Capitol District Energy Plant - © Gary Hall Photography, courtesy GB Architects (GBA)

Vermont
Clean Energy
2016 INDUSTRY REPORT

Prepared for the *Vermont Clean Energy Development Fund*
By BW Research Partnership

May 2016

Letter

This year marks the third of three in the series of Vermont Clean Energy Industry Reports (VCEIR) commissioned by the Vermont Clean Energy Development Fund (CEDF) at the Department of Public Service (DPS). In 2013, when this project was conceived, support for clean energy was ramping up as the State and many stakeholders moved to implement recommendations from the 2011 Comprehensive Energy Plan.

At that time Vermont like most other states did not have a clear picture of the number of employees engaged in the clean energy industry in the state. In 2011, the Commonwealth of Massachusetts released its first clean energy industry report, upon which Vermont's effort was modeled. Since then, BW Research Partnership, Inc., which conducted the industry census in both Massachusetts and Vermont, has gone on to work with the US Department of Energy to sample the entire nation in an effort to develop a standardized approach for measuring jobs related to clean energy. This third report for Vermont taps into this national dataset, which was developed using the methodology employed in Vermont and other earlier state industry census projects.

Three years into the report reveals that the number of Vermonters engaged in the clean energy industry has grown by nearly 20% since the baseline was collected. The 2016 survey identified over 17,700 clean energy workers, up more than 1,400 employees over 2015. These 17,700 workers represent 6% of the State's workforce, up from 4.8% last year and 4.3% in 2014. This year's report shows continued growth, particularly in renewable energy, where RE firms added another 1,800 new workers to payrolls. Given some of the uncertainties in the policy environment and challenges with the broader energy markets in which many businesses operate, we are pleased to see continued growth among the state's clean energy businesses.

In keeping with previous year's reports that delved into a particular topic, the 2016 VCEIR looks closer at Vermont's wood energy sub-sector. Forest products continue to play a central role in the state's economy, with wood energy receiving increasing attention. The *Vermont Forest Sector Systems Analysis*, released in January 2016 by the Working Lands Enterprise Initiative, points to wood energy as one of three key value chain opportunities. The CEDF continues to support the evolution of wood heat through its grant making and other incentive programs. This year's report provides data that acknowledges the impact of low oil prices and the warm winter on wood energy firms, but also shows signs of hope for this sector.

As the state's clean energy industry continues to grow and mature, the jobs picture helps to show the manifestation of increasing demand for clean energy goods and services. This vibrant part of the state's economy is helping to make our energy future more secure. We look forward to continued progress in meeting the State's energy goals and clean energy development across the state.

Sincerely,

Christopher Recchia, Commissioner

Department of Public Service

Andrew Perchlik, Fund Manager

Clean Energy Development Fund

Executive Summary

Vermont's clean energy economy has sparked remarkable employment growth, surpassing expectations for 2016 by three percentage points. The state now supports 17,715 workers who spend at least a portion of their time on clean energy, up more than 1,400 from last year. Vermont's clean energy economy has grown by 20% since 2013, and firms that engage in clean energy activities now employ about 6% of the state's workforce.[1]

Ambitious energy efficiency measures paved the way for a mature market trending towards more "pure-play" efficiency firms, while research and deployment across the storage and smart grid technology sphere has carved out a sector that supports just over 900 jobs in the state. It is generally less typical for energy efficiency employees to spend a majority of their time on efficiency-related business as these firms usually enter the sector from several different traditional trades such as contracting or electrical work. However, 7 in 10 efficiency workers across Vermont spend the majority of their time supporting the energy efficiency portion of business activities, suggesting that deployment of efficiency-related installations and upgrades is sufficient to service firm revenue.

This trend is also apparent at higher levels across the clean energy economy; as clean energy becomes an increasingly reliable source of revenue, more firms are specializing in providing clean energy-related goods and services. In the 2015 industry report, only 3 in 10 firms sourced all of their revenue from clean energy-related business. Data from this year's survey found that 4 in 10 firms attribute all of their revenue to clean energy activity.

With rapid growth resulting in more employment opportunity, the share of small business has shifted toward larger employers. Last year, 7 in 10 firms reported 1 to 5 clean energy workers. Though this year's industry report finds that these small firms still represent a little over half of the state's clean energy economy, about a third of clean energy establishments now employ between 6 and 24 workers; this is up from only a quarter in 2015.

Included in this industry report is a first-ever deep dive into the state's advanced wood heating industry, which is referred to as the "wood energy" sector. This data provides a baseline that will help the state monitor changes in this important subsector of the economy. Wood energy firms employ just over 1,500 workers across their component subsectors–logging, wood fuels (chips, pellets, and firewood), combustion systems, and power stations.[2] These businesses are mostly small—over three-quarters report 1 to 5 permanent employees—and just under half of firms that work with wood energy attribute all of their revenue to wood energy related activities. Interestingly, though the majority of firms reported market decline for their products as a result of low fossil fuel prices and warm winters, most have not changed their product offerings. In fact, a quarter of wood energy firms even report that their revenues have increased over 2015.

The state's clean energy market is transforming, as small businesses with a minor stake in clean activities grow to medium-sized firms that rely entirely on clean energy to produce their revenue streams. In-state suppliers are moving to meet this demand, ensuring that capital exchange remains local, while research institutions uncover the future of energy storage and grid efficiency.

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[1] Please see the Introduction for a definition of qualifying clean energy employees.
[2] Wood energy jobs encompass the power sector as well, such as employment associated with wood fuels at power stations and the wood chips that are delivered to those power plants.

Acknowledgements

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Introduction

As clean technologies continue to penetrate the energy market across the United States, it has become increasingly valuable to track the development of these markets and their associated employment impacts. With statewide commitment to renewable generation targets, efficiency standards, and academic research, Vermont has become a national leader in clean energy deployment. However, few studies aim to quantify and track employment growth that results from the growing share of clean energy activity. While the current structure of federal labor market data collection includes several energy production and distribution industries across utility generation, fuel extraction, manufacturing, and transmission, these classifications do not accurately delineate clean energy technologies and their associated value chain activities. This is particularly important for the energy efficiency sector, where efficiency installations and upgrades are largely conducted by firms across traditional construction trades that have entered the clean energy sphere. Indeed, much of the nation's clean energy workforce is actually embedded within these larger industries—construction, manufacturing, trade, professional and business services—and the current structure of federal data collection does not delineate between semiconductor manufacturers that produce solar panels and those that assemble computer components or medical equipment. As such, the Vermont Department of Public Service has commissioned BW Research Partnership to continue tracking the state's clean energy cluster.

One of the benefits of a multi-year, longitudinal study is the ability to monitor trends over time. This third annual Vermont Clean Energy Industry Report demonstrates continued growth of the sector, with overall clean energy employment growth of about 20% since 2013. This compares to overall statewide employment growth of approximately 2% over the same period. Energy efficiency-related employment remains the state's largest segment of the clean energy economy, but it grew more slowly than other sectors over the past three years, by a still impressive 10% since 2014. Renewable energy employment, by contrast, grew by more than 50% over the same period, reaching nearly 7,000 workers across a variety of technologies including solar, wind, and bioenergy.

20%
Since 2013

Vermont's Approximate Overall Clean Energy Employment Growth

Vermont's renewable energy sector is comparatively large given the state's small population, with good reason. In addition to being a leader in clean energy policies, Vermont has a well-developed wood energy sector (including logging, forestry, and pellet production as well as the sales, distribution, and maintenance of wood energy systems) and bioenergy production in agriculture, as well as a smaller amount of early stage liquid biofuel activity, largely stemming from the University of Vermont.

Vermont's clean energy industry is mostly deployment-driven, meaning that the jobs connected to the sector are largely focused on sales, installation, and maintenance of clean energy technologies. Such an emphasis makes the sector's employment more dependent on outside forces, such as general economic conditions (to support energy upgrades), policy (to incentivize or require additional deployment), fossil fuel energy prices, and even winter temperatures. While deployment focus is the norm across the United States, it does mean that Vermont's clean energy employment growth will be more volatile than states that are highly focused on production (such as manufacturing in Ohio) or innovation (such as Massachusetts and California).

Clean energy investment data from January 2013 through March 2016 illustrates Vermont's focus on deployment. The state's clean energy firms raised $13 million in outside investment over the period, which is the lowest of any New England state. When limited to just early stage capital focused on new technology development, Vermont's $2 million raised over the period is ahead of only New Hampshire.[3] Given the current headwinds facing deployment in Vermont, such as changing policies and declining prices for fossil fuels, innovation and early stage development may offer an opportunity to leverage the state's education and research assets and strong employer base to continue growing its clean energy sector.

Three Main Technology Sectors for Clean Energy Employment

1. Renewable Energy
2. Energy Efficiency
3. Motor Vehicles

As with previous reports, this study is based on a comprehensive survey of hundreds of Vermont employers, which has become a national model for studying energy-related employment and has recently been adopted by the U.S. Department of Energy. The research focuses on understanding how specific clean energy technologies are impacting employment within traditional employment sectors and creating opportunities for Vermont residents across a variety of technologies and activities, from solar panel installation to manufacturing wood pellets for heating systems.

For the purposes of this report, clean energy employment is divided into three main technology sectors as well as an "other" category.

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[3] Cleantech Group's i3 data platform

Renewable energy includes solar, wind, geothermal, bioenergy, and traditional and low-impact hydroelectric generation technologies. The generation sector also includes both renewable heating and cooling and a component designated as renewable fuel technologies; this subsector encompasses workers that support liquid biofuels and woody biomass technologies such as wood pellet or chip fuels and combustion systems. The energy efficiency sector is comprised of workers that spend their time on the research, manufacture, installation, or sale and distribution of energy star appliances, efficient lighting, insulation and other energy efficient building materials, high annual fuel utilization efficiency (AFUE) HVAC goods and services, as well as storage and smart grid technologies. Clean energy workers in the motor vehicle sector support hybrid, electric, and renewable fuel transportation technologies.

Employees are designated part of the clean energy workforce if they spend at least some amount of time supporting the portion of a firm's business activities that is related to clean energy; as such, estimates of the statewide clean energy workforce are not confined to full-time employees and include all workers that spend any amount of time conducting clean energy activities. The report provides more granularity on what percentage of renewable generation and energy efficiency workers spend the majority or all of their time on related activities.
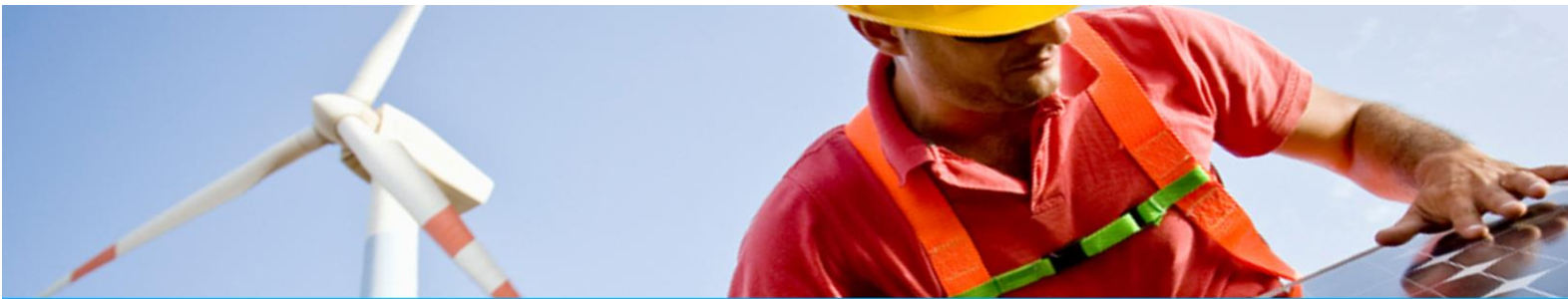
Vermont's Clean Energy Landscape

Two years following the first Clean Energy Industry Report, Vermont continues to lead its citizens towards cost savings and employment opportunities. Last year, the state was rated sixth in the nation for clean technology leadership across innovative infrastructure, policy, and financing mechanisms.[4]

In 1999, Vermont was first in the nation to create a statewide energy efficiency utility. Just last year, Vermont placed third in the nation for its leadership in both utility and government-led initiatives across energy efficiency policy, programs, and deployment. The state achieved a near perfect score for the energy efficiency resource standard, long-term electricity savings targets, and high electricity and natural gas savings. In addition to mandatory statewide building energy codes—updated every three years—Vermont also monitors compliance with gap analysis and code training. [5]

The state also established transportation efficiency targets, including tailpipe emission standards. Vermont is one of few states with a codified law designed to reduce vehicle miles traveled.[6] With 132 alternative fueling stations and ten laws and incentives that spur alternative fuel and advanced vehicle research and deployment,[7] hybrid and electric vehicle registration now totals 10,300 across the Green Mountain State.[8]

Since 2013, the state has made exceptional advancements in storage and smart grid research and market penetration. At the University of Vermont's Smart Grid Research Center, PhD students are trained to address both the technical barriers and social underpinnings of current energy infrastructure and usage behaviors. With research across the engineering, mathematic, and neuroscience disciplines, students at the Integrative Graduate Education and Training (IGERT) program are developing models and algorithms that predict blackouts, decrease intermittencies, and integrate weather forecasts and electric vehicle infrastructure into the state's current energy framework.[9] Between 2013 and 2015, the state increased smart meter ownership by 10 percentage points, from 80.4% of the population[10] to 9 in 10 residents today.[11]

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[4] 2015 U.S. Clean Tech Leadership Index, Clean Edge Inc.
[5] 2015 State Energy Efficiency Scorecard, American Council for an Energy-Efficient Economy
[6] *Id.*
[7] Alternative Fuels Data Center, U.S. Department of Energy
[8] 2015 U.S. Clean Tech Leadership Index, Clean Edge Inc.
[9] University of Vermont, IGERT Program; Vermont Quarterly, *In Search of the Smart Grid*, Joshua Brown
[10] 2015 U.S. Clean Tech Leadership Index, Clean Edge Inc.
[11] Vermont Quarterly, *In Search of the Smart Grid*, Joshua Brown

While fostering dependable and cost-effective grid infrastructure, the state is also pioneering localized energy generation and storage capacities to further optimize grid efficiency and increase penetration of renewable energy. The U.S. Department of Energy (DOE) named the Stafford Hill Solar Farm in Rutland the first and only all-solar micro-grid in the nation. Constructed and operated by Green Mountain Power (GMP) with funding from the CEDF and DOE, and technical assistance from Sandia National Laboratory, the system includes 2 MW of solar PV with 4 MW of battery storage for solar generation that can power 2,000 homes during full sun.[12]

In addition to advancing research and deployment across new clean energy technologies, the state also remains committed to traditional renewable energy generation. Just last year, Vermont enacted a statewide mandatory renewable portfolio standard, called the Renewable Energy Standard (RES). The RES requires that all retail electricity suppliers support 55% of their electricity sales with renewable resources by January 2017.[13] In fact, Vermont's 2016 Comprehensive Energy Plan (CEP) re-affirms the 2011 statewide goal of 90% renewably sourced energy production by 2050 (across all sectors), now with interim targets. Since the last CEP was issued in 2011, the state has added over 100 MW of additional capacity each across wind and solar photovoltaic generation.[14]

However, in spite of strong policy support and employer optimism, the industry will likely face some obstacles in the short- to middle-term. First, declining fossil fuel prices can dramatically impact clean energy deployment. As prices decline, consumers become less concerned with their electric, heating, and transportation fuel bills and therefore less frequently seek alternatives. Second, warmer winters impact fuel supplies, particularly in the wood energy sector, and inventories are reported to be high. This suppresses short-term future growth. Despite such headwinds, however, surveyed employers remain optimistic that growth will continue—if not at the same pace as the last three years—over the short term in Vermont.

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[12] *Id.*
[13] Database of State Incentives for Renewables and Efficiency, U.S. Department of Energy, Vermont June 2015
[14] 2016 Vermont Comprehensive Energy Plan, Vermont Department of Public Service
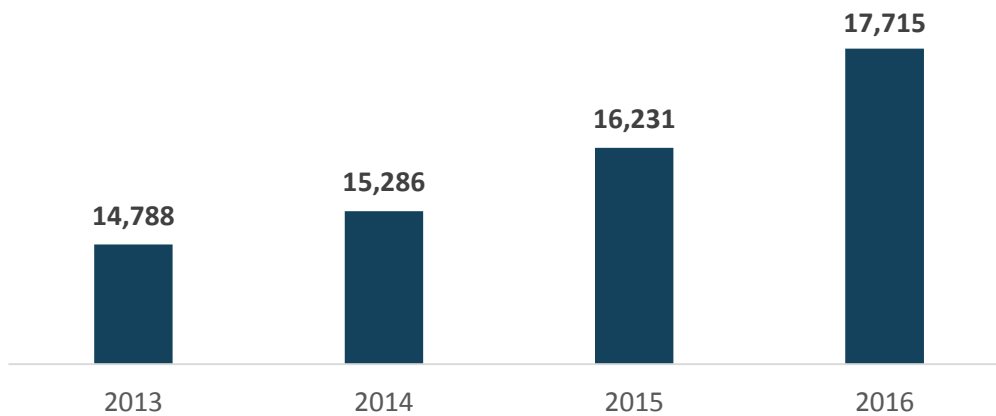
Industry Overview

Employment Growth

Advanced research and market penetration continues to fuel employment growth for clean energy establishments across the Green Mountain State. Vermont surpassed growth expectations reported in 2015 by 3%; the state is now home to just over 17,700 clean energy workers, up more than 1,400 employees over 2015. Since 2013, the state's clean energy workforce has expanded by 19.8%. Today, clean jobs compose almost 6% of statewide employment, which is the highest per capita employment of any U.S. state.[15] Clean energy workers are quite a significant component of the overall economy compared to other states with growing clean energy clusters. For comparison, clean energy workers in Rhode Island and California form about 3% of the overall statewide labor market.

Figure 1. Vermont Clean Energy Industry Employment, 2013-2016

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                                                              17,715

                                            16,231

                      15,286

14,788



   2013            2014            2015            2016
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Clean Energy Technologies

**Vermont's clean economy is largely composed of energy efficiency employees.** These workers account for nearly half of all clean jobs across the state. Renewable energy generation supports about 4 in 10 workers (39%), followed by clean vehicles at 5% of the clean energy workforce.

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[15] Bureau of Labor Statistics, Current Employment Statistics State and Area Employment, total nonfarm, November 2015

This is the first year in which storage and smart grid technologies were placed in a distinct category; these technologies support 932 jobs in Vermont.[16] The state's smart grid and storage sector is relatively large compared to other states,[17] and a developing ecosystem of advanced smart grid and storage research and deployment around Rutland and elsewhere in Vermont may signal future employment growth in this sector. Though the state does have some early stage research and development[18] across these technology spheres, this is a small part of the sector, and the majority of employment is likely in the construction and maintenance of storage and smart grid infrastructures.

Figure 2. Clean Energy Technology Employment Breakdown, 2016[19]
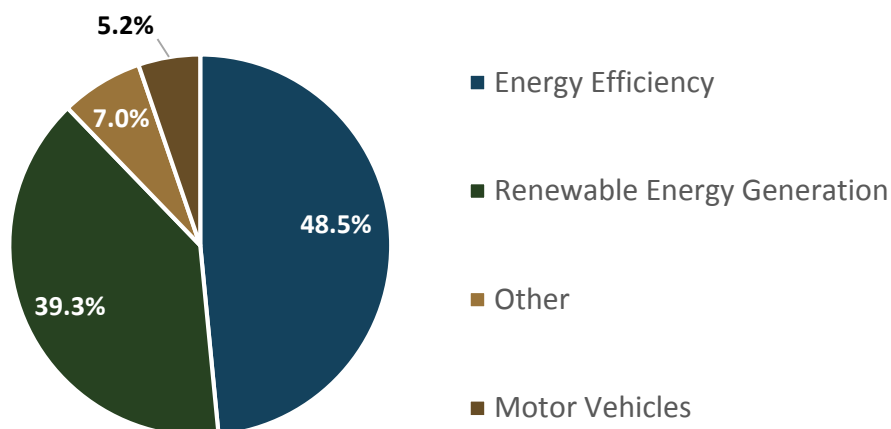
Renewable Energy Generation

Renewable energy employers saw robust growth over 2015. The renewable energy workforce grew by more than a third since the 2015 industry report (36%), with renewable energy firms adding another 1,800 new workers to their payrolls. Clean transportation employment also increased by 17%, though the sector has slowed down compared to the almost 20% growth experienced in the last industry report.

Energy efficiency employers rebounded from only 2% growth last year—the sector added jobs at a rate of nearly 8% over 2015, supporting an additional 600 clean energy workers.

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[16] In 2015, storage and smart grid technologies were included in the energy efficiency employment figure; while they still remain part of the energy efficiency employment total, the previous report did not delineate these sub-technologies.
[17] For comparison, Iowa, Indiana, Michigan, Minnesota, Nebraska, Ohio, and Wisconsin all support under 300 storage or smart grid workers.
[18] This sector attracted more than $350,000 in Seed funding since 2013.
[19] Due to rounding, the following charts may add up to just above or below 100 percent.

Figure 3. Employment Growth by Technology, 2014-2016[20]

Technology	2014	2015	2016
Energy Efficiency	7,800	7,974	8,585
Renewable Energy	4,546	5,111	6,965
Supporting Services	956	967	
Clean Transportation	666	792	929
Greenhouse Gas Emissions Accounting and Management	171	173	
Other	1,147	1,214	1,236
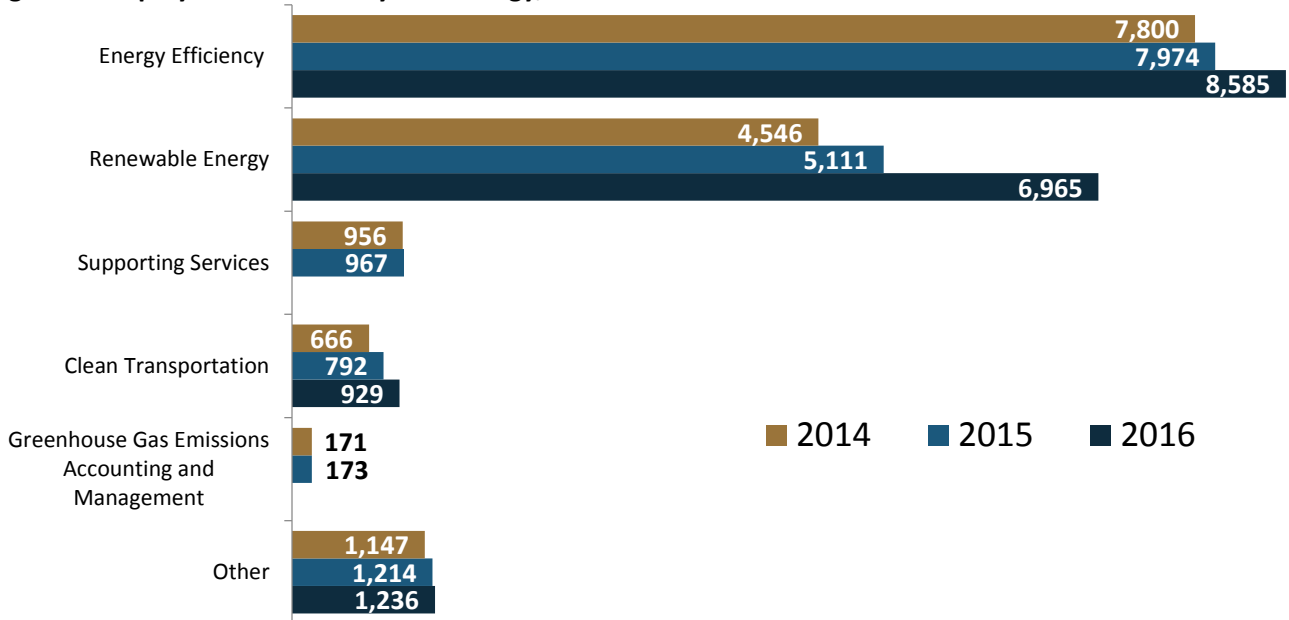
Vermont's solar energy workers remain at the core of the state's renewable generation economy. Though growth has slowed compared to 2015, solar technologies are still the largest renewable generation employer in the state; the solar electric generation sector employs more than 2,100 workers. Employment across the state's solar firms grew by 13% over 2015, about nine percentage points lower than last year's report.

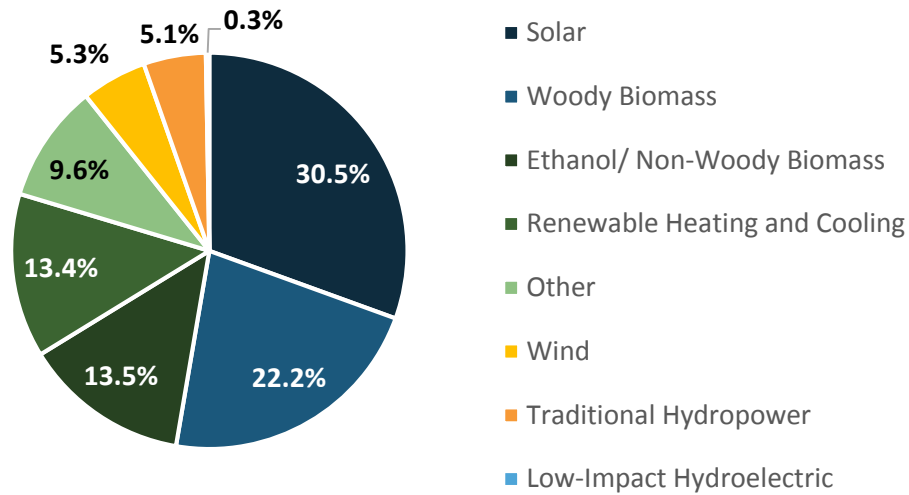Overall, renewable energy technologies now support 6,965 workers across the state. Seven in ten renewable energy employees (71%) spend at least half of their time on related work, while almost 6 out of 10 workers (57%) are reported to spend all of their time supporting renewable generation activities. This is largely comparable to the national average—80% of renewable energy workers spend most of their time on clean activities and 60% spend all of their time supporting the clean energy portion of business. In fact, the proportion of renewable energy workers that spend at least half of their time on clean energy-related work is also almost comparable to several states with large clean energy economies such as Massachusetts (82%), California (86%), and New York (72%). The state, however, does fall short of Rhode Island, where 9 in 10 (91%) renewable energy generation workers dedicate all of their time to clean activities.[21]

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[20] For this growth analysis, the renewable energy generation figure encompasses renewable fuels (ethanol/non-woody biomass and woody biomass) while energy efficiency employment includes storage and smart grid technologies. Supporting services and greenhouse gas emissions accounting and management are not included for 2016, though they were delineated in previous reports.

[21] These figures exclusively describe the renewable generation workforce and do not encompass all clean energy technologies. All data is from the BW Research Energy Employment Index 2016.

Figure 4. Renewable Energy Generation Employment by Sub-Technology, 2016[22]

Legend:
- Solar — 30.5%
- Woody Biomass — 22.2%
- Ethanol/ Non-Woody Biomass — 13.5%
- Renewable Heating and Cooling — 13.4%
- Other — 9.6%
- Wind — 5.3%
- Traditional Hydropower — 5.1%
- Low-Impact Hydroelectric — 0.3%

Renewable Fuels

The following employment figures for Vermont's wood energy sector are not additional to the overall renewable energy employment by technology presented above, but instead represent the fuels component of Vermont's renewable energy economy. This subsector of renewable generation encompasses all renewable fuels including ethanol, biodiesel, landfill methane, agricultural waste, and all other biofuels; it is split into two categories: non-woody biomass and woody biomass.

Vermont has a significant renewable fuels sector, totaling nearly 2,500 employees. About 62% of the workforce primarily works with woody biomass technologies, such as logging for fuel wood, chips, pellets, and firewood, or wood energy combustion systems; the remaining 943 employees work with non-woody biomass fuels (primarily biodiesel).

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[22] "Other" technologies include hydrogen/fuel cells, combined heat and power with renewable fuels, and waste to power (not municipal waste). The category also includes overlap, where employers were unable to allocate workers to a specific technology.

Vermont's Wood Energy Sector

For the purposes of this report, firms are qualified as wood energy employers if they support any of the following activities related to wood energy only: forestry; fuel supply chain such as logging, chipping, wood pellets, firewood, and other wood fuel production; as well as the design, development, production, sales, installation, and service of pellet, chip, or other wood burning stoves, inserts, furnaces, boilers, or other equipment that produces heat or electricity. The following analysis illustrates trends for the overall wood energy industry as well as its component subsectors: logging, wood fuels, and combustion systems. Wood fuels are further delineated by the type of fuel provided; these firms are broken into either chip and pellet, or firewood, suppliers.

The wood energy industry is a critical component of the state's clean economy. In fact, the Vermont Working Lands Enterprise Initiative released a report in January 2016 citing wood energy as one of three key value chain opportunities for the state.[23] For this 2016 VCEIR, the research team conducted a supplemental survey and subsequent interviews with wood energy related businesses to provide insights into a sector experiencing substantial pressures related to fossil fuel markets. Wood energy establishments include forestry and logging firms, processors and distributors of chips, pellets, and firewood, as well as manufacturers and installers of wood stoves, boilers, and furnaces. Together, these establishments employ 1,542 full-time-equivalent workers across Vermont.[24]

Wood energy firms are primarily small businesses. About 8 in 10 (84%) firms report five or fewer permanent employees. While some firms reported more than five temporary workers, the majority note that they do not employ subcontractors or temporary workers at their sites. Nearly half of participating firms (46%) receive all of their revenue from wood energy products.

Chip and pellet firms, a subsector of wood fuels, employ more workers per firm and attribute more revenue to wood energy activities compared to the overall wood energy average. Only 64% of employers also reported 1 to 5 permanent employees—20 percentage points lower than the industry average. Six in 10 (58%) chip and pellet firms reported that all of their revenue is attributable to wood energy; this is slightly higher than the 46% average across all wood energy firms.

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[23] Vermont Working Lands Enterprise Initiative. *Vermont Forest Sector Systems Analysis: Exploring New Market Opportunities across Value Chains*. January 2016.

[24] Unlike the other reported employment in this report, the 1,542 workers reported in the wood energy sector are Full-Time Equivalents (FTEs). See Appendix A for a description of the methodology.

Figure 5. Overall Wood Energy Firm Size, 2016

1 to 5 permanent employees at Vermont locations	**84.2%**
6 to 10 permanent employees at Vermont locations	**6.5%**
11 to 24 permanent employees at Vermont locations	**7.2%**
25 to 49 permanent employees at Vermont locations	**0.7%**
50 to 99 permanent employees at Vermont locations	**0.7%**
100 to 249 permanent employees at Vermont locations	**0.7%**
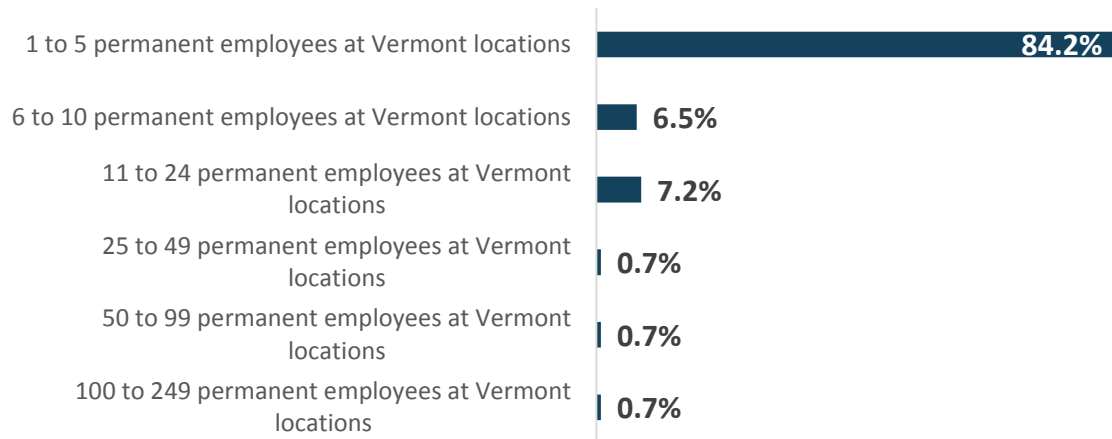
The wood energy industry mostly serves residential customers across Vermont. Almost 8 in 10 firms report that their customers are primarily residential; about 2 in 10 firms report primarily commercial or industrial clients.

Based on the interviews with employers, the institutional and industrial markets are becoming more attractive to wood energy companies in Vermont. The primary reason reported is that as traditional fuel prices decline, institutional clients are more likely to be interested in benefits other than simply cost of fuel, but also supporting the local economy and supporting renewable energy, which has positive branding implications in Vermont.

Figure 6. Overall Wood Energy Customers, 2016[25]

- Residential
- Commerical
- Industrial or Institutional

10.6% 10.6% 78.8%
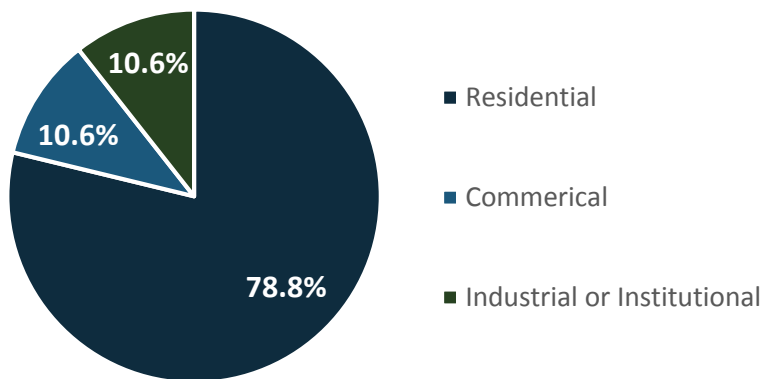
Vermont's wood energy industry is primarily concentrated in the harvest and logging of firewood as well as maintenance support for wood combustion systems.
These value chain activities account for 95% of firms across the state.

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[25] This question was only asked of wood fuel and wood combustion system firms.

Figure 7. Wood Energy Primary Activity, 2016
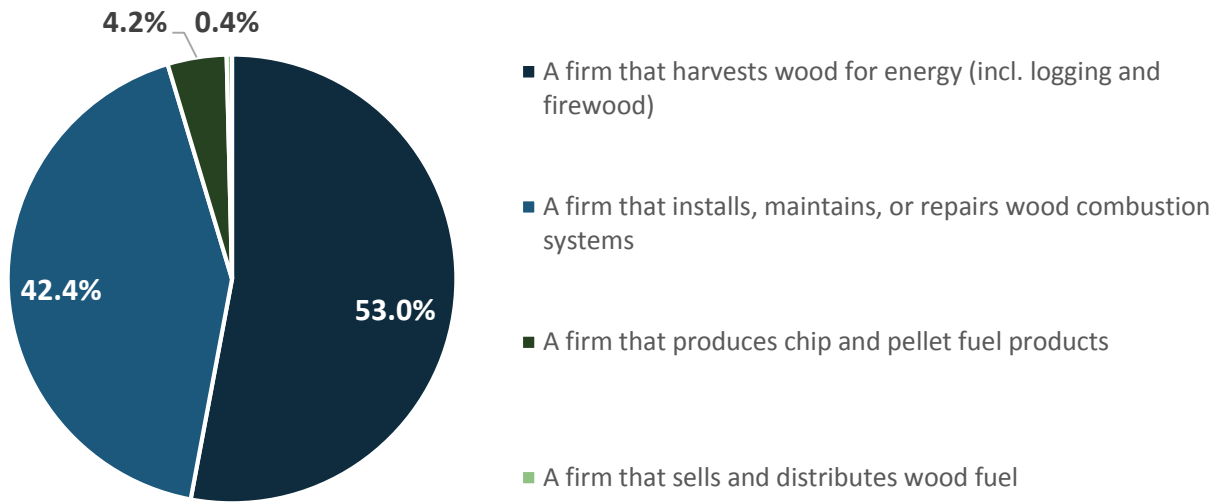

- 4.2%
- 0.4%
- 42.4%
- 53.0%

- A firm that harvests wood for energy (incl. logging and firewood)
- A firm that installs, maintains, or repairs wood combustion systems
- A firm that produces chip and pellet fuel products
- A firm that sells and distributes wood fuel

Wood combustion firms are most engaged in the sale, distribution, installation, or maintenance of combustion systems. These firms represent 8 out of 10 wood combustion employers. The state has a small share of wood combustion-related research and development and manufacturing.

Figure 8. Wood Combustion Primary Activity, 2016

- 10.0%
- 10.0%
- 40.0%
- 40.0%

- A firm that conducts R & D on wood combustion products
- A firm that manufactures wood combustion products
- A firm that sells and distributes wood combustion products
- A firm that installs, maintains, or repairs wood combustion product
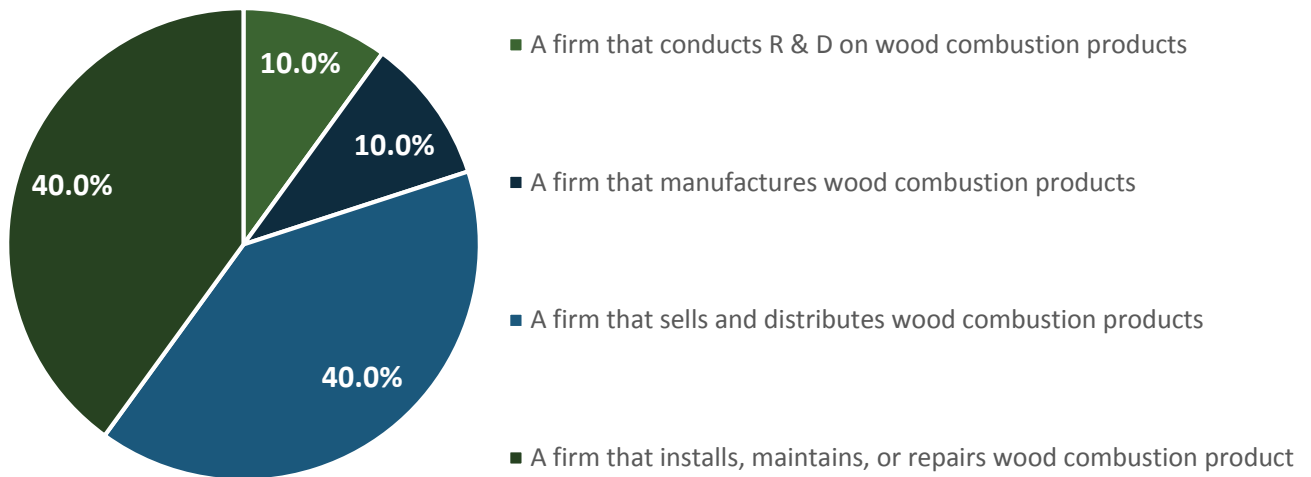
Wood energy employers across Vermont are not positive about the near-term market for wood energy. About 2 in three (69%) reported that the market for their products has declined in the last year – 42% note that it has declined significantly. Not surprisingly, the low price of fossil fuel was the most frequently cited reason for the decline (21%), followed by general declines in the pulp market (14%), and warm winters (13%). **Wood combustion saw the**

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greatest market improvement compared to other wood energy subsectors – 16% of firms reported market improvement.

Logging employers are even less optimistic about market demand than the overall wood energy sector. Eighty-four percent of employers report that the market for logging and forestry products has declined over 2015, and over half (58%) note significant market decline. Employers in the logging sector are concerned about overall wood product price declines as well as high inventories of wood energy products from a warm winter in 2015 and 2016.

Wood fuel firms are seeing variable market growth, depending on the type of fuel supplied. Chip and pellet firms reported no market growth at all for their products over 2015. Eight in 10 employers report that the market declined, and 60% report a significant decline. On the other hand, the **firewood subsector saw more market improvement compared to other wood energy subsectors.** Thirteen percent of employers report that they experienced market improvement over 2015, but the majority (58%) still reported a decline. In discussions with firewood processing and sales workers, it became evident that market forces such as price of oil have much less impact on cord wood sales than perhaps in other markets. Also, several pointed out that they typically sell the bulk of their product early in the season. As a result, the warm winter had less impact on their sales, though they note higher inventory this year as well as concern that their regular customers also have significant inventory stored as well, which would hamper their sales later in 2016.

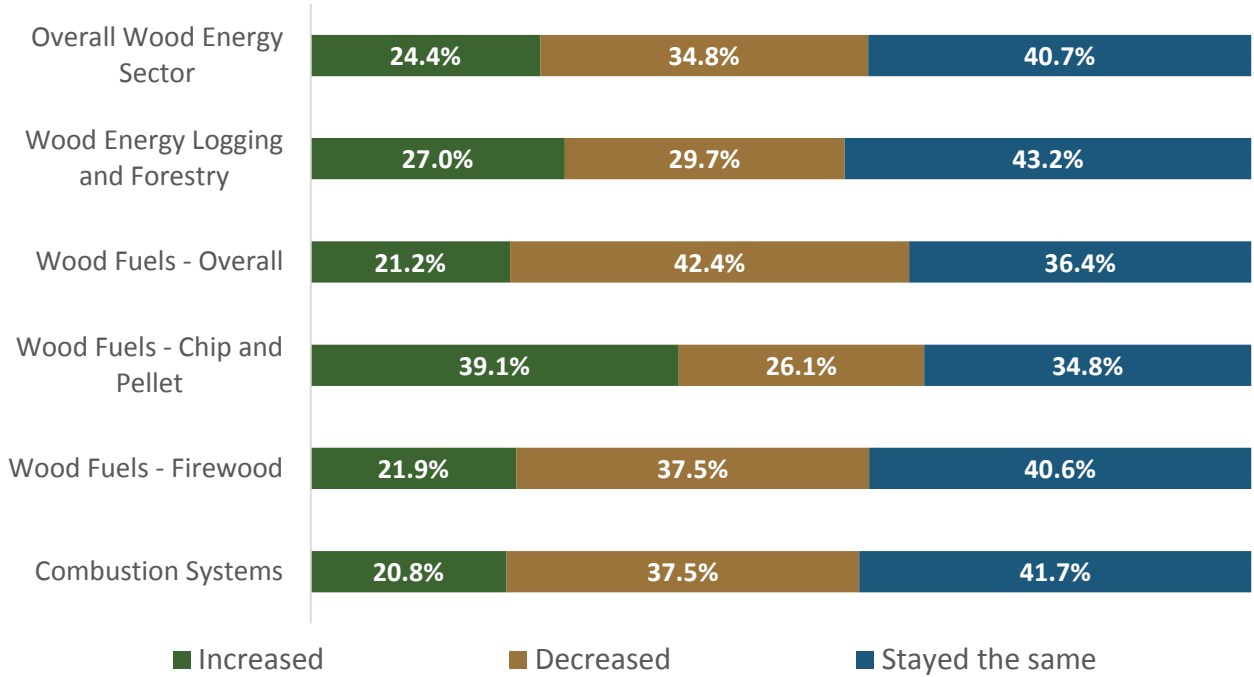**Figure 9. Market Demand for Wood Energy Related Products, 2015-2016[26]**

Category	Significantly improved	Somewhat improved	Neither improved nor declined	Somewhat declined	Significantly declined
Overall Wood Energy Sector	6.6%		22.1%	27.2%	41.9%
Wood Energy Logging and Forestry	5.4%		10.8%	25.7%	58.1%
Wood Fuels - Overall			30.3%	30.3%	33.3%
Wood Fuels - Chip and Pellet			20.0%	20.0%	60.0%
Wood Fuels - Firewood	9.7%		29.0%	35.5%	22.6%
Combustion Systems	12.0%		44.0%	32.0%	8.0%

■ Significantly improved   ■ Somewhat improved   ■ Neither improved nor declined
■ Somewhat declined   ■ Significantly declined

Interestingly, firm production and revenues have remained steady in the face of declining market demand. Despite reported market negativity, three in four employers (74%) report that these changes have not altered their wood offerings, though data does not reflect the establishments that may have closed business. In the face of declining market value and demand, almost a quarter (23%) of respondents report increased wood energy related revenues over 2015, while 35% reported a decline. In the interviews, employers noted that the overall wood market is down, especially in pulp markets. More importantly, many employers reported the unseasonably cold winter in the Northeast last year, which shrank inventories and spurred greater demand in early 2015.

Chip and pellet firms saw greater revenue growth compared to the industry average. Though no firms reported market improvement, 4 in 10 (39%) note that they saw revenues increase over 2015. One reason provided for this is increased export activity; however, firms noted the mild winter in the Northeast has created high remaining inventories, which causes worry for future years.

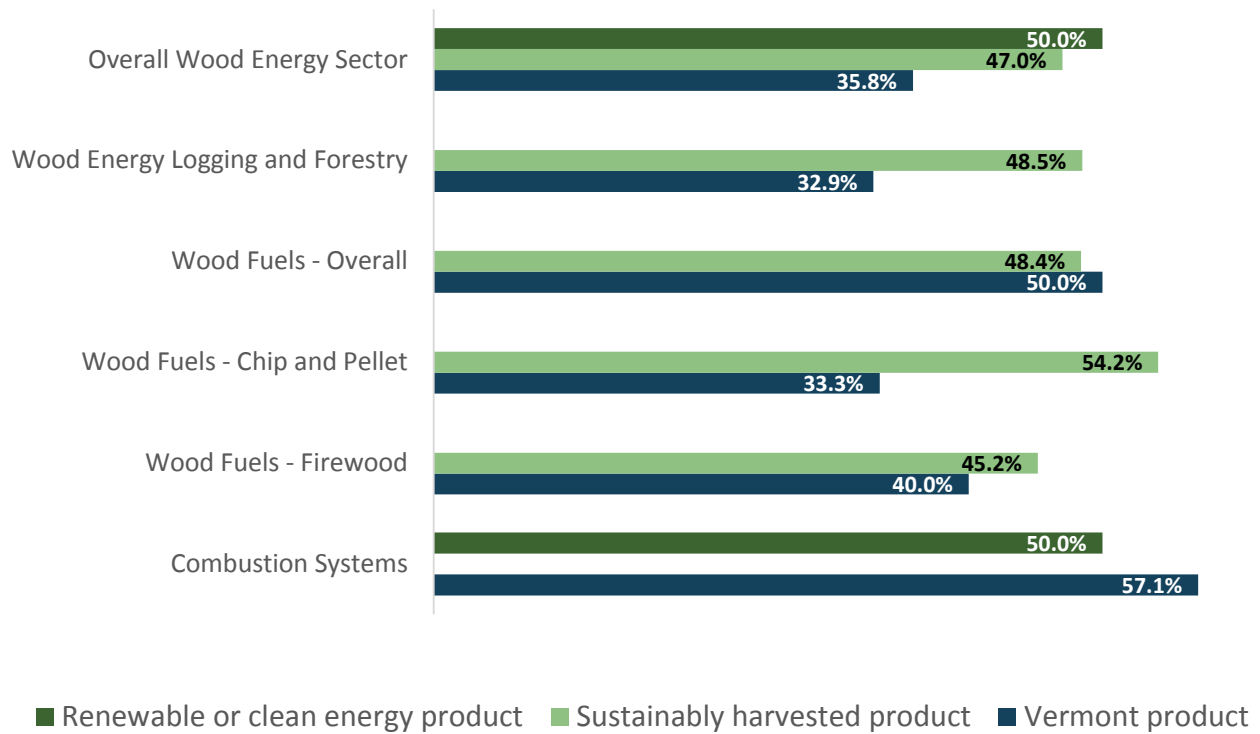
[26] For Figures 9, 10, and 11, the responses from wood fuel firms are displayed as an "overall" category, and further broken out into either primarily chip and pellet firms or firewood firms in order to display greater granularity in responses.

Figure 10. Wood Energy Revenues, 2015-2016

	Increased	Decreased	Stayed the same
Overall Wood Energy Sector	24.4%	34.8%	40.7%
Wood Energy Logging and Forestry	27.0%	29.7%	43.2%
Wood Fuels - Overall	21.2%	42.4%	36.4%
Wood Fuels - Chip and Pellet	39.1%	26.1%	34.8%
Wood Fuels - Firewood	21.9%	37.5%	40.6%
Combustion Systems	20.8%	37.5%	41.7%

Product branding improves sales for wood energy firms. Just over a third (36%) of employers report that they currently use the Vermont brand on their products, and 4 in 10 of these firms report that it benefits their sales. Half of surveyed firms (47%) also advertise their product as "sustainably harvested," with half also reporting that it benefits sales. **The renewable or clean energy brand improves sales for firms that provide combustion systems.** Fifty percent of employers brand their product as clean or renewable, and 9 in 10 of these firms (92%) report that a clean or renewable label has improved product sales.
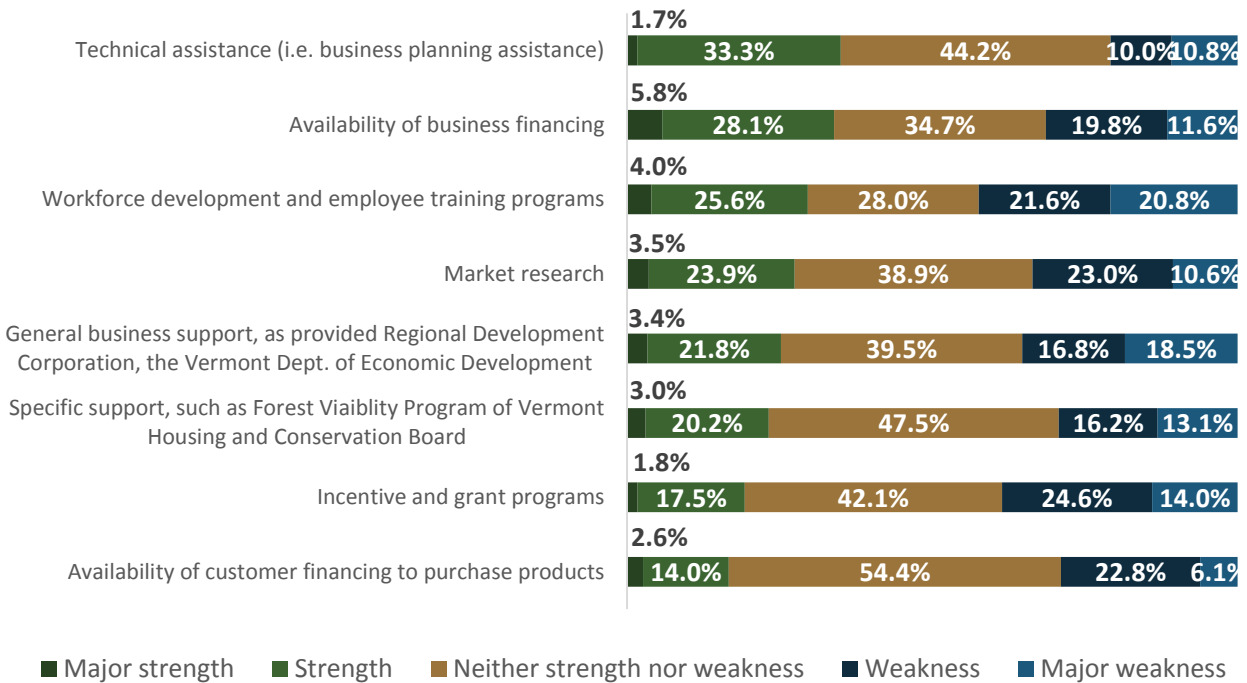
Figure 11. Wood Energy Product Branding, 2016[27]

Legend:
- Renewable or clean energy product (dark green)
- Sustainably harvested product (light green)
- Vermont product (dark blue)

Category	Renewable or clean energy product	Sustainably harvested product	Vermont product
Overall Wood Energy Sector	50.0%	47.0%	35.8%
Wood Energy Logging and Forestry		48.5%	32.9%
Wood Fuels - Overall		48.4%	50.0%
Wood Fuels - Chip and Pellet		54.2%	33.3%
Wood Fuels - Firewood		45.2%	40.0%
Combustion Systems	50.0%		57.1%

Overall industry averages indicate that wood energy firms do not view economic development support programs as major strengths. In fact, for most programs, about a third or more of firms found them to be neither a strength nor weakness. Each activity was rated a strength by no more than a third of firms; some activities, such as customer financing, receiving as low as 17% of employer satisfaction. The industry's component subsectors mostly mirror the industry average, with the exception of chip and fuel firms—more employers rated economic employment programs to be a strength.

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[27] Percentages indicate the number of firms who reported that they do brand their products with one of the three labels. Sustainably harvested branding was only asked of logging and wood fuel firms, while renewable or clean energy product branding was only asked of combustion firms.

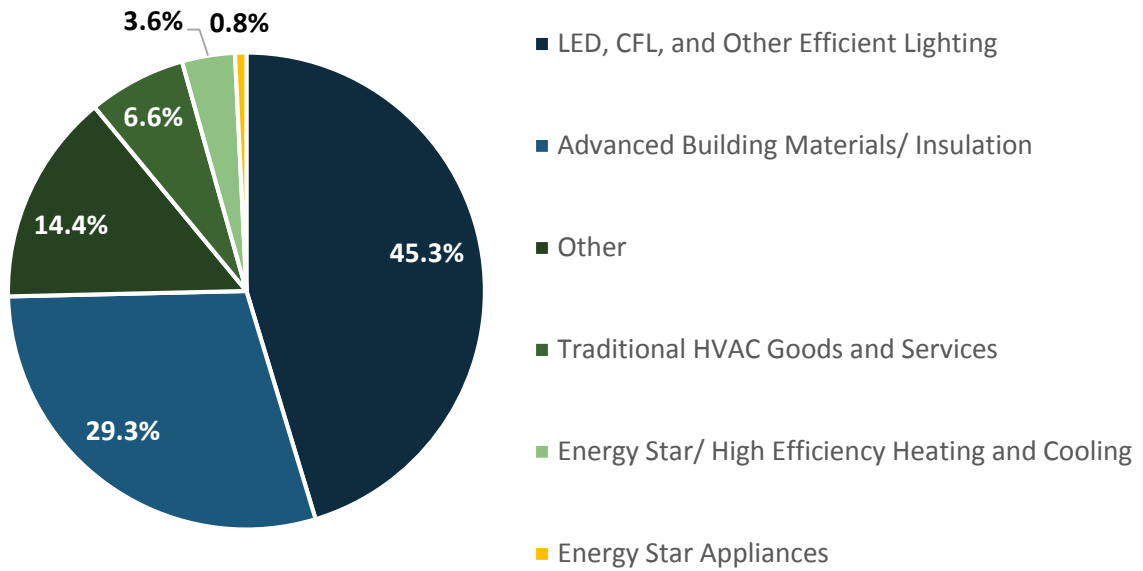**Figure 12. Wood Energy Economic Development Program Ratings, 2016**

Legend: ■ Major strength ■ Strength ■ Neither strength nor weakness ■ Weakness ■ Major weakness

Category	1st	Major strength	Neither	Weakness	Major weakness
Technical assistance (i.e. business planning assistance)	1.7%	33.3%	44.2%	10.0%	10.8%
Availability of business financing	5.8%	28.1%	34.7%	19.8%	11.6%
Workforce development and employee training programs	4.0%	25.6%	28.0%	21.6%	20.8%
Market research	3.5%	23.9%	38.9%	23.0%	10.6%
General business support, as provided Regional Development Corporation, the Vermont Dept. of Economic Development	3.4%	21.8%	39.5%	16.8%	18.5%
Specific support, such as Forest Viaiblity Program of Vermont Housing and Conservation Board	3.0%	20.2%	47.5%	16.2%	13.1%
Incentive and grant programs	1.8%	17.5%	42.1%	24.6%	14.0%
Availability of customer financing to purchase products	2.6%	14.0%	54.4%	22.8%	6.1%

Energy Efficiency

Vermont's energy efficiency sector is more highly concentrated with "pure-play" firms. In fact, the percentage of employees that spend at least half of their time supporting the energy efficiency portion of business (72%) is notably higher than other states and the national average (47%). The percentage of energy efficiency workers that spend the majority of their time on efficiency-related installations and upgrades is lower across Ohio (31%), Illinois (49%), California (50%), and New York (59%). However, Vermont is slightly behind Massachusetts, where 89% of the efficiency workforce spends at least half of their time supporting the energy efficiency portion of business.[28]

Unlike renewable energy, firms that support energy efficiency installations and upgrades come from traditional trades such as contracting and electrical wiring; as such it is far less typical for energy efficiency employees to spend a majority of their time on efficiency-related business. Energy efficiency firms across the state are mostly concentrated in efficient lighting and advanced, energy-saving building materials and insulation.

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[28] BW Research Energy Employment Index 2016.

Figure 13. Energy Efficiency Employment by Sub-Technology, 2016

- LED, CFL, and Other Efficient Lighting
- Advanced Building Materials/ Insulation
- Other
- Traditional HVAC Goods and Services
- Energy Star/ High Efficiency Heating and Cooling
- Energy Star Appliances

Clean Transportation

Vermont has a fairly small clean transportation industry. The state's 929 clean vehicle employees are mostly evenly split between electric vehicle and hybrid technologies. Fuel cell and hydrogen vehicles each make up under 1% of the state's clean vehicle workforce.

Figure 14. Clean Vehicle Employment by Sub-Technology, 2016

- Hybrid
- Electric
- Fuel Cell
- Hydrogen
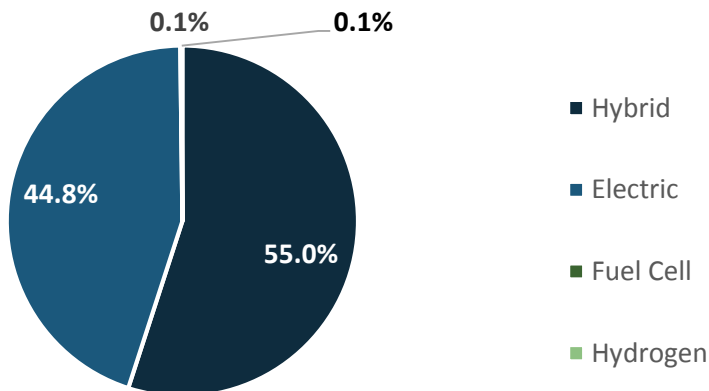
Clean Energy Value Chain Activities

Installation firms remain the foundation for clean energy employment in Vermont. The state's renewable energy industry is primarily composed of installation firms (42%), but there is also significant work in the research, engineering, and professional service sector (24%) as well as sales and distribution (18%).

Figure 15. Value Chain Breakdown, 2016[29]
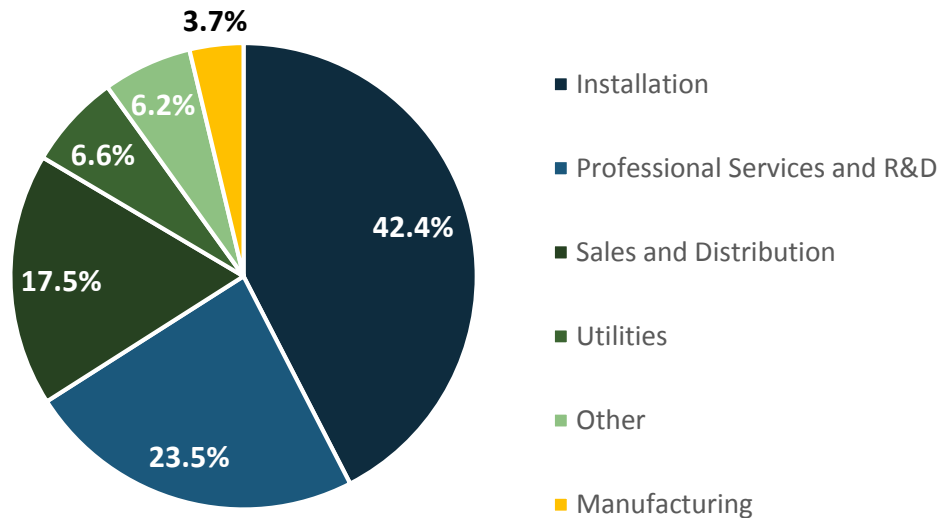
All value chain activities, except manufacturing, experienced growth since the 2015 industry report. Installation firms grew by about 10%, supporting an additional 660 workers, while sales firms (i.e. trade, distribution and transport) increased their payrolls by 440 employees for a growth rate of about 17%.
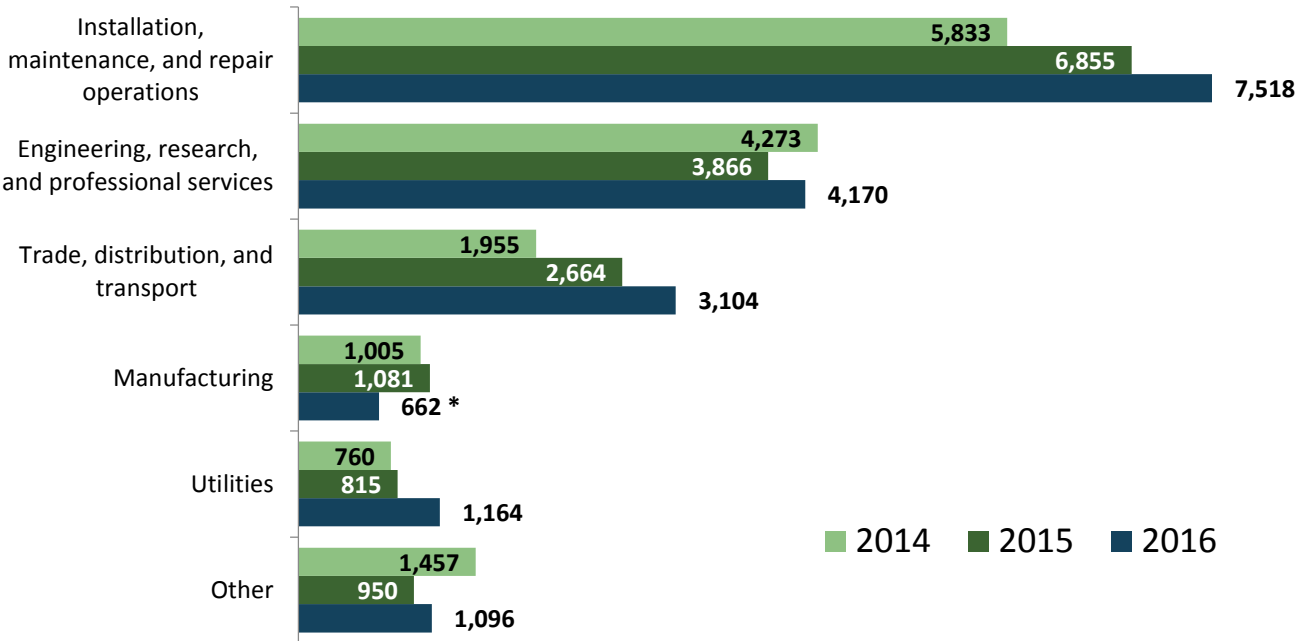
This value chain analysis is in line with the previous clean industry reports for Vermont in which value chain allocations are based on how employers self-reported their firms in the survey. Given the unique nature of wood energy firms, employers seemed to have difficulty selecting an appropriate value chain activity from the list of options provided. In fact, firms working in the wood energy sector mostly report their primary activities as sales and installation. While there are certainly many jobs focused on selling firewood or installing and maintaining boilers, the data seemed insufficient to fully account for the state's many loggers.

This year's more granular analysis of the wood energy sector, including the additional follow-on survey of wood energy employers, provides a new layer of data that suggests that if we

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[29] Though value chain titles are more comprehensive this year they are comparable to previous reports as follows: installation is now installation, maintenance, repair and operations; engineering, research, and professional services was previously split into engineering and research and consulting, finance, legal services etc.; sales and distribution is now trade, distribution, and transport; and utilities was previously energy generation.

consider production of wood fuel (loggers and producers of wood for energy, as well as chip and pellet manufacturers) as manufacturing workers, the sector is larger and, in fact, not in significant decline. Specifically, if the 1,542 wood energy employees are reallocated based on the *workers' activity* rather than the *firm's reported primary activity*, manufacturing employment would total 1,197 (a growth of 11%), installation and maintenance totals 7,458 workers, and trade totals 3,131.

Figure 16. Firm Growth by Value Chain Activity*

Installation, maintenance, and repair operations: 2014 = 5,833; 2015 = 6,855; 2016 = 7,518

Engineering, research, and professional services: 2014 = 4,273; 2015 = 3,866; 2016 = 4,170

Trade, distribution, and transport: 2014 = 1,955; 2015 = 2,664; 2016 = 3,104

Manufacturing: 2014 = 1,005; 2015 = 1,081; 2016 = 662 *

Utilities: 2014 = 760; 2015 = 815; 2016 = 1,164

Other: 2014 = 1,457; 2015 = 950; 2016 = 1,096
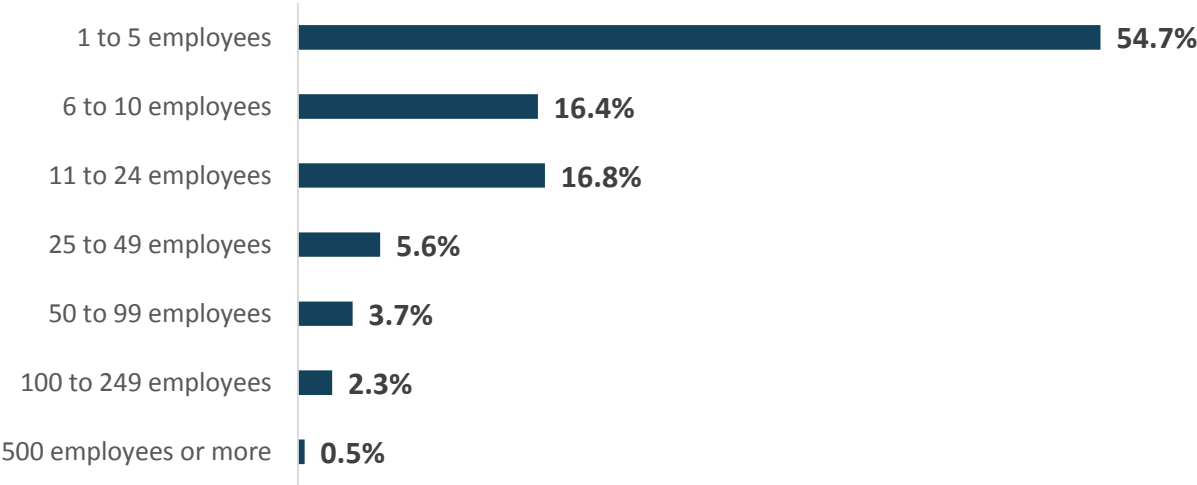
■ 2014   ■ 2015   ■ 2016

* The value chain allocations in this graph are based on employer self-reporting. However, this year's supplemental wood energy survey indicates that manufacturing may actually be growing. See text above for details.

Firm Size

The clean energy economy is shifting from primarily small businesses to medium-sized establishments. As clean technology growth creates more employment opportunity, the share of small business is shifting toward larger employers. Last year, almost 7 in 10 firms (66%) reported 1 to 5 clean energy workers. While data from this year's industry report indicates that these firms still represent a little over half of the state's clean economy (55%), about a third of clean energy establishments now employ between 6 and 24 workers; this is up from only a quarter in 2015.

Figure 17. Clean Energy Firm Size, 2016

- 1 to 5 employees — **54.7%**
- 6 to 10 employees — **16.4%**
- 11 to 24 employees — **16.8%**
- 25 to 49 employees — **5.6%**
- 50 to 99 employees — **3.7%**
- 100 to 249 employees — **2.3%**
- 500 employees or more — **0.5%**

Employer Hiring Experience

Employers across the state report trouble finding qualified applicants. Eight in ten firms (79%) reported hiring difficulty; 34% note it was "Very difficult." The top two most reported reasons for difficulty include insufficient qualifications, certifications, or education (33%) and lack of experience, training, or technical skills (32%). About a quarter of respondents also noted competition or a small applicant pool (24%). Firms report difficulty hiring managers, directors, and supervisors (28%) as well as electrician and construction workers (24%).

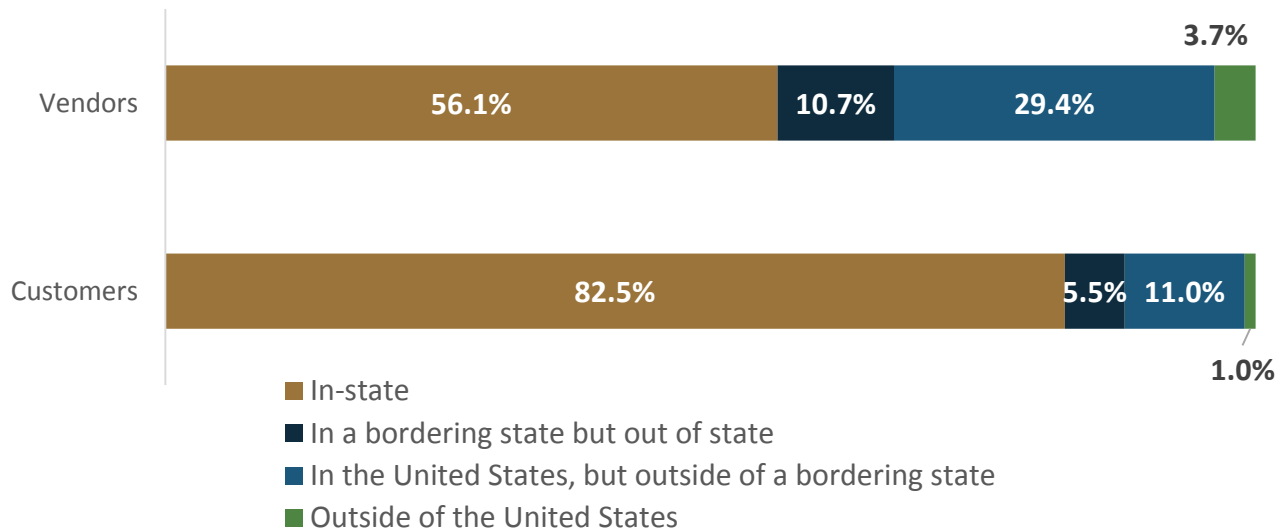**Figure 18. Hiring Difficulty, 2016**

- Very difficult — 34.2%
- Somewhat difficult — 45.0%
- Not at all difficult — 20.7%
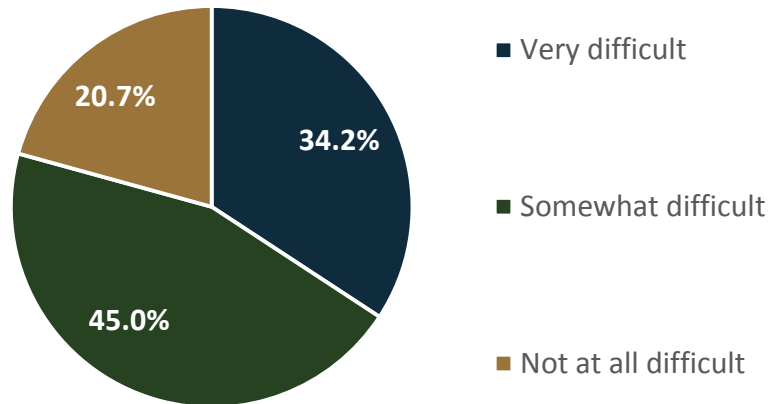
Customers and Vendors

Vermont's clean economy remains mostly localized. The majority of clean energy firms primarily source their equipment from in-state vendors; however, this has declined by about eight percentage points compared to the 2015 industry report.[30]

Clean energy firms in Vermont mostly conduct work for in-state customers – about 8 in 10 firms report that their customer base is in-state. One percent of firms primarily serve international clients.
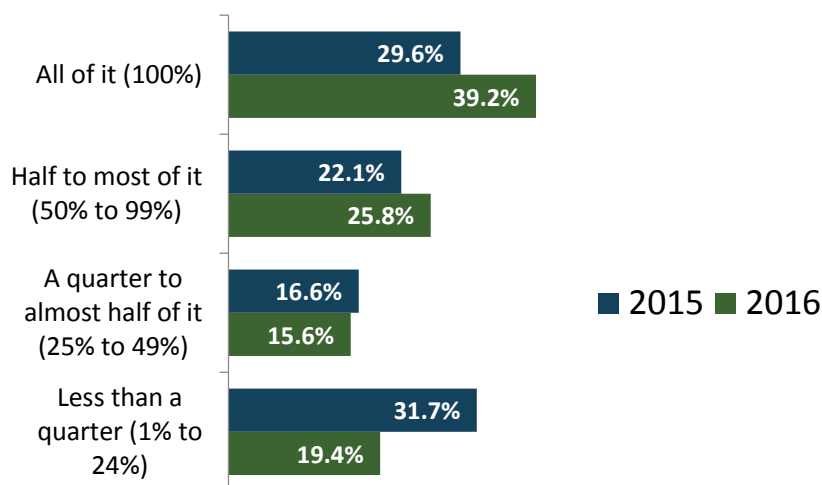
Figure 19. Customer and Vendor Locations, 2016

Vendors: 56.1% | 10.7% | 29.4% | 3.7%

Customers: 82.5% | 5.5% | 11.0% | 1.0%

- In-state
- In a bordering state but out of state
- In the United States, but outside of a bordering state
- Outside of the United States

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[30] The 2015 industry report asked what percentage of suppliers are within the state, whereas this year's survey asked where suppliers are primarily located. Sixty-four percent of firms in 2015 mentioned that at least 50% of their suppliers are within the state. This year 56% of firms report primarily in-state vendors.

Revenue Streams

Clean technology is an increasingly reliable source of revenue for firms. Because clean technologies generally provide new revenue opportunities for traditional industries across manufacturing, professional service, and building trades, it is rare for firms to derive all of their revenue from clean energy activities. In 2015, about 3 in 10 (30%) firms reported that all of their revenue came from clean energy work. Since 2015, this has increased to 4 in 10 firms that now attribute all of their revenue to clean technologies.

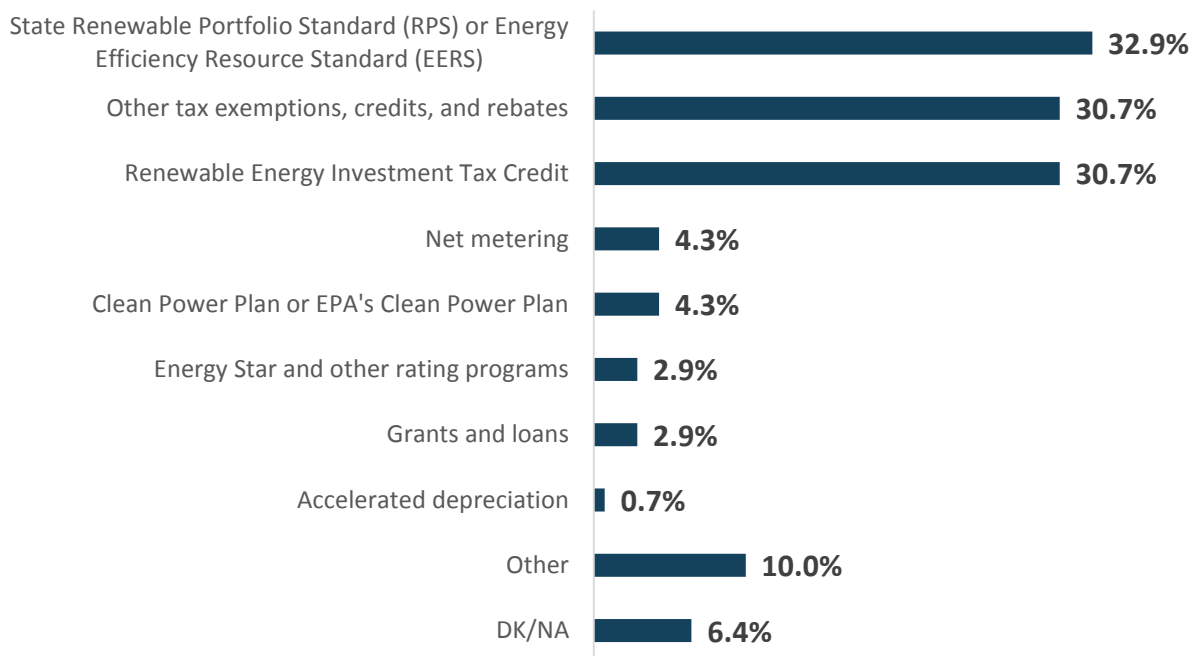**Figure 20. Percent of Revenue Attributed to Clean Energy Activity, 2015-2016**

Category	2015	2016
All of it (100%)	29.6%	39.2%
Half to most of it (50% to 99%)	22.1%	25.8%
A quarter to almost half of it (25% to 49%)	16.6%	15.6%
Less than a quarter (1% to 24%)	31.7%	19.4%

Clean Energy Policy: Success and Barriers

Firms note state-level policies and incentives contribute to business success. Three in ten mentioned the Renewable Energy Investment Tax Credit (REITC) unaided when questioned about specific policies that have contributed to firm success, and 33% mentioned the state-level RPS. With an aided question, two-thirds of firms (67%) are aware of the REITC, 35% are aware of EPA's Clean Power Plan, and 49% are familiar with a state-level RPS. Most employers feel the REITC (82%) and RPS (65%) have increased business prospects; 31% expect the Clean Power Plan to increase business prospects.

Just about 1 in 10 firms mentioned red tape regulations (13%) to be significant barriers to success, followed by policy uncertainty and insufficiency, reflecting a general desire for stronger or more supportive policies (7%).

Figure 21. Policies that Contribute to Firm Success, 2016[31]

Policy	Percentage
State Renewable Portfolio Standard (RPS) or Energy Efficiency Resource Standard (EERS)	32.9%
Other tax exemptions, credits, and rebates	30.7%
Renewable Energy Investment Tax Credit	30.7%
Net metering	4.3%
Clean Power Plan or EPA's Clean Power Plan	4.3%
Energy Star and other rating programs	2.9%
Grants and loans	2.9%
Accelerated depreciation	0.7%
Other	10.0%
DK/NA	6.4%

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[31] This was a multiple-choice response; answers will sum to greater than 100 percent.

Conclusions

In this third annual review of Vermont's clean energy economy, results indicate a maturing market. Across the state, government, utility, and research institutions have cultivated an industry cluster that supports 17,715 workers. Clean energy firms now provide 6% of jobs in the state, up from 4% two years ago. Employment has grown by 20% since the first Industry Report in 2013, and 9% since the 2015 publication, surpassing the 2015 projected growth by 3%.

This year's data underscores healthy market transformation; small businesses attributing only a fraction of their revenue to clean activities have grown to medium-sized firms that rely entirely on clean energy to produce their revenue streams. In-state suppliers are working to meet this demand, maintaining local capital exchange, as research institutions work to discover the future of energy storage and grid efficiency.

Demand for clean energy has fostered both firm and revenue expansion. In 2015, 7 in 10 firms reported 1 to 5 clean energy workers. These firms still compose a little over half of the clean economy, but about a third of the state's clean energy establishments now employ between 6 and 24 workers, up by eight percentage points over 2015. This growth has translated to profit, as more firms now specialize in providing clean goods and services. Last year, 3 in 10 firms sourced all of their revenue from clean energy-related business. Today, 4 in 10 firms attribute all of their revenue to clean energy activity.

Commitment to advanced research has cultivated a clean transmission sector that provides just over 900 jobs. These technologies, already implemented across Vermont, can supply the future of energy storage and grid efficiency.

The deep dive into Vermont's renewable wood energy industry indicates this subsector requires more support. The industry provides a significant source of jobs, the majority of which are within the wood fuel component. Though wood energy firms are mostly small, nearly half are able to derive all of their revenue from wood energy-related activities. However, the vast majority of these firms across the wood energy subsectors of logging, chip and pellet fuels, firewood, and wood combustion systems report that the market has been in decline due largely in part to the low price of fossil fuel and warm winters. While this does not seem to have affected profitability and product offerings over 2015, future industry assessments should look to monitor the market demand and revenue stream for these products.

The results of this year's survey suggest a future of technology innovation and economic growth for Vermont's clean energy industry. As the market continues to mature, many eagerly look toward the next round of advancements for 2016.

Methodology

Data for this year's report is derived from the comprehensive BW Research Energy Employment Index (EEI). The Index is the result of a rigorous survey effort of traditional and clean energy establishments across all 50 states, based in part on the methodology refined for the 2014 and 2015 Vermont Clean Energy Industry Reports. Final employment figures are extrapolated based on the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW, Q2). Though QCEW datasets track energy employment across traditional production, transmission, and distribution subsectors, the current structure of the North American Industry Classification System (NAICS) assigns a portion of the nation's energy and energy efficiency work into broad categories of non-energy specific industries, such as construction, wholesale trade, and professional services. For Vermont, these Q4 2015 data were adjusted based on historic and projected growth rates and seasonal variations to estimate Q1 2016 employment in each category for annual comparison.

Identifying energy-related employment within these broad industry sectors is particularly important for understanding employment trends across emerging renewable energy and advanced fuel technologies and infrastructures, such as solar, wind, geothermal, biomass, storage, and smart grid. Since rising deployment of efficiency-related technologies has carved out new opportunities for firms in traditional trades to research, manufacture, or install energy efficient products and upgrades, parsing out this employment is especially useful to determine the level of job growth across the nation's energy efficiency subsectors. However, energy efficiency and other clean energy workers are not exactly captured through traditional NAICS alone. For example, a subset of semiconductor manufacturers produces solar panels, while others assemble computer components or medical equipment. Even though the NAICS classifications include a "solar electric generation" subsector, important elements of the solar value chain, such as research, installation, manufacturing, sales, and distribution are embedded within these other broad NAICS categories. While federal labor market data alone presents an incomplete picture of the clean energy workforce, inclusion of these additional manufacturing or construction industries in their entirety would result in exaggerated employment figures, while their exclusion underestimates the clean economy and its workforce.

The data in this report are neither a replacement of the existing BLS data series nor do we attempt to reclassify the current system of industry codes. The Energy Employment Index instead provides an additional layer of employment analysis and may be viewed as a filter that identifies and apportions energy-related jobs from within the broad NAICS classifications and into their respective clean energy or energy efficiency technologies and sub-technologies. The EEI methodology has been used across local, state, and federal energy-related data collection and analysis for nearly a decade, including The first annual Department of Energy's U.S. Energy and Jobs Report, The Solar Foundation's National Solar Job Census series, and other clean energy industry reports for the Commonwealth of Massachusetts, State of Rhode Island, and numerous other nonprofit agencies across the United States. Both the U.S. Departments of Labor and Energy have reviewed the methodology used for this supplemental survey.

The survey was conducted with a stratified sampling plan represented by industry code (NAICS), establishment size, and geography; these variables are used to determine the proportion of establishments across energy-related technologies and value chain activities. Data from the Index is applied to the existing QCEW series in order to filter the universe of potential clean energy establishments from industries such as manufacturing and construction and allocate jobs into their component renewable energy or energy efficient technologies.

The survey was administered by both telephone and web; Castleton Polling Institute conducted phone calls, while the web instrument was programmed internally. All respondents are given a unique ID in order to prevent duplication. In order to participate, respondents must pass a set of screener questions that determine their involvement in the clean energy economy based on technology and employee time dedicated to the clean energy portion of business.

A clean energy firm is defined as being directly involved in the research, development, production, manufacture, installation, sale, or distribution of goods and services related to renewable energy and energy efficiency, including clean fuels and transportation; firms engaged in services such as consulting, finance, tax, and legal services that support the clean economy are also included in this report.

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.

The sample is split into two categories, referred to as the known and unknown universes; these are treated entirely separate until the employment figures from each are added together to produce final clean energy employment. The unknown universe encompasses the entire range of NAICS codes that could potentially support clean energy workers—agriculture, mining, utilities, construction, manufacturing, wholesale trade, professional services, repair, and maintenance. The known universe is comprised of establishments previously identified as energy-related, either with prior research or through industry associations and government programs. These establishments and their associated employment totals are removed from the unknown universe for both sampling and final employment extrapolations.

The distribution of QCEW establishments within potential energy-related industries was carefully analyzed in order to develop representative sampling clusters for the unknown universe. Incidence rates are developed based off employer responses from the unknown universe—the propensity of firms that report they are involved in clean energy work is applied to the QCEW dataset to derive final clean energy establishment and employment totals.

For the transport of clean vehicle parts and supplies, this report utilizes a methodology developed by the Department of Energy and the National Renewable Energy Laboratory. Employment related to clean vehicle transport via truck, rail, air, and water was calculated by dividing the value of commodity shipments by the total commodity value for each state. The

proportional value of clean vehicle transport was applied to QCEW employment totals for truck, water, air, and rail transportation.

As with previous studies, this report excludes any employment in the retail trade NAICS codes— fuel dealers, motor vehicle dealership, appliance and hardware stores, and other retail establishments. The survey was administered between September 15, 2015 and November 24, 2015 and averaged 14 minutes in length. The margin of error at the 95% level of confidence for energy establishments in Vermont is +/- 5.54%.

Following the initial survey, BW Research also administered a survey of the wood energy industry in Vermont. This supplemental survey was administered as a census, and each respondent was contacted up to six times. The largest segment of sample was loggers and foresters, followed by installation and maintenance of wood combustion systems, and pellet and chip manufacturers.

The survey, which averaged 14.5 minutes in length, was administered by phone (The Castleton Polling Institute) and online; field dates were from February 26 through March 14, 2016. Forty-one (41) wood energy businesses participated in the survey and eleven companies agreed to extended executive interviews. Unlike for other segments, the wood energy survey used a census approach. This allowed for full reporting of chip and pellet manufacturing as well as representative data to inform an economic model. As such, no statistical margin of error is calculated.

The data were used to probe specific questions relevant to the wood energy sector, as well as to develop a custom model for apportioning logging and forestry employment to fuel. Employment and production estimates were provided by employers by specific technologies used (e.g., mechanized, cut to length, conventional etc.) and applied to the total green tons of wood produced in Vermont in 2015. The cord-per-job figure used conversions for sawlog feet, tons of chips, and cords of firewood wood, as provided by the Vermont Department of Forests, Parks, and Recreation. Data that use these calculations are found in Chapter 6.1.1, "Vermont's Wood Energy Sector."

Investment data provided in this report are drawn from Cleantech Group's i3 platform, and include a subset of technologies that matches the definitions used for employment in the report. Early-stage investments refer to Seed, Series A, and Series B.

The Clean Energy Development Fund serves as one of the State's primary vehicles for advancing the clean energy economy in the state. Established by the Vermont General Assembly through Act 74 of 2005 (30 V.S.A. §8015), the purpose of the CEDF is *"to promote the development and deployment of cost-effective and environmentally sustainable electric power and thermal energy or geothermal resources for the long-term benefit of Vermont consumers, primarily with respect to renewable energy resources, and the use of combined heat and power technologies."*

An evaluation of the CEDF conducted in FY15 demonstrated that:

- CEDF-awarded projects resulted in 122.7 gigawatt-hours per year in annual energy production and savings, including:
  - 59.8 GWh/yr in annual electric energy production;
  - 45.9 GWh/yr in annual thermal energy production; and
  - 17.0 GWh/yr in energy efficiency savings.
- CEDF awards totaled $64.1 million, which leveraged $3.20 in outside funds for every $1 of CEDF awards. The total leveraged value of projects was $196 million of outside funding.
- During the time period, the Fund issued 3,983 awards including 1,389 awards via American Recovery and Reinvestment Act (ARRA) funding totaling $30,881,700 and 2,594 awards with non-ARRA resources totaling $33,227,700. These awards included competitive grants, loans, incentive payments via the Small Scale Renewable Energy Incentive Program (SSREIP), solar tax credits, feasibility studies, and contracts for services that were geographically distributed throughout the state.
- Total installed capacity of CEDF-awarded projects was 27.7 MW and 60.3 MMBtu/hr overall. This represents 2.5% of the state's total installed electric capacity and 1% of total electric generation.
  - CEDF investments yielded $6.2 million per year of total avoided electric system costs, of which $4.9 million were avoided energy costs and $1.3 million were avoided capacity costs.
  - CEDF-awarded projects resulted in 102 kilotons of CO_2e reductions per year. In addition, these projects reduced SO_2 emissions by 58.7 tons/yr and NO_x by 18.1 tons/yr.

BW Research Partnership is a full-service research consulting firm with offices in California and Massachusetts. Recognized by the Congressional Research Office as developing the most accurate data to date, BW Research has conducted more clean energy labor market analyses than any other firm. Recent projects include: The Department of Energy U.S. Energy and Employment Report, The Solar Foundation's National Solar Jobs Census, Massachusetts Clean Energy Industry Report, wind and solar labor market reports for the National Renewable Energy Laboratory (NREL), and clean energy studies for the Natural Resources Defense Council (NRDC), Clean Energy Trust (CET), Advanced Energy Economy (AEE), the State or Rhode Island, and many others.