAIT	$31,341	SINGAPORE	TURKMENISTAN	VIETNAM
46	UZBEKISTAN	$4,818	VIETNAM	SAUDI ARABIA	UNITED ARAB EMIRATES
47	NIGERIA	$4,005	KAZAKHSTAN	KUWAIT	KUWAIT
48	CHILE*	$19,075	CHINA	UNITED ARAB EMIRATES	QATAR
49	BANGLADESH	$1,777	SAUDI ARABIA	SINGAPORE	SAUDI ARABIA
50	COLOMBIA	$9,843	TURKMENISTAN	QATAR	TURKMENISTAN

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: *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	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 2017	Least Total Electricity Consumption per Capita (kWh/Person) in 2017	Most Total Renewable Electricity in 2017	Highest Share of Renewables (Renewable Electricity/Total Electricity) in 2017
1	NIGERIA	NIGERIA	EU-28	GERMANY*
2	BANGLADESH	BANGLADESH	CHINA	UNITED KINGDOM*
3	PAKISTAN	PAKISTAN	UNITED STATES*	SPAIN*
4	PHILIPPINES	PHILIPPINES	GERMANY*	CALIFORNIA
5	INDIA	INDONESIA	JAPAN*	ITALY*
6	INDONESIA	INDIA	INDIA	EU-28
7	COLOMBIA	IRAQ	UNITED KINGDOM*	BELGIUM*
8	VIETNAM	COLOMBIA	BRAZIL	CHILE*
9	EGYPT	ALGERIA	CALIFORNIA	NETHERLANDS*
10	IRAQ	UZBEKISTAN	ITALY*	BRAZIL
11	UZBEKISTAN	EGYPT	SPAIN*	PHILIPPINES
12	ALGERIA	VIETNAM	FRANCE*	POLAND*
13	BRAZIL	MEXICO*	CANADA*	JAPAN*
14	MEXICO*	VENEZUELA	TURKEY*	THAILAND
15	THAILAND	BRAZIL	AUSTRALIA*	TURKEY*
16	TURKEY*	TURKMENISTAN	POLAND*	UNITED STATES*
17	UKRAINE	THAILAND	THAILAND	AUSTRALIA*
18	CHILE*	UKRAINE	NETHERLANDS*	CZECH REPUBLIC*
19	VENEZUELA	ARGENTINA	MEXICO*	FRANCE*
20	ARGENTINA	TURKEY*	SOUTH KOREA	INDIA
21	SOUTH AFRICA	IRAN	BELGIUM*	CHINA
22	CHINA	SOUTH AFRICA	INDONESIA	CANADA*
23	ITALY*	CHILE*	PHILIPPINES	MEXICO*
24	MALAYSIA	POLAND*	CHILE*	INDONESIA
25	POLAND*	CHINA	SOUTH AFRICA	PAKISTAN
26	SPAIN*	MALAYSIA	CZECH REPUBLIC*	SOUTH AFRICA
27	UNITED KINGDOM*	UNITED KINGDOM*	TAIWAN	SOUTH KOREA
28	EU-28	KAZAKHSTAN	PAKISTAN	SINGAPORE
29	IRAN	ITALY*	RUSSIA	TAIWAN
30	FRANCE*	SPAIN*	EGYPT	ARGENTINA
31	JAPAN*	EU-28	ARGENTINA	COLOMBIA
32	CZECH REPUBLIC*	HONG KONG	UKRAINE	EGYPT
33	GERMANY*	CZECH REPUBLIC*	SINGAPORE	UKRAINE
34	HONG KONG	RUSSIA	COLOMBIA	ALGERIA
35	TAIWAN	NETHERLANDS*	MALAYSIA	MALAYSIA
36	CALIFORNIA	GERMANY*	UNITED ARAB EMIRATES	UNITED ARAB EMIRATES
37	KAZAKHSTAN	FRANCE*	ALGERIA	KAZAKHSTAN
38	RUSSIA	BELGIUM*	KAZAKHSTAN	RUSSIA
39	NETHERLANDS*	CALIFORNIA	IRAN	HONG KONG
40	BELGIUM*	JAPAN*	VIETNAM	QATAR
41	SOUTH KOREA	SINGAPORE	BANGLADESH	BANGLADESH
42	AUSTRALIA*	SAUDI ARABIA	SAUDI ARABIA	VIETNAM
43	UNITED STATES*	AUSTRALIA*	QATAR	NIGERIA
44	TURKMENISTAN	SOUTH KOREA	HONG KONG	IRAN
45	SAUDI ARABIA	TAIWAN	VENEZUELA	VENEZUELA
46	KUWAIT	UNITED STATES*	IRAQ	IRAQ
47	CANADA*	UNITED ARAB EMIRATES	NIGERIA	SAUDI ARABIA
48	UNITED ARAB EMIRATES	CANADA*	KUWAIT	KUWAIT
49	SINGAPORE	QATAR	UZBEKISTAN	UZBEKISTAN
50	QATAR	KUWAIT	TURKMENISTAN	TURKMENISTAN

Endnotes

[1] 1 The GHG inventory was developed in accordance with the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories, the internationally recognized standard for developing national GHG inventories. There exist other categories besides included emissions: excluded emissions, carbon dioxide from biogenic materials, emissions and removals from forest lands and wood products, and other emissions. Excluded emissions are discussed elsewhere in this chapter.

[2] Merchant-owned power plants are under private or corporate ownership, engaging in the buying and selling of electricity in the open market, and eventually selling the utilities that cannot provide all the electricity they need through their own plants. Definition based on the technical support document of California's 2000–2014 Greenhouse Gas Emission Inventory of California Air Resources Board (2016 Edition). Retrieved from: https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_00-14_technical_support_document.pdf

[3] In the Renewables Chapter, electricity generation from zero-carbon sources decreased in 2018 compared to 2017, which is primarily driven by a decrease in generation from large hydroelectric. By comparison, generation from natural gas increased in 2018 relative to 2017. This could be another plausible reason for the increase in GHG emissions from in-state electricity generation.

[4] Inflation-adjusted in 2017 dollars.

[5] Cavanagh, R. "How CA's Climate Leadership Yielded a Healthy Economy." Natural Resources Defense Council. May 10, 2019. Retrieved from: https://www.nrdc.org/experts/ralph-cavanagh/new-report-shows-how-climate-action-and-healthy-economy-wo

[6] Off-road vehicles include airport ground support equipment, construction and mining equipment, industrial equipment, and oil drilling equipment.

[7] The miles that vehicles are scheduled to or actually travel while in revenue service. Vehicle revenue miles include layover/recovery time and excludes deadhead, operator training, vehicle maintenance testing, and other non-revenue uses of vehicles.

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[12] According to the Air Resources Board, excluded emissions are tracked for informational purposes, but not included in the GHG inventory. Following Intergovernmental Panel on Climate Change (IPCC) guidelines, emissions from international aviation and water-borne navigation should be reported in an excluded category. In the case of a state-level rather than a national inventory, this raises the question of how to treat emissions from interstate flights. Based upon jurisdictional interpretation of IPCC protocols, ARB staff opted to estimate, but not include, emissions resulting from aviation fuel purchased in California and used for interstate flights, as is done for international flights.

[13] CalRecycle has not updated the data on recycling rate since April 2019. Based on the available historical data, California is unlikely to meet the 75 percent recycling goal in 2020. COVID-19 has driven up the use of one-time use and disposable plastic plus other materials, which may further hamper the state's recycling goal.

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[18] California Air Resources Board provided estimates for both a 100-year GWP time horizon and a 20-year GWP time horizon. Given that the GHG inventory is prepared using the IPCC's Fourth Assessment Report (AR) 100-year GWP values, the amount displayed here is for the 100-year GWP time horizon. Otherwise, using the 20-year GWP time horizon, emissions are estimated to be 25.4 MMTCO2e. This is not part of the included emissions.

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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. For state level comparisons, inflation-adjusted figures are converted into current dollars based on state-specific deflators, published by the Bureau of Economic Analysis, U.S. Department of Commerce.

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 and state GDP are at market prices in current 2018 dollars, expressed per U.S. dollar, unless otherwise noted, from the World Bank's World Development Indicators. Gross Domestic Product by State is also referred as Gross State Product (GSP).

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.

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 $MMTCO_2e$ dioxide emitted per quadrillion BTU of fuel consumed. Calculations used GDP and Population data where applicable, as described above.

Unless otherwise noted, 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 is 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" (2020 Edition). The 1990–1999 emissions include "gross emissions" and the 2000–2018 emissions are "included emissions" only unless otherwise noted. Calculations used GDP and Population data where applicable, as described above.

Disposal Rate

Data on waste disposal (landfilled or exported) in tons are from CalRecycle's Disposal Reporting System. The Disposal Reporting System (DRS) is the set of guidelines that tracks the origin of waste disposed in California's landfills, and waste sent from California to out-of-state landfills. DRS tracks disposal tonnages (including alternative daily cover (ADC), alternative intermediate cover (AIC), and beneficial reuse) and transformation sent to facilities in the state. Disposal and alternative daily cover (ADC) tonnage is subject to change due to revisions.

Transportation Fuel Consumption

Data on state-level transportation fuel consumption is compiled by the Alternative Fuel Data Center of the U.S. Department of Energy, based on the State Energy Data System from the U.S. Energy Information Administration. Transportation fuel consumption is converted to gasoline gallon equivalents of petroleum (GGEs) for the transportation sector. The following transportation fuel are converted: Gasoline, diesel, propane, natural gas, and electricity.

Wildfire Emissions

Data on historic wildfire emissions (2000–2019) is provided by California Air Resources Board. Greenhouse gas emissions from wildfires are tracked separately when compared to anthropogenic sources due, in large part, to carbon cycling. Current estimates of wildfire emissions for 2020 comes from the European Centre for Medium-Range Weather Forecasts. Wildfire emissions are displayed using the 100-year global warming potential horizon.

Special Topic: COVID-19

Air Pollution

Data for air pollution is provided by California Communities Environmental Health Screening Tool (CalEnviroScreen) 3.0 (updated June 2018). CalEnviroScreen identifies California communities by census tract that are disproportionately burdened by, and vulnerable to, multiple sources of pollution.

COVID-19 Cases and Deaths

Data on COVID-19 cases and deaths (per 100,000 people) is from the New York Times Tracker (https://www.nytimes.com/interactive/2020/us/coronavirus-us-cases.html). Data on the number of COVID-19 cases and deaths is compiled at the county level and comes from state and local health agencies while population and demographic data comes from the U.S. Census Bureau.

Greenhouse Gas Reduction Fund

The Greenhouse Gas Reduction Fund (GGRF) is a statewide program used to further the objectives of the California Global Warming Solutions Act of 2006 (Assembly Bill 32 (AB 32); Núñez, Chapter 488, Statutes of 2006). Funding for the GGRF comes from the State's portion of the Cap-and-Trade auction proceeds. California Climate Investment (CCI) oversees the implementation and appropriation of the GGRF. Data on the GGRF comes from the California Climate Investments Data Dashboard. Retrieved from: http://www.caclimateinvestments.ca.gov/cci-data-dashboard

BlueLA Expansion Project

BlueLA is a 100 percent electric car sharing service and part of the City of Los Angeles' mobility strategy. In 2015, The City of Los Angeles was awarded a grant from the California Air Resources Board through California Climate Investments (CCI) to pilot electric vehicle car sharing in low-income communities of Los Angeles. BlueLA Carsharing was selected to operate the service and has partnered with the Los Angeles Department of Transportation (LADOT) to deliver a system of 100 electric vehicles and 200 chargers to central Los Angeles. Data on BlueLA's impact comes from the City of Los Angeles application for GGRF funding for the Los Angeles EV Carsharing Serving Disadvantaged Communities: Phase 2. Retrieved from: https://clkrep.lacity.org/onlinedocs/2019/19-0131_rpt_DOT_02-08-2019.pdf

IMPLAN

IMPLAN is an economic input-output (I-O) model that includes transactions between industries and institutions, and between institutions themselves, thereby capturing all monetary market transactions in a given period. IMPLAN is used for conducting economic impact studies. The following impacts are typically measured:

Direct Effects/Impacts: Expenditures made by the producers and/or consumers of an event, activity or policy. These expenditures are applied to the industry multipliers in an IMPLAN model, which results in further, secondary expenditures (known as the indirect and induced effects).

Expenditures: Money buyers pay to sellers in exchange for goods or services.

Indirect Effects/Impacts: Expenditures made by local industries on goods and services from other local industries as a result of the direct effects. This cycle of spending works its way backwards through the supply chain until all money 'leaks' from the local economy.

Induced Effects/Impacts: Expenditures made by local households on local goods and services as a result of increased labor income generated by the direct and indirect effects.

Input-Output Analysis: A type of applied economic analysis that tracks the interdependence of various producing and consuming sectors of an economy.

Jobs (Employment): A job in IMPLAN is equal to the annual average of monthly jobs in that industry (this is the same definition used by the Bureau of Labor Statistic and the Bureau of Economic Analysis – Federal governmental statistical agencies that provide authoritative U.S. economic data). Thus, 1 job lasting 12 months is equal to 2 jobs lasting 6 months each, which is equal to 3 jobs lasting 4 months each. A job can be either full-time or part-time.

Labor Income: All forms of employment income, including employee compensation (wages and benefits) and proprietor income.

Leakages: Expenditures, income, resources or capital located outside the region of study. Because leakages do not affect local industries, they are not included in the economic impact results.

Multiplier Effect: Describes how for a given change in a particular Industry, a resultant change will occur in the overall economy (e.g., for every dollar spent in the economy an additional $0.25 of economic activity is generated locally, implying a Multiplier of 1.25).

Output: The value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are in producer prices. For manufacturers, this is sales plus/minus change in inventory. For service sectors, production is equal to sales. For retail and wholesale trade, output is equal to gross margin (not gross sales).

Total Effect/Impact: The entire economic impact of an event, activity or policy, found by combining the direct, indirect and induced impacts.

Fiscal Impact: Tax revenues generated at the Federal, state and local level. These expenditures are included in the total impact as government expenditures.

Transportation

Emissions, Surface Transportation, Vehicle Miles Traveled

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 to current are from the California Department of Transportation's Highway Performance Monitoring System's "California Public Road Data." Calculations use Population data sources where applicable.

New Light Vehicle Registrations

Data for new light vehicle registrations in California are from California New Car Dealers Association's Quarterly California Auto Outlook, which are sourced from IHS Markit. Light Vehicles include cars and light trucks. Cars are comprised of the following categories: subcompact, compact, sports/pony cars, mid-size, large, entry luxury, near luxury, luxury and high end sports cars. Light trucks are comprised of the following categories: compact/mid-size pickup, full size pickup, minivan, large van, subcompact SUV, compact SUV, mid-size SUV, large SUV, luxury subcompact SUV, luxury compact SUV, luxury mid-size SUV and luxury large SUV.

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 vehicles. Zero-emission fuel-types include electric, plug-in hybrid, and hydrogen.

Electric Vehicle Charging Station

Data on alternative fueling stations, which encompasses electric vehicle charging stations, are from Alternative Fuel Data Center, U.S. Department of Energy. The data in the Alternative Fueling Station Locator are gathered and verified through a variety of methods. The National Renewable Energy Laboratory (NREL) obtains information about new stations from trade media, Clean Cities coordinators, a Submit New Station form on the Station Locator website, and through collaborating with infrastructure equipment and fuel providers, original equipment manufacturers (OEMs), and industry groups.

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.

Transportation Network Companies' SB 1014 Requirements

Data related to transportation network companies' (TNCs) SB 1014 requirements regarding electric vehicle fleet is based on the 2018 study on SB 1014 Clean Miles Standard: 2018 Base-year Emissions Inventory Report.

Alternative Modes of Transportation

Data on alternative modes of transportation to and from work comes from the American Community Survey Public Use Microdata Samples (ACS PUMS). The ACS PUMS is a publicly available dataset, published annually, that allows for custom tabulations. The ACS PUMS dataset lists twelve modes of transportation, which are consolidated to the following categories for the purpose of this report: Passenger vehicles, public transportation, active transportation, and work from home.

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.

RPS Position of Community Choice Aggregations

Data on the annual renewable portfolio standards (RPS) position of community choice aggregations (CCAs) come from the California Public Utility Commission's annual RPS report to the legislature, which is based on the CCA draft RPS procurement plans submitted to the CPUC.

Integrated Resource Plan

Data on the integrated resource plan (IRP) scenarios comes from the 2019 unified resource adequacy (RA) and IRP modeling datasets hosted on the California Public Utility Commission's (CPUC's) website. The unified modeling input datasets and scenarios are used by Energy Division of the CPUC to model the electric and gas system, typically in support of the Resource Adequacy (RA) and Integrated Resource Plan (IRP) proceedings. The production cost model used by Energy Division is the SERVM model developed by Astrape Consulting.

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 U.S., 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 U.S., 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.

Energy Efficiency Savings

Data on energy efficiency savings come from the California Energy Commission's report "2019 California Energy Efficiency Action Plan" (docket number 19-IEPR-06). Units for natural gas and electricity have been converted to British thermal unit (BTU).

House Heating Fuel

Data on house heating fuel comes from the American Community Survey Public Use Microdata Samples (ACS PUMS). The ACS PUMS is a publicly available dataset, published annually, that allows for custom tabulations.

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.

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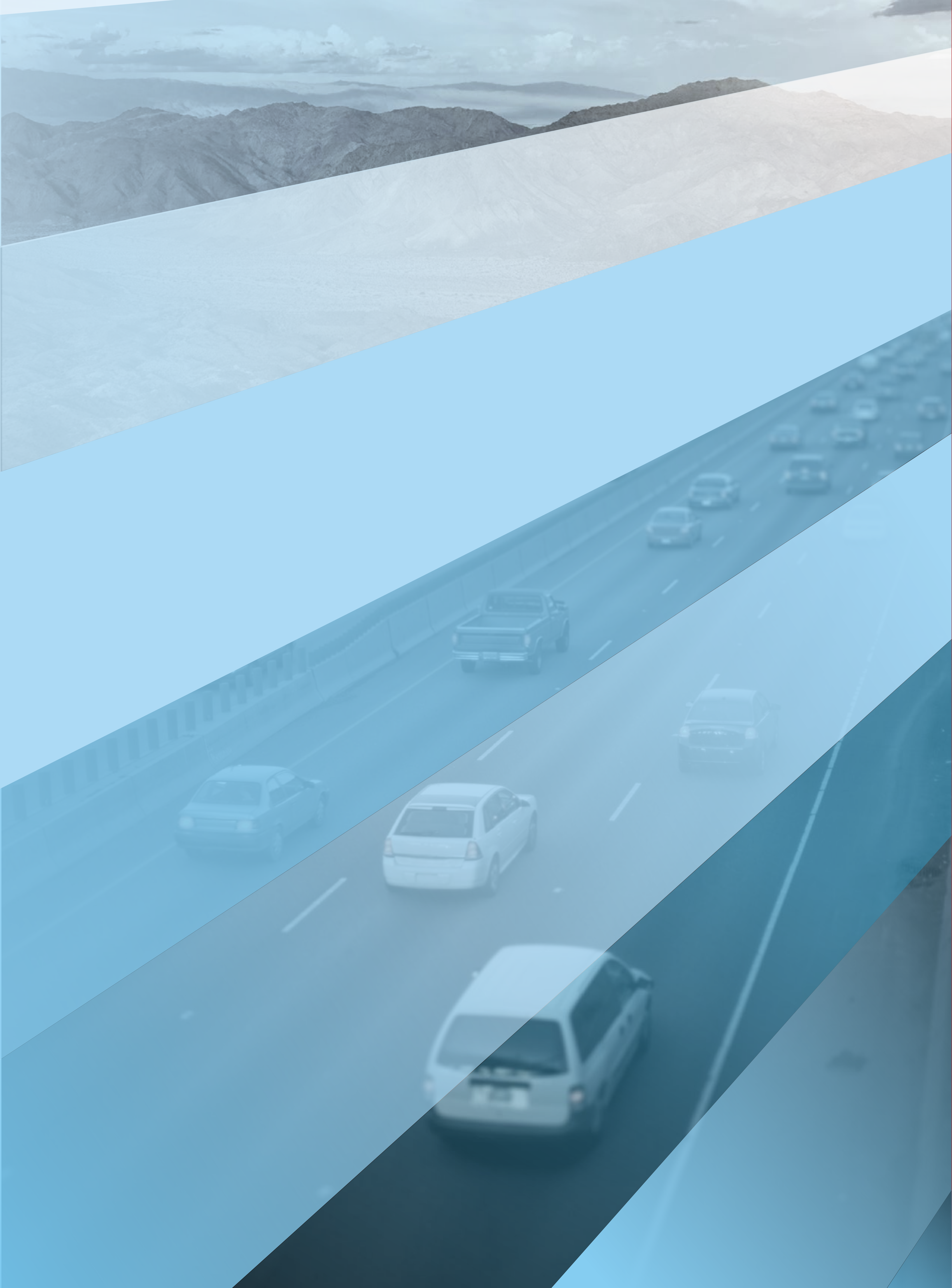

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