

# Massachusetts Clean Energy Industry Report

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Prepared for the Massachusetts Clean Energy Center by BW Research Partnership

50 Mill Pond Drive, Wrentham, MA 02093 | T (617) 395-8898 | [www.bwresearch.com](http://www.bwresearch.com)



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## Letter from MassCEC CEO Alicia Barton

I am pleased to report that, for the third straight year, the Massachusetts clean energy economy is growing. The 2013 Massachusetts Clean Energy Industry Report shows clean energy jobs grew by 11.8% from 2012 to 2013, following 11.2% growth the year before and 6.7% growth in 2011. In just the past two years, clean energy sector jobs have grown by 24% overall. This success in growing clean energy jobs is defying national and global economic trends and puts Massachusetts squarely on the global map as a leading clean energy economy.

Established in 2011, our Massachusetts Clean Energy Industry Report seeks to gauge the size and growth of clean energy sector employment and businesses across Massachusetts. This year's report provides further evidence that this remarkable rate of growth hasn't occurred by accident—it's by design. The seeds were sown for sweeping clean energy economic development policies when Governor Deval Patrick signed the Green Jobs Act creating the Massachusetts Clean

Energy Center (MassCEC) five years ago on August 13, 2008.

At MassCEC, we are dedicated to growing the clean energy sector from the ground up. We do this by assisting early-stage companies with funding for research and by targeting investments at companies that aim to create jobs here in Massachusetts. We work with schools, non-profit groups and businesses to develop clean energy job training programs and we fund internships so the next generation of clean energy workers is prepared to step into the jobs of tomorrow. We offer rebates and incentives for renewable energy projects that help create the markets for Massachusetts-made technologies. And we are building the infrastructure to ensure Massachusetts' clean energy leadership into the future.

As a result of these efforts, there are now 79,994 Massachusetts clean energy workers and 5,557 clean energy firms operating in Massachusetts.



And employers are “bullish” about continued growth in the year to come.

Stemming from Massachusetts’ unparalleled access to financial and intellectual capital, some of the largest gains in employment came from early-stage clean energy innovation firms entering the market. Engineering and research jobs grew by 32.4%. Manufacturing and assembly jobs rose again this year as well, by an impressive 20.6%.

And we’re seeing this growth across the state, with the southeastern region rebounding from a period of decline from 2011 and 2012 to become the fastest-growing region of the Commonwealth in terms of clean energy employment with a 14.3% increase from 2012 to 2013. Small, independent contractors were a major driver of growth in Central and Western Massachusetts.

The Massachusetts clean energy workforce is also expected to grow more diverse. Women now make up approximately 21% and racial or ethnic minorities make up 14% of Massachusetts’ total clean energy workforce.

For the first time, this year’s report provides a detailed report on the business climate for clean energy firms and reports a high level of business confidence. The employers surveyed provided detailed feedback that will help Massachusetts policymakers continue to implement policies that are tailored to meet the needs of this rapidly growing field.

The 2013 Massachusetts Clean Energy Industry Report is clear evidence that Massachusetts’ nation-leading investments in clean energy are paying off. With its continued projected growth, the clean energy sector is poised to join the Commonwealth’s other marquee industries including life sciences, financial services and information technology in the years to come.

It’s up to us to keep up the pace. Now is no time to let up.



Alicia Barton  
Chief Executive Officer

## Acknowledgments

The 2013 Massachusetts Clean Energy Industry Report is the result of an extensive research process that included a survey of more than 1,200 respondents. MassCEC would like to thank all of the respondents for engaging with us to gather this important data. Researchers could only gather these data because of each respondent's willingness to generously share their time and insights.

The publication of this report would not have been possible without the hard work and dedication of the following individuals:

### BW Research Team

- Philip Jordan, BW Research
- Kevin Doyle, Green Economy
- Gordon Carr, GMC Strategies
- Jamie Barrah-Burtoft, BW Research
- Josh Williams, BW Research
- Ryan Young, BW Research

### MassCEC Staff

- Martha Broad
- Sally Griffith
- Tamika Jacques
- Jeremy McDiarmid
- Arthur Natella
- Sasha Varasano

### Photo Credits

Thanks are due to the following Massachusetts clean energy firms, who allowed us to feature their photos in the report: CoolChip Technologies, Conservation Services Group, and Phillips Lightolier. In addition, thanks to Stephanie Stoops for her photography and collation of these photographs.



# Introduction

Massachusetts has a long history of technological innovation. Its world-class universities, access to capital, deep legal and financial services sectors and strong public policy commitments have kept it at the forefront of the 21<sup>st</sup> Century economy. As much of the nation emerges from a deep economic recession, Massachusetts has fared better, thanks to its diverse mix of industries and its ability to embrace change. No sector demonstrates the Commonwealth's competitive advantages better than its clean energy sector.

Among recent recognition of its accomplishments, the Commonwealth received a No. 1 ranking from the 2013 U.S. Clean Tech Leadership Index, in the Capital category, reflecting a nation-leading level of private investment activity, as well as our abundance of human and intellectual capital. Massachusetts-based companies have competed for and received 17%—or \$90.5 million—of the federal dollars awarded through the U.S. Department of Energy's ARPA-E program, which is devoted to advanced energy research projects that are transformational, sustain-

able, and bridge the gap between basic energy research and developmental and industrial innovation. At the same time, the Bay State has significantly increased its production of renewable energy, with an 85-fold increase in installed solar capacity in just under seven years. Furthermore, between 2007 and 2013, Massachusetts experienced a 157% growth in electric energy savings from energy efficiency measures.

With such a solid track record of performance on renewable energy and energy efficiency measures, it is no surprise that the Massachusetts clean energy sector continues to grow. Since 2011, our independent analysis of employer data has shown that Massachusetts has a strong and growing clean energy sector, with a diverse base of companies that conduct activities across the entire spectrum of the value chain and clean energy technologies. This is the third report released by the Massachusetts Clean Energy Center (MassCEC) as part of its requirement to conduct an annual accounting of the clean energy industry in Massachusetts. As with any longitudinal research study, each year presents new trends – and new

## KEY FINDINGS OF THE 2013 MA CLEAN ENERGY INDUSTRY REPORT

- **5,557** *clean energy firms*
- **79,994** *clean energy workers*
- **1.9%** *of total workers in the Commonwealth*
- **11.8%** *employment growth rate from 2012 to 2013*

questions to answer. In response to questions raised in previous years' efforts, the 2013 study dramatically expands the scope of the research, by adding employer feedback regarding the business climate and detailed workforce needs of Massachusetts clean energy companies, together with a clean energy capital snapshot. This report includes a summary of these expanded findings.

Since 2011, three themes have emerged as the key to employers' ability to meet customer demand and grow their businesses: 1) supportive public policies; 2) a well established culture of innovation and entrepreneurship; and 3) an education system that helps produce a highly talented workforce. These assets, coupled with continued growth in demand for cleaner energy goods and services, have led to an emerging sector that is on a path similar to the Commonwealth's other marquee industries including life sciences, financial services and information technology.

Comparison to other sectors in Massachusetts helps frame the clean energy sector in terms of its size and scope. Direct comparisons are difficult (and serve only as examples) because the clean

energy sector crosses over so many different traditional industries, and because most traditional labor market reports often do not count the small startup firms that do not have established payrolls. Examples of other sectors' employment include healthcare (including doctors' offices, hospitals, ambulatory care, etc.) at 462,362 workers,<sup>1</sup> construction, at 169,198 workers,<sup>2</sup> biopharma at 56,462 workers,<sup>3</sup> information technology at 151,025 workers,<sup>4</sup> and financial and insurance services at 177,567 workers.<sup>5</sup>

When the studies commenced in 2011, the Massachusetts clean energy sector employed 64,310 clean energy workers across renewable energy, energy efficiency, alternative transportation, carbon management and other related technologies. The 2012 report found a quickly growing sector, with employment growth of 11.2%, representing over 7,000 additional clean energy jobs. The information collected this year continues to update and expand our knowledge of the Massachusetts clean energy sector, which now stands at just under 80,000 workers.

As with the previous studies, this 2013 report is based on survey data gathered directly from clean energy employers in the Massachusetts. Unlike other studies, this report does not rely solely on databases of known employers—those organiza-

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1 EMSI Class of Worker, 2013.2

2 *Id.*

3 [http://www.massbio.org/news/397-massachusetts\\_continues\\_to\\_lead\\_biopharma\\_industry/news\\_detail](http://www.massbio.org/news/397-massachusetts_continues_to_lead_biopharma_industry/news_detail)

4 EMSI Class of Worker, 2013.2

5 *Id.*



tions that are members of industry associations, have signed up for various clean energy incentives or programs or have been otherwise identified as conducting clean energy work. While known-employer lists are important, analyses based solely on such lists can undercount clean energy workers because they miss the large number of companies engaged in clean energy work that have not yet been identified as part of the sector.

In addition to understanding the known employers, a truly comprehensive accounting of the clean energy economy requires collecting information on the thousands of companies that are conducting clean energy activities as part of their business, but are not identified in any database of clean energy firms. At the end of 2012, there were more than 5,000 plumbing, heating, ventilation and air conditioning (HVAC), and electrical contractor establishments in Massachusetts.<sup>6</sup> Many of these have a clean energy aspect to their business, yet few appear in any known clean energy database. Therefore, it is important to develop a methodology that can determine the number of firms in industries like these that are active in clean energy and the number of their workers that support clean energy activities, particularly in order to understand the distinct needs of these more traditional and often “population-serving” companies that manufacture, sell, install, and maintain existing clean energy products for the local market. Many other surveys simply cannot devote adequate time and resources to make the tens of thousands of inquiries necessary for such rigorous data collection.

A further advantage of the comprehensive survey method used in this report is a reduced reliance on models to estimate employment. Most clean energy employment studies rely on assumptions and economic models that estimate employment based on revenue. Studies have shown that economic models and the assumptions they require at the state and local level are low-cost fallback options but are not as accurate as direct survey methods.<sup>7</sup> Finally, the wide-ranging interviews conducted for this report allowed for in-depth employer information to be captured from a broad cross-section of stakeholders in the clean energy industry.

As with previous years, surveys were administered online and by telephone to a list of known clean energy employers, as well as to a representative, stratified, clustered sample<sup>8</sup> of companies across the entire Commonwealth. This sample includes the primary value-chain industries such as agriculture, construction, manufacturing, wholesale trade and research and development (R&D). While some supportive industries, such as financial services and law firms are included in the known list of employers, these firms are not targeted in the random sample outside of the known universe of clean energy activity. This same method of employer identification was used for the 2011 and 2012 report, allowing us to effectively and consistently compare data across time and to expand the baseline of data for future comparisons.

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7 See generally, <http://www.edrgroup.com/pdf/iowa-energy-econ-part1.pdf>, at p. 8-9 (1995) and <http://www.nrel.gov/analysis/jedi/limitations.html> (2012)

8 See <http://support.sas.com/rnd/app/da/new/801ce/stat/chap13/sect13.htm>.

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6 Economic Modeling Specialists, Inc., Complete Data 2013.2

*For the purpose of this report, a **clean energy firm** is defined as an employer engaged in whole or in part in providing goods and services related to renewable energy, energy efficiency, alternative transportation, and carbon management. **Clean energy workers** are defined as spending at least a portion of their time supporting the clean energy aspects of their businesses.*

The data presented in this report result from direct feedback from over 1,200 Massachusetts employers. Over the past three years, the research team attempted approximately 59,550 telephone calls and sent over 17,000 emails to employers. The level of sampling has generated highly reliable data, with a margin of error of approximately  $\pm 3.1\%$  at a 95% confidence interval, which is considerably more reliable than the industry standard for survey research.

The large sample size ensures that the *2013 Massachusetts Clean Energy Industry Report* provides comprehensive and reliable data on the number of clean energy firms and employees while validating the findings from previous studies. It also allows for deeper segmentation and analysis of regions and employers by size, technology, and value-chain activity. This report finds that the Massachusetts clean energy sector has expanded to 5,557 clean energy firms that employ 79,994 clean energy workers. The 79,994 clean energy workers in Massachusetts represent 1.9% of total employment in the Commonwealth, making the clean energy sector a key component of the Mas-

sachusetts economy. The growth pattern, while impressive in its own right, is even more meaningful because it is in a different form this year than in previous years. In 2012, the bulk of the employment growth was due to existing companies adding employees. This year, the overwhelming majority of growth came from new entrants to the sector – both startups and existing firms that have started conducting clean energy activities.

The research also finds that the clean energy sector is growing significantly faster than other sectors of the Massachusetts economy. Since 2011, clean energy employment has grown by an astounding 24.4%, more than eight times faster than the overall 3% growth rate<sup>9</sup> among all industries in the Commonwealth over the same period. This represents over 15,000 jobs in two years. The 11.8% employment growth rate is slightly faster than the 2011-2012 growth rate of 11.2%, demonstrating continued promise for the sector. At the same time, employers remain optimistic about the fu-

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<sup>9</sup> EMSI Complete Employment, 2013.2.

*Traditional industries create significant entrepreneurial activity, often in the form of small, independent contractors in plumbing, electrical or HVAC—which this year was a major driver of clean energy growth, especially in Central and Western Massachusetts.*

ture, anticipating another strong rate of 11.1% growth over the coming 12 months.

There are some changes to the 2013 report, with additional information that enables further refinement of the employment totals. For the first time this year, the study provides employment totals by *primary* clean energy focus (e.g., renewable energy, energy efficiency, etc.) that does not include overlap. There is also significant new data on employment for solar and wind technologies, as well as analysis of the representation of women and minorities in the clean energy workplace.

While the data in this report present an overview of the Massachusetts clean energy sector, they present a tale of two very different worlds. On the one hand are the early-stage, innovation companies that are on the cutting edge of research and development and focused heavily on deployment and global export markets. On the other are more traditional, population-serving firms that manufacture, sell, install and maintain existing clean energy products. These two worlds operate very differently and have different drivers for growth.

Traditional firms tend to be larger and more evenly spread throughout the Commonwealth. They are more often engaged with energy efficiency work, are older, and are responsible for a larger share of the clean energy workforce. Traditional firms are most typically service-related, including HVAC, plumbing, electrical and other building contractors, and business service establishments such as finance and law firms (finished product manufacturers are an exception to the more typical service focus of this category). While their growth rates are slower than innovation firms, they are also less likely to experience precipitous employment declines. While it is often overlooked, traditional industries do create significant entrepreneurial activity, often in the form of small, independent contractors in plumbing, electrical or HVAC. This year, new business activity in traditional fields was a major driver of clean energy growth, especially in Central and Western Massachusetts.

Innovation firms, on the other hand, tend to be early-stage and smaller. They are predominantly focused on renewable energy or energy storage

and often report being small consultancies, R&D firms or advanced or prototype manufacturing companies. These firms receive the bulk of the investment capital and start-up attention and are often closely linked to academic research centers.

Different types of firms have quite different needs. When interviewing employers for this study, innovation firms focused most heavily on higher-educated, high-wage employees. They seek access to capital, networking with suppliers, vendors, and customers, in addition to relationships with academic researchers. They have a strong interest in maintaining Massachusetts' quality of life and reputation as a good place to do business and as a forward thinking location for clean energy goods and services. Business costs rarely impact their decision-making, though transportation is critical to them—specifically regarding public transit, traffic, and commuting patterns.

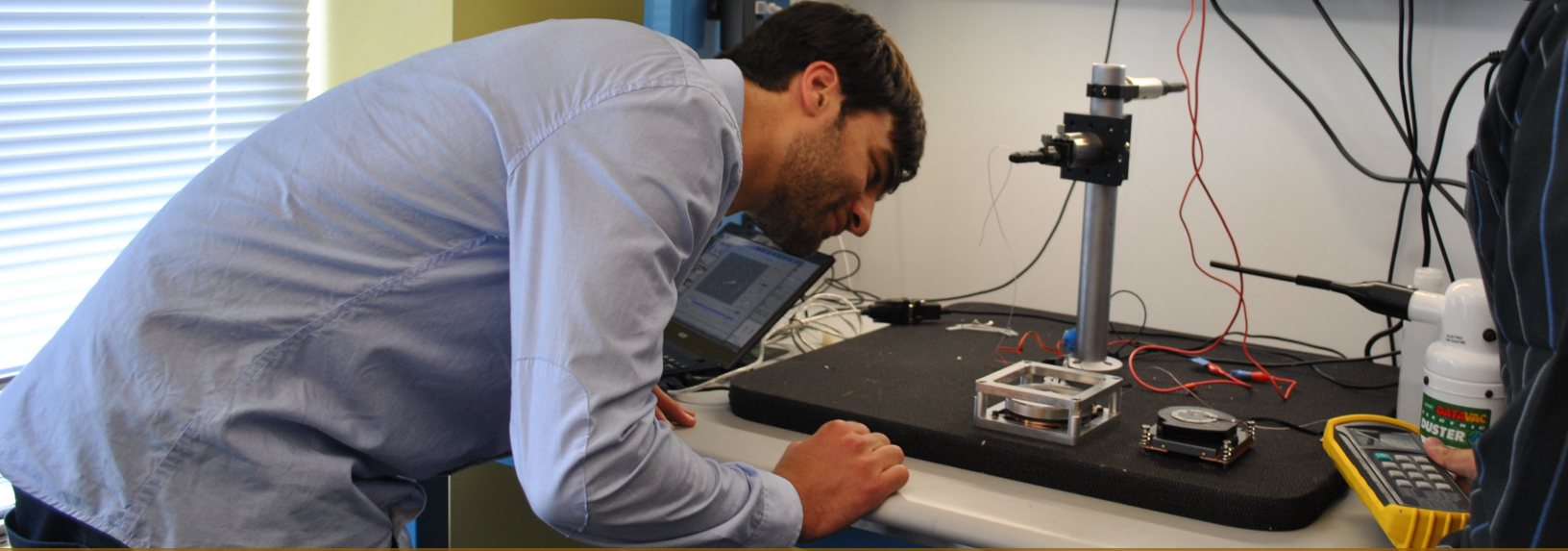
Innovation firms would like to see Massachusetts invest in education, transportation, health-care, and clean energy “statement” policies that highlight the Commonwealth's standing as an

environmentally-friendly place to live and work. Their preferences are strongly connected to attracting and retaining talent and connecting to global markets.

Traditional firms are focused on containing costs and spurring consumer demand. Most frequently, such firms report the cost of healthcare and wages as obstacles to growth and seek tax relief and affordable health insurance options from the Commonwealth. Additionally, these firms' fortunes are closely linked with local spending on clean energy goods and services, most typically at the consumer level (unlike innovation firms which are more closely tied to global demand). Traditional firms most frequently cite increased consumer incentives, enhanced customer awareness, and consumer-access to capital for home and business energy improvements in addition to their cost-containment requests.

Because each of these two worlds has different drivers for growth, both types of firms should be able to independently lead the charge into the future.





# Industry Overview

## The Clean Energy Sector Is a Large Component of the Massachusetts Economy

Massachusetts is already recognized as a leader in the global clean energy economy, and its position is strengthening. The Commonwealth's public investments in clean energy have solidified Massachusetts' position as a clean tech hub, receiving nation-leading rankings in energy efficiency investments. Massachusetts boasts 5,557 clean energy employers and 79,994 clean energy workers, as of June 2013.

Clean energy workers make up 1.9% of all workers in the Commonwealth and are found in nearly all industries across the state. Of the 79,994 Massachusetts clean energy workers, 21,637 work in sales and distribution; 19,031 work primarily with installation and maintenance firms; 17,458 work for engineering and research firms; 13,458 work for manufacturers; and 8,409 work for other types of clean energy companies, such

as those focused on law, finance, consulting, and policy (note: these numbers are rounded to the nearest worker).

Clean energy firms are most likely to work with energy efficiency or renewable energy goods and services. Specifically, 3,002 firms and 46,613 clean energy workers produce goods or services related to energy efficiency, while 2,312 firms and 30,537 clean energy workers work with renewable energy.<sup>10</sup>

For the first time this year, employers were asked about their primary clean energy focus. These initial results indicate that, of the firms that conduct energy efficiency and renewable energy activities, a greater percentage primarily conduct energy efficiency activities. It is estimated that there are 1,801 primary renewable energy firms employ-

<sup>10</sup> Note that these figures include overlap because many of the firms reported working with both renewable energy and energy efficiency technologies. See Table 3 for the breakdown of clean energy firms by technology without overlap.

*Clean energy employers are bullish about future growth again this year and expect to have 8,880 more clean energy jobs over the coming 12 months.*

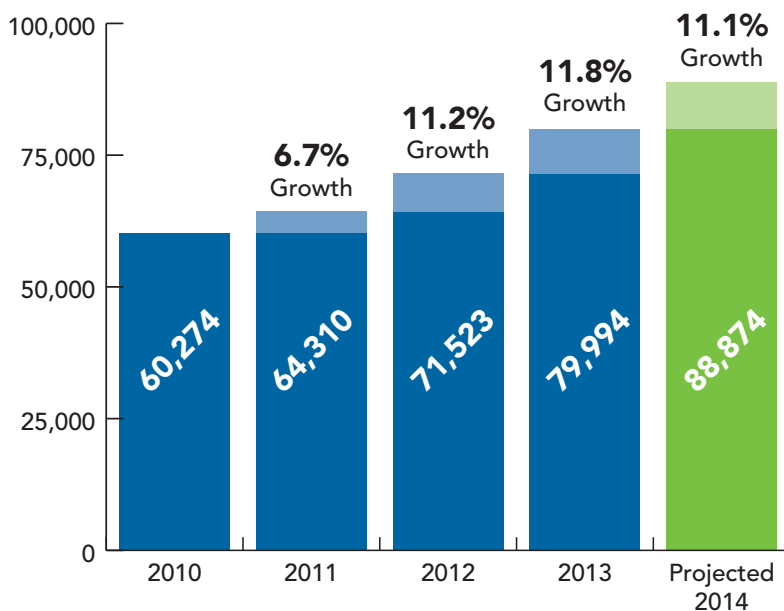
ing 21,017 workers in Massachusetts, while there are 2,634 firms that are primary energy efficiency firms, employing 46,947 workers.

## Clean Energy Employers in Massachusetts Continue to Grow Rapidly

The Massachusetts clean energy sector has grown at an impressive rate from June 2012 to June 2013, adding nearly 8,500 new jobs at an 11.8% growth rate. Since the MassCEC's first study in 2011, Massachusetts clean energy employers have added more than 15,500 jobs, representing 24% growth. Despite job growth of 1.6% for all Massachusetts jobs over the period,<sup>11</sup> about 25% of all clean energy companies grew, while only 15% cut their workforce. This finding highlights clean energy as a bright spot in jobs recovery in the Bay State, with the growth this year fueled more by startups and new entrants to clean energy than hiring at existing firms.

The research also found that respondents are bullish about future growth again this year. In most survey-based industry studies, employers tend to be overly sensitive to short-term trends. When the economy or industry is doing well, they tend to over-report,

**Clean Energy Job Growth**



<sup>11</sup> EMSI Complete Employment, 2013.2.

*27% of employers report that they have current openings that they expect to fill in the next three months.*

while during times of downturn, they are overly pessimistic. Over the last three years, however, employers that have participated in this study have been quite accurate in their predictions.<sup>12</sup>

Overall, clean energy employers expect to have 8,880 more clean energy jobs over the coming 12 months, which would represent an 11.1% growth rate in clean energy employment. Forty-two percent of employers expect to have more clean energy workers in the coming year, while only 3.2% expect fewer. In comparison, overall Massachusetts employment is projected to grow by 1.7% over the coming 12 months.<sup>13</sup>

This is not just long-range planning. **Twenty-seven percent of employers report that they have current openings that they expect to fill in the next three months.** The average firm has two to three current openings. This finding could represent thousands of new jobs filled over the summer and fall of 2013 alone.

<sup>12</sup> In the 2012 Massachusetts Clean Energy Industry Report, employers projected 12.4% growth in the upcoming year.

<sup>13</sup> EMSI Complete Employment, 2013.2

## Clean Energy Job Growth Has Been Fueled by Business Creation

The 11.8% growth from 2012 is a combination of new positions at existing clean energy firms, repurposing of employees to support clean energy at existing firms, and especially, new business creation. Annual hiring gains only account for about 15% of the new clean energy workers. Of these new workers, 83% were reported as having been hired to new positions, while 17% were in existing positions to which clean energy responsibilities were added.

## Clean Energy Workers Spend Most of Their Time Supporting Clean Energy

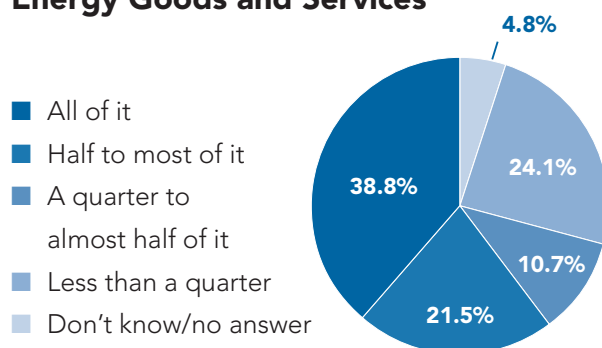
While this study's definition of a clean energy worker is any worker that spends *any* portion of his or her time supporting their firm's clean energy business, this year employers were also asked to report the number of workers who spend at least 50% or 100% of their time do-

ing so. The research indicates that a majority meet these thresholds, with 87% reported to spend at least 50% of their time supporting clean energy and 79% spending all of their time doing so.

## Clean Energy Is Responsible for a Significant Share of Respondent Company Revenue

Businesses report that their clean energy revenues continue to increase as a share of overall revenue. Thirty-nine percent of surveyed firms reported that 100% of their revenues are attributed to clean energy goods and services, while 60% receive at least half of their revenue from clean energy work. This work is defined as producing goods or services related to renewable energy, energy efficiency, carbon management or alternative transportation.

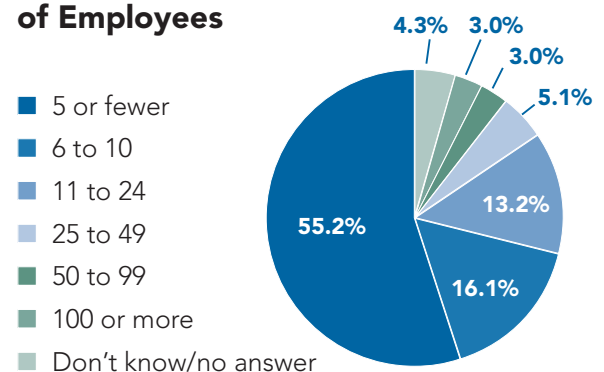
### Percent of Revenue from Clean Energy Goods and Services



## Small Businesses Continue to Play a Key Role in the Clean Energy Sector

The majority of the Commonwealth's clean energy employers are small, with 55% having five or fewer permanent clean energy employees.

### Company Size by Number of Employees



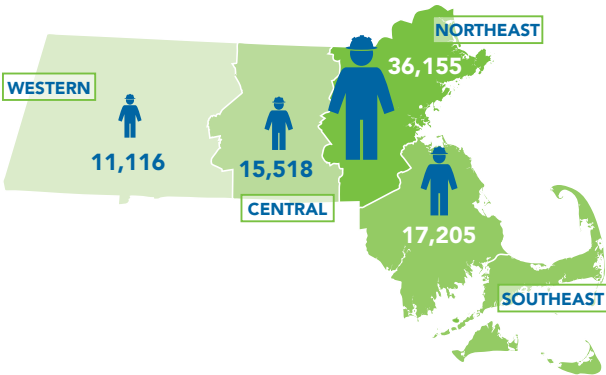
## Clean Energy Firms Are Growing in All Regions of Massachusetts

Clean energy employers operate in every county in Massachusetts. The map below illustrates the clean energy employment concentrations of the four regions in Massachusetts. Again this year, the Northeast has the greatest concentration of workers, followed by the Southeast, Central and West. All areas, however, show significant employment, ranging from 11,116 clean energy workers in the West to 36,155 clean energy workers in the Northeast.



All regions showed growth over the past 12 months. The Southeast rebounded from its decline in 2011-2012 to become the fastest growing region from 2012-2013, with a 14.3% employment growth rate.

Clean Energy Workers by Region



Clean Energy Crosses Many Traditional Industry Lines

One key driver of the sector’s growth is its penetration across traditional industry lines, illustrated by the ways that firms classified themselves in the survey. The clean energy sector is one that serves all others. With clear strength in the entire value chain of activities, the sector can withstand short-term fluctuations in various markets. This means that Massachusetts is not reliant on one activity (such as manufacturing or finance). The entire value chain of activities is well represented in Massachusetts, as illustrated by Table 1 below:

Table 1: Current Overall Clean Energy Employment<sup>14</sup>

Firm's Primary Clean Energy Activity	2013 Number of Clean Energy Firms	2013 Clean Energy Employment	2012 Number of Clean Energy Firms	2012 Clean Energy Employment
Total	5,577	79,994	4,995	71,523
Manufacturing and Assembly	564	13,458	489	11,162
Engineering and Research	1,018	17,458	889	13,182
Sales and Distribution	992	21,637	917	20,671
Installation and Maintenance	2,187	19,031	1,996	18,280
Other	816	8,409	705	8,229

<sup>14</sup> Note that the total in each category is rounded to the nearest worker, which explains the difference with the totals reported herein.

*The clean energy economy in the Commonwealth is not reliant on one single technology and is therefore better able to weather short-term variations in the market.*

While there are many firms engaged in more than one activity, installation and maintenance continues to be the largest value chain activity by number of firms. Sales and distribution firms still employ the most clean energy workers, though installation and maintenance and manufacturing are gaining fast. Engineering and R&D, long considered a strength of the Massachusetts clean energy economy, is also growing at an impressive rate.

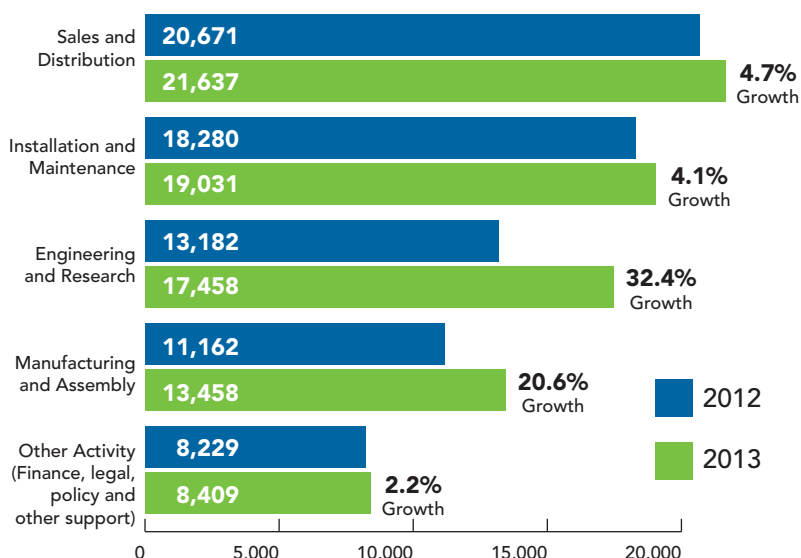
## All Technology Areas Are Growing

Massachusetts firms reported working with many different clean energy technologies, again demonstrating strength through diversity. The clean energy economy in the Commonwealth is not reliant on one single technology and is therefore better able to weather short-term variations in the market. Survey participants were first asked to list their employer's major areas of focus, such as renewable energy, energy efficiency, alternative transportation, etc. Because researchers anticipated that many employers would be active in a number of areas, multiple responses were permitted.

Renewable energy firms leveled off from their rate of growth in 2012, but still added 800 jobs over the past year. In contrast, energy efficiency added more than 6,000 new jobs, with a 16% growth rate over the past year.

Firms were also categorized by their primary focus. Energy efficiency remains the largest category in this analysis.

### Growth in Clean Energy Employment by Activity



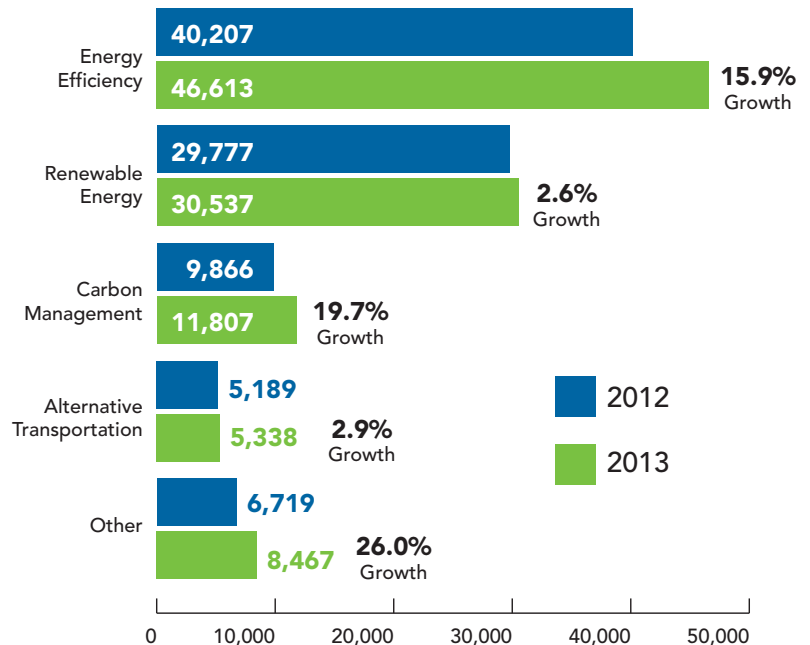
**Table 2. Firms and Employment by Clean Energy Focus (With Overlap)**

Clean Energy Focus (Overlap Included)	2013 Number of Clean Energy Firms	2013 Clean Energy Employment	2012-2013 Employment Growth
<b>Total</b>	<b>5,577</b>	<b>79,994</b>	<b>11.8%</b>
Renewable Energy	2,312	30,537	2.6%
Energy Efficiency	3,002	46,613	15.9%
Alternative Transportation	456	5,338	2.9%
Carbon Management	489	11,807	19.7%
Other	847	8,467	26.0%

**Table 3. Firms and Employment by Primary Clean Energy Focus**

Primary Clean Energy Focus (Without Overlap)	Current Number of Clean Energy Firms	Current Clean Energy Employment
<b>Total</b>	<b>5,577</b>	<b>79,994</b>
Renewable Energy	1,801	21,017
Energy Efficiency	2,634	46,947
Alternative Transportation	173	899
Carbon Management	303	2,480
Other	666	8,651

**Growth in Employment by Clean Energy Focus**

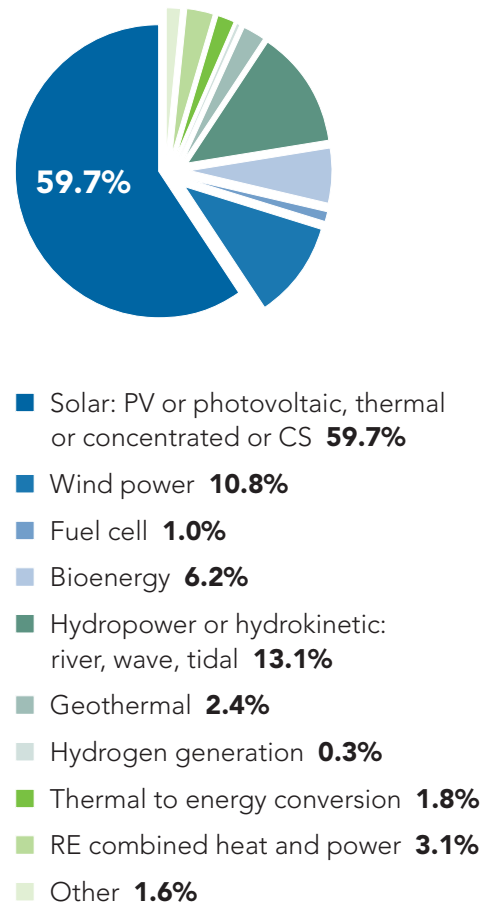


## Solar Energy Is a Bright Spot in the Massachusetts Renewable Energy Sector

For the first time as part of this study, employers were asked to allocate their employees by specific categories. The bulk of the renewable energy workers in Massachusetts support solar, wind, and hydroelectric technologies, from research and development through installation and maintenance. Nearly 60% support solar technologies, while another 13% are engaged in hydroelectric and 11% in wind power.

In Massachusetts, this survey finding translates to at least 8,400 workers that spend at least 50% of their time supporting the solar portion of their business.<sup>15</sup>

### Renewable Energy Employees by Technology



<sup>15</sup> This figure was calculated using a subset of clean energy employers that are engaged in solar activities. The calculation used solar-specific employer data on the total number of workers spending 50% of their time supporting clean energy and the total number of renewable energy employees predominantly working in solar.





# Business Climate Findings

The 2013 survey included in-depth questions about respondent business operations and trends. The responding firms ranged from very large employers with thousands of workers to very small, with just a handful of employees. The respondents' companies span the entire industry, and included manufacturers, consultancies, research laboratories, trade contractors, and nonprofit organizations.

The number of responses varied by question depending on the type of employer and the reported difficulties they faced. As a result, the sample size for each question ranges from 93 to 376 responses. In addition, 26 executives participated in follow up interviews to explore the context behind the survey results.

The questions about operating a clean energy business in Massachusetts provide some interesting results and highlight the dichotomy between innovation-focused firms and more traditional companies. Generally speaking, the smaller, early-stage, innovation companies welcome

Massachusetts as a place to do business due to its high quality of life, access to capital and talent and favorable reputation as a clean energy hotspot. Traditional firms, which tend to focus on business costs, still rank Massachusetts as a good place to operate a clean energy business, despite the reported higher cost of doing business, because they have access to a population of consumers that is higher-income and more positive about clean energy goods and services.

In terms of their needs and desires, innovation-focused firms seek improvements to transportation, education, and healthcare, as well as facilitated networking and increased access to capital (particularly venture capital and other private equity). Traditional firms, on the other hand, seek cost-containment (particularly of healthcare costs), improved public transit, and increased incentives and access to capital for consumers.

Specifically, employer responses yielded the following findings:

## Education and Environmental Protection Rank Highly

Overall, the findings illustrate that the K-12 system ranks as the Commonwealth's greatest strength of the tested components, followed closely by its history of environmental protection. Said one Massachusetts executive, "Everything that moves our society towards clean energy, environmental health, and sustainability is good. Massachusetts has done some great work and needs to continue it. Legislation and regulations are fine, but implementation, monitoring, and enforcement are equally important."

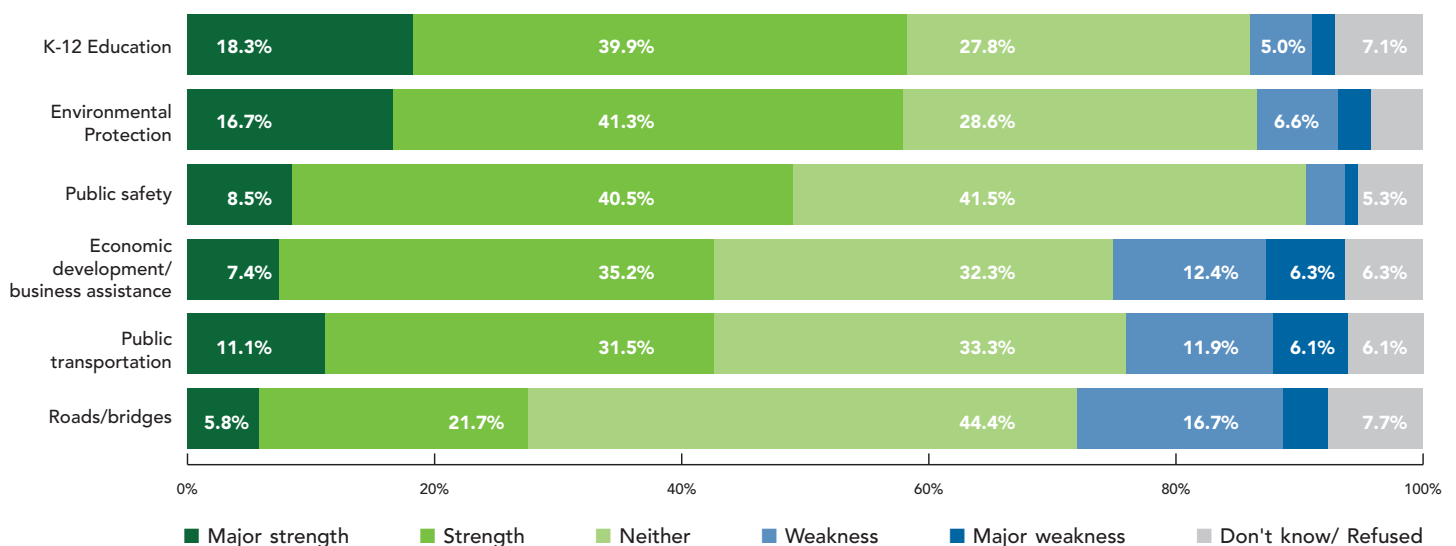
At the same time, public safety and public transportation both ranked well, while Massachusetts' roads and bridges and economic development and business services were rated as its biggest weaknesses. This point requires further nuance, however. Overall, employers gave Massachusetts high grades for targeted, clean energy-specific

support, yet felt as though the general incentives for starting a business were lacking. One good example of this is that numerous employers noted that the renewable energy credits offered by the state "has fostered a ton of enthusiasm, growth, and activity in our area," but that we need "more shared office space and incubators to help new companies grow."

Another industry executive discussed how Mass-CEC provided "much needed funds to local startups like ours that ... help them hire engineering support in critical early phases of their enterprise" but followed by suggesting that the Commonwealth needs more low-cost startup office space and help for new businesses to contain costs of healthcare.

These findings translate directly to the importance of quality of life in Massachusetts to growing the state's clean energy economy. Public education matters to companies. Most often, this is because executives either have children of school

### Strengths and Weaknesses of Massachusetts For Operating a Clean Energy Business



age and want strong schools for them or they recognize that effective schools can be a major incentive to attract talent from other states and countries. This is one finding that cuts across technology, purpose, activity, and geography.

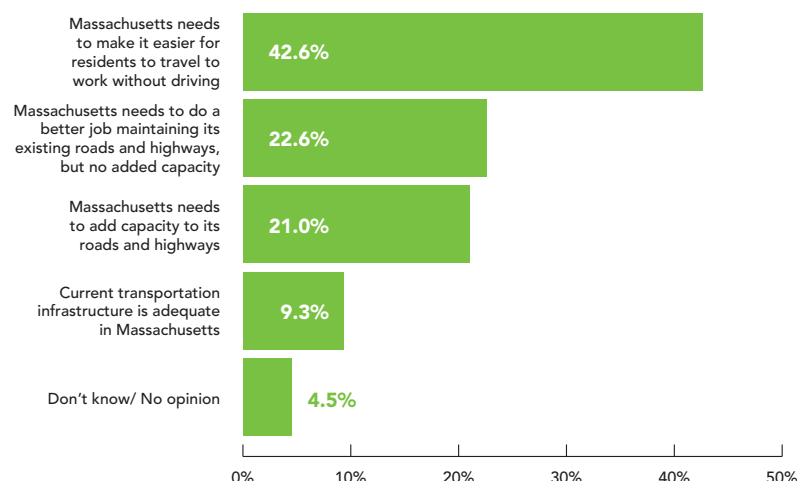
## Transportation Upgrades Are Critical

Employers most clearly emphasized the need for more public transit options, with 43% selecting “Massachusetts needs to make it easier for residents to travel to work without driving.” Twenty-three percent noted a need for Massachusetts to do a better job maintaining its existing roadway infrastructure, while 21% report that more capacity is needed. Fewer than 10% reported that the current infrastructure is sufficient.

Employers care a great deal about transportation in Massachusetts. One key reason is that an effective transportation system can more easily mitigate Boston’s high real estate prices in two key ways. First, it opens additional, lower-cost alternatives to the downtown by providing access for people and goods to be connected to the marketplace. Second, it allows workers to commute from farther, lower cost areas, which allows for wage-growth containment as it less frequently needs to be linked to cost of living standards of Boston.

Executives also recognize the cost to their businesses caused by inefficient transportation. One employer said, “Improving public transit would allow us to connect regionally, and would prevent wasting money on travel and transportation ...traffic kills our productivity but we need better and more options for people to reliably get to and from work.”

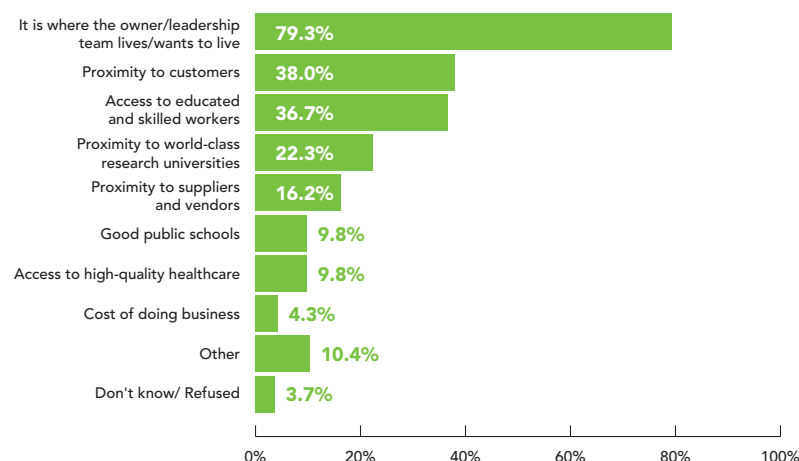
## Clean Energy Employers Opinion of Transportation Infrastructure



## Massachusetts Quality of Life Plays a Large Role in Business Expansion

When asked about why their firms are located in Massachusetts, the overwhelming majority fall into three categories (for this question, up to three responses were permitted). Eighty percent reported the reason is simply because it is where the owner and senior executives want to live. Additional rea-

## Reasons Why Clean Energy Businesses Choose Massachusetts



sons cited include access to healthcare, good schools and other typical quality of life issues, highlighting the importance of keeping Massachusetts a good place to live in order to grow businesses here.

These issues were followed by proximity to customers, with 38%, and access to a high skill, talented workforce, at 37%. Also of note (at 22%) is proximity to world-class universities.

## Cost of Living and Cost of Healthcare Are Perceived as Obstacles to Growth

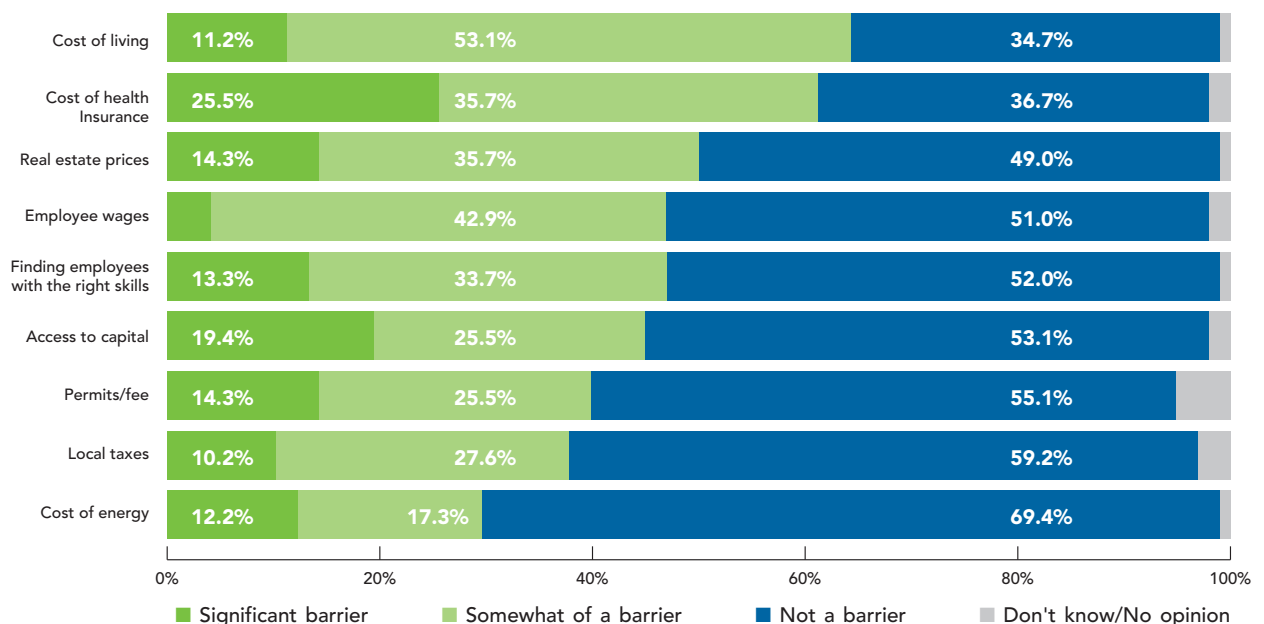
Businesses reported cost of living and cost of health insurance as the greatest barriers to expanding their clean energy operations in Massachusetts. This is especially true of traditional, mature companies. Costs of energy do not appear to be a common barrier to business expansion with 69.4% of firms indicating that energy costs are “not a barrier.” Sign codes, parking regulations, and online competition were reported as the lowest rated obstacles.

## Massachusetts Compares Favorably to Other Locations

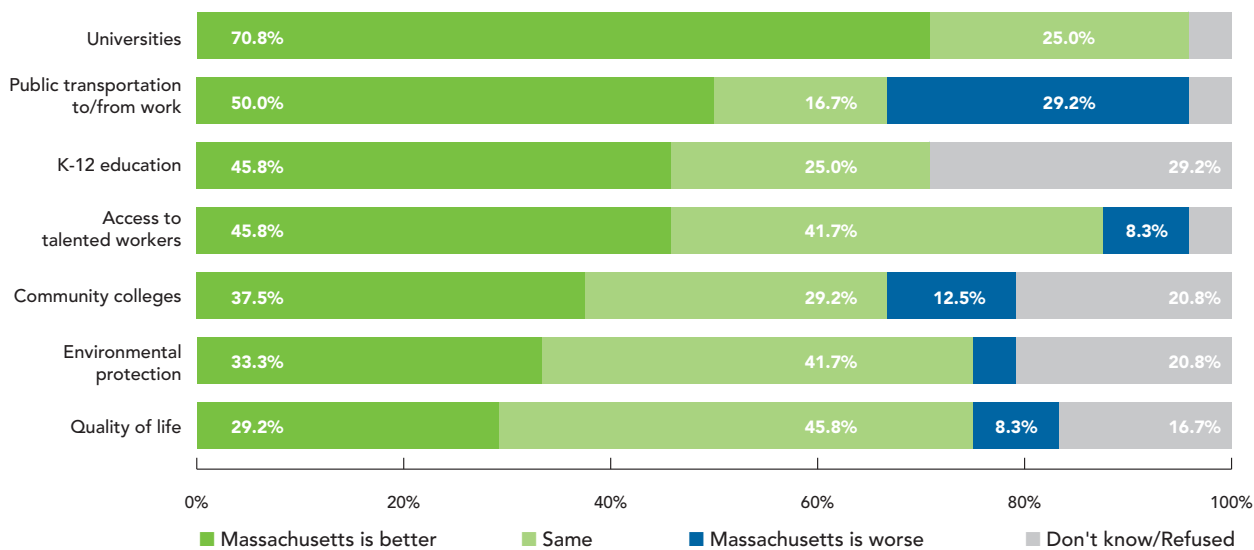
Firms that reported having locations in other states and countries were asked to rank Massachusetts as better, worse, or the same as their other business locations on a variety of measures. The majority ranked Massachusetts as a better overall place to do business than other locations, even if wages and business costs are higher.

Most typically, innovation firms focused on the attractiveness of Massachusetts, and Boston in particular, to attracting talent. One employer said, “Simply put, Massachusetts is a great place to live and talented people want to live here.”

More traditional firms added that they value a solid, educated consumer base, with the right policies in place to help grow demand. “The MassSAVE program, MassCEC internships, Green Communities Act and Stretch Code are all positive policies helping stimulate business and job growth...Those have really helped the sector to grow and make this a strong location for us.”

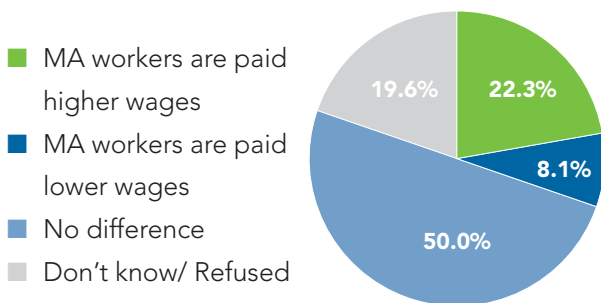






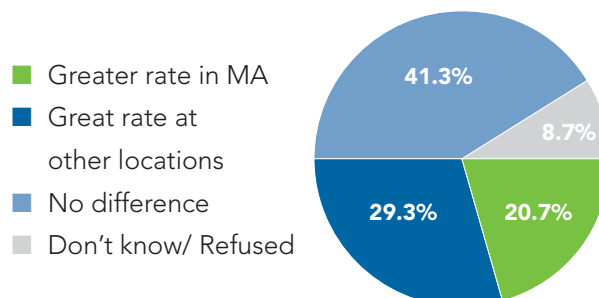
## Firms Are More Likely to Pay Higher Wages in Massachusetts Than Other Locations

Half of all firms that have out-of-state locations say that they pay the same wages, but nearly a quarter pay more wages in Massachusetts than out of state.



## Firms Are Growing Slightly Faster Outside of Massachusetts Than Within

While the plurality of firms expects no difference in the rate of hiring inside and outside of Massachusetts, more firms expect to grow outside Massachusetts than within. There are several potential reasons for this. The first is that many firms have more than two locations across the country, meaning that, in aggregate, they are growing more outside Massachusetts than within. Others noted that as they mature, higher costs limit their ability to expand certain parts of their business here, especially when the new jobs have a lower talent requirement, thereby making them easier to find elsewhere.

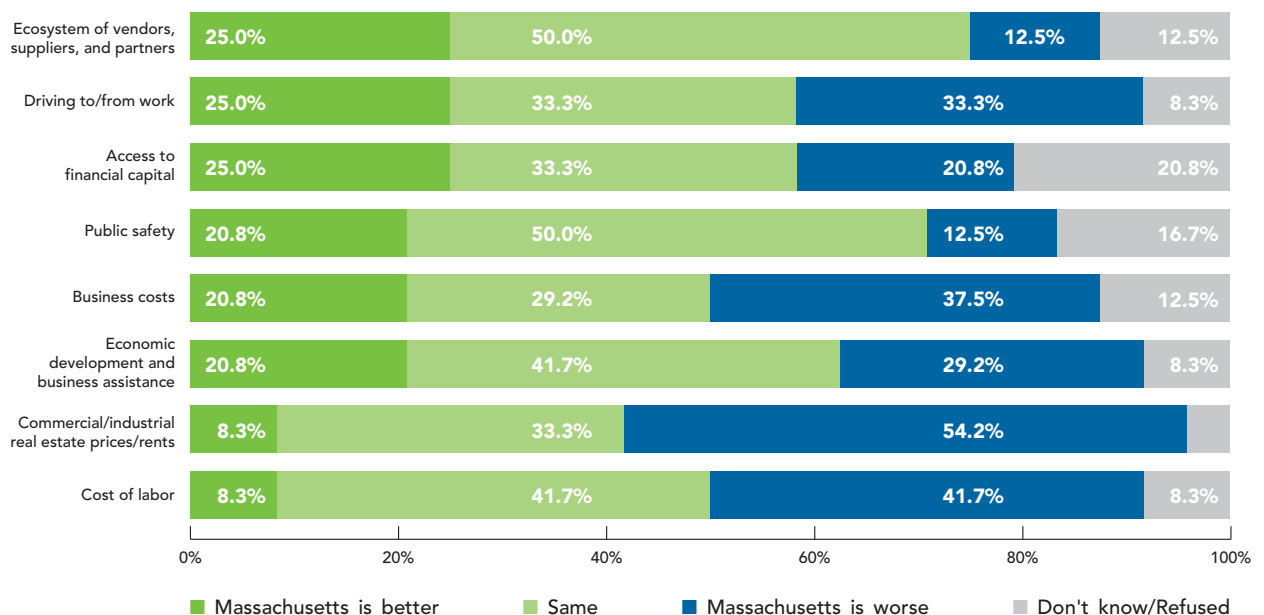
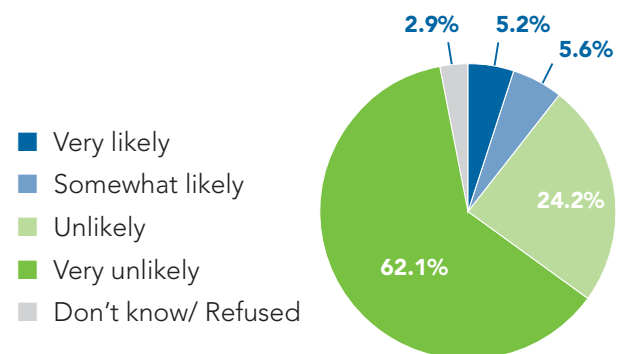


## Massachusetts Boasts a High Quality of Life But Is More Expensive than Other Locations

Massachusetts ranks highly in terms of quality of life, public transit, public safety, K-12 education, environmental protection, universities, community colleges and access to vendors. Massachusetts stacks up poorly next to its competitor locations in cost of labor, real estate prices, driving to and from work and business costs. Massachusetts firms are somewhat ambivalent about their access to capital here, with only a very slightly higher number reporting easier access in the Commonwealth. A plurality of firms report that Massachusetts economic and business development activities are the same as their other locations; however, more firms rank Massachusetts as worse in these categories than elsewhere. In the follow up interviews, employers seemed to focus less on clean energy-specific policies and more on the general business incentives available here.

## Most Firms Unlikely to Relocate Outside of Massachusetts

Firms were also asked about their expectations regarding relocation. Eleven percent are likely to relocate outside of Massachusetts (5.2% very likely and most often reporting due to higher costs), while 86% are unlikely (62% very unlikely).





# Clean Energy Capital Snapshot

Massachusetts has a strong reputation and long history of attracting capital for its growing innovation industries. The Commonwealth has effectively leveraged its core academic, human capital, and research strengths to attract a relatively large share of public and private funding for the clean energy sector, particularly with regards to federal research dollars and early-stage (Seed, Series A, and Series B) venture capital funding.

Clean energy investments remained a small portion of total global venture capital investment dollars through the early-2000s, but the promise of a clean energy future fueled a dramatic increase in the total number and value of deals, reaching a peak in 2011.<sup>16</sup> This trend was mirrored by global government spending on clean energy, which in the United States peaked with the passage of the American Reinvestment and

Recovery Act (ARRA).<sup>17</sup> Recently, and for a variety of reasons, overall global clean energy investments have cooled and shifted, which could have important implications for Massachusetts' clean energy sector.

Several widely reported studies<sup>18</sup> have illustrated a considerable global decline in clean energy investment; however, the wide range of capital sources included in these analyses, from government loan guarantees to venture capital to asset financing provide a high-level overview, which may not accurately describe trends for each capital source. To put these figures into context, this report includes information about four capital sources and analyzes each while also drawing some broad conclusions from the data.

A recent report by Bloomberg New Energy Finance and the Frankfurt School states that, from

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<sup>16</sup> See, e.g., Bryan Pearce and Dr. Martin Haemmig, Global Venture Capital Insights and Trends Report, EY, 2011, available at: <http://www.ey.com/GL/en/Services/Strategic-Growth-Markets/Global-venture-capital-insights-and-trends-report>. See also, <http://www.forbes.com/sites/energysource/2013/02/13/why-venture-capital-is-weak-fuel-for-clean-energy-startups/>.

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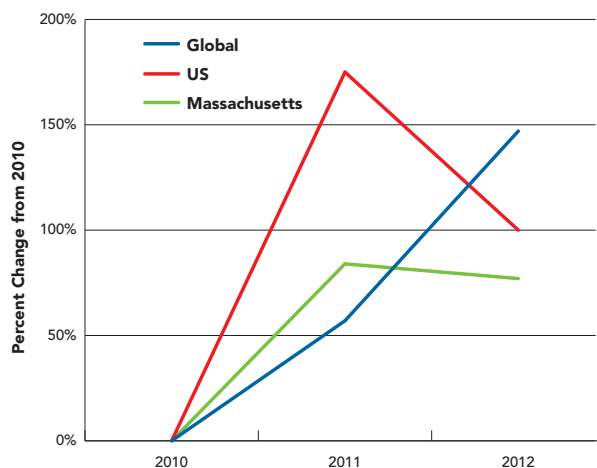
<sup>17</sup> See, e.g., <http://www.nytimes.com/2012/10/24/business/energy-environment/future-of-american-aid-to-clean-energy.html>.

<sup>18</sup> See citations throughout this section.

2011 to 2012, global clean energy investment declined by 12% while it declined in the U.S. by 34%.<sup>19</sup> A review of these data show that approximately 63% of the total value of the reported investment trends is based on a broad category called “asset finance” (see Appendix B for further discussion of capital trends data).

If the investment landscape is limited to venture capital (Seed, Series A, and Series B), growth equity, project finance, and government loans, guarantees and grants, however, the stated 12% global decline is misleading—the actual figure is a 57.2% *growth* in investments of these types. The impact of this change on the United States figure is much less, with the decline of 34% becoming a decline of 27.1%. The Massachusetts figure also demonstrates a decline, though it is a comparatively small 3.8%.

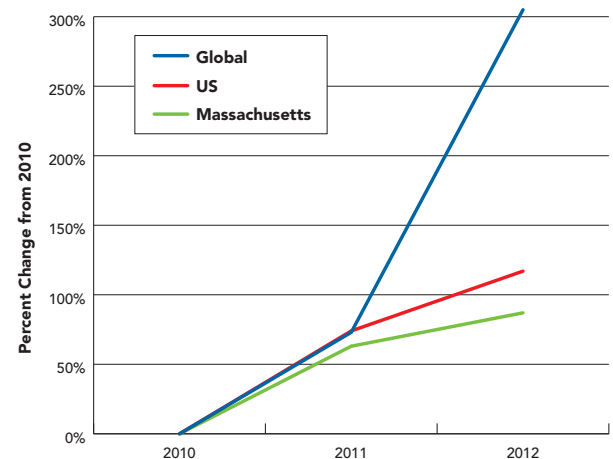
### Comparative Trends, 2010-2012



19 Bloomberg New Energy Finance and the Frankfurt School UNEP Collaborating Centre, GLOBAL TRENDS IN RENEWABLE ENERGY INVESTMENT 2013, available at: <http://fs-uneep-centre.org/sites/default/files/attachments/gtr2013keyfindings.pdf>.

When government loans, guarantees and grants are removed from the equation, the change is even more dramatic—global investment totals, excluding asset finance, show a 134.5% increase, while the U.S. figure is actually an increase of 19.7%.<sup>20</sup> In summary, between 2011 and 2012, when excluding debt-only asset-based financing deals and government loans, guarantees and grants, and focusing on the aggregate of venture capital, growth equity and project finance investments, there was significant global growth and positive, albeit much smaller, growth in the U.S.

### Comparative Trends, Government Excluded, 2010-2012



The figures above demonstrate the need for caution before reading too much into any broad or sweeping statements about clean energy trends, and to recognize the importance of definitions in any capital trend analysis. For the remainder of this section, a single, consistent data source

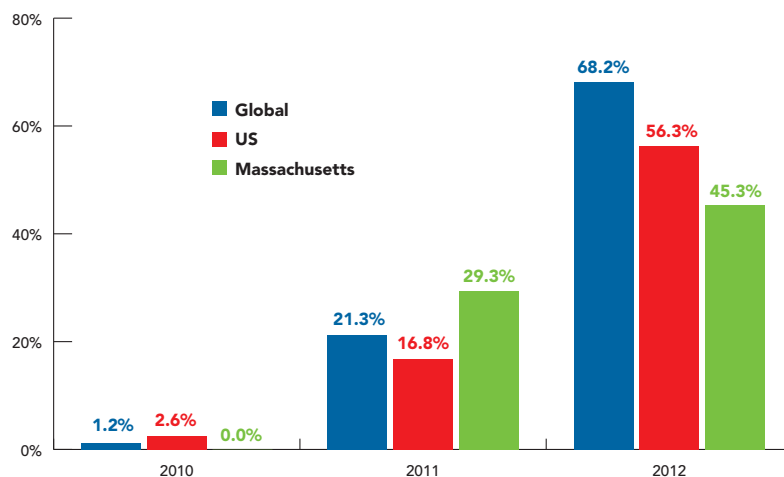
20 Cleantech Group i3 data.

is used.<sup>21</sup> The included capital sources for this analysis are limited to venture capital, growth equity, project finance, and government loans, guarantees, and grants.<sup>22</sup> Below is a summary of the data.

## Project Finance Is Driving Global Clean Energy Markets

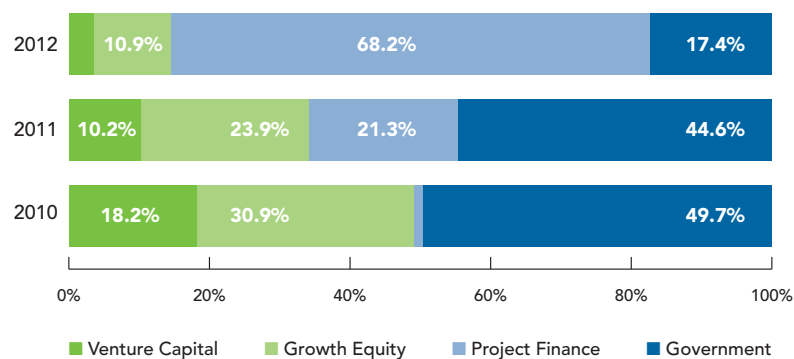
Worldwide, project financing grew by 404% between 2011-2012, from just under \$5 billion to nearly \$25 billion (up from only \$182.4 *million* in 2010). This increase has been fueled primarily by expansion of energy markets in developing economies and the declining price of solar photovoltaics.<sup>23</sup> The increased importance of project finance, defined as financing for the deployment of new, large scale energy generation projects, cannot be understated. From representing only 1.2% of the global investment total (of the four sources used in this analysis, venture capital, growth equity, project finance, and government loans, guarantees, and grants) in 2010, to representing 68% of the total investments in clean energy across the globe in 2012 (21.2% in 2011).<sup>24</sup>

## Project Finance Comparison, 2010-2012



U.S. capital markets have followed this trend, though not as quickly, which is likely due to constraints of existing, developed infrastructure (as compared to developing economies) and declining overall energy demand.<sup>25</sup> Between 2011 and 2012, project financing increased by 143.7%, from \$2.9 billion to \$7 billion (and up from \$161 million in 2010, when U.S. deals made up the majority of global project finance deals). In the U.S., the increase can also be illustrated as a share of investment, going from only 2.6% in 2010 to 16.8% in 2011 to 56.3% in 2012.<sup>26</sup>

## Percent of Global Investment by Category



21 The Cleantech Group's i3 platform is used because each investment is cited with date and amount, allowing each to be independently verified.

22 To keep the clean energy definition consistent across each segment of this report, the following tags were used to track clean energy investment: solar, wind, geothermal, biomass generation, biofuels and biochemicals, hydro and marine power, energy efficiency, energy storage, and alternative transportation. Two investments that were included in Cleantech's database, totaling \$1.25 billion to GreatPoint Energy for coal-to-gas plants, were excluded from this analysis because the projects do not meet MassCEC's definition of clean energy used in other sections of this report.

23 <http://fs-unep-centre.org/sites/default/files/attachments/gtr2013keyfindings.pdf>, at p. 11.

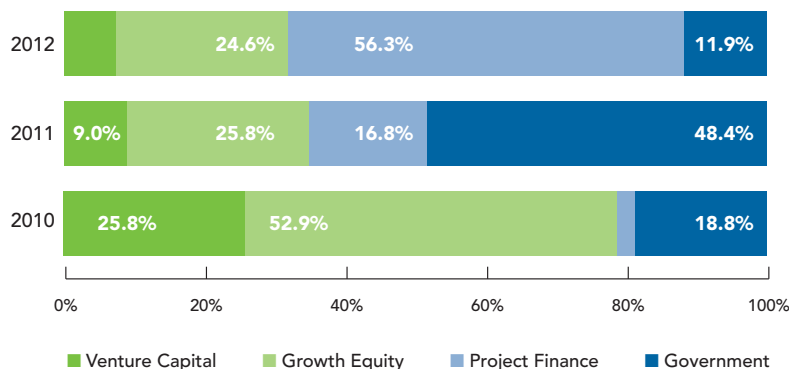
24 Cleantech Group i3 data.

25 [http://www.eia.gov/forecasts/aeo/MT\\_energydemand.cfm](http://www.eia.gov/forecasts/aeo/MT_energydemand.cfm).

26 *Id.*

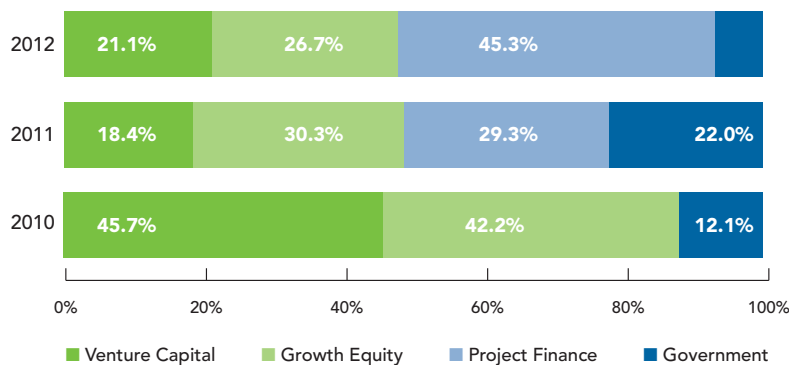


## Percent of U.S. Investment by Category



in terms of total dollar value, despite the relatively low number of deals, as a typical project financing deal is significantly larger compared to other types of investment deals. Nonexistent in 2010, Massachusetts firms attracted \$210 million in 2011 and \$312 million in 2012, representing 45.3% of its total clean energy investment in the selected categories. This growth is slower than the national and global trends, however, so if Massachusetts hopes to keep pace with “total” clean energy investment indices, supporting global companies with headquarters in Massachusetts and continuing to develop large clean energy projects, such as photovoltaic and offshore wind projects, will be critical.

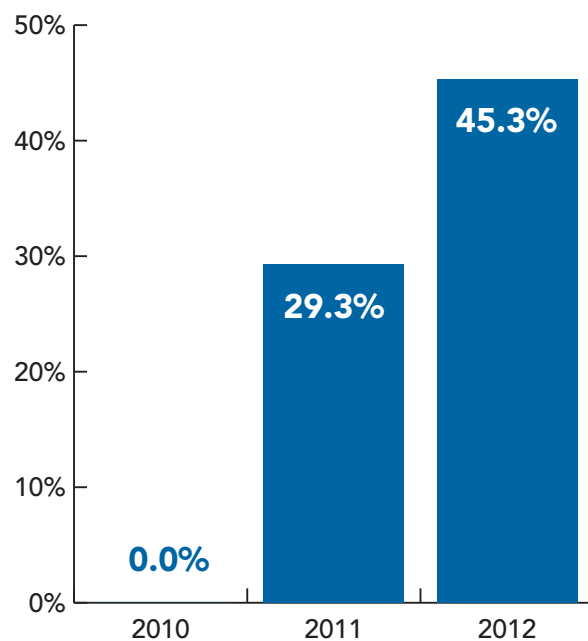
## Percent of Massachusetts Investment by Category



## Massachusetts Project Financing Totals Are on the Rise

Massachusetts is also attracting more project finance, which has been led by wind and solar projects and the number of firms headquartered in Massachusetts that conduct large-scale installations across the globe. The increase is dramatic

## Massachusetts Project Finance, Percent of Total, 2010-2012

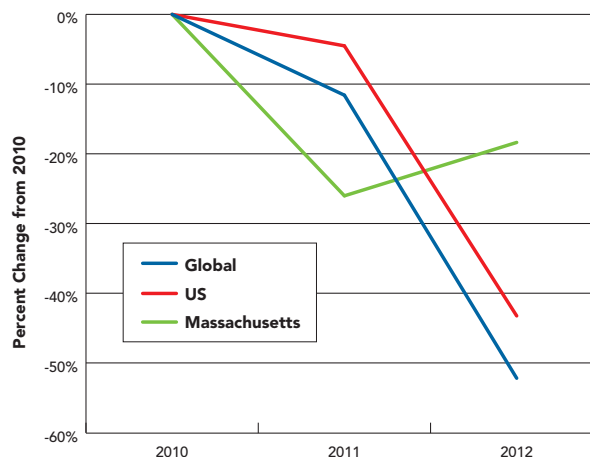


## While Venture Capital Is Falling Fast Across the Globe, Massachusetts Rises

One of the key trends in clean energy investment is the global decline in venture capital (VC). Experts have suggested that the decline is representative of the venture capital community now recognizing that many subsectors of clean energy require a long investment horizon and sustained capital investment to generate attractive returns. The challenging and competitive landscape, affected by a number of energy policy constraints, poses additional investment risk compared to other sectors, such as IT.<sup>27</sup> However, it is also widely reported that early-stage venture capital—though typically significantly smaller in dollar value than project finance or growth equity—is critical to the success of the industry. Massachusetts is bucking the national and global trends by significantly increasing its market share in clean energy venture capital investment.

As the global and national venture investments decline by double digits, Massachusetts companies attracted nearly \$146 million in venture capital in 2012, compared to only \$132 million in 2011, a 10.4% increase. The increase occurred during a period when global and national clean energy venture capital declined by 45.9% and 40.6%, respectively. As a result, Massachusetts' share of clean energy venture capital increased to almost 16% of the U.S. total and more than 11% of the global total.

### Venture Capital Comparison, 2010-2012



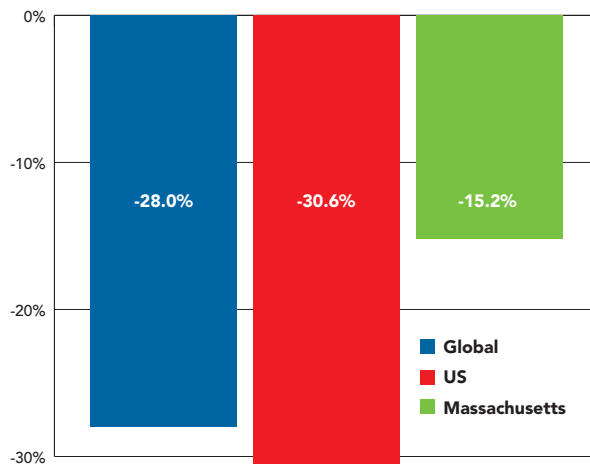
## Growth Equity Declines Globally; Massachusetts Fares Relatively Better

Growth equity is a type of private equity investment that typically is used by relatively mature firms seeking capital to expand their operations. Unlike many venture-backed firms, those seeking growth equity generally are later-stage, have demonstrable revenue and are seen as relatively less risky ventures.

Global growth equity investment in clean energy declined 28.0% between 2011 and 2012 from \$5.5 billion to just under \$4 billion. In the U.S., the figure declined by 30.6% to just over \$3 billion. In Massachusetts, this decline was less dramatic, falling from \$217 million in 2011 to \$184.1 million in 2012, a drop of 15.2%. Because its decline was not as fast, the share of growth equity coming to Massachusetts firms grew to 6% of the national total and 4.6% of all growth equity invested worldwide, up from 4.9% and 3.9% respectively.

27 See generally, Shikhar Ghosh and Ramana Nanda, Venture Capital Investment in the Clean Energy Sector, Working Paper 11-020, Harvard Business School, 2010. See also, <http://www.forbes.com/sites/energysource/2013/02/13/why-venture-capital-is-weak-fuel-for-clean-energy-startups/>.

## Growth Equity Comparison, 2011-2012



## Massachusetts Is Not Dependent on Any Single Source of Capital

Massachusetts firms are attracting capital from diverse sources, illustrating the benefit of being home to a number of firms at various stages of maturity. While project finance is becoming a major segment of the total clean energy capital coming to Massachusetts firms (45.3% of total capital in this analysis), venture capital (21%) and growth equity (26%) still play a large role.

## Government Investment Is Falling Sharply Worldwide

Government spending on clean energy, especially in the United States and European Union, is down sharply.<sup>28</sup> According to i3 data used for this report, government loans, guarantees and grants declined globally by 38.7% (over \$4 billion) from 2011 to 2012, and even more rapidly nationally by 82.2% (nearly \$6.8 billion).<sup>29</sup> Massachusetts, which has traditionally been quite effective in leveraging government clean energy spending, declined by 69.8%. As sequestration and other budget tightening continues at the federal level, Massachusetts companies will likely see diminishing total government-related investments in their firms.

In summary, global private clean energy capital is increasingly flowing to large generation projects (via project finance vehicles), most often in developing economies in Asia and the rest of the world. Venture capital and growth equity is steeply declining in the U.S. and abroad, but Massachusetts is increasing its total inflows (in venture capital) and percentage share of these important investments. The number of Massachusetts-headquartered firms with global operations that attract project financing—together with Cape Wind and large-scale solar generation projects—has clearly benefited the Commonwealth's position in terms of total dollars attracted. At the same time, the continued ability of Massachusetts firms to outpace competitors from other states in attracting government and private capital presents additional positive signs about the diversity of activities and the strong pipeline of Massachusetts companies of very different levels of maturity. It is critical to keep a close watch on these financial trends in an attempt to forecast future challenges and opportunities in the sector's ability to attract capital.

28 See generally, <http://www.bloomberg.com/news/2013-01-14/clean-energy-investment-fell-11-as-governments-cut-subsidies.html>.

29 These data include state and federal grant programs, though it is not an exhaustive database.



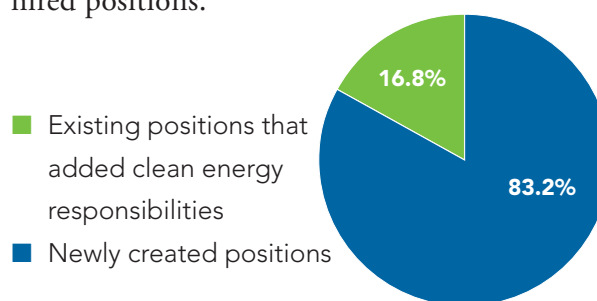
# Detailed Workforce Findings

As with previous years, the 2013 industry survey included detailed questions about employers' workforce needs. All of the respondents to the survey were asked if they were willing to be contacted for follow-up surveys or interviews regarding workforce, education, and training needs. Those who responded positively received additional survey questions. A diverse group of executives drawn from companies and industry groups in Massachusetts participated in follow up interviews to explain the context and questions related to the workforce issues identified in the survey. Respondents came from all sectors of the Commonwealth's clean energy industry ecosystem, including: solar, wind, residential and commercial/industrial energy efficiency, biofuels, marine renewables, consulting, software design, demand response, building controls, electrical contracting, law and marketing. The responding businesses were large and small; long established and brand new; and from every geographic region of the state.

This section provides a summary of the findings from the surveys and interviews.

## Most of the New Clean Energy Workers Are New Positions

While almost 17% of the nearly 8,500 additional clean energy workers added since 2012 are existing employees that added clean energy responsibilities, more than 83% were newly hired positions.



## Massachusetts Clean Energy Firms Expect More From Applicants

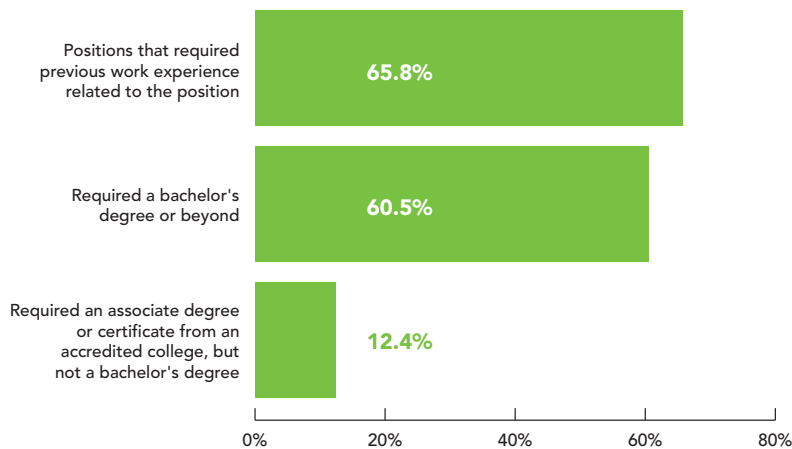
Massachusetts clean energy employers expect significantly more education and experience from applicants for open positions than do their na-



tional peers. Previous research has shown that most new hire positions required advanced education or previous experience.

The 2013 research shows an increase in the education and experience profiles of new hires, with 73% of the positions requiring at least some college education. At the same time, employers are seeking experienced workers, reporting that 65% of the new clean energy positions required previous work experience related to the job.

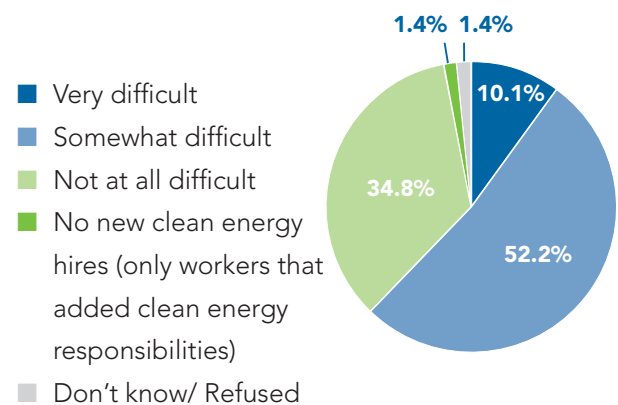
### Profiles of New Hires in Massachusetts



Of the new clean energy positions, the largest segment deals with technical work, such as production workers. Management and professional positions are the second largest segment, followed by administrative positions and sales positions. This is substantially similar to previous years' findings.

## The Current Clean Energy Workforce Is Generally Meeting Employer Needs

Even with the strong growth of the industry, 87% of clean energy employers in Massachusetts report no difficulty or only some difficulty finding adequately prepared workers, with only 10% reporting great difficulty. Employers reported that the greatest deficiencies of applicants include lack of required technical skills, lack of required education and poor communication, problem solving and analytical skills, again mirroring previous years' trends.



As in any industry, clean energy employers in Massachusetts would prefer a plentiful, talented, diverse, experienced and immediately available group of applicants for every job opening. No employer would say that it is "easy" to recruit, hire, train and retain productive employees.

One respondent summarized the challenge briefly by saying, "It is always difficult to find good people." Another said simply, "I'm picky." Another said, "This is a relatively new industry, with a limited track record. We don't realistically expect to find lots of people with deep knowledge



and experience, and specialized education. In many cases, we're happy to take bright, creative, hard working people who want to get into this business. We trust our own training program, along with mentoring from our best people to bring new hires up to speed. So far, that's worked out OK for us."

Respondents reported that the currently available workforce for clean energy job openings was generally meeting their needs. It does not appear that the growth of the clean energy industry in Massachusetts is being negatively affected by an inability of companies to find and hire employees for available positions.

## The Clean Energy Workforce Is Expected to Grow More Diverse

Long considered a sector dominated by men, the Massachusetts clean energy workforce is expected to become more diverse. Women now make up approximately 21% of the clean energy workforce and 14% of the total workforce are racial or ethnic minorities. Employers expect their new hires to include an even greater percentage of women and racial or ethnic minorities. While the increase is a step in the right direction clearly more can be done to attract and retain diverse talent, especially regarding women in the clean energy workplace to come closer to par with the overall workforce, which is 52% female.<sup>30</sup>

## Some Key Occupations Are Difficult to Fill

One workforce issue of general interest to the entire clean energy industry was a universal call for more, and better-trained, engineers and engineering technicians. A lack of available engineers in a wide variety of different tracks was noted by respondents, including: electrical, mechanical, environmental, civil, software, energy and controls. Some suggested a need for more engineers in specialty areas like ocean engineering and bio-fuels development.

A second workforce concern that resonated with several respondents was the need for skilled and productive sales people. For some, the inability to find and retain sales people was among their most serious organizational concerns. One said, "I just cannot find sales people to hire, period." Another lamented the long training period required before new sales people could master the combination of technical knowledge, financial calculation, tax considerations and customer benefits needed to successfully sell renewable energy solutions to senior executives at prospective business customers. A third said that sales and marketing hires (among others) wanted to "start near the top without putting in their dues."

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30 EMSI Complete Employment, 2013.2

## Employers Have Several Significant Long-Term Concerns

If clean energy employers in Massachusetts are relatively calm about their ability to meet current workforce needs, they are much more concerned about the future. Fully 88% of respondents noted concern about their long-term future ability to attract talent, with 52% indicating a high level of concern. This is a recurring theme among employers across all industries and all across the nation, where there is a sense that the future will be difficult, but few can tell what that future will look like or when it will arrive.

The causes of long-term workforce concerns varied, but there were several common themes, including:

### Impending retirements of experienced people

As one respondent put it, “The manufacturing base in the state has shrunk in the last twenty years to half the size it was. The engineers for these facilities have left the state or retired. There is presently a huge gap in engineers between the ages of 35 and 55. So, you find end of career folks and newbies just out of school with less than ten years experience.”

Other respondents made similar comments about a variety of occupations common to energy efficiency and renewable energy projects, especially those involving the building trades. As an entire generational cohort retires from the workplace, respondents expressed deep concern about who will take their place.

A corresponding concern was raised about the prospect that an aging group of workers will not retire, preventing a new generation from entering career tracks and gaining needed experience.

### General lack of “STEM” educated students

Among the responding employers there was a prevalent perception that there is a coming shortage of workforce age individuals who have selected educational and career tracks in “science, technology, engineering and math” fields. For employers large enough to draw on a statewide, regional or even national pool of applicants, this is of concern; but for smaller companies that depend upon more local job markets, such a shortage is perceived as a very serious workforce concern.

### Decreased capacity for on-the-job training coupled with concern about capacity/competency of the educational system

Several employers expressed serious concerns about their own ability to devote time and energy to training and mentoring their own employees as they moved to stay cost-competitive. With reduced time and resources to invest in their own people, respondents felt more dependent on the schools, colleges, community colleges and workforce training programs to graduate “workforce ready” students with reasonable skill levels and some practical experience. At the same time, there is little confidence that the educational system was prepared to take up this challenge effectively, especially at a time of limited financial resources for schools. This is especially frustrating to employers as it seems that “something has to give” but few have ideas for how to solve the paradox.

## Employers Value Experience-Based Career Training and the MassCEC Internship Program

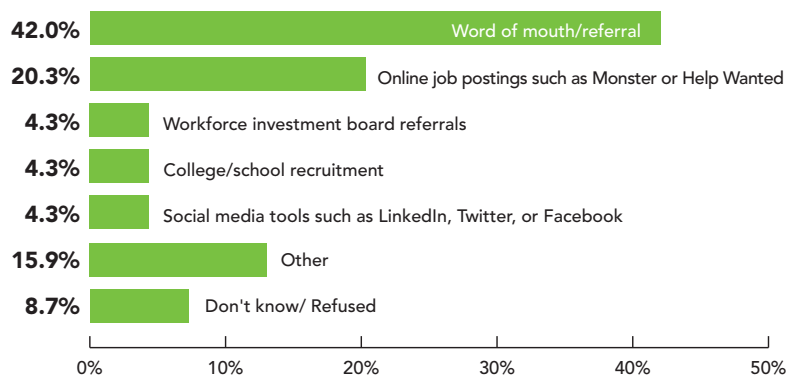
When asked, “What do you think should be done to improve the overall pipeline?” employers responded with overwhelming support for internships, fellowships, apprenticeships and other forms of education and job training that connected students and job seekers with practical experience in the work place. This was true for both technical and non-technical professions, occupations and trades.

Several respondents specifically noted the success of the Clean Energy Industry Internship Program. Since 2011, the program, a partnership between MassCEC and the New England Clean Energy Council (NECEC), placed 328 students and recent graduates in internships at more than 110 clean energy companies across the state. As a result of the internship program, 40 students gained full-time and part-time employment at their host companies.

Employers desire a deeper relationship with education and training providers, and they had a variety of recommendations to improve connections between themselves and educational institutions. One spoke for several in saying that “schools need to connect with the job markets. More schools need to have school officials on the boards of companies—and vice versa.”

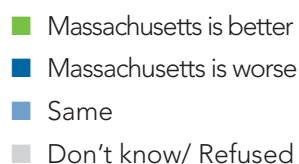
## Referrals and Networking Are the Pathways to a Clean Energy Job

Forty-two percent of firms that added workers over the past year ranked word of mouth and referrals as their most useful recruitment method, while about 20% reported posting the position online using a job board. In fact, only about 1/3 of the employers used online job postings over the last year to fill positions, suggesting that other methods continue to gain in popularity.



## Massachusetts Wins on Talent

Massachusetts seems to have much more talented workers available than other states, with 46% reporting that the Commonwealth has better access to talent and only 8.3% reporting less access.





# Conclusions

**A**s a catalyst of new business creation and impressive job growth, the clean energy sector continues to grow steadily in Massachusetts. Over the past two years, the sector has grown by more than 24%, adding 15,000 jobs to its ranks. In the past 12 months alone, the Massachusetts clean energy sector has added nearly 8,500 jobs and employers expect this growth to continue in the year ahead.

While the overall growth rate this year is similar to previous years, the primary driver of the growth has changed. In past years, existing firms were expanding and hiring at a rapid clip. This year, such growth only represented about 15% of the overall new clean energy workers. The balance of new workers was employed by startups or by existing firms expanding their activities to include clean energy goods or services.

Massachusetts has maintained its clean energy leadership position for several reasons. First, it has a diverse mix of companies, representing many different technologies and the entire spectrum of activities from research and development to installation and maintenance. Second, the Commonwealth has a strong entrepreneurial spirit and is also an attractive location for existing firms. This means that growth is fueled in different ways and can respond to different market positions. Third, public investment and sound public policy have created a fertile marketplace and improved business opportunities for clean energy firms.

There are a few areas and issues to monitor over the coming years. For the first time, existing Massachusetts clean energy firms added employees at about the same rate as the state average across all industries. In previous years, the rate was four to





five times higher (growth this year was predominantly from startups and new business entrants). Also, the more easily identifiable and clean energy intensive firms had lower optimism for their future hiring practices than in previous years.

Despite these issues, the basic framework for continued success remains in place. In a knowledge-based economy, human capital is the most important ingredient. Massachusetts continues to produce high quality science, technology, engineering and math (STEM) workers, as well as technically trained production workers and contractors. Massachusetts must maintain its academic excellence to continue its strong growth.

In the coming years, it will be critical for the Commonwealth to address the very different needs of both traditional and innovation firms. Startup ac-

tivity and entrepreneurship often means scientific research firms in Boston and Cambridge. Across the Commonwealth, it also means new contractors in electrical, plumbing, and other building trades. Meeting the needs of both segments of the Massachusetts clean energy economy will require deliberate policies that address their very different but equally pressing concerns.

Massachusetts has a history of technological innovation and has continued this tradition by creating a clean energy sector that is the envy of the world. Its mix of supportive government policy, entrepreneurial spirit, world-class talent, and base of educated consumers makes it a fertile environment for clean energy companies. Its proven track record of success, current strength, and optimistic trends suggest continued vibrancy far into the future.



## Appendix A: Research Methodology

In June and July of 2011, May and June of 2012, and May and June of 2013, BW Research worked on behalf of the Massachusetts Clean Energy Center to conduct a survey of clean energy companies in the Commonwealth. For the purposes of the survey, a clean energy firm is defined as a company involved with an activity related to the clean energy industry. The clean energy industry is defined as being 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 employees are defined as full-time and part-time permanent employees who support the clean energy portion of the business, including administrative staff and excluding interns and other temporary workers.

In order to accurately capture data from the sector, surveys were administered online and by telephone to a list of known employers as well as to a representative, clustered sample of companies from the NAICS industries identified by the Bureau of Labor Statistics and BW Research Partnership as being potentially related to the renewable energy, energy efficiency and alternative transportation sectors.

Over the three years of surveying, the research team attempted over 59,550 telephone calls and sent about 17,000 emails to employers. The survey effort, with a combined margin of error of approximately  $\pm 3.1\%$  at a 95% confidence interval, yielded 1,401 survey responses from the samples in 2011, 930 responses in 2012, and 1,090 responses in 2013. The 2011 survey fielded from June 30 to July 29, 2011 averaged 15 minutes in length, the 2012 survey fielded from May 8 to June 1 averaged 10 minutes in length, and the 2013 survey fielded from May 23 to June 24 averaged 15 minutes in length.

### **“Known Universe” – Firms Previously Identified by Researchers as Clean Energy Companies**

The original list, developed from previous work efforts and databases from the Massachusetts Clean Energy Center and partner organizations, contains the companies that are more likely to be active in the clean energy economy. After duplicate cleaning and applying estimates from the survey data to account for companies that are no longer in business, do not have at least one Massachusetts location or do not identify as in the clean energy industry, as well as improvements and additions since the first survey effort, the 2013 “known universe” of firms is estimated at 1,799 companies.

All firms in the database with email information were sent multiple online invitations. Firms 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 the telephone version.

Of the estimated 1,799 firms in the known universe, 419 completed a survey (23%, down from 28% last year). These employers have a mean of 21.36 clean energy workers per clean energy firm in the known database. The consistent mean and increased universe in 2013 yield 38,443 workers in the known universe, an increase of 12.5%. The margin of error at a confidence level of 95% is approximately +/- 4.2%.

#### **“Unknown Universe” – Firms Not Previously Identified by Researchers as Clean Energy Companies**

This database for the “unknown universe” was drawn from BLS NAICS industries and Dun & Bradstreet company listings in 2013 and InfoUSA company listings in 2011 and 2012. In 2013, the sample contains 33,974 records, which were clustered by industry (agriculture, manufacturing, sales/trade, services/R&D, construction, and repair) and by size (small, medium, large). Firms were randomly called within the clusters. Known firms were removed from the sample. In total, calls were made to 12,902 of the 33,974 records in the 2013 database and up to four attempts were made per firm.

The incidence rates (i.e., the percentage of firms that identified as clean energy) for the 18 clusters were updated from past years using the 2013

findings from the calling to the previously unknown 575 firms (that indicated whether or not they were in clean energy). Due to the change in sample provider (from InfoUSA to Dun & Bradstreet) and the significantly higher churn rates (i.e., the percentage of firms no longer in business or with a disconnected/wrong number, etc.) found in 2013 and also, the much higher number of records in the database, the 2012 incidence rates were carried over to 2013. Note that the 2012 study carried over the 2011 churn rates with the exception of four of the 18 clusters, where statistically significant differences were found from 2011. The overall margin of error for the updated incidence rate analysis is estimated at approximately +/- 4.02 at the 95% confidence level.

In addition, 111 firms from the “unknown universe” identified as clean energy and completed full surveys. Due to the more robust and representative survey effort undertaken in 2011, the data utilized for extrapolations for the “unknown universe” (with the exception of the future growth statistic) were carried over from 2011 (e.g., average clean energy employment, percent breakdown by technology area, value chain activity, and geography).

Compared to the known universe, the level of clean energy employment at “unknown” firms is lower by a significant margin, with a mean of 11 (compared to 21.36 in the known sample). Compared with 2012, the consistent mean and increased number of clean energy firms in the unknown universe results in 41,551 workers, up from 37,353.

## Appendix B: Capital Trends Data

This report's capital trends data include 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 (up to 63% of all investment dollars included in its 2013 report). 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.

There is sound justification for separating project finance from a broader category of asset finance. The first is in the nature of the investment.

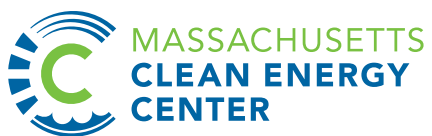
Whereas asset financing is commonly a debt-only transaction involving one or more banks, project finance typically involves both debt and equity, with project sponsors pledging 10-40% equity and banks or other lenders covering the remainder.<sup>31</sup> A second justification for separating project finance is that in clean energy markets it typically is used for “new” energy production rather than for restructuring “old” energy projects.

This report selected Cleantech Group's i3 data platform 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.

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31 <http://www.hsbcnet.com/gbm/attachments/products-services/financing/project-finance.pdf>, at p.7.





55 Summer Street, 9th Floor Boston, MA 02110

Phone: 617-315-9355 | Fax: 617-315-9356

Info@masscec.com | [www.masscec.com](http://www.masscec.com)