MASSACHUSETTS
CLEAN ENERGY
CENTER

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2016

MASSACHUSETTS CLEAN ENERGY INDUSTRY REPORT

[bw]
RESEARCH
PARTNERSHIP

A Message from the CEO

This was a watershed year for clean energy in Massachusetts.

Gov. Charlie Baker and the Massachusetts Legislature passed laws to expand the solar market and diversify the state's energy mix by making a first-in-the-nation commitment to 1,600 megawatts of cost-competitive offshore wind. The Massachusetts Clean Energy Center (MassCEC) teamed with the Massachusetts Department of Energy Resources to release a groundbreaking study on energy storage, laying the foundation for increasing project deployment and continuing innovative business model and technology development. Massachusetts was also named the most energy efficient state in the nation for the sixth year in a row.

And 2016 also saw the clean energy industry top 100,000 jobs in the Commonwealth.

Every year, MassCEC commissions an independent study that takes the pulse of our clean energy industry. And every year since we began collecting this information back in 2010 the clean energy sector has grown. This year is no exception as the 2016 Massachusetts Clean Energy Industry Report shows the local clean energy sector expanded for a sixth-consecutive year.

As a result of this steady growth, clean energy now employs 105,212 workers across the Commonwealth, an increase of 75 percent, or 45,000 jobs, since 2010. Clean energy employment in Massachusetts grew 6 percent between 2015 and 2016, adding more than 6,000 jobs. By comparison, Massachusetts total employment was 2 percent higher between the second quarter of 2015 and the second quarter of 2016, according to MassBenchmarks. MassBenchmarks also reported number of U.S. jobs grew at an annual rate of 1.3 percent.

Clean energy industry growth is in line with the growth of other Massachusetts larger and more established industries including the life sciences. According to MassBIO, Massachusetts biopharma employment grew by 4.2 percent in 2015 with total growth of 37 percent over the previous decade. For the technology sector as a whole – industry agnostic – the growth was 1.7 percent last year, according to the 2015/2016 Massachusetts Innovation Index. The index also reported that software and communications employment and biopharma and medical devices employment grew by 14 percent and 2.5 percent, respectively between 2009 and 2014.

The clean energy sector represents 2.9 percent of all jobs in Massachusetts. Looking at Gross State Product, the clean energy sector has become an important part of the overall Massachusetts economy,

contributing $11.8 billion in economic activity in 2015 and accounting for 2.5 percent of Massachusetts' Gross State Product (GSP).

Hiring among workers who have earned associate's degrees or high school diplomas or equivalents rose by 17 percent over the past year. Importantly, clean energy jobs in Massachusetts also continue to pay well. Just under 70 percent of workers earn more than $50,000 which is above the state's overall median wage of $45,573.

The growth of employment and economic activity has been coupled with a continued rise in the installation of renewable energy systems across the Commonwealth. Over that same period, businesses and homeowners in Massachusetts installed more than 25,390 such systems over the past year, adding an additional 374 megawatts (MW) of electric capacity in the process, enough to power 56,040 homes.

This report is not just a census of clean energy establishments and workers. The study includes in-depth data on industry trends and challenges that inform the feedback we hear throughout the year from business owners and consumers across the state. At MassCEC, we use this study as a tool to shape programs and initiatives, as we look to create the necessary framework for continued growth across the sector.

In 2017, MassCEC will focus on continuing to grow existing sectors, like solar and clean heating and cooling, and investing in emerging sectors, such as offshore wind and energy storage.

The growth reflected in this report is fueled not just by consumer choice and business opportunity but also by forward-thinking public policies that seek to drive the transition to a cleaner, more resilient, more cost-effective renewable energy portfolio in Massachusetts. States across the nation are hard at work supporting the expansion of the clean energy economy. As part of that trend, the Baker-Polito Administration will continue to build upon Massachusetts' success while meeting the Commonwealth's Global Warming Solutions Act greenhouse gas emissions targets.

We are counting on your partnership as we continue growing the clean energy industry and delivering the economic and environmental benefits of clean energy to all businesses and residents of the Commonwealth.

Stephen Pike

CEO, Massachusetts Clean Energy Center

TABLE OF CONTENTS

COMPANY NAME: HTP, INC.

LOCATION: NEW BEDFORD, MA

NUMBER OF EMPLOYEES IN MASSACHUSETTS: 240

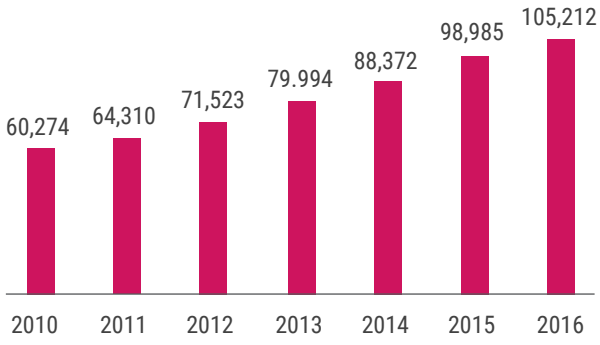
Founded in 1974, HTP is an American manufacturer of state-of-the-art, high efficiency water and space heating systems.

EXECUTIVE SUMMARY

As clean energy products and technologies become more mainstream, the Massachusetts clean energy sector continues to report sustained growth, expanding to over 105,000 jobs between 2015 and 2016, further strengthening the industry's standing as a robust source of statewide economic activity.

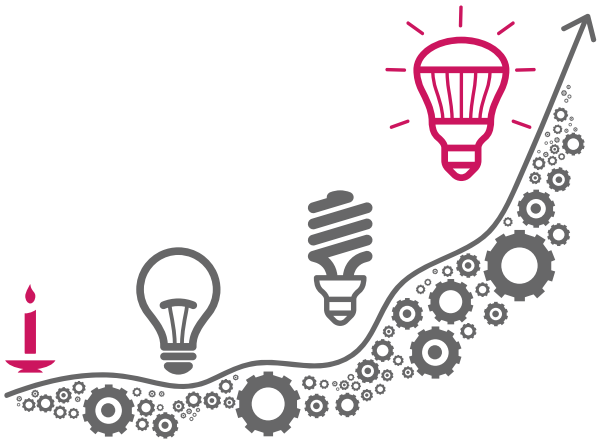
Since 2010, the Massachusetts clean energy economy experienced steady growth with a diverse range of industry activity from early stage research and development to the sale, installation, and maintenance of energy-efficient, renewable energy, and alternative transportation technologies.

The clean energy industry continues to be a growing segment of the overall Massachusetts economy, contributing $11.8 billion to Massachusetts' Gross State Product – an increase of $810 million over the previous year. The industry represents a 2.5 percent share of the entire Massachusetts economy and clean energy employees account for 2.9 percent of the state's labor market. With strong growth and demand for clean energy goods and services, the industry continues to contribute to statewide GSP—29 percent growth in total dollars since 2013.



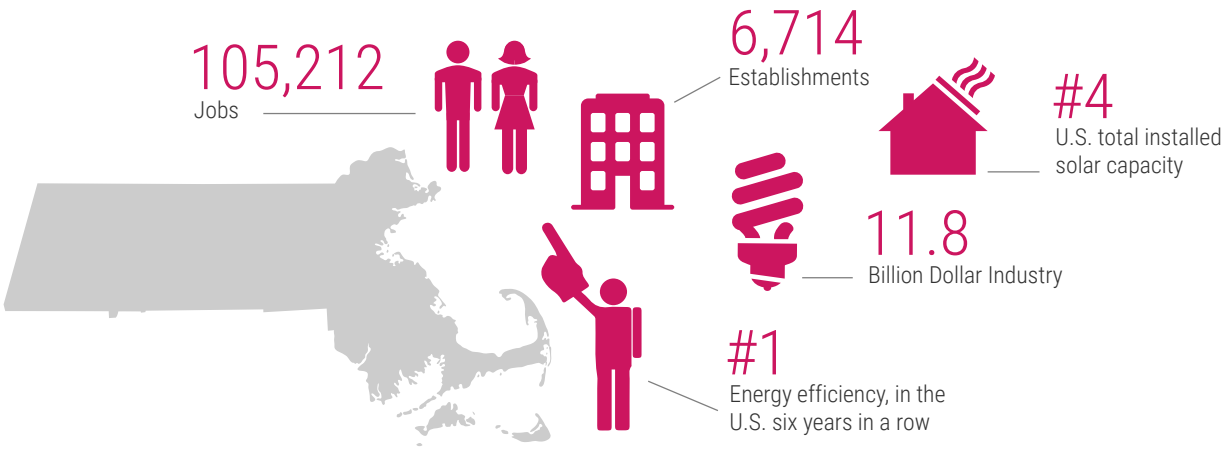
The 2016 Massachusetts Clean Energy Industry Report, which serves as an accounting of the sector's activity, shows an industry that has continued to grow notwithstanding low fossil fuel prices, evolving clean energy public policies, challenging private investment trends and uncertainty around federal spending commitments.

The report describes six key findings that reflect a dynamic industry with growth across the spectrum from ***innovation to installation***.



1. **105,212** – The number of clean energy jobs across Massachusetts.
2. **75%** – The number of clean energy jobs has grown markedly – by 75 percent– since 2010, with almost 45,000 more clean energy workers in the Commonwealth today than six years ago.
3. **6%** – Clean energy jobs in Massachusetts grew by 6 percent, continuing the sustained growth seen over the past six years.

MASSACHUSETTS BY THE NUMBERS



4. **$50,000** – Massachusetts clean energy jobs pay well, with almost 70 percent of full-time workers earning $50,000 or more annually, compared to a median wage of $45,573 for all jobs across Massachusetts.
5. **25,390** – The number of renewable energy projects installed in Massachusetts, adding an additional 374 megawatts (MW) of electric capacity in the process, enough to power 56,040 homes.
6. **#1** - The Commonwealth remained #1 in the United States for early-stage per-capita clean energy venture investment, beating out California. Early stage investment in Massachusetts clean energy companies grew 166 percent over the previous year.

Other observations of the report include:

OVERALL INVESTMENT IN CLEAN ENERGY COMPANIES HAS REBOUNDED IN MASSACHUSETTS

- Clean energy establishments closed more rounds of financing and attracted more public, private, and early-stage dollars and deals over the last 12 months.
- While the industry saw both global and nationwide investment dollars declined over 2015, Massachusetts' managed to attract more than double the amount of early-stage dollars compared to 2014.

EMPLOYMENT IS GROWING STATEWIDE.

- The Southeast and Northeast regions of the state constitute the most clean energy jobs among the four regions.
- The largest growth occurred in Northeastern Massachusetts at 8.8 percent.

THE MAJORITY OF ESTABLISHMENTS ARE SMALL

- Eighty-five percent of establishments have fewer than 50 employees and 61 percent have fewer than 10 employees.

MASSACHUSETTS CLEAN TECHNOLOGY INNOVATION IS STRONG

- According to patent data collected by Cleantech Group, Massachusetts clean energy companies accounted for 98 percent of related patent activity in New England over the last 12

months and eight percent of the nation's clean technology patents in the last five years.

- Massachusetts is a leader in New England for patent activity, accounting for the majority of clean-tech patents that have been filed over the last five years.
- Startup activity was greatest in Electrical Efficiency and Building Envelope with 61 percent growth of early-stage establishments.
- The clean energy sector is providing opportunities across education levels.
- The number of clean energy hires in Massachusetts with an associate's degree or high school diploma/equivalent increased by 17 percent over the past year.
- The Massachusetts industry is maturing and clean energy activity is becoming more specialized.
- Renewable energy generation deployment was nearly exclusively photovoltaic generation in 2015, and the alternative transportation market appears to be moving rapidly towards electric vehicles and away from other technologies.
- More establishments are exporting goods and services.
- Massachusetts is likely to remain a global clean energy leader.
- Massachusetts promises to continue to be a central actor in national and global clean energy development, supplying both high-wage employment opportunities and the next wave of clean energy technologies.

Among the challenging market forces were low prices for fossil fuels and an abnormally warm winter—which dampened demand for efficient heating equipment—in addition to regulatory and policy uncertainty at the state and federal levels, and increased competition from other states and countries. Unlike in the past, however, such trends seem to have less impact on industry growth and despite these challenges.

Within this environment, the state's clean energy economy continues to attract investments and create jobs across the Commonwealth. The sector saw growth in both early-stage establishments and investment dollars, with patent activity to match. Shifting markets focused workers towards distributed photovoltaic and electric vehicle technologies over 2015, changing this year's new hire profile in terms of education and wage distributions.

Though establishments are exporting their services outside of New England, they are also importing from out-of-state vendors, indicating an opportunity to strengthen in-state supplier networks. While trends in this 2016 industry report are not unlike previous years' assessments, they are markers for a maturing industry.

A better understanding of the state's clean energy value chain might explain these trends and may point to opportunities to utilize more in-state vendors and suppliers. As in-state installations begin to move towards capacity, the state must continue to strengthen both its innovative and export-oriented core of activities.

ORGANIZATION: BUNKER HILL COMMUNITY COLLEGE,
ENERGY AND SUSTAINABILITY MANAGEMENT CERTIFICATE

ENROLLMENT: 20 STUDENTS ENROLLED IN FALL 2016

Developed in 2013 as part of a U.S. Department of Labor grant, Bunker Hill Community College's Energy and Sustainability Management Certificate allows students to earn college credit while preparing for careers in clean energy services. Through project-focused learning, students develop skills across disciplines such as environmental science, business administration, project management, LEED concepts and sustainable facilities management.

METHODOLOGY

This report chronicles the core elements of the Massachusetts clean energy industry and its key levers through the analysis of (a) public data, such as federal and state labor market data, Census Bureau data, and input-output information from the Bureau of Economic Analysis; (b) proprietary data sources such as business listings from Dun & Bradstreet and InfoUSA; and, (c) investment and patent information from Cleantech Group's i3 platform. It also uses cutting-edge, rigorously developed and tested primary data collection techniques that provide novel insights into the Commonwealth's clean energy cluster.

Clean Energy, while defined by the Massachusetts Legislature (MGL 23J), does not have a consistent definition across states and nations, nor does it have a dedicated, well-defined set of North American Industry Classification System ("NAICS") codes associated with it. This report has adopted a definition for "clean energy" consistent with the MGL 23J in response to the absence of a universally accepted definition and dedicated clean energy industry data.

Since existing data frameworks do not provide meaningful insight into clean energy trends on their own, primary data, collected directly from employers, serves as a necessary substitute to ensure the accurate development of clean energy-specific metrics, including employment and establishment totals.

As with previous years' editions of the Clean Energy Industry Report, some of the primary data included in this study has been derived from a comprehensive survey of business establishments in Massachusetts. The survey was conducted on a random sample of businesses and results were extrapolated to the entire universe. Details on the survey are presented in a section below.

The research methodology employed for this report, including the survey instrument and sampling plan has been rigorously reviewed and accepted by the Department of Energy and Bureau of Labor Statistics. It has been used by the U.S. Government in its annual Energy and Employment Report, and has been used increasingly as a tool for measuring clean energy industry jobs and establishments across multiple states, including in California, Florida, Illinois, Iowa, Missouri, Ohio, Pennsylvania, Rhode Island, Tennessee, and Vermont.

For a comprehensive list of definitions, please refer to the glossary.

DATA SOURCES

GROSS STATE PRODUCT (GSP) AND REVENUES DATA

Any reported revenue data is collected through the employer survey described below. The associated validity period for the data is the 12 months between May 2015 through May 2016.

Gross State Product (GSP) is an important measure of economic activity, measuring the value and flow of goods and services produced in the economy. GSP is presented both for the overall clean energy economy and for each of the four major technologies; the data supports the economic index portion of each of the BW Indices. The input-output

data for GSP is derived from data from the U.S. Bureau of Economic Analysis, by NAICS code and for the calendar year.

This is then multiplied by the ratio of clean energy establishments to all establishments within the NAICS segment, which produces the Gross State Product contribution of establishments engaged in clean energy activities. To generate the clean energy proportion, this figure is further reduced by multiplying it by the mean reported revenues attributed to clean energy goods and services from the survey.

JOBS AND ESTABLISHMENTS DATA

Jobs and establishments data is collected from federal data sources, state data sources and employer surveys, referring to the 12 months between May 2015 through May 2016. The federal sources used include the Bureau of Labor Statistics' Quarterly Census of Employment and Wages, Current Employment Statistics, and Occupational Employment Statistics, all available publicly at http://bls.gov. This report uses state data provided by the Massachusetts Executive Office of Labor and Workforce Development.

INVESTMENT CAPITAL/ INNOVATION DATA

As with previous years, this report includes only "new energy" investments, which is in stark contrast to other widely circulated studies on clean energy investment trends. Most of those reports, including the Bloomberg New Energy Finance Reports, are heavily influenced by asset finance deals. Unfortunately, asset finance is not further delineated between new project financing and existing entity debt restructuring or other business lines of credit not focused on new energy. In clean energy markets, project finance typically is used for "new" energy production rather than for restructuring "old" energy projects. Only investments to private equity-backed establishments are included in this report[1].

1 This does not mean that only private equity is included. Rather, publicly traded companies and those operating exclusively on revenues from commercial projects are excluded from the dataset.

This report uses Cleantech Group's i3 Platform for all investment data. The Platform is a comprehensive catalogue of innovative clean energy companies worldwide; datasets can be filtered by technology, investment type, geography, and time frame. The data reported indicates both total dollar amounts and deals, which refers to the number of single investments closed. The i3 data platform was selected for the analysis because every investment included in the database is independently cited and can be verified, unlike many reports that do not disaggregate the data.

The i3 data includes a wide range of investment types, and also includes technologies that are outside of the scope of this report. As a result, Cleantech Group's publicly reported data will differ from the results included in this report. For the purposes of this study, the following filters were applied:

Investment Type: Early-stage (Seed, Series A, Series B), Structured Debt, Growth Equity, Project Finance, Grants, Loans, and Guarantees

Technologies: Energy Efficiency (including Energy Storage, Smart Grid); Renewable Energy (e.g., Geothermal, Hydro and Marine Power, Solar, Wind, Biomass Generation); Renewable and Efficient Heating and Cooling (Biofuels and Biochemicals); Transportation (e.g., Fuel Cells and Hydrogen, Hybrid Electric, Plug-in Hybrid, and Electric Vehicles)

PATENT DATA

This report uses patent data filings from Cleantech's i3 Platform; the latest data available is through 2015. It is important to note that the Platform does not yet provide disaggregated patent information by subtechologies. As a result, all patent data totals referenced in the report illustrate total patent

activity of all subtechnologies in a major category. For example, the Transportation sector includes a number of clean subtechnologies related not only to electric vehicles, but also car sharing, transportation software, or transportation infrastructure technologies. In some instances, such as with renewable and efficient heating and cooling, the only technology area that could be used as a proxy is biofuels and biochemicals. However, reporting for only those technologies would likely undercount the actual activity of the segment.

In addition, because of the highly technical nature of the patents, all patents awarded to establishments that identify as working in clean energy are counted, whether or not the patents are directly related to clean energy technologies.

MASSCEC CONTRIBUTIONS

Some of the material (marked with SOURCE: MassCEC) in the report has been provided by MassCEC. The contributed material includes activities that MassCEC supports through its programs or has been involved in.

BW INDICES

The indices are a metric developed by BW Research to track activity by sector over time. There are three indices: (1) employment index – sector growth rate, percentage of workers who spend all of their time on clean energy activities, (2) innovation index – change in total investment, number of deals, mergers and acquisitions, patent activity, and (3) economic index – Gross State Product.

EMPLOYER SURVEY METHODOLOGY

FIGURE 1.1. SURVEY METHODOLOGY FLOW CHART

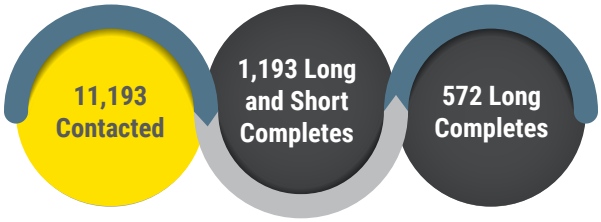
Surveys were administered online and by telephone to a list of known employers—developed using industry associations, data from past years, and other proprietary sources—as well as to a representative, clustered sample of companies from the NAICS system identified by the Bureau of Labor Statistics (BLS) and BW Research Partnership as being potentially related to the Renewable Energy, Energy Efficiency and Alternative Transportation technologies.

The survey used a stratified sampling plan (Figure 1.1) that is representative by industry code (NAICS or ANAICS), establishment size, and geography to determine the proportion of establishments that work with specific clean energy-related technologies, as well as the proportion of workers in such establishments that work with the same. This data is then analyzed and applied to existing public data published by the Bureau of Labor Statistics, effectively constraining the potential

universe of energy establishments and employment. It is important to note, this report excludes any employment in retail trade NAICS codes—fueling stations, fuel dealers, motor vehicle dealerships, appliance and hardware stores, and other retail establishments.

The survey was administered by telephone (34,495 outbound calls to 11,193 unique companies) and by web, with 1,680 emails sent to participants across the Commonwealth. The phone survey was conducted by I/H/R Research Group and Castleton Polling Institute. The web instrument was programmed internally by BW Research employees and each respondent was required to use a unique ID in order to prevent duplication.

FIGURE 1.2. SURVEY PARTICIPANTS: ***In total, 1,193 business establishments participated in the survey effort, with 572 providing full responses to the survey.***



These responses (Figure 1.2) were used to develop incidence rates (the proportion of clean energy establishments within traditional industries) as well as to apportion employment across various industry categories in ways currently not provided by state and federal labor market information agencies. The margin of error for incidence is +/-1.94% at a 95% confidence interval. The survey fielded from April 22 to May 19 and averaged 15.4 minutes in length. As such, data gathered from the survey refers to the 12 months between May 2015 through May 2016.

Margin of error is dependent on responses and universe size, while confidence interval is the width of error allowed within that. Ninety-five percent is the most commonly used confidence interval in polling; this means that the researchers have a 95 percent statistical confidence that the "true" result is within the margin of error. While the margin of error can change based on metrics, confidence interval does not—the margin of error is always reported with the confidence interval used for calculation.

In addition to providing overall totals, survey respondents were asked to select the technology to which their work is most closely associated: (1) Renewable Electrical Generation, (2) Renewable and Efficient Heating and Cooling, (3) Electrical Efficiency and Building Envelope, (4) Alternative Transportation, or (5) Other. Based on their selection(s), respondents were offered lists of specific sub-technologies that fit within each technology. The margin of error for this allocation by technology is +/-5.3% at a 95% confidence interval.

Establishments in manufacturing and research, design, and engineering were asked a specific question about whether they worked with any goods that are not yet commercially available. This helped gain insight into how research, development, and engineering startups and other early-stage, pre-commercial establishments might respond differently to survey questions from other established establishments with commercially available products.

The sample was split into two categories.[3] The first category includes establishments that have been previously identified as clean 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 second category (see below) for both sampling, resulting employment calculations and estimates. The second category includes an accounting of tens of thousands of

businesses in potentially clean energy-related NAICS codes across agriculture, utilities, construction, manufacturing, wholesale trade, professional services, and repair and maintenance. Each of these segments and their total reported establishments (within the Bureau of Labor Statistics QCEW) were carefully analyzed to develop representative clusters for sampling.

All data in the index rely on the Bureau of Labor Statistics Quarterly Census of Employment and Wages data for the fourth quarter of 2015.

3 In previous years, these categories have been referred to as the "known" universe and "unknown" universe.

ESTABLISHMENTS PREVIOUSLY IDENTIFIED BY RESEARCHERS AS CLEAN ENERGY COMPANIES (KNOWN UNIVERSE)

At the outset of the report's development, MassCEC provided an annual "known" database of firms. For 2016, MassCEC provided two lists; one with 2,972 entries and one with 1,243 entries. This list contained addresses and phone numbers for clean energy establishments and other organizations (and individuals) in the Commonwealth of Massachusetts. The list included some individuals and some system owners, so the first step was for BW Research to clean and de-duplicate the original list. Specifically, BW Research cleaned the MassCEC list to remove foreign corporations, obvious individuals, and duplicate entries, as well as companies that were asked to be placed on a DNC (do not call) list in previous years. This resulted in 2,841 entries. The next step was to add additional records from MassSave and various local and national industry associations (NECEC, AWEA, etc.). After completing the merge, BW Research conducted additional cleaning and de-duplication, resulting in a final total of 3,478 baseline industry contacts is established as the "known universe."

All establishments in the database with addresses were sent a letter with respondent-specific instructions for taking the survey. In addition, all businesses with email information were sent multiple online invitations. Establishments in the database that did not complete an online survey and those without email information were called up to six times and asked to complete by telephone.

After the survey was fielded, phone and online dispositions[4] were used to determine overall establishment totals. First, a churn rate was applied. Churn refers to any email bounce backs, fast-busy/ disconnected phone lines, or other dispositions that suggest a company has moved or is out of business. A total of 591 (17%) of the contacts had such a disposition, which reduced the baseline number of establishments from 3,478 to 2,887. Following churn, BW Research further reduced the baseline for duplication. A total of 445 firms were identified as duplicate locations based on survey responses or through secondary research (e.g., the same IP address, telephone number location, or physical address, etc.). This resulted in 2,442 contacts.

4 Dispositions refer to telephone or email outcomes (no answer, busy, refused, complete, terminate Mid-Q, not qualified, etc.)

In 2016, incidence for the known universe was 79.0% (708 of 896 de-duplicated employers that responded reported a clean energy technology). This incidence rate was then applied to the post-churn, post-duplication total of 2,442, resulting in 1,929 establishments.

Finally, in order to comply with the data sets produced by every state and federal business data collection (including Census Bureau, BLS, etc.), BW Research translates the company-level data to establishment totals. The following process is used: 85.5% of the sampled firms have one location. Of the 14.5% that have more than one location, the mean is 2.33 locations. This calculates as follows:

SINGLE LOCATION ESTABLISHMENTS

1,929 * 85% = 1,640

MULTIPLE LOCATION ESTABLISHMENTS

1,929 * 15% * 2.33 = 686

Total establishments were therefore calculated as 2,325.

Value chain and technology establishment totals were calculated using the screener distributions for known and unknown survey respondents. For value chain and major technology area, a "primary" category was chosen, avoiding overlap. For sub-technologies, a primary designation was not provided. As a result, the margin of error for known universe value chain and technology distribution is +/-3.07% at a 95% confidence interval and +/-2.58% at a 90% confidence interval.

Of these estimated 2,725 establishments, 708 completed a survey, up 222 responses from last year. The 2015 data show that there are 50,934 workers in these companies, an increase of eight percent. The margin of error at a confidence level of 95% is approximately +/- 3.12%.

ESTABLISHMENTS NOT PREVIOUSLY IDENTIFIED BY RESEARCHERS AS CLEAN ENERGY COMPANIES (UNKNOWN UNIVERSE)

BW Research, in coordination with the U.S. Department of Energy and independently with several states (including Massachusetts), developed a list of 93 six-digit NAICS codes that were likely to contain clean energy establishments. These NAICS included 18,630 establishments in Massachusetts and about 200,000 workers. Importantly, the unknown universe excluded academic research centers, nonprofit organizations, and sole-proprietors. The establishments and employment calculated for the known within each NAICS was subtracted from the NAICS totals and contacts were de-duplicated, avoiding overlap between the known and unknown universes.

The 2016 random sampling included 1,487 responses with 343 reporting "yes" as a qualifying clean energy establishment as well as a qualifying clean energy technology. This means that of the total sampled, about 23% of randomized companies within the unknown universe (after deduplication of all known firms) qualify as clean energy companies under the definition provided by statute. The rate over the last four years has been between 21 and 23.6%. After re-weighting and applying the appropriate incidence rate to each ANAICS, the result was 4,388 firms. This is largely the result of higher than average incidence rates in the construction and professional services industries, which have more establishments than agriculture, utilities, etc. The margin of error is +/-2.43% at a 95% confidence interval and +/-2.05 at a 90% confidence interval for unknown establishment estimates.

Value Chain and Technology estimates were conducted in the same manner in the unknown universe as in the known universe. The margin of error is higher, at +/-5.08% at a 95% confidence interval and +/-4.26 at a 90% confidence interval.

MassCEC has dramatically improved its database of contacts since this study was first conducted in 2011. However, due to the broad range of technologies and activities that make up the clean energy industry, many companies continue to be discovered in the research. Over the last six years, the research team has identified 976 companies in its random sampling, despite only contacting a small fraction of the total number of establishments in Massachusetts.

TABLE 1.1 INCIDENCE RATES BY INDUSTRY

INDUSTRY	INCIDENCE RATE
Agriculture	30.4%
Utilities	61.5%
Construction	24.6%
Manufacturing	26.0%
Trade	29.0%
Professional Services	19.4%
Repair	16.2%
Manufacturing	26.0%

In addition, 146 establishments from this category identified as clean energy and completed partial or full surveys. Compared to the previously identified universe, the mean number of clean energy employees at establishments not previously identified as clean energy is lower by a significant margin, depending on the specific industry. Compared to 2015, there was a six percent increase in workers— 54,278 workers, up from 51,027—in establishments not previously identified as clean energy.

Surveys were administered in accordance with the Code of Standards and Ethics for Survey Research (CASRO), which includes stringent guidelines for maintaining respondent confidentiality. As a result, employer lists and disaggregated data are not available for public release.

For all reported results to the tenth decimal, sample size was n=100. All other data with fewer than 100 responses is rounded to the nearest whole number.

COMPANY NAME: JAY MOODY, LLC

LOCATION: LEOMINSTER, MA

NUMBER OF EMPLOYEES IN MASSACHUSETTS: 6

Jay Moody, LLC is a North American Technician Excellence (NATE)-certified heating and air conditioning company that installs and services both residential and commercial systems including ductless mini-splits and traditional heating and cooling systems.

INDUSTRY OVERVIEW

HIGHLIGHTS

Massachusetts' clean energy economy continues to create jobs, as establishments add another 6,300 workers for a total of 105,212 workers to their payrolls in the 12 month period prior to the survey (mid-2015 through mid-2016, also written as "2015-2016"); this is a six percent annual increase and a 75 percent increase since 2010. For comparison in the same period, the state's overall employment grew by just two percent.

The clean energy contribution to Gross State Product (GSP) increased by seven percentage points from 2014 to 2015. In 2015, clean energy establishments accounted for $11.8 billion of statewide GSP Figure 2.1.

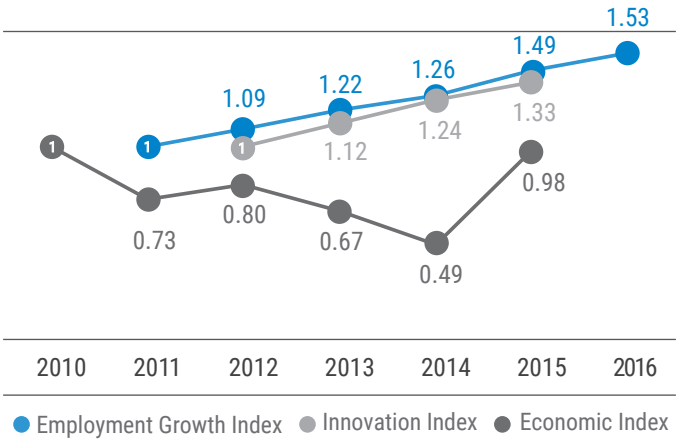
Deployment (installation and sales) constitute more than half the number of jobs (Table 2.2), other activities – particularly knowledge based export industries – are providing significant contributions to economic impacts. Specifically, service exports from engineering, research, consulting, finance, and other professional and legal services attract revenues from out of state and spend a greater percentage within Massachusetts.

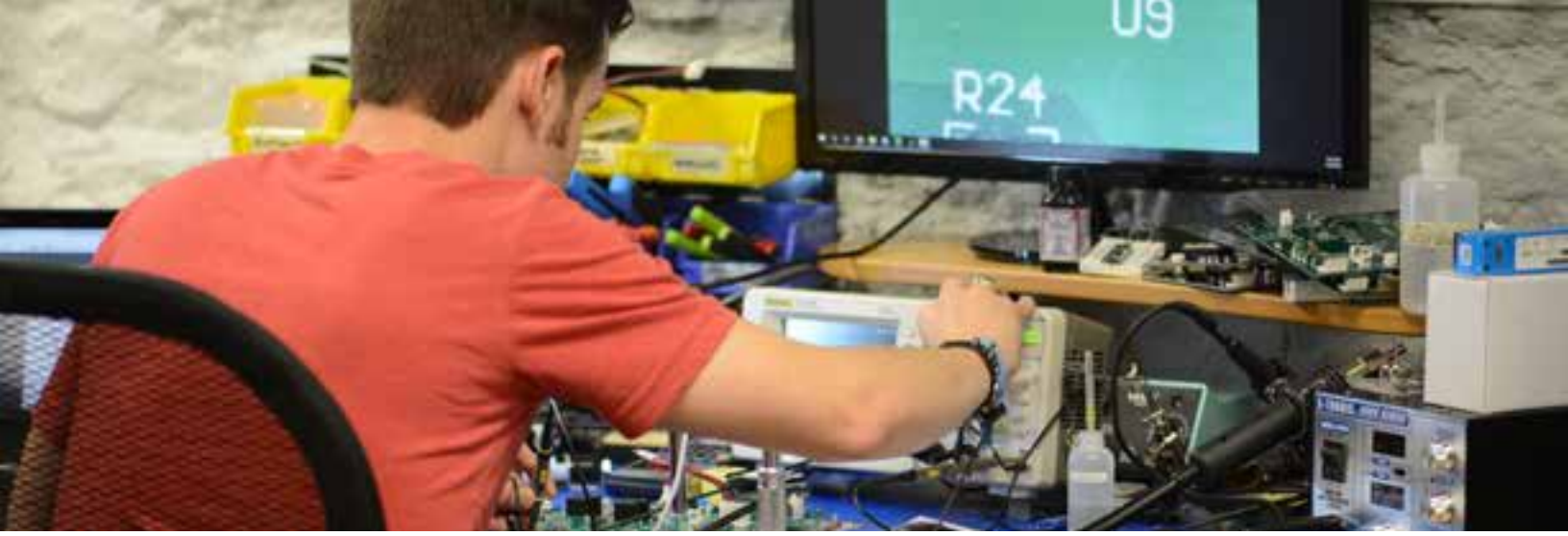
Clean technology innovation is strong. According to the Cleantech Group, Massachusetts accounted for 98 percent of related patent activity in New England over the last 12 months and eight percent of the nation's clean technology patents over the last five years. Even in the face of falling global and national investments, establishments across Massachusetts managed to attract more than double the early-stage investment dollars in 2015 compared to 2014.

Establishments hired more workers with an Associate's degree or a high school diploma and fewer individuals with a Bachelor's degree.

Accordingly, the wage distribution also shifted—the number of workers earning up to $75,000 increased by nine points. Total installed in-state renewable energy capacity over 2015-2016 rose to 374 MW, or a total of 25,390 RPS projects.

FIGURE 2.1. CLEAN ENERGY BW INDICES (DEFINED IN GLOSSARY), 2010-2016: ***The employment and economic growth indices remain closely related, while innovation metrics saw a major uptick this year; this is mostly attributed to large sums of early-stage investments in 2015.***





DEPLOYMENT

Deployment of clean technologies continues to rise dramatically across the state. Renewable Energy Generation establishments installed roughly 25,390 more Renewable Portfolio Standard (RPS) projects over 2015-2016, installing 374 megawatts (MW).

Between 2015 and 2016, MassSAVE reported MassSAVE reported $5.1 million in total benefits, with 3.1 MWh saved over the last 12 months. The program has saved a total of 5.4 million megawatt hours (MWh) over its lifetime. While Alternative Transportation is the smallest clean energy technology segment, it experienced the fastest deployment growth, when measured by the growth of new electric and other alternative fuel vehicle rebates and registrations, grants for fleet conversions, and charging and alternative fuel station construction.

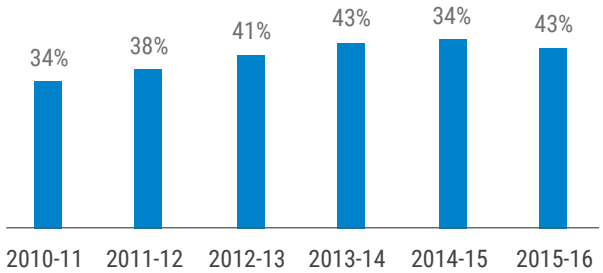
GROSS STATE PRODUCT AND CLEAN ENERGY COMPANY REVENUES

Clean energy establishments contributed a total of $11.8 billion to the GSP in 2015, a seven percent increase over 2014, and a 29 percent increase since the 2013 total of $9.1 billion.

Overall in Massachusetts, contributions to GSP are significantly greater from research, professional and financial services, and manufacturing, as compared to construction and wholesale trade. Measuring GSP illustrates that while installation makes up 26 percent of the jobs in clean energy in Massachusetts (Table 2.2), it contributes 14.5 percent of the total to GSP.

However, there was a slight decline in pure-play establishments (Figure 2.2).

FIGURE 2.2. PERCENTAGE OF PURE-PLAY ESTABLISHMENTS, 2011-2016: ***The proportion of pure-play establishments in Massachusetts' clean energy economy declined slightly.***



JOBS & ESTABLISHMENT GROWTH

Clean energy establishments[1] statewide continue to grow as employment grew 75 percent since 2010 (Figure 2.3). The number of workers who spend at least half and all of their time working with clean energy technologies is statistically unchanged compared to last year. About 81 percent of workers spend the majority of their time supporting the clean energy portion of business, while 70 percent spend all of their time on these activities.

Clean energy jobs and establishments are defined as those workers and establishments that spend any portion of their time conducting clean energy activities. This is important for several reasons. First, it is not a full-time equivalency number, meaning that some of the workers spend all of their time working with clean energy technologies while others spend only a small portion. Second, the figures include a wide range of business activities, including tax, engineering, finance, consulting, architecture, legal, and other professional services, many of which are only partially dedicated—from a revenue and labor hours perspective—to clean technologies, despite playing an important role in the clean energy ecosystem.

The benefit of measuring jobs and establishments in this way is that it allows for greater understanding of clean energy impacts in the traditional economy; this methodology is also consistent with recent measures produced by the U.S. Department of Energy.[2] However, it also means that changes in labor intensity relative to clean technology can impact year to year comparisons.[3]

1 An establishment is defined by the U.S. Department of Labor and the U.S. Census Bureau as a business location with employees.

2 U.S. Department of Energy, U.S. Energy and Employment Report, 2016, available at: http://energy.gov/sites/prod/files/2016/03/f30/U.S.%20Energy%20and%20Employment%20Report.pdf.

3 For instance, if a traditional HVAC establishment with 20 HVAC technicians, all of whom spend a few hours a week on high-efficiency installations, decides to shift to a specialist model with two full-time dedicated high-efficiency technicians, the overall jobs data would suggest a 90% employment decline, even though the actual labor hours at the establishment were unchanged.

Clean energy employment slowed to a six percent growth rate over 2015-2016, lower than in previous years (Figure 2.3). At 22 percent growth, Renewable Generation establishments had the highest growth rate while Renewable and Efficient Heating and Cooling businesses declined in employment; this was potentially due to warmer weather and lower fossil fuel prices (Table 2.1).

TABLE 2.1. JOBS AND ESTABLISHMENTS BY SUB-TECHNOLOGIES, 2015-2016: ***Employment increased across nearly all major technologies.***

TECHNOLOGY	2015 Jobs	Growth	2016 Jobs	Margin of Error +/-
Renewable energy	23,658	21.6%	28,769	5.78%
Renewable and efficient heating and cooling	24,966	-17.0%	20,714	12.96%
Electrical efficiency and building envelope	47,685	10.4%	52,656	7.96%
Alternative transportation	1,478	17.7%	1,740	3.79%
Other	1,107	20.4%	1,332	3.79%

Establishments hired fewer individuals with a Bachelor's degree (Figure 2.4). Installation establishments (Table 2.2) are less likely to require four-year degrees compared to other occupations in the clean energy sector. The number of new hires with a Bachelor's degree declined by 17 percentage points as those with an Associate's degree or high

school education increased by 17 points (Figure 2.4)With the shift in educational attainment, wage distributions have also flipped—workers earning less than $75,000 increased by nine percentage points and those earning above that decreased by nine points (Figure 2.5).

Hiring difficulty remains high over the last 12 months (Figure 2.6); the most commonly-reported reasons for hiring difficulty (Figure 2.7) include insufficiently qualified candidates (47 percent) and a lack of experience (28 percent).

TABLE 2.2. JOBS AND ESTABLISHMENTS BY ACTIVITY, 2015-2016: ***While Installation and Sales and Distribution establishments constitute half of the industry, Manufacturing and Engineering and research are significant portions of the industry as well.***

ACTIVITY	%of Jobs	% of Establishments
Manufacturing	15.0%	9.4%
Engineering and research	17.3%	13.5%
Sales and distribution	27.7%	12.3%
Installation	26.2%	42.8%
Consulting, finance, etc.	7.8%	14.9%
Other	5.9%	7.0%

FIGURE 2.3. CLEAN ENERGY EMPLOYMENT GROWTH, 2010-2015: ***Clean energy establishments statewide continue to grow as employment climbed from just 60,000 workers in 2010 to just over 105,212 clean energy employees in 2016.***

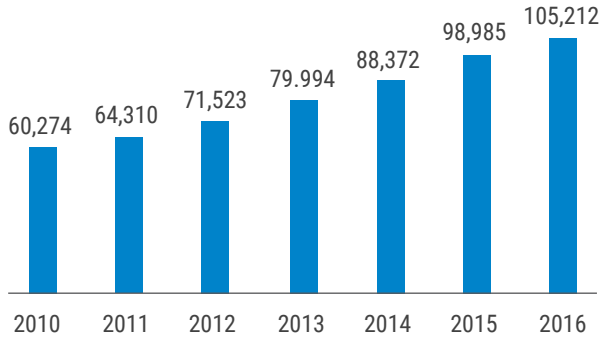


FIGURE 2.4. EDUCATIONAL ATTAINMENT FOR RECENT HIRES, 2015-2016: ***Establishments are shifting their hiring activity towards occupations that do not typically require four-year degrees. New hires with a Bachelor's degree declined while those with an Associate's degree or high school education increased.***

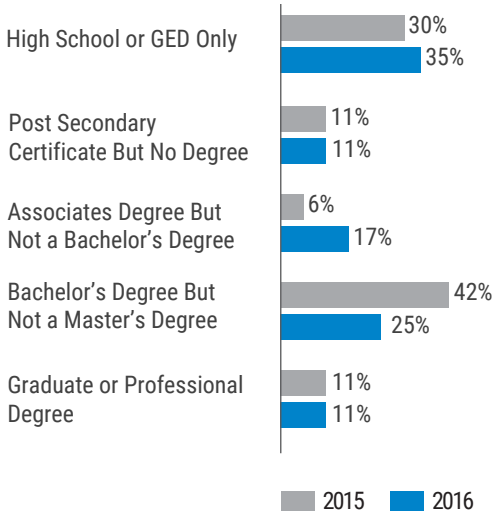


FIGURE 2.5 FULL-TIME PERMANENT WORKER PAY RANGE, 2015-2016: ***Seven in ten clean energy employees earn at least $50,000 a year.***

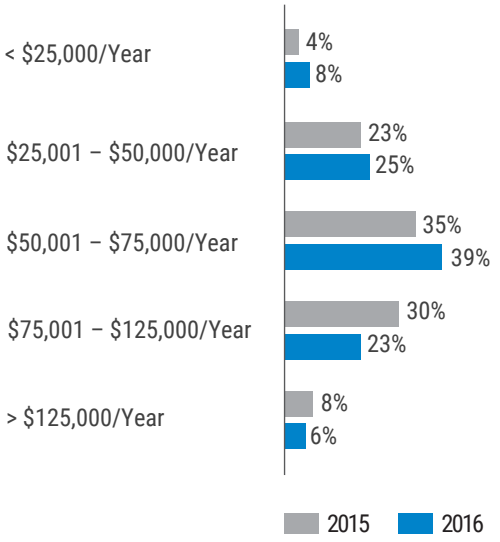


FIGURE 2.6. DIFFICULTY FINDING QUALIFIED EMPLOYEES, 2015-2016: ***Nearly three-quarters of employers report hiring difficulty over the last 12 months.***

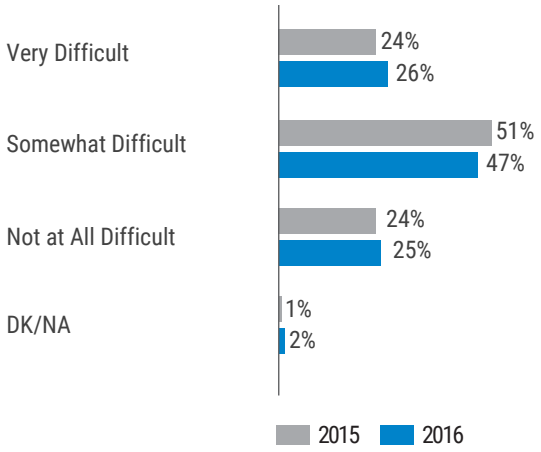


FIGURE 2.7 REASONS FOR HIRING DIFFICULTY, 2015-2016: ***Qualifications and experiences were cited as the major causes of hiring difficulties.***

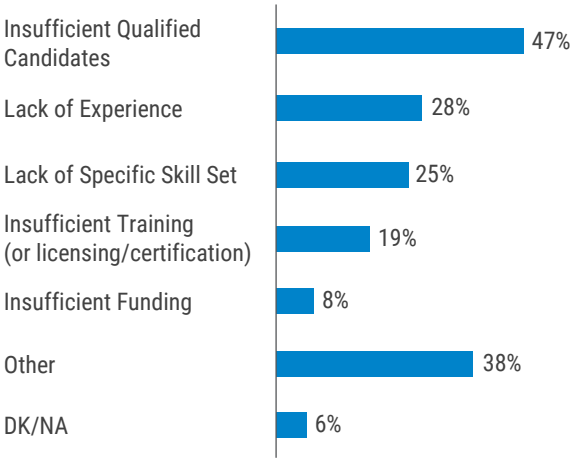
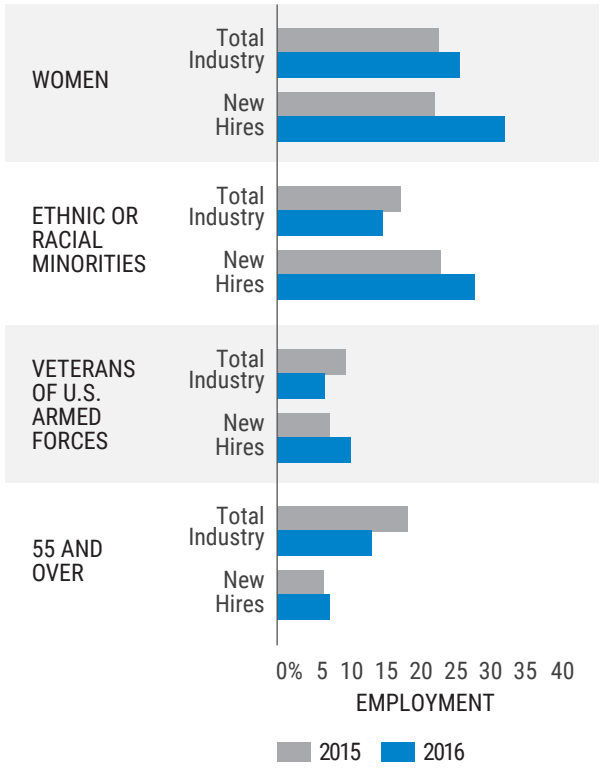
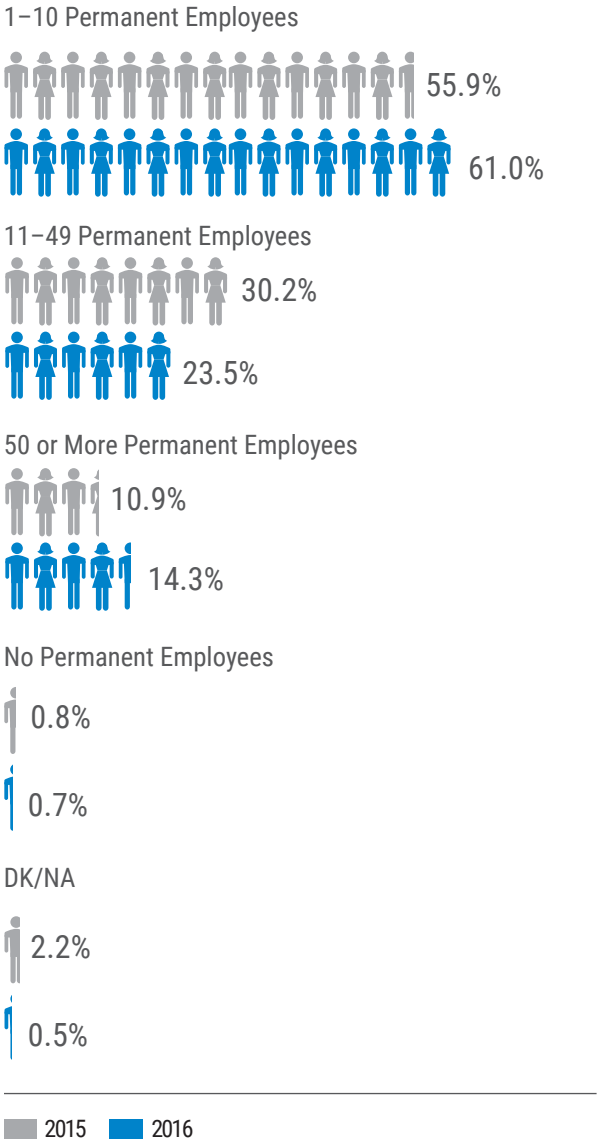


FIGURE 2.8 DEMOGRAPHICS OF CURRENT WORKFORCE AND RECENT HIRES, 2015-2016: ***The clean energy workforce became more diverse over 2015, as the percentage of women, ethnic minorities, Veterans, and workers over the age of 55 increased by as much as seven points.***



Small businesses that employ less than 50 employees are the largest segment of employers at 85 percent (Figure 2.9).

FIGURE 2.9. PERMANENT EMPLOYMENT, 2015-2016: ***Six in ten (61 percent) clean energy businesses employ one to 10 permanent employees and 14 percent of establishments employ more than 50.***



While more clean economy establishments primarily service customers outside of New England, a few Massachusetts establishments are serving the global energy market (Figure 2.10). Vendors also appear to be facing greater competition from outside establishments as well, reducing the potential economic impact of such activities in the Commonwealth (Figure 2.11).[4]

4 Economic impacts (indirect and enduced employment and wages) are driven largely by the amount of supply chain activity captured locally.

FIGURE 2.10. CLEAN ENERGY CUSTOMERS PRIMARY LOCATION, 2015-2016: ***The clean energy economy is serving more customers outside of New England, a seven point increase over the last 12 months.***

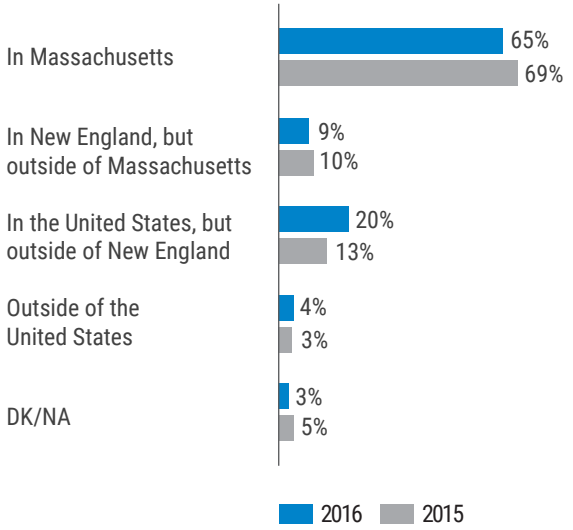


FIGURE 2.11. CLEAN ENERGY VENDORS PRIMARY LOCATION, 2015-2016: ***Fewer Massachusetts' clean energy establishments sourced their technologies from within Massachusetts.***

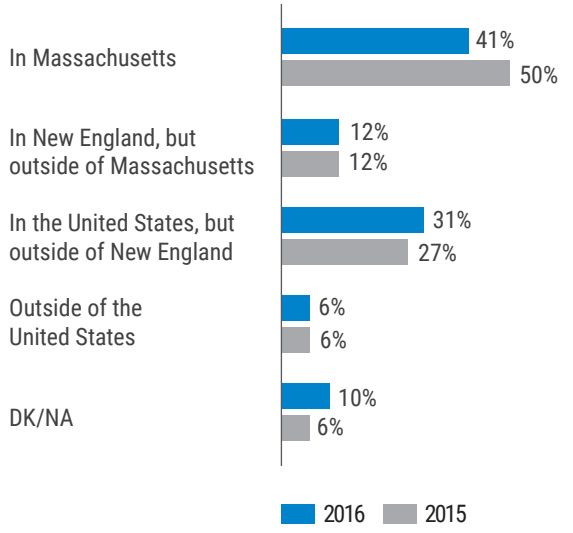
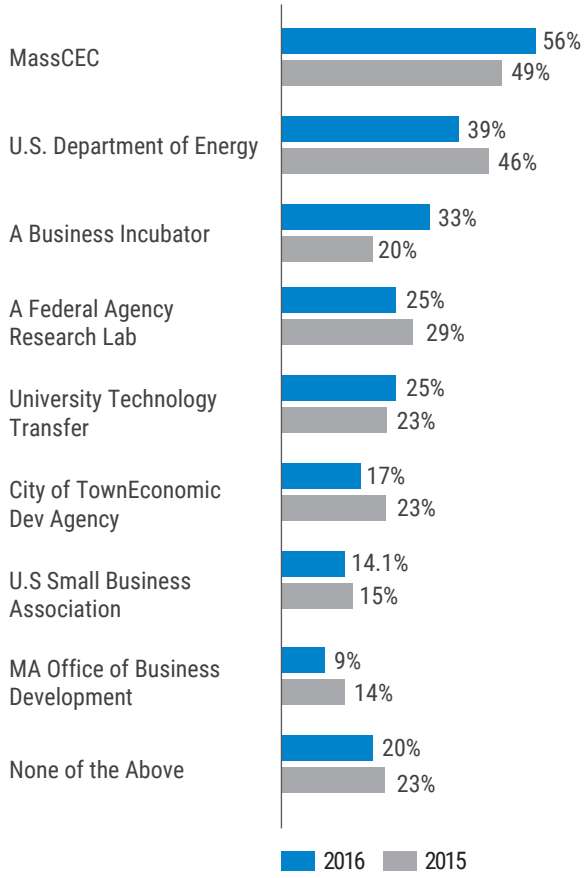


FIGURE 2.12 ESTABLISHMENTS HAVE WORKED WITH, 2015-2016: ***At least a third of establishments report working with MassCEC, the Department of Energy, and Incubators over the last 12 months.***



INNOVATION

Engineering and research establishments engaged in clean technology innovation are poised to supply local, national, and global supply chains with clean energy goods and services; this not only boosts the local economy but also maintains the state's leadership role in the clean energy sphere.

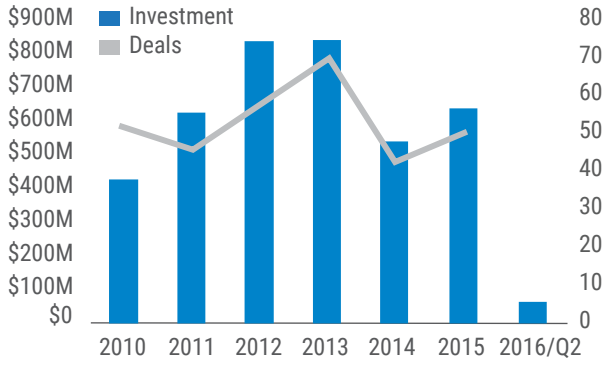
While Massachusetts is typically considered a deployment-based clean energy economy, there is value in tracking innovation across clean energy establishments and technologies in order to explore the economic multipliers that clean technology research and development has created for the state's economy.

Clean energy establishments closed more deals and attracted more public, private, and early-stage dollars in 2015 when compared to 2014 (Figures 2.13, 2.15 and 2.19). Private investment in Massachusetts kept up with the uptick in global and national trends (Figure 2.14). While the industry saw both global and nationwide public investment dollars decline over 2015, Massachusetts' clean energy establishments managed to attract more than double the amount of public and early-stage dollars compared to 2014. (Figure 2.16). It should be noted that clean energy investment data for this

report covers only private equity-backed "innovation" companies. The database does not track project or asset-based finance for public, mature companies and instead details recent funding that goes to private equity-backed companies. For more in-depth information on the investment data source, please see the Methodology in Chapter 1. This report also does not track public investments or incentives made in clean energy projects, except for MassCEC equity investments in early stage companies.

Energy efficiency companies attracted more investment than renewable energy companies (Figure 2.17), likely due to their capital efficiency (Energy Storage is also counted under Energy Efficiency).

FIGURE 2.13 PRIVATE INVESTMENT, 2010-2015: ***Private investments dollars increased by 18 percent between 2014 and 2015, as establishments attracted more deals and investment dollars.*** [5]



5 These numbers illustrate investments for calendar years 2010 through 2015. The survey term covers the 12 months from the beginning of Q3 2015 through the end of Q2 2016; for these 12 months, private investments totaled $278,432,079.

FIGURE 2.14. CHANGE IN PRIVATE INVESTMENT, 2010-2015: ***Private investments to private equity-backed establishments saw an uptick across the world, nation, and Massachusetts.***

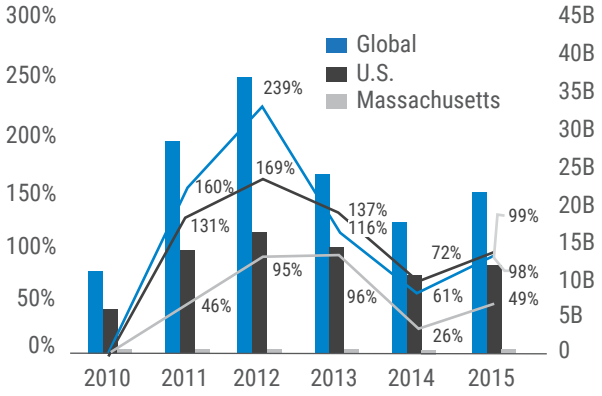
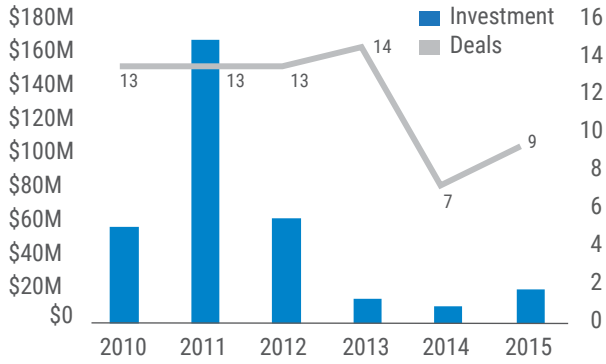


FIGURE 2.15. PUBLIC INVESTMENT, 2010-2015: ***Establishments received more than double the public investment dollars in 2015 compared to 2014*** [6].



6 There were no public investments recorded for the first two quarters of 2016. For the survey term (Q3 2015 – Q2 2016), there was a total of $18,227,827 in public investments.

FIGURE 2.16. CHANGE IN PUBLIC INVESTMENT 2010-2015: ***Despite global and nationwide declines, Massachusetts' clean energy establishments attracted more public investments over the time period.***

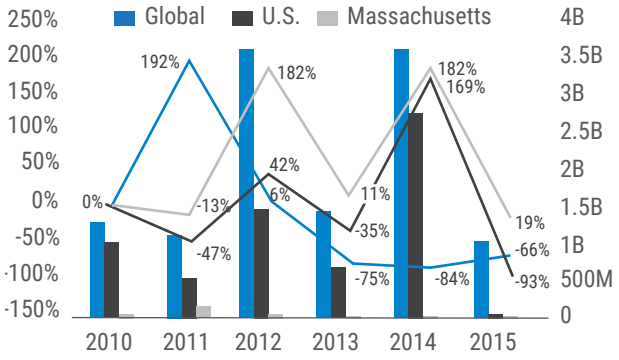
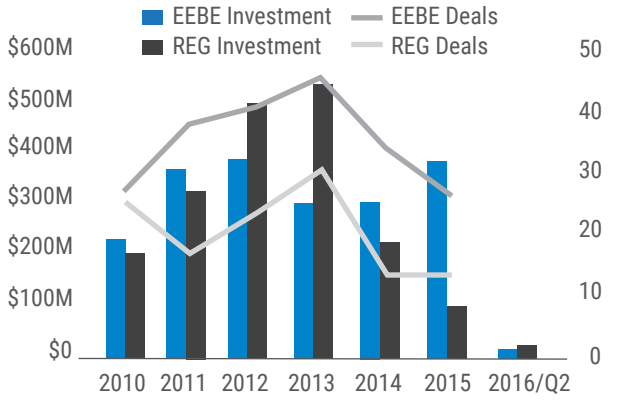


FIGURE 2.17 ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE AND RENEWABLE ENERGY GENERATION PRIVATE INVESTMENTS IN MASSACHUSETTS, 2010-2016 Q2: ***As with last year, Electrical Efficiency and Building Envelope establishments received more private investments in 2015 than Renewable Energy Generation establishments. However, for the first two quarters of 2016, renewable energy generation establishments have attracted more investment dollars compared to energy efficiency establishments. Energy efficiency notably includes Storage, which may soon warrant its own category.[7]***



7 For the survey term (Q3 2015 – Q2 2016), EEBE firms received a total of $104,321,625 in private investments and REG firms received a total of $98,610,454 in private investments.

Early-stage investments are defined as those provided to innovative clean energy companies—seed, series, A, and series B—that have a product or service that is still being tested or developed and are not ready to go to market. Despite the significant uptick this year, total early-stage investment dollars remain below 2010 levels (Figures 2.19).[8] The state's clean energy establishments accounted for just over 12 percent of global early-stage funds awarded in 2015 and 20 percent of nationwide early-stage dollars (Figure 2.20). It should be noted that the amount of early-stage investments continue to be volatile.

8 2011 represented the American Recovery and Reinvestment Act, ARRA, dollars.

The number of early-stage establishments increased and more workers dedicated the majority of their labor hours to pre-commercial activities (Table 2.3 and Figure 2.18).

TABLE 2.3. EARLY-STAGE ESTABLISHMENTS BY TECHNOLOGY, 2015-2016: ***The number of early-stage establishments increased over the last 12 months.***

	2015	2016
Renewable Electricity Generation	167	177
Energy Efficiency and Building Envelope	49	79
Renewable and Efficient Heating and Cooling	27	17
Alternative Transportation	19	42

FIGURE 2.18. PERCENT OF LABOR HOURS DEVOTED TO PRE-COMMERCIAL ACTIVITIES, 2015-2016: ***Of establishments that conduct pre-commercial activities, six in ten workers are reported to spend the majority of their labor hours dedicated to pre-commercial activities—up slightly from 2015.***

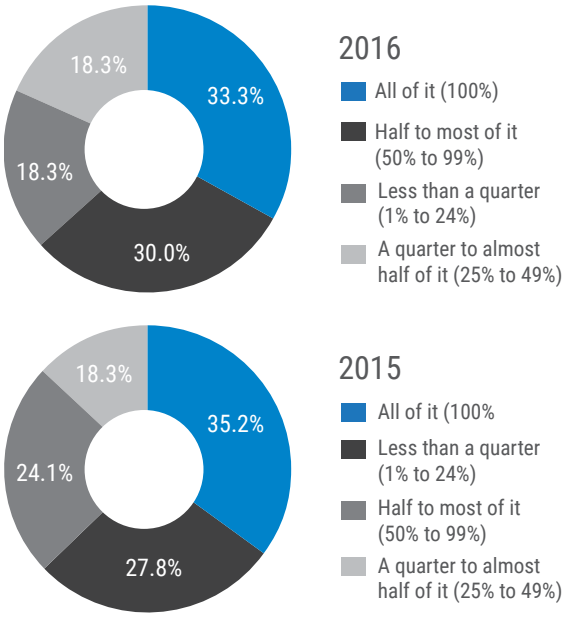
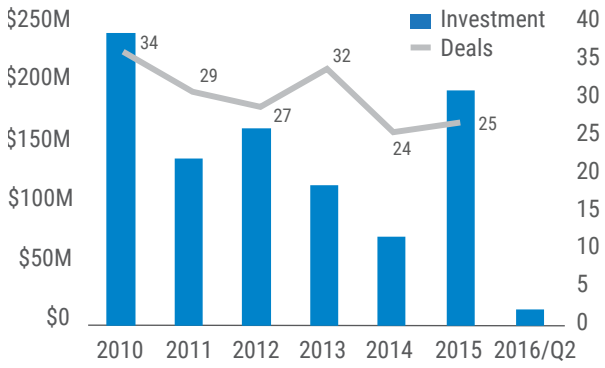
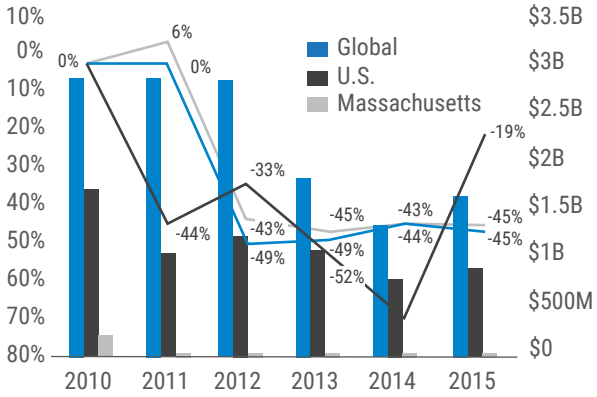


FIGURE 2.19. EARLY-STAGE INVESTMENTS, 2010-2016 Q2: ***Clean energy establishments across the state attracted $184.2 million in early-stage funding over 2015, and an additional $14 million over the first two quarters of 2016.[9]***



9 For the survey term (Q3 2015 – Q2 2016), clean energy establishments attracted a total of $135,802,603 in early-stage investment dollars.

FIGURE 2.20 CHANGE IN EARLY-STAGE INVESTMENTS, 2010-2015: ***In the face of global and nationwide declines in early-stage investments, Massachusetts' establishments still attracted more than double the dollar amount they received in 2014, as the average dollar amount of the deals increased dramatically.***



According to the Cleantech Group, Massachusetts' clean energy establishments accounted for eight percent of the nation's clean technology patent activity between 2010 and 2015 and 67 percent of patents filed across all six New England states over the same time. In 2015 alone, Massachusetts' companies filed 144 clean technology patents—98 percent of total clean-tech patent activity in New England over the last 12 months.

Despite receiving fewer early-stage investment dollars (Figure 2.22) compared to Renewable Energy generation, Electrical Efficiency and Building Envelope establishments filed more patents in 2015 compared to 2014—a 12 percent increase (Figure 2.21).

FIGURE 2.21 CLEAN ENERGY PATENT ACTIVITY, 2010-2015: ***Establishments involved in clean energy filed a total of 1,093 patents over the last six years across all four major technologies. Electrical Efficiency and Building Envelope establishments account for almost three-quarters of patent activity.***

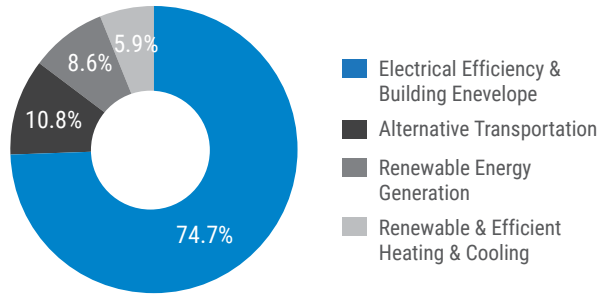
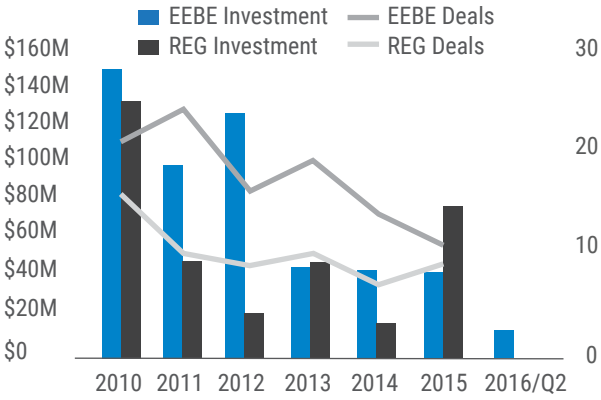


FIGURE 2.22. ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE AND RENEWABLE ENERGY GENERATION EARLY-STAGE INVESTMENTS, 2010-2016 Q2: ***Early-stage investments in renewable energy generation technologies topped those for energy efficiency establishments, this is the opposite compared to 2014. However, as of the first two quarters of 2016, only energy efficiency firms have attracted early-stage dollars.***[10]



10 For the survey term (Q3 2015 – Q2 2016), EEBE firms attracted $33,348,603 in early-stage dollars and REG firms attracted $43,454,000 in early-stage investments.

COMPANY NAME: BEVI

LOCATION: BOSTON, MA

NUMBER OF EMPLOYEES IN MASSACHUSETTS: 32

Bevi develops high-tech machines that create personalized flavored water beverages on demand, eliminating the need for disposable bottles and cans. Machines are internet-connected and controlled, enabling remote customization and seamless restocking of ingredients, which reduces energy use and transportation fuel costs.

REGIONAL HIGHLIGHTS

Clean energy employment relative to regional population[1] was similar across the four regions listed below—that is, for every 100 individuals, there are between one to two clean energy workers in each region. However, with regards to establishments, central and southeast Massachusetts have a slightly higher concentration of clean energy establishments as a function of total establishments in the region. For every 100 establishments in central and southeastern Massachusetts, there are five and four clean energy establishments, respectively. (Figures 3.1 and Figure 3.3)

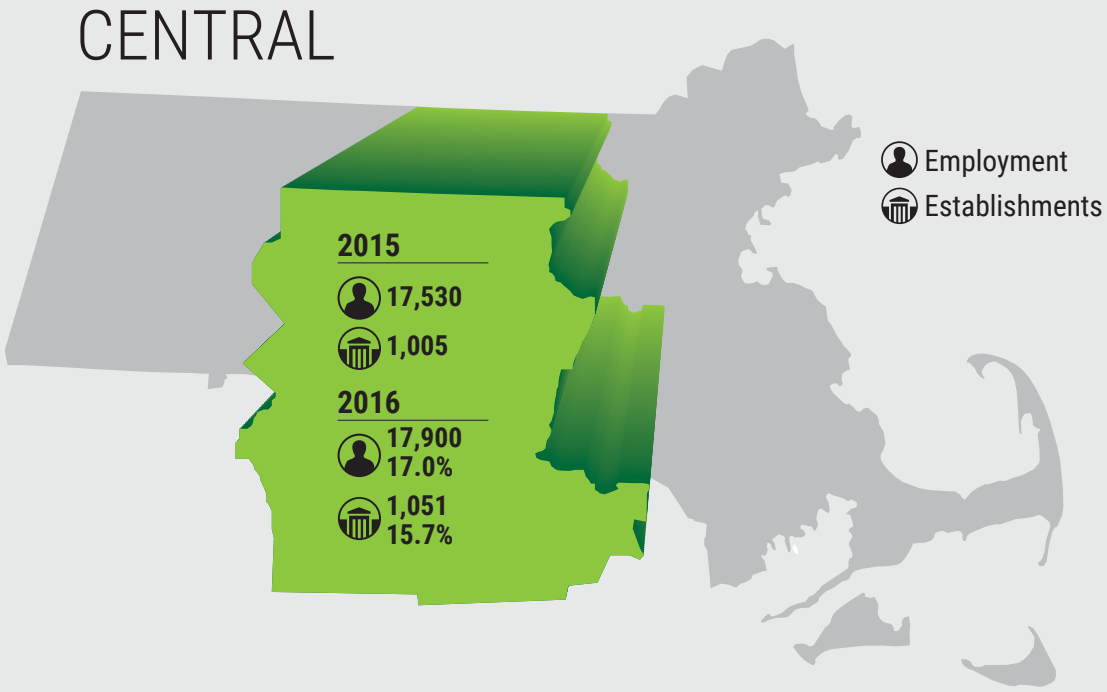
Though Electrical Efficiency and Building Envelope represents the majority of employment activity in each of the four regions, some regions specialize in technologies. Northeastern Massachusetts has the highest concentration of Renewable Generation activity, with approximately 42 percent of its workforce spending most of their time supporting these technologies (Figure 3.2).

Of the four regions, the Northeast has the greatest variety of clean energy employment activities while the Western (Figure 3.4) and Southeastern parts of the state are heavily reliant on either installation or sales and distribution, respectively. The regions with a narrow spread of activities are more likely to experience shifting employment compositions as a result of market changes or demand swings .

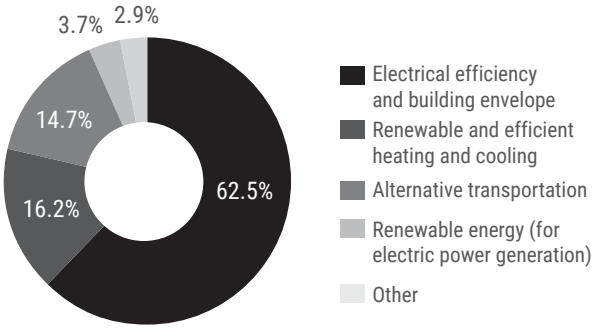
1 The regions coincide with those defined in the Green Communities Act of 2008.

CENTRAL MASSACHUSETTS

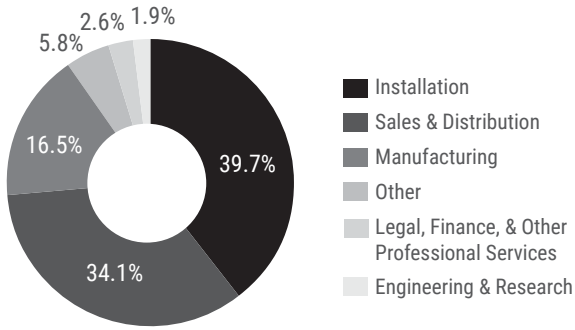
FIGURE 3.1. EMPLOYMENT AND ESTABLISHMENTS BY REGION, 2015-2016: ***Jobs and establishments held steady in Central Massachusetts.***



EMPLOYMENT BY TECHNOLOGY: ***Electrical Efficiency and Building Envelope jobs account for more than half of the clean energy workers.***

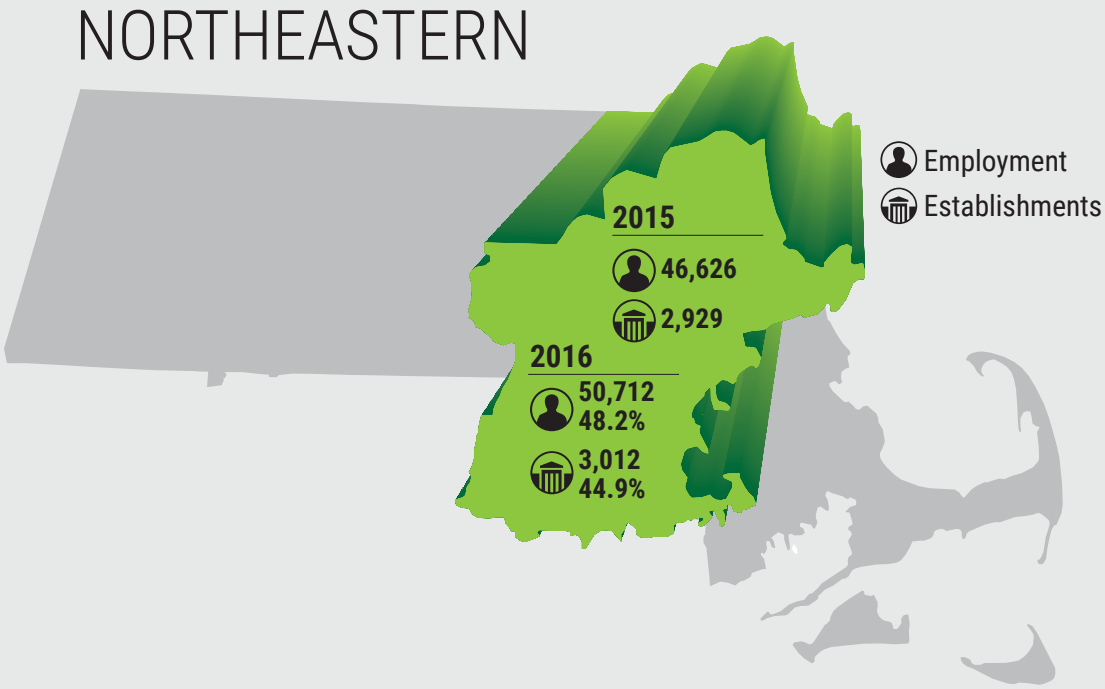


EMPLOYMENT BY ACTIVITY: ***Installation and sales & distribution dominate clean energy jobs.***

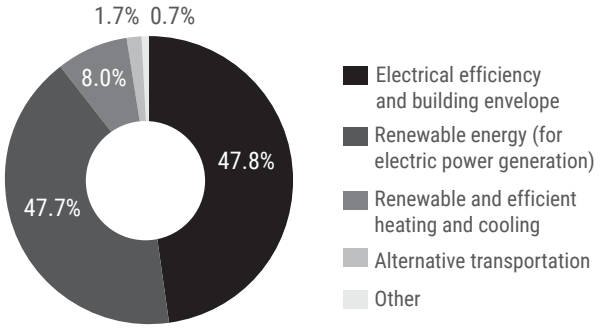


NORTHEASTERN MASSACHUSETTS

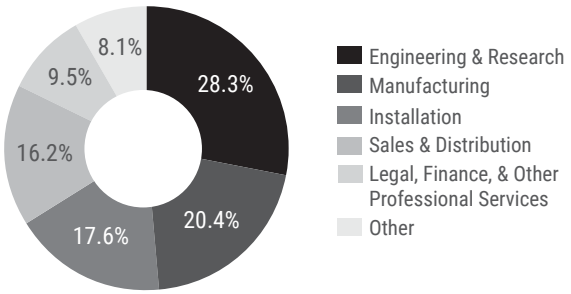
FIGURE 3.2 EMPLOYMENT AND ESTABLISHMENTS BY REGION, 2015-2016: ***Clean energy activity is highest in Northeastern Massachusetts.***



EMPLOYMENT BY TECHNOLOGY: ***Electrical Efficiency and Building Envelope jobs and renewable energy jobs are evenly split in the region.***

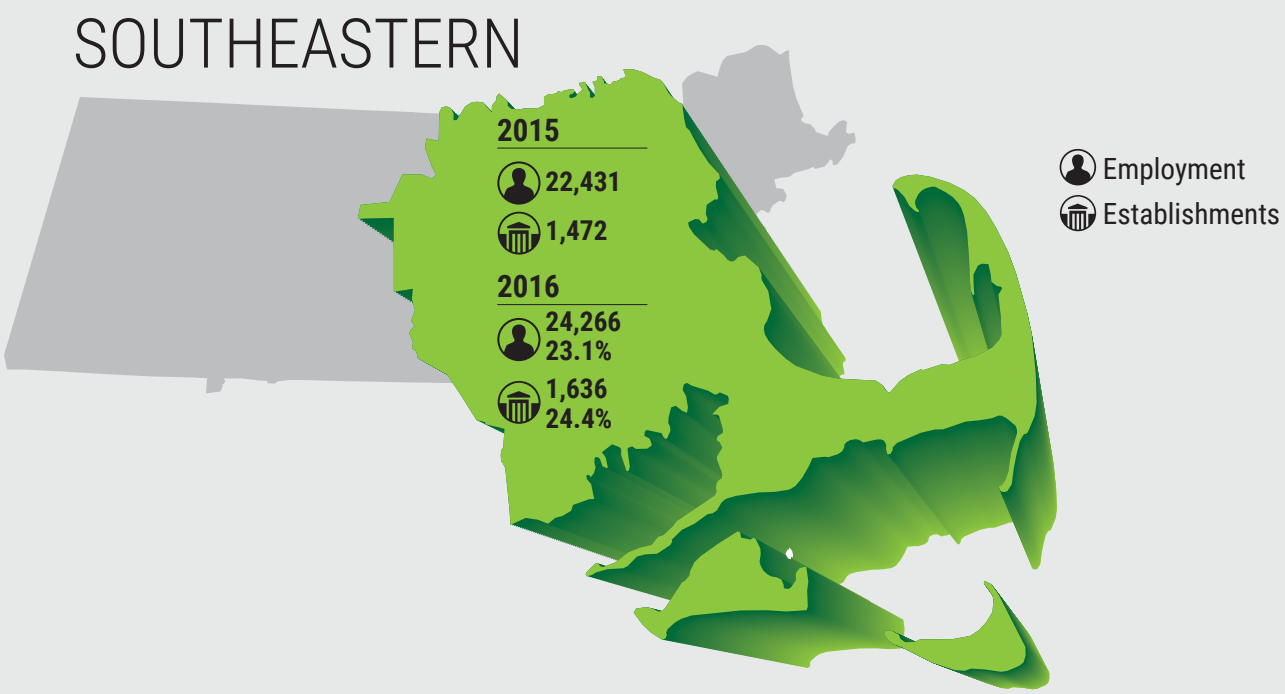


EMPLOYMENT BY ACTIVITY: ***Northeastern Massachusetts' clean energy businesses work across all activities.***

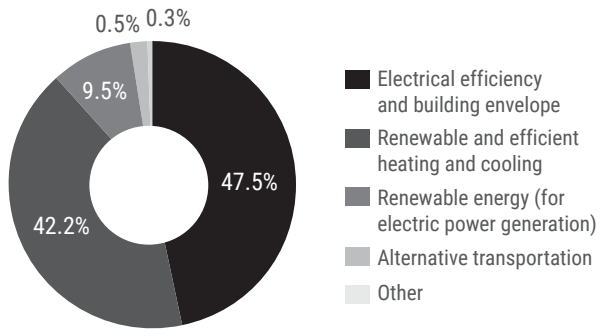


SOUTHEASTERN MASSACHUSETTS

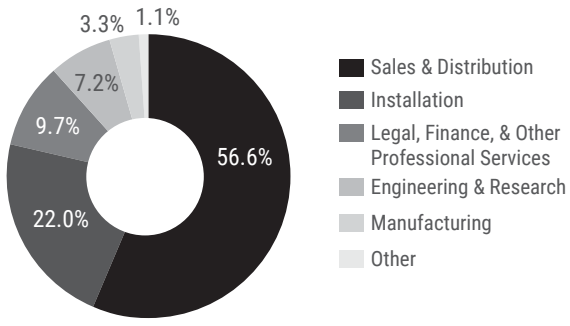
FIGURE 3.3 EMPLOYMENT AND ESTABLISHMENTS BY REGION, 2015-2016: ***Clean energy activity in Southeastern Massachusetts in the second largest region for clean energy jobs and establishment.***



EMPLOYMENT BY TECHNOLOGY: ***Electrical Efficiency and Building Envelope jobs and renewable efficient and cooling jobs constitute the majority of clean energy employment.***

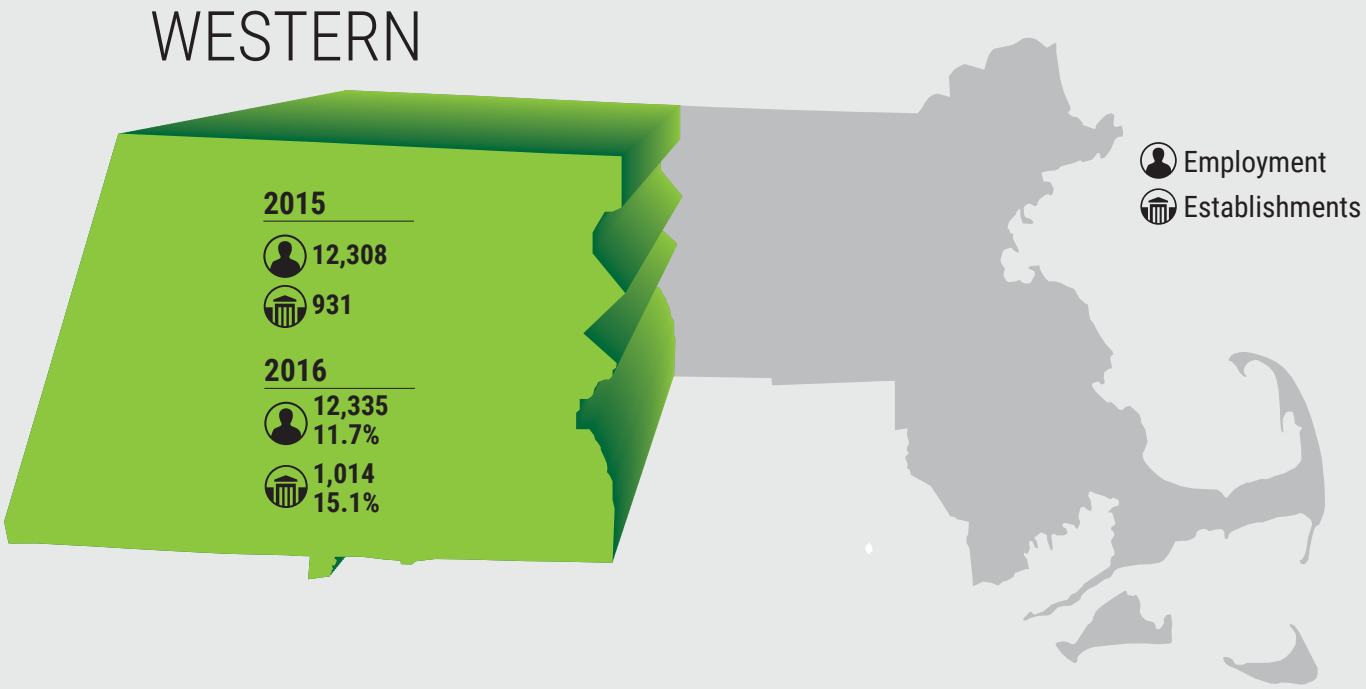


EMPLOYMENT BY ACTIVITY: ***Sales & distribution is the leading value chain activity in southeastern Massachusetts.***

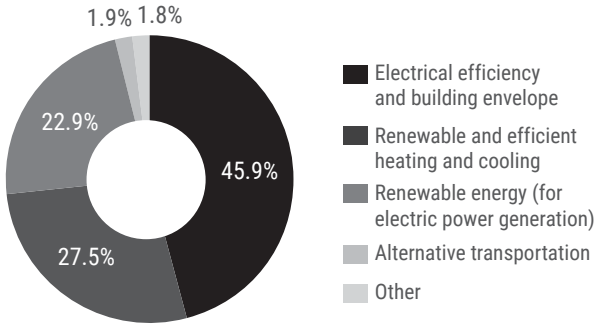


WESTERN MASSACHUSETTS

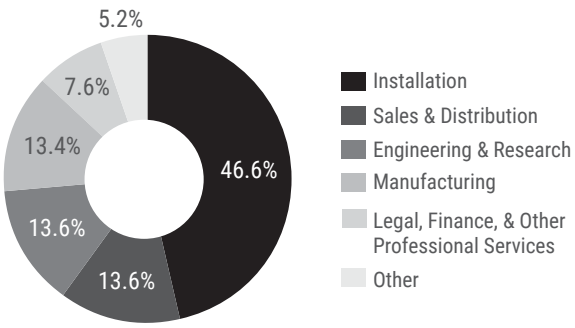
FIGURE 3.4 EMPLOYMENT AND ESTABLISHMENTS BY REGION, 2015-2016: ***Jobs and establishments held steady in Western Massachusetts.***



EMPLOYMENT BY TECHNOLOGY: ***Clean energy jobs are distributed over various technologies.***



EMPLOYMENT BY ACTIVITY: ***Different value chain activities contribute to clean energy employment in Western Massachusetts.***



ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE

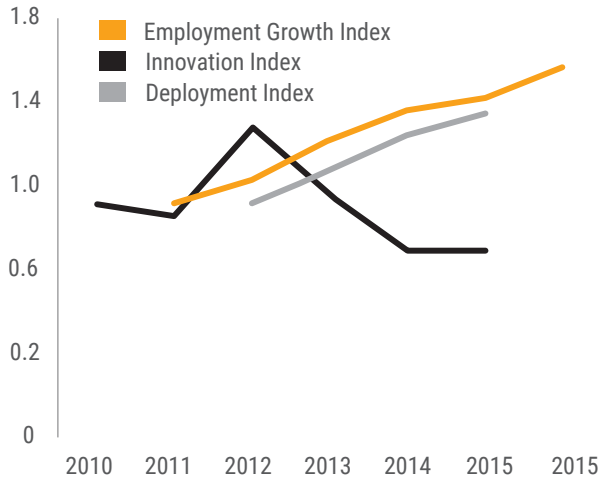
Employment growth across Electrical Efficiency and Building Envelope (EEBE) outpaced the overall construction industry in Massachusetts. The sector added an estimated 5,000 new workers over the last 12 months—a growth rate of about ten percent—while the state's overall construction industry grew by seven percent during the same time.

The Electrical Efficiency and Building Envelope sector is more diverse than the general construction industry. Women account for three in ten workers—up nine percentage points over the last 12 months—compared to representing just 18 percent of the overall construction industry.

Demand for energy-efficient goods and services significantly impacts revenue streams. Three-quarters of Electrical Efficiency and Building Envelope employers report that half to all of their revenue is supported by energy efficiency work.

Hiring activity was divided this year, as establishments hired more individuals with either a high school diploma or a graduate degree. The percentage of new hires with a Bachelor's degree decreased.

FIGURE 4.1. ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE BW INDICES (DEFINED IN GLOSSARY), 2010-2016: ***Contributions to Gross State Product and employment are strongly correlated, while innovation activity saw no growth over the last 12 months.***



DEPLOYMENT

Massachusetts has been ranked by the American Council for an Energy Efficient Economy as the top state in the nation for energy efficiency six years in a row. Supportive policies and generous incentives have driven the adoption of energy efficiency measures all across the Commonwealth.[1]

The MassSAVE program, administered by Massachusetts' utilities and available to all electric and natural gas customers in the Commonwealth, provides incentives to help residents and businesses manage energy use and related costs. Between mid-2015 and mid-2016, MassSAVE electrical participants were responsible for 3.1 million annual MWh savings and $4.1 million in benefits.[1]

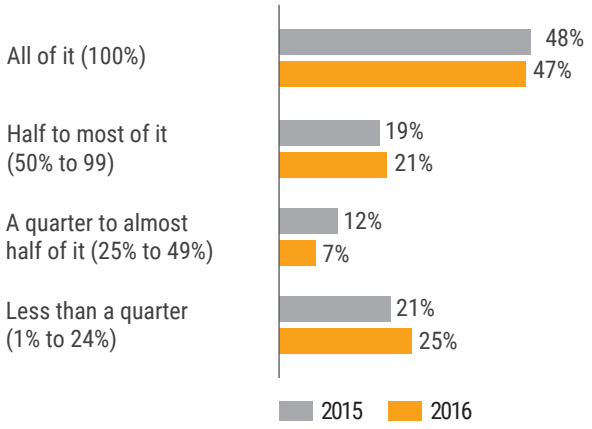
1 American Council for an Energy-Efficient Economy, The 2015 State Energy Efficiency Scorecard

GROSS STATE PRODUCT AND CLEAN ENERGY COMPANY REVENUES

EEBE establishments contributed about $3.4 billion to statewide GSP over 2015—about 18 percent of the total clean energy share and the second highest contribution behind Renewable Energy Generation.

Demand for energy-efficient goods and services is strong, as the percentage of pure-play establishments is just slightly higher than the overall clean energy industry average (Figure 4.2).

FIGURE 4.2. ESTABLISHMENT REVENUE ATTRIBUTED TO CLEAN ENERGY, 2015-2016: ***Almost half of establishments derive all of their revenue from conducting energy-efficient upgrades and building retrofits, while three-quarters report that at least half of their revenue is supported by energy-efficient goods and services.***

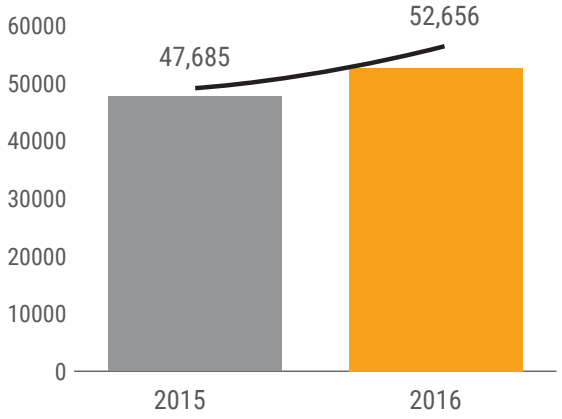


JOBS AND ESTABLISHMENT GROWTH

Employment growth across Electrical Efficiency and Building Envelope outpaced both the statewide economy and the construction industry. These establishments added jobs at a rate just over 10 percent (Figure 4.3) while employment in the overall Massachusetts economy and construction industry grew by two and seven percent respectively.[3]

3 Current Employment Statistics, Bureau of Labor Statistics

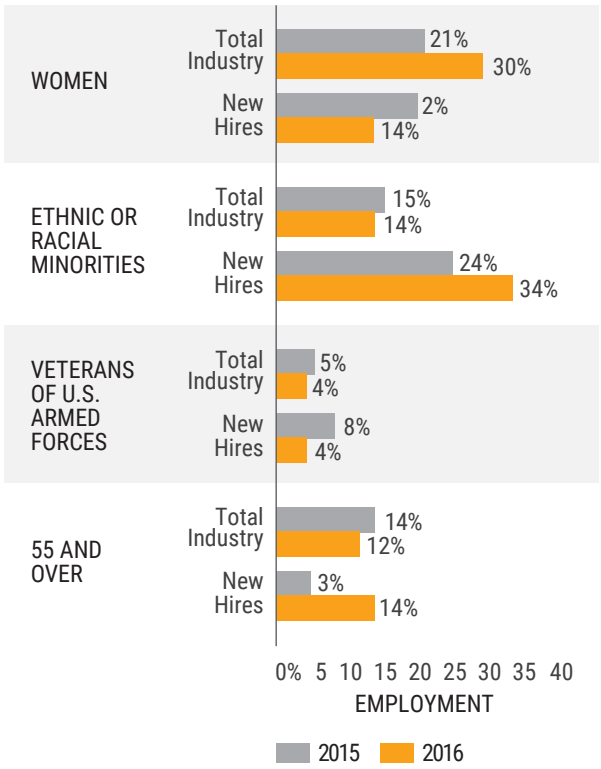
FIGURE 4.3. ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE EMPLOYMENT GROWTH, 2015-2016
Establishments increased employment by about 5,000 workers over the last 12 months.



Diversity in EEBE trades is higher than the Massachusetts construction industry as a whole. Women represent three in ten EEBE workers (Figure 4.4). Comparatively, women comprise about 18 percent of the state's overall construction industry.[4]

4 JobsEQ, Chmura Analytics, 2014Q3

FIGURE 4.4. DEMOGRAPHICS OF CURRENT WORKFORCE AND RECENT HIRES, 2015-2016: ***The percentage of women in the EEBE sector has grown by almost nine percentage points, while workers over the age of 55 declined by three percentage points.***



Most of the jobs and establishments in this sector are devoted to energy efficiency upgrades to existing building (Figure 4.5).

Figure 4.6 shows a polarization in the educational attainment for jobs, perhaps reflecting the value chain activity (Figure 4.9). Consequently, wage distributions shifted as well (Figure 4.7). General construction workers in Massachusetts make an average of $57,000 annually; entry-level new hires earn about $37,000 and experienced workers make $68,000 per year.[5] The clean energy entry-level new hires with less education in 2015-2016 are likely earning at the low end of the wage spectrum. Employers reported less hiring difficulty this year (Figure 4.8), in contrast to the overall industry. Therefore, it appears unlikely that the shift towards entry-level workers and individuals with only a high school diploma resulted from a talent shortage.

5 JobsEQ, Chmura Analytics, 2014 – for all Construction and Extraction Occupations (SOC 47-000)

FIGURE 4.5. EMPLOYMENT BY SUB-TECHNOLOGIES: ***Nearly all sub-technologies—except smart grid—increased employment over 2015.***

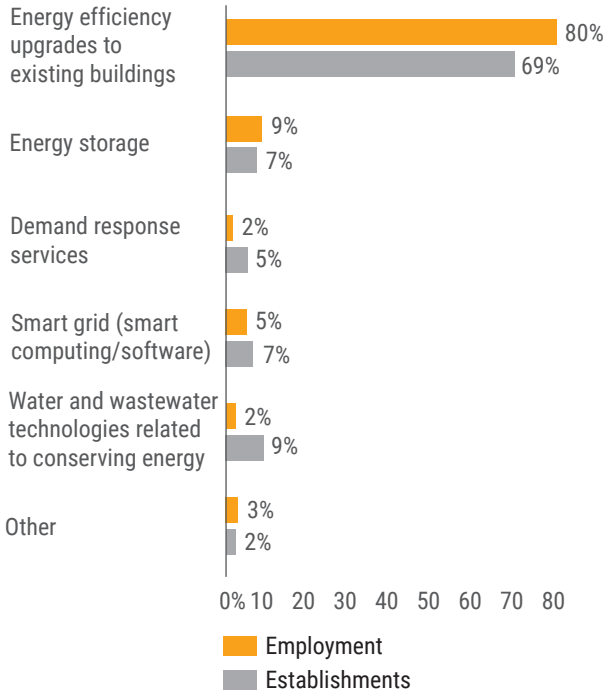


FIGURE 4.6 EDUCATIONAL ATTAINMENT FOR NEW HIRES, 2015-2016: ***Establishments are hiring more individuals with either a high school diploma or a graduate degree.***

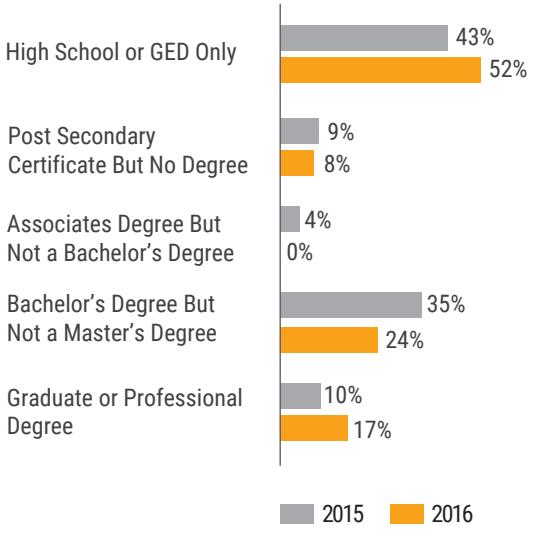


FIGURE 4.7 FULL-TIME PERMANENT WORKER PAY RANGE, 2015-2016: ***There was marked growth in the number of permanent full-time workers making under $75,000 per year (25 percent increase), as the proportion of employees earning between $75,001 and $125,000 a year declined by 22 percentage points.***

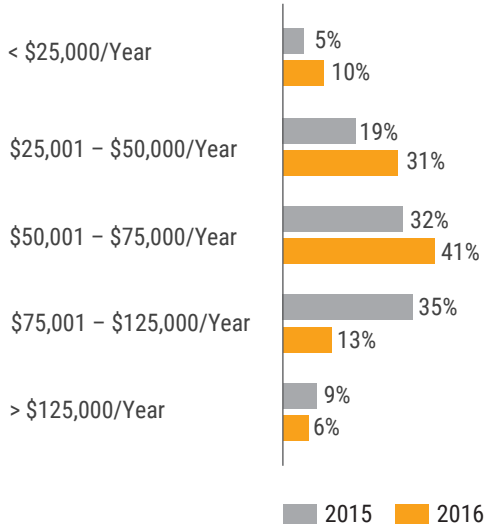


FIGURE 4.8 DIFFICULTY FINDING QUALIFIED EMPLOYEES, 2015-2016: ***Reported hiring difficulty has declined over the last 12 months; eight in ten establishments report difficulty finding qualified candidates in 2016, compared to nine in ten in last year's industry report.***

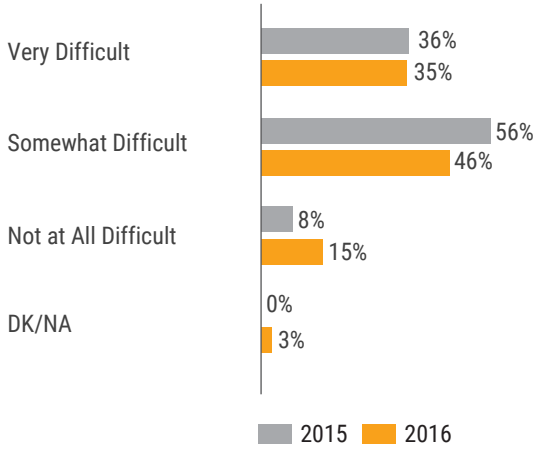
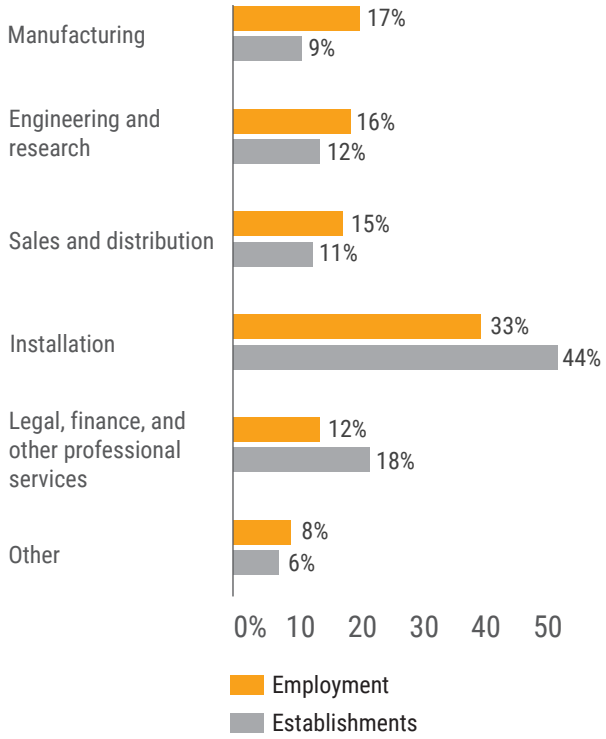
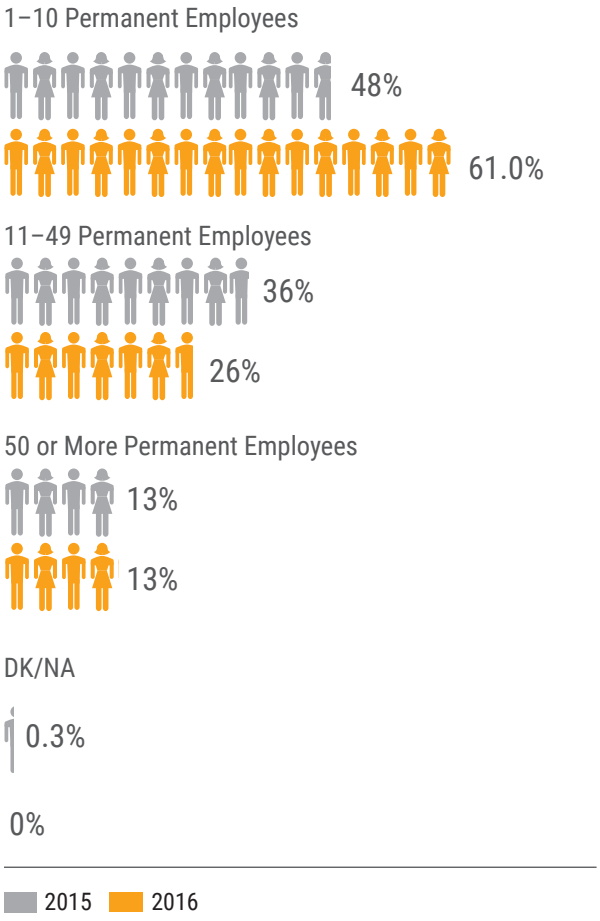


FIGURE 4.9 JOBS AND ESTABLISHMENTS BY ACTIVITY, 2015-2016: ***Not surprisingly, installation represents the largest fraction of establishments.***



The small business trend has intensified over the past year (Figure 4.9).

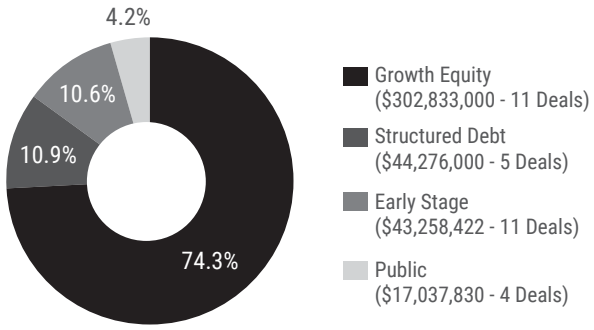
FIGURE 4.10 PERMANENT EMPLOYMENT, 2015-2016: ***Six in ten establishments employ one to ten permanent employees, up from just under half in 2015.***



INNOVATION

The Electrical Efficiency and Building Envelope sector received more than triple the amount of investments in 2015 compared to Renewable Energy Generation. It is possible that high investment in the sector is one of the explanations for the large difference in patent activity—94 patents for solar and wind compared to 817 patents for electrical efficiency technologies over the last six years (Table 4.1). Electrical efficiency establishments attracted 31 investment deals totaling $436 million (Figure 4.11).

FIGURE 4.11 ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE INVESTMENTS, 2015: ***Electrical Efficiency technologies attracted a total of $407.4 million in investments in 2015, primarily in the form of growth equity.***[6]



6 For the survey term (Q3 2015 – Q2 2016), EEBE firms attracted a total of $121, 279,455 in investment dollars.

Electrical Efficiency and Building Envelope establishments account for 64 percent of patent activity across New England over the last five years. The state filed more patents than New York (390 patents) over the same time frame, but less than California (3,045 patents) (Table 4.1). It should be noted that since patent data is derived from a secondary source, sub-technologies are not completely in line with the study definition for EEBE; though the four listed below—advanced materials, energy efficiency, energy storage, and smart grid—are included in the study definition, it is difficult to parse out additional sub-technologies such as water and wastewater, appliances, weatherization services, and building controls.

TABLE 4.1 ELECTRICAL EFFICIENCY AND BUILDING ENVELOPE PATENTS, 2010-2015: ***Massachusetts' companies filed a total of 817 patents for electrical efficiency-related technologies over the last five years.***

	Advanced Materials	Energy Efficiency	Energy Storage	Smart Grid
2010	57	56	29	3
2011	39	53	26	2
2012	44	67	50	1
2013	39	105	36	4
2014	8	76	14	4
2015	2	109	2	0
TOTAL	**189**	**8**	**148**	**14**

COMPANY NAME: HTP, INC.

LOCATION: NEW BEDFORD, MA

NUMBER OF EMPLOYEES IN MASSACHUSETTS: 240

Founded in 1974, HTP is an American manufacturer of state-of-the-art, high efficiency water and space heating systems.

RENEWABLE ENERGY GENERATION

HIGHLIGHTS

At 22 percent—the highest employment growth across all clean energy sectors—Renewable Energy Generation establishments added an estimated 5,100 jobs to the economy. Renewable energy system deployment increased. Establishments installed almost 25,390 renewable projects—more than double the projects completed in the previous year, for a total of 374 megawatts (MW) installed.

Rising deployment in residential installations coincided with the shift the new hire educational requirements. There was a marked trade-off between new hires with a four-year education and those with an Associate's degree (22 percentage point decline vs. 25 point increase respectively).

The state attracted the most early stage investments since 2011. Massachusetts' renewable generation establishments closed nine deals for a total of $78 million in early-stage funding.

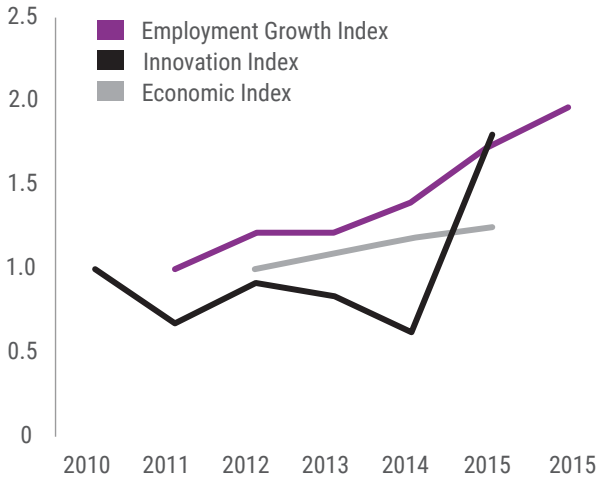
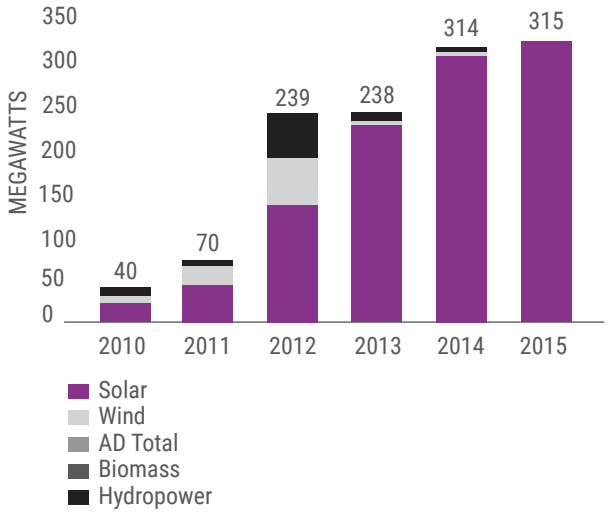


FIGURE 5.1. RENEWABLE ENERGY GENERATION BW INDICES (DEFINED IN GLOSSARY), 2010-2016: ***Employment growth and economic contributions to the GSP are closely related while innovation metrics saw a significant uptick over 2015 following the increase in early-stage funding between 2014 and 2015.***

DEPLOYMENT

The number of Renewable Portfolio Standard (RPS) qualified projects installed in Massachusetts increased to 25,390 systems in 2015-2016. The cumulative total of RPS eligible in-state capacity increased by 33 percent from 1,016 MW in 2014 to 1,349 MW in 2015. As seen in Figure 5.2 below, a significant portion of recent in-state renewable capacity additions have been distributed solar installations supported through the state's Solar Carve-Out II Program.

FIGURE 5.2. INSTALLED CAPACITY, 2011-2015:
Renewable energy capacity has seen steady increase over the last five years

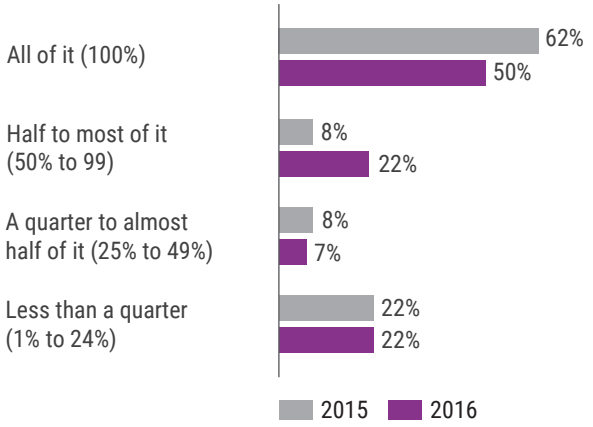


GROSS STATE PRODUCT AND CLEAN ENERGY COMPANY REVENUES

Renewable Energy Generation establishments still comprised just under half of statewide clean energy GSP, accounting for $5.3 billion in gross state product in 2015—up from $5 billion from the previous year—or about 45 percent of the total clean energy share.

There are fewer pure-play establishments in the Renewable Energy Generation sector compared to last year. About half of all renewable generation establishments derive all of their revenue from clean energy activities, compared to 62 percent in 2015 (Figure 5.3).

FIGURE 5.3 ESTABLISHMENT REVENUE ATTRIBUTED TO CLEAN ENERGY, 2015-2016: ***The majority of renewable generation establishments derive at least half of their revenue from providing renewable energy goods and services.***



JOBS AND ESTABLISHMENTS GROWTH

At 22 percent, renewable energy generation is the fastest growing sector of the state's clean energy economy, outpacing electrical efficiency establishments by eleven percentage points (Figure 5.4), with solar technology leading others (Figure 5.5).

FIGURE 5.4 RENEWABLE ENERGY GENERATION EMPLOYMENT GROWTH, 2015-2016: ***Establishments hired more than 5,100 renewable energy workers in 2015—a growth rate of almost 22 percent.***

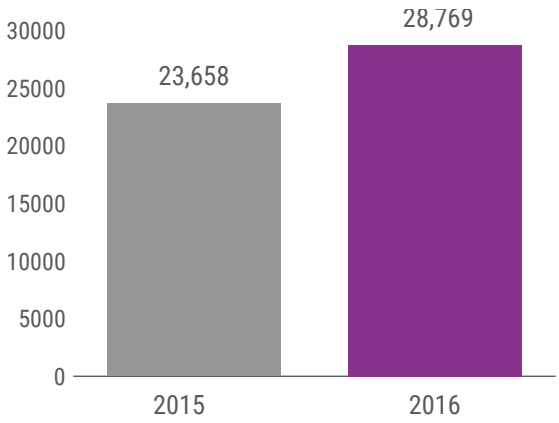
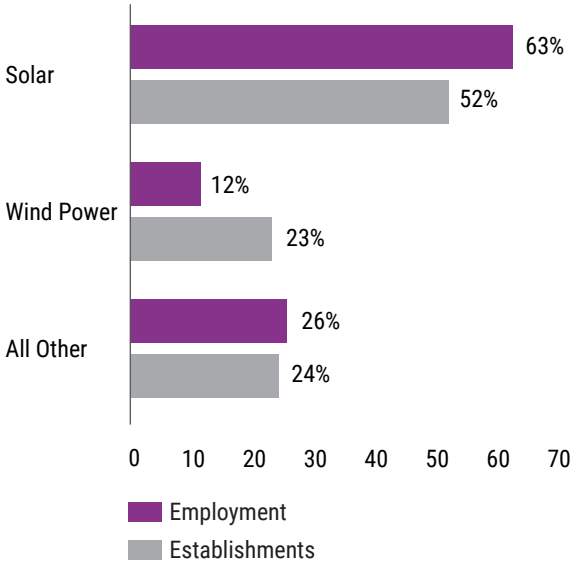
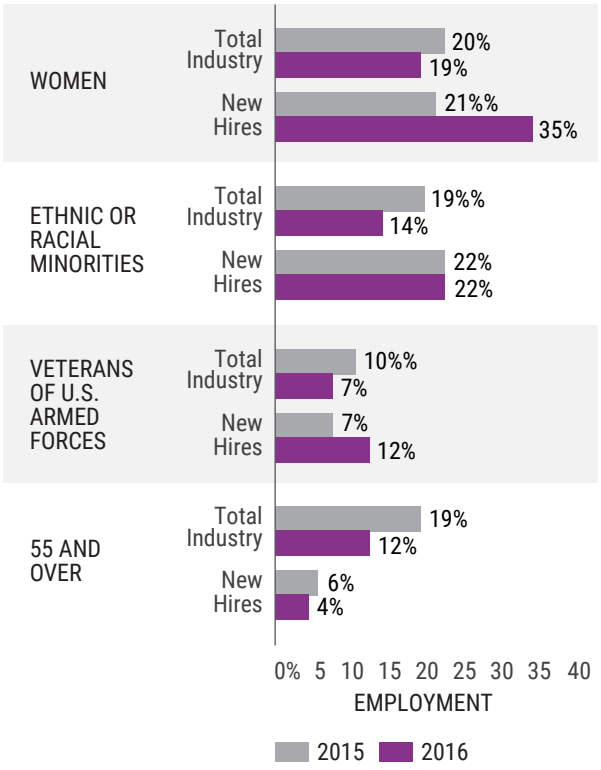


FIGURE 5.5. RENEWABLE ENERGY JOBS BY SUB-TECHNOLOGIES, 2015-2016: ***Solar jobs and establishments led the Renewable Energy Generation sub-technologies***



The overall increase in new hires that were women did not offset the sector's declining demographic diversity in 2016 (Figure 5.6). The influx of less diverse construction establishments into the residential installations market may have contributed to this.

FIGURE 5.6. WORKFORCE DEMOGRAPHICS, 2015-2016: ***Diversity across the renewable generation workforce has declined, however new hires are increasingly diverse.***



Despite reporting hiring difficulty (Figure 5.8), Renewable Energy Generation job growth continued to expand in 2016. This hiring difficulty may have led to a decrease in the educational levels for new hires in the industry (Figure 5.10). The trade-off in new hires with a four-year education (22 percentage point decrease) for those with only an Associate's degree (25 percentage point increase) may explain the wage shift—entry-level new hires with an Associate's degree are likely to earn less compared to their experienced counterparts (Table 5.1).

Indeed, the proportion of experienced new hires declined by 10 percentage points, as over a quarter of employers note hiring difficulty due to lack of experience (31 percent) and insufficiently qualified candidates (26 percent) (Table 5.7).

FIGURE 5.7 EXPERIENCED VS. ENTRY-LEVEL NEW HIRES, 2015-2016

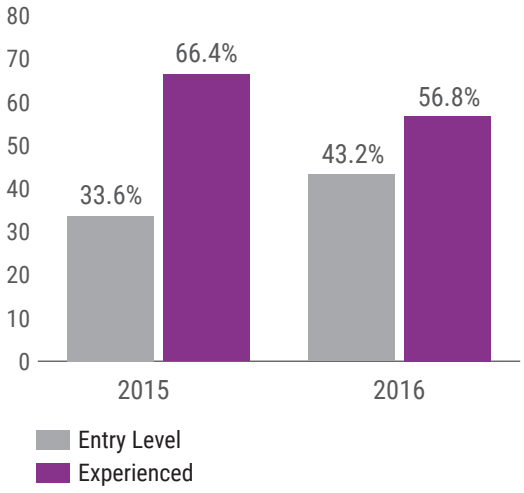


FIGURE 5.8 DIFFICULTY FINDING QUALIFIED EMPLOYEES, 2015-2016: ***Establishments note greater hiring difficulty over 2015—an increase of nine percentage points.***

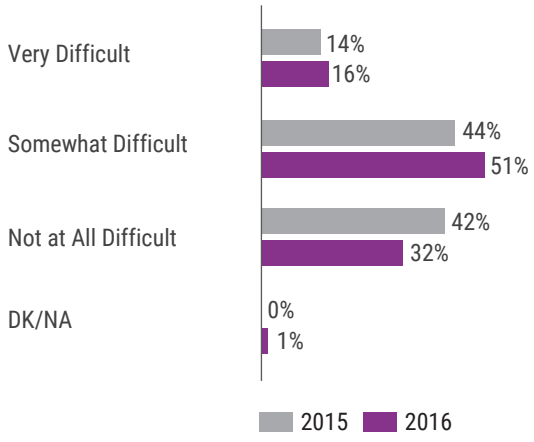


FIGURE 5.9 FULL-TIME PERMANENT WORKER PAY RANGE, 2015-2016: ***Similar to last year, almost three-quarters of renewable generation workers earn an average annual wage of more than $50,000 per year.***

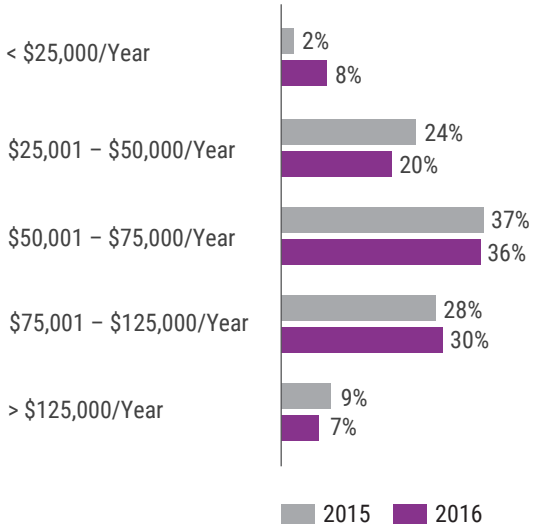
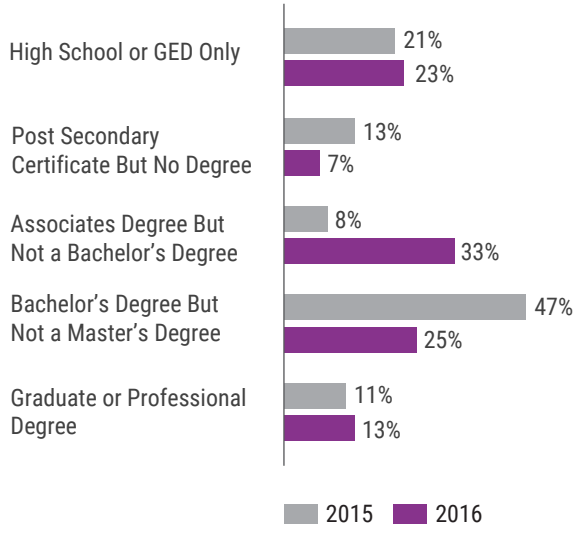


FIGURE 5.10 EDUCATIONAL ATTAINMENT FOR RECENT HIRES, 2015-2016: ***Overall, new hires across the renewable generation sector were slightly more educated this year; seven in ten have at least an Associate's degree.***



While the number of installation related establishments dominate the other value chain activities (Figure 5.11), the jobs are more evenly spread across different value chain activities. The small business trend intensified this year (Figure 5.12).

FIGURE 5.11 JOBS AND ESTABLISHMENTS BY ACTIVITY, 2015-2016: ***Nearly all sectors of the renewable generation economy—except sales and distribution—increased employment over 2015.***

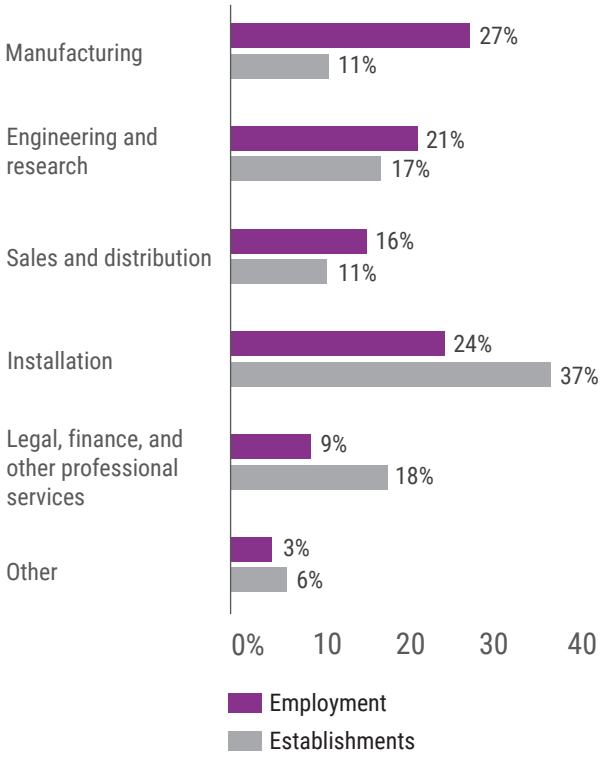
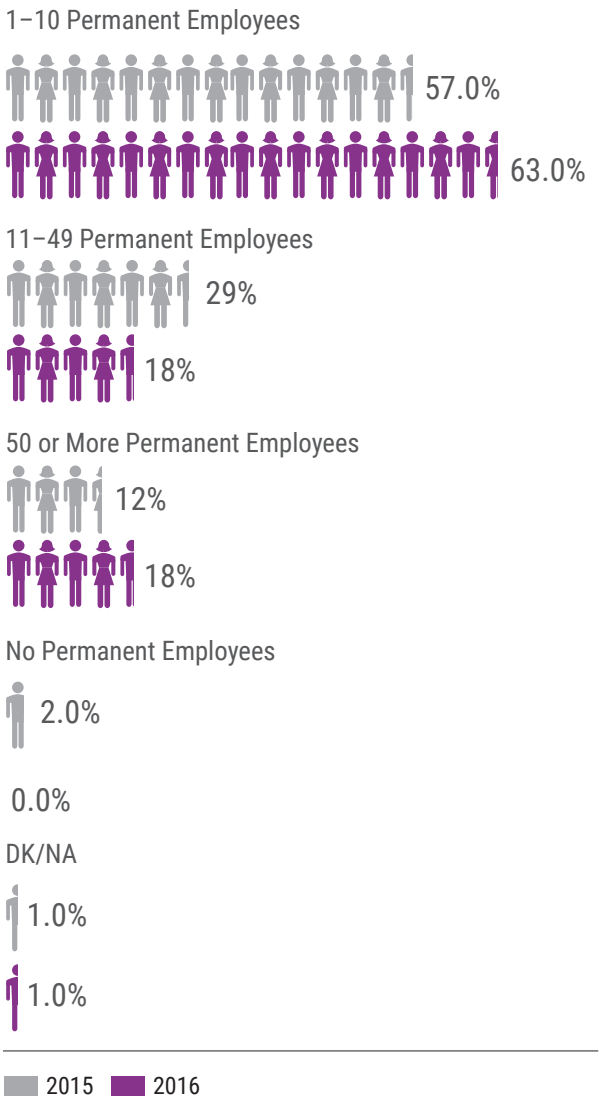


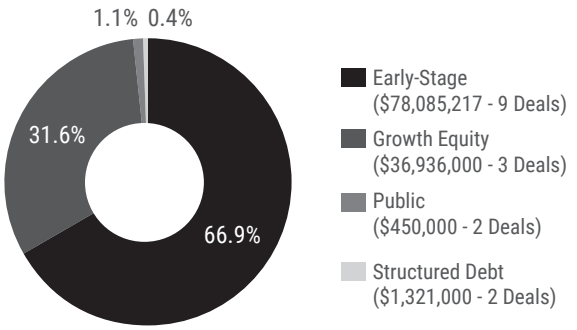
FIGURE 5.12. PERMANENT EMPLOYMENT, 2015-2016:
There are more small and large-sized establishments, but fewer medium-sized renewable energy businesses.



INNOVATION

The state saw a large uptick in early-stage investments over 2015—rebounding from the $18 million in 2014 to $78 million in 2015—a 337 percent increase (Figure 5.13).

FIGURE 5.13 RENEWABLE ENERGY INVESTMENTS, 2015: ***Renewable Energy Generation technologies attracted a total of $117 million in 2015, the majority of which were early-stage funds and growth equity. There were no reported bridge or project finance funds in 2015.[1]***

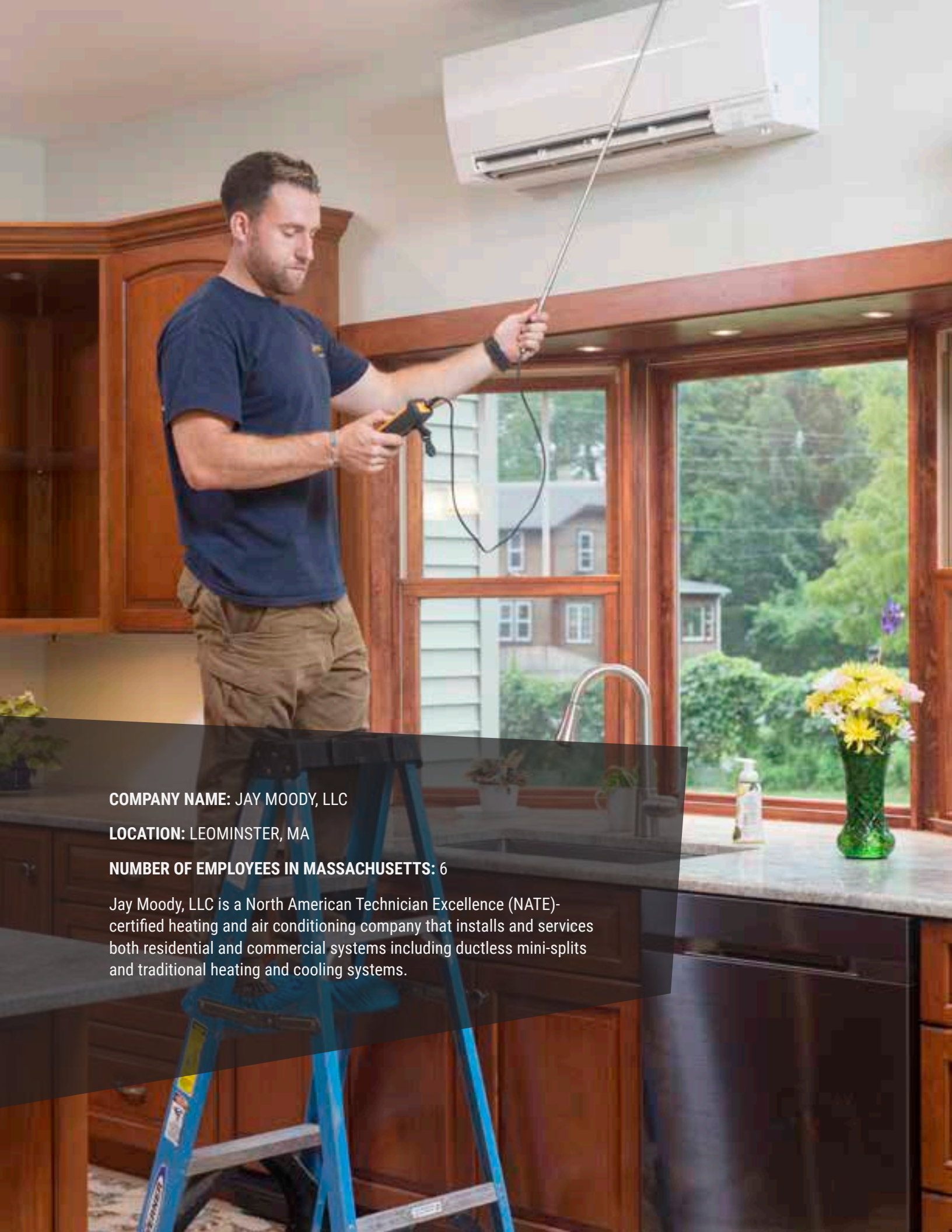


1 For the survey term (Q3 2015 – Q2 2016), REG firms attracted a total of $98,610,454 in investment dollars.

For the survey term (Q3 2015 – Q2 2016), REG firms attracted a total of $98,610,454 in investment dollars. According to the Cleantech Group, Massachusetts establishments account for 78 percent of all renewable energy generation patent activity across New England between 2010 and 2015. In fact, the state also surpassed New York's total patent count over the last five years by 52 patents. Massachusetts takes the lead in New England for both solar (86) and wind (8) patents (Table 5.1); New Hampshire (22 solar patents) and Maine (four solar patents) are the only other states with recorded patents over the last five years. However, the state's patent activity is eclipsed by the 677 patents filed in California since 2010—623 solar patents, 39 wind patents, 11 for biomass generation, and two each for geothermal and hydropower. It should be noted that while patent classifications are based on a establishment's primary sector, Massachusetts and New England as a whole have no recorded patents for biomass, geothermal, or hydroelectric technologies.

TABLE 5.1 RENEWABLE GENERATION PATENTS, 2010-2015: ***Massachusetts filed a total of 94 patents for renewable generation technologies; 92 percent of these patents were for solar technologies and the remainder for wind.***

	Solar	Wind
2010	15	0
2011	30	2
2012	28	4
2013	9	1
2014	4	1
2015	0	0
TOTAL	**86**	**8**



COMPANY NAME: JAY MOODY, LLC

LOCATION: LEOMINSTER, MA

NUMBER OF EMPLOYEES IN MASSACHUSETTS: 6

Jay Moody, LLC is a North American Technician Excellence (NATE)-certified heating and air conditioning company that installs and services both residential and commercial systems including ductless mini-splits and traditional heating and cooling systems.

RENEWABLE AND EFFICIENT HEATING AND COOLING

HIGHLIGHTS

Job growth was slow in the Renewable and Efficient Heating and Cooling sector in 2015-2016. A historically warm winter along with low fossil fuel prices may have contributed to this finding. Establishments shed 4,200 jobs over the last 12 months—a 17 percent decline.

Establishments reported more revenue from clean energy-related activities and GSP contributions increased from $1.9 billion to $2.1 billion.

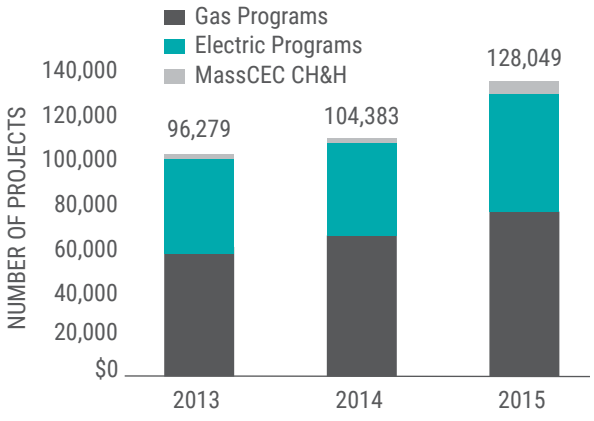
Employment shifted hiring activity towards occupations with fewer educational requirements. Over the last 12 months, recent hires with a Bachelor's degree declined by 12 percentage points.

DEPLOYMENT

While only accounting for a sub-set of activity in this sector, participation in the MassSAVE Residential Heating and Cooling programs increased significantly between 2014 and 2015 with 125,363 residents taking part in the program in 2015 versus 104,220 in 2014.

Similarly, MassCEC saw a significant increase in participation in its clean heating and cooling programs during this time as it launched new initiatives. Total participants increased from 163 projects in 2014 to 2,868 in 2015 (Figure 6.1).

FIGURE 6.1 RENEWABLE AND EFFICIENT HEATING AND COOLING PROGRAM PARTICIPATION 2013- 2015[1]:
The number of projects completed under the Program Administrator residential heating and cooling system programs and the MassCEC's Clean Heating and Cooling initiatives over the past three years has increased from 96,279 in 2013 to 125,363 in 2015.

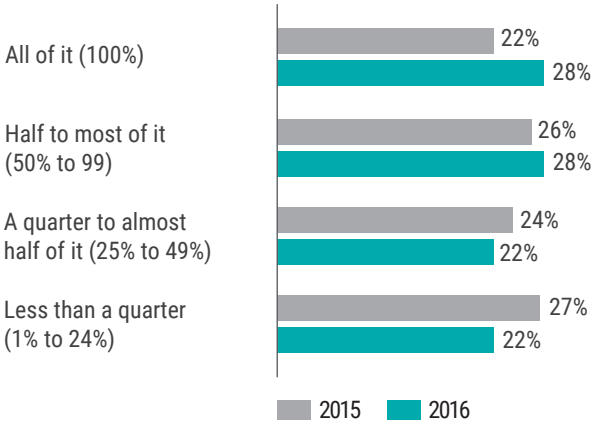


1 This figure represents residential projects only as these can be disaggregated from available MassSAVE data. Inclusion of MassSAVE commercial and low-income renewable and efficient heating and cooling projects would likely significantly increase these totals, however public data specific to this technology sector is not available.

GROSS STATE PRODUCT AND CLEAN ENERGY COMPANY REVENUES

Renewable and Efficient Heating and Cooling activities constituted about 18 percent of the state's clean energy GSP—roughly $2.1 billion in 2015. The sector's contribution to GSP increased by ten percent over the last 12 months from $1.9 billion.

FIGURE 6.2 ESTABLISHMENT REVENUE ATTRIBUTED TO CLEAN ENERGY, 2015-2016: ***The number of pure-play establishments increased slightly in 2016, and over half of the establishments report that they derive at least half of their revenue from renewable and efficient heating and cooling services.***



JOBS AND ESTABLISHMENT GROWTH

Despite the decline in overall jobs (Figure 6.3), new hires were significantly more likely to be women or minorities than the previous year (Figure 6.4).

FIGURE 6.3 RENEWABLE AND EFFICIENT HEATING AND COOLING EMPLOYMENT GROWTH, 2015-2016: ***The sector shed just over 4,200 jobs in 2015, a decline of about 17 percent.***

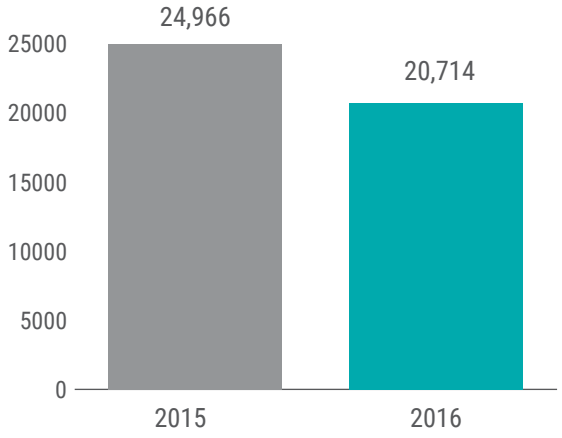


FIGURE 6.4 DEMOGRAPHICS OF CURRENT WORKFORCE AND RECENT HIRES, 2015-2016 ***There are more women and ethnic or racial minorities among recent hires over 2015.***

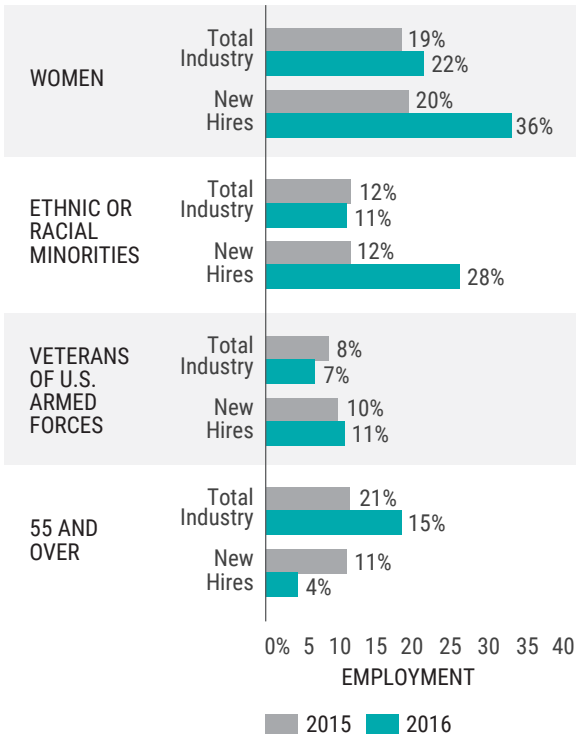
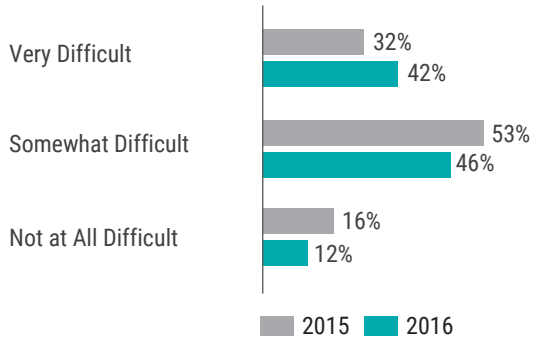
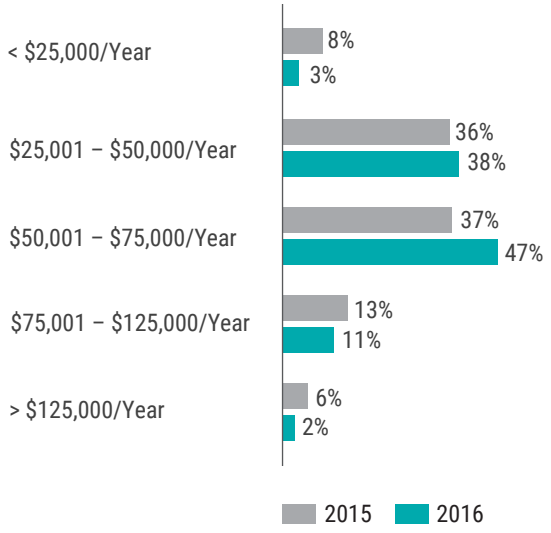


FIGURE 6.5 DIFFICULTY FINDING QUALIFIED EMPLOYEES, 2015-2016: ***Hiring difficulty increased by four percentage points over the last 12 months.***



There was a slight increase in hiring difficulty (Figure 6.5) but the wage trend in Figure 6.6, if sustained, could be promising for job seekers.

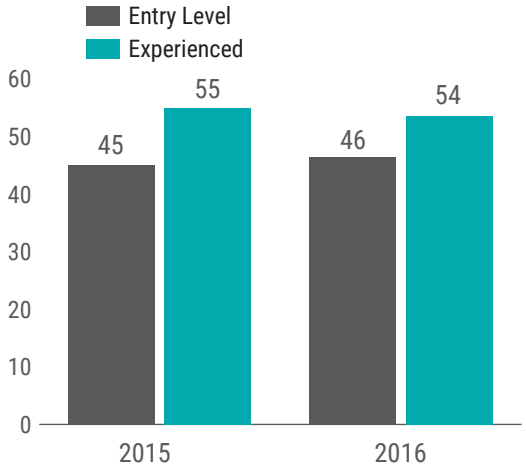
FIGURE 6.6 FULL-TIME PERMANENT WORKER PAY RANGE, 2015-2016: ***Workers earning between $50,000 and $75,000 increased by 12 percentage points over the last 12 months. The overall trend largely mirrors increased wages in the construction industry in Massachusetts.[3]***



3 Bureau of Labor Statistics, Quarterly Census of Employment and Wages.

Employers in the sector typically favor experienced new hires (Figure 6.7). Interestingly, over half the employers attributed hiring difficulty to insufficiently qualified candidates as hiring difficulty increased over the last 12 months (Figure 6.5).

FIGURE 6.7 NEW HIRE EXPERIENCE: ***Over the last 12 months, establishments hired more experienced employees than entry-level workers.***



The sector moved towards less educational attainment (Figure 6.8) and continues to be dominated by small businesses (Figure 6.9).

FIGURE 6.8 EDUCATIONAL ATTAINMENT FOR RECENT HIRES, 2015-2016: ***Renewable Heating and Cooling establishments hired more individuals with less educational attainment than in 2015.***

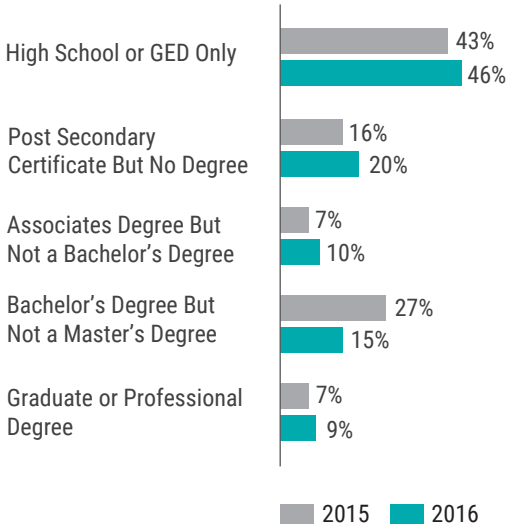
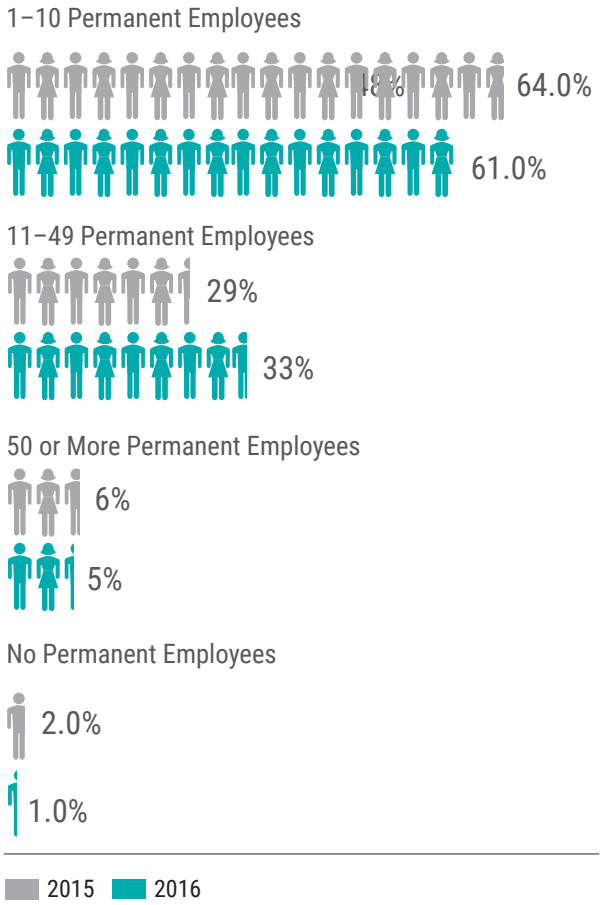


FIGURE 6.9 PERMANENT EMPLOYEES, 2015-2016: ***The sector is comprised mostly of small businesses; six in ten establishments reported having one to 10 permanent employees, similar to 2015.***



INNOVATION

The data sources used for innovation, specifically patents and investments, are not available for the sector.


VOLT

ALTERNATIVE TRANSPORTATION

HIGHLIGHTS

- **Investment in Alternative Transportation reached a new high, at nearly $58 million across four deals.[1]**
- **Employment grew by 18 percent.**
- **Patent activity in 2014-2015 was strong for Alternative Transportation. The bulk of patents were focused on electric vehicles and charging, and there were no awards in fuel cells or hydrogen vehicles.[2]**

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1 XL Hybrids (Growth Equity); E-Circuit Motors (Series A); and Joule (Growth Equity and Structured Debt)

2 Patent data for 2016 is not yet available.

DEPLOYMENT

Massachusetts has seen a significant increase in the number of alternative vehicles on its roads – demonstrated by the success of the Commonwealth's DOER MOR-EV program which has reserved and issued more than $5 million in rebates and incentives since June 2014.

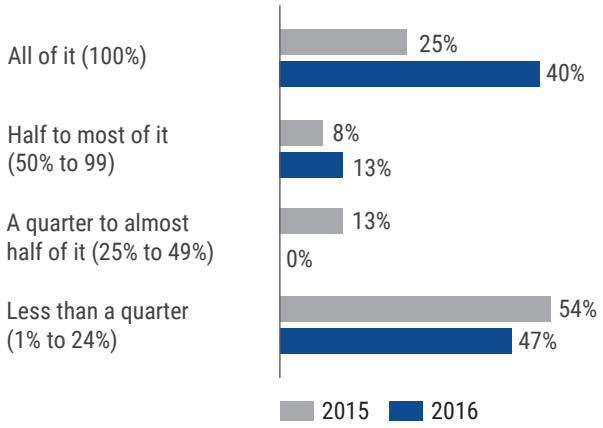
As of June 30, 2016, more than three-quarters of the year's allocated program funding had been issued or reserved.[3] Despite lower gasoline and diesel prices than in previous years, there has been an uptick in metrics such as charging station construction and fleet grants.

3 https://mor-ev.org/program-statistics.

GROSS STATE PRODUCT AND CLEAN ENERGY COMPANY REVENUES

Alternative Transportation establishments' contributions to GSP grew more slowly than other segments of the Commonwealth's clean energy economy, adding about $13 million over the past year, for a growth rate of about two percent.

FIGURE 7.1. ESTABLISHMENT REVENUE ATTRIBUTED TO CLEAN ENERGY, 2015-2016: ***The majority of establishments either receive all of their revenue from Alternative Transportation technologies (40 percent) or less than a quarter (47 percent).***



JOBS AND ESTABLISHMENT GROWTH

While it represents only two percent of clean energy employment, Alternative Transportation establishments demonstrated impressive employment growth—18 percent over the last 12 months (Figure 7.2).

FIGURE 7.2. ALTERNATIVE TRANSPORTATION EMPLOYMENT GROWTH, 2015-2016: ***Businesses supporting Alternative Transportation technologies grew by 18 percent over the past 12 months.***

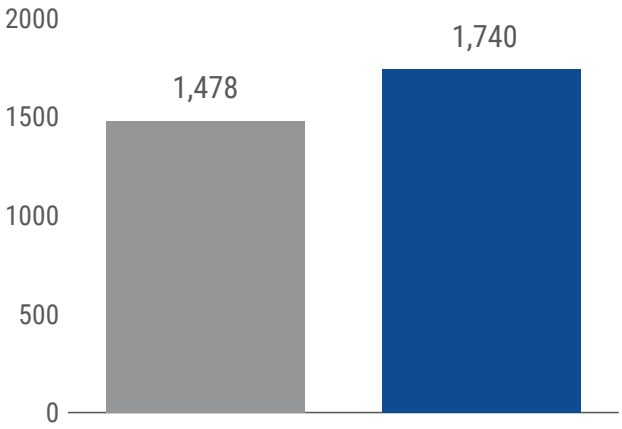
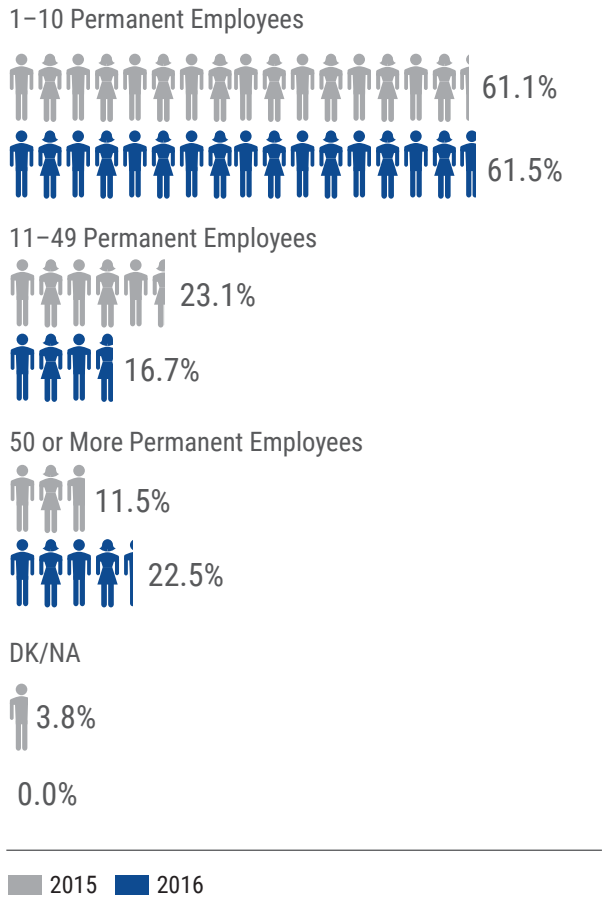


FIGURE 7.3. PERMANENT EMPLOYEES, 2015-2016:
Alternative Transportation establishments are mostly small businesses; six in ten employers report one to 10 permanent workers at their locations.



INNOVATION

There appears to be a slight lag several months following large sums of investment dollars and patent filings. Alternative Transportation establishments received $17.5 million over 2013 (Figure 7.4), but patent activity did not increase until the following year; establishments filed 48 patents for transportation, fuel cell, and hydrogen technologies compared to only 13 patents in 2013.

The 76 percent decline in investment dollars between 2013 and 2014 correlates with the decline in patent activity observed in 2015 (Table 7.1). In 2015, however, establishments attracted the highest amount since 2010—almost $58 million dollars.

FIGURE 7.4. ALTERNATIVE TRANSPORTATION INVESTMENTS, 2010-2015: ***Alternative Transportation investments increased dramatically over the past 12 months; this is the highest recorded dollar amount for investments in sector since 2010.***

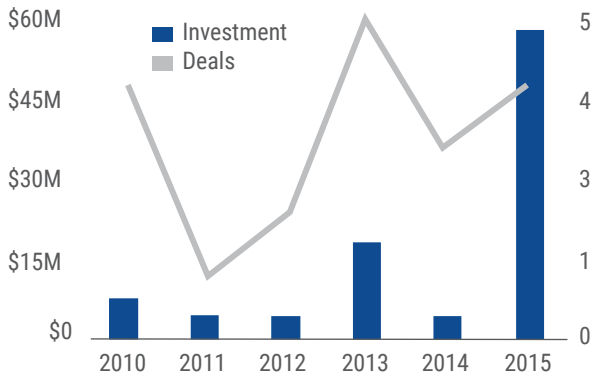


TABLE 7.1. ALTERNATIVE TRANSPORTATION PATENT ACTIVITY, 2010-2015: ***Patent activity declined between 2014 and 2015, following an almost three-fold increase the previous year.***

	Transportation Patents	Fuel Cells and Hydrogen Patents
2010	4	5
2011	2	1
2012	6	8
2013	6	7
2014	47	1
2015	31	0
TOTAL	**96**	**22**


DANGER
CAUTION

STRENGTHS, BARRIERS, AND OPPORTUNITIES

This section is based on a number of open-ended responses that employers provided to questions regarding advantages, disadvantages, or challenges to operating a clean energy business in Massachusetts as well as supportive policies for clean energy establishments.

These responses were then coded into categories based on similarity and frequency; responses that were not reported more than two percent of the time are placed in an "other" category. As such, much of the following section is subject to respondent interpretation. These data are intended to provide broad indications of top-of-mind issues rather than a detailed Strengths, Weaknesses, Opportunities, and Threats analysis.

Talent and education is the number one advantage to operating in a clean energy business in Massachusetts, followed by the educated customer base and subsequent high demand for clean energy, in the advantages reported by 62 respondents (Table 8.1). This is not surprising considering Massachusetts has long been considered a hub for clean energy deployment, and with university graduates and research centers, the state also has a steady supply of skilled workers to support the clean energy industry.

Fewer employers noted regulatory and tax burdens to be a disadvantage to conducting clean energy operations in Massachusetts among the 63 respondents; at the same time, businesses (also 63 respondents) were more likely to suggest that supportive regulatory programs would actually have the greatest positive impact (Tables 8.2 and 8.3).

When asked about the two most significant barriers or obstacles to their company's ability to grow its clean energy business in Massachusetts, about one-third of the 25 surveyed employers reported that finding early adopters was a barrier over the last 12 months, and five cited the lack of demonstration sites—up 12 points from last year (Table 8.4).

TABLE 8.1 REPORTED ADVANTAGES TO OPERATING IN MASSACHUSETTS, 2015-2016: ***Employers found the state's level of talent and education, high consumer demand, and thriving business environment to be the greatest advantages to operating a clean energy business in Massachusetts.***

	2016
Talent/Education	30.6%
Educated customer base, green culture, high demand	25.8%
Thriving clean energy business environment, good network, high growth/ profits	17.7%
Location	14.5%
Consumer incentives (utility support, state support, etc.)	6.5%

TABLE 8.2. REPORTED DISADVANTAGES TO OPERATING IN MASSACHUSETTS, 2015-2016: ***Establishments are most concerned with fiscal and marketing resources.***

	2016
High cost of business/insufficient access to capital	23.8%
Insufficient marketing/consumer demand and education	11.1%
Unavailable skilled workforce	7.9%
Insufficient/ unstable policy support	6.3%
Regulatory/ tax burdens (including utilities)	4.8%

TABLE 8.3. POLICY OR PROGRAM WITH GREATEST POTENTIAL IMPACT, 2015-2016: ***Regulatory policies have taken center stage as the type of program that would have the greatest potential impact for clean energy businesses.***

	2016
Supportive regulatory policies	32%
Consumer incentives	24%
Innovation funding	10%
Lower regulatory/tax burdens	6%
Marketing/public engagement	4%

TABLE 8.4. SIGNIFICANT BARRIERS TO COMPANY GROWTH, 2015-2016: ***Identifying first customers and early adopters continues to present a significant barrier to company growth.***

	2016
Identifying first customers/ early adopters	32%
Availability of demonstration sites	20%
General economic conditions	20%
Cost of labor	20%
Access to skilled labor	12%
Real estate costs	12%
Working with utilities	12%

GLOSSARY OF TERMS

Activity: For the purposes of this report, an establishment's activity refers to the primary value-chain industry to which it most associates its work. Activities include research, development and engineering, manufacturing, sales and distribution, installation and maintenance, legal, finance, and other professional services, and other.

Administrative hires: Workers who perform secretarial or assistant level tasks.

Alternative Transportation: Alternative Transportation includes non-fossil fuel related vehicles, including electric rail and electric vehicles. This includes

- **Electric Vehicles:** Passenger or freight cars, trucks or buses that use electric drive systems and electric motors for propulsion.
- **Electric Rail:** Passenger or freight trains or trolleys that operate with electric motors for propulsion.

Asset-based finance: A business loan that is secured by collateral. The loan, or line of credit, is secured by inventory, accounts receivable and/or other balance-sheet assets.

British thermal units (BTUs): British thermal units is an energy unit. It is approximately the energy needed to heat one pound of water for one Fahrenheit.

Clean Energy Industry: The aggregate of establishments that are directly involved with researching, developing, producing, manufacturing, distributing or implementing components, goods or services related to Renewable Energy, Energy Efficiency or Conservation, Smart Grid, Energy Storage, Carbon Management and/or Electric or Hybrid Vehicles.

Clean Energy Establishment: For the purposes of this report, an establishment is any establishment that is involved with an activity related to the clean energy industry.

Clean Energy Worker: Full-time and part-time permanent employees who support the clean energy portion of the business, including administrative staff, excluding interns and other temporary workers.

Cluster: A geographic concentration of interconnected establishments in related industries.

Deal: Refers to the single number of investments closed.

Early-stage Investment: Investments including Seed, Series A, and Series B investments.

Electrical Efficiency and Building Envelope: Goods and services that reduce electricity demand. Electrical Efficiency and Building Envelope includes the following technologies:

- Energy efficiency upgrades to existing buildings (retrofitting and retrocomissioning)
- **Energy Storage:** Devices or physical media that store energy.
- **Demand Response Services:** Operations that balance energy supply and demand. Include offering time-based rates such as time-of-use pricing, critical peak pricing, variable peak pricing, real time pricing and critical peak rebates. It also includes direct load control programs which provide the ability for power companies to cycle air conditioners and water heaters on and off during periods of peak demand in exchange for a financial incentive and lower electric bills.
- **Smart Grid:** Automated, computer-based electricity delivery, including smart computing and software.

- **Water and Wastewater:** Technologies related to Conserving Energy: Products related to reducing energy for water purification, distribution or treatment.

Establishment: For the purposes of this report, a business location in Massachusetts with at least one employee.

Establishment: A business organization, such as a corporation, company, or partnership. A establishment can have multiple establishment locations.

Greenhouse Gas Emissions Accounting and Management: Primarily includes carbon capture and storage, secondary carbon markets (such as RGGI) and coal gasification. This includes

- **Carbon Capture and Storage:** The process of capturing waste carbon dioxide from large point source emitters and depositing it in a location that cannot enter the atmosphere, such as in deep geological formations. Also referred to as sequestration.
- **Secondary Carbon Markets:** Trade of carbon credits in a cap and trade or similar system.
- **Coal Gasification:** The production of synthetic gas from coal via thermo-chemical processes.

Management/professional hires: Workers who supervise others and or work in an professional position such as accountant, attorney, or executive. Sales - workers who predominantly sell products or services.

Megawatt hour (MWh): A megawatt is a unit for measuring power that is equivalent to one million watts. A megawatt hour is equal to 1,000 Kilowatt hours—or 1,000 kilowatts of electricity used continuously for one hour.

Pre-commercial: Work that has yet to reach market or products that are in the development phase.

Production/technician Hires: Workers in the field or on the floor, generally working in assembly, installation, or other technical, non-managerial tasks.

Professional service: Any sort of finance, legal, architecture, or other mathematical or scientific services that support clean energy technology development and deployment.

Project Finance: Financing of long-term infrastructure, projects, and services. The project debt and equity used to finance the project are paid back from the cash flow generated by the project.

"Pure-play": Refers to a company or establishment that has or is very close to possessing a single business focus, i.e. a "pure-play" Energy Efficiency establishment would be only associated with Energy Efficiency work.

Regulatory Policies: Regulatory policies, or mandates, are limits placed on individuals or agencies meant to compel certain types of behavior.

Renewable and Efficient Heating and Cooling (REHC): refers to establishments that are involved with heating, ventilation and air conditioning (HVAC) from Renewable Energy sources or work that increases the Energy Efficiency of HVAC systems. REHC includes the following sub-technologies:

- **Solar Thermal:** Uses the sun's energy to generate thermal energy.
- **High Efficiency Air-Source Heat Pumps:** Transfers heat between a structure and the outside air efficiently.
- **HVAC and Building Controls:** Heating, ventilation, and air conditioning systems (HVAC), including building retro-commissioning and retrofits connected to heating and cooling.
- **Ground-Source Heat Pumps:** Central heating and/or cooling that moves heat from or to the ground from a structure.

- Woody biomass (wood, wood pellets)
- Biofuels (biodiesel for heating)
- **Renewable Combined Heat and Power:** Production of electricity and usable heat from renewable sources. Also called cogeneration.

Renewable Energy Generation (REG): Any establishments that are involved in the manufacturing, sale, installation, or research and development of renewable electricity generation technologies.

Retrocommissioning: Refers to the process of improving a building or structures operating process by increasing occupant comfort and saving energy usually through Energy Efficiency measures (weatherization, lighting, etc.).

Renewable Portfolio Standard (RPS): A regulation requiring the increased production of energy from renewable energy sources. Typically, states set an RPS quota in which utilities must obtain some percentage of their production capacity from renewable sources by a certain time.

Startup companies: A business entrepreneurial venture, typically aimed at meeting marketplace demand by developing or providing an innovative product, process, or service.

Stretch Energy Code: The Stretch Code is at least 20% more energy efficient than the state's base IECC code; it is optional for municipalities that wish to achieve higher energy efficiency than the baseline.

Sub-technology: For the purposes of this report, sub-technology refers to the specific technologies with which an establishment works, within each technology area. The sub-technologies for Energy Efficiency and Renewable Energy are listed under the respective definitions.

Technology: For the purposes of this report, technology refers to the primary application or end use of a establishment's produced goods or services. Technologies include Energy Efficiency, Renewable Energy, alternative transportation, greenhouse gas management and accounting, or other.

GROSS STATE PRODUCT

The clean energy portion of Gross State Product calculated for this report was derived from survey incidence rates and proportional revenue reporting, together existing data from the Bureau of Economic Analysis, calculated by NAICS code. Utility-data and state government spending were included as direct inputs (rather than using a proportional analysis).