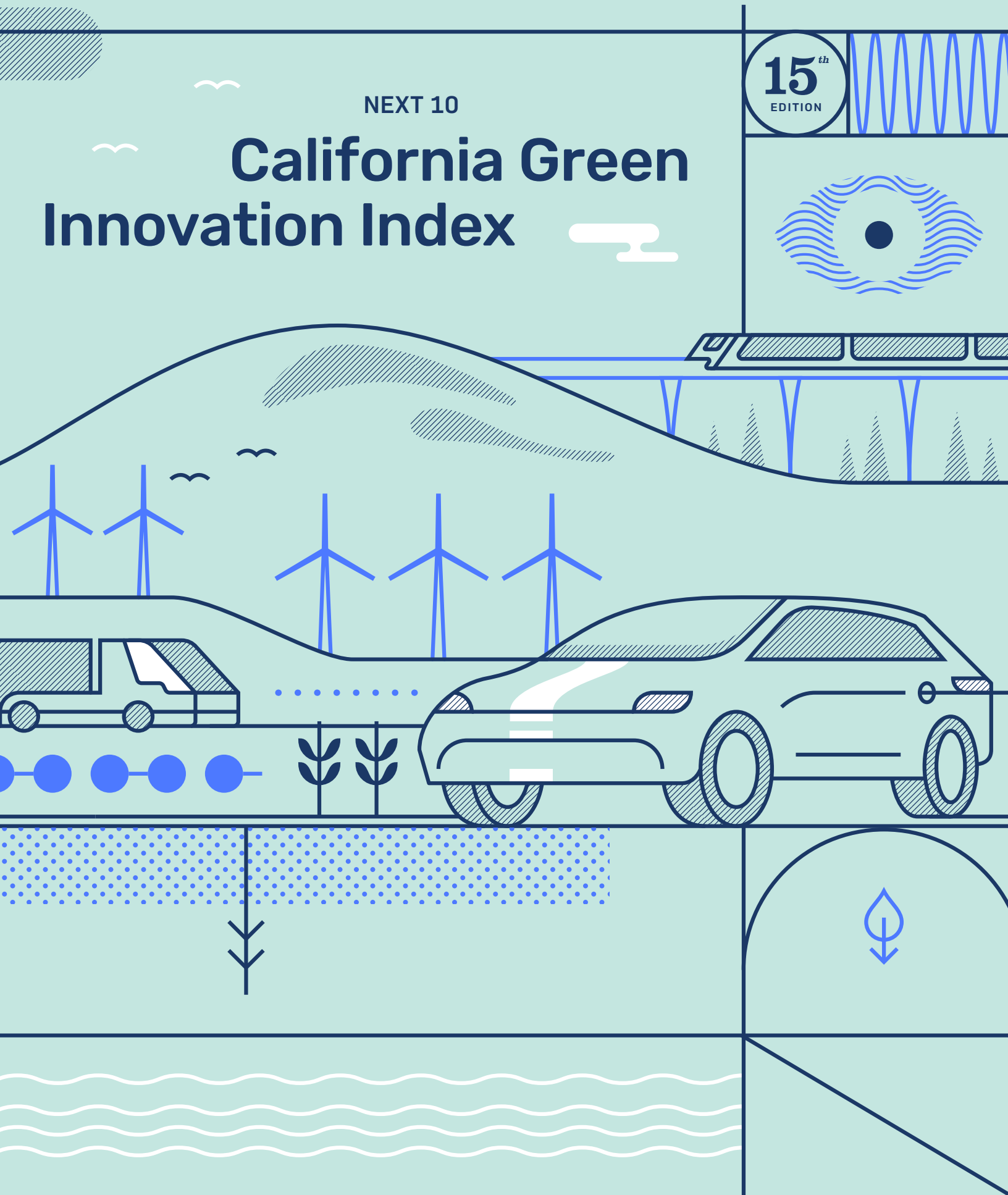
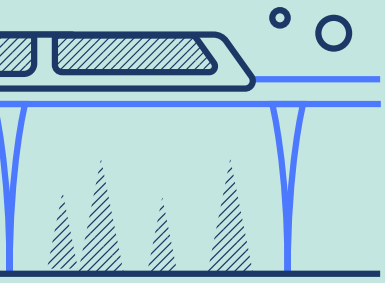
NEXT 10

California Green Innovation Index

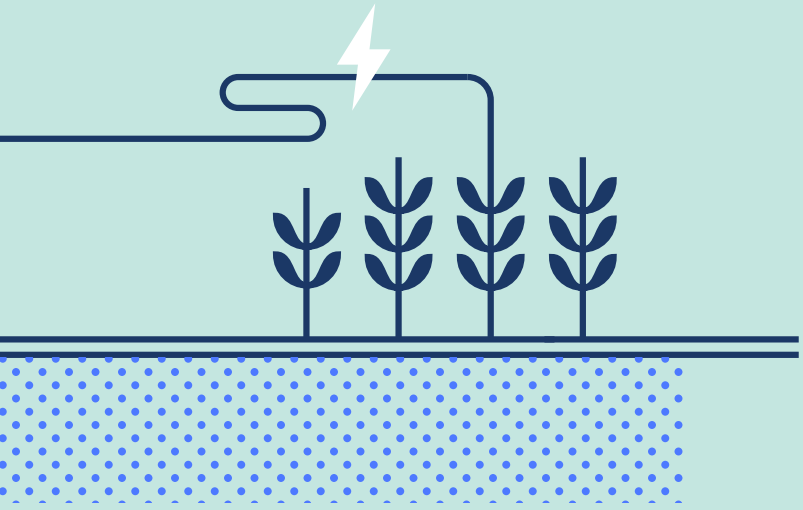
15th EDITION

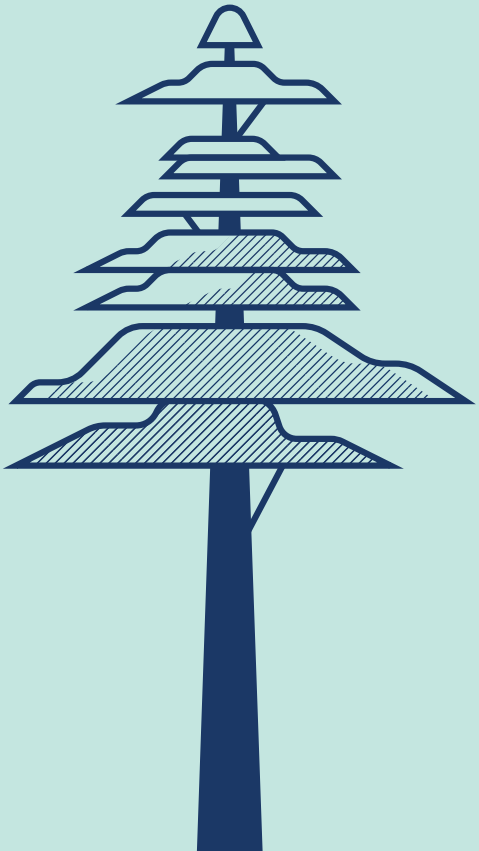


This marks the release of the 15th edition of Next 10's California Green Innovation Index. The 2023 edition continues the shift in format for our readers that we introduced in 2021: a fully online, immersive experience for the Index that allows our readers to jump straight to the issues most important to their work, and easily find, interact with, and share the most critical climate and clean energy trends facing the state. This year's edition also features more interactive graphics, allowing readers to dig even deeper into the data.



This overview provides a snapshot of some of this year's key takeaways. You can learn more about these trends and others at **GreenInnovationIndex.org**. We're excited for you to experience our third online edition of the California Green Innovation Index, and we hope it can be useful to your work.





Following a historic federal and state investments in climate action, California is well-positioned to expand our clean energy economy. However, challenges remain for the state to meets its renewable energy, transportation, and climate goals. Key takeaways from this year's analysis include:

View the entire index at
greenInnovationIndex.org

KEY FINDING 1

California is unlikely to meet the 2030 climate goal at the current emissions reduction rate.

After the large 8.8 percent drop in emissions from 2019 to 2020 due to the COVID-19 pandemic, emissions rose by 3.4 percent from 2020 to 2021. While 2021 emissions remained 5.7 percent below 2019 emissions, the state still needs to reduce emissions much faster in order to meet the SB 32 goal by 2030. To meet the goal, California would need to reduce emissions by 4.4 percent annually between 2022 and 2030. From 2016 to 2021, emissions fell at an average annual rate of only 1.6 percent.

2020 — 2021

CALIFORNIA GHG EMISSIONS INCREASED BY

3.4%

2000 — 2021

GREENHOUSE GAS EMISSIONS HAVE **DECREASED** BY

17.4%

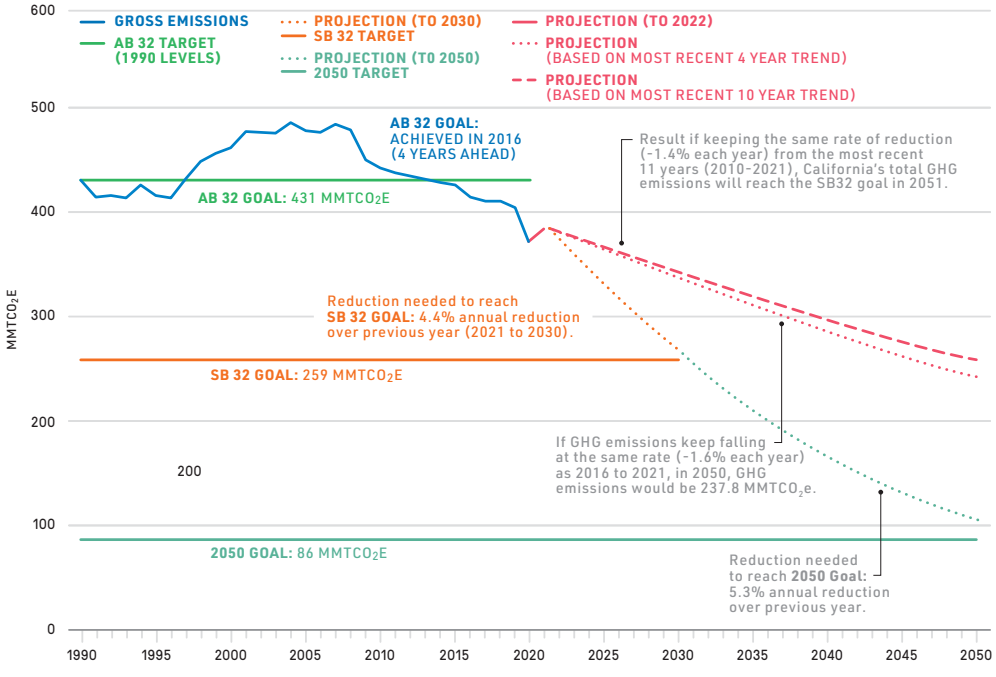
THE STATE NEEDS TO **REDUCE** EMISSIONS BY

4.4%

EACH YEAR TO MEET 2030 GOAL

FIGURE 1. GHG Emissions and Projected Reduction Goals

CALIFORNIA, 1990–2050



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Historical emissions data was re-calculated in the 2022 update to the CARB GHG Inventory. Data Source: California Air Resources Board, California Greenhouse Gas Inventory. NEXT 10 / SF · CA · USA

The rebound in emissions from 2020 to 2021, particularly in the transportation sector, as pandemic restrictions eased means that California now needs to reduce emissions at a greater rate to meet our 2030 goal. In 2020, emissions only need to be reduced by 3.6 percent each year. California has only reduced emissions by more than 4 percent annually twice since 2000—by 8.8 percent in 2020 due to the pandemic followed by the second-largest decrease of 6.1 percent during the Great Recession from 2008 to 2009.

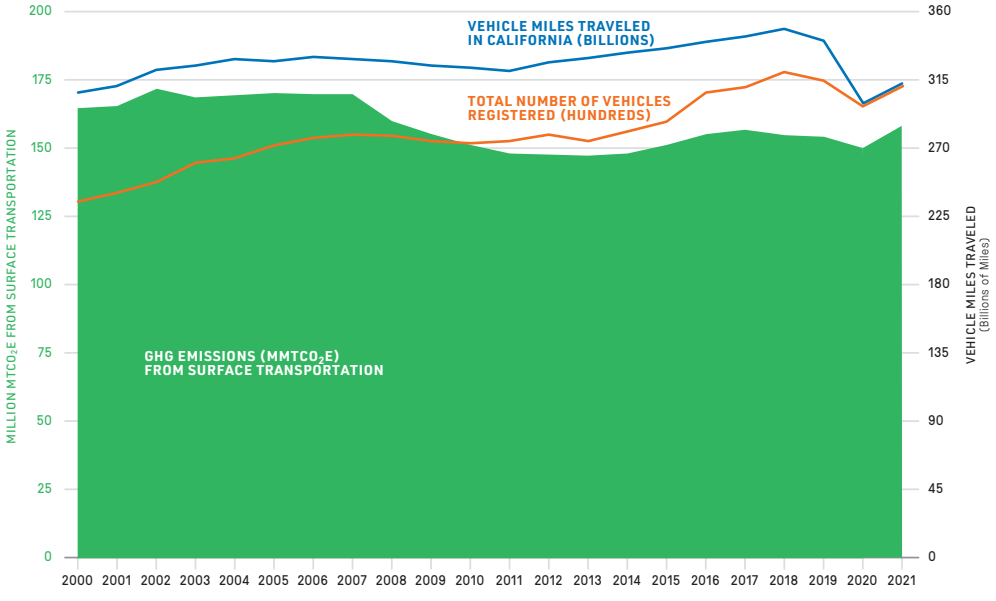
KEY FINDING 2

Emissions from transportation rose after three years of declines.

After three years of consecutive decreases in emissions from the transportation sector, emissions increased by 7.4 percent from 2020 to 2021 as travel restrictions eased. The transportation sector continues to be the largest emitter in California, comprising 38.2 percent of the total emissions in 2021—an increase from the 36.8 percent in 2020. In 2021, both the total number of vehicles registered and vehicle miles traveled (VMT) were higher than in 2020, increasing by 3.9 percent and 3.7 percent, respectively.[2]

FIGURE 2. Total Vehicles Registered, Vehicle Miles Traveled and Greenhouse Gas Emissions

CALIFORNIA, 2000–2021



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity; Federal Highway Administration, U.S. Department of Transportation. NEXT 10 / SF · CA · USA

In 2022, light-duty pickup trucks, mini-vans, and SUVs made up 68.5 percent of new light vehicle registrations—up from 66.4 percent in 2021. This continues a trend of consumers preferring these types of vehicles more than cars and sedans, and new car registrations dropped by more (-16.1%) than new light truck registrations (-9.1%) in 2022. However, as more electric pick-up trucks and SUVs have come on the market, the number of electric light-duty pickups, SUVs and vans registered hit an all-time high in 2022, up 49.3 percent compared to 2021.

2021

SHARE OF GHG EMISSIONS FROM TRANSPORTATION SECTOR:

38.2%

2020 — 2021

MOST OF THE INCREASE IN TRANSPORTATION EMISSIONS CAME FROM THE PASSENGER VEHICLES SUB-SECTOR

+10.6%

2020 — 2021

EMISSIONS FROM HEAVY-DUTY TRUCKS **DECREASED** BY:

1.6%

EMISSIONS FROM HEAVY-DUTY TRUCKS HAVE CONTINUOUSLY **DECLINED** EACH YEAR SINCE

2018

KEY FINDING 3

Decarbonizing cement could produce significant industrial emissions decreases.

CALIFORNIA'S CEMENT PLANTS ACCOUNT FOR **2%** OF TOTAL STATEWIDE CARBON EMISSIONS AND ALMOST **10%** OF INDUSTRIAL EMISSIONS

2011 — **2021**

CEMENT PLANT-ASSOCIATED EMISSIONS AT THE EIGHT PLANTS IN CALIFORNIA HAVE GROWN BY

26%

(THE 8TH PLANT IN CUPERTINO CLOSED IN 2020)

THE REMAINING SEVEN OPERATIONAL PLANTS' EMISSIONS HAVE INCREASED BY

46%

OVER THE SAME TIME FRAME

CEMENT IS USED IN ALMOST EVERY SECTOR OF CONSTRUCTION, WITH NO SINGLE USE ACCOUNTING FOR MORE THAN

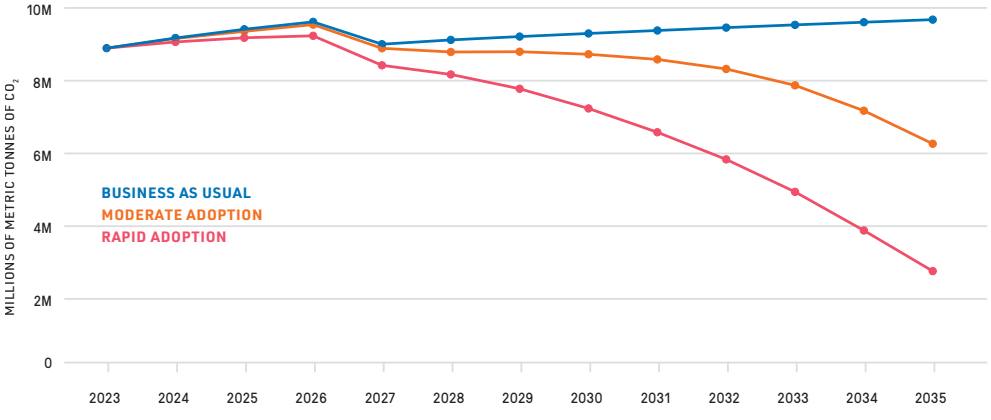
20%

OF STATEWIDE CONSUMPTION

The manufacture of traditional cement and concrete is a highly carbon-intensive process. Every pound of cement results in the emission of approximately 0.9 pounds of CO_2. Although California's cement plants are marginally more emissions-efficient on a per-ton basis than the average American plant, they emit about 33 percent more than plants in China and India. A number of companies are working to produce less carbon-intensive cement through a number of processes, including replacing components, electrifying kilns, or capturing the carbon produced by the manufacturing process.

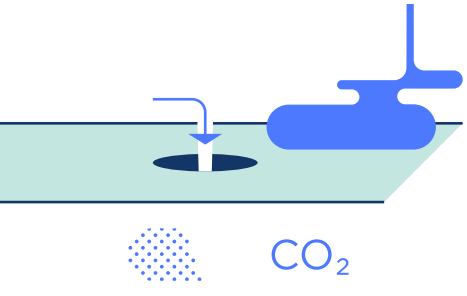
FIGURE 3. Cement CO_2e Emissions Modeling

CALIFORNIA, 2023–2035



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: National Transit Database, Department of Transportation; Motor Fuel & Highway Trust Fund, Office of Highway Policy Information, U.S. Department of Transportation. NEXT 10 / SF · CA · USA

To determine the impact of less carbon-intensive cement on California emissions, a model was developed to quantify the potential of these new technologies The analysis projects California's cement consumption through 2035 using a combination of expected housing construction and linear projections, based on the previous decade of use, of other uses for cement. As a percentage, the rapid model represents a 24 percent reduction in emissions over the 2023-2035 period, and the moderate case only a 9 percent saving, when compared to the business-as-usual scenario.



KEY FINDING 4

California's average residential electricity bills are now higher than the U.S. average.

Despite having the most expensive kilowatt-hour electricity rates, California's residential electricity bills had been below the U.S. average for years. However, California's once-held advantage of having a lower average residential electricity bill compared to the rest of the U.S. has vanished in the wake of the pandemic. In 2011, the margin stood at 15.9 percent below the national average, but as of 2021, it has shifted to a 2.2 percent higher than the U.S. average. On the other hand, California has consistently maintained its price advantage over the U.S. for the industrial sector, with the gap widening nearly fourfold from 8.7 percent in 2011 to 32.8 percent in 2021.

Table 1. Electricity Prices and Bills (Inflation-Adjusted) by Sector California and the Rest of the U.S.

PRICE PER KWH			AVERAGE MONTHLY			
		2021	2011	2021	10YR % CHANGE	YOY % CHANGE
RESIDENTIAL	CALIFORNIA	$0.23	$118.58	$123.67	4.3%	1.0%
	FLORIDA	$0.12	$158.56	$130.40	-17.8%	-3.2%
	ILLINOIS	$0.13	$113.71	$95.86	-15.7%	-2.6%
	NEW YORK	$0.19	$128.34	$116.70	-9.1%	0.9%
	OHIO	$0.13	$134.92	$112.21	-16.8%	-0.1%
	PENNSYLVANIA	$0.14	$142.84	$117.11	-18.0%	-2.6%
	TEXAS	$0.12	$167.44	$132.40	-20.9%	-4.6%
	UNITED STATES	$0.14	$140.92	$121.01	-14.1%	-1.6%
INDUSTRIAL	CALIFORNIA	$0.15	$8,322.58	$3,932.92	-52.7%	-1.8%
	FLORIDA	$0.08	$7,461.09	$4,733.59	-36.6%	3.3%
	ILLINOIS	$0.07	$48,787.55	$46,247.54	-5.2%	9.1%
	NEW YORK	$0.06	$13,037.02	$12,211.54	-6.3%	14.5%
	OHIO	$0.07	$17,867.72	$13,834.28	-22.6%	8.6%
	PENNSYLVANIA	$0.07	$13,074.93	$18,148.95	-38.8%	7.4%
	TEXAS	$0.06	$6,124.17	$2,307.82	-62.3%	10.2%
	UNITED STATES	$0.07	$9,111.36	$5,856.17	-35.7%	4.1%
COMMERCIAL	CALIFORNIA	$0.19	$971.99	$992.86	2.1%	4.7%
	FLORIDA	$0.10	$749.32	$584.71	-22.0%	2.9%
	ILLINOIS	$0.10	$784.81	$596.27	-24.0%	3.3%
	NEW YORK	$0.16	$806.07	$806.07	-24.7%	5.2%
	OHIO	$0.10	$571.00	$571.00	-27.0%	1.2%
	PENNSYLVANIA	$0.09	$378.38	$378.38	-35.7%	4.0%
	TEXAS	$0.09	$692.26	$692.26	-18.1%	10.7%
	UNITED STATES	$0.11	$650.04	$650.04	-19.9%	3.0%

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

Additionally, California's average monthly commercial electricity bill has become considerably more expensive relative to the U.S. average during the last decade—from 31.3 percent higher in 2011 to 52.7 percent higher in 2021. This rise can be attributed to a disparity between the growth in the number of customers and the surge in prices during the same period. The state of California can no longer depend solely on mild weather and energy efficiency measures to mitigate the impact of high utility bills. Rising rates have been driven by wildfire-related expenses, insurance, and solar adoption that reduces revenue.

2011 — 2021

RESIDENTIAL ELECTRICITY RATES IN CALIFORNIA HAVE INCREASED BY

54.4%

TOTAL U.S. RESIDENTIAL RATES ALSO INCREASED BY **16.6%** OVER THE SAME TIME PERIOD

2020 — 2021

RESIDENTIAL RATES HAD THE HIGHEST ONE-YEAR GROWTH RATE IN BOTH CALIFORNIA AND THE U.S.—BY **11.6%** AND **3.9%** RESPECTIVELY

KEY FINDING 5

California met the 2025 electric vehicle goal two years early.

California met the 2025 goal of 1.5 million zero-emission vehicles (ZEVs) on road two years early in 2023. The state now accounts for 40 percent of all ZEV sales in the U.S. The market share of ZEVs increased from 12.8 percent of total sales in 2021 to 17.1 percent in 2022. New light-duty electric vehicle sales grew by 79 percent from 2020 to 2021 and by 41.4 percent from 2021 to 2022. As more models have become available, the number of electric light-duty pickups, SUVs and vans also hit an all-time high in 2022, up 49.3 percent from 2021.

2022

NEW LIGHT-DUTY ELECTRIC VEHICLE SALES IN ALL CLASSES **ROSE** BY

61.7%

COMPARED TO THE PREVIOUS YEAR

2022

ZERO-EMISSION VEHICLES (ZEVS) ACCOUNTED FOR OVER

16.3%

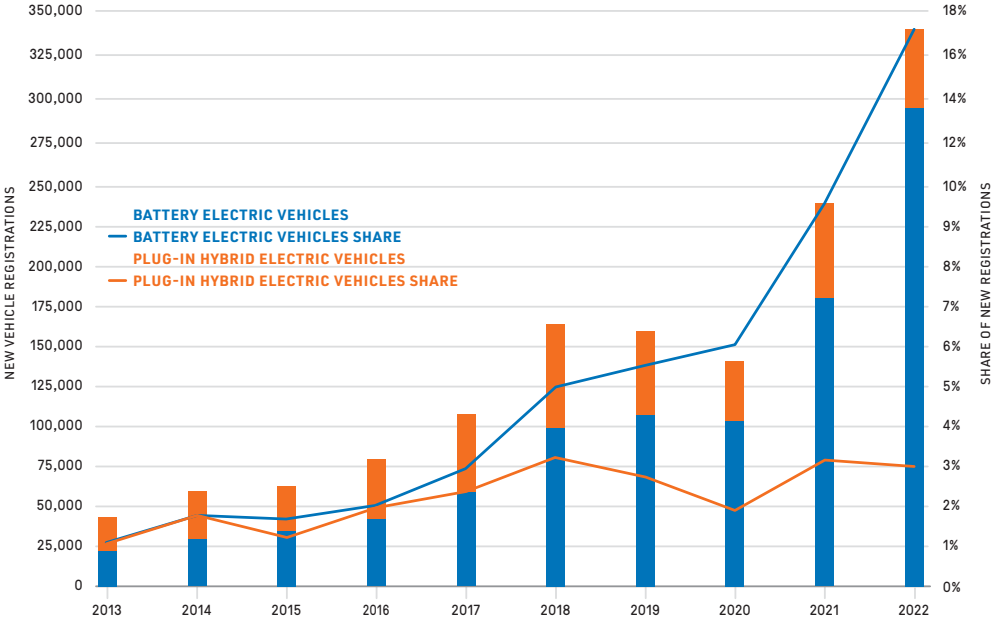
OF TOTAL NEW REGISTRATIONS IN PICKUPS, SUVS, AND VANS

2022

FOR THE FIRST TIME, THE COUNTY-WIDE AVERAGE ZEV ADOPTION RATE EXCEEDED 2%—REACHING **2.4%**.

FIGURE 4. Electric Vehicle Registration and as Percent of Total New Light Vehicle Registration

CALIFORNIA, 2013–2022



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: AutoCount data from Experian; California New Car Dealers Association. NEXT 10 / SF · CA · USA

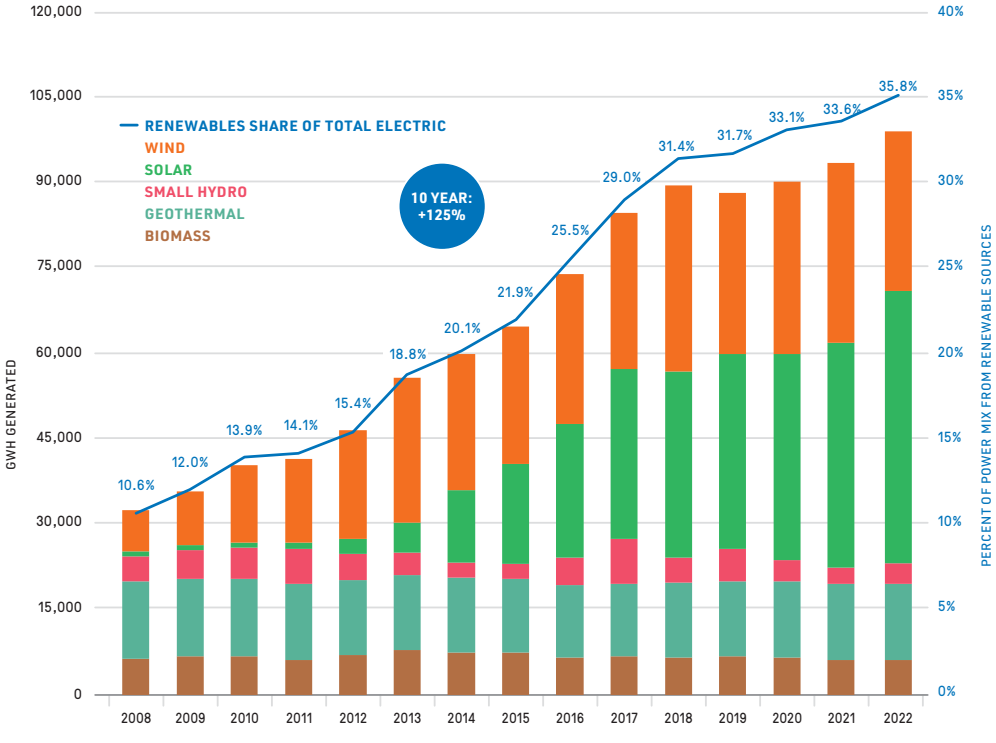
Meeting the 2025 goal early puts California in a better position to meet the 2030 goal of 5 million ZEVs on-road. To reach that goal, ZEV registrations in California need to increase by an annual average of 18.8 percent from 2024 to 2030, revised downwards from the 27.2 percent required in 2022. At the current trajectory (five-year Compound Annual Growth Rate (CAGR) of 25.6% from 2018 to 2023), California is anticipated to achieve the milestone of 5 million ZEVs on the road by 2029, one year before the target date in 2030.

California is behind on meeting its upcoming renewable energy targets.

In 2022, the share of renewable sources in California's power mix (including imports) increased to 35.8 percent, a rise of 2.2 percent compared to 2021. It is the largest increase since 2017 to 2018. To meet the upcoming 2026 goal of 50 percent of generation from RPS-eligible renewable sources, California's share of electricity generation from renewables would need to increase by 8.7 percent each year from 2022 to 2026, revised upward from 8.3 percent previously.

FIGURE 5. California Renewable Electricity Generation

GIGAWATT-HOURS BY SOURCE, 2008–2022



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

To reach the 2027 goal of 52 percent, the share of electricity generation from renewables would need to increase by 7.8 percent each year from 2022 to 2027. To meet the 2030 goal of 60 percent, the share of electricity generation from renewables would need to increase by 4.9 percent annually from 2027 to 2030. Although the growth rate of renewables in the power mix has increased from 2021 to 2022—at 2.2 percent, it is still slower than the rate needed to reach 2026 goal.

SOLAR AND WIND

ARE THE LARGEST RENEWABLE SOURCES, MAKING UP

17% AND 10.8%,

RESPECTIVELY, OF THE STATE'S TOTAL POWER MIX

2021 — 2022

SOLAR ENERGY AS PERCENT OF TOTAL POWER MIX **INCREASED** BY:

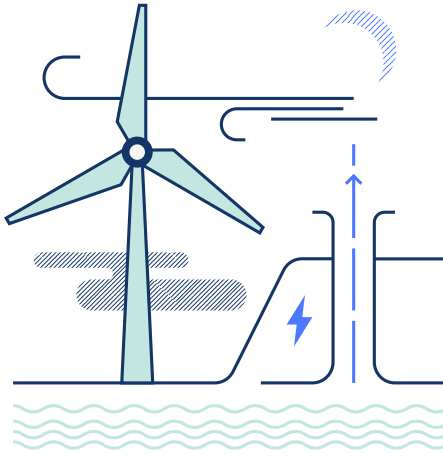
2.8%

WHILE WIND ENERGY'S CONTRIBUTION TO THE POWER MIX EXPERIENCED A DECREASE OF **0.5%**

IN THE U.S., RENEWABLES ONLY MAKE UP

15.3%

OF ELECTRICITY GENERATION



KEY FINDING 7

Battery storage in California more than quadrupled from 2020 to 2021.

2021

UTILITY-SCALE LITHIUM-ION BATTERY STORAGE INCREASED BY A FACTOR OF

4.3

OVER THE AMOUNT REPORTED IN 2020

THE CALIFORNIA-ISO (CAISO) ADDED ABOUT **1GW** OF BATTERY STORAGE BETWEEN THE SUMMER OF 2020 AND THE END OF 2021

2023

BATTERY STORAGE CO-LOCATED WITH SOLAR GENERATION WAS THE FASTEST GROWING BATTERY TYPE—ADDING

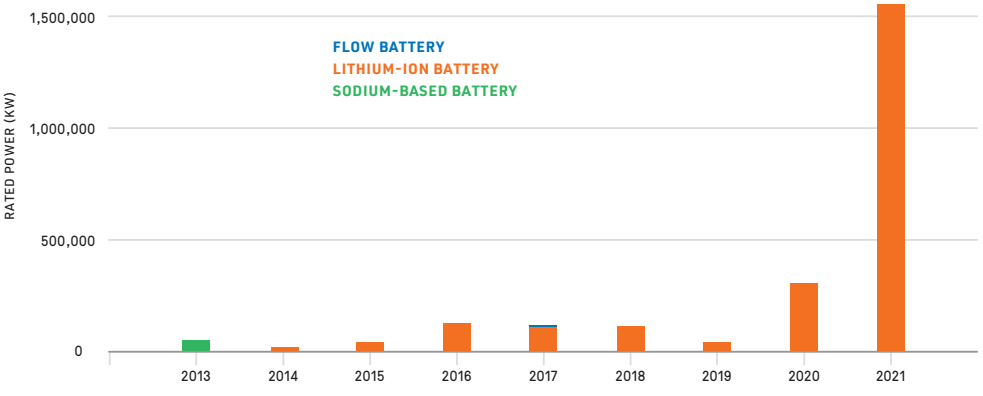
2,000MW

TO THE GRID

More utility-scale storage, such as lithium ion battery and long-duration, is needed to make the grid better at incorporating renewables and reduce curtailments that have been trending upwards in recent years. California's legislators have been modernizing the state's energy storage infrastructure, reducing its heavy reliance on large hydro-electric projects. In 2021, utility-scale lithium-ion battery storage increased by a factor of 4.3 over the amount reported in 2020 and projects expanded into 11 counties across the state. This underscores the extensive reach and impact of energy storage endeavors, signifying a widespread commitment to harnessing the potential of emerging technologies for a more sustainable and resilient energy landscape.

FIGURE 6. Non-Hydro Energy Storage Rated Capacity

TOTAL BY TECHNOLOGY TYPE, CALIFORNIA, 2013–2021



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission. Based on SGIP applications with the status "Incentive Claim Form Pending Payment", "Payment PBI in Process", or "Payment Completed". NEXT 10 / SF · CA · USA

The California battery storage industry proliferated starting in 2021 and the landscape of energy storage projects in California is rapidly evolving. By May 2023, stand-alone battery storage accounted for 47.1 percent of the total installed battery capacity, while co-located battery storage with solar accounted for 35.3 percent of the total installed battery capacity, an increase by more than 50 percent in just one year. While these increases are impressive, storage resources must grow considerably to meet the 15 GW of energy storage target by 2032.

About Next 10's California Green Innovation Index

Next 10's *California Green Innovation Index* tracks the state's progress in reducing greenhouse gas emissions, spurring technological and business innovation, and growing businesses and jobs that enable the transition to a more resource-efficient economy. The 2023 *Index* is the 15th 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.

Advisors to the California Green Innovation Index

Next 10 thanks the following expert advisors for their generous time and guidance on this project over the last twelve editions:

Dan Adler
Senior Advisor for Climate Finance, Governor's Office of Business and Economic Development

Morrow Cater
Founding Principal, Cater Communications

Ralph Cavanagh
Energy Co-Director, NRDC

Michael Hanemann
Professor & Julie A. Wrigley Chair in Sustainability, Department of Economics, Arizona State University

Hal Harvey
CEO, Energy Innovation: Policy and Technology LLC

Elliot Hoffman
CEO, REV

Mark Jacobson
Prof. of Civil and Environmental Engineering, Director of the Atmosphere/Energy Program, Stanford University

Dan Kammen
Class of 1935 Distinguished Professor of Energy in the Energy and Resources Group and the Goldman School of Public Policy. Director, Renewable & Appropriate Energy Laboratory, U.C. Berkeley

Joel Makower
Chairman and Executive Editor, GreenBiz Group Inc.

Walter McGuire
Owner, McGuire & Co., Inc./Flex Your Power

Manuel Pastor
Professor of Sociology and American Studies & Ethnicity, Director of the USC Program for Environmental and Regional Equity, University of Southern California

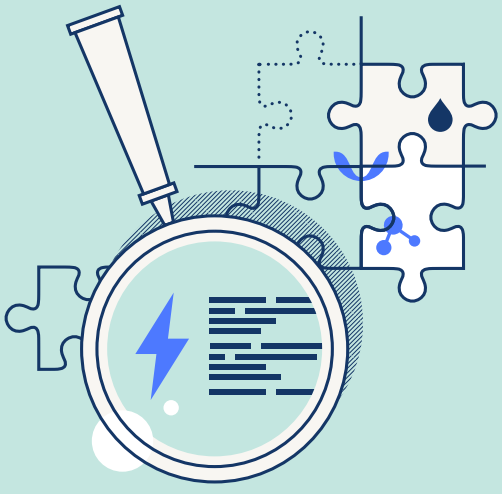
Former State Senator Fran Pavley
Environmental Policy Director, USC Schwarzenegger Institute

Wendy Pulling
Director, ESG Integration, University of California, Office of the Chief Investment Officer

Dan Skopec
Vice President, Regulatory Affairs, Sempra Energy Utilities

James (Jim) Sweeney
Professor of Management Science and Engineering, Senior Fellow at Precourt Institute for Energy, Stanford University

Tim Woodward
Managing Director, Prelude Ventures LLC



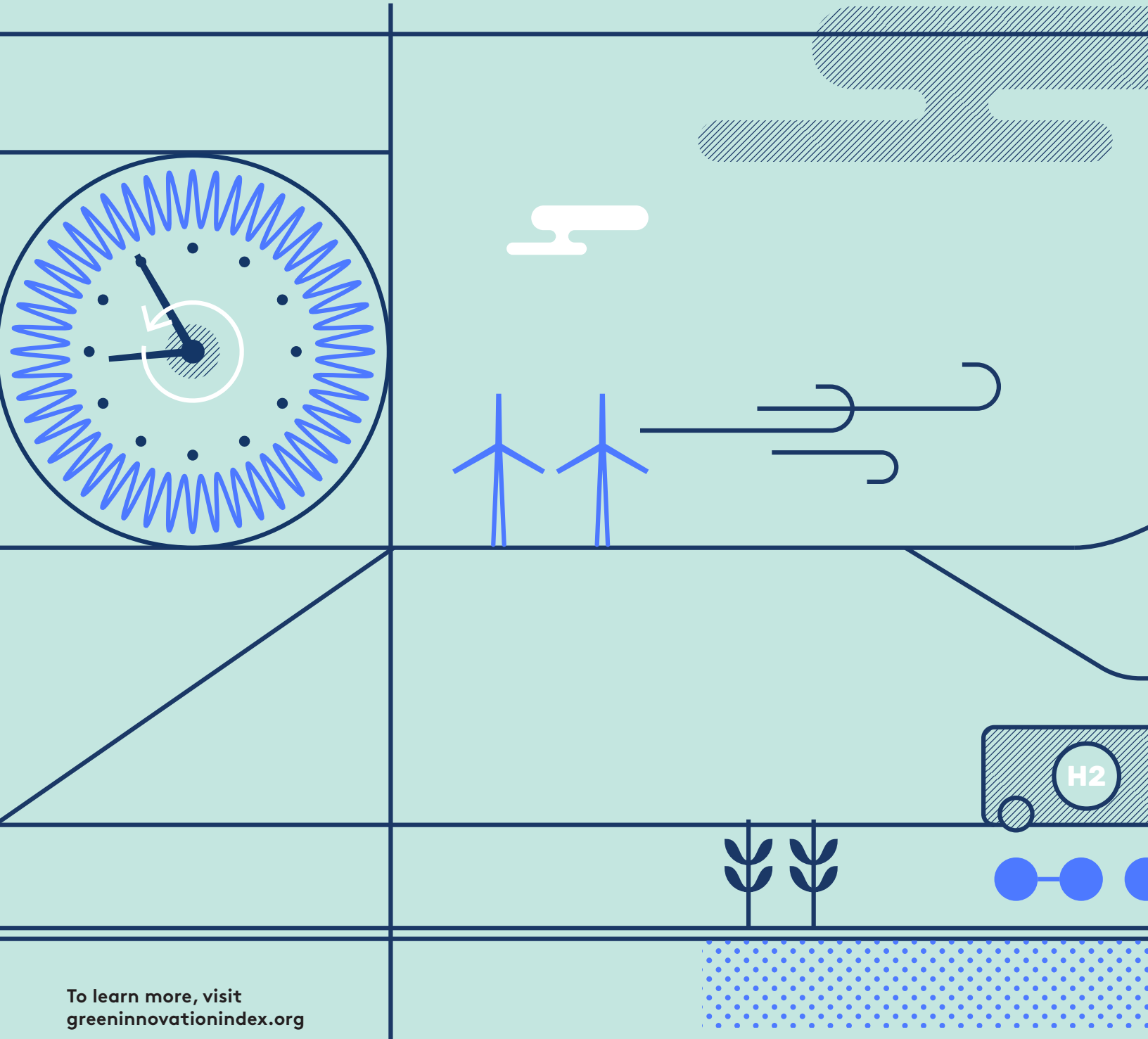
Endnotes

1 "California Climate Policy Fact Sheet: Emissions Reduction Policy." Center for Law, Energy & Environment, UC Berkeley Law. Available at: https://www.law.berkeley.edu/wp-content/uploads/2019/12/Fact-Sheet-Emission-Reduction-Policy.pdf

2 Vehicle registration data from the California Energy Commission, California Department of Motor Vehicles - Quarterly vehicle registration database.

3 Hasanbeigi, A. & Springer, C. (2019.) California's cement industry: failing the climate challenge. Global Efficiency Intelligence. San Francisco, CA.

4 RFS-eligible resources include Biomass, small Hydro, Geothermal, Solar, and Wind.



To learn more, visit greeninnovationindex.org

NEXT 10

www.next10.org

Printed on 100% recycled paper
using vegetable-based inks