



2023

# Vermont Clean Energy Industry Report

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# Acknowledgements

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# Executive Summary

This year's *Vermont Clean Energy Industry Report* is the tenth in a series of annual clean energy industry reports that track the progression of Vermont's clean energy labor market. The 2023 report covers calendar year 2022, highlighting the continued recovery of clean energy businesses across the state after the sudden COVID-19 related economic downturn that resulted in the loss of 1,400 clean energy jobs in 2020.

Vermont's clean energy industry has continued to set an example for the rest of the nation, with the highest level of clean energy employment per capita among all the states, at 2.8 percent. Clean energy jobs also represented 6 percent of all jobs in the state in 2022. Between the fourth quarters of 2021 and 2022, clean energy jobs in Vermont increased by a modest 1 percent—a gain of 172 jobs—indicating that the state's clean energy economy continues to recover from the unprecedented job losses witnessed in 2020. However, Vermont's clean energy workforce has not yet returned to pre-pandemic levels of employment.

Over the last year, every sector in Vermont's clean energy industry exhibited minimal growth in employment, and the energy efficiency sector remained the largest sector of the clean energy economy, accounting for nearly 10,000 jobs. Jobs in both the energy efficiency and renewable energy sectors remained depressed relative to pre-pandemic levels, but jobs in the clean transportation and other clean energy sectors have surpassed pre-pandemic levels.

Almost all employers hiring in Vermont (98 percent) surveyed reported difficulties in hiring clean energy workers. The proportion of employers reporting high levels of difficulty in hiring clean energy workers has continued to rise sharply since 2020, with more than two-thirds of employers (68 percent) reporting the highest level of difficulty in hiring clean energy workers, as compared to just over one-half (52 percent) of employers one year ago.

The most cited reason for hiring difficulties was competition with other industries, with more than half (52 percent) of Vermont's clean energy employers implicating competition as limiting the size of the applicant pool. Furthermore, according to Vermont's clean energy employers, the most difficult clean energy positions to fill were technical or mechanical support positions, followed by electrical/construction worker positions, engineer/scientist positions, installation worker positions, and management positions (including director, supervisor, and vice president positions).

This year's report includes the wood fuels employer survey, which examines a critical sub-sector of Vermont's clean energy economy. This year's survey found that total employment in the wood fuels industry has recovered to pre-pandemic levels. In addition, the survey found that nearly all of Vermont's wood fuel employers (94 percent) are concerned with government regulations that limit the harvesting of wood fuels. However, nearly half of the wood fuel employers feel that Vermont's forests are being properly managed and a majority plan to invest in their wood fuel businesses over the next year.

# Clean Energy Policy Landscape

Vermont is a leader in state clean energy policy. In 2022, Vermont ranked fourth in the American Council for an Energy Efficient Economy's *State Efficiency Scorecard*, behind California, Massachusetts, and New York.<sup>1</sup> The state also had the most clean energy jobs per capita in 2022.

Vermont also continues to make strides towards its goal to transition to 90 percent renewable energy equitably and efficiently by 2050, as provided in its Comprehensive Energy Plan (CEP) released in January 2022.<sup>2</sup> The 2022 CEP sets a foundation for achieving Vermont's energy goals, including the following set of sector-specific targets:

- In the transportation sector, meet 10% of the state's energy needs from renewable energy by 2025, rising to 45% by 2040.
- In the thermal sector, meet 30% of the state's energy needs from renewable energy by 2025, rising to 70% by 2042.
- In the electric sector, meet 100% of the state's energy needs from carbon-free resources by 2032, with at least 75% from renewable energy.<sup>3</sup>

These targets were set in accordance with emissions reduction standards established by the Global Warming Solutions Act of 2020<sup>4</sup> (GWSA) and in coordination with the Climate Action Plan prepared by Vermont Climate Council.<sup>5</sup> The GWSA requires the following reductions in greenhouse gases:

- 26% reduction from 2005 levels by 2025
- 40% reduction from 1990 levels by 2030
- 80% reduction from 1990 levels by 2050

After the 2022 CEP was published, Act 154 of 2022 was signed into law, creating an environmental justice policy for Vermont.<sup>6</sup> The law aligned principals and priorities for energy equity for marginalized communities and placed new obligations on Vermont state agencies to address disproportionately high human health and environmental effects of state development activities on minority and low-income populations.<sup>7</sup> Vermont acknowledges that the burden and benefits of its energy policy have not been equitably distributed and plans to mitigate negative

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<sup>1</sup> American Council for an Energy-Efficient Economy. State and Local Policy Database, Vermont.

<https://database.aceee.org/state/vermont>

<sup>2</sup> *2023 Annual Energy Report for progress towards state energy goals*. | Department of Public Service. (n.d.).

<https://publicservice.vermont.gov/document/2023-annual-energy-report>

<sup>3</sup> 2022 Vermont Comprehensive Energy Plan. (n.d.).

[https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan\\_Executive%20Summary.pdf](https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan_Executive%20Summary.pdf)

<sup>4</sup> Vermont Acts and Resolves 153 of 2020, Global Warming Solutions Act

<https://legislature.vermont.gov/Documents/2020/Docs/ACTS/ACT153/ACT153%20As%20Enacted.pdf>

<sup>5</sup> 2022 Vermont Comprehensive Energy Plan

<sup>6</sup> *2023 Annual Energy report*. 2023 Annual Energy Report | Department of Public Service. (n.d.).

<https://publicservice.vermont.gov/document/2023-annual-energy-report>

<sup>7</sup> No. 154. an act relating to environmental justice in Vermont. (n.d.-c).

<https://legislature.vermont.gov/Documents/2022/Docs/ACTS/ACT154/ACT154%20As%20Enacted.pdf>

impacts surrounding the historical exclusion of marginalized communities from accessing affordable energy, green spaces, and other environmental benefits.

For the first time, this year's clean energy report includes demographic data on Vermont's clean energy workforce, an important addition given the environmental justice priorities established by Act 154. Act 154 is Vermont's first codified environmental justice policy, with a number of initiatives developed to "provide the opportunity for the meaningful participation of all individuals with particular attention to environmental justice focus populations, in the development, implementation, or enforcement of any law, regulation, or policy."<sup>8</sup> Tracking clean energy demographic data can help to ensure that benefits from climate policies and funding are positively impacting overburdened communities and populations.

In addition to Act 154, Vermont's energy programs work towards compliance with the Justice40 initiative created by Executive Order 14008, which mandates that 40 percent of federal funding towards clean energy be targeted towards disadvantaged communities.<sup>9</sup> In July 2022, the U.S. Department of Energy announced that 144 programs, including the State Energy Program and programs under the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA), would be covered under the Justice40 initiative.<sup>10</sup>

The IIJA, enacted in November 2021, has several objectives:

- To repair and rebuild U.S. roads, bridges and rails, through a \$110 billion investment in transportation infrastructure, with \$66 billion in funding allocated to the modernization of the U.S. passenger rail system
- To expand access to clean drinking water, through a \$55 billion investment in water infrastructure and elimination of lead service pipes
- To expand access to high-speed Internet, through a \$65 billion investment in broadband infrastructure deployment
- To address the climate crisis, through a \$39 billion investment in modernizing public transit, a \$17 billion investment in port infrastructure and waterways, and a \$25 million investment in airports; a \$7.5 billion investment in building out a national network of electric vehicle chargers in the U.S.; and a \$65 billion investment in upgrading the U.S. power infrastructure
- To advance environmental justice and to invest in disadvantaged communities that have been overburdened by pollution, with funding of over \$50 billion allocated toward protecting vulnerable communities from droughts, heat, floods, and wildfires, and funding of \$21 billion to tackle legacy pollution issues

In total, the IIJA authorizes \$1.2 trillion for transportation and infrastructure spending, of which \$550 billion is allocated toward new investments and programs. Combined with President Biden's Build Back Framework, the IIJA was projected to add 1.5 million jobs per year, on average, for the next 10 years.

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<sup>8</sup> *Id.*

<sup>9</sup>The United States Government. (2021, January 27). *Executive order on tackling the Climate Crisis at home and abroad*. The White House. <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/>

<sup>10</sup> *2023 Annual Energy report*. 2023 Annual Energy Report | Department of Public Service. (n.d.). <https://publicservice.vermont.gov/document/2023-annual-energy-report>

The IRA, enacted in 2022, aims to reduce the budget deficit and lower inflation, while investing in domestic energy production and lowering prescription drug prices. The IRA authorizes \$370 billion in funding aimed at lowering energy costs for families and small businesses, accelerating private investment in clean energy solutions, and strengthening domestic supply chains. Through the IRA and the IIJA, the U.S. Department of Energy estimates that the U.S. will achieve a 40 percent reduction in greenhouse gas emissions by 2030.

Thus, both the IRA and the IIJA will provide significant funding opportunities for clean energy projects over the next five to ten years, which are expected to spur increases in clean energy hiring in regional economies across the U.S., including Vermont's. Vermont is working to implement transformative changes to its energy system to build an adequate, secure, and reliable energy service through the lens of equity. When considering energy burdens—a household's annual utility expenses spent on electricity, gas, and heat as a percentage of the household's annual gross income—low-income Vermont households have the highest energy burden.<sup>11</sup> Given Vermont's rural character, the age of its building stock, and variable weather, the average energy burden for its towns ranges from 6-20 percent, and for many individuals, this percentage can be much higher.<sup>12</sup>

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<sup>11</sup> Vermont Energy Burden Report. October 2019. <https://www.encyvermont.com/Media/Default/docs/white-papers/2019%20Vermont%20Energy%20Burden%20Report.pdf>

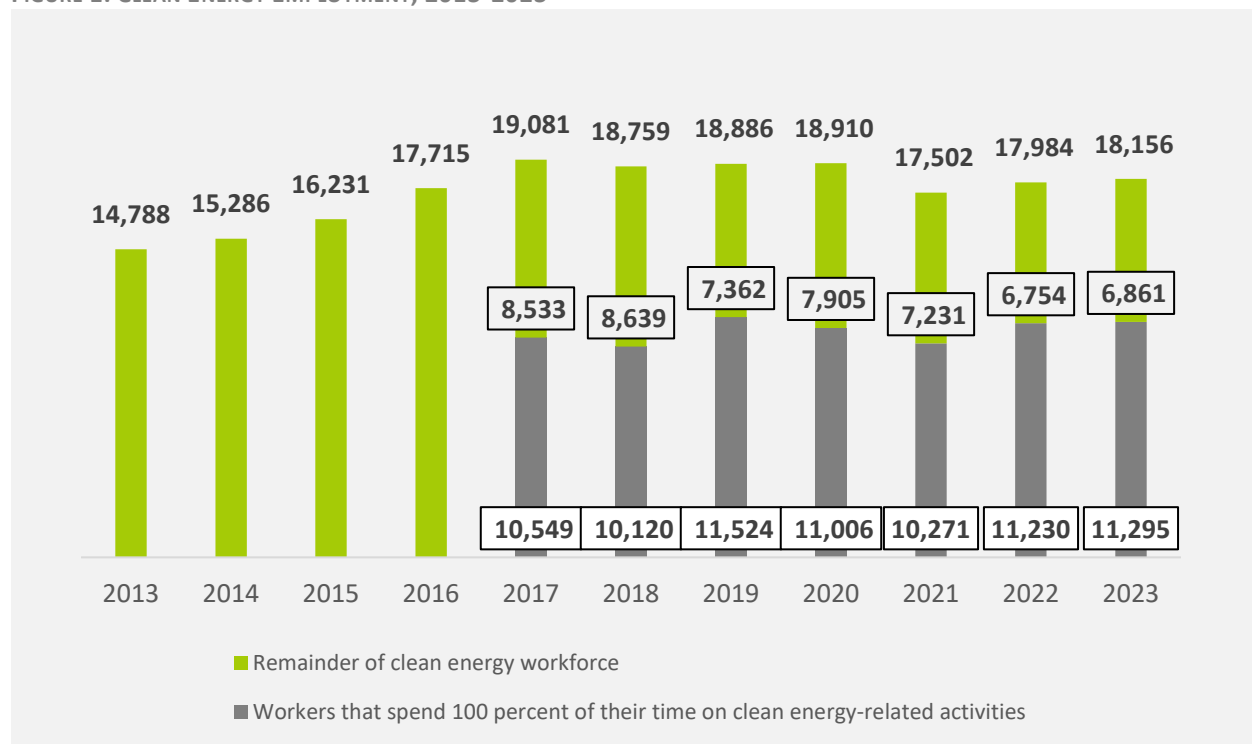
<sup>12</sup>2022 Vermont Comprehensive Energy Plan. (n.d.). [https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan\\_Executive%20Summary.pdf](https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan_Executive%20Summary.pdf)

# Clean Energy Employment in Vermont

## Overall Clean Energy Jobs

Vermont continues to lead the nation in clean energy jobs per capita at 2.8 percent. Clean energy jobs total 18,156 workers across Vermont, representing 6 percent of all jobs in the state. Clean energy jobs grew by 1 percent over the last 12 months, for a total of 172 new jobs in the labor force. While the state’s clean energy economy has continued to recover from the unprecedented losses witnessed in 2020, it has not yet returned to pre-pandemic levels of employment.

FIGURE 1. CLEAN ENERGY EMPLOYMENT, 2013-2023<sup>13</sup>

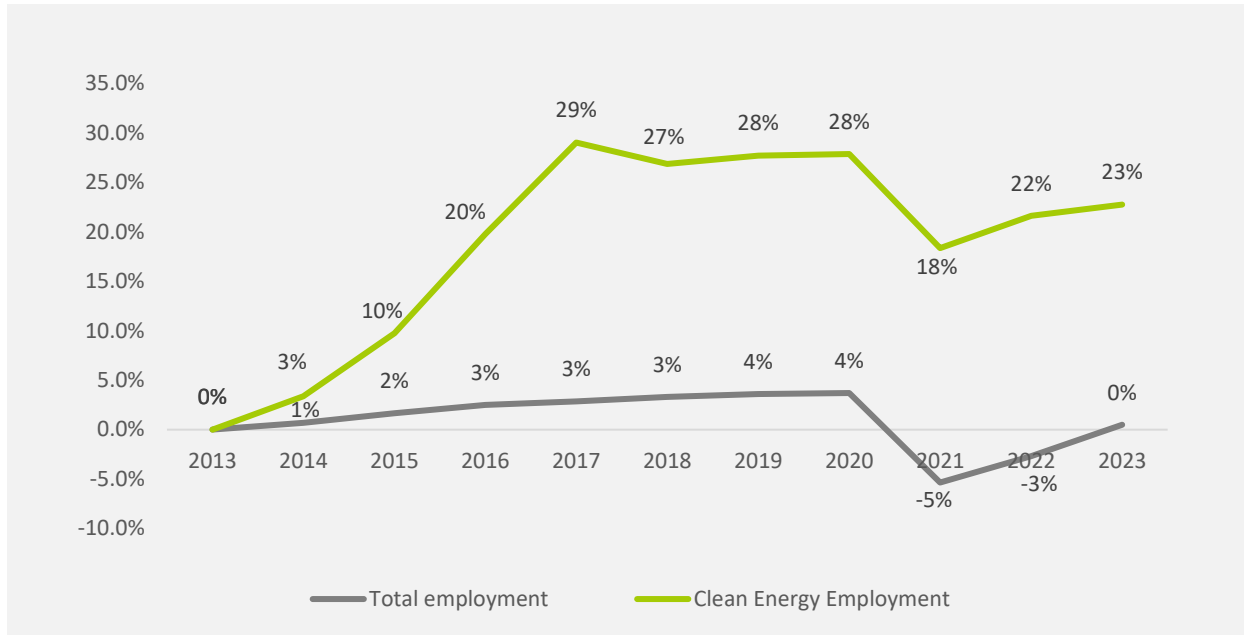


Both total statewide and clean energy employment continued to recover from the significant drop reported in 2021. During the pandemic, clean energy employment declined more than the statewide average for all occupations (10 percent versus 9 percent) but rebounded more sharply than statewide employment over the following year. However, the pace of recovery in clean energy employment slowed in 2022. (Figure 2)

<sup>13</sup> Data on the percentage of the clean energy workforce that spent 100 percent of their time on clean energy-related activities was not available prior to 2017.



FIGURE 2. CUMULATIVE PERCENT CHANGE, TOTAL JOBS & CLEAN ENERGY JOBS IN VERMONT, 2013-2023<sup>14</sup>



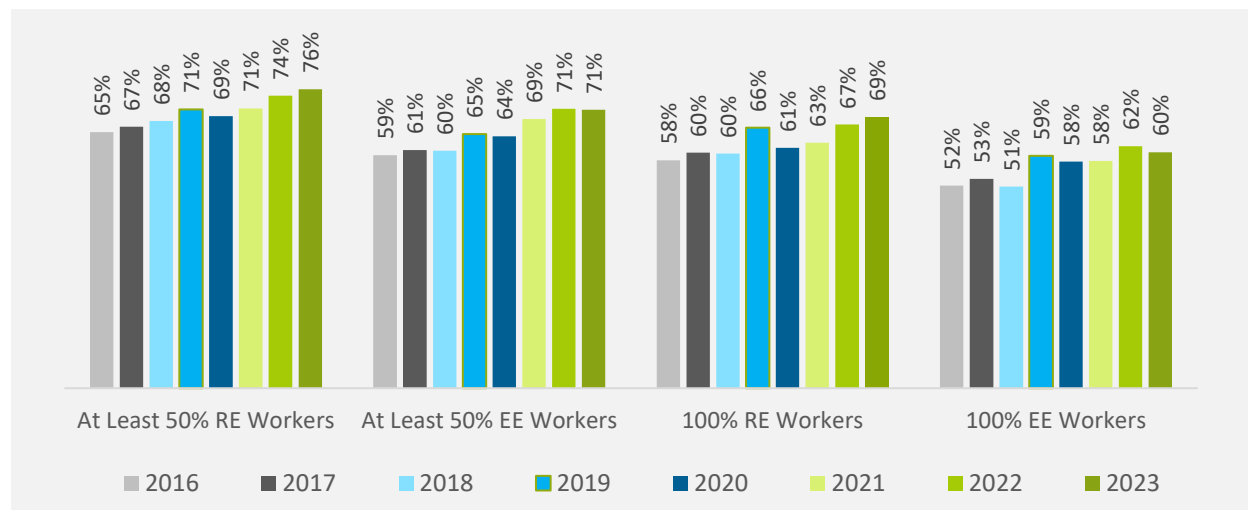
The number of workers spending 100 percent of their time on clean energy-related activities increased by less than 1 percent (65 jobs) year-over-year (Figure 1). The proportion of renewable energy workers spending between 50 and 99 percent of their time on clean energy-related activities increased by 2 percent, while the proportion of energy efficiency workers spending between 50 and 99 percent of their time on clean energy-related activities remained roughly constant (Table 1). The majority of new jobs created in the renewable energy sector were in the renewable heating and cooling segment, which gained 100 jobs over the last year.

TABLE 1. CLEAN ENERGY EMPLOYMENT THRESHOLDS BY TECHNOLOGY SECTOR, 2016-2023

WORKERS THAT SPEND AT LEAST 50 PERCENT OF THEIR TIME										
	2016	2017	2018	2019	2020	2021	2022	2023		
<b>Renewable Energy</b>	65%	67%	68%	71%	69%	71%	72%	74%	73%	76%
<b>Energy Efficiency</b>	59%	61%	60%	65%	64%	69%		71%	71%	
WORKERS THAT SPEND AT LEAST 100 PERCENT OF THEIR TIME										
	2016	2017	2018	2019	2020	2021	2022	2023		
<b>Renewable Energy</b>	58%	60%	60%	66%	61%	63%	64%	67%	63%	69%
<b>Energy Efficiency</b>	52%	53%	51%	59%	58%	58%		62%	60%	

<sup>14</sup> U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages. Series Id: ENU5000010010.

FIGURE 3. CLEAN ENERGY EMPLOYMENT THRESHOLDS BY TECHNOLOGY SECTOR, 2016-2023



## Full-Time Equivalent Clean Energy Workers

Figure 1 highlights the total number of “100 percent” clean energy workers—those that spend their whole work week, or all their labor hours, dedicated to clean energy-related services. However, not all clean energy workers spend 100 percent of their labor hours on clean energy activities. Full-time equivalent clean energy jobs (FTEs) estimate the total amount of clean energy labor performed in the state.<sup>15</sup>

In addition to those that spend 100 percent of their time working on clean energy activities, the FTE metric weights employment for the following categories as well: those that spend 0 to 49 percent of their time on clean energy work and those that spend 50 to 99 percent of their time on clean energy work. A worker that spends 0 to 49 percent of their time on clean energy activities receives a weight of 0.25 in the final FTE employment estimate, while a 100 percent clean energy worker is weighted as one FTE clean energy job.<sup>16</sup>

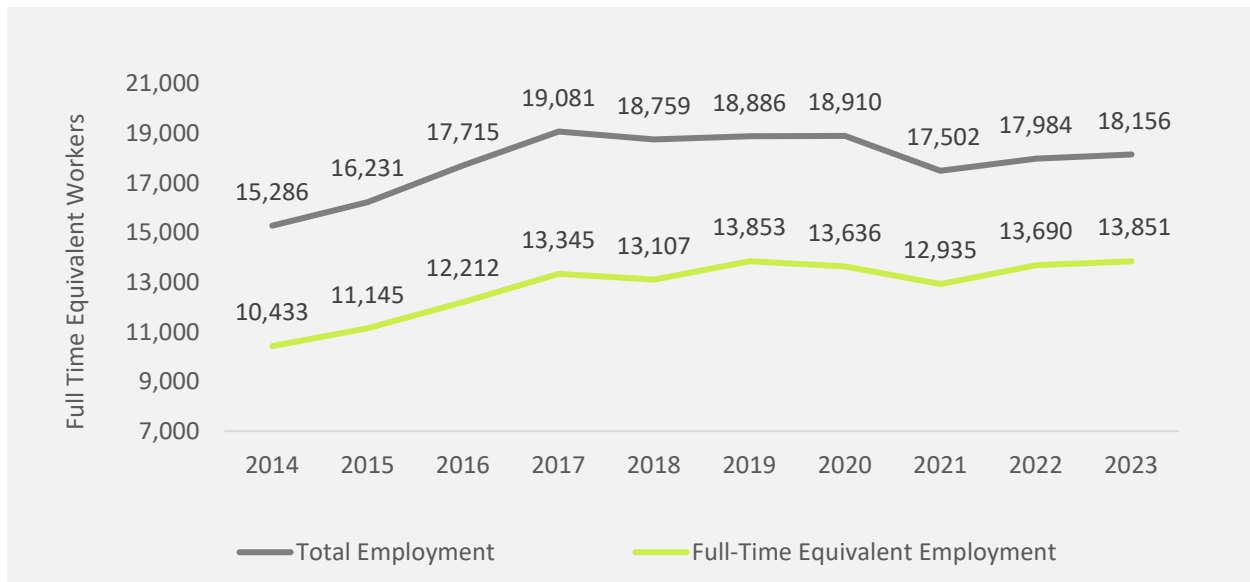
At the end of 2022, there were 13,851 full-time equivalent clean energy jobs in Vermont. Full-time equivalent jobs increased by 1 percent compared to the end of 2021; this represents an increase of 161 FTE jobs in 12 months, almost matching the record-high reported in 2019, pre-pandemic.

Vermont’s clean energy FTE jobs in 2022 nearly reached the record high reported pre-pandemic.

<sup>15</sup> For more information on full time equivalent employment, see 100 Percent & Full-Time Equivalent Jobs (pg. 29).

<sup>16</sup> This metric measures the proportion of total labor hours dedicated to clean energy activities and is unrelated to the total number of hours worked in a week. A part-time clean energy employee who works 20 hours a week with 100 percent of these hours dedicated to clean energy activities would be counted as one FTE clean energy job.

FIGURE 4. TOTAL & FULL-TIME EQUIVALENT CLEAN ENERGY EMPLOYMENT, 2014-2023<sup>17</sup>



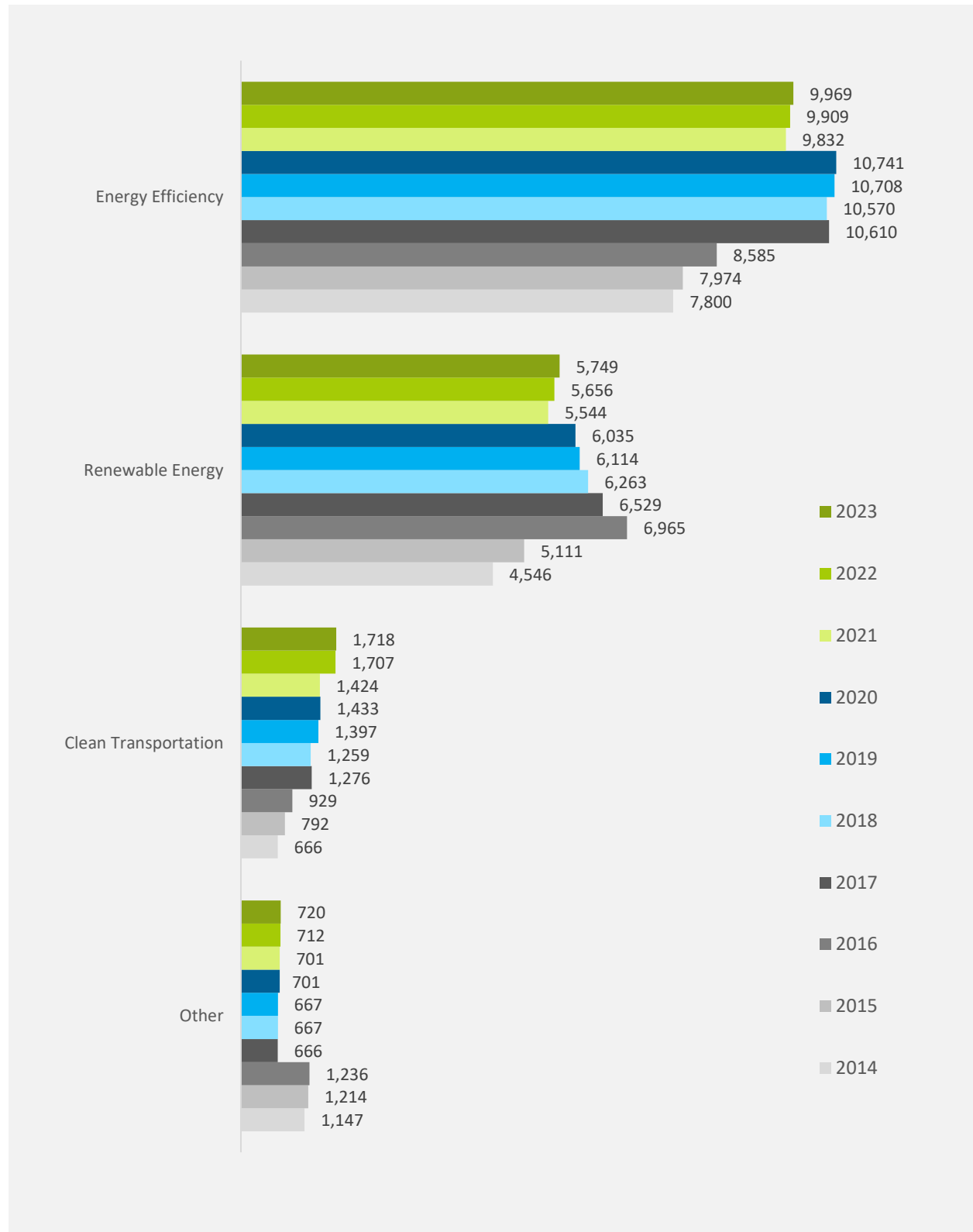
## Clean Energy Jobs by Sector

Over the last year, every sector within Vermont’s clean energy industry exhibited modest employment growth. The renewable energy sector had the largest gain in employees in percentage terms, increasing by 93 workers (+2 percent). Jobs in the clean transportation sector and the energy efficiency sectors each grew by less than 1 percent.

The energy efficiency sector remained the largest sector of the clean energy economy, accounting for 9,969 jobs in total—60 more jobs as compared to the prior year.

<sup>17</sup> To reconcile the Vermont-specific methodology that has historically been used for these reports with the methodological updates to other clean energy reports, the research team revised both the 100 percent and FTE employment figures in the 2020 report and moving forward. As such, the 100 percent employment estimates presented in this report for 2017, 2018, and 2019 will not match previous Vermont Clean Energy Industry Reports (VCEIRs). This methodological update provides a more accurate representation of clean energy activity in Vermont and allows for comparison across other state-level clean energy reports. For more information, please refer to the Research Methodology in Appendix A.

FIGURE 5. CLEAN ENERGY EMPLOYMENT GROWTH BY TECHNOLOGY SECTOR, 2014-2023



# Clean Energy Employment by Sector

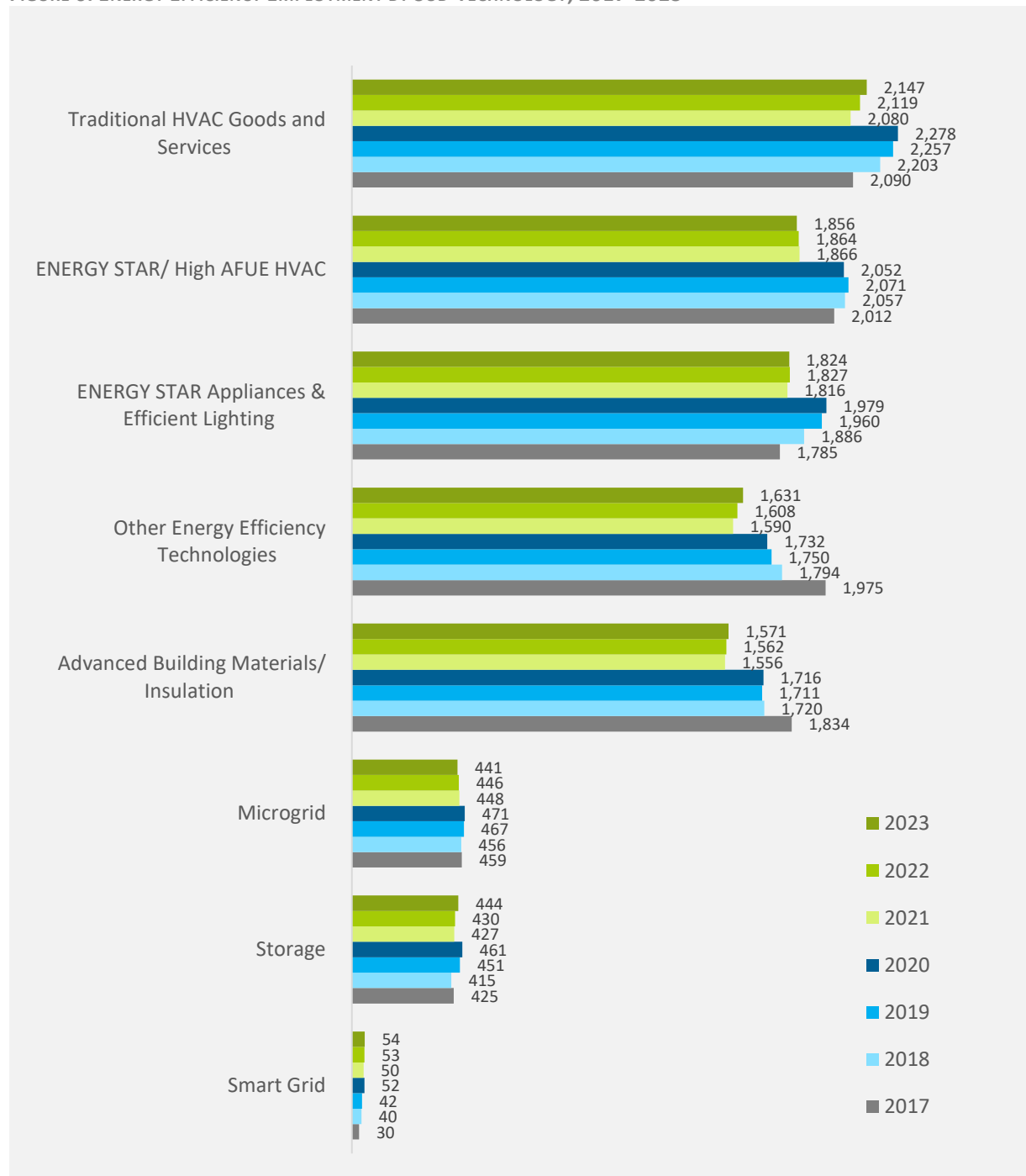
## Energy Efficiency

Energy efficiency employment remained stable between 2021 and 2022, exhibiting year-over-year growth of less than 1 percent. Storage technologies reported the highest year-over-year rate of growth in percentage terms, at 3 percent (+14 jobs). In absolute terms, traditional HVAC technologies accounted for the largest number of jobs added, growing by 28 jobs (+1 percent).

Other energy efficiency technologies added 23 jobs (+1 percent), and smart grid technologies added 1 job (+1 percent). Advanced building materials/insulation added 9 jobs (+<1 percent). The ENERGY STAR® or high-efficiency HVAC, ENERGY STAR appliances & efficient lighting, and the microgrid categories each reported job losses of 1 percent or less.

The labor force remained evenly distributed across a variety of energy efficiency technologies, with traditional HVAC goods and services accounting for the largest share of jobs (22 percent), followed by ENERGY STAR or high-efficiency HVAC (19 percent), and ENERGY STAR appliances and efficient lighting (18 percent).

FIGURE 6. ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2017-2023<sup>18</sup>

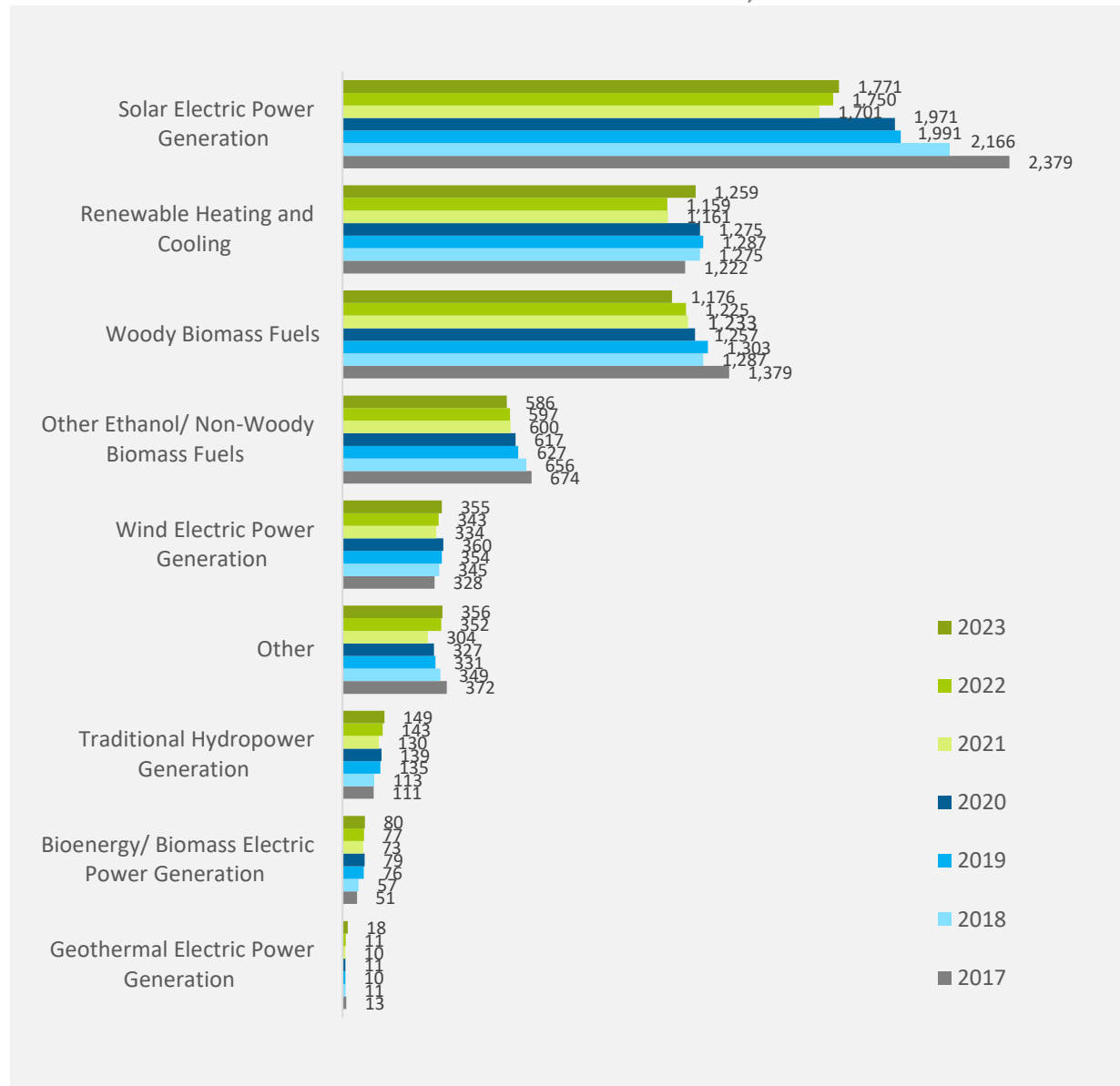


<sup>18</sup> “Other energy efficiency technologies” include variable speed motors, other design services not specific to a sub-technology, software not specific to a sub-technology, energy auditing, rating, monitoring, metering, and leak detection, energy efficiency policy not specific to a sub-technology, LEED certification, consulting not specific to a sub-technology, and phase-change materials.

# Renewable Energy Generation

Solar, renewable heating and cooling, and woody biomass fuels remained the largest components of Vermont’s renewable energy generation sector, collectively accounting for nearly three-quarters of the workforce (73 percent).

FIGURE 7. RENEWABLE ENERGY GENERATION EMPLOYMENT BY SUB-TECHNOLOGY, 2017-2023<sup>19</sup>

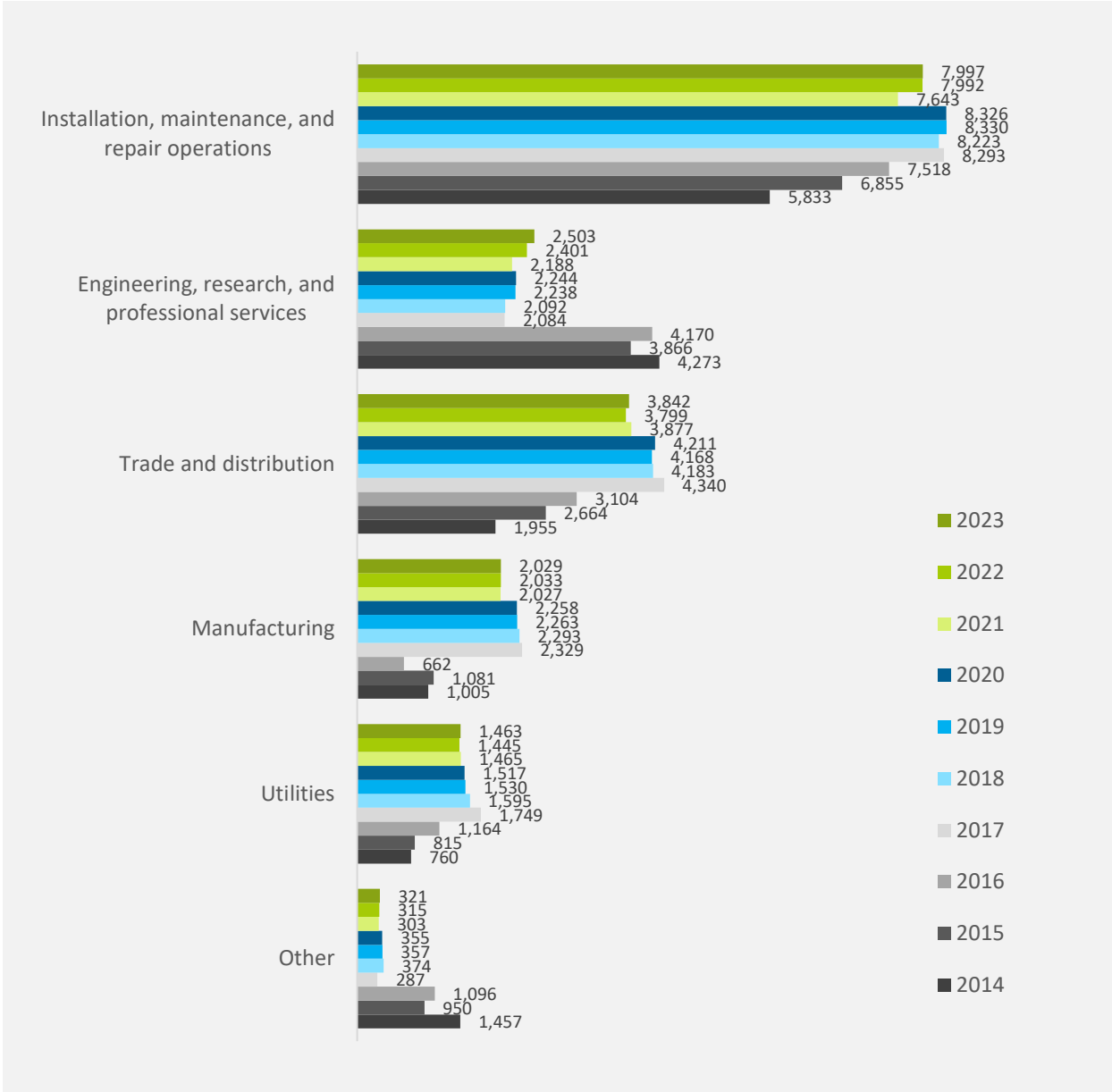


<sup>19</sup> While “low-impact hydropower” is included in Vermont’s clean energy technology definition, it is not pictured on this graph because there were no captured jobs in Vermont.

# Clean Energy Value Chain Employment

The engineering, research, and professional services sector exhibited the highest rate of job growth among all value chain sectors over the last year, adding over 100 jobs to achieve a year-over-year growth rate of 4 percent. The other clean energy jobs sector gained 6 jobs (+2 percent), the utilities sector gained 18 jobs (+1 percent), and the trade and distribution sector gained 43 jobs (+1 percent). The installation, maintenance, and repair operations sector remained relatively stable, gaining 5 jobs (less than 1 percent), and continued to account for the largest share of all clean energy jobs (44 percent). The manufacturing sector also remained relatively stable, with 4 jobs lost (less than 1 percent).

FIGURE 8. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2014-2023





# Clean Energy Employment Demographics

Males accounted for nearly three-quarters of the clean energy workforce, consistent with nationwide demographics for the total energy workforce (including, but not limited to, the clean energy workforce).<sup>20</sup> White employees accounted for nearly 9 in 10 clean energy workers, with minorities and multiracial employees accounting for the remainder. While Vermont’s minority and multiracial clean energy workers were underrepresented relative to the nationwide energy workforce, they constituted a higher share of employment than the statewide average for Vermont’s total civilian labor force.<sup>21</sup> Vermont’s clean energy workforce was also slightly younger than the national average for the total energy workforce (including, but not limited to, the clean energy workforce), with only 14 percent of the state’s clean energy workforce over 55 years of age.<sup>22</sup>

**TABLE 2. SELECTED DEMOGRAPHICS OF CLEAN ENERGY WORKERS IN VERMONT, 2023**

GENDER		RACE	
Male	73%	American Indian or Alaska Native	1%
Female	27%	Asian	4%
ETHNICITY		Black or African American	4%
Hispanic or Latino	6%	Native Hawaiian or Other Pacific Islander	0%
Not Hispanic or Latino	94%	White	88%
VETERAN STATUS		Two or more races	4%
Veterans	7%		
AGE GROUP			
55 and over	14%		

<sup>20</sup> According to the 2023 USEER, males constituted 73 percent of the nationwide energy workforce and 53 percent of the total nationwide workforce in 2022. According to the BLS Local Area Unemployment Statistics for 2022, males constituted 51 percent of Vermont’s total civilian labor force.

<sup>21</sup> According to the 2023 USEER, White employees constituted 75 percent of the nationwide energy workforce and 77 percent of the total nationwide workforce in 2022. However, according to the BLS Local Area Unemployment Statistics for 2022, White employees constituted 94 percent of Vermont’s total civilian labor force.

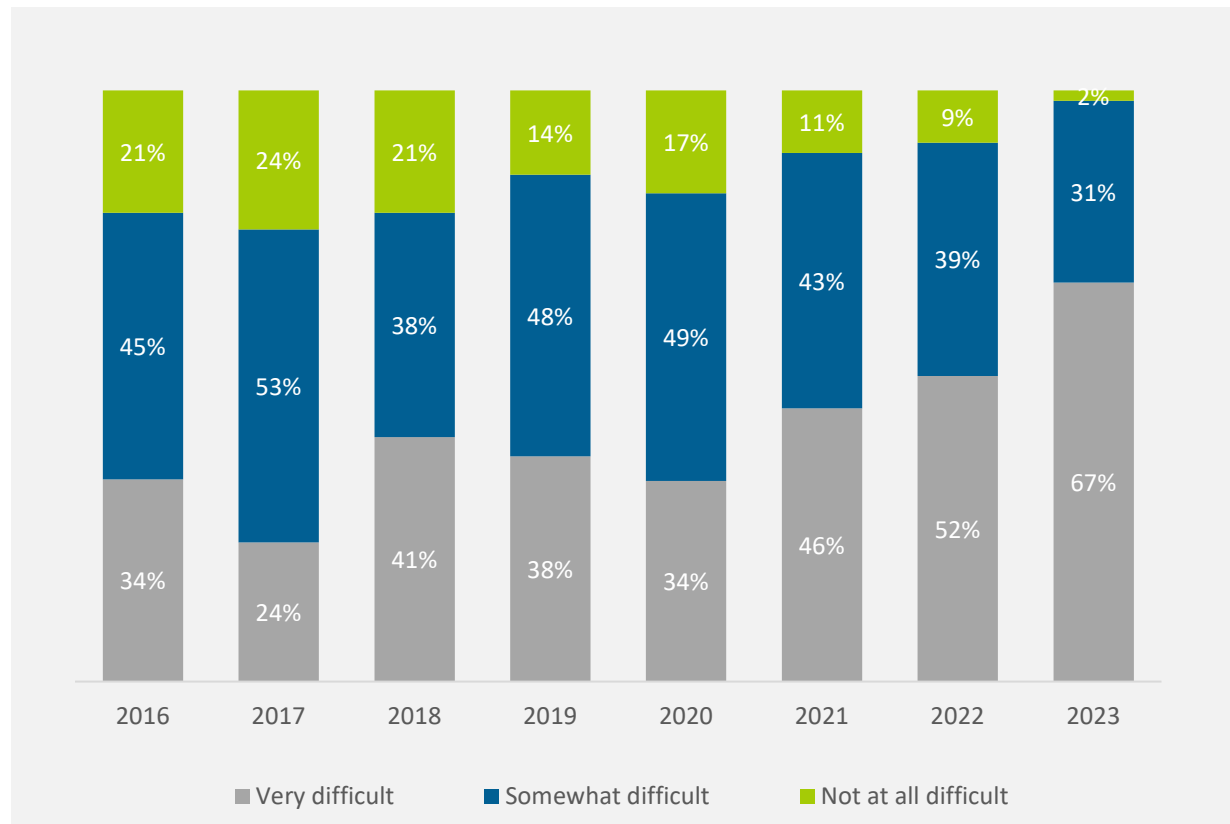
<sup>22</sup> According to the 2023 USEER, workers over 55 years of age constituted 17 percent of the nationwide energy workforce and 24 percent of the total nationwide workforce in 2022. According to the BLS Local Area Unemployment Statistics for 2022, workers aged 55 and over constituted 30 percent of Vermont’s total civilian labor force.

# Clean Energy Hiring

Almost all employers hiring in Vermont (98 percent) reported encountering difficulties in hiring clean energy workers. The proportion of employers reporting high levels of difficulty in hiring clean energy workers has continued to rise sharply since 2020, with more than two-thirds of employers (67 percent) reporting high levels of difficulty in hiring clean energy workers, as compared to just over one-half (52 percent) of employers one year ago.

Almost all employers hiring in Vermont reported difficulties in hiring clean energy workers in 2022.

FIGURE 9. EMPLOYER-REPORTED HIRING DIFFICULTY, 2016-2023

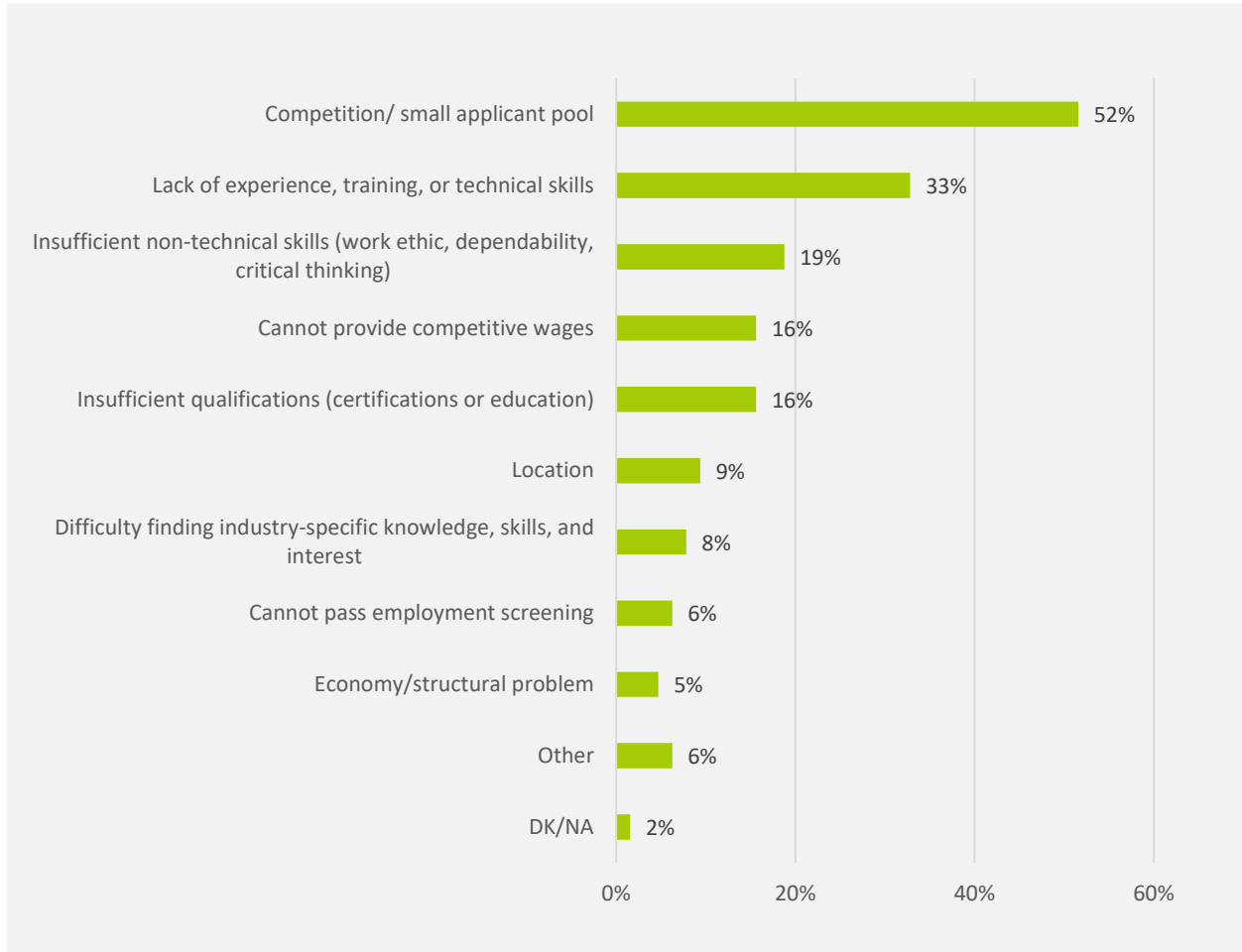


When asked to describe the two most significant reasons for the reported hiring difficulties, over half (52 percent) of Vermont’s clean energy employers cited competition with other industries, which was associated with a small applicant pool. Lack of experience, training, or technical skills amongst applicants was the next most frequently cited reason for hiring difficulties, according to one-third (33 percent) of Vermont’s clean energy employers.

Other significant causes of hiring difficulties cited by Vermont’s clean energy employers include a lack of sufficient non-technical skills among applicants, such as work ethic, dependability, and critical thinking (19 percent); an

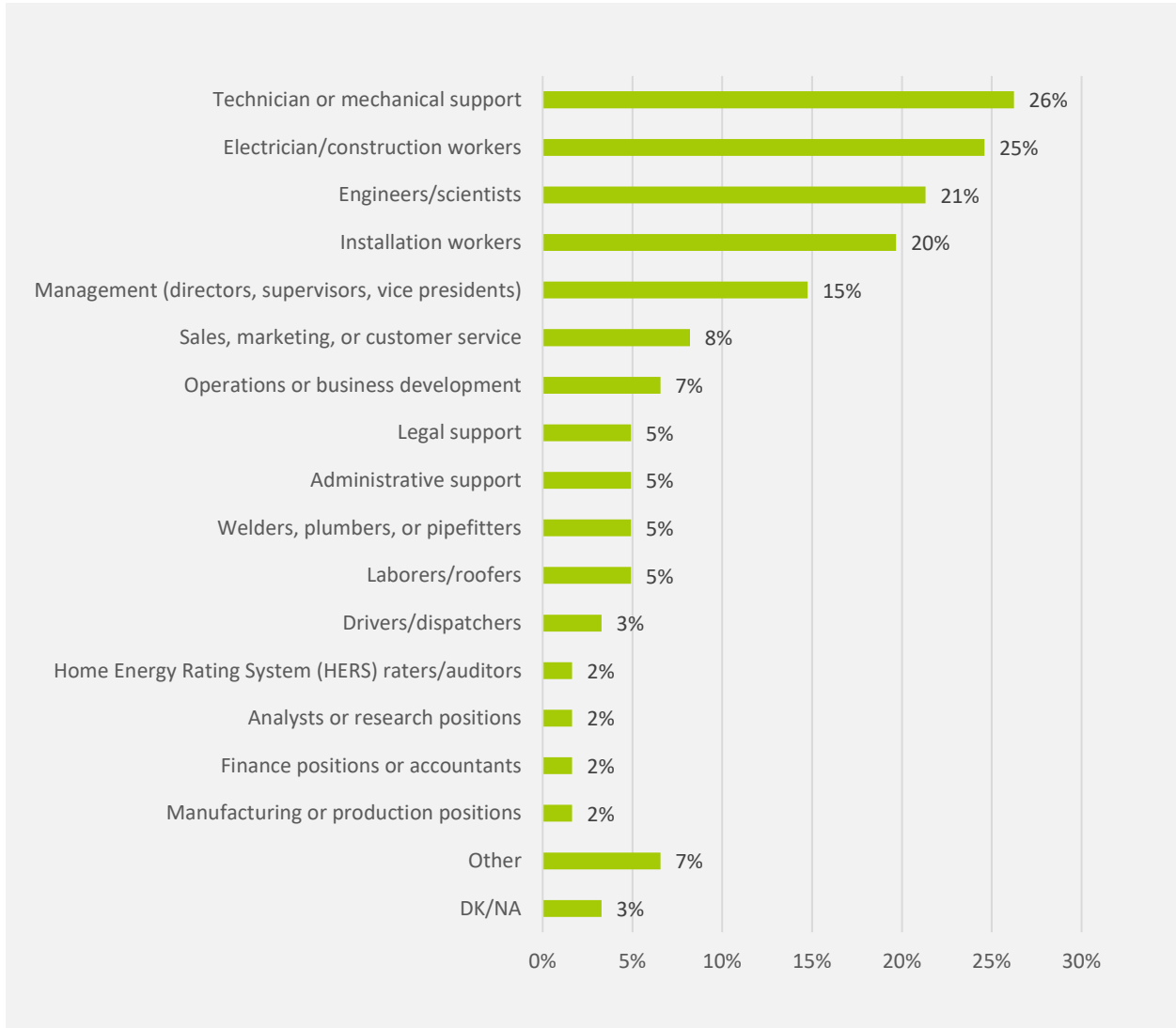
inability to offer sufficiently competitive wages to attract qualified candidates (16 percent); and insufficient applicant qualifications, such as a lack of certifications or education (16 percent).

**FIGURE 10. MOST SIGNIFICANT REASONS FOR REPORTED HIRING DIFFICULTY, 2023**



Among Vermont’s clean energy employers who reported that hiring was “very difficult” or “somewhat difficult”, slightly over a quarter (26 percent) cited difficulties in filling technical or mechanical support positions, and one-quarter (25 percent) cited difficulties in filling electrical/construction worker positions. Slightly over one-fifth (21 percent) of clean energy employers reported difficulty in filling engineer/scientist positions, one-fifth (20 percent) reported difficulty in filling installation worker positions, and approximately one-seventh (15 percent) reported difficulty in filling management positions (including director, supervisor, and vice president positions).

**FIGURE 11. MOST DIFFICULT POSITIONS FOR VERMONT'S CLEAN ENERGY EMPLOYERS TO FILL, 2023**



Other, less frequently cited positions mentioned as having been difficult to fill included sales, marketing, and customer service positions; operations and business development positions; legal and administrative support positions; welding, plumbing, and pipefitting positions; roofing positions; and other positions.

# Vermont's Wood Fuel Market

The Vermont Clean Energy Industry Reports include a biennial survey of wood fuel employers across the state to gain a better understanding of the opportunities, challenges, and strengths of the state's wood fuels economy. The survey questions for the 2023 Clean Energy Industry Report refer to the 12 months between the first quarters of 2022 and 2023, and historical comparisons are made to the supplemental wood energy surveys administered in 2016, 2018, and 2020.

## Wood Energy Sector Overview

Vermont is 74 percent forested and is home to two wood-fired commercial electric generating stations, McNeil<sup>23</sup> and Ryegate,<sup>24</sup> which have historically generated approximately 6 percent of Vermont's electricity needs since the 1980s.<sup>25</sup>

Over one-third of Vermont schoolchildren attend facilities heated by wood, and more than one in eight Vermont households use wood for their primary heating source, about nine times more than the national average and the largest share of any state.<sup>26</sup>

**Wood currently accounts for 24 percent of Vermont's thermal energy needs.** However, the state set a goal to meet 90 percent of its energy needs using renewable energy by 2050, with 35 percent of the state's thermal energy met by wood by 2030. When this goal is reached, it is estimated that state residents will displace 40 million gallons of fossil fuel and save \$120 million annually.<sup>27</sup>

**When Vermonters use imported fossil fuels for heating, 78 cents of every fuel dollar leave the region.**<sup>28</sup> Heating with locally sourced wood allows the local economy to retain wealth, creating jobs and keeping forests as forests. Thus, Vermont has sought to promote the use of locally harvested and processed wood fuel to help support local economies and provide markets for the products of sustainable forest management.

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<sup>23</sup>The McNeil Generating Station is jointly owned by Burlington Electric Department (operator and 50 percent owner), Green Mountain Power (31 percent), and the Vermont Public Power Supply Authority (19 percent). At full load, the plant generates 50 MW of electricity, and consumes approximately 76 tons of wood chips per hour. Source: <https://vppsa.com/energy/mcneil/>

<sup>24</sup>The Ryegate Generation Facility is a 20 MW wood-fired electrical power (biomass) generation facility operated by Ryegate Associates. Approximately 250 workers produce and deliver whole tree chips to Ryegate. Source: <https://vermontstandardoffer.com/ryegate/>

<sup>25</sup> Biomass Energy Resource Center. "2018 Vermont Wood Fuel Supply Study". Prepared for the Vermont Department of Forests, Parks, and Recreation. March 28, 2019. [https://fpr.vermont.gov/sites/fpr/files/Forest\\_and\\_Forestry/Wood\\_Biomass\\_Energy/Library/2018%20VWFSS%20Final%20Report%20with%20Letter.pdf](https://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Wood_Biomass_Energy/Library/2018%20VWFSS%20Final%20Report%20with%20Letter.pdf)

<sup>26</sup> U.S. Energy Information Administration, Vermont State Energy Profile, updated October 20, 2022. <https://www.eia.gov/state/print.php?sid=VT>

<sup>27</sup> <https://fpr.vermont.gov/forest/wood-energy#:~:text=38%25%20of%20Vermont%20homes%20heat,generating%20stations%2C%20McNeil%20and%20Ryegate.>

<sup>28</sup> Id.

Various types of financial incentives are available to state residents, schools, and businesses seeking to purchase wood heating systems and wood fuel storage bins in Vermont. The relevant federal and State incentives are summarized below.

## RESIDENTIAL INCENTIVES

The Clean Energy Development Fund, some of the electric distribution utilities, and Efficiency Vermont offer financial incentives to residential customers for automated wood heating systems, wood and pellet stoves, storage bins, and other technologies. Other incentives available include federal tax credits for residential customers for ENERGY STAR-rated wood heating appliances; and income-eligible financing for home energy loans from Efficiency Vermont via the Vermont State Employees Credit Union (VSECU) and Opportunities Credit Union, which can be used toward small projects such as new pellet boilers and pellet stoves.<sup>29</sup>

## SCHOOL & MUNICIPAL INCENTIVES

Public schools and municipalities in Vermont are eligible for grant funding for the repair, upgrade, or installation of new wood heating systems through the state's School Heating Assistance with Renewables & Efficiency (SHARE) program.<sup>30</sup>

In addition, Vermont public elementary, middle, and secondary schools, and Vermont town and city municipalities in underserved and disadvantaged communities in Vermont are eligible for financial and technical support for the installation and/or repair of clean energy technologies such as solar, advanced wood-fueled heating systems, and cold climate air- or ground-source heat pumps through federal funds from the U.S. Department of Energy (DOE) awarded through a sub-grant through Vermont's Department of Public Service.<sup>31</sup>

School districts can also qualify for incentives through the US Forest Service (USFS) Wood Innovations Funding Opportunity Program, which offers grants that expand traditional wood utilization projects; promote using wood as a construction material in commercial, institutional and multifamily buildings; and expand wood energy markets.<sup>32</sup> Higher learning institutions are also eligible for grants offered by the USFS Community Wood Energy and Wood Innovation Program, which is designed to support forest health and to stimulate local economies by expanding renewable wood energy use and innovative wood products manufacturing capacity.<sup>33</sup>

In addition, schools may qualify for targeted technical assistance from the USFS Wood Energy Technical Assistance Team, which helps public and private sector facility owners evaluate and develop community-scale projects that use woody biomass for heat energy, or for both heat and power, throughout the United States.<sup>34</sup>

## SMALL BUSINESS INCENTIVES

The Vermont Department of Forest, Parks, and Recreation in partnership with the Vermont Energy Investment Corporation (VEIC)<sup>35</sup>, offers free assessments for small businesses in Vermont interested in switching from fossil

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<sup>29</sup> Financing for Homeowners, Efficiency Vermont. <https://www.encyvermont.com/services/financing/homes>

<sup>30</sup> <https://publicservice.vermont.gov/renewables/clean-energy-development-fund-cedf/funding-opportunities-projects>

<sup>31</sup> [https://publicservice.vermont.gov/sites/dps/files/documents/NOFO\\_Clean-Energy\\_Schools-Munis\\_%20July-10-2023.pdf](https://publicservice.vermont.gov/sites/dps/files/documents/NOFO_Clean-Energy_Schools-Munis_%20July-10-2023.pdf)

<sup>32</sup> Forest Service, U.S. Department of Agriculture. <https://www.fs.usda.gov/science-technology/energy-forest-products/wood-innovation/grants>

<sup>33</sup> <https://www.grants.gov/web/grants/view-opportunity.html?opId=345549>

<sup>34</sup> <https://www.fs.usda.gov/detail/r9/communityforests/?cid=fseprd1046786>

<sup>35</sup> VEIC is the third-party program administrator of Efficiency Vermont.

fuels to Advanced Wood Heat (AWH) to meet their heating needs, determining the potential upfront costs and long-term savings that participating businesses can expect to incur when switching.

Efficiency Vermont and CEDF offer incentives for commercial buildings, with a flat rate rebate available to commercial buildings up to 5,000 sq. ft. and a custom rebate available for larger buildings. In addition, the Vermont Working Lands Enterprise Initiative offers grants to Vermont’s forest, farm, and food enterprises.<sup>36</sup>

In July of 2018, Vermont implemented a retail sales and use tax exemption for qualifying advanced wood heat boilers, with a sunset date of July 1, 2023. This tax provision was extended until July 1, 2024.<sup>37</sup>

Federal support is also available from the USDA Rural Energy for America Program, which offers grants and loans to farms and small businesses for renewable energy systems or to make energy efficiency improvements.<sup>38</sup> In addition, small businesses with qualifying wood fuel projects are available for grant assistance from the USFS Wood Innovations Funding Opportunity Program<sup>39</sup> as well as targeted technical assistance from the USFS Wood Energy Technical Assistance Team, which helps facility owners evaluate and develop community-scale projects that use woody biomass for heat energy, or for both heat and power, throughout the United States.<sup>40</sup>

## VERMONT FOREST FUTURE STRATEGIC ROADMAP

As required in Act 183 of 2022, FPR is developing the Vermont Forest Future Strategic Roadmap, which aims to identify actionable strategies “to protect the long-term viability of forest-based businesses—and the many benefits they provide to the state’s environment, economy, and quality of life.” The results of this initiative will be available in 2024.

## Wood Fuels Employment and Revenues

Wood fuels employment is a breakdown of both “woody biomass fuels” and “renewable heating and cooling” jobs within the renewable energy generation sector.<sup>41</sup> This includes workers involved in the production, refinement, and sales and distribution of wood fuels used to either heat homes or generate electricity but does not include, for example, bioenergy power generation jobs, which are expressly involved in the electricity-producing component of energy generation, such as the utility workers at wood chip electric power generation plants. Also included in this wood fuels cross-cut employment estimate are workers involved in the heating of buildings using wood fuels technologies.

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<sup>36</sup> <https://workinglands.vermont.gov/grant-contract-opportunities/overview>

<sup>37</sup> Vermont Acts and Resolves No. 72 of 2023, Section 8.

<https://legislature.vermont.gov/Documents/2024/Docs/ACTS/ACT072/ACT072%20As%20Enacted.pdf>

<sup>38</sup> Rural Development, U.S. Department of Agriculture. <https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans>

<sup>39</sup> Forest Service, U.S. Department of Agriculture. <https://www.fs.usda.gov/science-technology/energy-forest-products/wood-innovation/grants>

<sup>40</sup> <https://www.fs.usda.gov/detail/r9/communityforests/?cid=fseprd1046786>

<sup>41</sup> See the Detailed Clean Energy Sector Employment Section on page 12 of this report.

Wood fuels jobs are broken down into the following industries specific to wood fuels related categories:

1. Logging and harvesting of wood fuels
2. Production and processing, wholesale distribution, and professional service support of wood fuels such as chips, pellets, or firewood<sup>42</sup>
3. Manufacturing, research and development, sales, installation, or professional service support for wood fuel combustion systems, such as stoves, furnaces, boilers, or inserts

In 2023, there were 1,901 wood fuel workers across the state of Vermont, a 6 percent increase over 2020, driven by substantial growth in employment at firms engaged in the manufacture, development, sales, or support of wood fuel combustion systems. (Table 3)

**TABLE 3. WOOD FUEL EMPLOYMENT BY INDUSTRY, 2016, 2018, AND 2023**<sup>43</sup>

	EMPLOYMENT			
	2016	2018	2020	2023
<b>Logging</b>	517	461	452	407
<b>Wood fuel processing and preparation, including chips, pellets, or firewood</b>	982	790	768	684
<b>Combustion systems, such as stoves, furnaces, boilers, inserts, etc.</b>	629	554	536	778
<b>Other</b>	42	36	37	31
<b>TOTAL</b>	<b>2,171</b>	<b>1,841</b>	<b>1,794</b>	<b>1,901</b>

Prior-year wood fuel revenue performance was mixed.<sup>44</sup> Respondents were nearly evenly split between those indicating that their wood fuel revenues increased, stayed the same, or decreased, with the share of respondents slightly higher than the other two categories. While the proportion of employers reporting increased prior-year wood fuel revenues rose (32 percent, as compared to 28 percent in 2020), the proportion of employers reporting decreased prior-year wood fuel revenues also rose (38 percent, as compared to 28 percent the prior year), resulting in a hollowing-out of the middle category.

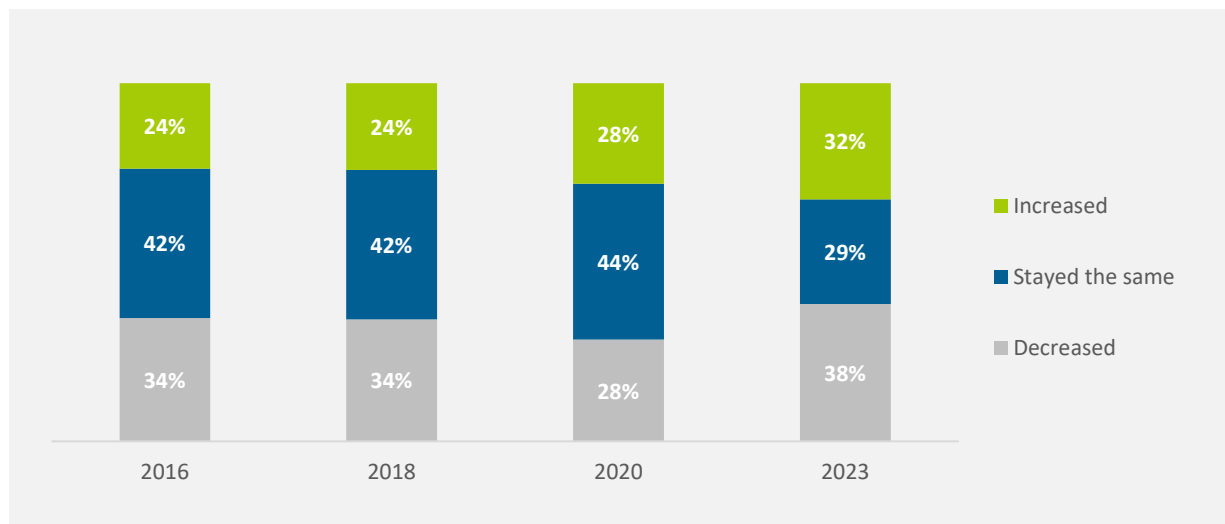
<sup>42</sup> This includes companies that produce, sell, or transport wood chips for the heating of homes and businesses or for wood-fired electric power plants.

<sup>43</sup> Totals may not be exact due to rounding.

<sup>44</sup> Employers were asked whether their firm’s wood fuel-related revenues increased, decreased, or stayed the same over the past year; 2016 employers were asked about their 2014-2015 revenue change, 2018 employers were asked about their 2016-2017 revenue change, 2020 employers were asked about their 2018-2019 revenue change, and 2023 employers were asked about their 2021-2022 revenue change. Responses were adjusted to reflect 2022 industry employment shares.



FIGURE 12. ANNUAL WOOD FUEL FIRM REVENUE CHANGE, 2016, 2018, 2020, AND 2023



However, it should be noted that examination of revenue trends alone does not provide a complete picture of the economic health of Vermont’s wood fuel firms. Revenues may increase to reflect increases in demand for, or decreases in supply of, wood fuel products, that may occur due to various changes in market conditions in the local economy, assuming elasticity of demand.

In 2021, raw material costs for firewood/pulpwood logs were elevated due to supply constraints, forcing many firewood producers to raise prices, passing on a portion of these increases in costs to their customers while increasing revenues. Absent additional data on marginal costs, it is not possible to determine whether increases in revenues translated to increases in profitability for the surveyed firms.

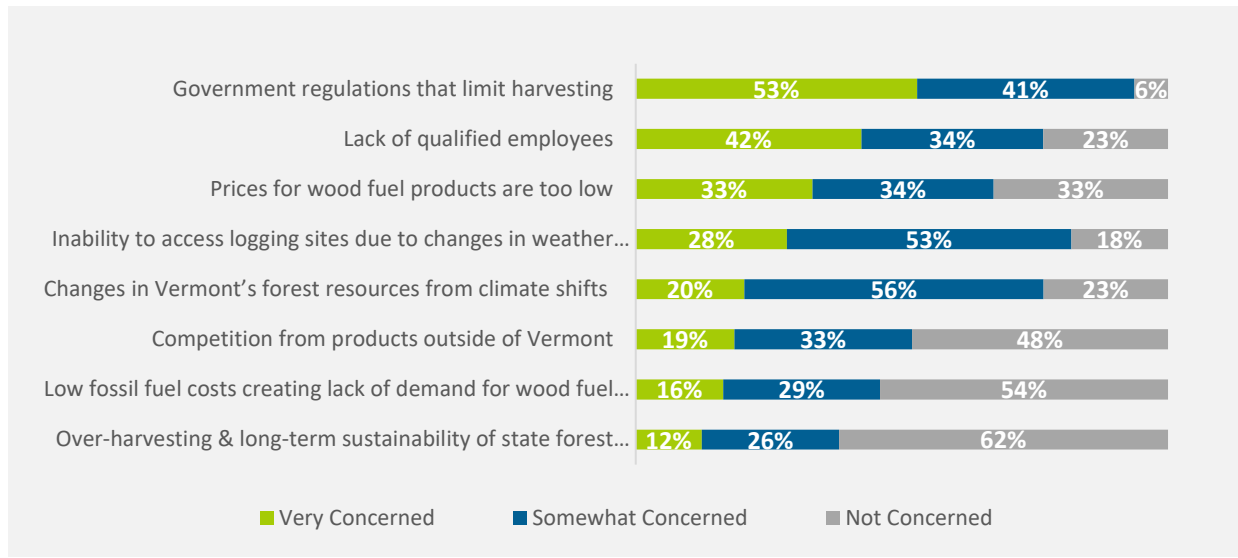
Furthermore, while revenue trends during the COVID-19 pandemic may be atypical from a long-term perspective, revenue trends still generally serve as one of the most valuable tools for measuring firm growth over time.

## Business Prospects and Support

Among the surveyed potential concerns, Vermont’s wood fuel employers were least concerned about over-harvesting and long-term sustainability of Vermont’s forest resources; 62 percent of employers indicated they were not concerned about this issue. On the contrary, nearly all employers (94 percent) were concerned with government regulations that limit harvesting of Vermont’s forests, the highest level of concern among issues tested. In fact, 53 percent of employers indicated that they were very concerned, and another 41 percent indicated that they were somewhat concerned with government regulations that limit harvesting.

Inability to access logging sites due to changes in weather patterns (82 percent), changes in Vermont’s forest resources due to climate shifts (76 percent), a lack of qualified employees (76 percent), low wood fuel prices (67 percent), and competition from exports (52 percent) were the next most commonly cited concerns, with more than half of the employers surveyed reporting being either very or somewhat concerned with these issues.

**FIGURE 13. CONCERN LEVEL FOR FIRM'S FUTURE BUSINESS PROSPECTS, 2023**

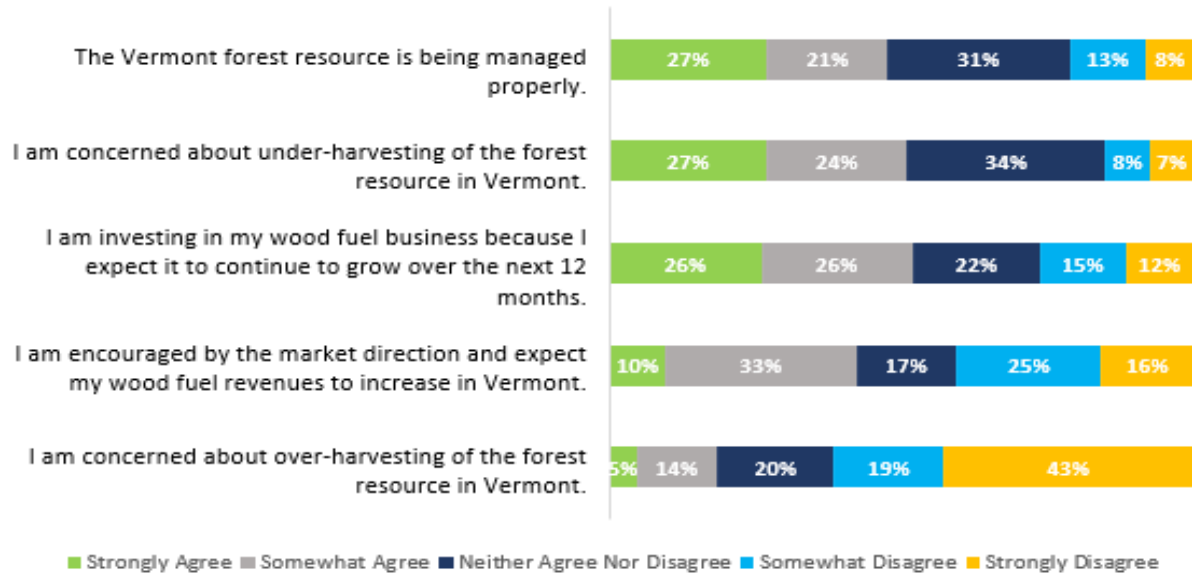


Employers were more concerned about under-harvesting (51 percent) than over-harvesting (19 percent).<sup>45</sup> However, despite concerns regarding harvesting levels and government regulations, only one in five wood fuel employers felt that Vermont's forest resources were not being managed properly (21 percent). Furthermore, most employers (52 percent) planned to invest in their wood fuel businesses in anticipation of continued growth over the next 12 months.

Most wood fuel employers plan to invest in their wood fuel businesses over the next year, in anticipation of continued growth.

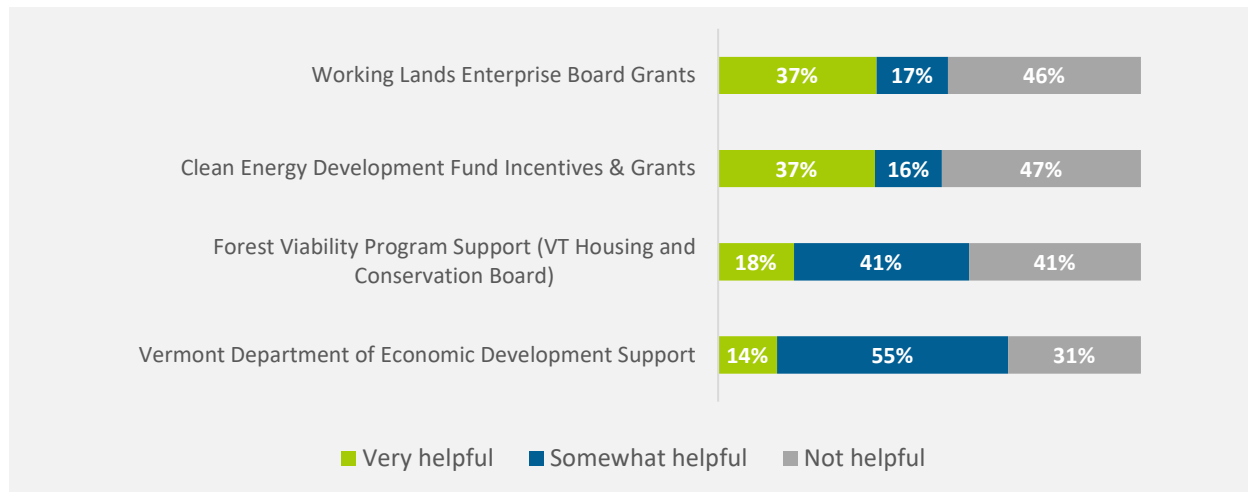
<sup>45</sup> Net growth currently exceeds removals by a ratio of more than 2:1.

FIGURE 14. WOOD FUEL BUSINESS AND FOREST HEALTH, 2023



Vermont’s Department of Economic Development was considered the most helpful organization in terms of promoting the health of wood fuels businesses in Vermont; about seven in ten (69 percent) employers who had some level of experience with the department indicated that it had helped their business. More than half of the employers surveyed also indicated that business support through the Forest Viability Program of the Vermont Housing and Conservation Board (59 percent), grants from the Working Lands Enterprise Board (54 percent), and customer incentives and grants offered by the CEDF (53 percent) had been helpful to the health of their wood fuel business.

FIGURE 15. PROGRAM AND ORGANIZATIONAL SUPPORT, 2023



# Conclusion

Vermont's clean energy industry continues to set an example for the rest of the nation, with the highest level of clean energy employment per capita in the nation. Employment in Vermont's clean energy industry has also continued to rise, nearly recovering from COVID-19 pandemic-induced job losses, with full-time clean energy jobs in 2022 nearly reaching the record high reported pre-pandemic. However, growth in Vermont's clean energy employment is constrained by a limited pool of qualified applicants, as over half of Vermont's clean energy employers cited competition with other industries as a significant cause of difficulties in filling clean energy positions.

Nearly all the employers surveyed (98 percent) in 2023 reported encountering difficulties hiring clean energy workers, and the proportion of employers reporting high levels of difficulty in hiring clean energy workers continued to rise sharply since 2020, with more than two-thirds of employers (68 percent) reporting high levels of difficulty in hiring clean energy workers, as compared to just over one-half (52 percent) of employers two years ago. Addressing these labor supply constraints will be crucial to maintaining the upward trajectory of Vermont's clean energy employment and growth in years to come, and to helping the state achieve its long-term clean energy goals.

Within the wood fuels industry, total employment has recovered from COVID-19 pandemic-induced job losses. However, concerns regarding government regulation limiting the harvesting of Vermont's forest have increased, with almost all wood fuel employers surveyed indicating concern.

Despite these concerns, however, Vermont's wood fuel employers have remained optimistic, with most of the wood fuels employers surveyed indicating plans to continue investing in their wood fuels businesses over the next 12 months. Vermont's wood fuels industry has benefited from the support of various incentives and grants from government-funded programs, which help the industry continue its positive trajectory toward meeting the state's thermal energy goals and benefitting rural natural resource economies.

# Appendix A: Research Methodology

## EMPLOYMENT DATA

In congruence with previous reports, this year's Clean Energy Industry Report is based on the 2023 United States Energy and Employment Report (USEER). The 2023 USEER utilized data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW 2022 Q3), the BLS Unemployment Situation Table B-1 monthly reports, together with a detailed supplemental survey of business establishments. The survey was designed and implemented by BW Research Partnership in partnership with the Department of Energy (DOE). For the past decade, national, state, and local energy-related data collection and analysis efforts have used this survey methodology.

The survey uses a stratified sampling plan based on industry code (North American Industry Classification System or NAICS), establishment size, and geography to determine the proportion of establishments that work with specific energy related technologies, as well as the proportion of workers in such establishments that work with the same. These data are then analyzed and applied to existing public data published by the BLS QCEW, effectively constraining the potential universe of energy establishments and employment.

The survey was administered by phone and by web from January 31, 2023 through March 30, 2023, with more than 7,800 outbound calls and more than 1,000 emails sent to potential participants across Vermont. The phone survey was conducted by ReconMR. The web instrument was programmed internally, and each respondent was required to use a unique ID to prevent duplication.

The sample was split into two categories, the known and unknown universes. The known universe includes establishments that have previously identified as energy-related, either in prior research or some other manner, such as membership in an industry association or participation in government programs. These establishments were surveyed census-style, and their associated establishment and employment totals were removed from the unknown universe for both sampling and resulting employment calculations and estimates. Over the summer of 2022 BW Research cleaned, deduplicated, added to, and refined its database to reflect churn (companies out of business, moved, no longer in energy), unverified (no answer, answering machine, fast-busy, disconnect, etc.), verified, and other available demographic tags (industry, technology, sub-technology, size, etc.).

In addition to cleaning the original known energy database, BW Research also supplemented with industry association contact lists by technology (biofuels, coal, oil, gas, energy storage, energy efficiency, solar, and wind), new companies from the unknown database that took the 2022 survey and contact lists from subcontractors. BW Research also appended contact information, including six-digit NAICS codes, contact, employment, and location information.

The unknown universe includes thousands of businesses in potentially energy related NAICS codes, across agriculture, mining, utilities, construction, manufacturing, wholesale trade, professional services, and repair and maintenance. Each of these segments and their total reported establishments (within the BLS QCEW) were carefully analyzed by size (employment – provided by the Census Bureau's County Business Patterns) and state to develop representative clusters for sampling.

In total, 371 business establishments in Vermont participated in the survey effort. These responses were used to develop incidence rates among industries as well as to apportion employment across various industry categories in

ways currently not provided by state and federal labor market information agencies. The margin of error is +/- 4.99 percent for Vermont at a 95 percent confidence interval.

With clean data files in place, BW Research developed a general methodology for state employment estimation that has a few variations depending on sub-technology. Steps in the process are listed below.

#### **100% NAICS A**

These are NAICS codes where 100 percent of the reported employment is energy related AND 100 percent are allocated to a specific sub-technology. Examples include solar electric power generation, hydroelectric power generation, and motor vehicle manufacturing.

#### **Actual Survey Responses**

These include the reported sub-technology employment totals by company location. Responses from establishments in 100 percent NAICS codes are excluded.

#### **Known Database**

Employment is allocated by location for verified establishments in the known when the following conditions are met: 1) have InfoUSA or DatabaseUSA appended data; 2) did not take survey (or actual survey response would be used), and 3) are not in a 100 percent NAICS.

#### **Remainder**

This represents remaining employment based on statistical extrapolation.

#### **Industry Mix**

Industry mix is the national proportion of industries that contribute to sub-technology employment. The mix of these industries (by 6-digit NAICS) is used to create proportions by state and remainder employment is allocated by these proportions. This “industry mix” was developed by analyzing completed survey incidence nationally for all clean energy sub-technologies.

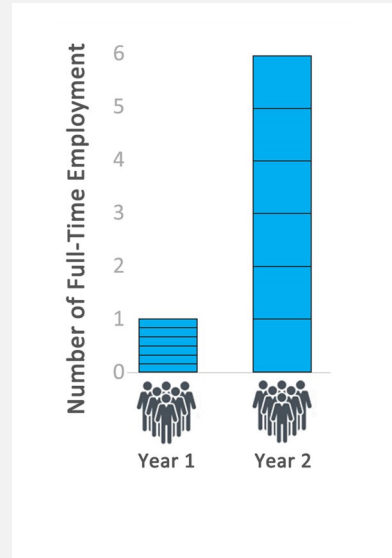
## **100 PERCENT & FULL-TIME EQUIVALENT JOBS**

Full-time equivalent (FTE) jobs are extrapolated using state employment thresholds by technology weighted on census division and previous year’s data. These thresholds are adjusted for response bias between our known and unknown universes, then the proportion of firm revenues from energy projects are incorporated. Employment thresholds are survey data from questions asking what percent of a firm’s employment spends at least 50 percent of their time working on energy-related activities and what percent spend all their time on clean energy activities. Using the adjusted thresholds, employment by state is then split into three groups, those that spend all (100 percent) of their time on energy-related activities, those that spend a majority (50 to 99 percent) of their time, and those that spend less than a majority (0 to 49 percent) of their time. These employment groups are weighted 0.25 on the less than a majority group, 0.75 on the majority group, and 1 on the 100 percent group. FTE jobs are the sum of these products.

Because the 100 percent employment estimates are a subset of the overall FTE metric, these employment figures have also been updated accordingly using the above methodology.

**FIGURE 16. FULL-TIME EQUIVALENT CLEAN ENERGY JOBS EXPLAINED**

An example can illustrate the importance of tracking FTE clean energy employment. If a Heating, Ventilation, and Air Conditioning (HVAC) firm had 6 installers in 2019 who occasionally installed heat pumps, and now has 6 installers who exclusively do so, there would be no change in the total number of clean energy workers reported. However, because the number of labor hours working with heat pumps has increased, FTE jobs would show a corresponding increase.



# Appendix B: Clean Energy Technology List

A clean energy job is defined as any worker that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, or repair of components, goods, or services related to the following sectors: Renewable Energy Generation; Clean Grid and Storage; Energy Efficiency; Clean Fuels; and Clean Transportation. These jobs also include supporting services such as consulting, finance, tax, and legal services related to energy.

The State of Vermont categorizes sub-technologies differently from the USEER data collection effort and reports. The below lists identify which sub-technologies are specific to Vermont’s clean energy definition. They are placed in their respective USEER category, with additional in-text and footnote explanation as to where they would fall for the Vermont Clean Energy Industry Report.

## RENEWABLE ENERGY GENERATION

Renewable energy generation jobs cover all utility and non-utility employment for renewable electricity-generating technologies. Included in these employment estimates are any firms engaged in renewable energy facility construction, generation equipment manufacturing, wholesale parts distribution, and professional and business services such as consulting, finance, administrative, and legal support for the following renewable energy generation sub-technologies:

- Solar Photovoltaic Electric Generation
- Concentrated Solar Electric Generation
- Wind Generation
- Geothermal Generation
- Bioenergy/Biomass Generation
- Low-Impact Hydroelectric Generation, including wave/kinetic generation
- Traditional Hydroelectric Generation
- Combined Heat and Power
- Other Renewable Electric Power Generation
- Renewable Heating and Cooling<sup>46</sup>
  - Solar Thermal Water Heating and Cooling
  - Other Renewable Heating and Cooling (geothermal, biomass, heat pumps, etc.)

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<sup>46</sup> For Vermont, “renewable heating and cooling” is included under the “renewable energy generation” sector, while for USEER data collection, this sub-technology is categorized under “energy efficiency”.



## RENEWABLE FUELS<sup>47</sup>

These jobs encompass all work related to the production of clean fuels. Fuels employment spans industries such as agriculture and forestry, manufacturing, professional and business services, wholesale trade, transportation, and construction.

It is important to note the difference between bioenergy electricity generation jobs and woody biomass fuels jobs. The former includes workers that are involved in the utility generation of electricity from materials derived from biological sources or any organic material, while the latter encompasses those workers who are engaged in fuel development from these materials such as manure, vegetable oil, trees and woody plants, and other living matter. Bioenergy generation workers are expressly involved in the electricity-producing component (including the construction of facilities and manufacture and wholesale trade of generators or turbines) while woody biomass workers are involved in the production, refinement, and distribution of those fuels used to produce the electricity. Vermont includes the following renewable fuel sub-technologies under the overall renewable energy generation sector:

- Woody Biomass, including cellulosic biofuel
- Non-Woody Biomass, including biodiesel

## ENERGY EFFICIENCY

- Traditional HVAC goods, control systems, and services
- ENERGY STAR Certified Heating Ventilation and Air Conditioning (HVAC), including boilers and furnaces with an AFUE rating of 90 or greater and air and central air conditioning units of 15 SEER or greater
- ENERGY STAR® Appliances & Efficient Lighting
  - ENERGY STAR Certified Appliances, excluding HVAC
  - ENERGY STAR Certified Electronics (TVs, Telephones, Audio/Video, etc.)
  - ENERGY STAR Certified Windows and Doors
  - ENERGY STAR Certified Roofing
  - ENERGY STAR Certified Seal and Insulation
  - ENERGY STAR Certified Commercial Food Service Equipment
  - ENERGY STAR Certified Data Center Equipment
  - ENERGY STAR Certified LED Lighting
  - Other LED, CFL, and Efficient Lighting
- Advanced Building Materials/Insulation
- Other Energy Efficiency
  - Reduced Water Consumption Products and Appliances
  - Recycled Building Materials

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<sup>47</sup> For Vermont, “non-woody biomass” and “woody biomass” are included under the “renewable energy generation” sector, while for USEER data collection, these sub-technologies are categorized as “fuels”.

## CLEAN GRID & STORAGE<sup>48</sup>

### Electric Power Transmission and Distribution

- Smart Grid
- Microgrids
- Other Grid Modernization

### Storage

- Pumped Hydropower Storage
- Battery Storage, including battery storage for solar generation
  - Lithium Batteries
  - Lead-Based Batteries
  - Other Solid-Electrode Batteries
  - Vanadium Redox Flow Batteries
  - Other Flow Batteries
- Mechanical Storage, including flywheels, compressed air energy storage, etc.
- Thermal Storage
- Biofuel, including ethanol and biodiesel storage

## CLEAN TRANSPORTATION

- Hybrid Electric Vehicles
- Plug-In Hybrid Vehicles
- Electric Vehicles

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<sup>48</sup> For Vermont, these are included under the “energy efficiency” sector, while for USEER data collection, these sub-technologies are categorized under “transmission, distribution, and storage” (or clean grid and storage for clean energy-specific industry reports).