TOWARD A

CLEAN ENERGY FUTURE

2018 **IEPR**

INTEGRATED ENERGY POLICY REPORT UPDATE VOL. 1

CEC-100-2018-001-V1

Dedicated to Nancy McFadden, 1959-2018

ABOUT THE CALIFORNIA ENERGY COMMISSION

The California Energy Commission is the state's primary energy policy and planning agency. Established in 1974 by the Warren-Alquist Act, the Energy Commission is committed to promoting a clean, affordable, and reliable energy supply for all Californians.

INTEGRATED ENERGY POLICY REPORT

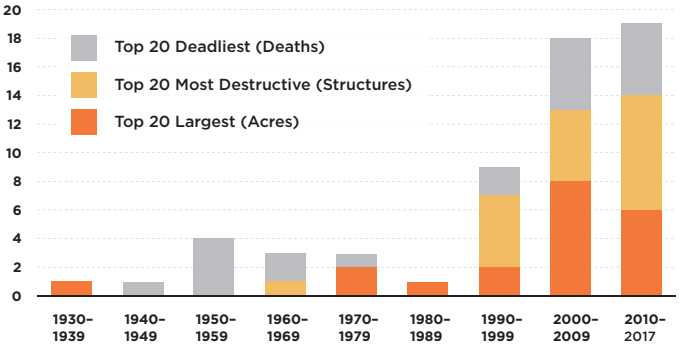
Every two years, the California Energy Commission prepares the Integrated Energy Policy Report (IEPR). This year, the IEPR Update contains two volumes. Volume I (this document) highlights the implementation of California's innovative policies and the role they have played in establishing a clean energy economy. Volume II, scheduled for completion in February 2019, will provide more detail on several key energy issues and will encompass new analyses, as well as significant opportunities for public participation.

CLIMATE CHANGE

Climate change represents one of the greatest threats facing the world today. Already, California has seen impacts in the form of sea-level rise, drought, wildfires, coastal erosion, disruption of water supply, and threats to agriculture. Last year, California experienced the largest and most damaging forest fires in the history of the state. In total, the 2017 fire season killed 43 people and damaged or destroyed more than 10,000 structures. Just two years prior, the drought cost the state's agricultural sector an estimated $2.7 billion and more than 20,000 jobs. The most recent drought was followed by record-breaking rains, resulting in flooding that tore through freeways and threatened rural and coastal communities. Climate change continues to increase the risk of natural disasters in California and around the globe.

California's leadership in climate change policy builds on a strong foundation of climate science and research. The state's Climate Change Assessments provide interagency analysis of climate change impacts. *The Fourth Climate Change Assessment*, to be released in 2018, will detail climate impacts on regions, industries, ecosystems and communities, highlighting key vulnerabilities and adaptation and mitigation priorities. These assessments inform policymakers, influence legislation, and support California's commitment to reduce greenhouse gas emissions and build a healthy, safe, and sustainable future.

TOP 20 LARGEST, MOST DESTRUCTIVE, AND DEADLIEST WILDFIRES IN CALIFORNIA



Source: Cal Fire

A Ventura, California home destroyed by the 2017 Thomas Fire.

LEADING THE WAY TO A CLEAN ENERGY FUTURE

CLIMATE LEADERSHIP

For decades, California has remained at the forefront of clean energy leadership, demonstrating that environmental protection does not need to come at the expense of a thriving economy. Today, California is committed to addressing climate change in partnership with other states and nations around the world.

CALIFORNIA'S GROWING ECONOMY

With the fifth largest economy in the world, California is implementing an ambitious array of climate and renewable energy policies, demonstrating that economic growth and environmental protection can go hand in hand. As California has pressed forward to reduce pollution, the state's gross domestic product (GDP) growth has consistently outpaced the U.S. national average.

GDP GROWTH SINCE 2000

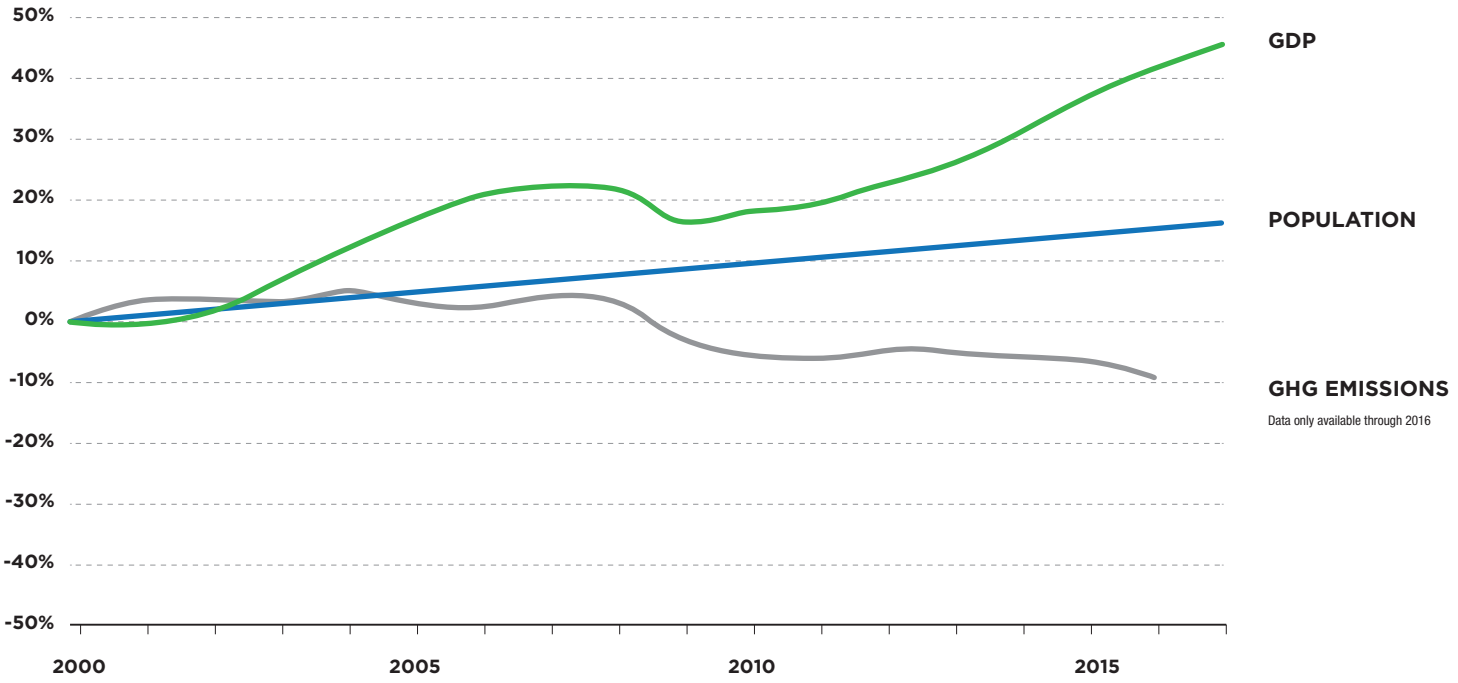
CALIFORNIA **46%**

REST OF UNITED STATES **35%**

Source: California Department of Finance and U.S. Bureau of Economic Analysis

BUILDING A CLEAN ECONOMY

PERCENT CHANGE SINCE 2000



Source: U.S. Census Bureau, California Air Resources Board, and California Department of Finance

SINCE 2000 CALIFORNIA HAS SEEN ...

9%
decrease in GHG emissions

16%
increase in population

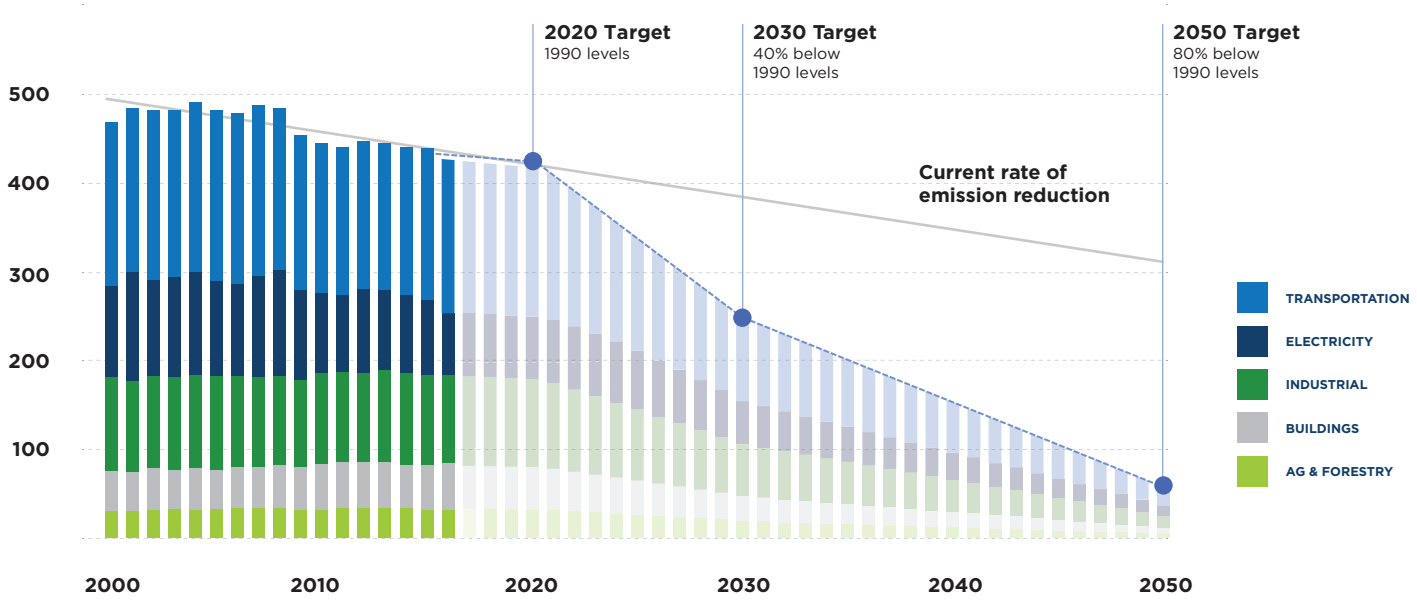
46%
increase in GDP

GREENHOUSE GAS EMISSION REDUCTIONS

AMBITIOUS TARGETS

California's greenhouse gas reduction targets are a cornerstone of the state's groundbreaking efforts to fight climate change. Under the leadership of the last two governors and through landmark legislative actions, the state has cultivated a robust climate policy portfolio that addresses emissions across sectors including electricity, buildings, transportation, land use and agriculture, and industry. This comprehensive approach helps reduce the impacts of climate change, promotes energy resiliency, improves public health, supports disadvantaged and low-income communities, and fosters economic growth and jobs.

CALIFORNIA GREENHOUSE GAS EMISSIONS ($MMTCO_2e$)



Source: California Air Resources Board

GREENHOUSE GASES

Although California's emissions are primarily (84 percent) carbon dioxide (CO_2), reduction efforts also target other harmful gases, which can be tens to thousands of times more potent in terms of global warming potential.

METHANE

Primary component of natural gas; livestock and landfills are the largest sources in California.

25x
more potent than CO_2

NITROUS OXIDE

Released in agricultural and industrial processes and fossil fuel combustion.

300x
more potent than CO_2

FLUORINATED GASES

Human-made gases released through industrial processes.

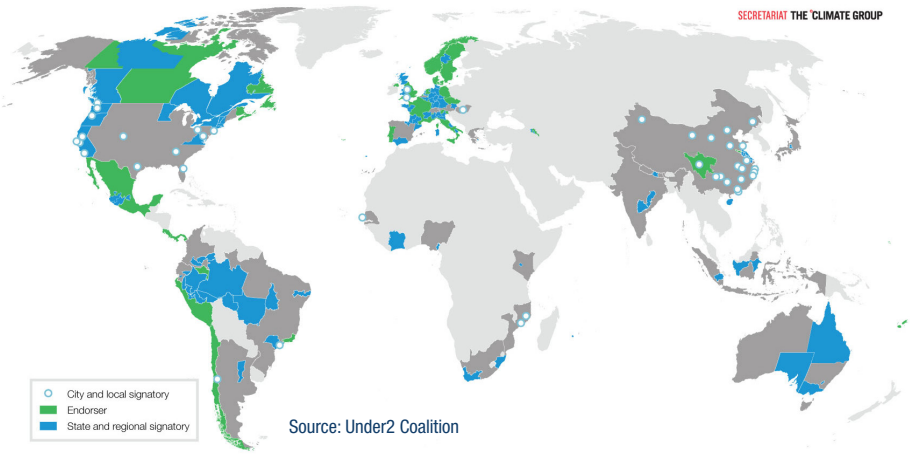
Up to 22,800x
more potent than CO_2

100-year potency compared to CO_2
Source: California Air Resources Board

INTERNATIONAL COLLABORATION

The Under2 Coalition, co-chaired by Governor Edmund G. Brown Jr., is an international pact among cities, states, and countries formed to galvanize bold climate action around the globe. Signatories pledge to limit the increase of the global average temperature to below 2 degrees Celsius and strive to remain below 1.5 degrees—the level of potentially catastrophic consequences—by either reducing emissions by 80 to 95 percent below 1990 levels or holding annual emissions to less than 2 metric tons per capita by 2050. Since 2015, the coalition has grown to include 206 jurisdictions, representing 43 countries, 1.3 billion people, and almost 40 percent of the global economy.

UNDER 2° SIGNATORIES



Source: Under2 Coalition

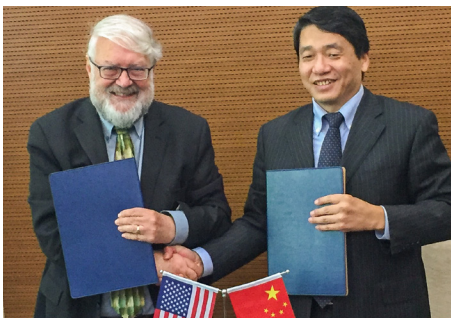
PUTTING A PRICE ON CARBON

The Cap-and-Trade Program helps California reach its climate targets at low costs. The program places a firm, declining cap on the primary sources of emissions. Businesses can then choose to reduce emissions below the cap or use a limited number of tradable emissions allowances. More than $6 billion collected through these allowance auctions is being invested in programs to further reduce emissions, including energy efficiency upgrades, clean transportation incentives, urban tree planting, and affordable housing development. More than $1 billion (half of the funding spent through 2017) has benefited disadvantaged communities.

SPOTLIGHT: *CALIFORNIA-MEXICO PARTNERSHIP*

California has established multiple channels of cooperation with Mexico to promote renewable energy, clean transportation, energy efficiency, and climate mitigation. California has signed agreements with the federal government of Mexico, and at the subnational level with the Mexican states of Aguascalientes and Jalisco. Both states, as well as 11 others, have also joined the Under2 Coalition. In addition, the Mexican federal government has endorsed the Under2 MOU.

California Energy Commissioner David Hochschild signed a memorandum of understanding with Aguascalientes Governor Martín Orozco Sandoval to cooperate on clean energy programs and policies (January 2017).



Energy Commission Chair Robert B. Weisenmiller and Director General Wang Qin of the Jiangsu Science & Technology Department advanced a clean energy memorandum of understanding (November 2017).

SPOTLIGHT: *CALIFORNIA-CHINA PARTNERSHIP*

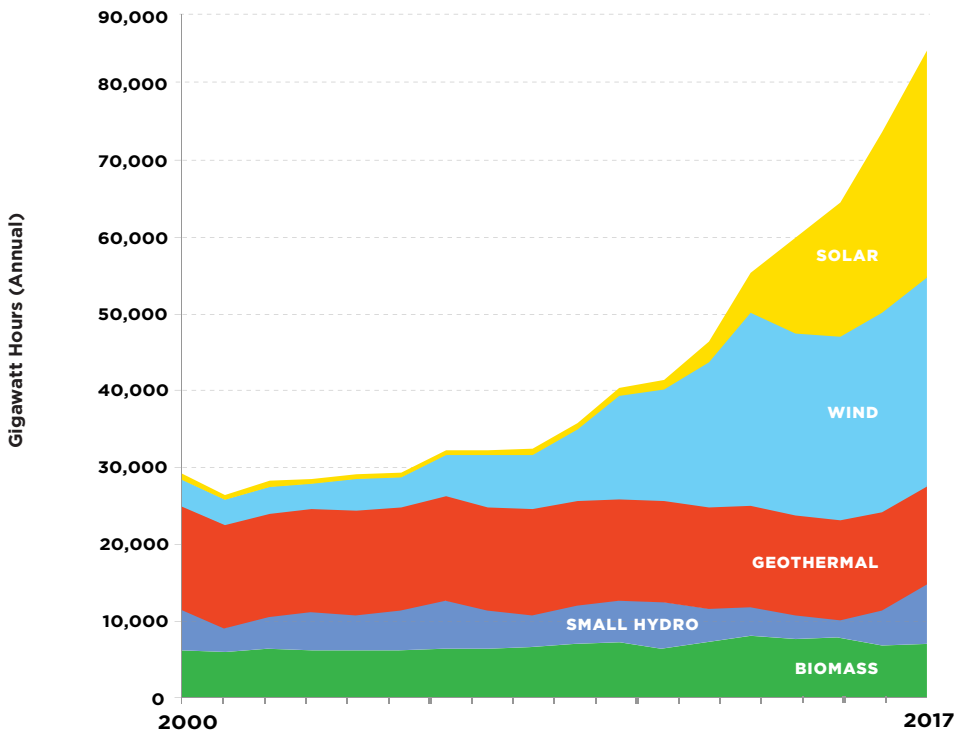
In 2017, Governor Brown met with President Xi Jinping of the People's Republic of China and signed an agreement with the Chinese Minister of Science and Technology to cooperate on research, innovation, and investment to develop low-carbon energy technologies. California also has agreements with the National Development and Reform Commission (NDRC) and strong regional relationships with several municipalities and provinces, including Jiangsu, Sichuan, Shenzhen, and Beijing, to advance clean energy and reduce greenhouse gas emissions and air pollution.

UTILITY SCALE RENEWABLE ENERGY

CLEANING UP THE ELECTRIC GRID

California's electric grid relies increasingly on clean sources of energy such as solar, wind, geothermal, hydroelectricity, and biomass. As this transition advances, the grid is also expanding to serve new sectors including electric vehicles, rail, and space and water heating. California has installed more renewable energy than any other U.S. state with 22,250 megawatts (MW) of utility-scale systems operational today. The state continues to shatter installation records and is home to some of the largest solar, wind, and geothermal power plants in the world.

RENEWABLE ENERGY GENERATION



Source: California Energy Commission

CALIFORNIA'S RENEWABLE ENERGY MIX

SOLAR

Capacity: 10,875 MW

Sites: 667

WIND

Capacity: 5,678 MW

Sites: 112

GEOTHERMAL

Capacity: 2,694 MW

Sites: 43

32%

RENEWABLE ENERGY IN 2017

In 2017, 32 percent of California's electricity was procured from renewable sources and the state is well on track to meet—and likely exceed—its 2020 and 2030 targets.

Source: California Energy Commission

78%

SOLAR COST DECREASE SINCE 2010

Continued cost declines in utility-scale renewable energy installations, particularly in solar PV, have helped maintain a fast pace of market growth.

Source: National Renewable Energy Laboratory

86,400

CALIFORNIA SOLAR JOBS IN 2017

California leads the nation in solar jobs with more than one-third of total solar jobs in the United States.

Source: The Solar Foundation

CLEAN ENERGY TARGETS

California's Renewables Portfolio Standard (RPS) is among the most ambitious energy policies in the nation. The RPS establishes increasing renewable energy procurement requirements for electric utilities and other load-serving entities.

RENEWABLE ENERGY PROCUREMENT REQUIREMENTS

Source: California Energy Commission

SMALL HYDRO

Capacity: 1,707 MW

Sites: 282

BIOMASS

Capacity: 1,317 MW

Sites: 105

EXPLORING OFFSHORE WIND

In 2016, former U.S. Interior Secretary Sally Jewell and Governor Brown signed a memorandum of understanding to implement renewable energy goals including potential offshore wind development. To support this effort, a joint federal and state government task force was formed to coordinate planning and permitting for offshore renewable energy. The task force is engaging with stakeholders to explore opportunities for offshore wind development along the California coast.

DISTRIBUTED RENEWABLE ENERGY GENERATION

THE ROOFTOP REVOLUTION:

ONE MILLION SOLAR ROOFS

Distributed renewable energy systems play an important role in helping California meet its climate goals and produce clean energy locally. In 2005, Governor Arnold Schwarzenegger established the audacious goal to install one million solar roofs. Since then, incentives, rate design, and new construction requirements have streamlined installations, reduced costs, and supported deployment across the state. Today, California is fast-approaching one million rooftop solar energy systems on homes, schools, businesses, and public buildings. Total installed behind-the-meter solar capacity is expected to reach 7,900 MW by the end of 2018.

SOLAR ON NEW HOMES:

FROM INCENTIVE TO NEW STANDARD

The 2019 Building Energy Efficiency Standards, adopted by the Energy Commission and set for approval by the Building Standards Commission in late 2018, will require new homes in California to include enough solar to meet the home's electricity consumption annually—a critical stepping stone for moving toward zero-emission buildings. The standard ensures new homes install solar during construction, when it is least expensive, often reducing costs by up to 20 percent compared to installations on existing homes. At the time of construction, developers can also address challenges, including shading, tilt, and roof obstructions that can significantly reduce system efficiency or make it difficult to install a system at all.

This major milestone was made possible by the New Solar Homes Partnership (NSHP) voluntary incentive program, which helped grow the market for solar installations on new homes. NSHP has allocated nearly $400 million over 10 years, providing higher incentive levels for affordable housing projects and highly energy-efficient homes.

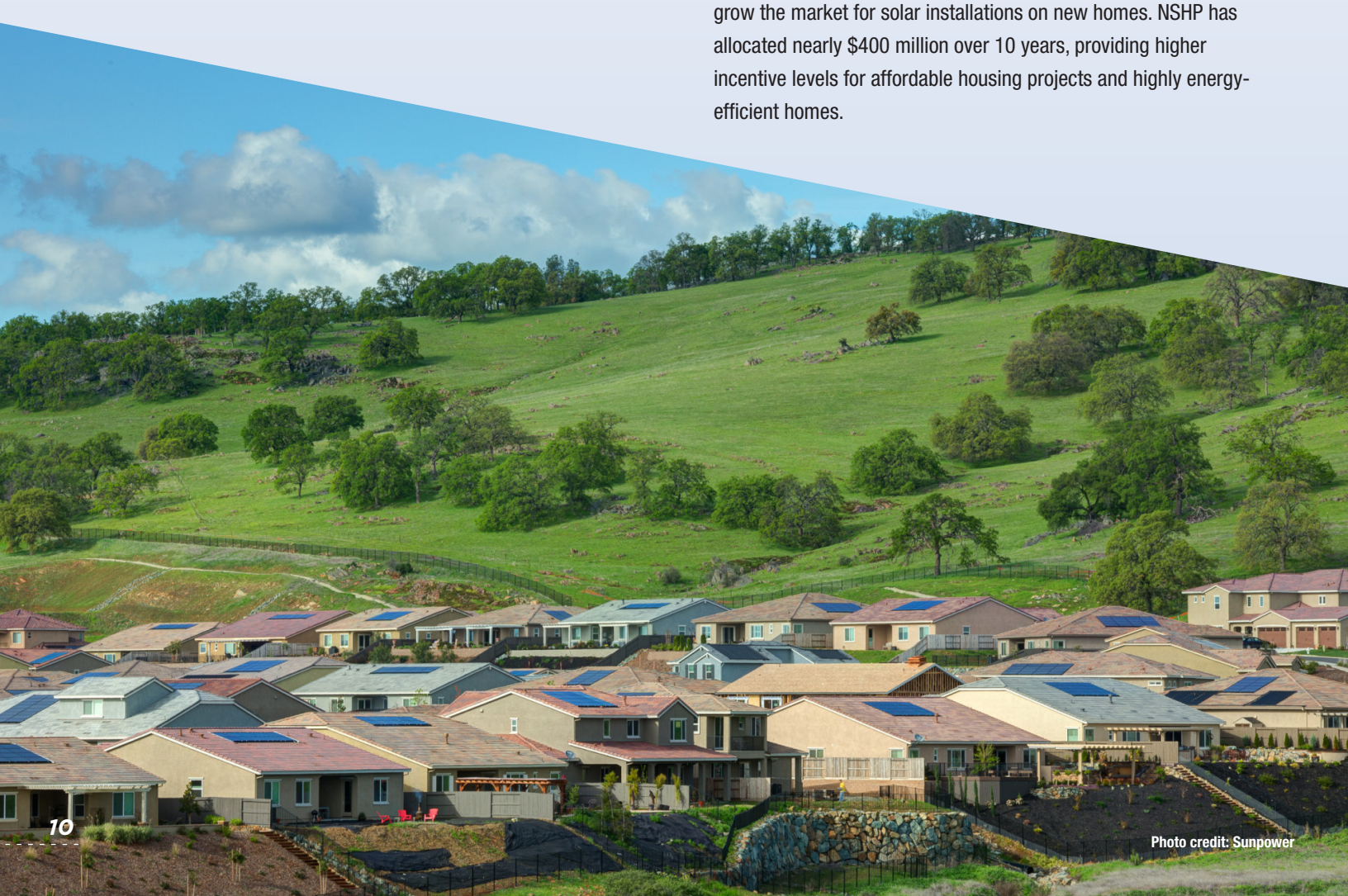


Photo credit: Sunpower

KEY INCENTIVE PROGRAMS

CALIFORNIA SOLAR INITIATIVE

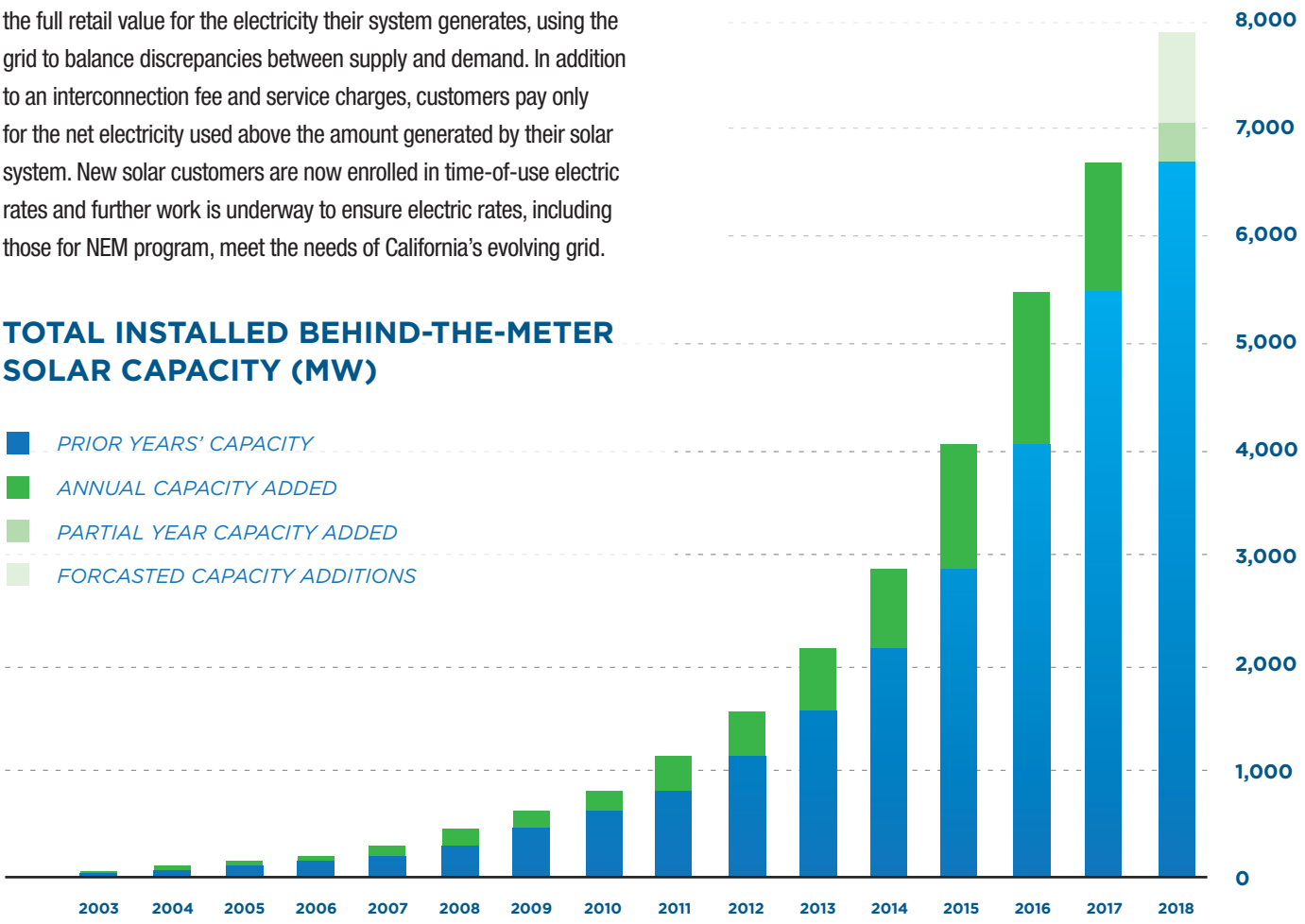
The California Solar Initiative (CSI) was a decade-long program designed to create a self-sustaining solar market by providing rebates for solar power installations for homes and businesses. The incentive program, which included specific funding for installations on low-income housing and new homes, helped create economies of scale, drive down costs of solar energy, create jobs, and reduce pollution. Overall, CSI provided more than $2.9 billion in incentives to California customers. As of 2018, nearly 248,000 residential and commercial solar systems totaling 2,500 MW of were installed through the program.

The CSI also expanded use of net energy metering (NEM), another key program that has helped make rooftop solar installations cost-effective for California consumers. NEM allows solar customers to be credited at the full retail value for the electricity their system generates, using the grid to balance discrepancies between supply and demand. In addition to an interconnection fee and service charges, customers pay only for the net electricity used above the amount generated by their solar system. New solar customers are now enrolled in time-of-use electric rates and further work is underway to ensure electric rates, including those for NEM program, meet the needs of California's evolving grid.

SELF-GENERATION INCENTIVE PROGRAM

The Self-Generation Incentive Program (SGIP) is one of the longest-running and most successful distributed generation incentive programs in the country. The program was created in response to the 2000-2001 energy crisis to encourage the adoption of distributed generation technologies and reduce peak energy loads. Over nearly two decades, the program has evolved to reflect market conditions and the state's commitment to reduce emissions and increase system reliability. Today, 80 percent of program funding is reserved for energy storage projects, while 20 percent supports the installation of generation technologies such as small-scale wind turbines, combined heat and power, and fuel cells. In total, the program has awarded more than $1.5 billion to support the installation of 7,100 projects.

TOTAL INSTALLED BEHIND-THE-METER SOLAR CAPACITY (MW)



Source: California Distributed Generation Statistics

ENERGY EFFICIENCY

EFFICIENCY STANDARDS

California developed the nation's first energy conservation standards for buildings and appliances in the 1970s. Since then, the state has continued to establish cost-effective efficiency standards and incentive programs, and the resulting energy savings translate to financial savings for California consumers. The standards developed in California continue to be adopted around the world.

BUILDINGS

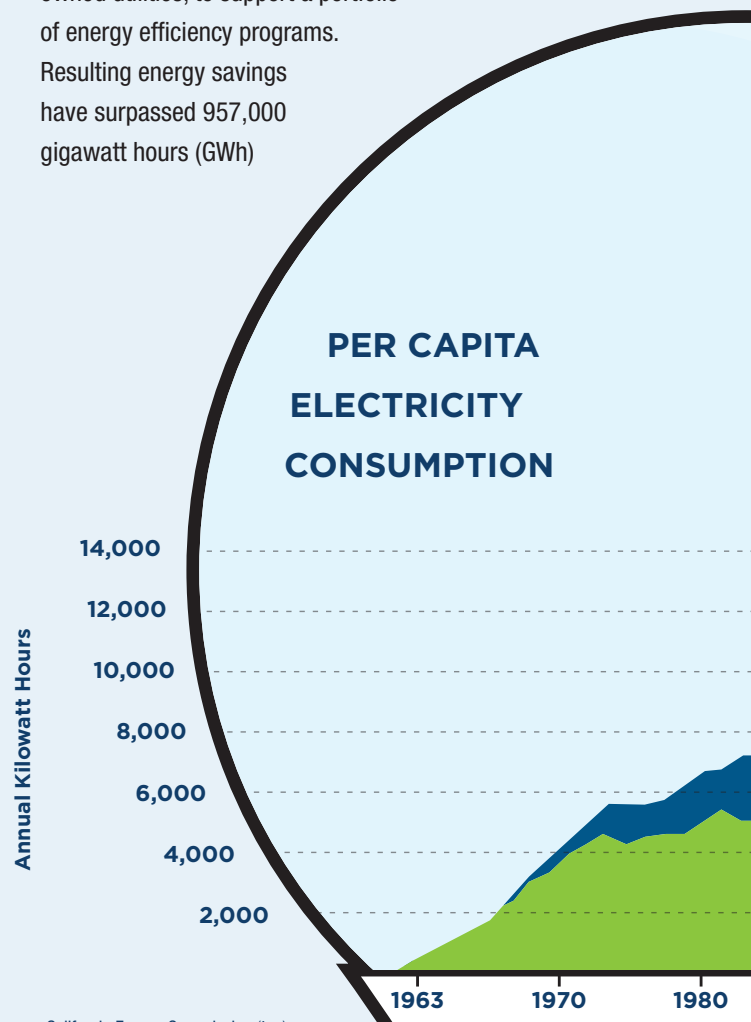
New buildings are becoming increasingly energy-efficient, due to progressive building standards, which are updated and improved about every three years. A home built under the recently adopted 2019 standards, for instance, will use 53 percent less energy than a home built under the 2016 building code. Existing buildings, however, are often more challenging to upgrade. To address this hard-to-reach sector, California developed the Existing Building Energy Efficiency Action Plan, which provides a 10-year roadmap to activate market forces and transform California's existing building stock into high-performing and energy efficient buildings.

APPLIANCES

Appliance standards have proven to be effective levers to reduce statewide energy consumption. California regulates the efficiency of many common appliances, including computers, televisions, light bulbs, battery chargers, and plumbing fixtures, and continues to set the most aggressive standards in the nation. These standards shift the market toward more efficient products, providing energy, water, and cost savings without compromising appliance utility or functionality.

ENERGY SAVINGS

For more than 40 years, California has been a pioneer in energy efficiency, which remains one of the state's top energy priorities. California provides $1.2 billion in funding annually, from ratepayers of investor-owned and publicly owned utilities, to support a portfolio of energy efficiency programs. Resulting energy savings have surpassed 957,000 gigawatt hours (GWh)



Sources: California Energy Commission (top), Energy Information Administration (bottom)

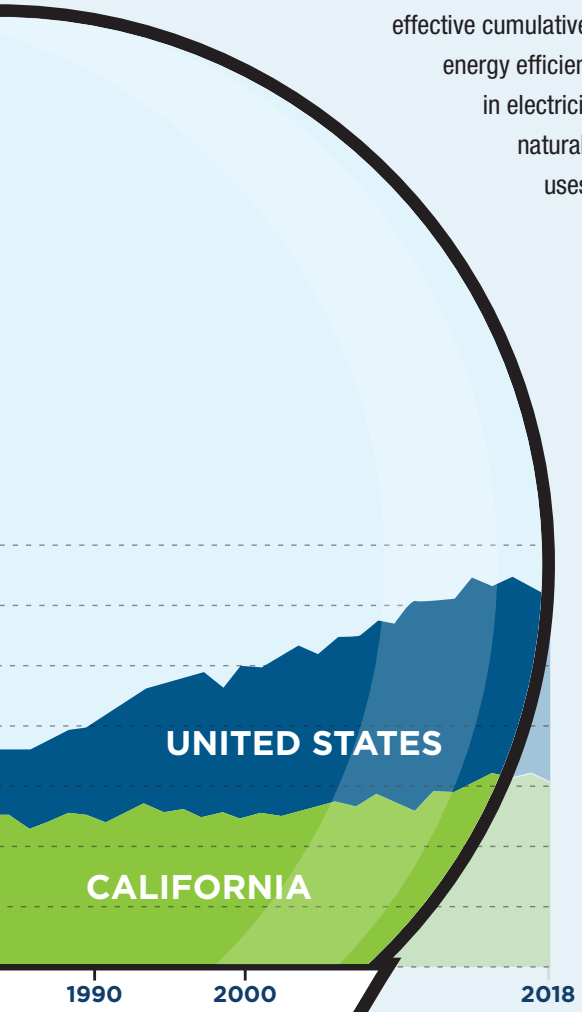
SPOTLIGHT: LIGHTING EVOLUTION

California has adopted a series of lighting standards to transition away from the nearly 150-year old incandescent light bulb. Since commercialization in the late 1880s, the incandescent bulb has remained highly inefficient, wasting about 90 percent of the electricity it uses as heat, which is why incandescent bulbs are hot to the touch. California's most recent lighting standards, which went into effect in January 2018, established requirements that only highly efficient bulbs, such as light-emitting diodes (LED), can meet.

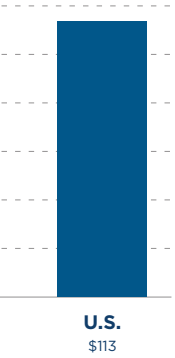
BUILDING BENCHMARKING

In March 2018, California launched the first statewide building energy-benchmarking program in the nation, which requires large commercial building owners to report the building's energy use data. The program enables comparison between similar sized buildings, allows owners and tenants to make more informed purchasing and leasing decisions, and encourages energy efficient upgrades.

of electricity and 93 billion therms of natural gas. Over time, California's per capita energy use has dropped significantly below the U.S. average, helping reduce the number of power plants constructed. In 2015, California enacted landmark legislation to achieve a cost-effective cumulative doubling of energy efficiency savings in electricity and natural gas end uses by 2030.



AGE MONTHLY
BILL CHART



DECOUPLING UTILITY SALES FROM REVENUES

In the 1980s, California adopted "decoupling," eliminating the direct link between energy sales and utility revenues. This better aligns financial incentives for utilities with societal benefits, supporting the goal to provide energy services at overall least cost with minimal environmental impact.

EFFICIENCY JOBS

California employs more than 300,000 workers in energy efficiency fields. These jobs—spanning construction, manufacturing, distribution, transportation, and professional and business services—are largely non-exportable and benefit California communities through better performing buildings and indoor environments.

INVESTING IN SCHOOLS AND LOCAL GOVERNMENTS

Through the California Clean Energy Jobs Act (Prop 39), the state has approved more than $1.5 billion for energy efficiency and clean energy generation projects in public and charter schools. This program provides improvements in the majority of school districts and educational organizations across the state, with about 70 percent of these funds allocated to schools within disadvantaged areas. Projects such as lighting improvements, heating and cooling upgrades, thermostat controls, and solar panel installations, make schools more comfortable, create better learning environments, and help California schools reduce their utility bills.

Through the Energy Conservation Assistance Act (ECAA), the state also provides low- and zero-interest loans to cities, counties, school districts, community colleges, and universities to implement energy efficiency upgrades. Since 1979, more than $414 million has been loaned to 860 recipients across California.

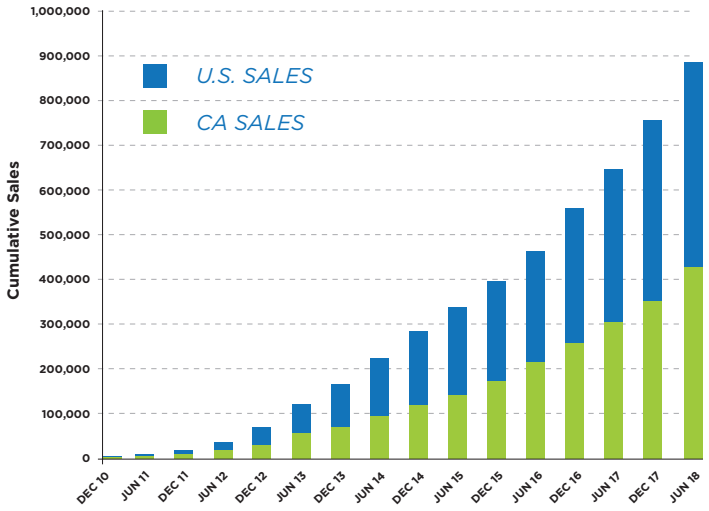
Since 1990, the state's energy efficiency standards for buildings and appliances have saved Californians more than $100 billion in utility costs.

CLEAN TRANSPORTATION

TRANSFORMING CALIFORNIA'S TRANSPORTATION LANDSCAPE

Today, the transportation sector is the largest source of greenhouse gases in California, responsible for 50 percent of emissions when fuel refining is included, as well as 80 percent of smog-forming pollutants. However, transportation markets and services are evolving quickly, and California is at the forefront of the transition. The state has outlined a vision to power California's cars, public transportation, and freight systems with clean electricity and low carbon fuels in the decades ahead and to promote active modes of transportation, including walking and cycling. Though this shift will take time, California has begun laying the groundwork necessary to make this vision a reality.

ZERO-EMISSION VEHICLE SALES



Source: Veloz

SCALING THE MARKET

To support continued market growth and make zero-emission vehicles (ZEVs) accessible to more Californians, the state administers programs to offer incentives for the purchase of ZEVs in the light, medium, and heavy duty sectors.

PASSENGER CARS

With more than 40 light duty battery electric, plug-in hybrid, and fuel cell electric models available today, and many more expected in the years to come, the light duty ZEV market in California continues to expand. California's Clean Vehicle Rebate Project provides rebates of up to $7,000 for the purchase or lease of eligible zero-emission and plug-in hybrid vehicles.

MEDIUM AND HEAVY DUTY VEHICLES

While medium and heavy duty vehicles represent only 3 percent of California's vehicle stock, this small subset of vehicles is responsible for about 22 percent of California's on-road emissions. Providing zero- and near zero-emission technology options can dramatically reduce emissions while targeting only a small number of vehicles. To date, the state has invested more than $360 million to advance clean vehicle technologies that can be incorporated into California's truck and bus fleets.

FIVE MILLION ZERO-EMISSION VEHICLES BY 2030

This year, Governor Edmund G. Brown Jr. signed an executive order calling for at least five million ZEVs on California roads by 2030 and an extensive expansion of charging and refueling infrastructure. This goal will boost the ZEV market from just over 1 percent of California's fleet today to nearly 20 percent by 2030.

	ZERO-EMISSION VEHICLES	CHARGING STATIONS	HYDROGEN STATIONS
TODAY	420,000	15,000	35
GOAL	**5 MILLION** BY 2030	**250,000** BY 2025 (INCLUDING 10,000 DC FAST CHARGERS)	**200** BY 2025

LAYING THE FOUNDATION

The success of a zero-emission transportation system depends on the deployment of robust charging and refueling infrastructure across California and beyond. Today, California has the largest network of nonresidential electric vehicle chargers in the nation (accounting for nearly 25 percent of public charging stations) and is home to the nation's largest open-retail hydrogen refueling network.

CELEBRATING 10 YEARS OF CLEAN TRANSPORTATION INVESTMENTS

The state's Alternative and Renewable Fuel and Vehicle Technology Program has invested $750 million to fund more than 600 projects designed to transform California's transportation fuels and vehicles. The program continues to deploy $100 million annually and supports climate, air quality, and clean transportation goals while benefiting underserved and disadvantaged communities.

PROGRAM SUCCESSES:

Building the West Coast Electric Highway

The Electric Highway will include fast-charging stations every 25 to 50 miles, allowing plug-in EV drivers to travel from British Columbia, Canada, to Baja California, Mexico.

Deploying a Hydrogen Refueling Network

California has committed to building an initial network of 200 public hydrogen refueling stations, 35 of which are operating today. These stations allow fuel cell electric vehicle drivers to move freely between Northern and Southern California.

Supporting California's Seaports

Recognizing the growing economic and environmental challenges facing California's seaports, the Energy Commission has partnered with six ports–Oakland, Stockton, Hueneme, Los Angeles, Long Beach, and San Diego–to collaborate on transitioning to cleaner transportation technologies.

CALIFORNIA IS HOME TO:

NEARLY
50%
of zero-emission vehicles in the U.S.

10,900
electric vehicles purchased per month

NEARLY
90%
of total U.S. investment in clean transportation

11
electric vehicle manufacturers

HIGH SPEED RAIL

California has started construction on the nation's first high-speed rail system, which will connect Northern and Southern California, transforming the way people move around the state. The fast, efficient, and clean rail system will be electric and powered with 100 percent renewable energy. All stations and high-speed rail facilities along the network will be zero-net-energy buildings, further contributing to the decarbonization of the economy.

ENABLING A CLEAN ELECTRIC GRID

Maintaining the reliability of the electricity system while integrating larger amounts of variable wind and solar generation, distributed energy resources, and electric vehicle charging infrastructure requires a more flexible grid with new communication capabilities. California has taken bold steps to ensure supply and demand remain in balance as more clean energy resources are added to the grid.

INCREASING GRID FLEXIBILITY

ENERGY STORAGE

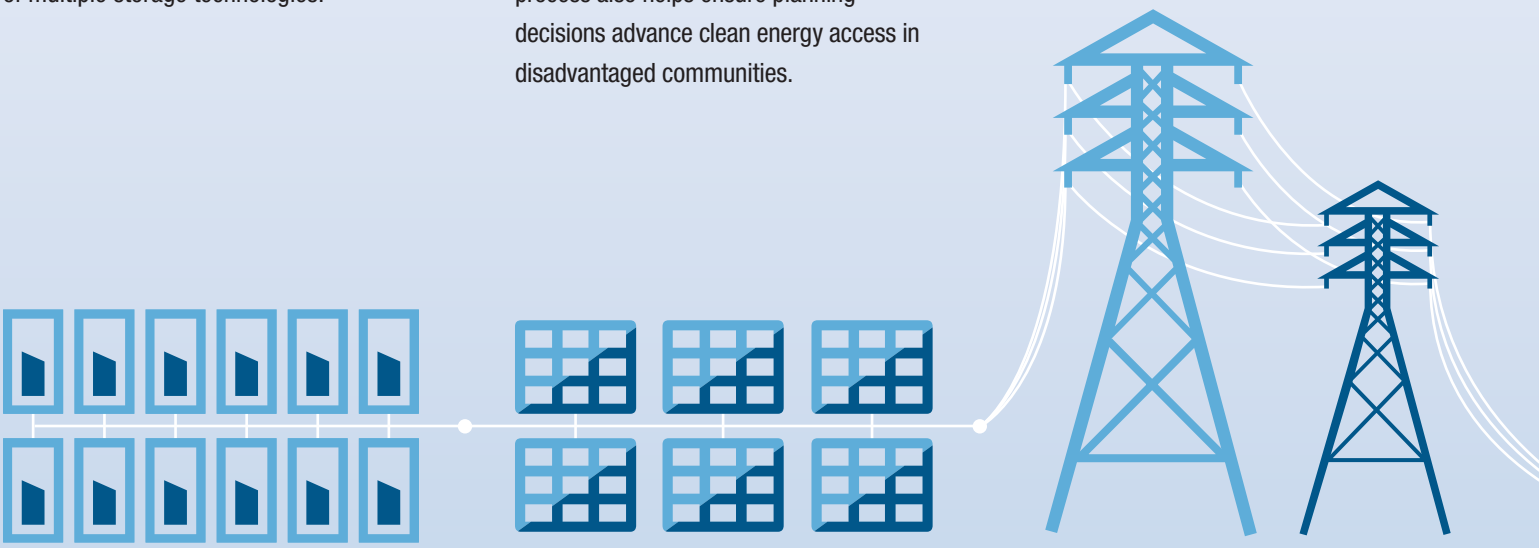
California has required the investor-owned utilities to procure 1.3 GW of energy storage by 2020, and authorized an additional 500 MW specifically connected to the distribution grid or located on the customer side of the meter. The state also provides incentives and grants for research and demonstration projects to advance technology development and encourage adoption of multiple storage technologies.

INTEGRATED RESOURCE PLANNING

State agencies oversee resource planning for California's load-serving utilities. Through this process, California guides energy procurement decisions, supporting efforts to implement emissions reduction targets, achieve at least 50 percent renewable energy procurement, double energy efficiency, and promote transportation electrification. This process also helps ensure planning decisions advance clean energy access in disadvantaged communities.

GEOGRAPHIC DIVERSITY

Much of California's grid is connected to the western Energy Imbalance Market (EIM), which enables real-time energy trading across eight western states. By optimizing energy resources, the EIM has generated more than $400 million in gross benefits for participants and displaced 300,000 metric tons of CO_2 emissions from 2014 through the second quarter of 2018.



ENABLING COMMUNICATION

SMART ENERGY RESOURCES

Since 2017, solar and energy storage projects connected in utility territories must be enabled with smart inverter technology, providing functions that support grid operations. In the years ahead, systems are expected to have additional communication functionalities and provide services such as data monitoring and advanced power controls.

CONNECTED BUILDINGS

Through California's demand response programs, participating buildings adjust energy loads according to grid conditions. During times of high electricity demand, these buildings receive signals to reduce electricity use or shift loads to other times, saving money on electric bills while providing greater grid reliability. In addition, buildings increasingly provide valuable grid resources, such as generation and storage.

INTEGRATION OF ELECTRIC VEHICLES

The state is exploring the integration of plug-in electric vehicles onto the grid with smart charging technologies. These technologies provide charging flexibility and can help maximize consumption of renewable energy resources. New research, including a pilot project at the Los Angeles Air Force Base with 43 vehicles, will also help assess long-term viability of vehicle-to-grid programs, in which electric vehicles can provide energy back to the grid.

CLEAN ENERGY INNOVATION

BUILDING TOMORROW'S ENERGY SYSTEM

California recognizes that technological progress and policy development go hand in hand. The state has filled funding gaps in research and development (R&D) to drive the market and help meet customer needs with cost-effective and equitable solutions. California's research programs provide $150 million each year to scale innovative products and bring new technologies to market. The solutions supported by California's R&D programs provide necessary building blocks for the smarter, cleaner, more resilient electric grid of tomorrow.

California's R&D programs have also created a statewide network of laboratory facilities, mentors, training, and resources, increasing local capacity across the state to support clean energy researchers and entrepreneurs. Furthermore, state funding leverages private and federal funding, often in the form of match funding or subsequent investments, particularly when strong policies and predictable incentive programs contribute to stable market development. This has catalyzed an innovation ecosystem, in which ambitious policy goals spur funding for strategic innovation and support technological advancements that drive market change.

DEMONSTRATION PROJECTS

WATER-ENERGY SAVINGS

Energy is a critical component of California's expansive water system. Water transportation, treatment, heating, use, and disposal account for nearly 20 percent of the state's total electricity consumption. The state's R&D funding advances technologies that increase the efficiency of these processes, decreasing the amount of water and energy required. Current funding areas focus on reducing energy use in water and wastewater treatment, onsite water reuse, agriculture irrigation, and water consumption in buildings. To date, the state has awarded $34 million to 20 active projects across these areas.

A number of state-funded energy efficiency research projects have helped inform changes to the building and appliance energy codes, resulting in savings of up to $350 to Californians for every $1 invested in R&D.

BENEFITING DISADVANTAGED COMMUNITIES

A minimum of 25 percent of all technology demonstration and deployment funding is reserved for projects in disadvantaged communities, plus an additional 10 percent for projects located elsewhere but benefiting low-income communities. In 2017, 32 percent of technology demonstration and deployment funds were allocated to 97 projects located in disadvantaged communities, exceeding the 25 percent target. These funds increase access to innovative technologies, such as high-performance housing, zero net electricity communities, and efficient water systems, and spur future adoption of these technologies in low-income and disadvantaged communities.

MICROGRIDS

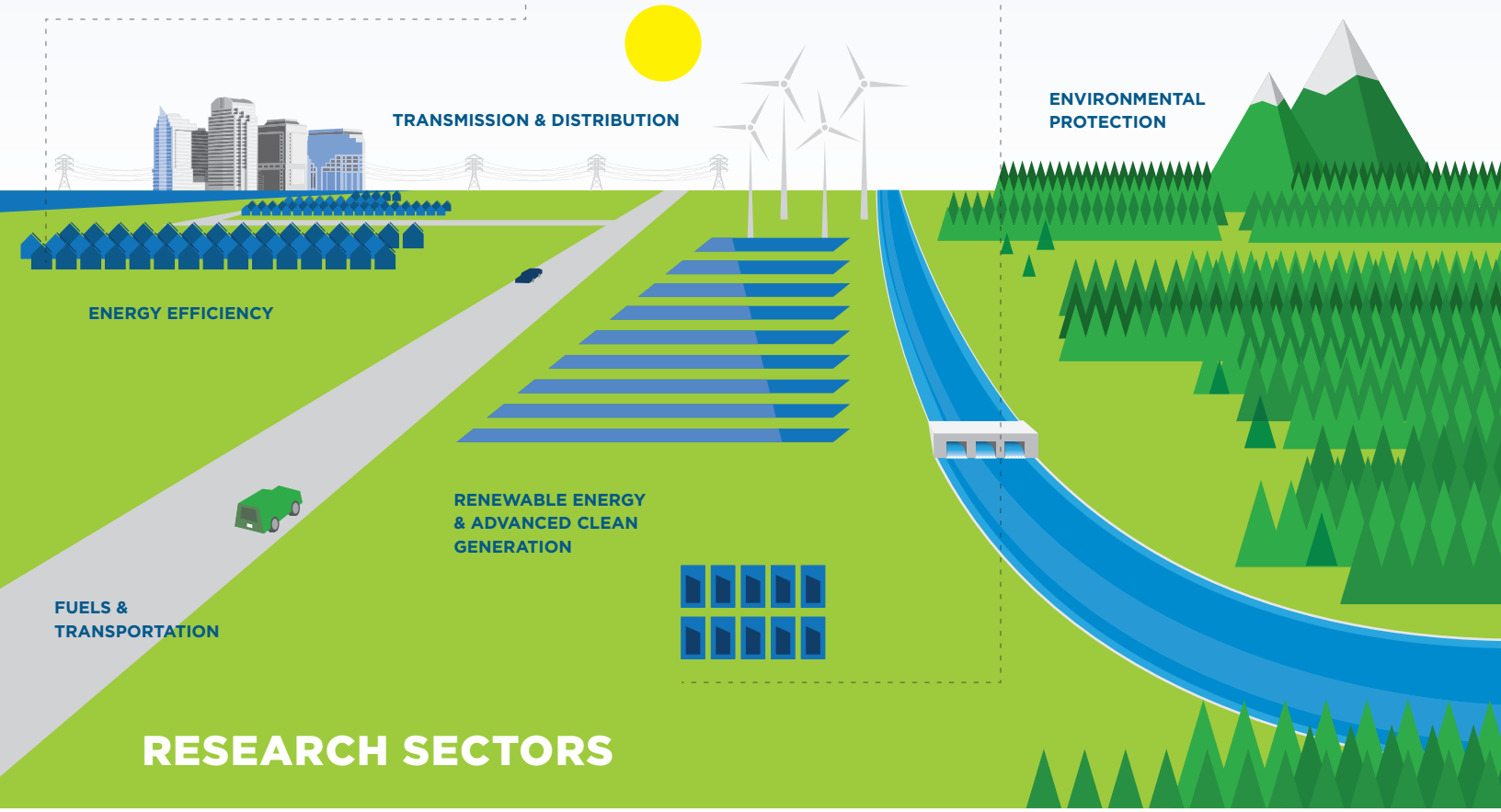
By allowing sections of the electric grid to operate independently of the larger system, microgrids can keep power flowing to critical loads during a blackout. The value of microgrids to protect local areas from power outages is becoming increasingly important in the face of more frequent and severe weather events and wildfires. To date, California has funded 24 microgrid projects, most of which include onsite solar and storage and can continue to supply power to schools, hospitals, fire stations, industrial facilities, or critical community emergency response services, even when disconnected from the larger grid.

PLUG LOAD RESEARCH

Plug-load devices (anything that plugs into a wall, including appliances, electronics, and tools) are responsible for roughly 20 percent of electricity consumed in buildings and are the fastest growing category of energy use in homes and businesses. Most of these devices also continue to draw power even when not in use—commonly referred to as "phantom power." Current state research focuses on eliminating standby energy use through an array of management tools, such as remote detection and control, as well as reducing power consumption from video gaming computers and consoles.

ENERGY STORAGE

Storage is a key tool for managing the grid as California transforms its energy system to more renewable sources. State programs have funded 25 energy storage projects, demonstrating technologies in various stages of development. Understanding specific characteristics of storage technologies, including batteries, thermal energy storage, flywheels, and compressed air energy storage, informs how, where, and when energy storage can be most effectively used to support the electric grid and meet customers' energy needs.



RESEARCH SECTORS

CLEAN ENERGY FOR ALL CALIFORNIANS

FOCUS ON DISADVANTAGED AND LOW-INCOME COMMUNITIES

The burden of pollution disproportionately falls on communities where power plants, refineries, and heavy traffic contribute to high rates of cancer and asthma, among other health impacts. Many low-income customers spend a larger share of their income on utility bills than the rest of the state and are often the last to gain access to clean energy technologies. California is committed to addressing these challenges and increasing the equitable distribution of clean energy benefits.

To this end, state agencies completed the two-part *Low-Income Barriers Study* to identify strategies to overcome structural, policy, and market barriers that limit access to energy efficiency, renewable energy, and clean transportation options for low-income customers. The state is implementing priorities set forth in the two-part study to ensure all Californians are able to benefit from new economic opportunities created by a low-carbon economy.

PRIORITY ACTIONS TO INCREASE CLEAN ENERGY ACCESS

Promote Interagency Coordination

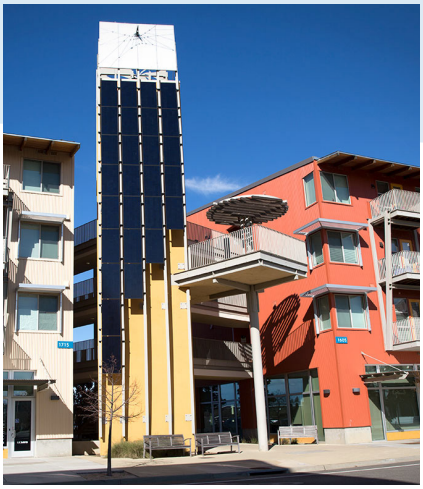
Since 2017, the state has formed two new entities to improve efficacy of energy equity programs. The Barriers Interagency Task Force increases coordination and collaboration among state agencies for energy, water, resilience, housing, transportation, and infrastructure, while the Disadvantaged Communities Advisory Group engages directly with local governments and community organizations. Together, these groups help ensure clean energy efforts reach and benefit communities as intended.

Outline Solutions for Multifamily Residents

Nearly half of low-income residents live in multifamily housing, yet these housing units present some of the most complex barriers to clean energy access. Such challenges include aging building structures and complicated ownership models. This year, the state launched a new effort to address barriers specific to residents and owners of low-income multifamily housing and ensure that renters can access the benefits of clean energy technologies.

Formulate a Comprehensive Workforce Development Strategy

Local workforce participation in clean energy programs is integral to enabling the full range of benefits of a clean energy economy to low-income communities. The *Low-Income Barriers Study* calls on state agencies to develop a labor and workforce strategy across clean energy and transportation sectors. Efforts are expected to prioritize collaboration with labor and workforce experts, as well as community-based organizations to support direct hiring, empower communities, and foster local economic development.



72
Megawatts

SOLAR INSTALLATIONS

California programs have helped stimulate solar adoption in the affordable housing sector, placing 72 MW of no- or low-cost solar on more than 8,500 new and existing affordable housing units across California. Recent legislation also created the Solar on Multifamily Affordable Housing program, which will direct $100 million annually toward the installation of solar on multifamily affordable housing.

3.7
Million

ENERGY EFFICIENCY

California's Energy Savings Assistance and Low-Income Weatherization programs provide no-cost energy efficiency services to low-income households, including the installation of insulation, efficient appliances, and low-flow showerheads. These programs have served more than 3.7 million residents since 2002 and continue to help customers reduce bills and increase indoor health and comfort.

Create Regional One-Stop Shops

Regional one-stop shops that provide local outreach and technical assistance are an innovative solution to streamlining access to the state's energy efficiency, clean energy, low-emission transportation, and water efficiency programs. These crosscutting hubs will use a combination of physical centers and online portals ("bricks and clicks") to provide information and resources to low-income consumers and stakeholders to navigate available incentive programs and funding opportunities.

Unlock New Financing Opportunities

Although clean energy and efficiency measures save money over time by reducing utility bills, they often require an upfront investment, posing a key barrier to low-income households. State agencies are exploring new financing pilot programs to overcome this challenge and encourage investment for low-income customers. The California Hub for Energy Efficiency Financing pilot is one example of a new public-private partnership model expanding access to capital for energy efficiency retrofits.

Improve Data Collection & Evaluation Metrics

The use of common metrics and data across agencies is vital to accurately evaluate programs and track progress toward statewide goals. This year, the Energy Commission released a new program evaluation framework, including standardized metrics (called energy equity indicators), to track how programs are benefiting low-income customers. Tracking along these metrics will help highlight data gaps and opportunities to improve program development and implementation over time.

PARTNERSHIPS ACROSS THE STATE

INTERGOVERNMENTAL COLLABORATION

Partnering across jurisdictions is imperative to achieving California's climate and clean energy targets. The state collaborates with the federal government and local, regional, and tribal governments to implement clean energy projects and leverage resources across jurisdictions. Below are examples of strong partnerships that are helping make California's clean energy vision a reality.

CALIFORNIA NATIVE AMERICAN TRIBES

Under Governor Brown's leadership, state agencies engage in government-to-government cooperation and communication concerning the development of legislation, regulations, rules, and policies that affect tribes and tribal communities. Several tribal governments have also partnered with the state to implement innovative clean energy pilot projects, including the Blue Lake Rancheria and Chemehuevi Indian Reservation renewable energy microgrids. These projects reduce local pollution and emissions, lower energy costs, increase electricity resiliency and create local jobs.

In 2017, the Blue Lake Rancheria completed an award-winning microgrid project that includes a 420-kilowatt solar array and nearly 1 megawatt-hour of energy storage. The system can automatically disconnect from the grid when needed to continue powering critical infrastructure, preparing the local community for the impacts of wildfires, earthquakes, and tsunamis.

LOCAL BUILDING REQUIREMENTS

Local governments in California can adopt clean energy standards for new buildings that are more stringent than the statewide building code. These local standards allow cities and counties to demonstrate cost-effective methods to reduce energy consumption in homes and buildings and often pave the way for statewide requirements.

HEALDSBURG
Efficiency

NOVATO
Efficiency

DAVIS
Efficiency & Solar

MILL VALLEY
Efficiency

MARIN COUNTY
Efficiency

SAN FRANCISCO
Solar & Solar Thermal

FREMONT
Solar & Lighting

BRISBANE
Cool Roofs & Solar

SAN MATEO
Cool Roofs & Solar

PORTOLA VALLEY
Efficiency

PALO ALTO
Efficiency & Solar

LANCASTER
Solar

SANTA MONICA
Efficiency & Solar

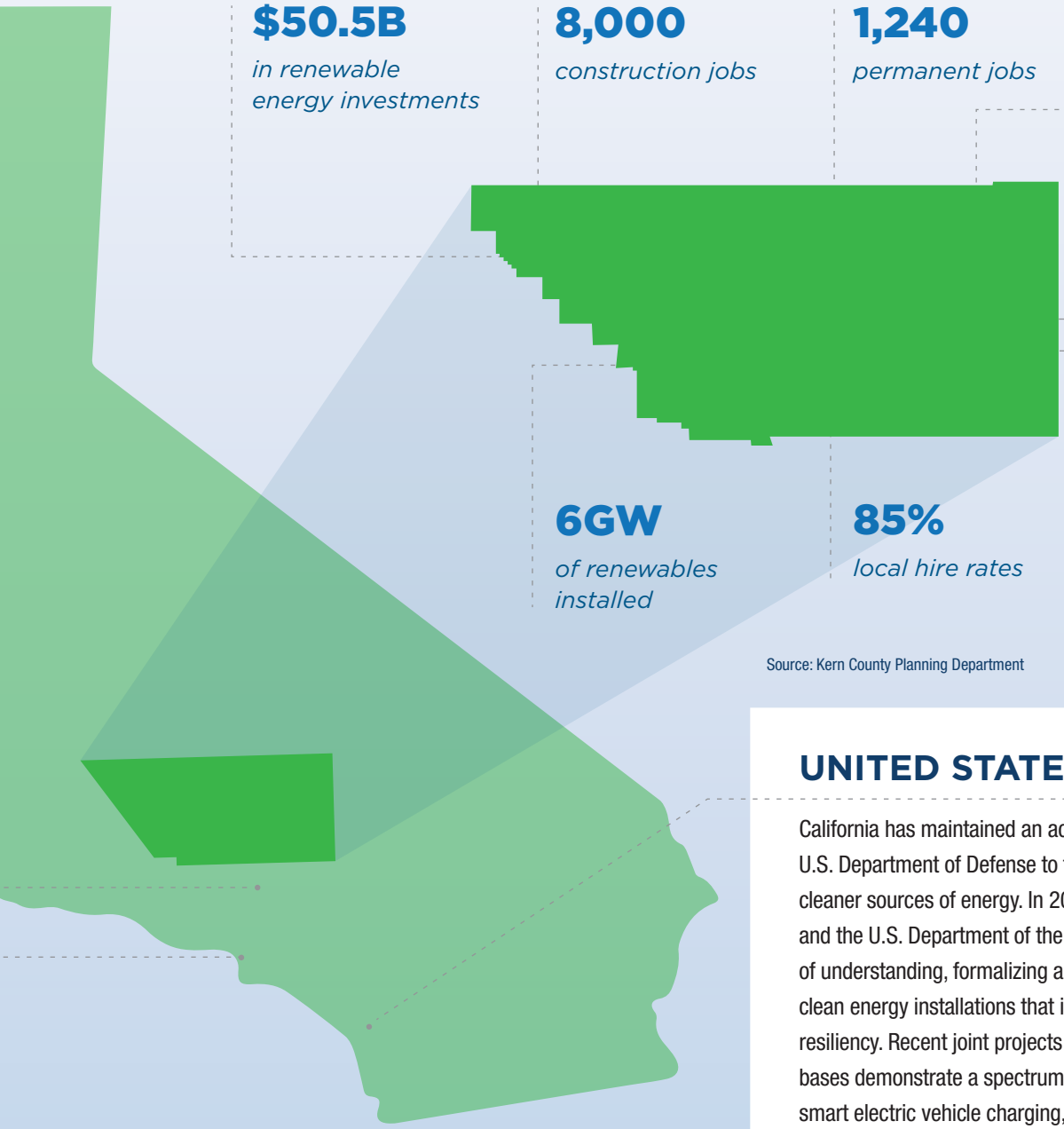
Today, cities are exceeding the state's code with local requirements for rooftop solar systems, increased energy efficiency, cool roofs (reflective roofing that reduces sunlight absorbed by buildings), and high-efficiency lighting.

Source: California Energy Commission.

PROFILE OF SUCCESS: *KERN COUNTY*

Kern County has more renewable energy capacity than any other county in the United States and is home to some of the nation's largest wind and solar plants. To date, the county has installed nearly 6 GW of renewable energy projects, ranging from rooftop solar to utility-scale wind and solar. More than $50 billion has been invested in the county's renewable energy projects, creating thousands of local jobs and raising millions in annual tax proceeds.

KERN COUNTY RENEWABLE ENERGY INVESTMENTS *SINCE 2009*



$50.5B
in renewable energy investments

8,000
construction jobs

1,240
permanent jobs

18% to 9%
unemployment rate decrease

6
battery storage projects in permitting process

6GW
of renewables installed

85%
local hire rates

$25M
annual tax proceeds from renewables to Kern County

Source: Kern County Planning Department

UNITED STATES MILITARY

California has maintained an active partnership with the U.S. Department of Defense to transition military bases to cleaner sources of energy. In 2016, the Energy Commission and the U.S. Department of the Navy, signed a memorandum of understanding, formalizing a partnership to support clean energy installations that increase energy security and resiliency. Recent joint projects on Army, Navy and Marine bases demonstrate a spectrum of technologies, including smart electric vehicle charging, energy storage, demand response services, and microgrids with advanced clean energy capabilities. Information gained from these efforts will help create models for military bases around the world.