



# ADVANCED ENERGY JOBS IN CALIFORNIA



Results of the 2016 California Advanced Energy  
Employment Survey

Prepared by BW Research Partnership





## About the Advanced Energy Economy Institute

The Advanced Energy Economy Institute (AEEI) is a 501 (c)(3) charitable organization whose mission is to raise awareness of the public benefits and opportunities of advanced energy. AEEI provides critical data to drive the policy discussion on key issues through commissioned research and reports, data aggregation and analytic tools. AEEI also provides a forum where leaders can address energy challenges and opportunities facing the United States. AEEI is affiliated with Advanced Energy Economy (AEE), a 501(c)(6) business association, whose purpose is to advance and promote the common business interests of its members and the advanced energy industry as a whole.

## About BW Research Partnership

BW Research Partnership ([www.bwresearch.com](http://www.bwresearch.com)) is a full-service research consulting firm with offices in California and Massachusetts. Recognized by the Congressional Research Office as developing the most accurate data to date, BW Research has conducted more clean energy labor market analyses than any other firm. Recent projects include: The Solar Foundation's National Solar Jobs Census, wind and solar labor market reports for the National Renewable Energy Laboratory (NREL), and clean energy studies for the Natural Resources Defense Council (NRDC), the Massachusetts Clean Energy Center, the Clean Energy Trust (Illinois), the State of Vermont, and many others.

*Advanced Energy Jobs in California 2016*

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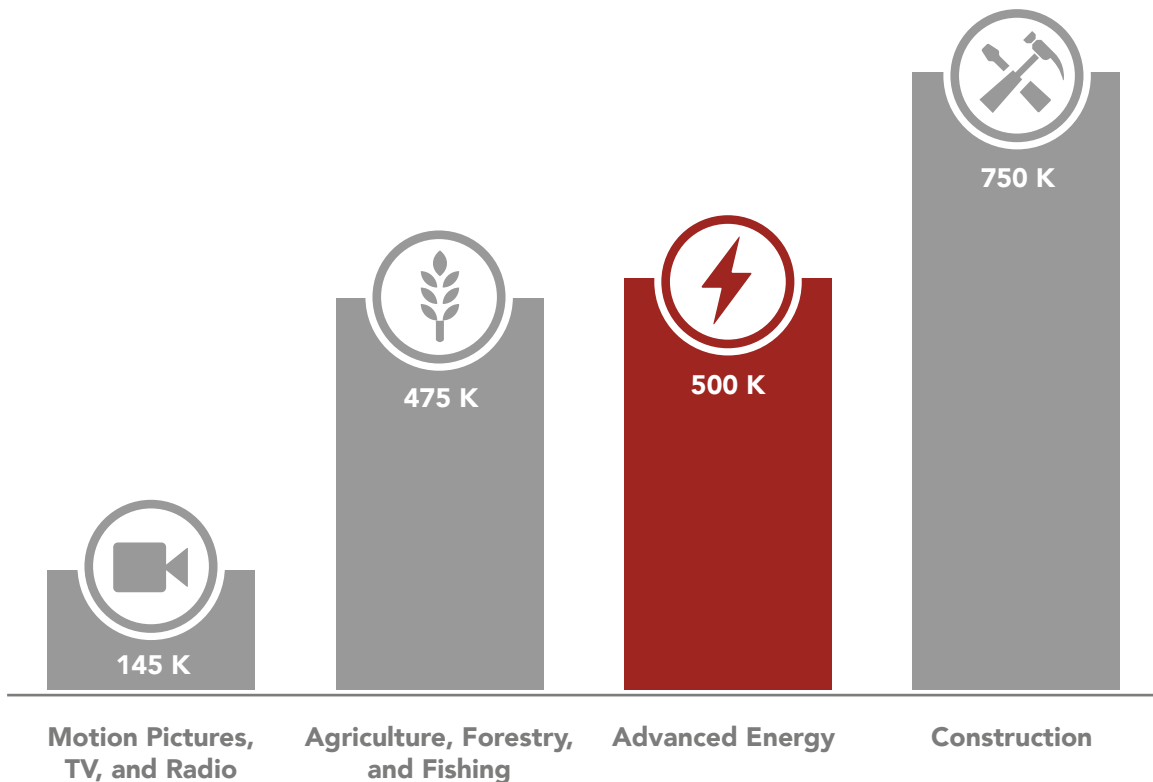
# ADVANCED ENERGY JOBS IN CALIFORNIA 2016 - HIGHLIGHTS

**Advanced energy generated jobs at six times the rate of the overall California economy last year.**

Advanced Energy employment grew 18% in 2015 while overall statewide employment grew 3%.<sup>1</sup> Employers expect to increase advanced energy employment in California by 8% over the coming year.

**Advanced energy technologies employ more than half a million workers in California, over 3% of the state's total workforce.**<sup>2</sup> Advanced Energy employs over 500,000 workers in California, three times Motion Pictures, TV, and Radio (145,000), bigger than Agriculture, Forestry, and Fishing (475,000), and approaching Construction (750,000).

## Major Industry Comparisons, 2015



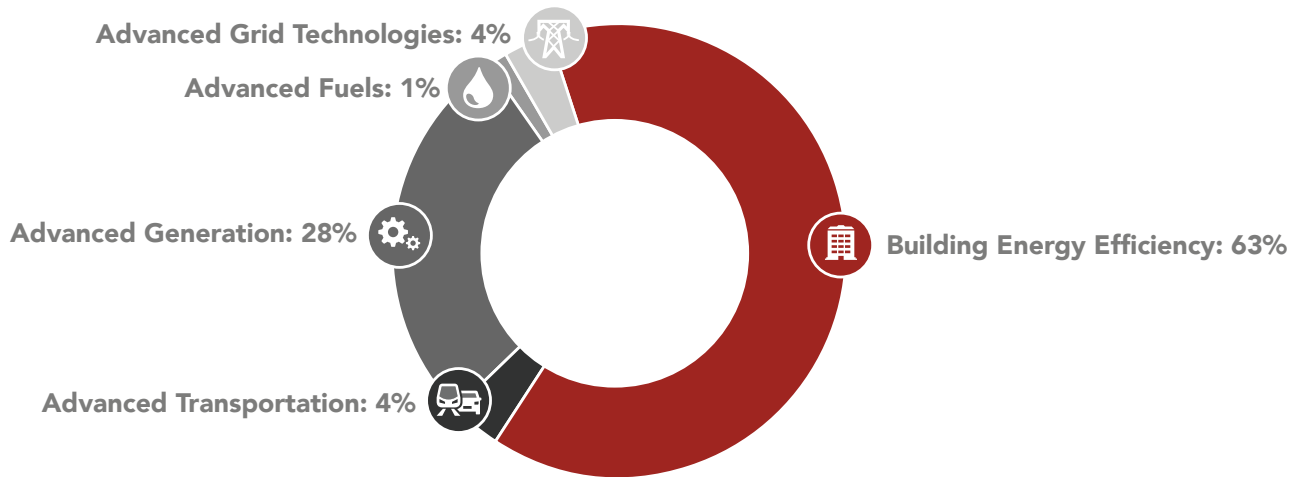
1. Bureau of Labor Statistics (BLS), Current Employment Statistics State and Area Employment, total nonfarm, Nov. 2014 – Nov. 2015. Available at <http://www.bls.gov/ces/>.

2. BLS, Current Employment Statistics State and Area Employment, total nonfarm, Jan, 2016. Industry figures are from Q2 2015, available at [http://www.bls.gov/cew/apps/data\\_views/data\\_views.htm#tab=Tables](http://www.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables). Industry definitions are available at [http://www.census.gov/eos/www/naics/2012NAICS/2012\\_Definition\\_File.pdf](http://www.census.gov/eos/www/naics/2012NAICS/2012_Definition_File.pdf).

**Energy Efficiency accounts for the largest share of advanced energy jobs in California.** About six in 10 advanced energy workers are employed in the Energy Efficiency sector; these firms support over 321,000 jobs in total.

Driven by strong supporting policies and declining prices, employment across **Advanced Grid technologies – energy storage, smart grid, and electric vehicle charging stations – more than doubled between 2014 and 2015.**

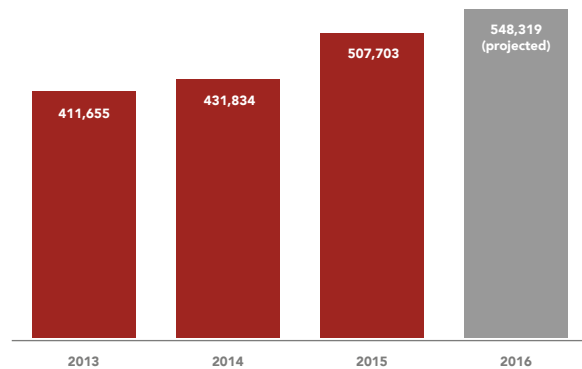
### Advanced Energy Employment by Segment, 2015



**This growth has enabled California’s advanced energy industry as a whole to mature.** Firm sized has increased, and many are able to specialize in advanced energy goods and services as these technologies have also increasingly become a primary source of revenue for more employers.

**The advanced energy workforce in California is quite diverse.** Although predominantly male (74%), advanced energy workers are 38% racial or ethnic minorities. In fact, four in 10 (39%) recent hires over the last year are reported ethnic minorities.

### Advanced Energy Employment, 2013 - 2016





## INTRODUCTION AND METHODOLOGY

California is the nation's most populous state and the national leader in policies that promote secure, clean, and affordable energy. It is no surprise that California has a large and growing advanced energy economy as a result. *Advanced Energy Jobs in California 2016* is the second annual report quantifying employment across California's advanced energy economy.

This report, based on a survey of 831 companies doing business in California, finds that the Golden State is home to nearly 43,000 advanced energy businesses that span the entire value chain and include a wide range of energy technologies that address both supply and demand.

Last year's *California Advanced Energy Employment Survey* was the first attempt to comprehensively measure the size of advanced energy employment in the state; it predicted that Advanced Energy would surpass 500,000 workers in 2015. This prediction came true as findings from this year's *Advanced Energy Jobs in California 2016* report that advanced energy technologies now employ an estimated 507,703 workers. Energy Efficiency accounts for the majority of advanced energy jobs in California. This segment supports six in 10 advanced energy jobs, followed by Advanced Electricity Generation, which supports about three in 10 jobs.

**These jobs represent remarkable growth – 18% over 2015 and 23% since 2013, the earliest year for which we have data.** Growth in advanced energy far outpaced overall statewide employment growth of just under 3%, meaning that advanced energy generated jobs at six times the rate of the California economy overall.<sup>3</sup> Growth in 2015 was led by Advanced Grid, which more than doubled in employment over 2014 (up 132%), followed by Advanced Transportation (up 65%), and Advanced Electricity Generation (up 50%). Overall, employers expect to add advanced energy workers in California at a rate of 8% over the coming year.

**In addition to growing rapidly, the advanced energy industry in California has become more mature.** While still made up primarily of small businesses, the advanced energy industry saw an increase in the percentage of medium- to large-sized businesses in 2015. These businesses are also increasingly specialized in advanced energy goods and services, as advanced energy has become their primary source of revenue. A similar shift is taking place in the types of jobs performed by these businesses. Though the majority of firm activity is still concentrated in installation, the share of research, engineering, and professional services increased 9% over 2014. California's network of in-state vendors and suppliers ensures that capital flow from these businesses remains local and employment and economic benefits ripple throughout the state's economy.

**The advanced energy workforce in California is quite diverse.** Although predominantly male (74%), advanced energy workers are 38% racial or ethnic minorities, with the minority share of recent hires (within the past 12 months) slightly higher (39%). A national leader in advanced energy policies and deployment, California continues to pave the way towards a more secure, clean, and affordable energy future. In 2015, one study that compares state policies, financing mechanisms, and deployment metrics for a number of advanced energy technologies found that the state led the pack for the sixth year in a row.<sup>4</sup> With new, ambitious policies put in place as recently as last year, the state shows no signs of relinquishing its leadership position.

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3. BLS, Current Employment Statistics State and Area Employment, total nonfarm, Nov. 2014 – Nov. 2015. Available at <http://www.bls.gov/ces/>.

4. Clean Edge Inc., 2015 U.S. Clean Tech Leadership Index. Available at <http://cleanedge.com/indexes/u.s.-clean-tech-leadership-index>.

In January 2015, Governor Jerry Brown and the California legislature expanded the state’s already ambitious renewable portfolio standard (RPS) from 33% to 50% renewable electricity generation by 2030. Local governments, including some of the state’s biggest population centers – San Francisco, San Jose, and San Diego – have set their own targets to 100% renewable energy generation. In addition, the state has numerous financing and incentive programs designed to spur renewable energy deployment. Consequently, the state ranks first in the nation in geothermal, biomass, solar photovoltaic, and solar thermal electric deployment, and second in wind and hydroelectric power deployment.<sup>5</sup>

In a ranking compiled by the American Council for an Energy-Efficiency Economy (ACEEE), California is a national leader in energy efficiency policy and deployment; the state is surpassed only by Massachusetts. In fact, the state was also ranked one of the most improved states in 2015. Among the policies supporting energy efficiency deployment in the state, California has long-term savings targets in place for both electric and natural gas utilities, and is one of the few states that requires disclosure of energy information in commercial buildings.<sup>6</sup> In 2012, voters passed Proposition 39, which promised to produce new revenue of up to \$1 billion per year by ending a tax benefit for out-of-state companies. A large portion of these dollars are being directed towards energy improvements in K-12 public schools over four years – producing energy cost-savings that can then be redirected towards educational resources and programs.<sup>7</sup>

In the same national ranking, California received a perfect score for its transportation policies, building energy codes, combined heat and power (CHP), and appliance standards. It was the first state in the nation to adopt appliance and equipment efficiency standards, and not only does the state have the most standards in the country, but many other states are also using California’s model to develop their own policies. The state has both the most aggressive building codes and enforcement standards in the nation, as well as high compliance rates. California allows CHP to be used for compliance with its RPS and energy efficiency resource standard (EERS).

## Methodology

The BW Research Energy Employment Index (the “Index”) methodology relies on the most recently available data from the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) together with a detailed survey of business establishments across the United States. Taken together, the data provide the most comprehensive calculation of energy-related employment available. The methodology has been used for local, state, and federal energy-related data collection and analysis for nearly a decade, including The Solar Foundation’s National Solar Jobs Census series; clean energy reports for state agencies in the Commonwealth of Massachusetts, State of Vermont, and State of Rhode Island; and numerous nonprofit agencies across the U.S.

Advanced energy employees are defined as full-time and part-time permanent employees who support the advanced energy portion of the business, including administrative staff and excluding interns and other temporary workers.

The Index survey uses a stratified sampling plan that is representative by industry code (NAICS or ANAICS), establishment size, and geography. These data are then analyzed and applied to existing public data published

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5. American Council for Renewable Energy (ACORE), Renewable Energy in the 50 States: Western Region. Available at <http://acore.org/files/pdfs/states/California.pdf>.

6. American Council for an Energy-Efficient Economy (ACEEE), 2015 State Energy Efficiency Scorecard. Available at <http://aceee.org/state-policy/scorecard>.

7. Gerdes, Justin. “California to Invest \$2.5 Billion to Retrofit Energy-wasting Schools,” *Forbes*, Jan. 2013.





by BLS, effectively constraining the potential universe of energy establishments and employment. BW Research Partnership believes that the methodology used for the Index could be adopted as a supplemental series to the QCEW with only minor revision.

The Index survey was administered by telephone (more than 300,000 outbound calls) and by web, with more than 50,000 emails sent to participants throughout the U.S. The phone survey was conducted by I/H/R Research Group and Castleton Polling Institute. The web instrument was programmed internally and each respondent was required to use a unique ID in order to prevent duplication.

The sample was split into two categories, referred to as the known and unknown universes. The known universe includes establishments that have previously identified as energy-related, either in prior research or some other manner, such as membership in an industry association or participation in government programs. These establishments were surveyed census style, and their associated establishment and employment totals were removed from the unknown universe for both sampling and for resulting employment calculations and estimates.

The unknown universe includes hundreds of thousands of businesses in potentially energy-related NAICS codes, across agriculture, mining, utilities, construction, manufacturing, wholesale trade, professional services, and repair and maintenance. Each of these segments and their total reported establishments (within the BLS QCEW) were carefully analyzed by state to develop representative clusters for sampling. In total, approximately 20,000 business establishments participated in the survey effort, with more than 8,500 providing full responses to the survey. These responses were used to develop incidence rates among industries (by state) as well as to apportion employment across various industry categories in ways currently not provided by state and federal labor market information agencies.

For several industries, particularly transportation of goods, the Index utilized the methodology developed by the Department of Energy and the National Renewable Energy Laboratory for the Quadrennial Energy Review (QER). This methodology applies commodity flow data at the state level to employment within each transportation segment, including rail, air, truck, and water transport.

Of important note, the Index expressly excludes any employment in retail trade NAICS codes. This excludes gasoline stations, fuel dealers, appliance and hardware stores and other retail establishments.

All data in the index rely on BLS QCEW data for the second quarter of 2015. The survey was administered between September 15, 2015 and November 24, 2015 and averaged 14 minutes in length.



## INDUSTRY OVERVIEW

**Advanced energy employs over half a million workers in California.** The State of California has a significant advanced energy industry, employing over 500,000 workers at nearly 43,000 businesses in 2015. That is three times Motion Pictures, TV, and Radio (145,000), bigger than Agriculture, Forestry, and Fishing (475,000), and approaching Construction (750,000).<sup>8</sup> (Figure 1.1) Advanced energy employment represents over 3% of California’s workforce overall.<sup>9</sup>

**Advanced energy generated new jobs at six times the rate of the overall California economy.** In 2015, advanced energy added 18% more jobs than 2014, and 23% more than 2013, the first year for which we have data. Meanwhile, overall statewide employment rose by 3% over 2014.<sup>10</sup> The state’s advanced energy economy surpassed growth expectations from the 2014 industry report by over 4,500 jobs. Next year, employers expect to increase advanced energy employment by 8%, which would bring total advanced energy employment in California to almost 550,000. (Figure 1.2)

Employment grew fastest in the Advanced Grid segment, which includes smart grid, storage, and electric vehicle charging technologies. The Advanced Grid workforce more than doubled between 2014 and 2015, adding over 11,000 new jobs. The greatest net increase, however, came in Advanced Generation, which grew by 50% over 2014, creating almost 48,000 new jobs in the state. Advanced Transportation also saw impressive growth, adding just under 7,000 new workers to payrolls, 65% more than in 2014. Firms in the already substantial Energy Efficiency segment reported 6% employment growth. This more modest growth rate still translated to a substantial addition of 18,000 new jobs. California’s Advanced Fuel

### Major Industry Comparisons, 2015

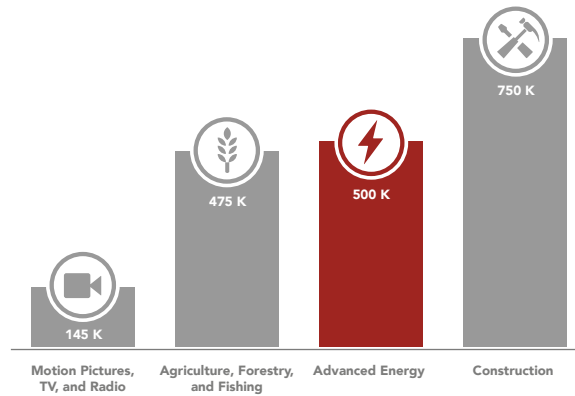


Figure 1.1

### Advanced Energy Employment, 2013 - 2016

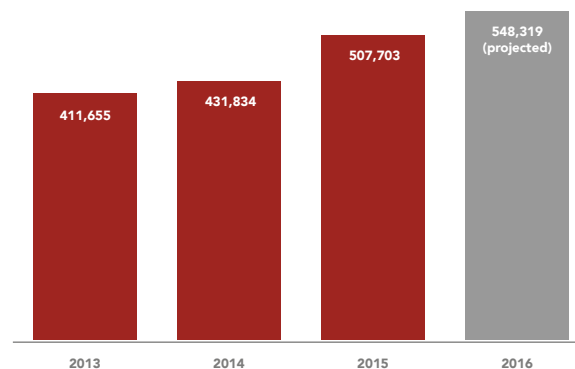


Figure 1.2

8. BLS, Current Employment Statistics State and Area Employment, total nonfarm, Jan. 2016. Industry figures are from Q2 2015, available at [http://www.bls.gov/cew/apps/data\\_views/data\\_views.htm#tab=Tables](http://www.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables). Industry definitions are available at [http://www.census.gov/eos/www/naics/2012NAICS/2012\\_Definition\\_File.pdf](http://www.census.gov/eos/www/naics/2012NAICS/2012_Definition_File.pdf).

9. BLS, Current Employment Statistics State and Area Employment, total nonfarm, Nov. 2014 – Nov. 2015. Available at <http://www.bls.gov/ces/>.

10. BLS, Current Employment Statistics State and Area Employment, total nonfarm, Nov. 2014 – Nov. 2015. Available at <http://www.bls.gov/ces/>.

sector was the only segment of Advanced Energy that did not create additional jobs in 2015. Challenged by several factors including persistently low gasoline prices, Advanced Fuels saw employment decline more than 50% from 2014, resulting in a loss of about 8,300 jobs. (Figure 1.3)

### Advanced Energy Employment by Segment, 2014 - 2015

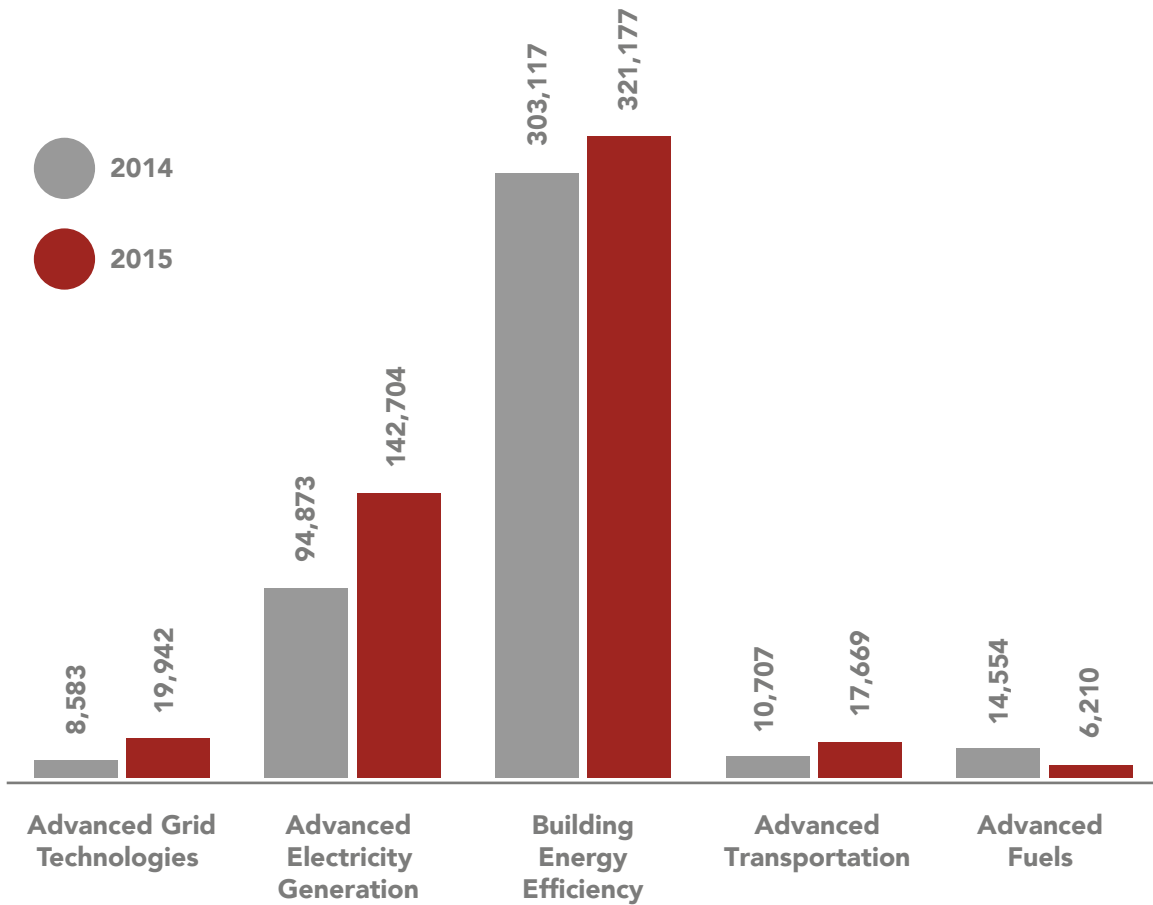


Figure 1.3

About six out of every 10 workers in California’s advanced energy economy are employed in Energy Efficiency, which supports over 321,000 jobs in total. Nearly three in 10, or about 143,000 workers, perform jobs in the Advanced Electricity Generation segment. The remaining 44,000 advanced energy workers are employed in the Advanced Transportation, Advanced Grid, and Advanced Fuel sectors. (Figure 1.4)

### Advanced Energy Employment by Segment, 2015

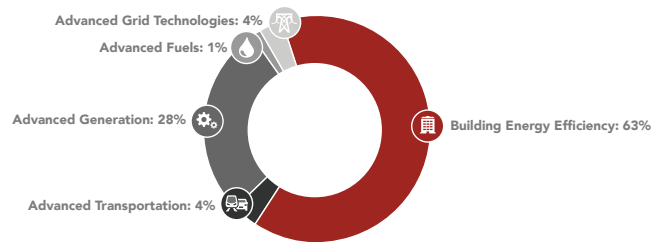


Figure 1.4



## SEGMENT-BY-SEGMENT RESULTS

### Advanced Electricity Generation

Advanced Electricity Generation employs 142,704 workers, 86% of whom spend at least half of their time on advanced energy-related work, with half devoting all their working time to it; 14% spend less than half their work time on advanced energy.<sup>11</sup> With 50% growth over last year, this segment added 47,831 new jobs in California.



*“Working at Natel has been great because there is so much variety in the type of work I do — design, fabrication, testing, and fieldwork — and in the type of skills I am developing at a small company. Developing new technology for renewable energy is so exciting, because I get to work on something that’s both important and interesting.”*

**Joanna Noble**  
Mechanical Engineer  
Natel Energy  
Alameda

Joanna Noble is a Mechanical Engineer for Natel Energy. Natel manufactures a proprietary hydroelectric turbine, the hydroEngine, that provides a fish-friendly hydropower solution at low head sites, where small drops in elevation create water flow that is high volume but low pressure. Natel Energy’s distributed approach to hydropower development, which it calls EcoSmartHydro, contributes to state energy goals as a baseload renewable energy source, as well as to state water management. Natel currently has 23 employees, all in California.

At Natel’s headquarters in Alameda, Joanna focuses on design, fabrication, testing, and fieldwork, including the design and testing of seals, design and fabrication of oil recirculation systems and machine assembly tools, and load testing of machine components. This past summer, Joanna also worked in the field installing Natel’s first commercial unit, the Monroe Hydro Project in Madras, Oregon. Joanna has been working on projects related to renewable energy since 2009. Before joining Natel in 2013, she spent two years as a technician at Makani, an innovative wind power company.

Joanna graduated from Duke University with a degree in Biomedical Engineering, and received her M.S. in Mechanical Engineering at U.C. Berkeley.

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11. For the purposes of this report, advanced energy employees are defined as workers who spend any of their time on the advanced energy portions of the business. This methodology may differ from other reports that rely on the same BW Research Energy Employment Index data. For example, The Solar Foundation, California Solar Jobs Census 2015, available at [www.TSFCensus.org](http://www.TSFCensus.org) counts only those who spend the majority of time on solar work.

The solar industry continues to be the core of California’s Advanced Electricity Generation employment. With steady growth of 4% over 2014, roughly eight out of 10 workers in Advanced Electricity Generation hold jobs in some part of the solar value-chain. (Figure 2.1)

### Advanced Electricity Generation by Technology, 2015

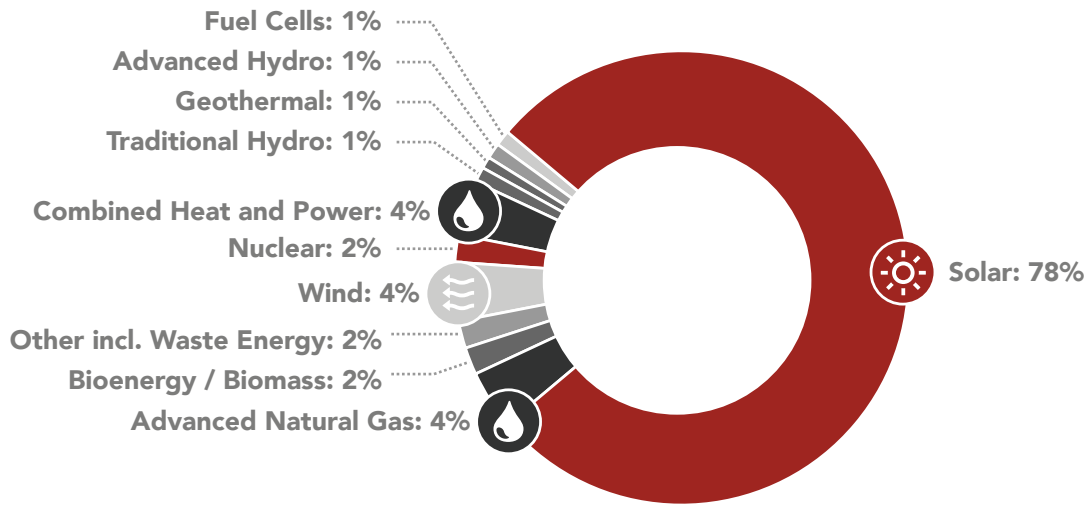


Figure 2.1

## Energy Efficiency

With 321,177 workers, energy efficiency is the largest employment segment of California’s advanced energy economy. Employment in Energy Efficiency grew 6% over 2014, adding 18,060 new jobs.

As large as Energy Efficiency employment is in California, there is still plenty of room for more energy efficiency activity. California has a smaller share of “pure-play” energy efficiency firms than some other advanced energy economies.<sup>12</sup> In fact, less than a quarter (23%) of the state’s efficiency workers spend all of their time on energy efficiency-related work; about 50% spend at least half of their time on efficiency-related activities. This is lower than both Vermont (38%) and Texas (35%), where about four in 10 employees spend all of their time on energy efficiency activities. HVAC – the largest category of energy efficiency employment in California – is divided into two categories: Traditional HVAC and Advanced HVAC. Notably, in HVAC twice as many employees spend most of their time on traditional HVAC as spend most of their time on high-efficiency HVAC technologies. (Figure 2.2)

### Energy Efficiency by Technology, 2015

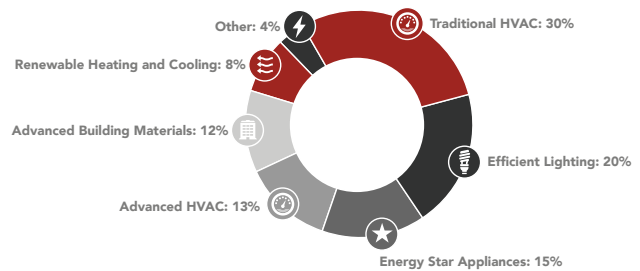


Figure 2.2

12. Pure-play firms are firms that are highly concentrated in advanced energy work and conduct limited business outside of the advanced energy technology sphere.





*“What I like about working in the energy industry is that every day is different — not the same routine. Part of that is we’re always working on new solutions to complex challenges. I’m surrounded by good talented people; there is great satisfaction working together to find an answer and reaching a goal.”*

**Dipal (Paul) Patel**  
Senior Operations Systems Analyst  
Veolia North America  
Los Angeles

As a senior operations systems analyst for Veolia, Dipal (Paul) Patel supports Veolia’s energy operations in California and the Western United States. His role spans a wide range of responsibilities from ensuring effective automation and control between facilities to certifying that their facilities follow all environmental practices and regulations for compliance. As part of a team, Paul also supports energy efficiency practices working with internal and external experts to improve operational efficiency. Finally, Paul supports energy metering implementation, management, and customer billing – ensuring accurate and effective customer billing and contractual relations.

Paul started his career with Veolia as a data entry administrator 17 years ago. His responsibilities have expanded to his current role as senior operations systems analyst. His formal training was a bachelor’s degree in computer information systems from California State University. However, Paul says he’s learned the most on the job from his peers and industry colleagues.

Veolia is a leading operator and developer of energy efficient solutions with 7,800 employees in North America. Their solutions optimize energy efficiency, performance and reliability, while reducing energy consumption, environmental impact and costs to meet the specific needs of the diverse customers and industries we serve. In California, Veolia operates a district energy network in Los Angeles and provides energy consulting and operations and maintenance services at universities, hospitals, and industrial and commercial operations.

## Advanced Fuels

Advanced Fuel was the only segment of advanced energy that lost jobs in 2015. Employment fell more than 50% from 2014, resulting in a loss of 8,344 jobs and may have been driven by shifting policy priorities, drought and low gasoline prices. Half of the state’s advanced fuels economy is supported by woody biomass, followed by corn ethanol (32%), and other liquid biofuels (16%).

### Advanced Fuel Employment by Technology, 2015

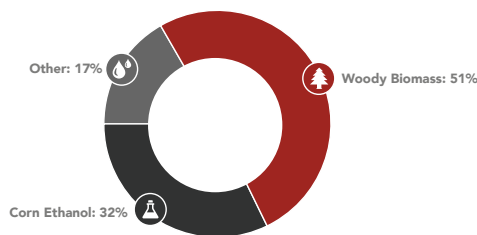


Figure 2.3



## Advanced Transportation

California’s Advanced Transportation segment is booming: it grew 65% in 2015, the second highest growth of any segment. The largest share of employment is in natural gas vehicle technologies, which support 45% of the Advanced Transportation workforce. (Figure 2.4) Cities are a major purchaser of buses with natural gas-fueled vehicles comprising 40% of city bus fleets in the state.

## Advanced Transportation Employment by Technology, 2015

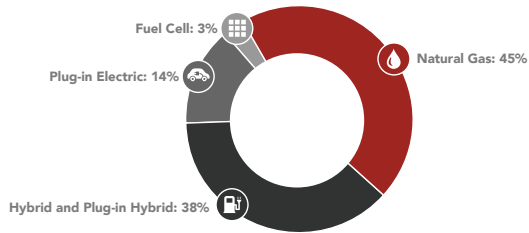


Figure 2.4

However, when considering all vehicle types (hybrid, plug-in hybrid, and fully electric vehicles), electric vehicles are the largest component of this segment, employing over half of the entire Advanced Transportation workforce in California. A number of factors are driving the growth in electric vehicles in the state, primarily the increased availability of electric vehicle charging infrastructure. Charging stations are becoming more widespread in part due to California Air Resources Board and California Energy Commission funding. More apps and web-based charging locators are making these charging stations easier to find and electric vehicle trips easier to plan. Combined with incentive programs such as “No Charge to Charge,” all of these factors are making electric vehicles a more attractive option for many California drivers.

## Advanced Grid

Advanced Grid is largely made up of two types of technologies: advanced storage and smart grid. (Figure 2.5) These technologies provide ancillary services, enhance reliability and resiliency, and integrate variable renewable generation. In addition to providing valuable services in their own right, storage and smart grid technologies will play an essential role in helping California meet its ambitious RPS targets.

## Advanced Grid Employment by Technology, 2015

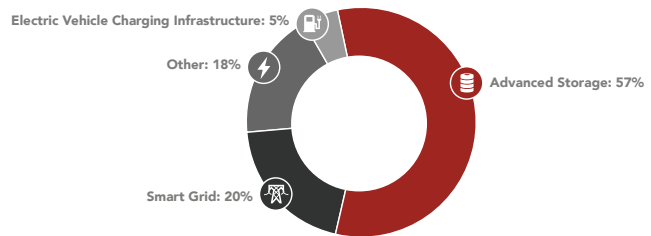


Figure 2.5

Coupled with declining costs, particularly in advanced storage, California’s efforts to modernize its power system have resulted in a boom in demand for Advanced Grid technologies. As a result, employment in the Advanced Grid sector more than doubled in 2015, growing by 132% and adding 11,359 jobs – the strongest growth of any sector.



## MARKET COMPOSITION

### Energy Workforce

**The advanced energy workforce in California is quite diverse.** Although predominantly male (74%), advanced energy workers are 38% racial or ethnic minorities, with the minority share of last year's hires slightly higher (39%). Among new hires, women make up a slightly smaller share (23%) than overall (26%). Veterans make up 9% of California's advanced energy employees overall, and 10% of recent hires. Eight percent of advanced energy workers are age 55 or older, 7% of new hires.



*"I like leading a team of highly skilled professionals to change the way the world uses energy. I love unlocking the key to the individual's success, so we can achieve even more as a whole."*

**Charlotte Wagner**

Director, Energy Intelligence, P.E., CEM, LEED AP  
EnerNOC  
Irvine

Charlotte W. Wagner, P.E., is Director of Energy Intelligence at EnerNOC (NASDAQ: ENOC), which provides energy intelligence software and demand response solutions to enterprises and utilities globally. Charlotte oversees a team of nearly 50 technical professionals, including energy advisors, energy analysts, and engineers. Professional services provided by her team include energy advising, energy efficiency and supply consulting, managed performance, and ensuring high staff utilization. She joined EnerNOC in 2009.

Charlotte has experience applying a variety of technologies to all types of facility systems. She has served as Commissioning Authority for projects at university and county buildings; overseen energy project development and implementation for large organizations; and developed, programmed, and implemented sequences for automatic temperature control systems for commercial buildings, designing the hardware and software, and providing operator training.

She has served in leadership roles for the Society of Women Engineers (SWE) for over 25 years, as president of two local sections and national membership chair. Charlotte led an effort to revitalize the SWE Orange County Section, growing membership from 37 to more than 300.

Charlotte Wagner holds a B.S. in Mechanical Engineering from the University of Maryland at College Park. She is a registered professional mechanical engineer in California, a LEED Accredited Professional, a Certified Energy Manager, a Certified Lighting Efficiency Professional, and has served on the Board of Governors for the Orange Empire chapter of ASHRAE.

EnerNOC employs over 80 people in California and has a total workforce of 1,300 nationwide.



## Value Chain

California’s advanced energy industry is dominated by installation, maintenance, and repair firms, which comprise 42% of advanced energy businesses, similar to last year (41%). (Figure 3.1) However, engineering, research, and professional services have become an important component of advanced energy activity across the state.<sup>13</sup> The share of research activity has grown by 9% since last year – these services now comprise about a third of the state’s advanced energy firms, indicating that the industry is mature enough to warrant more services.

## Firm Size

California’s advanced energy economy is still primarily composed of small businesses, though the industry is slowly shifting towards larger establishments. Three-quarters of advanced energy businesses employ 24 permanent employees or fewer, but that is down from 81% last year. At the same time, firms that employ between 25

### Advanced Energy Employment by Value Chain, 2015

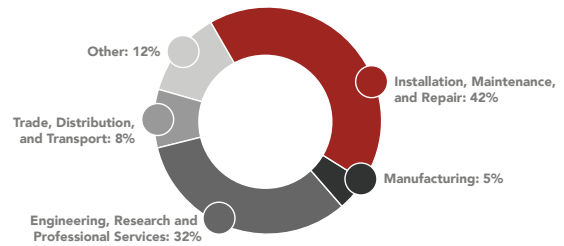


Figure 3.1

### Advanced Energy Employment by Firm Size, 2015

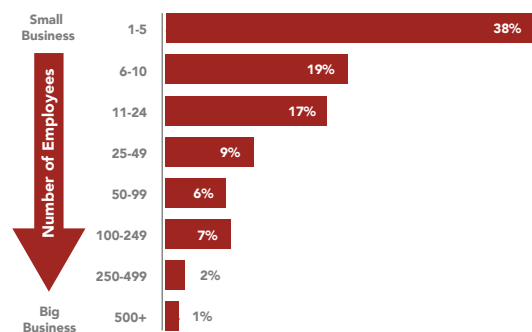


Figure 4.1



*“It’s exciting to work in the energy storage area today — I have an opportunity to enable our transformation to a clean, unbreakable, and flexible power grid. I enjoy my work; it’s fun creating such future-proof solutions.”*

**Kate McGinnis**  
 Western U.S. Market Director  
 AES Energy Storage  
 San Francisco

Kate McGinnis is responsible for energy storage project and market development in the Western United States at AES Energy Storage, a leading commercial energy storage provider that serves utilities, power system operators and other customers in the United States and around the world. Kate works with utilities, regulators, and other stakeholders to promote the benefits of energy storage. She has over 15 years of experience in the energy industry. Prior to joining AES, Kate worked at Chevron, where she led global development of stationary storage projects co-located with oil and gas infrastructure. There she was also involved with the development of renewable energy projects including geothermal, solar thermal, and wind.

Early in her career she collaborated with industry to promote energy efficient products to consumers. She holds an MBA from Cornell University and a B.S. in Environmental Science from George Washington University.

13. Though value chain titles are more comprehensive this year they are comparable to previous AEE Institute surveys as follows: installation is now installation, maintenance, repair and operations; engineering, research, and professional services was previously split into engineering and research and legal, consulting, finance, etc.; sales and distribution is now trade, distribution, and transport.

and 49 employees have grown from representing only 6% of the industry in 2014 to 9% in 2015. The share of medium to large firms (those that employ between 25 to 249 workers) has also grown, from 13% in 2014 to 22% 2015. (Figure 4.1)

## Employer Hiring Experience

**The majority of firms reported difficulty in hiring over the past 12 months.** Just under three-quarters of firms (73%) report difficulty finding qualified workers in 2015; two in 10 employers report that hiring was “very difficult.” The top two reasons for difficulty were lack of experience, training, or technical skills (44%), and insufficient qualifications, certifications, or education (31%); about two in 10 respondents also noted lack of soft skills (18%). (Figure 4.2)

About a quarter of firms report difficulty hiring managers, directors, and supervisors (24%) and sales, marketing, or customer service representatives (24%), while almost two in 10 firms reported difficulty hiring installation (18%) and technician or technical support (18%) workers.



*“Every day we see the tangible, positive results of our work. Whether it’s making a home more comfortable and affordable or helping a contractor expand his business, we know that our job is to constantly innovate in order to create more value in every community we serve.”*

**Tamiko Kikuchi**

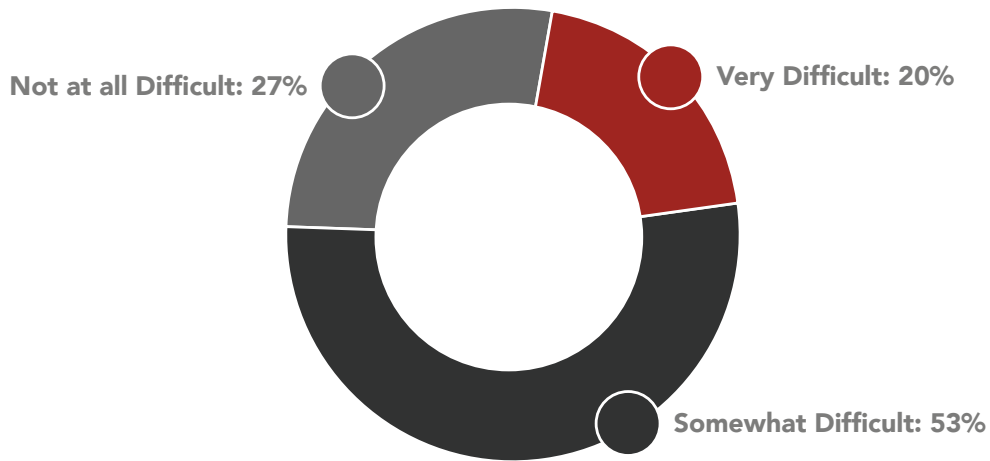
Vice President of Product Management  
Renovate America  
San Diego

Tamiko Kikuchi is a founding member of Renovate America, the nation’s leading provider of residential Property Assessed Clean Energy (PACE) financing. The San Diego-based Renovate America partners with local governments to provide the HERO program, which enables homeowners to make renewable energy and energy and water-efficient upgrades that benefit their homes and communities and pay for those improvements through their property taxes. Renovate America currently has 640 employees in California.

Tamiko and her team drive strategic vision, user experience, and implementation of Renovate America’s innovative technology platform. Renovate America’s integrated software provides homeowners, municipalities, realtors, and contractors with product and underwriting data as well as industry-leading consumer protections.

Renovate America’s robust platform includes an end-to-end financing origination system, a mobile application for local government leaders to see the impact of HERO within their community, a customized contractor portal, and a database containing information on over 1 million products rated as energy or water efficient.

As of March 2016, Renovate America financed over \$1.3 billion in home energy and water upgrades that helped create over 11,000 local jobs and generate \$2.3 billion in economic impact while reducing carbon emissions and water usage. The HERO Program is now offered in more than 380 communities across California and is launching in additional states this year.



### Hiring Difficulty, 2015

Figure 4.2

## Customers and Vendors

The state’s customer and supplier base remains locally focused. California’s advanced energy economy supports more in-state suppliers compared to other advanced energy economies. This is in part a reflection of the size of California itself, as well as a sign of the advanced energy industry taking deeper root.<sup>14</sup> Six in 10 firms report primarily in-state suppliers and vendors, an increase of about 2% since last year’s survey. Three-quarters of the state’s advanced energy firms serve in-state customers; about 2% reported primarily international clients. (Figure 4.3)

### Customer and Vendor Locations, 2015

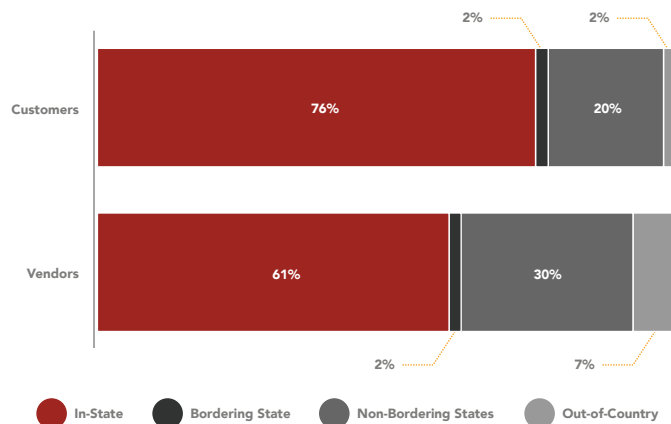


Figure 4.3

## Revenue Streams

**Advanced energy is becoming a more reliable source of revenue for firms.** In 2014, four in 10 firms derived all of their revenue from advanced energy activity; this has increased to almost half of the state’s advanced energy firms today. (Figure 4.4)

### Percent of Revenue Attributed to Advanced Energy Activities, 2015

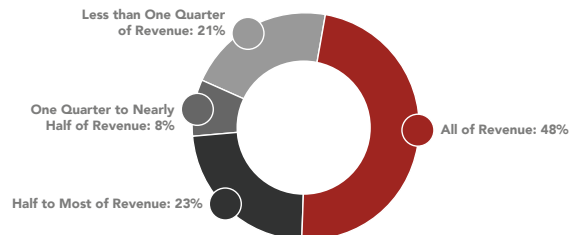


Figure 4.4

14. Just over half (56%) of advanced energy firms across Vermont and just under half (49%) of advanced energy firms across Florida report primarily in-state suppliers and vendors.





*“When you think about it, the grid of the future will be a mixture of all sorts of technologies, with energy storage being key to integrating different renewable solutions.”*

**Melanie Jasper**  
Market Development Engineer  
Ice Energy  
Santa Barbara

It was a magazine article highlighting Ice Energy’s ice battery technology that caught Melanie Jasper’s attention, back when she was in college at Carnegie Mellon University. That serendipitous encounter led her to research the company and she liked what she learned. Ice Energy is a leading energy storage provider for the grid, delivering behind-the-meter thermal storage for HVAC systems, transforming air conditioning into a clean, flexible, and responsive grid resource for more than 40 utility service territories nationwide. The system works by creating and storing ice at night, when electricity is cheaper, then drawing on this cooling system during peak demand hours.

After graduating with a B.A. and M.A. in Mechanical Engineering, Melanie applied for an engineering job at Ice Energy, and she has been working at the Santa Barbara-based company for more than two years. Melanie’s job is to create energy models to help commercial and industrial customers determine energy and financial savings. She is also involved with the sales team and provides back-end support. Melanie receives inquiries from a variety of customers, including utility companies, property managers, and business owners, who are interested in ice batteries. She expects that more will be drawn to the technology, thanks to the many benefits the system brings.

Ice Energy employs 34 staff in the United States, including 28 in California.

## Regional Results

**The majority of advanced energy jobs are located in Southern California and the Greater San Francisco Bay Area**, the two largest regions by population. (Table 1.1) This finding is similar to last year’s survey in which 64% of advanced energy employment was located in these two regions. This year, 67% of advanced energy jobs are located in Southern California and the Greater San Francisco Bay, an increase of 3 percentage points from last year.

**Almost all regions, with the exception of the Inland Empire, saw advanced energy grow as a share of total employment over last year.** The largest increase occurred in the Greater Sacramento region. In 2014, advanced energy jobs supported 2% of the region’s workforce. Today, that figure has more than doubled: these workers now represent 4% of total employment in the region. The Inland Empire saw the share of advanced energy employment decline to about 3% of all jobs from about 4% last year. Meanwhile, advanced energy’s share of California’s jobs overall rose from 2.4% to 2.9% over the past 12 months.



## Advanced Energy Employment by Region, 2015<sup>15</sup>

Region	Population	Advanced Energy Jobs	Total Jobs	% of Total Jobs
Southern California	17,635,918	229,153	8,145,109	2.8%
Inland Empire	4,693,171	40,377	1,531,663	2.6%
Central Coast	1,504,111	20,138	655,819	3.1%
Greater San Francisco Bay	7,161,311	113,020	3,750,379	3.0%
Greater Sacramento	1,896,552	30,399	832,042	3.7%
Rest of California	6,609,205	74,616	2,396,978	3.1%
<b>California Total</b>	<b>39,500,268</b>	<b>507,703</b>	<b>17,311,990</b>	<b>2.9%</b>

Table 1.1

**Energy efficiency remains the largest segment of jobs across all regions**, though other segments have seen gains since last year's report. Energy efficiency jobs make up the greatest share of advanced energy employment in Southern California, where they account for 72% of the advanced energy workforce. Table 1.2) The region's advanced energy market has also diversified a bit since last year, when energy efficiency was 77% of advanced energy employment. The diversification of California's advanced energy economy was also evident in the growth rate of individual segments. While energy efficiency grew 6% (twice the rate of the rest of California's job market), nearly every other segment grew by double or even triple digits. While energy efficiency is still the majority of advanced energy jobs, the rest of the advanced energy economy is starting to catch up.

## Energy Efficiency Employment by Region, 2015

Region	Energy Efficiency Jobs	Percent of Advanced Energy Jobs
Southern California	164,661	72%
Inland Empire	23,738	59%
Central Coast	10,017	50%
Greater San Francisco Bay	62,192	55%
Greater Sacramento	17,000	56%
Rest of California	43,568	58%

Table 1.2

15. Population (2015Q4) and total employment (Census 2014) estimates are from Chmura Analytics JobsEQ.



Energy efficiency jobs saw the least loss of market share in Greater Sacramento, where they only decreased by 1 percentage point compared to other advanced energy jobs. Other regions saw energy efficiency as a share of total advanced energy employment decrease by 15 percentage points, as other advanced energy segments, especially Advanced Electricity Generation ticked up. (Table 1.3) Still, this year, energy efficiency jobs make up between 50% and 60% of advanced energy employment in all regions of California except Southern California.

**Advanced Electricity Generation is the second largest subset of advanced energy technologies for nearly all regions in California.**

The impressive growth seen in this segment across the state last year suggests that declines in the share of energy efficiency employment may be attributed to gains across advanced generation firms. However, there are three regions – the San Francisco Bay, Sacramento, and Rest of California – that also exhibit a significant share of other advanced technologies, including Advanced Fuels, Advanced Transportation, and Advanced Grid.



**Share of Advanced Energy Technology Employment by Region, 2015**

Region	Advanced Electricity Generation	Energy Efficiency	All Other Advanced Energy Technologies	% of Total Jobs
Southern California	26%	72%	2%	2.8%
Inland Empire	33%	59%	8%	2.6%
Central Coast	50%	50%	0%	3.1%
Greater San Francisco Bay	27%	55%	18%	3.0%
Greater Sacramento	24%	56%	20%	3.7%
Rest of California	28%	58%	13%	3.1%

Table 1.3

## CONCLUSION

This second review of California’s advanced energy economy shows a maturing industry with substantial – and growing – employment opportunity. A culture of entrepreneurial spirit and technological innovation combined with a supportive policy infrastructure have contributed to an advanced energy economy that now employs over half a million workers, 3% of total employment across the state, and is growing at a rate six times faster than the overall economy. Employers expect to grow employment by 8% over the coming year.

This year’s data also shows evidence of market transformation; small businesses are growing larger, and firms are finding that they increasingly rely entirely on advanced energy to produce their revenue streams. In-state suppliers continue to meet this demand, supporting local growth and capital exchange, and the growth of a service sector in the industry.

Demand growth has translated to both firm and revenue expansion. In 2014, eight in 10 firms reported fewer than 25 permanent employees; this share of the smallest firms has declined to 74%, while the proportion of firms that employ between 25 and 249 workers has grown from 13% of the industry in 2014 to 22% in 2015. More firms derive all of their revenue from advanced energy activity. Last year, four in 10 firms sourced all of their revenue from advanced energy-related business; this has increased to almost half of the state’s advanced energy firms today.

The state’s commitment to advanced energy deployment has resulted in growth across nearly all technology segments. The Advanced Grid segment more than doubled its employment, while Advanced the Transportation and Advanced Electricity Generation segments increased their payrolls by 65% and 45%, respectively.

This year’s study suggests a future of continued employment growth. As the market matures, California will see greater specialization in energy efficiency, business expansion, revenue growth, and changes in the state’s overall composition of advanced technologies. These factors will continue to allow California’s advanced energy industry to grow and thrive, and employment along with it.





## APPENDIX

**Advanced Energy Jobs by California State Senate District** (Table 2.1)

District	Jobs	District	Jobs
1	21,714	21	7,197
2	12,958	22	9,317
3	21,547	23	4,627
4	10,797	24	16,095
5	10,137	25	6,307
6	5,119	26	7,624
7	7,324	27	13,791
8	11,689	28	8,693
9	16,600	29	10,357
10	20,675	30	13,107
11	21,445	31	12,994
12	12,855	32	11,109
13	13,310	33	17,421
14	12,768	34	12,700
15	12,045	35	19,272
16	11,630	36	21,544
17	13,938	37	18,473
18	21,496	38	8,281
19	9,319	39	6,633
20	7,213	40	7,583



## Advanced Energy Jobs by County (Table 2.2)

County	Jobs	County	Jobs
Alameda County	21,600	Orange County	44,100
Alpine County	20	Placer County	7,318
Amador County	737	Plumas County	727
Butte County	3,353	Riverside County	19,993
Calaveras County	847	Sacramento County	23,081
Colusa County	558	San Benito County	389
Contra Costa County	12,924	San Bernardino County	19,242
Del Norte County	458	San Diego County	59,994
El Dorado County	2,770	San Francisco County	17,760
Fresno County	8,538	San Joaquin County	5,370
Glenn County	697	San Luis Obispo County	5,173
Humboldt County	2,590	San Mateo County	11,757
Imperial County	2,441	Santa Barbara County	8,763
Inyo County	707	Santa Clara County	33,534
Kern County	8,220	Santa Cruz County	3,071
Kings County	1,143	Shasta County	2,869
Lake County	996	Sierra County	130
Lassen County	667	Siskiyou County	1,345
Los Angeles County	114,292	Solano County	3,078
Madera County	1,624	Sonoma County	9,334
Marin County	6,111	Stanislaus County	4,892
Mariposa County	528	Sutter County	1,255
Mendocino County	2,042	Tehama County	1,046
Merced County	2,321	Trinity County	478
Modoc County	458	Tulare County	3,856
Mono County	498	Tuolumne County	1,186
Monterey County	2,742	Ventura County	10,767
Napa County	1,614	Yolo County	2,979
Nevada County	2,032	Yuba County	687

**Advanced Energy Jobs by Congressional District** (Table 2.3)

Congressional District	Jobs	Congressional District	Jobs
1	22,662	28	15,916
2	19,343	29	6,460
3	17,525	30	11,808
4	14,537	31	7,430
5	13,518	32	13,067
6	12,300	33	11,000
7	8,589	34	8,151
8	8,361	35	7,912
9	8,860	36	15,932
10	16,996	37	9,844
11	8,635	38	11,848
12	7,854	39	12,047
13	11,143	40	17,428
14	7,697	41	19,215
15	5,787	42	3,253
16	6,276	43	12,507
17	6,334	44	3,799
18	4,569	45	16,050
19	6,298	46	5,617
20	3,876	47	7,956
21	3,637	48	9,418
22	3,496	49	4,245
23	11,604	50	6,949
24	2,708	51	4,716
25	3,882	52	7,199
26	5,307	53	7,963
27	8,175		



**Advanced Energy Jobs by California State Assembly District** (Table 2.4)

District	Jobs	District	Jobs	District	Jobs
1	13,137	28	4,577	55	6,722
2	9,429	29	5,371	56	2,928
3	4,991	30	1,870	57	6,247
4	10,247	31	2,335	58	1,822
5	8,554	32	3,871	59	1,133
6	9,891	33	6,028	60	3,577
7	14,532	34	3,219	61	4,324
8	2,782	35	7,423	62	4,175
9	2,128	36	4,969	63	3,981
10	6,851	37	11,394	64	4,578
11	3,110	38	8,216	65	5,589
12	5,716	39	5,265	66	4,003
13	2,707	40	5,184	67	3,452
14	9,168	41	11,620	68	12,384
15	7,433	42	6,844	69	3,615
16	3,548	43	6,085	70	5,624
17	16,446	44	3,345	71	10,687
18	6,412	45	9,046	72	4,024
19	3,278	46	2,945	73	5,621
20	6,373	47	2,558	74	6,182
21	3,150	48	5,114	75	9,040
22	8,081	49	3,528	76	7,423
23	6,561	50	11,055	77	17,674
24	12,664	51	7,244	78	12,052
25	15,137	52	7,199	79	3,302
26	5,555	53	5,211	80	140
27	2,612	54	5,395		



## Advanced Energy Jobs by California Metropolitan Statistical Area (MSA) (Table 2.5)

MSA	Jobs
Bakersfield	8,221
California Non-MSA	18,355
Chico	3,342
El Centro	2,392
Fresno	8,587
Hanford-Corcoran	1,139
Los Angeles-Long Beach-Santa Ana	157,805
Madera	1,539
Merced	2,313
Modesto	4,924
Napa	1,608
Oxnard-Thousand Oaks-Ventura	10,728
Redding	3,048
Riverside-San Bernardino-Ontario	39,207
Sacramento-Arden-Arcade-Roseville	37,625
Salinas	2,732
San Diego-Carlsbad-San Marcos	59,781
San Francisco-Oakland-Fremont	70,646
San Jose-Sunnyvale-Santa Clara	33,265
San Luis Obispo-Paso Robles	5,156
Santa Barbara-Santa Maria-Goleta	8,731
Santa Cruz-Watsonville	3,060
Santa Rosa-Petaluma	9,305
Stockton	5,361
Vallejo-Fairfield	3,067
Visalia-Porterville	3,842
Yuba City	1,926





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