NEXT 10

BAY TO MARKET

NOVEMBER 2014

Bay Area Innovations Leading Clean Technology Development

ACKNOWLEDGEMENTS

We would like to thank the following people for taking the time to discuss clean economy activities in their region and/or organizations:

- Jeff Anderson – CalCharge
- Doug Davenport – Prospect Silicon Valley
- Mike Mielke – Silicon Valley Leadership Group
- Rafael Reyes – Bay Area Climate Collaborative
- Kim Walesh and Reena Brilliot – City of San Jose

Special thanks to Roxanna Smith at Cater Communications for providing comments on report drafts.

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

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. Next 10 was founded in 2003 by businessman and philanthropist F. Noel Perry.

PRODUCED BY:
Next 10
F. Noel Perry
Marcia E. Perry
Sarah Henry
Laura MacArthur

PREPARED BY:
Collaborative Economics
Doug Henton
Kim Held
John Melville
Radhika Mehlotra
Renae Steichen
Janine Kaiser
Francie Genz

DESIGN BY:
José Fernandez

BAY AREA COMPANIES NOTED IN THIS REPORT

Tesla Motors
Honda
BMW
Nissan
Volkswagen
GM
Ford
Mercedes-Benz
chargepoint
ABM Building Value
Prospect Silicon Valley
Berkeley Lab
CalCharge
Webcor Builders
Primus Power
nest
stem
enovix
Lawrence Livermore National Library
extended stay America
Philips Lumileds
BuildingIQ
Xicato Making sense with LEDs

ABOUT THIS REGIONAL CLEAN ECONOMY SERIES

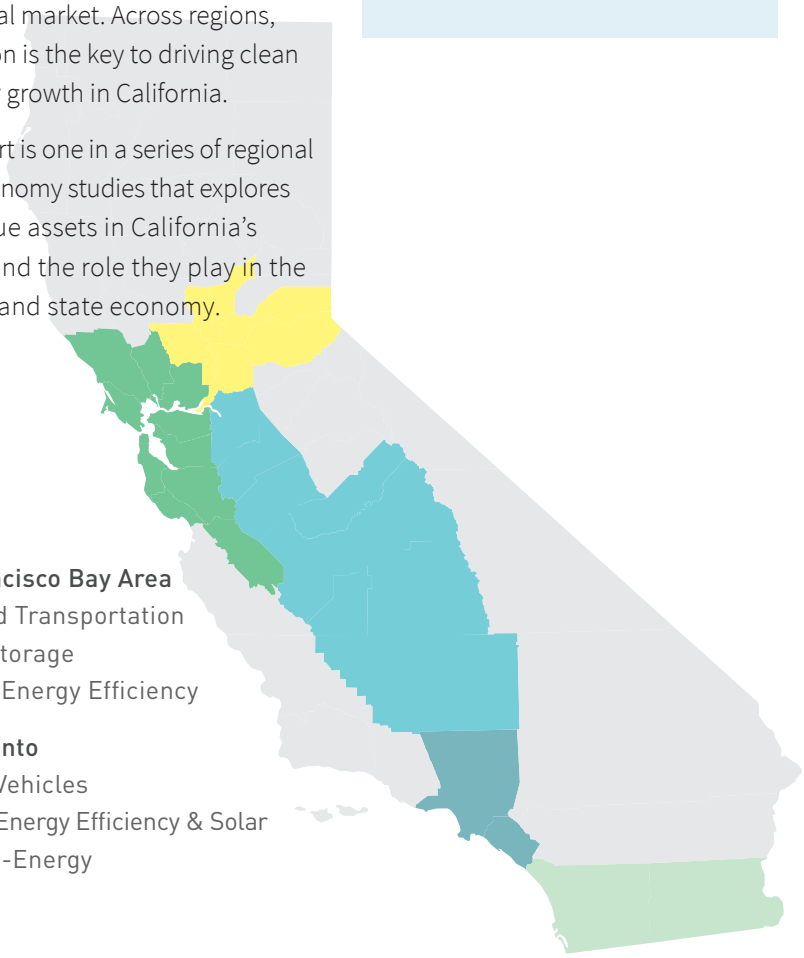
California is a national leader in the clean economy, with companies pushing the envelope developing and deploying clean technologies, spurred by progressive state policies stimulating company growth. As a result, the core clean economy has become an important driver of California's overall economic vitality, employing over 185,000 workers as of January 2014 while protecting the state's natural resources.

California's statewide economy is comprised of regional economies, each with distinct assets and strengths. Regional stakeholders are leveraging their unique assets in innovative ways to develop and expand clean technologies within their region, with potential applications in the broader state and global market. Across regions, innovation is the key to driving clean economy growth in California.

This report is one in a series of regional clean economy studies that explores the unique assets in California's regions and the role they play in the regional and state economy.

What is the core clean economy?

The "core clean economy" includes businesses that provide the cutting-edge products and services that allow the entire economy to transition away from fossil fuels and use natural resources more efficiently.



San Joaquin Valley
Water-Agriculture
Renewable Energy

San Diego - Imperial
Smart Grid
Biorenewables

Los Angeles & Orange
Advanced Transportation

San Francisco Bay Area
Advanced Transportation
Energy Storage
Building Energy Efficiency

Sacramento
Electric Vehicles
Building Energy Efficiency & Solar
Waste-to-Energy

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report explores how the Bay Area has leveraged its assets to accelerate clean technology innovation and drive growth in the region's clean economy. The report is based on new data analysis and interviews with regional stakeholders who identified advanced transportation, energy storage, and building energy efficiency (i.e. technologies and building improvements that minimize energy output while maximizing comfort), as major areas of clean economy innovation in the region. Innovation in the Bay Area's clean economy includes both the development of new technologies and companies, as well as the application and deployment of clean technologies in new ways.

Highlights of clean economy innovation in the Bay Area include:

- **The Bay Area is leveraging its information technology assets and entrepreneurial culture, as well as its strong early-stage financing and research institutions,** to develop cutting-edge, clean technologies in advanced transportation, energy storage and building energy efficiency.
- **The region is a global leader in developing and implementing advanced transportation technologies,** which include electric vehicles (EVs) as well as technology that increases transportation infrastructure efficiency and car connectivity.
- **The Bay Area is leading the nation in EV adoption,** with the highest per capita adoption rate of EVs nationally. In addition to a high concentration of EVs, the region is home to a number of EV-related companies, including Tesla Motors as well as a range of EV charging infrastructure companies.
- **The region is a global center of innovation in energy storage,** with one of the largest concentrations of energy storage companies in the world. Recently, San Jose State University developed the first master's degree program in the country focused exclusively on battery science to prepare Bay Area students for careers in the industry.
- **The Bay Area is home to a growing number of companies that develop, test, and manufacture building energy efficiency technologies.** Regional stakeholders have also taken strides to support and incentivize the installation of advanced energy efficiency technology in Bay Area buildings.
- **Growth in the Bay Area's clean economy has been spurred by innovative public-private partnerships that support the commercialization of clean technologies developed in the region.** Multiple municipalities, including the cities of San Jose, San Francisco and Berkeley have led strategic initiatives that increased clean technology deployment.

INTRODUCTION TO THE BAY AREA'S CLEAN ECONOMY

The Bay Area is world-renowned as a center of innovation, with cutting edge technologies, forward-thinking policies and an entrepreneurial culture. The region has leveraged these assets to develop and strengthen its clean economy. The Bay Area's clean economy spans a wide range of sectors including advanced transportation, energy efficiency, and energy storage. By leveraging its information technology base and building strategic partnerships, the Bay Area has become a global leader in developing and deploying clean technologies.

The core clean economy in the Bay Area has generated significant economic growth by creating new jobs and providing businesses with new opportunities to meet growing regional and global demand. Regional employment in the Bay Area is spread across many clean economy segments, but recent growth and innovation has been centered on advanced transportation in particular, as well as energy storage and energy efficiency.

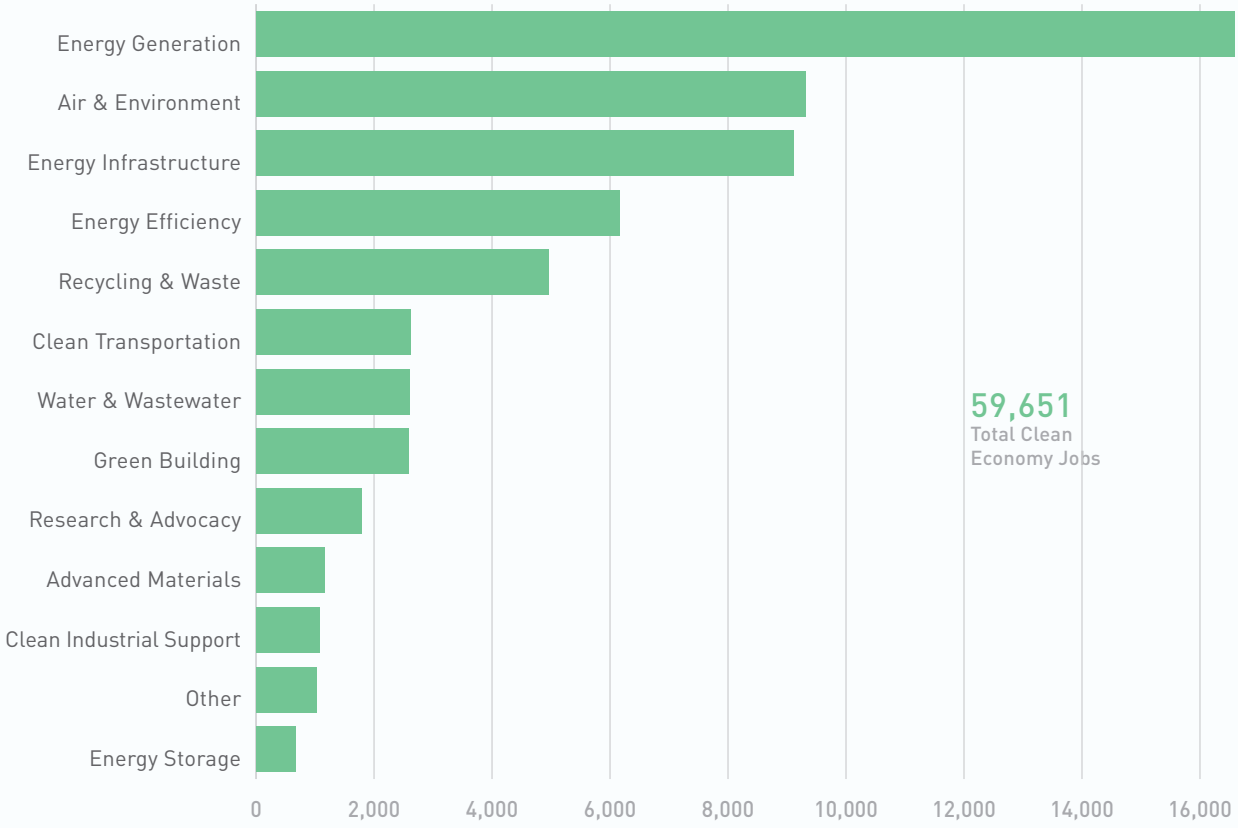
As a global center for information technology, the Bay Area attracts highly skilled and entrepreneurial talent from around the world. In addition, the region is a hub for venture capital, attracting billions of dollars of investment each year and supporting the development and growth of new startups in a range of industries. These core strengths have contributed to the growth of the clean economy in the region, which has been fueled by the region's entrepreneurial culture and concentration of highly skilled workers. The Bay Area's clean technology companies have attracted well over half of the state's clean technology venture capital over the past few years.[1] In addition, the region is home to leading universities and national labs, which have helped clean technology companies access the research and development (R&D) infrastructure they need to commercialize their technologies.

Public-private partnerships have helped accelerate commercialization and deployment of clean technologies in the region. These partnerships among businesses, local government, and community organizations have helped to assess and leverage clean technology assets in the region to stimulate the growth of the sector as a whole. Public sector leadership, particularly from the City of San Jose, has also played

What unique assets drive the Bay Area's clean economy?

The Bay Area has leveraged its strengths as a global center of information technology, as well as its strong venture capital base and world-class research institutions, to push the envelope across a range of clean technologies. In addition, the Bay Area's entrepreneurial culture has helped foster a mindset of early adoption among individuals, businesses, and municipalities, who are eager to test out new, clean technologies.

Figure 1: Core Clean Economy Jobs, Bay Area, 2014



In January 2014, there were nearly 60,000 jobs in Bay Area's "core" clean economy. These core jobs were in a range of businesses that provide the products and services that allow the entire economy to transition away from fossil fuels and improve efficiencies in the use of natural resources.

Employment in the Bay Area's clean economy is primarily in the Energy Generation, Air & Environment and Energy Infrastructure segments, though the region's clean economy includes a wide range of sectors and activities. This report, however, focuses on the segments of the clean economy that are driving innovation in the region, both in terms of new technologies and deployment strategies. For a more in-depth analysis of employment data in the clean economy, see Next 10's *California Green Innovation Index*, which tracks the clean economy statewide and includes an analysis of the fifteen segments of the clean economy.

NOTE: "Other" includes Agricultural Support, Business Services, and Finance & Investment segments.
SOURCE: National Establishment Time Series, Green Establisments Database.
ANALYSIS: Collaborative Economics

an important role in accelerating commercialization of clean technologies developed in the region.

While the Bay Area is home to a wide range of clean economy activities, the region has been particularly innovative in developing and implementing advanced transportation, energy storage and building energy efficiency technologies. This report focuses on innovations in these areas of the Bay Area's clean economy.

LEADING THE MARKET IN ADVANCED TRANSPORTATION INNOVATION

With transportation accounting for the largest share of greenhouse gas emissions in California, creating more efficient transportation systems is a priority across the state. Technologies developed in the Bay Area are helping to enable a broad transition to a cleaner transportation system, decreasing emissions and promoting the use of alternative vehicles. In addition to being a center of research and development for advanced transportation technology, the Bay Area is also a leader in deploying alternative vehicles, with the highest per capita adoption rate of electric vehicles (EVs) nationwide.[2]

The advanced transportation segment (i.e. clean transportation segment in the clean economy jobs analysis), is a major driver of the clean economy in the Bay Area. Advanced transportation includes electric vehicles as well as technology that increases infrastructure efficiency and car connectivity. The Bay Area has the largest total number of employees in advanced transportation in California, with over 2,600 jobs in January 2014.[3] Growth in the advanced transportation segment is driven by the region's unique assets, as well as regional collaborations that have cultivated a supportive climate for the development and deployment of advanced transportation technology.

Electric Vehicles

The Bay Area is committed to establishing itself as the "EV capital of the U.S.,"[4] and is on its way to gaining that title with the highest per capita adoption rate of EVs in the country, as well as a strong base of EV design, manufacturing, and infrastructure companies. The region is home to Tesla Motors, a global leader in the design, development, and manufacturing of electric vehicles. In addition, the high concentration of EVs in the region supports a number of companies that specialize in development and deployment of EV infrastructure, creating jobs and spurring innovation in the region.

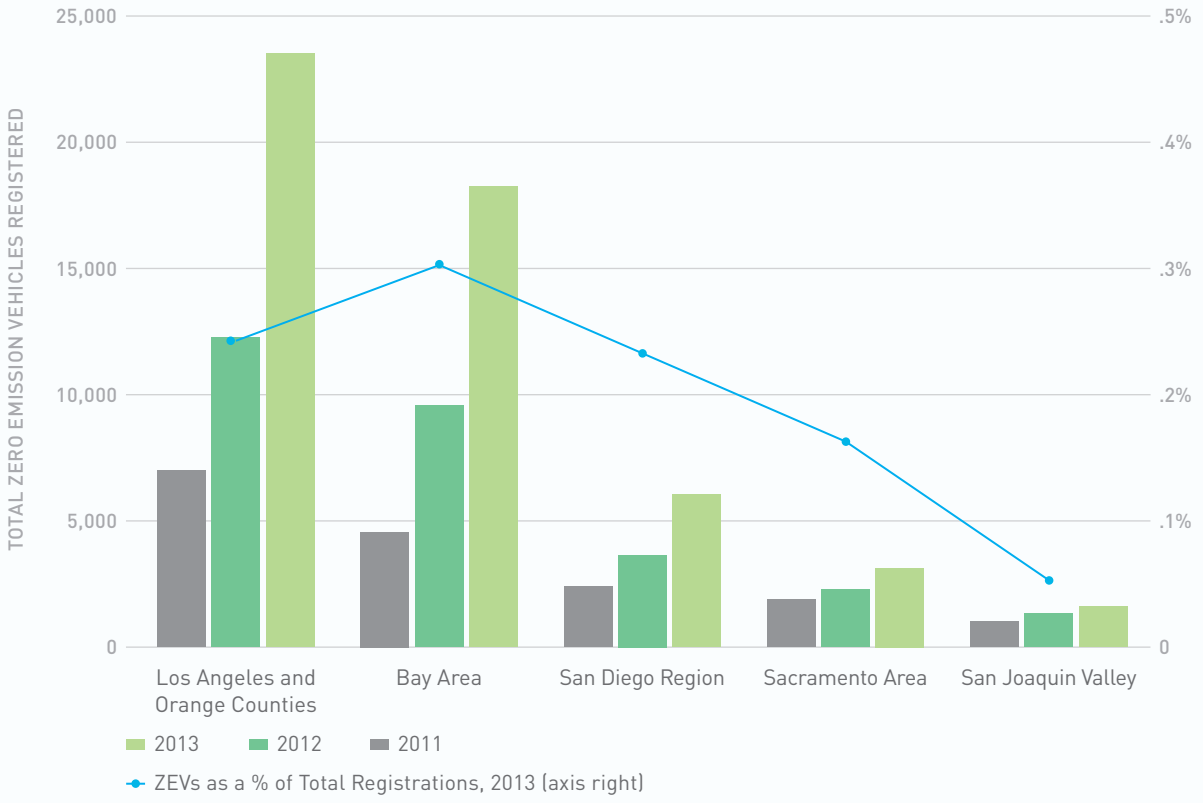
Advanced Transportation in the Bay Area

Global auto companies, entrepreneurs, public-private partnerships and other regional stakeholders are accelerating advanced transportation technologies in the Bay Area for regional and global markets.

The advanced transportation sector in the Bay Area includes electric vehicles, technologies that increase car connectivity while decreasing emissions, as well as smart infrastructure, or transportation infrastructure that integrates new hardware and software technologies.

Regional collaborations aimed at increasing adoption of EVs and creating a supportive climate for EV companies have played a critical role in positioning the Bay Area as a leader. Public-private partnerships have been particularly key in driving innovation and growth in the sector. The EV Strategic Council, for example, is a regional forum for EV businesses and public sector partners to collaborate in positioning

Figure 2: Zero Emission Vehicle Registrations, by region in California



NOTE: ZEVs include Battery Electric and Plug-in Hybrid Electric Vehicles.
SOURCE: California Energy Commission
ANALYSIS: Collaborative Economics

the region as a global EV leader. This Council has been an active player in stimulating regional demand for EVs, streamlining charging installations, and removing barriers to EV adoption. Convened and co-facilitated by the Bay Area Climate Collaborative and the EV Communities Alliance, the Strategic Council includes executive representatives from business, local and regional government, and major non-profits advancing EV adoption in the region.

Electric Vehicle Deployment

The Bay Area represents a large and growing share of the overall state and national EV market. As of November 2013, the Bay Area represents 11 percent of the total United States plug-in EV market.[5] The region increased the number of zero emission vehicles (ZEVs) (including plug-in hybrid and battery electric vehicles) registered by 90 percent between 2012 and 2013 to just over 18,200, and has 30 percent of the state's total ZEVs (Figure 2). While the Bay Area trails Los Angeles and Orange Counties in total ZEV registrations, the Bay Area outperforms all California regions in the concentration of ZEV registrations compared to total registrations.

The high rates of EV adoption have both direct and indirect impacts on the region's economy. This includes new jobs at companies that produce electric vehicles and EV infrastructure, as well as new indirect jobs at companies that supply to the direct producers.[6] The sector has created jobs in EV sales and repair as well as charging station infrastructure. The regional economy has also benefited indirectly, with decreased air

pollution as well as thousands of Bay Area residents saving on fuel costs and reinvesting these additional resources in the region.

A dozen Bay Area organizations, led by Alameda County, the Metropolitan Transportation Commission and the Bay Area Climate Collaborative, announced the addition of 90 all-electric vehicles into local government fleets in July 2014. This will be the largest government deployment of EVs in the nation. This rollout will save over $500,000 in operational costs, and avoid two million pounds of CO_2 over five years

The concentration of EVs in the region has also created an environment that supports innovation in the development of EV technologies as well as the deployment of EVs to consumers. With high rates of adoption, the region had to ramp up deployment of charging infrastructure to support the new market. Regional partnerships have helped accelerate EV infrastructure installations. The California EV Alliance, a Bay Area private-public partnership, recently launched the *Bay Area Charge Ahead Project* to deploy 66 charging stations (a total of 152 charge ports) throughout the peninsula and south bay with funding from the California Energy Commission.[7] This project is a result of a partnership between ChargePoint, a regionally-based national leader in EV charging station design and manufacturing, and ABM, a local facility management company. The project also includes community partners like the Bay Area Climate Collaborative, the California EV Alliance, and ten Bay Area municipalities. This new infrastructure will support the growth of the Bay Area EV industry, which aims to have 100,000 EVs on the road in the region by 2020.[8]

Public agencies have partnered to increase EV deployment in public sector fleets, both as a strategy to decrease emissions from public sector fleets and to save on fuel and maintenance costs. Expanding the number of EVs in public fleets also exposes the public to EVs and increases market penetration and infrastructure installation. A dozen Bay Area organizations, led by Alameda County, the Metropolitan Transportation Commission and the Bay Area Climate Collaborative, announced the addition of 90 all-electric vehicles into local government fleets in July 2014. This will be the largest government deployment of EVs in the nation. This rollout will save over $500,000 in operational costs, and avoid two million pounds of CO_2 over five years.[9] While a relatively small portion of the agencies' overall fleets, this deployment adds to the 50 all-electric vehicles San Jose, Los Gatos, Campbell and Mill Valley purchased in 2013 and is one in a series of planned deployments.[10] With its electric fleet, Alameda County is also deploying EV charging infrastructure.

Prospect Silicon Valley

Prospect Silicon Valley is a Bay Area-based nonprofit organization that strives to accelerate technology solutions for cities everywhere to help solve major city infrastructure and system problems. The organization focuses on strategies that make cities clean, smart, and connected. Their mission is to help emerging technology companies accelerate their path to market by connecting them to demonstration facilities, city resources, financing, partners and potential customers. Prospect Silicon Valley serves as a broker, bringing together key partners to help companies advance technologies that will benefit cities in the Bay Area and beyond.

Prospect Silicon Valley is currently working with the City of San Jose and local technology companies to develop an Innovation Zone to test smart transportation infrastructure technologies. They are also working with a number of other Bay Area cities as well as Lawrence Berkeley National Lab to pilot energy efficiency toolkits that stimulate smart energy efficiency upgrades. Their new 22,500 square foot demonstration center in San Jose, which provides facilitates to develop, test and launch new products, opened to the public in early October 2014.

The City of San Francisco has proactively taken steps to develop the EV infrastructure of the City, in turn fostering wider EV adoption. In 2008, San Francisco was the first city worldwide to install ChargePoint stations for its city EV fleets and city car share program.[11] A year later, San Francisco was the first city to install networked charging stations to support its electric vehicle fleets, as part of a two year public demonstration pilot project to increase EV adoption.[12] To further incentivize adoption, San Francisco offered free charging through the end of 2013 as a mayoral executive directive to encourage residents to purchase EVs.[13] These efforts have been driven by an understanding that increased EV adoption depends on the availability of networked infrastructure in the city and region.

Electric Vehicle and Conventional Car Innovations

The Bay Area is a leader in EV research and development, as well as technology advancements that increase efficiency of conventional cars. As a global technology center, the region has attracted a range of R&D facilities for car manufacturers. In the Bay Area, auto companies maintain a combined 520,000 square feet of R&D facilities, with Tesla's EV manufacturing facility accounting for over half of the number.[14] Mercedes, BMW and Volkswagen located offices in Silicon Valley in the mid-1990s and, in the last few years, Honda, Nissan and Ford have moved to the region. Tesla, the global leader in EV design and manufacturing, was founded by Bay Area engineers and is headquartered in Palo Alto. Tesla opened its manufacturing and R&D facility in the region in 2009,[15] and in 2010 they opened the only auto assembly plant in the state and the first facility exclusively producing EVs at a factory in Fremont.[16]

Local automobile company R&D centers leverage the Bay Area's information technology expertise. In addition to EV manufacturing, the Bay Area is home to R&D facilities focused on developing advanced transportation technology to increase efficiency and mitigate the environmental impact of conventional vehicles. The Volkswagen Group's Electronics Research Laboratory in Belmont, for example, is working with universities to develop machine learning technology, where cars adapt to driving preferences and road conditions to use less fuel and minimize traffic congestion.[17] Similarly, BMW is working on smart phone-powered infotainment systems that improve navigation to make driving more efficient.[18] Other auto companies, including Nissan, General Motors, and Ford, also have research labs located in the region.

This concentration of automotive companies helps spur innovation through collaboration. Mercedes-Benz, which opened its R&D North America headquarters in the region in November 2013, teamed up with Tesla to integrate Tesla's electric engine in their first all-electric car.[19] Nissan has also tapped into the region's innovation assets by choosing to move its Japan-based R&D facility to the Bay Area to be closer to the technology they hope to integrate into their cars. The company will be working with automotive labs at Stanford and University of California Berkeley to develop its self-driving car.[20]

Google's development of its own self-driving car highlights the increasing convergence of information technology and vehicles. Since 2008, Mountain View-based Google has been developing their prototype, which is now an all-electric vehicle without a steering wheel, brake or accelerator.[21] Google has stated that these cars will be ready for market by 2017. While the benefits and risks of self-driving cars are mixed, they are predicted to increase car sharing, therefore reducing the number of cars on the road, reduce accidents and congestion, and will also be fuel-efficient.[22]

Smart Transportation Infrastructure

Innovations in advanced transportation also includes "smart transportation" infrastructure. This infrastructure integrates technology into transportation infrastructure to make driving easier, safer and more efficient. Smart transportation infrastructure includes smart phone applications that direct drivers to open parking spaces, traffic lights that react and adjust to the amount of traffic on the road, as well as integrated communications systems and analytics that streamline transportation systems. The Bay Area is a leader in developing and deploying cutting-edge smart transportation technologies, leveraging its regional strengths as a software leader. However, taking these technologies to scale depends on access to demonstration facilities and funding. Through public-private collaborations, the Bay Area has fostered an environment that supports development and commercialization of these technologies.

> In San Jose we are striving to create an ecosystem that encourages innovation. Our big vision is to be a global leader in urban technology demonstration, especially in clean technologies.
>
> —**Kim Walesh,** City of San Jose

Public sector agencies in the Bay Area have shown leadership in testing and demonstrating new, smart transportation technologies. The San Francisco Metropolitan Transportation Administration (SFMTA), for example, helped test new parking infrastructure by piloting a smart parking meter project. Beginning in the summer of 2010, the SFMTA began testing parking technology and flexible pricing in eight regions across San Francisco. The goal of this federally funded pilot was to make it easier for drivers to park, eliminating double parking, increasing business for stores and decreasing emissions from drivers circling. Using demand-responsive parking pricing and real-time data on parking, this public sector SFMTA pilot resulted in less time to park, decreasing the pilot areas' greenhouse gas emissions by six percent and vehicle miles traveled by 30 percent or 2,413 miles per day compared to two years prior.[23]

Local jurisdictions have also demonstrated a willingness to collaborate with regional companies in implementing smart transportation technologies. Foster City-based Streetline, Inc., for example, has worked with the City of San Carlos to demonstrate its real-time parking guidance application for smartphones and in-car navigation systems. Through the sensor-enabled

mobile and web applications, the company's Parker app helps drivers find available parking spots, decreasing the number of cars on the road looking for an open parking spot. The City of San Carlos has worked with Streetline to better understand their parking needs, make policy changes to ease congestion, and increase parking space turnover. In February 2014, the City of San Carlos received a gold award at the Connected World Conference Awards event for their implementation of Streetline's smart parking system.[24]

In the Bay Area, auto companies maintain a combined 520,000 square feet of R&D facilities, with Tesla's EV manufacturing facility accounting for over half of the number.

The City of San Jose is a driver and catalyst of innovation in clean technology in the Bay Area. The City has made sustainability a main priority through initiatives such as its Green Vision Plan, which prioritizes the "double bottom line," an approach that integrates environmental sustainability into economic growth. In addition to supporting sustainability from an environmental perspective, the City sees its role in clean technology as an important economic development strategy, creating policies that advance technology development and encourage companies to locate and grow in the region. The City has set a goal of creating 25,000 clean tech jobs and to make San Jose the world center of clean tech innovation.[25] San Jose was the first city in the U.S. to develop a demonstration policy in 2007, allowing companies to utilize city facilities to test their technology for a public audience. ChargePoint, a local EV charging infrastructure company, installed the first public solar power EV charging station as a demonstration. Since then, the demonstration policy has been used by a wide range of clean technology companies to collaborate with the City in testing and commercializing their products.

The City of San Jose is enhancing its role in clean technology demonstration projects by partnering with the nonprofit Prospect Silicon Valley and Bay Area technology companies including Cisco and Siemens to launch an Innovation Zone. While in the beginning stages of development, this physical area in the city will provide an opportunity for companies to test and showcase their technologies on city streets, including smart streetlight infrastructure, devices that improve pedestrian safety, vehicle communication, and automated traffic systems. This unique role the City of San Jose plays is critical in accelerating clean technology development and commercialization.

PUSHING THE ENVELOPE IN ENERGY STORAGE DEVELOPMENT

As more energy is generated by renewable sources globally, viable ways to store energy from these intermittent sources is increasingly important. Energy storage technologies enable a transition away from fossil fuels by allowing users to store renewable energy to use at a later time.

The Bay Area is a major innovation center for energy storage, with one of the largest concentrations of energy storage companies in the world.[26] These innovative companies, combined with regional research assets, are driving the development of storage technologies in the region. Partnerships with national labs and local universities, as well as industry organizations such as CalCharge, have helped advance this industry and solidify the Bay Area as a global leader.

Regional Innovation in Energy Storage

The Bay Area is a central hub of energy storage innovation. Of the 128 energy storage companies identified in California, about 80 of them are located in the Bay Area.[27] As demand for alternative and renewable energy continues to grow, there is tremendous potential for the Bay Area to develop new storage products and enter the energy storage manufacturing market.

The concentration of energy storage companies in the Bay Area is driven in part by the close proximity of both companies developing major applications and end users of batteries, such as consumer devices, cell phones, hybrid cars, and grid-scale storage for utilities and distributed sources. University and research assets including the Stanford Linear Accelerate Center, Lawrence Berkeley National Lab, and Lawrence Livermore National Lab also provide the facilities needed to develop and commercialize storage technologies. The availability of venture capital financing in the Bay Area also supports energy storage start-ups.

Energy storage companies in the region focus on a range of technologies, from batteries for wearable devices to utility scale storage. In utility scale storage, Primus Power, based in Hayward, is developing a grid-scale large energy storage solution and the company raised $20 million in funding in 2014 to ramp up its operations. In distributed storage, the Millbrae- based company Stem focuses on behind-the-meter battery systems that help buildings manage energy consumption. In September 2014, Stem announced a no-money-down financing program and the hotel chain Extended Stay America will be installing its systems at 68 locations in California.[28] In smaller storage for wearable and mobile technologies, Fremont-based Enovix is developing improved rechargeable batteries for mobile devices.

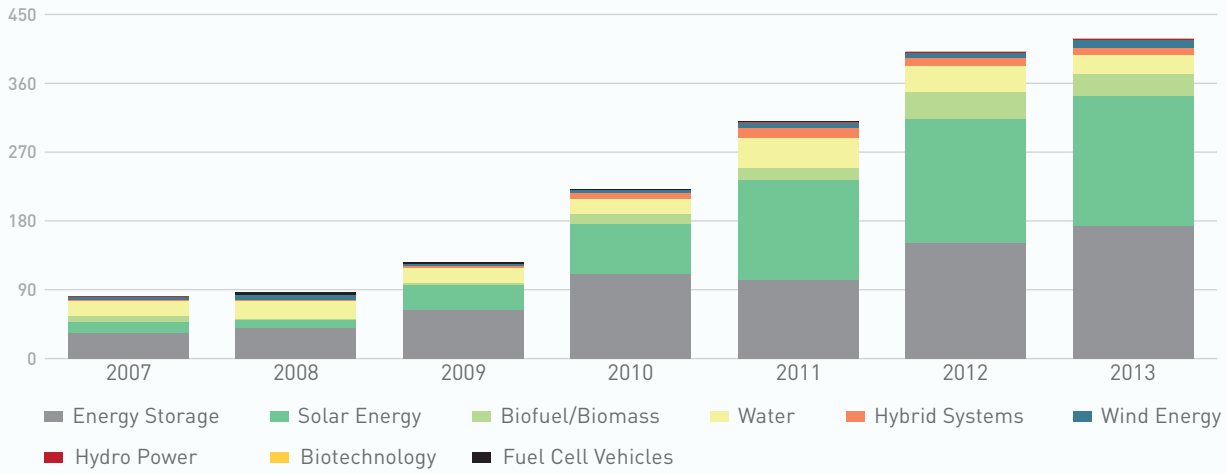
Innovation in energy storage can be measured by the increased

Energy Storage in the Bay Area

Industry organizations, universities, national labs and regional companies are pushing the envelope in terms of energy storage technology development, making the Bay Area a major innovation center for energy storage.

The energy storage sector in the Bay Area includes devices such as batteries, spinning flywheels and compressed air that have applications in consumer devices, electric vehicles, and grid-scale energy.

Figure 3: Clean Technology Patents, Bay Area, 2007 - 2013



SOURCE: 1790 Analytics, Patents by Technology; USPTO Patent File
ANALYSIS: Collaborative Economics

The Bay Area has one of the largest concentrations of energy storage companies in the world. It's the connections among these companies and with the region's research universities, national labs, and clean technology community, that drive innovation and make the Bay Area different.

– Jeff Anderson, CalCharge

number of patent registrations in the industry. Patent activity in energy storage has been steadily growing over the last seven years and currently constitutes the largest share of regional clean tech patents overall (Figure 3). The Bay Area registered 174 energy storage patents in 2013, 42 percent of total clean technology patents in the region.

CalCharge, a statewide public-private partnership dedicated to advancing the energy storage sector, has played a pivotal role in helping to identify gaps within the sector and create a supportive climate to enable sector growth. CalCharge recently played a key role in the Bay Area by developing research fast track lanes to streamline the process for entrepreneurs to gain access to labs and other facilities.

The Bay Area has also been a leader in developing a specialized workforce for the energy storage field. While the region attracts science and engineering talent from around the world, there is a shortage of workers with the specialized skills the storage sector needs. In response to this workforce gap, San Jose State University developed Battery University, the first master's degree program focused on battery science in the country. The program includes opportunities for hands-on experience and projects with local battery storage firms, as well as courses taught by Lawrence Berkeley National Laboratory scientists. There are roughly 50 students in the first cohort, and the program is also open to individuals who want to take the courses for professional development.[29] This program will help develop a trained workforce ready to enter the energy storage industry, driving further growth in the sector.

IMPROVING BUILDING ENERGY EFFICIENCY IN THE REGION AND BEYOND

Building energy efficiency (i.e. technologies and building improvements that minimize energy output while maximizing comfort) is a growing industry worldwide. Growth in the sector has been driven in part by California's Title 24 energy use requirements, which includes strict energy-saving measures. With the Bay Area as a center for the development, testing, manufacturing, and installation of building energy efficiency technologies, these policies have helped to simulate demand for Bay Area products and technology.

Development of Energy Efficiency Technology

The Bay Area is home to a number of energy efficiency technology companies that benefit from the region's numerous resources, including business financing, entrepreneurial mindset, talent, and early adopter culture. The region's companies specialize in a range of technologies, including those that develop and manufacture smart thermostats, lighting and building energy efficiency analytics. A prime example is Nest Labs Inc., the Palo Alto-headquartered self-learning thermostat company founded in the Bay Area by two former Apple engineers and recently acquired by Google. Nest smart devices can save families up to $173 a year by learning when individuals are home and only heating and cooling the houses during these times.[30] Nest also activates other energy saving features depending on the type of air systems in the home, increasing energy efficiency.

Another growing energy efficiency company is BuildingIQ, which was founded in Australia and relocated their headquarters to San Mateo in 2011 to tap into the Bay Area market. BuildingIQ focuses on developing energy management software for commercial buildings. Their Predictive Energy Optimization uses algorithms to automatically control HVAC systems helping reduce energy cost and use. As of second quarter 2014, the company manages over 15 million square footage of commercial space worldwide and has continued to expand their client base and exponentially grow their revenues.[31]

The Bay Area is also home to energy efficiency manufacturers. Xicato is a San Jose-based company that is a leading developer of energy-efficient LED modules. Earlier this year, Xicato doubled its facility space in San Jose to incorporate manufacturing space for its new LED light module, which has improved

Building Energy Efficiency in the Bay Area

National labs, public-private partnerships, companies, contractors and developers are moving the needle on building energy efficiency, technology development, commercialization, and deployment.

The building energy efficiency sector in the Bay Area includes technologies and building improvements that minimize energy output while maximizing comfort such as light-emitting diode (LED) lights, energy management devices and analytics and smart thermostats.

efficiency and will significantly reduce energy use and costs.[32] Phillips Lumileds, developed 40 years ago under HP, is another LED manufacturer located in San Jose. By locating their manufacturing facility close to their research and development center, both Xicato and Phillips Lumileds are better able to seamlessly develop and manufacture innovative products.

Deployment of Energy Efficiency Technology

Bay Area contractors and developers are integrating new energy efficiency technologies developed in the region into local buildings. These companies in the region have leveraged the research assets and strategic community partners of the region including Lawrence Berkeley National Lab and Prospect Silicon Valley. The desire to save money and to minimize energy use has been a main driver behind the growth in the building energy efficiency industry.

Bay Area companies, entrepreneurs, and public agencies have access to a new testing facility, the FLEXLAB located at Lawrence Berkeley National Lab. This facility is the most advanced building efficiency simulator in the world, and is the first research facility that can test system level technologies under real-world conditions. It provides a platform to test buildings as integrated systems, and validate the technology performance before they go to scale. The lab can test HVAC, lighting, windows, building envelope, control systems and plug loads, in any combination.[33] Bay Area companies, utilities, designers and architects use the facility on a fee-for-service basis to test their technology.

The construction firm Webcor is using FLEXLAB's rotating test bed to test plans for a new 250,000 square foot building for Genentech in South San Francisco. Berkeley Lab scientists are now working with Webcor to measure the energy efficiency levels and comfort of the building before breaking ground.[34] The local utility PG&E plans to use the facility next to test the next generation of energy efficiency technologies for emerging technologies incentive programs.

Prospect Silicon Valley is another catalyst for improving energy efficiency in the region. The organization developed the Silicon Valley 2030 Program, a public-private-nonprofit collaborative working to reduce environmental impacts of existing buildings in Silicon Valley by demonstrating that energy investments result in both environmental and economic benefits. Working with Lawrence Berkeley National Labs, the program has created toolkits for small, commercial building owners highlighting available resources and financing options that can help make energy-efficiency improvements cost-effective.

Other Bay Area cities have paved the way for building energy efficiency improvements through innovative policies. San Francisco was one of the first cities nationwide to develop a progressive green building ordinance in 2008. This ordinance required new construction and renovations of existing buildings to follow new green building standards that reduce water and energy use and waste. In 2011, San Francisco won the World Green Building Council's Best Green Building Policy Award for its Green Building Ordinance.[35]

Bay Area cities and counties also helped pave the way for property assessed clean energy (PACE) financing programs. Energy upgrades can be expensive and difficult to finance, so these programs allow homeowners to finance energy efficiency retrofits, water conservation, and/or solar panels through a loan payback from the energy savings through their property taxes. Berkeley had one of the first in 2009, and while Berkeley suspended the program in 2010 while the nation figured out mortgage finance challenges with the program, it was recently reinstated. Sonoma County's PACE program, called the Energy Independence Program, also began in 2009 and provides incentives for residential and commercial properties. These areas are now among 186 counties and cities in California, including San Mateo County and San Francisco, with PACE financing options for residential and commercial buildings.[36]

FLEXLAB at Lawrence Berkeley National Lab is the most advanced building efficiency simulator in the world, enabling testing under real-world conditions.

CONCLUSION

The Bay Area is a statewide leader in clean technology development and deployment, particularly in the areas of advanced transportation, energy storage, and building energy efficiency. Leveraging its innovation assets, including software strengths, entrepreneurial culture, and available financing, the region has made strides in developing and scaling product innovations. The world-renowned universities and national laboratories in the region have provided important testing grounds for cutting-edge technologies and have helped prepare a talented workforce to join the clean technology sector. In addition, public-private partnerships have played a key role in validating and commercializing technologies produced by Bay Area companies. As a region of early adopters, Bay Area residents have been receptive to clean technology innovations, accelerating the deployment of new technologies such as EVs. Building off of these strengths and recent regional innovation activity, the Bay Area can be expected to continue to push the boundary on clean technology innovation.

Endnotes

1. Analysis by Collaborative Economics, data source CB Insights.
2. O'Brien, Matt. "Fleet of plug-in cars rolls out to Bay Area governments." Mercury News. July 9, 2014. http://www.mercurynews.com/drive/ci_26110714/fleet-plug-cars-rolls-out-bay-area-governments
3. Analysis by Collaborative Economics, data source National Establishment Time Series – Green Establishment Database. Clean transportation segment is termed advanced transportation for the purposes of this report.
4. Bay Area EV Strategic Council. Bay Area Climate Collaborative. http://www.baclimate.org/impact/ev-strategic-council.html
5. ICF International. "Bay Area Plug-In Electric Vehicle Readiness Plan." Summary 2013. http://www.bayareapevready.org/assets/Bay-Area-PEV-Readiness-Plan-Summary-2013-web.pdf
6. International Economic Development Council. "Creating the Clean Energy Economy: Analysis of the Electric Vehicle Industry." http://www.iedconline.org/clientuploads/Downloads/edrp/IEDC_Electric_Vehicle_Industry.pdf
7. ChargePoint. "EV Alliance to Deploy EV Charging Stations in Bay Area." May 15, 2014. http://www.chargepoint.com/press-releases/2014/0515
8. Reyes, Rafael. "Nearly 80 Electric Vehicle Charging Ports to be Deployed by Bay Area Climate Collaborative." Bay Area Climate Collaborative. June 19, 2014. http://www.baclimate.org/bay-area-climate-collaborative-blog/nearly-80-electric-vehicle-charging-ports-to-be-deployed-by-bay-area-climate-collaborative.html
9. Chou, Diana. "Ten Bay Area Local Governments Roll Out 90 All-Electric Vehicles." Bay Area Climate Collaborative. July 8, 2014. http://baclimate.org/bay-area-climate-collaborative-blog/
10. BACC Editor. "Four Bay Area Local Governments Participate in Single Largest Municipal Fleet Deployment of Light-Duty All-Electric Vehicles in Nation." Bay Area Climate Collaborative. June 26, 2013. 50 all-electric vehicles San Jose
11. ChargePoint. "Coulomb Technologies Introduces MasterCard PayPass Contactless Payments for Electric Vehicle Charging in San Francisco." November 16, 2010. http://www.chargepoint.com/press-releases/2010/1116b

12. ChargePoint. "City of San Francisco Unveils Charging Station for Electric Vehciles." February 18, 2009. http://www.chargepoint.com/press-releases/2009/0218

13. SF Environment. "Incentives." http://www.sfenvironment.org/article/ev-vehicles/incentives-financial-and-non-financial

14. Donato-Weinstein, Nathan. "Mercedes-Benz R&D unit takes Peery Arrillaga building in Sunnyvale." Silicon Valley Business Journal. March 29, 2013.

15. Tesla Press Releases. "Tesla to open power train facility in Palo Alto, California. August 18, 2009. http://www.teslamotors.com/it_CH/about/press/releases/tesla-open-power-train-facility-palo-alto-california

16. Tesla Press Releases. "Telsa motors opens Telsa factory - home of the Model S." October 27, 2010. http://www.teslamotors.com/about/press/releases/tesla-motors-opens-tesla-factory-%E2%80%93-home-model-s

17. ERL. "Connectivity Enabled Eco-Conscious Driving." February 2012. http://www.vwerl.com/our-work/view/41

18. Hepler, Lauren. "Silicon Valley hits overdrive: Is it a car or a consumer electronic device?" August 9, 2013. Silicon Valley Business Journal. http://www.bizjournals.com/sanjose/print-edition/2013/08/09/silicon-valley-hits-overdrive-is-it-a.html?s=print

19. Hepler, Lauren. "Mercedes-Benz teams with Tesla on $41K car, taps Silicon Valley tech for mind-reading autos". April 30, 2014. Silicon Valley Business Journal. http://www.bizjournals.com/sanjose/news/2014/04/30/mercedes-benz-teams-with-tesla-on-41k-car-taps.html?page=all

20. Ohnsman, Alan. "Nissan Opens Silicon Valley Center for Self-Driving Car Research." February 18, 2013. Bloomberg. http://www.bloomberg.com/news/2013-02-18/nissan-opens-silicon-valley-center-for-self-driving-car-research.html

21. Gibbs, Samuel. "Google's self-driving car: How does it work and when can we drive one?" The Guardian. May 29, 2014. http://www.theguardian.com/technology/2014/may/28/google-self-driving-car-how-does-it-work

22. Schonberger, Ben. "A Self-Driving Future." Sightline Daily. June 4, 2014. http://daily.sightline.org/2013/06/04/a-self-driving-future/

23. SFpark. "Pilot Project Evaluation Summary." June 2014. http://sfpark.org/wp-content/uploads/2014/06/SFpark_Eval_Summary_2014.pdf

24. Streetline. "Streetline and San Carlos Win Gold at the Connected World Awards." February 14, 2014. http://www.streetline.com/2014/02/streetline-and-san-carlos-recognized-at-the-connected-world-awards/

25. City of San Jose. "City of San Jose Green Vision 2013 Annual Report." http://www.sanjoseca.gov/DocumentCenter/View/27914

26. PRN Newswire. "CalCharge announced first corporate members, including Duracell, Volkswagen, Eaton, LG, and Hitachi." April 17, 2014. http://www.prnewswire.com/news-releases/calcharge-announces-first-corporate-members-including-duracell-volkswagen-eaton-lg-and-hitachi-255672051.html

27. Xavier, Jon. "CalCharge leads Bay Area's play to be the battery-tech capital of the U.S." April 18, 2014. Silicon Valley Business Journal. http://www.bizjournals.com/sanjose/news/2014/04/18/calcharge-leads-bay-areas-play-to-be-the-battery.html?page=all

28. St. John, Jeff. "Stem Extends Its Reach in California's Distributed Energy Storage Market." October 1, 2014. Greentech Media. http://www.greentechmedia.com/articles/read/stem-extends-its-reach-in-californias-distributed-energy-storage-market

29. Professional Degree Programs, San Jose State University. College of International and Extended Studies. "Battery Technology." http://www.sjsu.edu/pdp/programs/mse-battery/

30. Nest. "Saving Energy." http://nest.com/thermostat/saving-energy/

31. BuildingIQ. "BuildingIQ Surpasses 15 Million in Square Footage Under Management in Q2 2014." August 5, 2014. http://www.buildingiq.com/2014/08/05/buildingiq-surpasses-15-million-square-footage-management-q2-2014/

32. Xicato. "Xicato expands and brings manufacturing to San Jose." January 9, 2014. http://www.xicato.com/xicato-expands-and-brings-manufacturing-san-jose

33. Hull, Dana. "FLEXLAB: New Berkeley facility tests super-efficient energy." San Jose Mercury News. July 10, 2014. http://www.mercurynews.com/business/ci_26122091/lawrence-berkeley-lab-unveil-flexlab

34. Weiner, Jon. "Department of Energy's FLEXLAB Opens Testbeds to Drive Dramatic Increase in Building Efficiency." Berkeley Lab. July 10, 2014. http://newscenter.lbl.gov/2014/07/10/department-of-energys-flexlab-opens-testbeds-to-drive-dramatic-increase-in-building-efficiency/

35. URS. "San Francisco Green Building Ordinance Wins Worlds Green Building Council Award." December 19, 2011. http://www.urs.com/ch/press/san-francisco-green-building-ordinance-wins-world-green-building-council-award/

36. Hales, Roy L. "PACE Has Returned To Berkeley, Birthplace Of The PACE Program. Clean Technica. September 17, 2014. http://cleantechnica.com/2014/09/17/pace-returned-berkeley-birthplace-pace-program/