DEC 2011

POWERING INNOVATION

NEXT 10

CALIFORNIA IS LEADING THE SHIFT TO ELECTRIC VEHICLES FROM R&D TO EARLY ADOPTION

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. WE PROVIDE CRITICAL DATA TO HELP INFORM THE STATE'S EFFORTS TO GROW THE ECONOMY AND REDUCE GLOBAL WARMING EMISSIONS.

THIS REPORT ON CALIFORNIA'S GROWING ELECTRIC VEHICLE INDUSTRY IS A NEXT 10 WHITE PAPER THAT REVEALS THE STATE'S GLOBAL LEADERSHIP IN TECHNOLOGY AND BUSINESS DEVELOPMENT RELATED TO ELECTRIC VEHICLES. WHILE ACKNOWLEDGING THE CURRENT OBSTACLES TO WIDE-SPREAD ADOPTION OF EVS, THE REPORT EXAMINES THE STATE'S PROGRESS IN PUBLIC POLICY, TECHNOLOGICAL DEVELOPMENT AND EARLY ADOPTION BY CONSUMERS THAT POSITION CALIFORNIA WELL TO BECOME A GLOBAL LEADER IN THIS EMERGING INDUSTRY.

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POWERING INNOVATION

CALIFORNIA IS LEADING THE SHIFT TO ELECTRIC VEHICLES FROM R&D TO EARLY ADOPTION

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KEY FINDINGS

California benefits from the leadership of community and public policy efforts to reduce pollution from vehicles and support the adoption of cleaner alternatives.

While there is still much to do, these efforts are already paying off in terms of adoption rates for electric vehicles (EVs) and a demonstrated commitment to building the charging station infrastructure.

- California ranks first in the nation in total charging stations installed with 609 stations.
- With 16.3 charging stations per million residents, California also ranks first per capita.

California is a global leader in technology innovation related to electric vehicles.

- In 2010, California accounted for 80 percent ($840 million) of total U.S. and 60 percent of total global venture capital investment in EV-related sectors.
- In the first half of 2011, California attracted 69 percent of global investment in EV-related sectors and 74 percent of United States investment in EV-related sectors ($467 million).
- California leads the nation and world in growth since 2006 in venture capital investment in EV-related industries.
- California ranks first in the nation in total EV technology patents. Globally, the state trails only Japan and South Korea in patents and exceeds others including Germany, Taiwan and France.
- Research related to EVs is being explored at world-class research institutions around the state. Institutions include the Lawrence Berkeley National Laboratory, the University of California Berkeley, the University of California Davis, and the Luskin School of Public Affairs at the University of California Los Angeles. Topics of research range from batteries, vehicle design, and public policy.

California is well-positioned to lead the way in the U.S. clean transportation revolution with its population of early adopters, advanced technology industries, public policy leadership and research institutions. As a market leader in this growing sector, California can reap significant economic benefits.

Employment and businesses in California's EV industry are growing and demonstrate the potential for continued growth.

- California's EV industry has increased 142 percent or 2.4 times since 1995, growing from 740 jobs to 1,790 in January 2010. Most recently from January 2009 to 2010, EV jobs expanded by four percent while total employment in the state dropped by seven percent.
- The Los Angeles Area and Silicon Valley together make up 47 percent state EV employment.
- Different hubs of specialization are emerging across the state.
  - — Silicon Valley leads in Electric Vehicles.
  - — The San Diego Region is top in Motor Vehicle Components and Advanced Batteries.
  - — The Bay Area is strong in Charging Infrastructure.
- The Los Angeles Area is particularly strong in Advanced Batteries.
- Manufacturing makes up 59 percent of EV industry jobs and grew 132 percent 2004 to 2010.
- Research & Development accounted for 14 percent of employment in 2010 and surged by 434 percent between 2004 and 2010.

Addressing the barriers to EV commercialization presents economic opportunities and once addressed, will encourage widespread adoption in California, the rest of the country, and abroad.

- Vehicle batteries are currently expensive and economic opportunities exist for improving technology, reducing systems costs, adjusting for varying weather conditions, and recycling and creating post-vehicle secondary uses.
- Finding the appropriate models for both the distribution of public charging infrastructure and easy installation of private units that integrate seamlessly into the electricity grid will boost the viability of EVs as transportation options.

INTRODUCTION

CALIFORNIA AT THE HUB OF ELECTRIC VEHICLE INNOVATION

CALIFORNIA IS LEADING THE NATION IN THE GROWING ELECTRIC VEHICLE (EV) INDUSTRY. This leadership is a result of strong market demand for EVs, pioneering policies encouraging the development and adoption of EVs, including Plug-in Electric Vehicles (PEVs) and Hybrid Electric Vehicles (HEVs), and strong venture capital investment. There is a high concentration of companies and diversity in the business base related to EVs across the state as well as strong research efforts at the state's world-class research institutions. These factors give California a competitive advantage in the global race, where other countries like China, the United Kingdom, France and Japan have committed millions of dollars to reach their own goals for EV deployment and technology development.[1]

Given this environment, California is the only state where all three of the current EV models – the Chevrolet Volt, Nissan LEAF, and Ford Focus Electric – are being deployed.[2] The state is projected to rank first in the country for EV sales in 2015.[3] The large customer base and encouraging policy environment in California will drive the demand for EVs and accelerate industry growth to reach economies of scale.

Because of its public policy leadership, talent base, research and development capabilities, and innovative technological and scientific industries, California is well positioned to strengthen its role as the global center for electric vehicles. In addition to the core base, California is home to a dense network of suppliers to automotive industries.[4] As California's EV industry grows, the supplier base will too, producing benefits along the automobile value chain. These assets are self reinforcing as reflected in flows of venture capital investment, significant patent activity, and the creation of effective political action plans and community engagement.

Further, together these forces of innovation serve as a magnet for businesses eager to serve the state's population of early adopters. This is exemplified in the decision of Electric Vehicles International (EVI) to relocate its headquarters and manufacturing facility from Toluca, Mexico to Stockton, California. After 20 years of operating abroad, the new headquarters and manufacturing facility opened for business in late 2009 to produce electric vehicles ranging from light duty to delivery fleet vehicles, like those they produced for UPS for parcel delivery services. Since moving to California, EVI has received $3.9 million in grant funding from the California Energy Commission (CEC) to expand and modernize the Stockton manufacturing facility.[5] An additional $3.9 million grant was awarded by the CEC to develop an automated production process for on-site EV manufacturing.[6] The CEO of EVI attributes California's role as a leader in adopting green technology and sustainable transportation as a main driver behind

ELECTRIC VEHICLE TYPE GLOSSARY		
ELECTRIC VEHICLE	EV	A VEHICLE POWERED BY AN ELECTRIC DRIVE TRAIN, ALSO KNOWN AS A BATTERY ELECTRIC VEHICLE (BEV)
PLUG-IN ELECTRIC VEHICLE	PEV	AN ELECTRIC VEHICLE THAT CAN BE RECHARGED FROM AN EXTERNAL SOURCE OF ELECTRICITY THAT IS STORED IN RECHARGEABLE BATTERY PACKS
HYBRID ELECTRIC VEHICLE	HEV	AN ELECTRIC VEHICLE THAT COMBINES A CONVENTIONAL INTERNAL COMBUSTION ENGINE SYSTEM WITH AN ELECTRIC PROPULSION SYSTEM
PLUG-IN HYBRID ELECTRIC VEHICLE	PHEV	A HYBRID ELECTRIC VEHICLE WITH AN ENERGY STORAGE DEVICE THAT CAN BE RECHARGED FROM AN EXTERNAL SOURCE OF ELECTRICITY

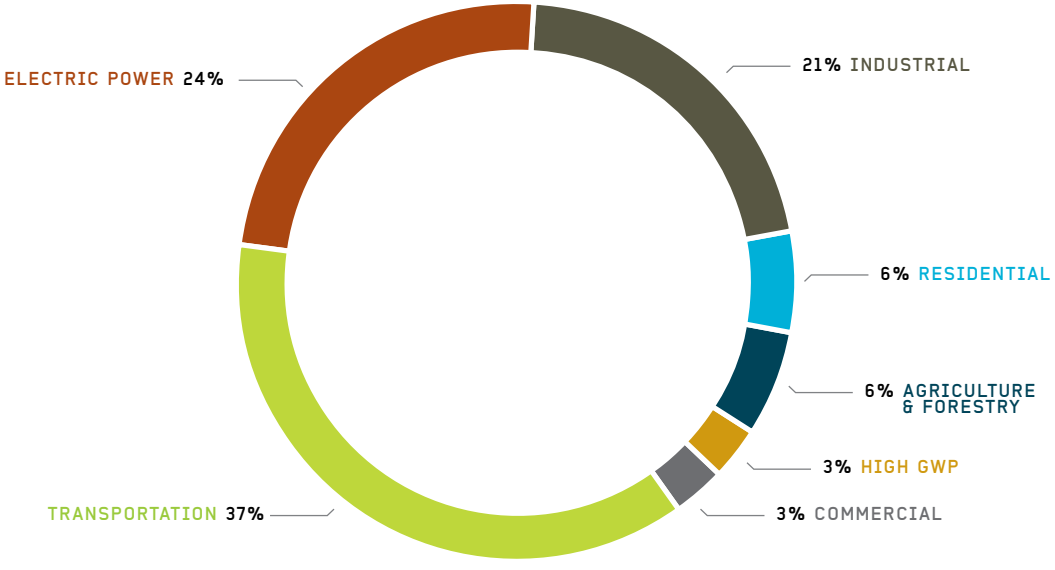
relocating their facilities. This company demonstrates the formidable potential for growing markets and job opportunities by supporting the early adoption of important new technologies.[7]

Other EV companies that have set up shop in California share the sentiment. Tesla Motors was founded in 2003 in Silicon Valley and now has 18 locations worldwide and road presence in 31 countries. Aerovironment, founded in 1971 and located in Monrovia, California, provides EV charging systems and installation services for consumers, automakers, utilities and government agencies.

The transformation of transportation will help to reduce greenhouse gas emissions in the most carbon intensive sector of California's economy, transportation. Transportation made up 37 percent of total state emissions in 2008. Speeding the commercialization of EVs and other clean transportation options will help to reduce California's emission levels and, furthermore, will be necessary to meet the greenhouse gas (GHG) reduction goals outlined by AB 32, California's Global Warming Solutions Act of 2006.[8]

In the sections that follow, Section 1 examines California's trailblazing public policy and community efforts that have helped to drive early adoption of cleaner vehicle options, the development of the charging station infrastructure, and business growth. Section 2 demonstrates California's lead in both technology and business innovation which are vital for the broader adoption of EVs. Section 3 illustrates the solid business and employment growth in California industries related to EVs. In Section 4, the basics are addressed concerning the benefits and challenges to broad-based adoption of EVs across the nation.

FIG 01 **GREENHOUSE GAS EMISSIONS /** BY SOURCE / CALIFORNIA 2008



NEXT 10 POWERING INNOVATION. Data Source: California Air Resources Board, California Greenhouse Gas Inventory—by Sector and Activity. Analysis: Collaborative Economics

PIONEERING POLICY AND COMMUNITY ACTION

CALIFORNIA HAS BENEFITED FROM THE THOUGHT LEADERSHIP of its community and public policy leaders in efforts aiming to reduce pollution from vehicles and support the adoption of cleaner alternatives. While there is still much to do, these efforts are already paying off in terms of adoption rates for EVs and a demonstrated commitment to building the charging station infrastructure.

PIONEERING PUBLIC POLICY TOWARD CLEANER VEHICLES ON CALIFORNIA'S ROADS

During his State of the Union address in January 2011, President Obama announced a goal for the United States to become the first country with one million EVs on the road by 2015. State and national policies play a crucial role in providing the standards, funding and incentives necessary for increasing EV commercialization and developing EV technology and infrastructure.

California has pioneered much policy in the U.S. related to reducing pollution from transportation sources and improving vehicle efficiency. California standards have set a precedent for vehicle-related policy around the country. For example, in 2002 California passed the Pavley Bill (AB 1493) requiring that manufacturers reduce GHG emissions from passenger vehicles. Implementing this policy into law required a waiver from the U.S. Environmental Protection Agency (EPA) to allow the state to impose stricter regulations on car manufacturers. After much delay at the federal level, California was granted the waiver in June of 2009 allowing the adoption by the California Air Resources Board (CARB). Implementation of this bill was projected to reduce GHG emissions from passenger vehicles in California by 22 percent in 2012 and by 30 percent in 2016. In addition to reducing pollution, this law will stimulate the market for clean transportation alternatives like EVs.[9] In response to California's commitment to regulating GHG emissions from passenger vehicles, in May 2009, the EPA collaborated with the National Highway Traffic Safety Administration (NHTSA) to set national standards.

An executive order for the Low Carbon Fuel Standard (LCFS) Program was issued in January 2007 for a reduction of at least ten percent in the carbon intensity of transportation fuels in California by the year 2020. In April 2009, CARB approved the regulations that would go into effect starting January 1, 2011. The positive impact of fuel and vehicle-related standards cannot be overlooked. According to a study on how fuel and emissions standards will affect economic growth and job creation, the consequences of enforcing the LCFS and the 2016 state vehicle emissions standards through

2025, when compared to the "Business as Usual" scenario, will produce 38,000 new jobs and an additional 0.03 percent growth in gross state product by the year 2025.[10]

Another policy program that continues to encourage transportation options that reduce GHG and pollutant emissions is the Zero Emission Vehicle (ZEV) Program, which was adopted in 1990 under the Low Emission Vehicle (LEV) Program. The initial standards set by the program required a percentage of vehicles sold by major manufacturers in California to be ZEVs, with the percentage increasing incrementally. The program standards have been amended several times since adoption. Following the primary injunction issued to CARB, which prohibited enforcement of the 2001 ZEV amendments, efforts were made to better align the program requirements with the status of technology development in March 2003. Since then, two ZEV technology symposiums have been held to help guide amendments to the program. The goal of commercializing ZEVs within technological, market and economic constraints has not changed. With the most recent development, the ZEV program, as a component of the Advanced Clean Cars Program that encompasses both pollutant and GHG emissions, will require manufactures to produce increasing numbers of ZEVs and plug-in hybrid electric vehicles for 2018 to 2025 model years.

In regards to current policy activity, CARB is working to amend the LEV regulations that were initially adopted in 1990 and later amended in 1998 with the adoption of LEV II. While the standards set by the first LEV program required a percentage of vehicles sold by major manufacturers in California to be ZEVs, the latest amendments, LEV III, call for more stringent tailpipe and GHG standards for new passenger vehicles and will promote the sale and use of ZEVs. Modifications to the set of LEV standards, along with new approaches for the ZEV program and Clean Fuels Outlet are also referred to as the Advanced Clean Cars Program. This program marks the first time standards for smog-causing pollutants and GHG emissions have been coordinated in the same program.

In November 2011, CARB introduced regulations for new cars sold between 2015 and 2025. On a national level, the EPA and NHTSA worked in coordination with California to issue a joint proposal to extend national programs to establish stricter GHG and fuel economy standards for light-duty vehicles from model years 2017 to 2025. Greenhouse gas emission standards are proposed under the Clean Air Act. Fuel standards are proposed under the Corporate Average Fuel Economy (CAFE) standards, which falls under the Energy Policy and Conservation Act as amended by the Energy Independence and Security Act (EISA).[11]

California has been at the forefront of supporting the advance of EV technologies and spurring the adoption of EVs through incentives for vehicle purchase, technology innovation, manufacturing, infrastructure implementation, and demonstration projects. Motivated by goals to reduce petroleum consumption, generate new jobs, and transition California to cleaner transportation alternatives, the California Energy Commission (CEC) has distributed grant funding for a variety of clean transportation projects. The CEC was granted $100 million to develop and deploy alternative and renewable fuels, in addition to advanced transportation technologies. In May 2011, a portion was awarded by the CEC to CARB to implement alternative fuel vehicle incentive programs and to various businesses to develop new technologies for batteries and fuels.[12] California companies also receive grant and private funding to develop products and infrastructure that will support electric vehicles and other technologies that will help to meet emissions and vehicle standards.

COMMUNITY ACTION AND PILOT PROJECTS

In addition to public policy, community groups are pioneering countrywide, statewide and regional efforts to drive the broad-based adoption of EVs. Committing to the development of the charging infrastructure for EVs is at the core of much of this activity. A select few include:

Bay Area Climate Collaborative (BACC) is a public-private initiative launched by the mayors of San Francisco, San Jose and Oakland to create unified efforts to accelerate development of the clean energy economy in the Bay Area. The Collaborative is launching the **Local Government EV Fleet National Demonstration** with the goal of facilitating the deployment of 90 fleet EVs along with the necessary charging infrastructure in the Bay Area. This project will serve as a regional visibility campaign for the adoption of EVs in fleets and an outreach effort to share best practices. The Collaborative has secured $2.8 million from the Metropolitan Transportation Commission to launch the project, along with matching funds bringing total project funding to $5 million. Another effort focused on encouraging EV adoption is Ready, Set, Charge California! — a collaborative effort involving the BACC that provides a model development plan for how cities can prepare ordinances and regulations to streamline EV charging station installation.[13]

CALIFORNIA & U.S. TRANSPORTATION POLICY TIMELINE

US HISTORY

1955 — National Air Pollution Control Act

1963 — Clean Air Act

1965 — National Emissions Standards Act; Motor Vehicle Air Pollution Control Act

1967 — Air Quality Act

1973 — OPEC Oil Embargo

1975 — Congress enacts the CAFE (Corporate Average Fuel Economy) regulations to improve average fuel economy of cars and light trucks in the U.S.

1990 — Clean Air Act Amendments set new auto emissions standards, low-sulfur gas, required Best Available Control Technology (BACT) for toxins, reductions in CFCs

1993 — Inception of the Clean Cities Program aimed at capitalizing on public-private partnerships to make vehicle fleets more energy efficient and reduce petroleum dependency

2001 — Toyota Prius introduced worldwide

2006 — Film Release: *Who Killed The Electric Car?*

2007 — Energy Independence and Security Act (EISA) enacted to improve vehicle fuel economy and reduce U.S. dependency on foreign oil

EISA Section 131: Initiated grant programs for projects to encourage PHEVs and other electric technologies

EISA Section 134: Authorized loan guarantees for production facilities for fuel efficient vehicles and parts

EISA Section 135: Authorized loan guarantees for manufacturing facilities for advanced vehicle batteries and battery systems

CA HISTORY

1947 — Los Angeles Air Pollution Control District created

1959 — California Motor Vehicle Pollution Control Board created to test automobile emissions and set standards

1967 — California Air Resources Board established

1990 — California Air Resources Board adopts the first Low Emission Vehicle (LEV) standards applicable from 1994 through 2003. Zero Emission Vehicle (ZEV) regulations were adopted as a part of LEV standards to reduce vehicle emissions

1998 — California Air Resources Board amends LEV standards with the more stringent LEV II, extending standards to SUVs and trucks. LEV II standards are applicable from 2004 to 2010

2002 — California sets standards for emissions of CO2 and other greenhouse gases from autos and light duty trucks (Pavley Act)

2006 — California Global Warming Solutions Act of 2006 (A.B. 32)

2007 — California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (A.B. 118) provides $200 million annually through 2015 to three programs dedicated to air quality improvement, fleet modernization, and alternative and renewable fuel and vehicle technology

Enhanced Fleet Modernization Program (A.B. 118) provides $30 million annually for voluntary retirement of high emitting passenger cars and light to medium-duty trucks

United States retail price for conventional gasoline reaches a high of $4.11 per gallon

2008

The Recovery Act contributed $400 million to transportation electrification projects and $2 billion towards construction of advanced vehicle battery facility construction under the EISA

EPA adopts more stringent tailpipe rules modeled after those of California

The Recovery Act made available tax credits up to $7,500 for PEV purchases and up to $4,000 for PEV conversion kits purchased prior to 2010

2009

Energy Department provides $465 million loan to electric vehicle maker Tesla Motors to construct two manufacturing plants

Electric cars and alternative fuels receive $114.3 million boost from California state, federal and private funds

Energy Department launches $2 billion program to put 400,000 electric cars on the road in three years

Executive Order 13514 requires 30% decrease in petroleum consumption by 2020

Delivery of the first Nissan Leaf order at the San Francisco City Hall Plaza

2010

In State of the Union Address, President Obama calls for the U.S. to become first country with a million electric vehicles on the road by 2015

Department of Transportation, EPA and California Air Resources Board announce single timeframe to establish GHG standards for cars model years 2017-2025

Obama administration proposes an up-front $7,500 rebate for electric vehicle purchase

Proposed energy-efficiency partnership between FedEx, UPS and U.S. government will increase the use of electric and alternative fuel vehicles in their fleets

Clean Cities Program awarded $5 million to deploy EV infrastructure and charging stations in partnership with Google

2011

Film Release: *The Revenge of the Electric Car*

More than 1,800 electric vehicle chargers installed under the Recovery Act

Energy Department in partnership with industry forms U.S. DRIVE to accelerate the development of clean, advanced, energy-efficient car technologies

Obama administration issues a Presidential Memorandum requiring that by 2015, 100% of fleet vehicles purchased by the government be alternative fuel vehicles

Obama administration and carmakers agree to raise fuel economy standards up from 27 to an average of 54.5 miles per gallon by 2025

Obama administration announces fuel economy standards for work trucks, buses and other heavy duty vehicles for model years 2014 to 2018

The EPA and DOT National Highway Traffic Safety Administration (NHTSA) adopt joint standards for fuel efficiency and GHG emissions from medium to heavy duty vehicles

2008 2009 2010 2011

Sustainable Communities and Climate Protection Act of 2008 (S.B. 375), requires ARB to set regional GHG emissions reduction targets for passenger vehicles to promote good planning and sustainable communities in California

California Air Resources Board adopts Low Carbon Fuel Standard (LCFS) regulations to reduce carbon intensity of transportation fuel by 10% by 2020

California was granted a waiver allowing the adoption by CARB of regulations on car manufacturers for reduced GHG emissions from passenger vehicles

California Public Utilities Commission, in collaboration with stakeholders, will work to formulate and implement policies to develop fueling infrastructure for plug-in hybrid and electric vehicles (S.B. 626)

California Air Resources Board finalizes regulation of Pavley Act for greenhouse gas emissions for passenger vehicles

California Energy Commission awards nearly $9.6 million for eight grants to reduce petroleum use and advance biofuels and electric vehicles manufacturing

Zero-emission vehicle rebate demand exceeds allotted funding under the Clean Vehicle Rebate Project

California leads the nation in total and per capita EV charging stations

California Plug-In Electric Vehicle Collaborative is a group composed of appointed officials, automakers, utilities, infrastructure providers, environmental organizations and other stakeholders who are working together to help the market for PEVs to grow in California. In collaboration with the PH&EV Research Center at the Institute of Transportation Studies at the University of California, Davis, the group has published an actionable plan for how California can capitalize on its technological, political and consumer base resources to become the leader in the PEV market. Specific strategies include educating the market, simplifying home charging installation, improving grid reliability, reducing vehicle costs, and encouraging local and regional government efforts.[14]

SoCalEV is a collaborative effort between the Los Angeles Department of Water and Power, cities, utilities, automakers, local and regional government agencies, businesses and others with the objective of developing and implementing a PHEV Readiness Plan. The plan includes the following objectives: coordinate education and outreach for EVs, build necessary infrastructure, offer financial incentives, streamline permitting requirements, and collaborate on fleet acquisition plans. The goal is to prepare Southern California for EV penetration. Specific partners include Southern California Edison, Cal Tech and CODA.[15]

ChargePoint America is a program sponsored by Coulomb Technologies, located in Campbell, California, in collaboration with Ford, Chevrolet, and Smart USA. Supported by a $15 million grant from the American Recovery and Reinvestment Act, the goal of the program is to provide charging infrastructure to nine regions in the United States. Three of the nine regions are in California: Sacramento, the San Jose-San Francisco Bay Area, and Los Angeles. Coulomb will provide around 5,000 fully networked charging stations, and automobile partners agree to deliver EVs in each of the designated regions. Individual residents as well as companies and municipalities in each of the regions will be eligible to receive networked charging stations for free. The distribution and installation of these charging stations is the first stage of the program which will commence in October 2011. During the second stage, lasting two years, anonymous data from all program participants will be collected in order to better understand usage patterns and future needs.[16]

The California Plug-in Electric Vehicle (PEV) Collaborative is a multi-stakeholder effort between public and private entities aimed at strengthening the PEV market in California, which will confer added benefits of energy security, improved air quality, public health and economic benefits.[17] The Collaborative is composed of appointed officials, automakers, utilities, infrastructure providers, and environmental organizations. Partnered with the PH&EV Research Center at the University of California, Davis, the Collaborative has created and published an actionable plan titled, *Taking Charge: Establishing California Leadership in the Plug-In Electric Vehicle Marketplace*. The Collaborative will work towards implementation of the recommendations outlined in the plan including educating consumers, reducing PEV costs, providing charging infrastructure, and preparing for the impact on the electricity grid.

The EV Project is an effort to speed the deployment of EVs and charging infrastructure across the country. The U.S. Department of Energy (DOE) launched this program in October 2009 with the goal of installing 14,000 EV chargers in major cities in California, Oregon, Washington, Arizona, Texas, Tennessee, and Washington D.C. over a three-year period. San Diego, San Francisco and Los Angeles are participating cities. Residents who purchase EVs from automobile partners – Chevrolet and Nissan – will receive a free charger with the majority of the installation cost covered by the program. Data collected from recipients of chargers will be analyzed for charging infrastructure effectiveness, potential revenue systems for commercial and public infrastructure, and vehicle performance in different topographic and climate conditions.[18] ECOtality, a San Francisco-based company, was awarded $99.8 million from the Department of Energy as part of this effort.

EXPANDING THE CHARGING INFRASTRUCTURE

Although the majority of vehicle charging will occur at the owner's home, achieving broad-based adoption of plug-in electric vehicles will be aided by the widespread development of the charging station infrastructure outside of PEV owners' homes. Regional initiatives and government sponsored programs are working to increase the simplicity and abundance of public charging options to help alleviate range anxiety of all-electric vehicle drivers. Research is currently being conducted to find the best pricing structures and business models for the development of public charging infrastructre.

Currently, California ranks first in charging stations installed, reporting the largest total number of stations, and with 16.3 EV charging stations per million residents, the largest number per capita. California also ranks first in the country in total number of charging stations, electric vehicles and hybrid vehicles. The State of Washington has 101 charging stations in total and ranks second in terms of total charging stations and per million residents.

Within California, the Sacramento Area leads with 27.9 stations per capita. The San Francisco Area (without Silicon Valley)

falls second with 24.1 stations per million people and 111 total stations in the region. Silicon Valley and the Los Angeles Area rank closely third and fourth with 19.5 and 19.4 stations per capita, respectively. In terms of total number of stations per city, Los Angeles tops the list of the state's top ten cities with 48 charging stations. Of the top ten California cities, four are located in the Los Angeles Area.

FIG 02 / TOP 10 STATES IN CHARGING INFRASTRUCTURE

RANK	STATE	CHARGING STATIONS (PER MILLION PEOPLE)	TOTAL CHARGING STATIONS	TOTAL ELECTRIC VEHICLES*	TOTAL HYBRID VEHICLES
1	CALIFORNIA	16.3	609	18,780	470,895
2	WASHINGTON	15.0	101	359	59,553
3	OREGON	14.5	56	166	38,255
4	MARYLAND	9.4	54	91	47,903
5	HAWAII	8.5	11	197	10,200
6	CONNECTICUT	8.2	29	36	27,953
7	ARIZONA	7.9	23	2,156	42,430
8	MINNESOTA	7.4	39	87	29,413
9	SOUTH CAROLINA	6.7	31	113	13,384
10	MICHIGAN	5.0	50	494	33,293

*Electric Vehicles are those powered by a battery and include neighborhood electric vehicles (NEVs).

Note: California population estimates are estimates for January 2011. Charging stations include those in operation and planned through 2012.

NEXT 10, POWERING INNOVATION. Data Source: California Department of Finance, US Department of Energy. Analysis: Collaborative Economics

FIG 03 / CHARGING INFRASTRUCTURE ACROSS CALIFORNIA'S REGIONS

TOP REGIONS			TOP CITIES*	
	CHARGING STATIONS (PER MILLION PEOPLE)	TOTAL CHARGING STATIONS		TOTAL CHARGING STATIONS
SACRAMENTO AREA	27.9	65	SACRAMENTO	28
SAN FRANCISCO WITHOUT SILICON VALLEY	24.1	111	SAN FRANCISCO VACAVILLE SANTA ROSA	29 14 9
SILICON VALLEY	19.5	57	SAN JOSE PALO ALTO	13 8
LOS ANGELES AREA	19.4	191	LOS ANGELES SANTA MONICA PASADENA ANAHEIM	48 16 11 8
ORANGE COUNTY	15.2	46	-	-
REST OF CALIFORNIA	9.6	139	-	-
SAN DIEGO REGION	8.7	27	SAN DIEGO	15

*Top cities are those that rank in the top ten in the state in terms of absolute number of charging stations.

Note: California population estimates are estimates for January 2011. Charging stations include those in operation and planned through 2012.

NEXT 10, POWERING INNOVATION. Data Source: California Department of Finance, US Departmetnt of Energy. Analysis: Collaborative Economics

GLOBAL LEADER IN TECHNOLOGY INNOVATION IN ELECTRIC VEHICLES

CALIFORNIA IS A GLOBAL LEADER IN TECHNOLOGY INNOVATION RELATED TO ELECTRIC VEHICLES. The state attracts the vast majority of U.S. venture capital (VC) investment, registers the most patents and benefits from a world-class talent base and R&D resources. The state's forward-thinking public policy efforts have helped establish the state's leadership through supporting the early adoption of EVs. These assets are self-reinforcing and suggest a strong foundation is building for economic growth in related industries.

VENTURE CAPITAL INVESTMENT

California accounts for the lion's share of national and global venture capital investment in EVs and leads in investment growth since 2006. In 2010, California accounted for 80 percent ($840 million) of total U.S. and 60 percent of total global VC investment in EV-related sectors. VC investment has grown rapidly in areas related to EVs since 2006, increasing 673 percent globally and 571 percent nationally.

Investment in California has risen even more rapidly, expanding 712 percent since 2006. The expansion of VC investment in EV-related technologies in California is a strong indicator for continued innovation and growth in the state's EV industry. In the first half of 2011, California attracted 69 percent of total global EV-related investment and 74 percent of United States investment. California's investment for the first half of 2011 totaled $467 million for electric vehicles and related industries.

Venture capital investment in EVs and related industries in California increased by more than a factor of eight from 2006 to 2010. In 2010 alone, investment expanded by 44 percent over 2009. Attracting significant investment shares, 46 percent of investment was in Charging Infrastructure and 42 percent in Electric & Hybrid Vehicles. In 2010, Motor Vehicles & Equipment and Advanced Batteries accounted for seven percent and five percent of investments, respectively.

FIG 04A / VENTURE CAPITAL INVESTMENT IN ELECTRIC VEHICLES & RELATED INDUSTRIES / CALIFORNIA VS US AND GLOBAL (MIL $)

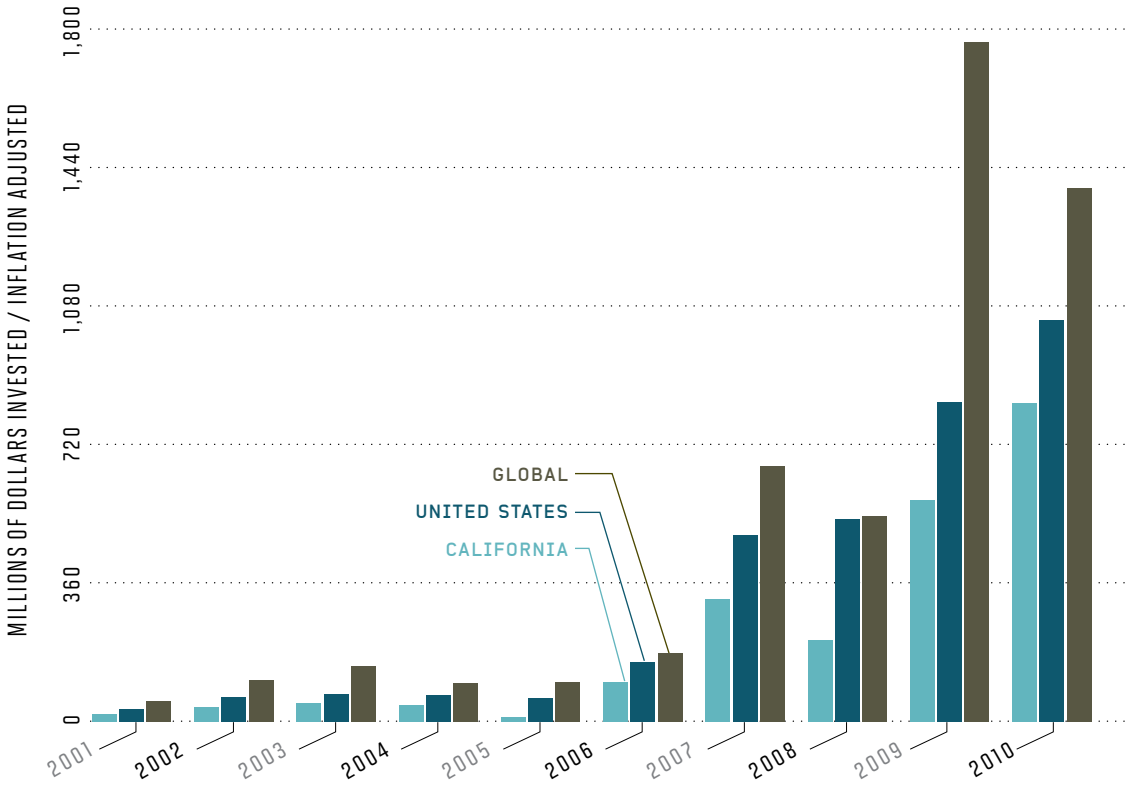
	2010	2011*
CALIFORNIA	$840	$467
UNITED STATES	$1,056	$633
GLOBAL	$1,404	$672
CA % US	80%	74%
CA % GLOBAL	60%	69%

*First Half of 2011

NEXT 10, POWERING INNOVATION. Data Source: Cleantech™ Group LLC. Analysis: Collaborative Economics

FIG 04B VENTURE CAPITAL INVESTMENT IN ELECTRIC VEHICLES & RELATED INDUSTRIES

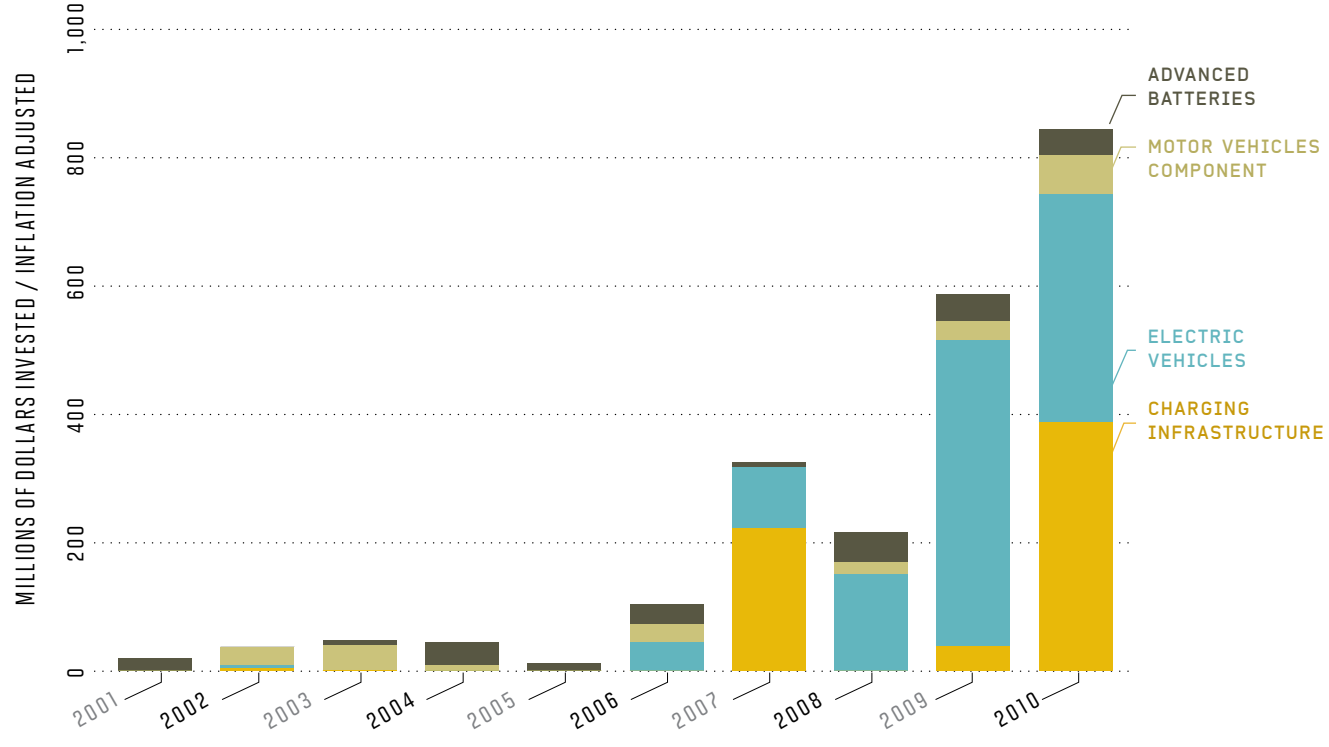
CALIFORNIA, UNITED STATES & GLOBAL



Note: California values are included in the United States values and United States values are included in the Global values.

NEXT 10, POWERING INNOVATION. Data Source: Cleantech™ Group LLC. Analysis: Collaborative Economics

FIG 05 VENTURE CAPITAL INVESTMENT IN ELECTRIC VEHICLES & RELATED INDUSTRIES / CALIFORNIA

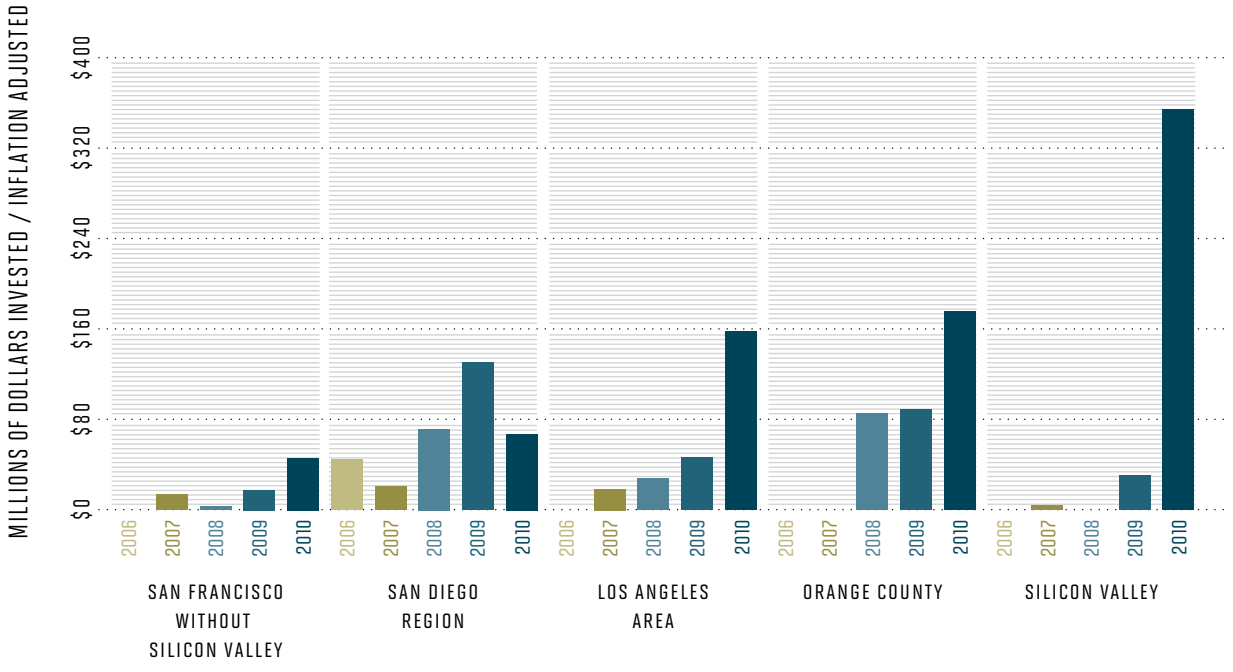


Note: Cleantech data for Advanced Batteries includes non-EV applications

NEXT 10, POWERING INNOVATION. Data Source: Cleantech™ Group LLC. Analysis: Collaborative Economics

FIG 06 VENTURE CAPITAL INVESTMENT IN ELECTRIC VEHICLES & RELATED INDUSTRIES

BY REGION IN CALIFORNIA



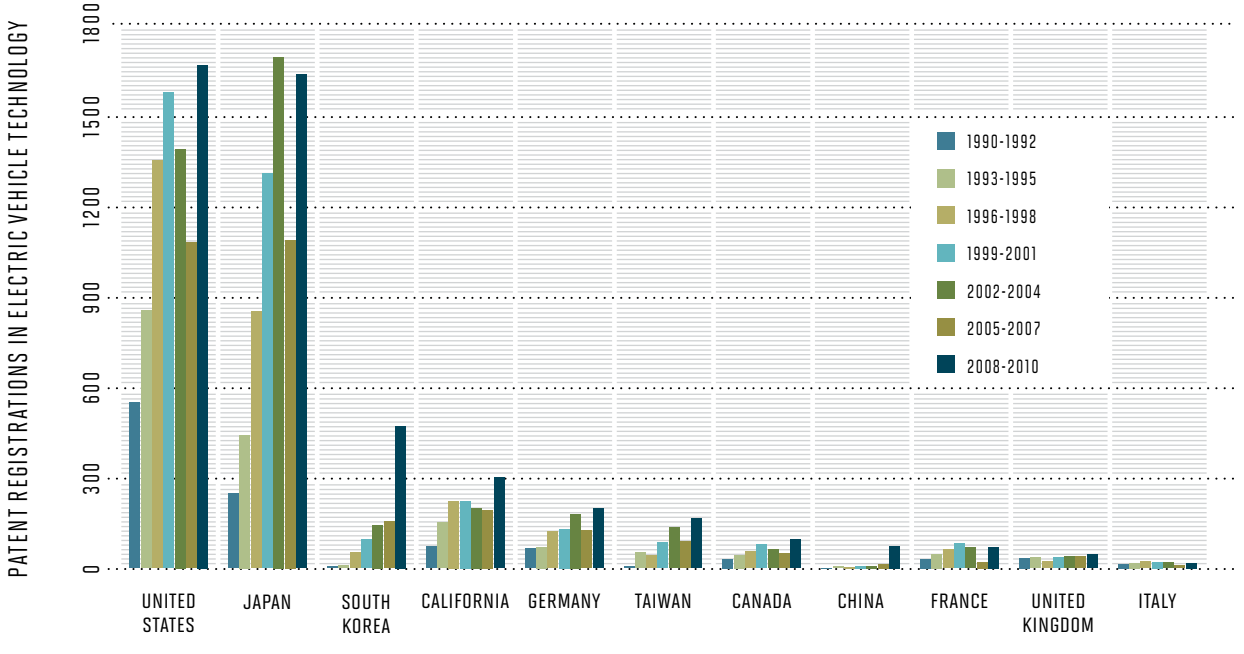
Note: Data for Venture Capital Investment in Electric Vehicles & Related Industries includes advanced battery applications not exclusive to EVs

NEXT 10, POWERING INNOVATION. Data Source: Cleantech™ Group LLC. Analysis: Collaborative Economics

FIG 07 ELECTRIC VEHICLE TECHNOLOGY PATENT REGISTRATIONS / 1990 – 2010

TOTAL PATENTS REGISTERED IN BATTERIES AND HYBRID & ELECTRIC VEHICLES

CALIFORNIA AND OTHER COUNTRIES WITH THE HIGHEST NUMBER OF PATENTS IN EV



NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

Regionally, investment activity in EV-related industries is concentrated in five areas: Silicon Valley, Orange County, the Los Angeles Area, the San Diego Region and the San Francisco Bay Area (without Silicon Valley). Over the five-year span from 2006 to 2010, Silicon Valley attracted nearly a fifth of the state's VC investment in EVs and related industries, receiving $358 million in 2010. Orange County is the second strongest region in VC investment in EVs and related industries, garnering 21 percent of the state's investments in 2010 ($177 million). Investment in the Los Angeles Area nearly tripled from 2009 to 2010, reaching $160 million in 2010.

PATENTING NEW TECHNOLOGY

Patent activity in EV and related industries has increased substantially in recent years in California and globally. California is a leading state in the U.S. but is also a leader among the top-patenting countries in EV and related technologies.

In the period 2008-2010, 1,668 patents in EV and related technologies were registered the U.S., an increase of 204 percent from the early 1990s. Meanwhile, Japan, a close second with 1,637 patents, increased patenting activity by seven fold since the period 1990-1992. In the most recent period, 2008-2010, 300 patents were registered in California, trailing South Korea, and Japan, but outpacing top performing Germany, Taiwan and Canada.

Within the United States, California and Michigan rank at the top in total EV technology patents in the period 2008-2010 with 300 patents each. Texas follows third with 95 patents. Compared to two decades ago, California ranked 17th, Michigan ranked 8th, and Texas was 22nd. This suggests that California and Michigan are taking the lead over older players in the development of newer technologies.

ELECTRIC VEHICLE SECTOR	DESCRIPTION
Advanced Batteries	Multiple battery technologies with applications related to EVs such as Li-Ion, Nickel Zinc, other technologies
Charging Infrastructure	Charging stations, battery switching stations, and software for managing consumption and access to charging infrastructure
Electric Vehicles	Electric and hybrid vehicles, including commercial and personal vehicles, motorcycles, bicycles, and scooters
Motor Vehicle Components	Vehicle engines and components such as connectors, controllers, and adapter kits for electric and hybrid vehicles

FIG 08 / TOTAL ELECTRIC VEHICLE TECHNOLOGY

TOP RANKING STATES IN PATENTS REGISTERED

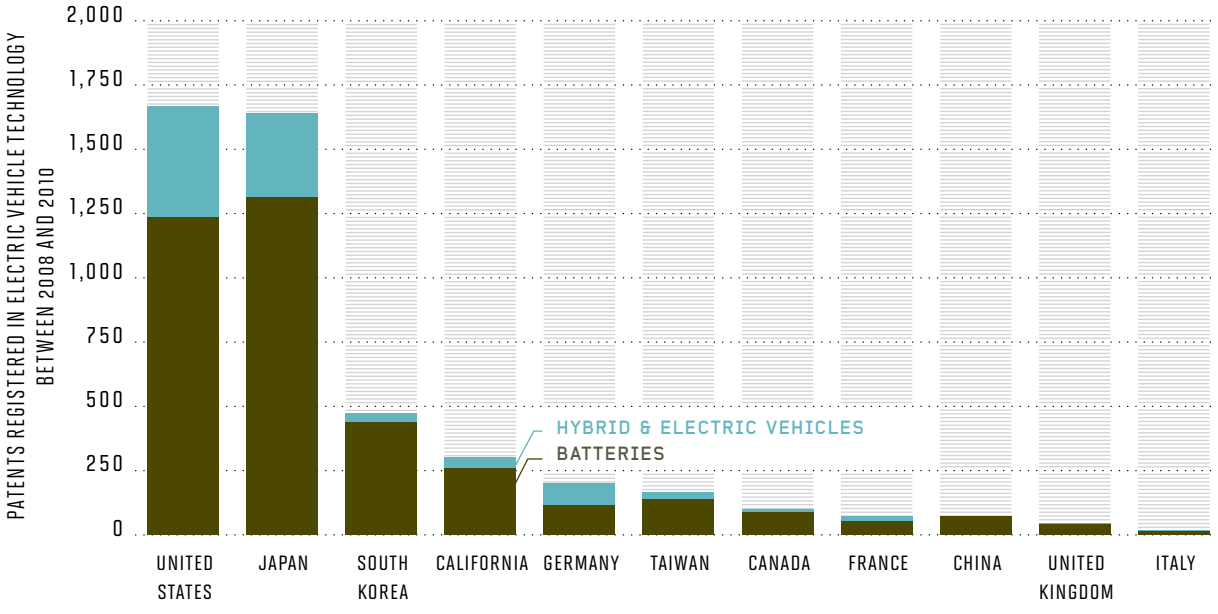
STATE	NUMBER OF PATENTS 2008-2010	RANKING 2008-2010	RANKING 1990-1992
CALIFORNIA	300	1	17
MICHIGAN	300	1	8
TEXAS	95	3	22
NEW YORK	89	4	2
OHIO	88	5	33
ILLINOIS	76	6	14
WISCONSIN	69	7	33
MASSACHUSETTS	66	8	13
MINNESOTA	64	9	28
PENNSYLVANIA	55	10	42

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

FIG 09 ELECTRIC VEHICLE TECHNOLOGY PATENT REGISTRATIONS / 2008 – 2010

SHARE OF PATENTS REGISTERED IN BATTERIES AND HYBRID & ELECTRIC VEHICLES

CALIFORNIA AND OTHER COUNTRIES WITH THE HIGHEST NUMBER OF PATENTS IN EV



NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

FIG 10 / DISTRIBUTION OF PATENTS IN EV TECHNOLOGIES

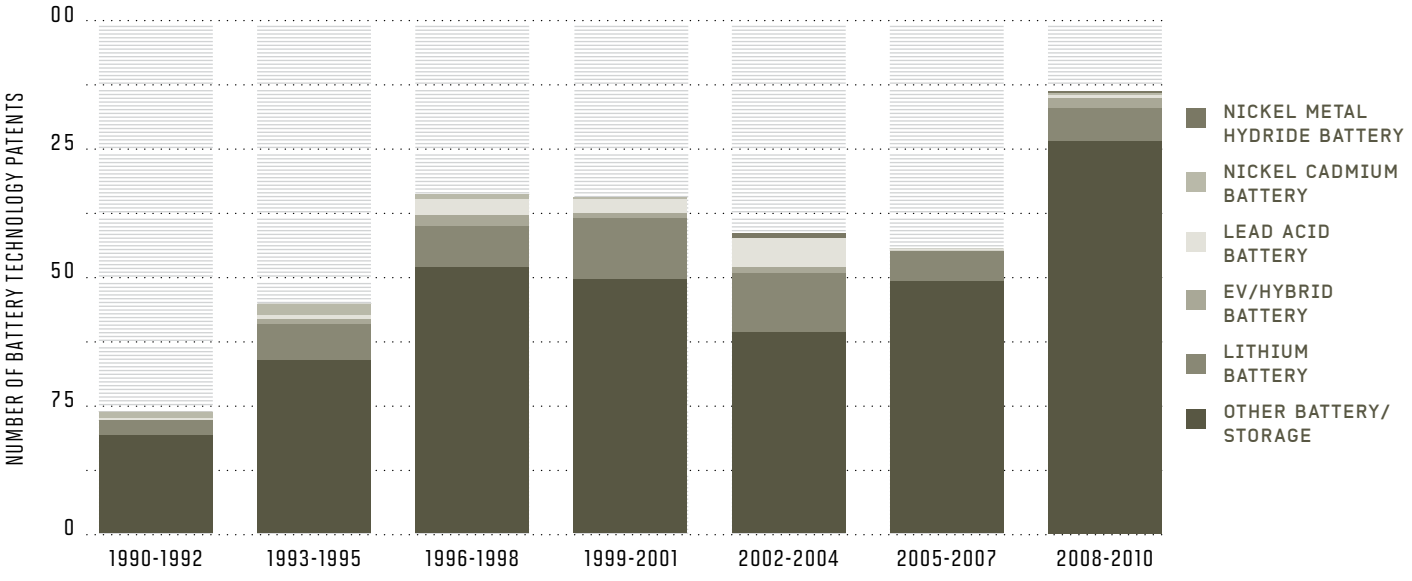
FROM 2008-2010

COUNTRY	HYBRID & ELECTRIC VEHICLES	BATTERIES
UNITED STATES	26%	74%
JAPAN	20%	80%
SOUTH KOREA	7%	93%
CALIFORNIA	14%	86%
GERMANY	42%	58%
TAIWAN	16%	84%
CANADA	8%	92%
FRANCE	23%	77%
CHINA	4%	96%
UNITED KINGDOM	13%	87%
ITALY	29%	71%

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

By technology, the distribution of patenting activity varies by country. In the most recent period, 74 percent of U.S. patents were in Batteries followed by 26 percent in Hybrid & Electric Vehicle technology. Japan's distribution is similar with slightly more activity in Batteries and less in Hybrid & Electric Vehicle technology. South Korea is more heavily focused in Batteries, which represent 93 percent of patents. In Germany, on the other hand, there is a more even distribution with 42 percent in Hybrid & Electric Vehicle technology and 58 percent in Batteries. In California, 86 percent of EV related patents were in Batteries and 14 percent in Hybrid & Electric Vehicle technology. For China, 96 percent of patent registrations were in Batteries over the same time period.

FIG 11 BATTERY TECHNOLOGY PATENTS / BY TECHNOLOGY / CALIFORNIA



NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

California leads the nation in battery technology patents in the latest time period as well as two decades before. Battery technology patents represent the largest portion of EV patents in California with 258 registered patents in the 2008-10 period. Patent registrations in this category increased by 55 percent from 2005-07 to 2008-10. Accounting for 89 percent of total battery patents in the recent period, Other Battery/Storage represents a mix of energy storage technologies. The second largest category was Lithium Battery Technology, with seven percent of total battery patents in the same period.

FIG 12 / BATTERY TECHNOLOGY

TOP RANKING STATES IN PATENTS REGISTERED

STATE	NUMBER OF PATENTS 2008-2010	RANKING 2008-2010	RANKING 1990-1992
CALIFORNIA	258	1	1
TEXAS	87	2	12
NEW YORK	75	3	11
MICHIGAN	73	4	10
OHIO	72	5	2
ILLINOIS	62	6	6
WISCONSIN	60	7	3
MINNESOTA	59	8	9
MASSACHUSETTS	56	9	8
MARYLAND	47	10	13

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

Following Michigan, California is a distant second in U.S. patent activity related to Hybrid & Electric Vehicle technology. Over the last two decades, California as well as three other states have surpassed New York State in patents in this domain. Electric Vehicle patents made up a third of total patents in the period 2008-10 in California, and expanded by 40 percent over the previous period. Total California patents in Hybrid & Electric Vehicle technology increased by 56 percent during that same time frame.

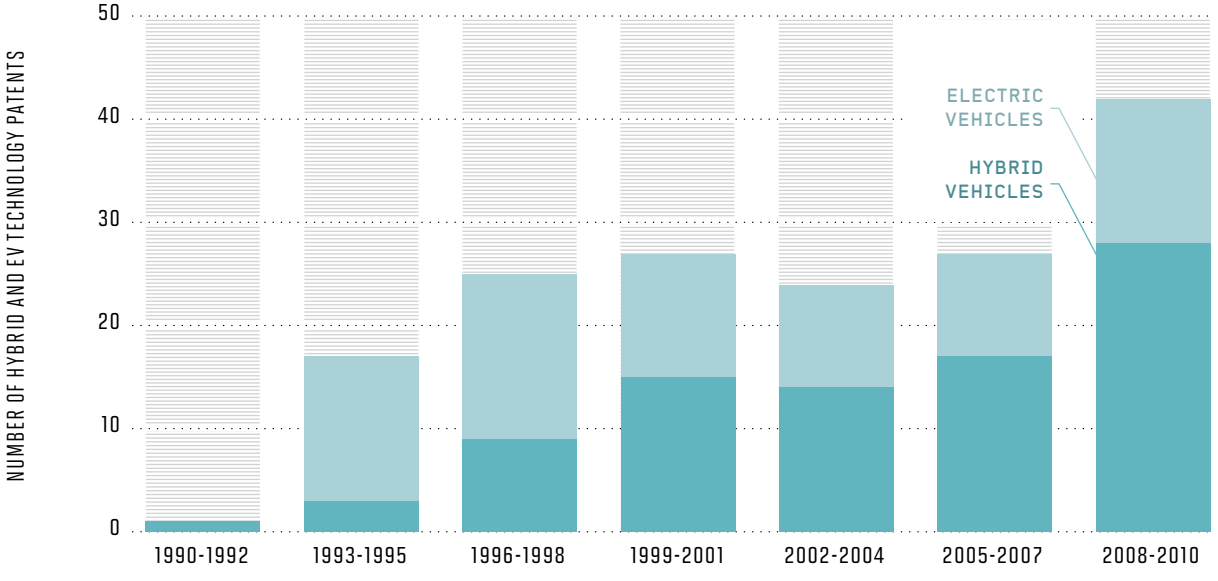
FIG 13 /HYBRID & ELECTRIC VEHICLE TECHNOLOGY

TOP RANKING STATES IN PATENTS REGISTERED

STATE	NUMBER OF PATENTS 2008-2010	RANKING 2008-2010	RANKING 1990-1992
MICHIGAN	227	1	1
CALIFORNIA	42	2	10
INDIANA	25	3	10
OHIO	16	4	10
ILLINOIS	14	5	10
NEW YORK	14	5	3
PENNSYLVANIA	11	7	10
MASSACHUSETTS	10	8	3
WISCONSIN	9	9	19
TEXAS	8	10	3

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

FIG 14 HYBRID AND ELECTRIC VEHICLE TECHNOLOGY PATENTS / BY TECHNOLOGY / CALIFORNIA



Note: The category "Electric Vehicles" contains vehicle components and parts, excluding those for hybrids, and does not include battery technology

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

ELECTRIC VEHICLE RESEARCH IN CALIFORNIA

California is the home of world-class research labs and educational institutions that are making significant contributions to the advancement of EV-related technologies.

The Lawrence Berkeley National Laboratory hosts a Department of Energy supported research program called **Batteries for Advanced Transportation Technologies (BATT).** This program is top in the nation for developing high-performance, rechargeable batteries for EVs and HEVs through research in six task areas: anodes, cathodes, electrolytes, cell analysis, diagnosis and modeling.[19]

The University of California, Berkeley houses several centers that research EV related concepts. **The Center for Entrepreneurship and Technology (CET)** released a paper examining the economic impact of EV deployment in the United States through 2030.[20] **The Transportation Sustainability Research Center (TSRC)** was formed at the university to research the economic, social, and environmental aspects of sustainable transportation. More specifically, they have investigated policy and regulations surrounding electric fueling, PEV battery reuse, and rebate programs schemes for purchasing low emission vehicles to name a few.[21]

The Plug-in Hybrid and Electric Vehicle (PH&EV) Research Center is part of the Institute of Transportation Studies at the **University of California, Davis** and provides technology and policy guidance to the state regarding issues in commercializing PHEVs. The research center was established in 2007 and is funded by the California Air Resources Board (CARB) and the Public Interest Energy Research (PIER) Program of the California Energy Commission (CEC). The five areas of research explored at the PHEV center are: modeling alternative PHEV designs and battery performance testing; impacts of PHEVs on the electrical grid; consumers and PHEVs; environmental impacts of PHEVs; and lifecycle costs of PHEVs.[22]

Staff members and graduate researchers at the **Luskin School of Public Affairs at the University of California, Los Angeles** are working with the City of Los Angeles on policies that will accelerate the adoption of EVs in the city. Research identifies unique characteristics of Los Angeles that influence EV adoption and outlines policies and recommendations for the city including: streamline permitting and installation for charging stations; increase charging access for multifamily housing, and increase consumer education and marketing.[23]

The Center for Auto Research at Stanford (CARS) is an affiliates program at the university that unites researchers from different departments who are focused on the future of transportation. There are three founding labs at CARS; Dynamic Design Lab, Artificial Intelligence Lab, and Communication between Humans and Interactive Media (CHIMe) Lab. CARS researchers address technology with broad applications in the realm of vehicles and transportation such as communications which have application also for EVs.

ROBUST BUSINESS AND EMPLOYMENT GROWTH IN ELECTRIC VEHICLES

CALIFORNIA'S DIVERSE EV INDUSTRY IS GROWING IN NUMBER OF BUSINESSES AND IN EMPLOYENT. Business activity in EVs spans industries ranging from advanced batteries to vehicle components and includes work across all segments of the value chain. The mix of businesses and services is evolving to meet the demands for products and technologies required to propel EV commercialization forward. With this, regional hubs of specialization are emerging across the state.

DISTRIBUTION AND TRENDS IN BUSINESS AND EMPLOYENT

The four sectors related to electric vehicles examined in this analysis are Advanced Batteries, Charging Infrastructure, Electric & Hybrid Vehicles, and Motor Vehicle Components. **Advanced Batteries** includes a range of battery technologies with applications related to EVs such as Li-Ion, Nickel Zinc, and other technologies. **Charging Infrastructure** consists of charging stations, battery switching stations, and software for managing consumption and access to the charging infrastructure. **Electric Vehicles** consists of companies manufacturing electric and hybrid vehicles, including commercial and personal vehicles, motorcycles, bicycles, and scooters. This sector includes EV manufacturers which also sell individual components to other EV manufacturers. **Motor Vehicle Components** includes producers of vehicle engines and components such as connectors, controllers, and adapter kits for electric and hybrid vehicles.

In 2010, the EV industry employed nearly 1,800 workers in California – a 142 percent increase over 1995. Even with the effects of the recent recession, EV employment expanded by four percent, adding almost 70 jobs statewide from January 2009 to 2010. By comparison, total employment in California's economy declined by seven percent during this period.

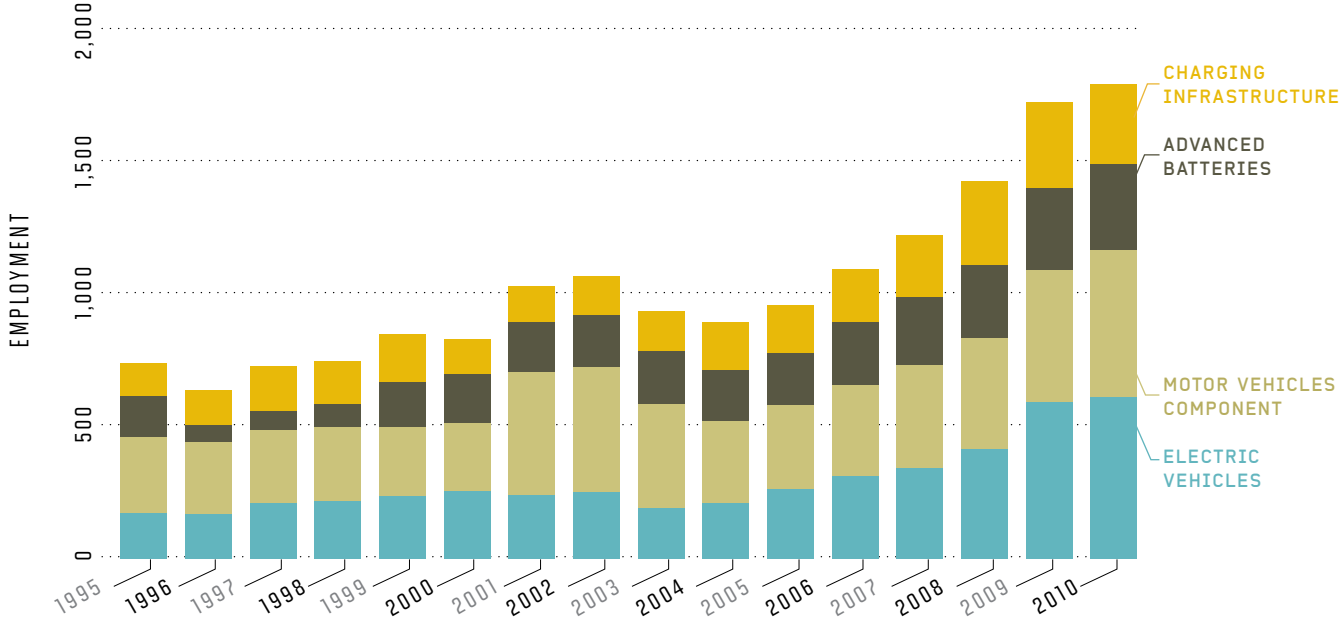
Employment grew in all sectors of the EV industry over the long-run and all but one in the short-term. Across the four segments of the EV industry, Electric Vehicles represents the largest employment, accounting for 34 percent (610 jobs) of total EV employment in 2010. This sector posted a growth rate from 2009 to 2010 of three percent.

Motor Vehicle Components accounts for 31 percent of the state's total EV employment in 2010 and nearly doubled over 1995 levels. Advanced Batteries accounts for 18 percent of the state's total EV employment. Representing 17 percent, Charging Infrastructure is the smallest EV sector with just over 300 employees statewide.

Establishment numbers in Electric Vehicles nearly tripled from 1995 to 2010 and more than tripled for the remaining sectors during that time frame. Overall in 2010, Electric Vehicles accounted for 37 percent of establishments, followed by Advanced Batteries with 28 percent, Motor Vehicle Components with 24 percent, and Charging Infrastructure with 11 percent.

In contrast with employment trends, establishment numbers dropped ten percent from January 2009 to 2010. The drop in establishments coupled with the continued employment growth over the recent period suggests that some consolidation in the industry is possible in the context of the economic downturn and evolving markets related to EVs. From 2009 to

FIG 15 EMPLOYMENT IN ELECTRIC VEHICLES AND RELATED INDUSTRIES / CALIFORNIA



*The employment decrease in Advanced Batteries in 1996 is due to an establishment moving out of the region.

NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics.

2010, Advanced Battery business establishments witnessed the strongest growth in number, expanding five percent from 2009 to 2010. The number of businesses held steady in Charging Infrastructure and declined 18 percent in Electric Vehicles and 14 percent in Motor Vehicle Components over this period.

California's EV industry sectors are concentrated in different parts of the state. Los Angeles, Silicon Valley, and the San Francisco Bay Area (without Silicon Valley) account for the largest EV employment levels and together compose two-thirds of state EV employment. The San Diego Region and Orange County follow in size.

The Los Angeles Area's total EV employment nearly doubled from 2004 to 2010 driven primarily by activities related to components, vehicles and charging. The region's employment is distributed across all four EV sectors: Motor Vehicle Components (33%), Electric Vehicles (28%), Advanced Batteries (20%), and Charging Infrastructure (18%).

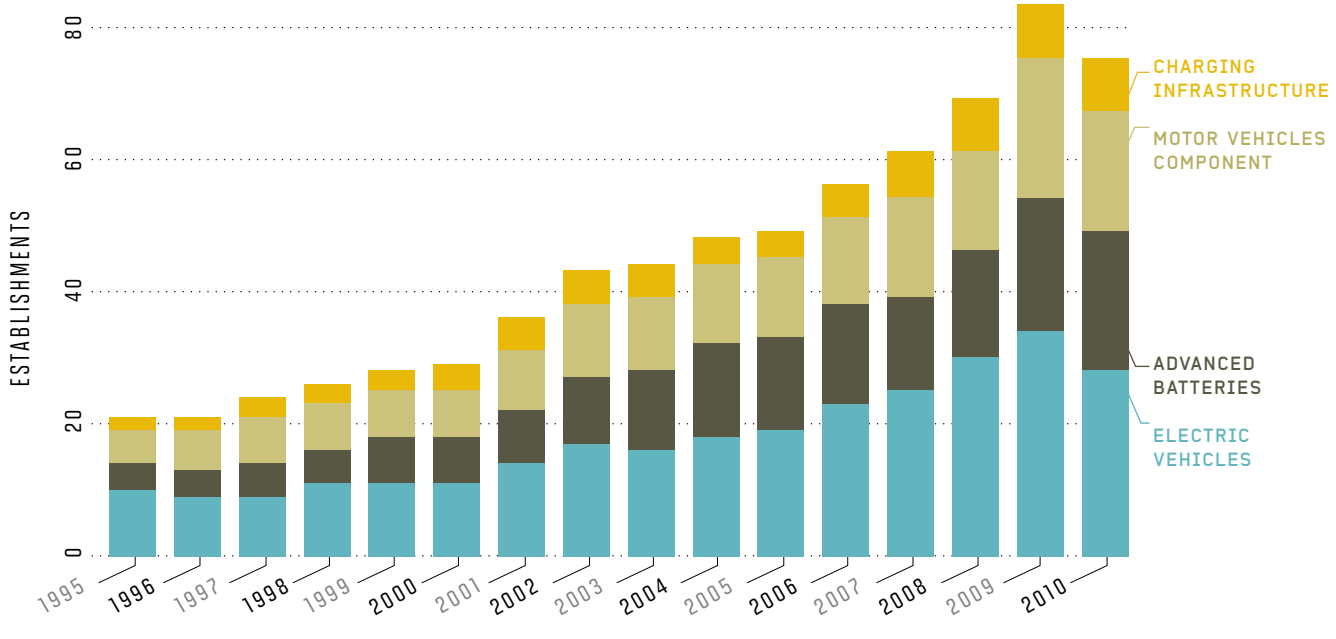
Silicon Valley's employment in EV sectors shot up most robustly from 25 to 375 from 2004 to 2010. The region accounted for 39 percent of statewide employment in Electric Vehicles and 29 percent of jobs in Charging Infrastructure in 2010.

The San Francisco Bay Area (without Silicon Valley) has hosted EV employment in all sectors since 1995. Total EV jobs in the region expanded by 18 percent since 2004 and maintained growth of one percent from 2009 to 2010. The largest segment in 2010 was Charging Infrastructure with 35 percent of regional EV employment, followed by Motor Vehicle Components with 29 percent.

The San Diego Region more than tripled its EV workforce between 2004 and 2010. The largest contributions to growth have been Motor Vehicle Components, composing 52 percent of the region's EV employment in 2010, and Advanced Batteries with 42 percent of regional EV employment.

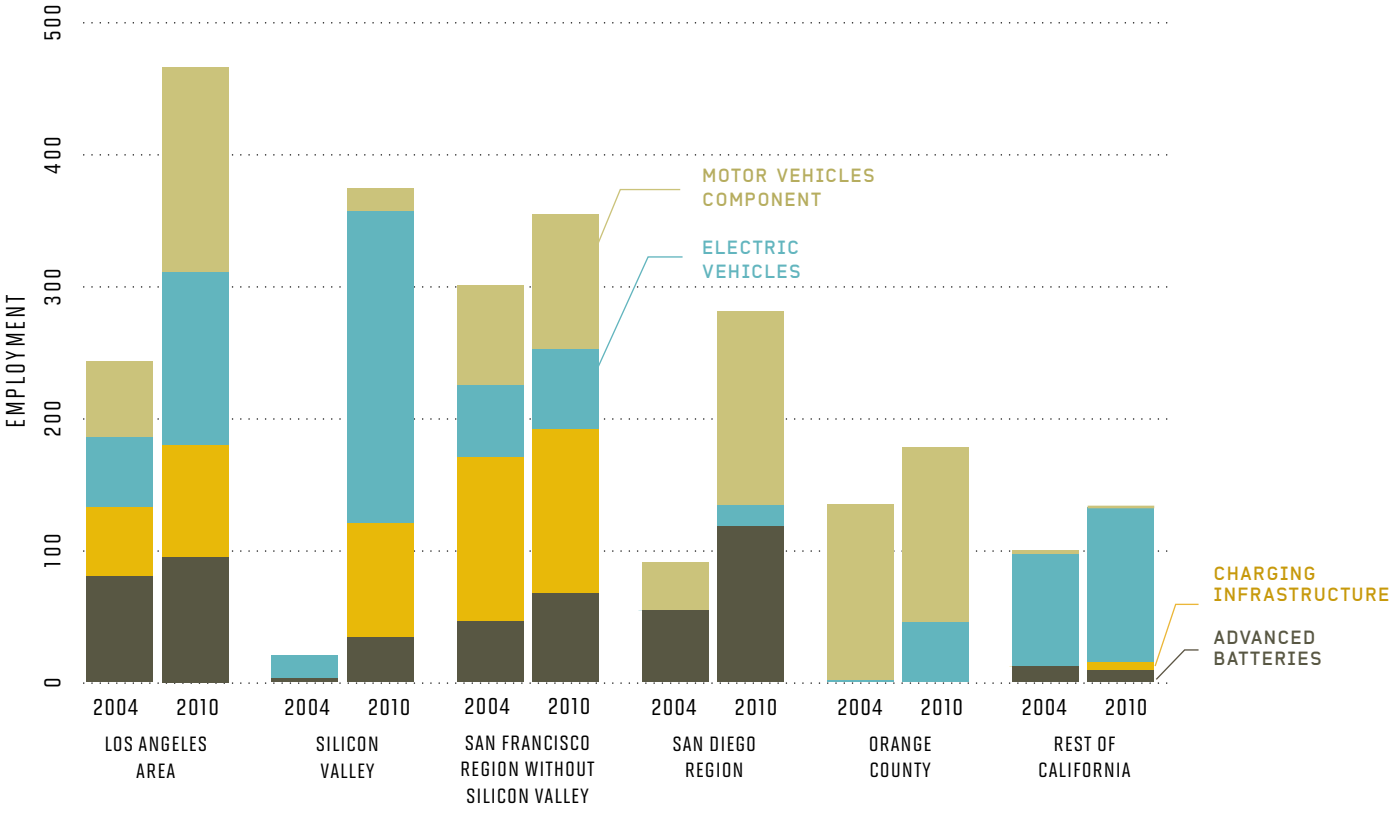
Employment growth accelerated in EV and related businesses in Orange County and grew 32 percent from 2004 to 2010. This region features jobs exclusively in Motor Vehicle Components (75%) and Electric Vehicles (25%).

FIG 16 ESTABLISHMENTS IN ELECTRIC VEHICLES AND RELATED INDUSTRIES / CALIFORNIA



NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics

FIG 17 EMPLOYMENT IN ELECTRIC VEHICLES AND RELATED INDUSTRIES / BY REGION / 2004 & 2010



NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics

Regional hubs specializing in one or more of the EV sectors are concentrated in the state's metropolitan areas. These hubs represent areas in which EV employment represents a large share of total regional employment relative to the statewide average. High employment concentrations suggest that highly specialized and high-value activities are taking place in these regions in particular sectors.

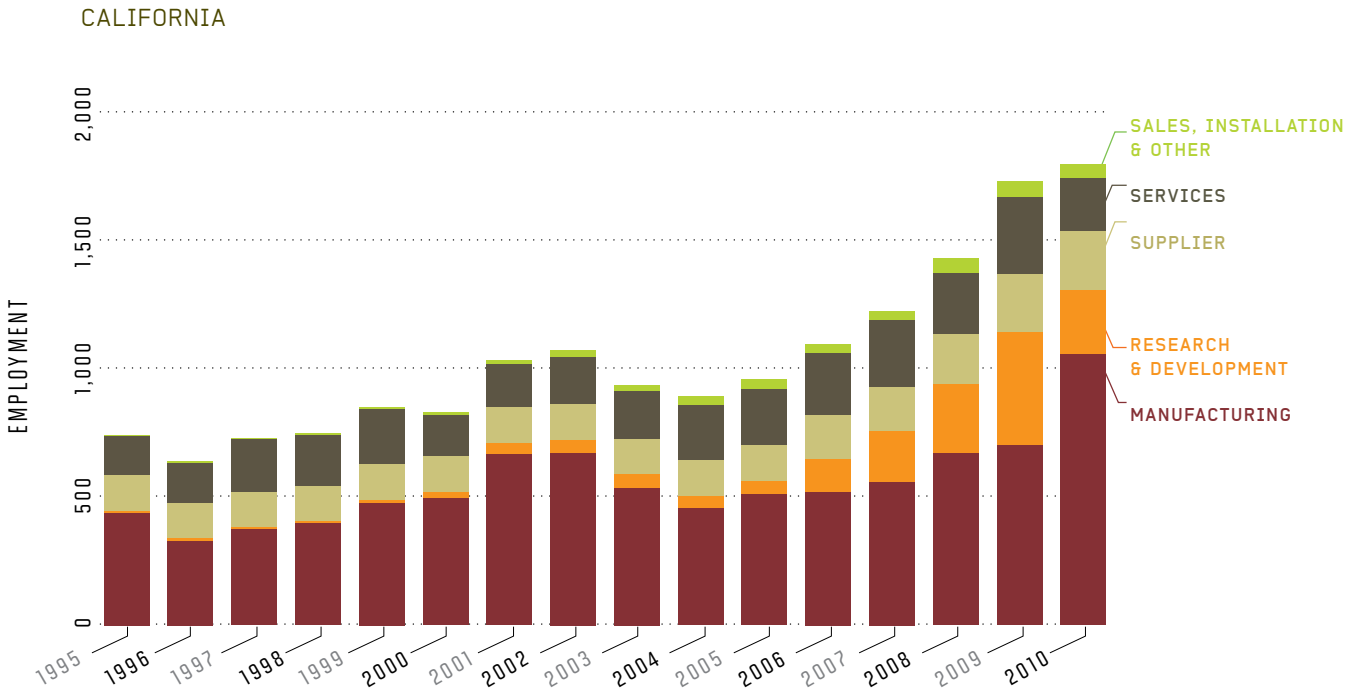
The Los Angeles Area reflects areas of specialization in Advanced Batteries, Charging Infrastructure and Motor Vehicle Components. The San Diego Region boasts the highest employment concentrations in both Advanced Battery and Motor Vehicle Components. Orange County reports a high concentration of employment in Motor Vehicle Components. Silicon Valley reflects strong employment shares in Electric Vehicles and also reports strengths in Advanced Batteries and Charging Infrastructure. High employment concentrations exist in Advanced Batteries and Charging Infrastructure in the Bay Area (without Silicon Valley).

FIG 18 / CALIFORNIA'S ELECTRIC VEHICLE INDUSTRY HUBS

	EV SECTOR			
REGION	ADVANCED BATTERIES	CHARGING INFRASTRUCTURE	ELECTRIC VEHICLES	MOTOR VEHICLES COMPONENTS
LOS ANGELES AREA	●	●		●
SILICON VALLEY	●	●	●	
SAN FRANCISCO REGION (WITHOUT SILICON VALLEY)	●	●		●
SAN DIEGO REGION	●			●
ORANGE COUNTY				●

NEXT 10, POWERING INNOVATION. Data Source: 1790 Analytics, Patents by Technology; USPTO Patent File. Analysis: Collaborative Economics

FIG 19 EMPLOYMENT IN ELECTRIC VEHICLES AND RELATED INDUSTRIES ALONG THE VALUE CHAIN



Note: The increase in Manufacturing employment and decrease in Research & Development employment from 2009 to 2010 is largely attributed to the change in industry classification of Tesla Motors from "Electronic Research" to "Assembly of Electric Cars". This resulted in a shift in employment from Research and Development in 2009 to Manufacturing in 2010.
NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics

DIVERSITY OF ACTIVITIES ACROSS THE VALUE CHAIN

Manufacturing establishments account for 59 percent of California's total EV employment. Research & Development accounted for 14 percent of employment in 2010, followed by employment in Supplier establishments (13%), and Services (12%). This distribution indicates that occupational opportunities in the state's EV-related sectors are broad in scope. The large share of employment in research and development illustrates that a significant level of high-value technological development is also taking place in the state.

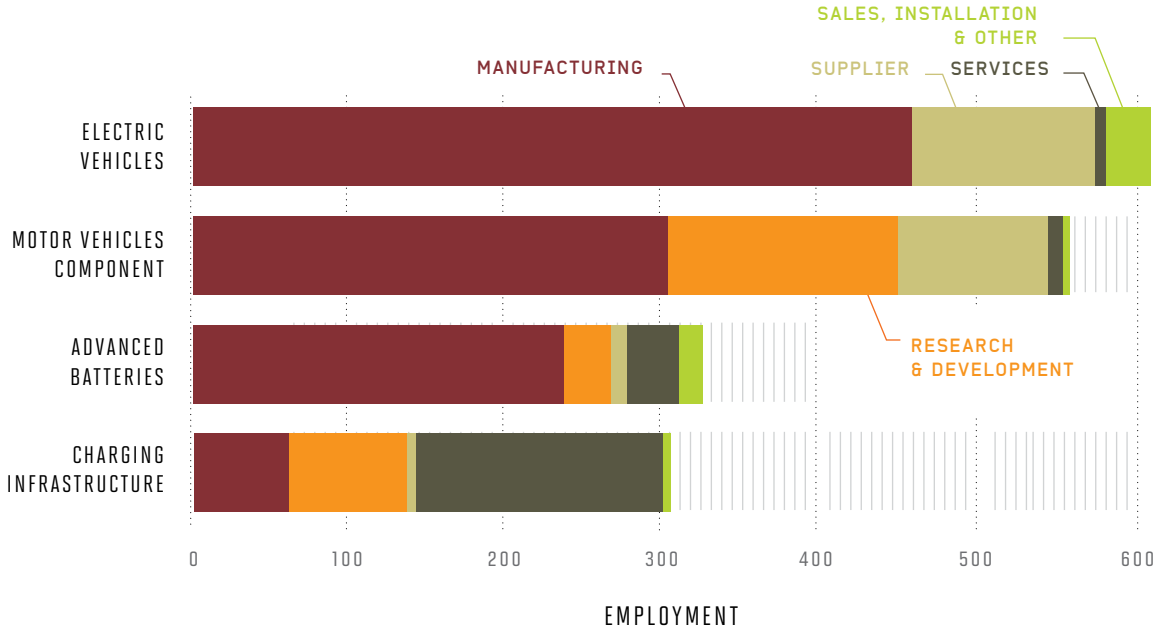
Manufacturing employment has increased 132 percent since 2004. Surging 51 percent over January 2009, manufacturing employment accounts for the total EV growth from January 2009 to 2010. This growth is largely explained by the change in industry classification of Tesla Motors from "Electronic Research" to "Assembly of Electric Cars". This demonstrates the shift from developmental stage to commercialization stage for the company but also for the technology more broadly.

Primary activities differ by EV segment. Seventy-five percent of jobs in Electric Vehicles and 73 percent of jobs in Advanced Batteries are in Manufacturing establishments. In Charging Infrastructure, 52 percent of employment is in Services and 25 percent in Research & Development establishments. Employment in Motor Vehicle Components and Electric Vehicles is predominantly in Manufacturing and Research & Development establishments.

The distribution of primary value chain activities of California's EV industry varies by region. The majority of manufacturing establishments related to the EV industry are located in Southern California, in the state's traditional manufacturing base. These establishments account for 65 percent the state's employment in manufacturing related to the EV industry. By region, the Los Angeles Area accounted for 37 percent of employment in manufacturing establishments, Orange County 17 percent, and the San Diego Region 11 percent. The Bay Area also has a strong manufacturing base. Silicon Valley hosts 26 percent of manufacturing employment in EV establishments across the state with the San Francisco Bay Area (without Silicon Valley) contributing six percent.

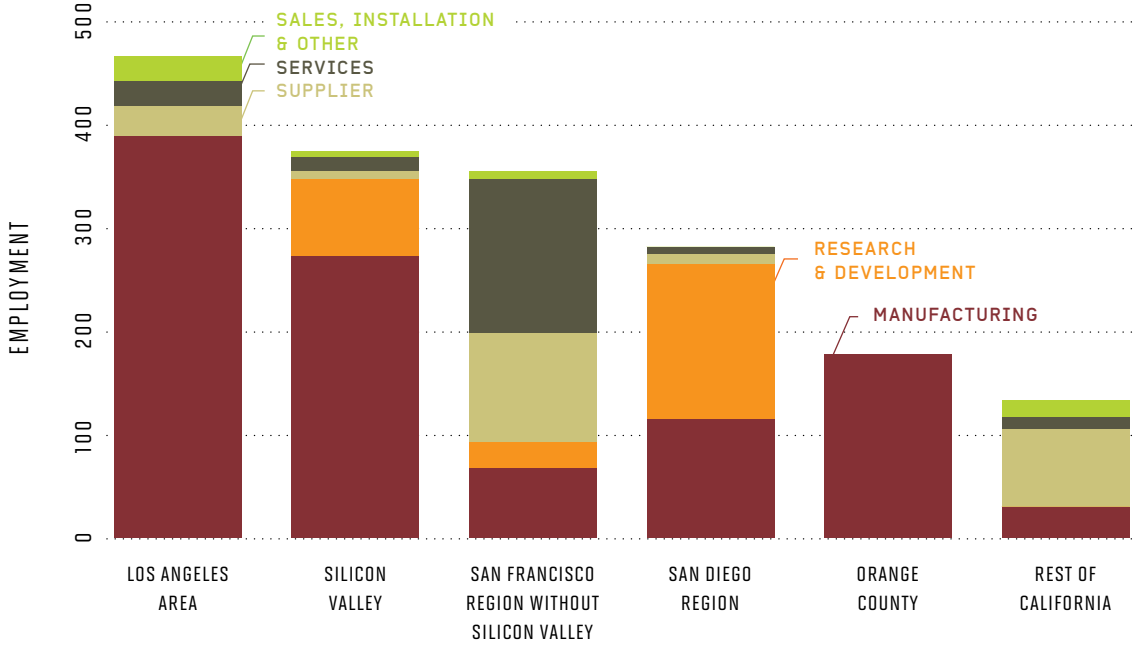
In Research and Development, San Diego represents 60 percent of EV related employment statewide, equal to roughly 150 jobs of the more than 280 EV jobs in the region. In the San Francisco Bay Area (without Silicon Valley), the EV industry is largely focused in Services and Supplier establishments. This region accounts for 72 percent of employment in Services across the state and 46 percent of employment in Suppliers.

FIG 20 EMPLOYMENT ALONG THE VALUE CHAIN BY SEGMENT / CALIFORNIA / 2010



NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics

FIG 21 EMPLOYMENT IN ELECTRIC VEHICLES & RELATED INDUSTRIES / VALUE CHAIN & REGION / 2010



NEXT 10, POWERING INNOVATION. Data Source: Green Establishment Database. Analysis: Collaborative Economics

WHY ELECTRIC VEHICLES? BENEFITS AND CHALLENGES TO POWERING INNOVATION

ELECTRIC VEHICLES DATE BACK TO THE EARLY DAYS OF THE AUTOMOBILE, BUT GASOLINE-POWERED VEHICLES SOON CAME TO DOMINATE THE MARKETS. Technological advances in batteries, updates to the electrical grid system, and the imperative goal of reducing greenhouse gas (GHG) emissions and criteria air pollutants have raised new attention toward the commercialization of EVs. Today, advancements in battery technology and manufacturing are increasing the durability and range while decreasing the risk of toxic material release and also decreasing the cost of production. Across the country, the electrical infrastructure is evolving into an intelligent grid equipped with sophisticated power management applications and greater ability to incorporate distributed renewable energy and energy storage. There is great potential for driving this transition away from dependence on petroleum-consuming vehicles to cleaner vehicles. Electric models are being developed and deployed by automakers including BMW, Chevrolet, Coda, Ford, Honda, Mitsubishi, Tesla and Toyota. By aligning public and private efforts to stimulate the market demand for EVs and related technologies, California can expand fleets of cleaner vehicles and even zero emission vehicles. With its population of early adopters, advanced technological clusters, research and advocacy groups and institutions, California is well positioned to lead the way for the U.S. to achieve cleaner transportation and to reap the economic rewards as market leaders in this growing arena.

The widespread use of EVs has the potential to confer multiple benefits to consumers and the environment, as well as entrepreneurs and innovators of EV technologies. HEVs (as well as plug-in hybrid electric vehicles) represent a bridging technology today between internal combustion engines and the development of all-electric vehicles. EVs present ground transportation options without the air pollution and volatile fuel costs associated with the combustion engine. Additionally, EV drivers will benefit from reduced exposure to volatile fuel prices and increased convenience from being able to refuel at home. However, enjoying these benefits will require the resolution of challenges impeding the successful commercial development of EVs.

EVs are more energy efficient. Traditional internal combustion engine (ICE) powered vehicles reach 35 percent efficiency at best in converting gasoline into thermal energy that powers the vehicle, losing the majority as heat. Electric vehicles like the Tesla Roadster have 88 percent drive efficiency, which is almost three times more efficient than an ICE powered vehicle.[24] However, it is important to note that some energy is lost in the transmission and distribution of electricity used to charge EVs. This efficiency affords the benefits described below.

The fuel economy of plug-in hybrid electric vehicles (PHEVs) and HEVs is superior to that of traditional gasoline-powered vehicles. The Honda Civic attains 25 miles per gallon (MPG) for city driving and 36 MPG for highway travel. The hybrid equivalent of the Civic gets 40 MPG in the city and 45 on the highway - 20 percent greater fuel economy for highway and 38 percent greater for city travel.[25] Topping that, plug-in hybrids use roughly 40 to 60 percent less fuel than conventional fuel vehicles.[26] Reducing the amount of fuel required to power vehicles and displacing gasoline as the primary transportation fuel source can save the consumer money, cut pollution, and help ease dependence on foreign oil.

EVs produce less pollution. Reductions in GHG and criteria pollutant emissions are clear benefits of using cleaner fuels and bolstering fuel economy. Controlling emissions and other pollutants from a power plant is vastly more efficient than from individual tailpipes. When running off electricity generated by renewable sources, like solar and wind, EVs produce near zero emissions. Research conducted by the Argonne National Lab shows that electric vehicles emit approximately three milligrams of air toxics per mile driven compared with more than 30 milligrams per mile from conventional gasoline vehicles.[27] In terms of GHG emissions, an EV model like the Nissan Leaf produces less than half the GHG emissions of the average gasoline powered vehicle.[28] Additionally, California has a high portion of energy generated from renewable sources, which increases the positive impact of driving EVs.[29]

EVs offer real operational cost savings to consumers. Improvements in fuel economy also translate into fuel cost savings. HEVs cost roughly half as much to operate ($0.05 to $0.07 per mile) when compared with conventional vehicles which cost $0.10 to $0.15 per mile for fuel[30]. Using the average price for electricity in the United States, EVs cost only $0.02 to $0.04 per mile to operate. Since PHEVs use a combination of electricity and gasoline to power their engines, the fuel cost per mile ranges from $0.02 to $0.04 when running on electricity and $0.05 to $0.07 when running on gasoline.[31] EVs do not require oil changes, tune-ups, spark plugs, timing belts and other costly maintenance required for gasoline-powered cars, resulting in additional savings. However, EVs, HEVs and PHEVs may require a battery replacement during the lifespan of the vehicle. A multiplier effect results from savings in fuel costs from driving more efficient vehicles. Savings can be reinvested into local economies, through the purchase of goods and services and will help to stimulate the economy.[32]

The barriers to wide-spread adoption of EVs must be addressed so that the economic and environmental benefits can be enjoyed. In order for EVs to become easily adopted and bring to fruition benefits in fuel economy, fuel cost savings, reduced emissions and eased dependence on petroleum, a few challenges must be addressed. Tackling these challenges and others will spur innovation related to multiple aspects of EV development and use and grow business opportunities and employment. In addition, reducing the barriers to EV adoption will help drive economic growth in electric vehicle and related industries in California where a strong concentration of activity already exists and can be built upon. Replicating California's success in deploying EVs presents some challenges. In colder regions, drivers need to expend more of the vehicle's energy on heating, creating additional drain on the battery in the process. In addition, California's relatively high percentage of power generated by renewable energy sources makes for "cleaner" operation of EVs. Nonetheless, regardless of the source of electricity, emissions from power plants are more efficiently managed than from individual vehicles.

Batteries represent the most expensive component of an EV and account for the higher price when compared with combustion engine vehicles. Finding more efficient production methods and achieving economies of scale will reduce the cost of EV batteries. Manufacturing batteries with a higher energy density, so the battery stores more energy in a smaller volume, will also help reduce battery costs. Reducing battery costs will lower the price of EVs and make them more competitive with traditional gasoline powered vehicles, especially in areas where lower incomes constrain vehicle purchasing decisions.

There are additional opportunities for innovation around Li-Ion battery technology, reducing systems costs, battery recycling and creating post-vehicle secondary uses for vehicle batteries. The IBM Research Center in Almaden, California is investing in the future of EVs with their Battery 500 project.[33] This high risk, high payoff project began in 2009 and has a long project timeline. Lab researchers have demonstrated the basic chemistry involved in the charge-and-recharge process for lithium/air batteries that have the potential for a 500 mile range per charge. The limit of drivable range per battery charge is a barrier to wider commercialization of EVs that can be alleviated with the success of this project.

Another challenge for battery performance is the impact of inclement weather. This factor is being mitigated by vehicle producers with the addition of cold weather features that increase the battery efficiency in harsh weather conditions.[34] [35]

There are also concerns about the future of vehicle battery production due to constraints associated with the availability of lithium. A recent study conducted at the Argonne National Lab investigated this concern by estimating the volume of lithium reserves in comparison to the total amount required for vehicle battery production based on estimated EV demand.[36] Adjustments for lithium recycling were also considered. The study concluded that aggressive adoption of EVs can be supported for decades with the known supply of lithium.[37]

An extensive charging infrastructure system is necessary to enable the widespread use of electric vehicles. The upgrade of the nation's electrical grid and the rollout of the smart grid will improve the feasibility and convenience of EVs. The smart grid will improve grid efficiency by connecting advanced battery storage systems to the grid and smoothing the variable production from renewable sources. The smart grid will also enable smart charging and vehicle-to-grid where EVs not only take energy from the grid but can feed electricity back into the grid in times of need thereby expanding the total load capacity of the grid. Several companies are working to increase the efficiency of vehicle-to-grid and EV economics with battery swapping stations that will help remove the burden on consumers to strategically time charging to minimize stress on the grid and avoid charging during peak hours.[38]

Another component to the charging infrastructure is the actual charging stations. The National Renewable Energy Laboratory (NREL) is seeking jurisdictions that are interested in receiving assistance in streamlining the permitting process for EV charging stations. Similar efforts are a part of Project Get Ready, in Los Angeles and the Bay Area. By speeding up the installation process, this will also speed up the development of public charging infrastructure that will offer consumers confidence and options in the use of EVs. Efforts to expedite the permitting process for charging stations have already been especially successful in Sonoma County.[39]

California has demonstrated that aligning public policy and community efforts can spur market growth in clean energy technology, such as electric vehicles, allowing the roots to take hold for emerging industries and employment growth. A study by the Center for Automotive Research (CAR) justifies this dominance by showing a correlation between HEV adoption and current incentives. CAR ranks California third in terms of HEV current and past incentives, which include rebates, grants, HOV lane access, discounted parking, insurance discounts, and even hotel discounts.[40] The same CAR report projects California will rank first in the country for EV sales in 2015 with over 33,000 EV sales.[41] Texas is projected to have the second largest volume of EV sales in 2015 with over 7,600 EV sales – less than a quarter of California's projected volume.

CONCLUSION

California is a global leader in technology innovation in the electric vehicle industry. The state is home to a diverse and growing business base that has continued to grow its workforce over the recession. With its population of early adopters, advanced technology industries, public policy leadership and research institutions, California is well positioned to lead the way for the U.S. to achieve cleaner transportation and to reap the economic rewards as a market leader in this growing arena. Further, the state's mild climate make it the perfect test bed for the continued development of technology related to EVs so that with time, they will become more viable in other places with colder temperatures (and therefore greater energy requirements).

California's assets are self reinforcing as reflected in flows of venture capital investment, significant patent activity, and the creation of effective political action plans and community engagement. These forces of innovation drive the growth of emerging markets and expanding job opportunities by supporting the early adoption of important new technology.

California is a global leader in technology innovation related to electric vehicles. In 2010, California accounted for 80 percent of total U.S. and 60 percent of total global VC investment in EV-related sectors. Further, the state leads the nation and world in growth in venture capital investment in EV-related industries since 2006. In the patenting of EV-related technology, California ranks among the top global players, trailing only Japan and South Korea and exceeding others including Germany, Taiwan and France. In addition, the state's world-class research institutions are driving breakthroughs in technology and public policy.

And as the story of Electric Vehicles International (EVI) shows, these forces of innovation establish the state as a magnet for businesses eager to serve the state's population of early adopters. In this example, California's policy leadership attracted new jobs to the City of Stockton. These jobs will create networks of supplier jobs as well as jobs in the immediate community providing products and services to the families of these employees.

Employment and businesses in California's EV industry are growing and demonstrate the potential for continued growth. Between 1995 and 2010, employment in the EV industry expanded by 142 percent. Even through the recession, EV jobs rose by four percent from January 2009 to 2010. Manufacturing makes up 59 percent of EV industry jobs, and these jobs grew 132 percent between 2004 and 2010. Research & Development accounted for 14 percent of employment in 2010 and surged by 434 percent between 2004 and 2010. Hubs of specialization are developing across the state's metropolitan areas.

Further, as a result of the state's forces of innovation, California is the only state where all three of the major EV models (Chevrolet Volt, Nissan LEAF, and Ford Focus Electric) have been deployed,[42] and the state is projected to rank first in the country for EV sales in 2015.[43] This activity has the potential to feed the dynamics of innovation in the state and grow the industry and employment opportunities.

What it takes now is acceleration of innovative efforts in public policy, community action, and research and development to help drive the growth in viable businesses and new jobs in the EV arena. Will our current public policymakers continue to drive California's legacy for breakthrough policy action? Will our population of early adopters of technology help drive demand and grow the electric vehicle markets? Will the state's creative entrepreneurs find the conditions and financing they need to build new viable businesses related to the diverse field of electric vehicles?

The combination of these efforts will build upon California's success to date and demonstrate the economic and environmental benefits associated with widespread adoption of EVs. The California experience demonstrates that aligning public policy and community efforts can drive market growth of electric vehicles, allowing the roots to take hold for emerging industries and employment growth.

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APPENDIX

GREENHOUSE GAS EMISSIONS BY SOURCE

Greenhouse gas emissions data are from the *California Air Resources Board's California Greenhouse Gas Inventory—by Sector and Activity.* The Greenhouse Gas (GHG) Inventory provides estimates of the amount of GHGs emitted to the atmosphere by human activities within California. The inventory includes estimates for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), which are often referred to as the "six Kyoto gases", and nitrogen trifluoride (NF_3).

The current (May 2010) GHG inventory covers years 2000 to 2008. The emissions estimates are statewide estimates that rely primarily on state, regional or national data sources, rather than individual facility-specific emissions. As estimates are refined to include additional years and improved estimation methods, new editions of the inventory are released. GHG emissions for the years 1990 through 1999 are from the archived 1990-2004 GHG inventory published in November 2007, which provided the basis for developing the 1990 statewide emissions level and 2020 emissions limit required by AB 32.

CHARGING STATION INFRASTRUCTURE

Data on charging stations are downloaded in July 2011 from the Energy Efficiency & Renewable Energy Alternative Fuels & Advanced Vehicles Data Center at US Department of Energy. The data in the Alternative Fueling Station Locator and Route Mapper 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 submittal form on the Alternative Fuels and Advanced Vehicles Data Center website, and through collaborating with infrastructure equipment and fuel providers. For electric charging locations, Level 1 and Level 2 electric vehicle supply equipment (EVSE) refers to 120V and 240V EVSE (respectively) with one of the following connector standards: NEMA 5-15, NEMA 5-20, or J1772. Residential refueling or recharging facilities are not included. The information for each new station is verified by contacting the station before adding it to the database. Existing stations in the database are contacted once a year on an established schedule to verify they are still operational and selling the fuel specified. Stations that are no longer operational or no longer sell alternative fuel are removed from the database on a monthly basis or as they are identified.

Population data used to calculate charging stations per million in the population is from the US Census Bureau. Data for preliminary estimates of total population by state is from the population division of the US Census Bureau. For Vintage 2010, the US Census updated their current state and county methodology to produce population estimates as of April 1, 2010, in order to allow for direct evaluation with Census 2010 population counts. They utilized our standard methodology to produce annual July 1, 2000 to July 1, 2010 population estimates based on the updated Census 2000 data and the components of change (births, deaths, international migration, and domestic migration) occurring each year. To estimate the April 1, 2010 population, they began with the July 1, 2009 population and estimated the components of change that occurred in the intervening nine months.

ELECTRIC AND HYBRID VEHICLES BY STATE

Data for total electric and hybrid vehicles by state are from Polk. Data is collected directly from each state as well as from each state's Department of Motor Vehicles (DMV).

VC INVESTMENT IN ELECTRIC AND HYBRID ELECTRIC VEHICLES

Venture capital investment data for smart grid is based on Cleantech™ Group LLC Venture Investment data. The definition for the four sectors composing electric vehicles and related industries is based on the Primary, Secondary and Tertiary Industries created by Cleantech™ Group LLC. The three levels of Industries included in the electric vehicles and related industry VC investment definition is as follows: Transportation with the secondary industries Vehicles and Fuels and tertiary industries Bicycles & Scooters, Electric & Hybrids, Vehicle Components/ Engines, and Fueling Infrastructure; Energy Storage with secondary industries Advanced Batteries with tertiary industries Lithium-Ion, Nickle Zinc, Zinc Air, and Other Technologies.

VC INVESTMENT IN ELECTRIC AND HYBRID ELECTRIC VEHICLES, BY REGION

See the appendix entry for VC Investment in Electric and Hybrid Vehicles. Regional Definitions are those used in the Next 10 Many Shades of Green report, except for

the Silicon Valley region which is composed of Santa Clara and San Mateo Counties, San Benito County, Fremont, Newark, Union City, and Scotts Valley and the San Francisco without Silicon Valley region which is composed of Contra Costa County, Marin County, Napa County, San Francisco County, Solano County, Sonoma County, Santa Cruz County (except Scotts Valley) and Alameda County (except Fremont, Newark and Union City).

PATENT ACTIVITY IN ELECTRIC AND HYBRID ELECTRIC VEHICLES

1790 Analytics developed and performed the search of detailed US Patent data from the US Patent & Trade Office based on search criteria defined by Collaborative Economics for the technology areas: batteries and hybrid systems.

BUSINESS AND EMPLOYMENT TRENDS RELATED TO ELECTRIC AND HYBRID ELECTRIC VEHICLES

Electric Vehicle and Related Industry Sectors

The electric vehicle and related industry sectors were created using establishment information from the Green Establishment Database and the 15 Green Segments as defined in Next 10's *Many Shades of Green* Report. A large portion of electric vehicle and related industry sector data originates from two of the 15 Green Segments: Clean Transportation and Energy Storage. All establishments from the Green Establishment Database with products or services applicable to a sector of electric vehicles and related industries are included. Additional outside research identified electric vehicle related companies that were not previously identified with one of the 15 Green Segments. These companies where analyzed for relevance and included in the appropriate electric vehicle sector.

California's Core Green Economy: Green Business Establishments Database

Collaborative Economics (CEI) has developed an approach for identifying and tracking the growth of businesses with primary activities in the Core Green Economy. This methodology was originally developed for work carried out on behalf of Next 10 and published in the *California Green Innovation Index* (2008, 2009, and 2010). Building on this work, CEI designed and conducted the nationwide analysis of green business activity on behalf of the Pew Charitable Trusts. The Pew Center on the States reformatted the results of the analysis and developed the report, *The Clean Energy Economy* (June 2009).

The accounting of green business establishments and jobs is based on multiple data sources (including New Energy Finance and the Cleantech GroupTM, LLC) for the identification and classification of green businesses and also leveraged a sophisticated internet search process. Collaborative Economics designed the parameters of the internet search platform which was engineered by PlanetMagpie, a Bay Area-based IT service company. The National Establishments Time- Series (NETS) database based on Dun & Bradstreet business-unit data was sourced to extract business information such as jobs. The operational definition of green is based primarily on the definition of cleantech defined by the Cleantech Network.

The jobs numbers reported in the database reflect all jobs at each business location. In the case of multi-establishment companies, only the green establishments are included. While this approach does not examine specifically green occupations that are appearing across the entire economy (such as Chief Sustainability Officer), it does account for the businesses behind the products and services that these new professionals need to use in their jobs (such as advanced metering devices, co-generation equipment, and various high-efficiency materials).

The multilayered process involves both automated and manual verification steps of business establishments and their activities. In cases where the results were uncertain and the activities of a business establishment could not be verified (e.g. on a company's website), the establishment was dropped from the database. Therefore, the database offers a conservative estimate for the numbers of establishments and jobs in the Core Green Economy.

National Establishment Time-Series (NETS) Database

The NETS database is constructed from 20 "snapshots" taken every January since 1990 of all active Dun and Bradstreet establishments (currently 41.7 million unique establishments with over 24 million still active). That data is then put through rigorous quality control, statistical analysis, and additional estimation procedures to create the resulting time-series in the NETS Database. These snapshots use the Duns Marketing Information (DMI) file to determine which establishments were active. Other archival files (e.g., the Credit Rating file) were utilized to provide annual raw establishment data that allowed us to create time-series information. Each summer the NETS Database is updated with another year of establishment information. No establishments are ever deleted from the Database; but their "LastYear" is indicated, so one can explore the dynamics of "births" and "deaths" of establishments. Walls & Associates maintains the NETS Database and continues to update and improve estimates before the next annual update.

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