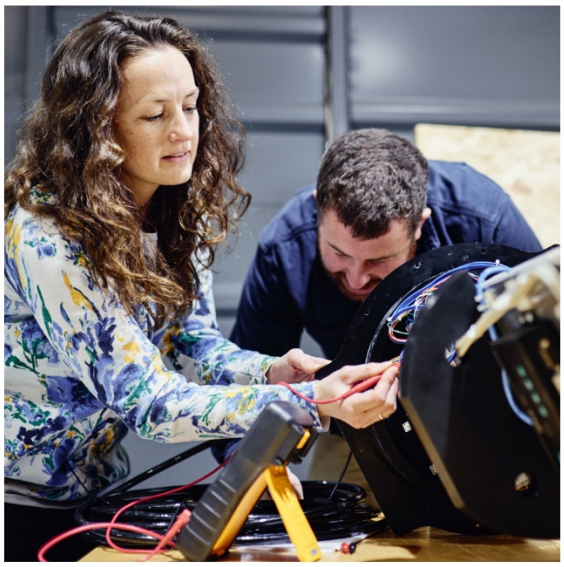

MAINE GOVERNOR'S
Energy Office

2023
MAINE CLEAN ENERGY INDUSTRY REPORT

[bw] RESEARCH PARTNERSHIP

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Executive Summary

Maine's clean energy economy now accounts for over 2% of the state's total workforce, or more than 15,000 jobs in the state, a growth of 14% from 2016. With a population of almost 1.4 million in 2022, this clean energy workforce represents 1% of Maine's residents. Clean energy jobs in Maine have bounced back from COVID-19 disruptions and are back on the pathway to reach Governor Janet Mills' announced goal of supporting 30,000 clean energy jobs by 2030. Also underway are plans for the state to reach 100% clean energy by 2040 set forth by Governor Mills. The growth of the industry presents new and increasingly valuable career opportunities to Maine residents from many backgrounds and with a wide range of skills and knowledge.

This 2023 report details employment across five key technology sectors of the clean energy economy: energy efficiency; clean energy power generation; alternative transportation; clean grid and storage; and clean fuels. The data is based on the data collection effort conducted for the annual United States Energy and Employment Report (USEER) in the fourth quarter of 2022. Historical clean energy employment data is also included, beginning in 2016. All annual comparisons reference the fourth quarter of the respective year. At the end of this year's report, new to the Maine Clean Energy Industry Report series, are data on Maine's clean energy patent trends, as well as an assessment of Maine's clean energy contributions to its Gross State Product.[1]

Nationwide, 2022 was a time of continued economic recovery. The second half of the year marked the onset of new climate-related commitments and targeted investments from the federal government at a scale not seen before. This year's report documents Maine's clean energy industry over this period of restoration and advancement, while a forthcoming report on 2023 trends will include a more fulsome look at the impacts of the new federal initiatives. Key findings on clean energy employment trends in Maine, based on both historical and new 2022 data, are as follows:

1 **Maine has the fastest-growing clean energy economy – as measured by new job creation – of any New England state. It is also one of only two New England states to increase the number of clean energy jobs to above 2019 pre-pandemic employment levels.**

As a result of the economic disruptions felt worldwide stemming from the COVID-19 pandemic, efforts to regain lost jobs and restore pre-pandemic employment in the clean energy sector are widespread. In New England, only Maine and Connecticut achieved this thus far, with Maine's jobs growing by almost 3% and Connecticut's jobs rising by just under 1% from 2019. In the greater Northeast region of the United States, only New York outperformed Maine with a growth rate of just over 3% from 2019 to 2022. As of 2022, the U.S. was still working to regain its 2019 level of clean energy employment.[2] The state can

[1] Data on patents and investment deals were gathered from the U.S. Patent & Trademark Office, the U.S. Small Business Administration America's Seed Fund SBIR/STTR, the U.S. Department of Energy Solar Energy Technologies Office, the U.S. Department of Energy Advanced Research Projects Agency – Energy, the U.S. Department of Energy Office of Science, and Crunchbase.

[2] All comparisons are with respect to Maine's clean energy definition, which includes employment in Electric Power Distribution (NAICS 221122) and excludes natural gas vehicle jobs. Details on Maine's clean energy definition can be found in Appendix A.

now focus on new growth instead of rebuilding to reach its goal of having 30,000 clean energy jobs by 2030.

2 **Maine's clean energy economy grew more than three times faster than its overall economy between 2016 and 2022.**

From 2016 to 2022, the number of clean energy jobs in Maine increased by 14% or almost 2,000 jobs. During the same time, employment in Maine's overall economy rose by 4%, approximately 24,700 jobs. From 2018 to 2022, the clean energy workforce grew by 6% while the overall workforce grew by 2%. Further, the renewable electric power generation sector of Maine's clean energy industry grew by 11%, adding 300 jobs, between 2018 and 2022, a faster rate than the national renewable electric power generation sector growth (5%).

3 **Maine's energy efficiency sector is the largest and fastest growing technology sector of the state's clean energy industry from 2021 to 2022. It grew faster than any other New England state's energy efficiency sector.**

The energy efficiency sector in Maine employed over 8,600 jobs in 2022, accounting for more than half (58%) of the state's clean energy workforce. Maine's renewable electric power generation sector is the second-largest clean energy sector with nearly 3,000 jobs in 2022, followed by grid modernization and storage, renewable fuels, and alternative transportation. Similarly, three-fifths of clean energy establishments in the state work in the energy efficiency sector while one-fifth work in renewable electric power generation. Employment in this sector increased in all New England states between 2021 and 2022, though it did not grow at the same rate in the other New England states as it did in Maine[3] (4%). With Governor Mills' new goal of installing 175,000 heat pumps by 2027 after already meeting the goal of installing 100,000 heat pumps by 2025,[4] it is likely that employment in this sector will continue to rise.

4 **Clean energy workers in Maine are not only growing in numbers, but also in the amount of time they spend on clean energy-related activities.**

Maine's clean energy industry is strong as both total employment and intensity-adjusted employment have bounced back from pandemic-related impacts, surpassing 2019 numbers. Intensity-adjusted employment – or a measure of clean energy workers who spend 100% of their time on clean energy activities calculated by weighing total clean energy employment on the amount of time workers spend on these activities – in Maine increased by 5% from 2021 to 2022 and by 24% from 2016 to 2022. By the end of 2022, 63% of workers in the clean energy industry were spending all their time on clean energy activities.

[3] All comparisons are with respect to Maine's clean energy definition, which includes employment in Electric Power Distribution (NAICS 221122) and excludes natural gas vehicle jobs. Details on Maine's clean energy definition can be found in Appendix A.

[4] Governor's Energy Office News & Updates. Governor's Energy Office. August 2023. https://mailchi.mp/8ecaae3bc285/governors-energy-office-news-and-updates-9392885?e=78653346ec

5 **The state's clean energy workforce has a higher concentration of diversity as well as veteran workers compared to its overall workforce, though women continue to be underrepresented in clean energy.**

Non-White workers, workers of Hispanic or Latino ethnicity, and veterans each make up a higher share of Maine's clean energy talent compared to the statewide labor force. On the other hand, workers aged 55 and over represent one-fifth of the clean energy workforce compared to approximately 28% in the state economy. Significantly, women, who make up more than half of the workers across the state, comprise only one-quarter of Maine's clean energy workers. The demographic composition of Maine's 2022 clean energy workforce is comparable to that of its 2020 make up. Targeted recruitment and training strategies are important for ensuring a representative workforce in the clean energy industry.

6 **Accelerating clean energy employment will require more than just increasing installations. Supply chain investments can create oversized impacts and long-term, export-focused jobs that spur wealth creation to the state.**

In 2022, wind electric power generation employed the greatest number of workers within the renewable electric power generation sector. Targeted investments in strategic segments of the supply chain for wind energy in Maine can drive additional demand for an offshore wind (OSW) workforce. With Maine's high OSW energy potential, floating OSW, which has already been advancing in Maine, is an optimal target for steering supply chain investments. As the attributes of the Gulf of Maine guide the state towards floating OSW, funding toward the supply and on-land assembly of floating OSW foundations (and steel sub-structures) as well as their anchor and mooring systems can create long-term jobs, in both construction and operations, as floating OSW continues to advance. Further, as Maine works to meet, the state's procurement of 3 GW installed by 2040, these supply chain investments can help Maine increase its own, and the region's, longer-term capacity for renewable energy generation.[5]

7 **Clean energy establishments in Maine, totaling 2,500 in 2022, make up 4% of all businesses in the state.**

With 2,500 clean energy businesses in 2022, Maine's clean energy industry represents 4% of total businesses throughout the state. The energy efficiency technology sector holds the largest proportion of clean energy establishments in all three states, specifically 62% in Maine. Within the clean energy value chain, 51% of Maine's firms are involved in construction.

[5] *Maine Offshore Wind Roadmap*. Maine Governor's Energy Office. February 2023. https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/Maine_Offshore_Wind_Roadmap_February_2023.pdf
& *State of the Offshore Wind Industry: Today through 2050*. DNV®. Maine Governor's Energy Office. 28 January 2022. https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/Maine%20OSW%20DNV%20Task%201%20-%20State%20of%20the%20OSW%20Industry_Final.pdf

8

The state's clean energy industry contributed $2.31 billion, or almost 3%, of Maine's total Gross State Product in 2022.

In 2022, Maine's clean energy industry contributed $2.31 billion to the state's economy, totaling $1,690 per capita and representing nearly 3% of its overall Gross State Product (GSP). The utilities sector contributes the largest proportion (44%) to Maine's clean energy economic output.

Introduction

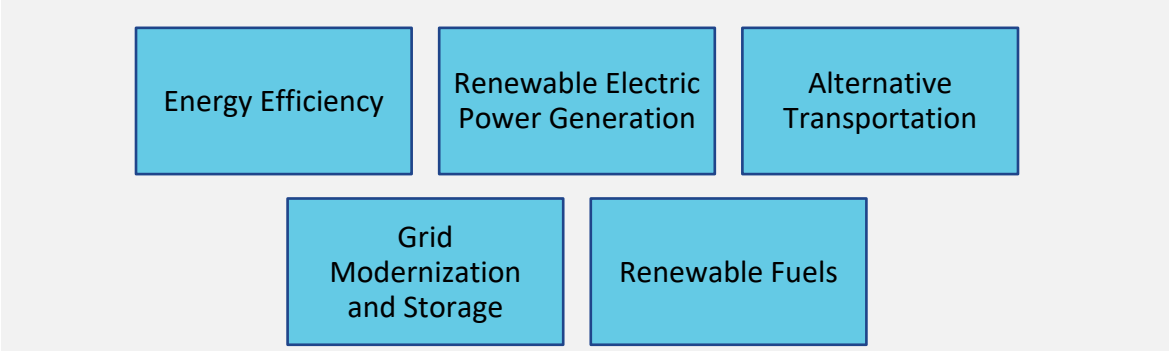
This 2023 Maine Clean Energy Industry Report was commissioned by the Maine Governor's Energy Office (GEO) to better understand the scale and composition of the clean energy economy in the state. This year's report comes at the heels of recovery from the COVID-19 pandemic and amidst significant federal initiatives intended to boost clean energy development and domestic manufacturing across the country. The publication provides insight into potential challenges and opportunities in Maine's clean energy industry to inform policies and other decisions that impact the state's people, workers, and industries.

CLEAN ENERGY JOBS

Employment trends within the clean energy industry's five major technology sectors (Figure 1), and their sub-technologies, are discussed throughout this report. In addition, this report looks at the clean energy jobs from a value chain perspective and in terms of intensity. Value chain segments include installation, manufacturing, professional services, sales, and utilities.

Maine, like many states, has its own unique classification of clean energy technology sectors, which is laid out in Appendix A. For example, electric transmission and distribution workers[6] are included in Maine's clean energy employment data and classified under grid modernization and energy storage due to their crucial role in bringing renewable electric power generation online and their heavy involvement grid modernization activities.

FIGURE 1. CLEAN ENERGY TECHNOLOGY SECTORS[7]



[6] This includes workers in NAICS 22112 Electric Power Transmission, Control, and Distribution

[7] Electric transmission and distribution workers (which includes workers in NAICS 22112 Electric Power Transmission, Control, and Distribution) are included in Maine's clean energy employment data and classified under grid modernization and energy storage due to their crucial role in bringing renewable electric power generation online and their heavy involvement grid modernization activities.

Clean Energy Industry Overview

Total Clean Energy Employment

As of the last quarter of 2022, over 15,000 workers are employed in Maine's clean energy industry. Compared to 2018, this is a gain of nearly 800 jobs, or a cumulative growth of almost 6% (Figure 2). The clean energy industry's cumulative change in employment from 2016 to 2022 reaches a growth of 14%. Employment in Maine's overall economy rose by 2%, or more than 12,000 jobs, from 2018 to 2022.[8] Thus, the clean energy industry accounted for almost 7% of total employment growth in Maine from 2018 to 2022.

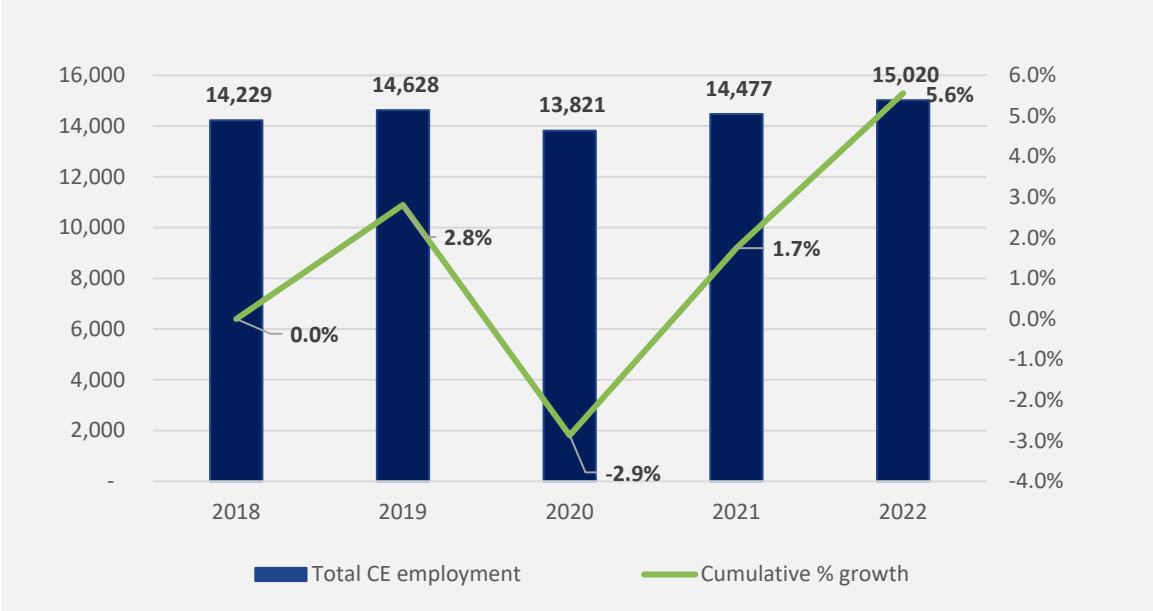
Since 2019, total employment in Maine has risen by 1% and clean energy employment by almost 3%. Although dropping in 2020 due to pandemic-related impacts, both clean energy employment and total employment in Maine have bounced back and are now exceeding 2019 pre-pandemic employment levels. Across New England, only Connecticut and Maine surpassed pre-pandemic levels of employment in the clean energy industry by the end of 2022, with respect to Maine's clean energy definition. In fact, from 2019 to 2022, Maine's clean energy workforce grew by the largest percentage. Within the larger Northeast region of the United States (U.S.), New York and Pennsylvania also surpassed their pre-pandemic clean energy employment, but Maine's clean energy industry grew at the second-fastest rate during this time, behind New York whose industry grew by over 3%. By the last quarter of 2022, clean energy employment the U.S. was still below what it totaled in 2019.[9]

Through numerous interviews and survey responses from professionals in the field, it has become clear that certainty of policy and a diverse array of initiatives can serve as signals to the private sector that can favorably influence a widespread adoption of clean energy technologies and employment growth rates in the industry. Efforts already prioritized in Maine are already beginning to show a positive response.

[8] *Quarterly and Annual Industry Employment and Wages*. Center for Workforce Research and Information. Maine Department of Labor. https://www.maine.gov/labor/cwri/qcew1.html

[9] All comparisons are with respect to Maine's clean energy definition, which includes employment in Electric Power Distribution (NAICS 221122) and excludes natural gas vehicle jobs. Details on Maine's clean energy definition can be found in Appendix A.

FIGURE 2. CLEAN ENERGY EMPLOYMENT IN MAINE, 2018-2022



The largest clean energy technology sector in Maine is energy efficiency, accounting for over 8,600 jobs, or 58% of the clean energy workforce. The next largest clean energy segment is renewable electric power generation which employs approximately one-fifth (20%) of the state's clean energy workers. There are just under 900 clean energy alternative transportation workers, constituting 6% of total clean energy workers in Maine (Figure 3).

Since 2018, all clean energy technology segments experienced job growth. Jobs in alternative transportation grew at the highest rate (28%), adding almost 200 jobs. In terms of absolute jobs, the renewable electric power generation segment added the greatest number (300) between 2018 and 2022, translating to a growth rate of just over 11%. Comparatively, renewable electric power generation across the country rose by 5% from 2018 to 2022.

Over the last year, from 2021 to 2022, energy efficiency saw the largest increase in employment both in terms of growth rate (over 4%) and in terms of total jobs (356). Employment in renewable fuels grew the slowest, rising by less than 1% and adding approximately four jobs during this timeframe.

Approximately 2,500 businesses in Maine are involved with clean energy-related activities. Clean energy establishments represent 4% of total establishments in Maine.[10] Comparatively, in Massachusetts and New York,[11] clean energy firms make up 3% and 2% of total establishments, respectively.[12] There is also a

[10] Total establishments in Maine, Q42022, are sourced from: *Quarterly and Annual Industry Employment and Wages*. Center for Workforce Research and Information. Maine Department of Labor. https://www.maine.gov/labor/cwri/qcew1.html

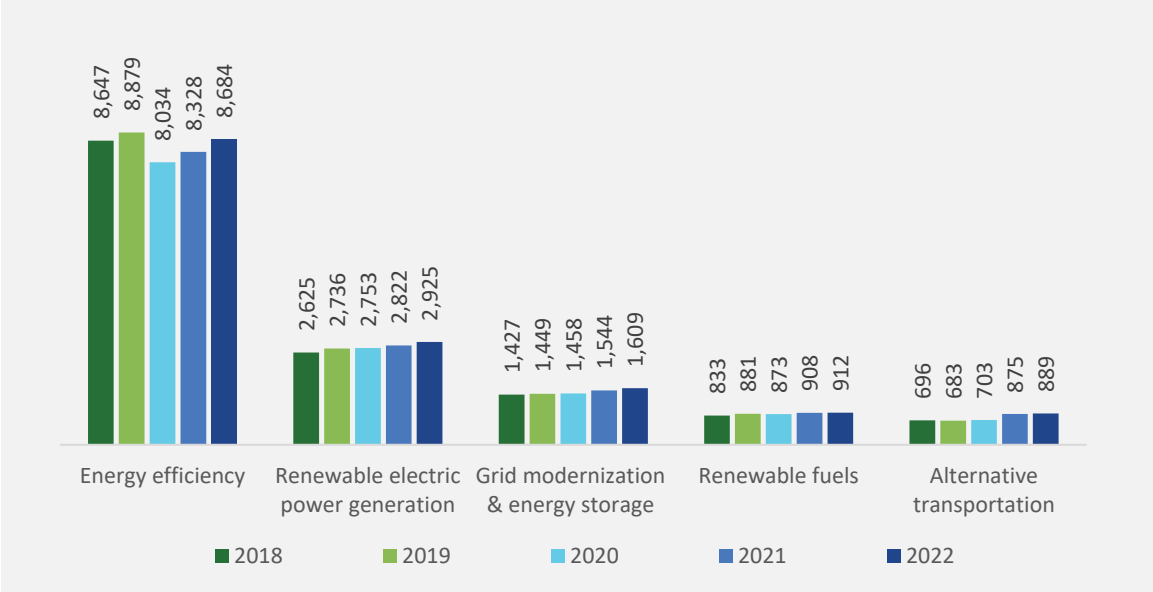
[11] Massachusetts and New York have varying clean energy definitions from Maine. Most significantly, Maine includes electric transmission and distribution workers, and Massachusetts excludes traditional HVAC employment. More details on the states' clean energy definitions can be found in Appendix E.

[12] Clean energy establishment data, Q42022, for Massachusetts and New York are sourced from their respective Clean Energy Industry Reports, based on the 2023 United States Energy and Employment report (USEER).

higher concentration of clean energy establishments per capita in Maine (0.2%) than in New York (0.1%) and Massachusetts (0.1%).[13]

In all three states, Maine, Massachusetts, and New York, most clean energy firms are involved in the energy efficiency technology sector, with 88% in New York, 62% in Maine, and 54% in Massachusetts. In Maine, renewable electric power generation establishments follow, making up 21% of the state's clean energy businesses, while they represent 35% in Massachusetts and 5% in New York. Around 5% of Maine's clean energy firms work with grid modernization and energy storage technologies, the smallest clean energy segment of businesses in the state (Figure 4).

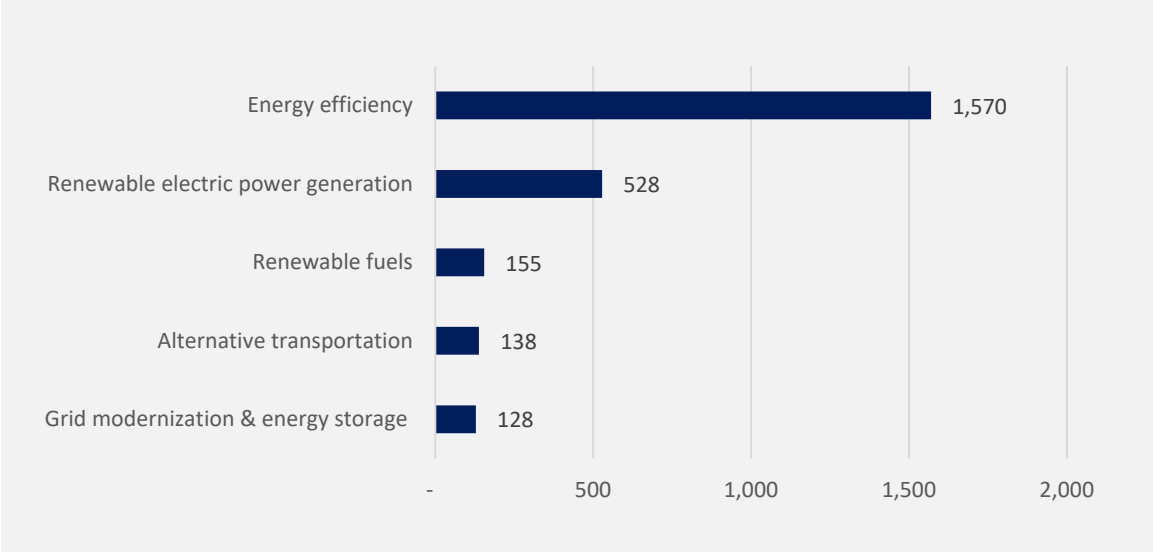
FIGURE 3. CLEAN ENERGY EMPLOYMENT BY TECHNOLOGY SECTOR, 2018-2022



& Total covered establishments, Q42022, in Massachusetts and New York are sourced from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages database.

[13] Total population data for Maine, Massachusetts, and New York are sourced from the U.S. Census Bureau, 2022 American Community Survey 5-year estimates, Table B01003.

FIGURE 4. CLEAN ENERGY ESTABLISHMENTS BY TECHNOLOGY, 2022



Clean Energy Value Chain Employment

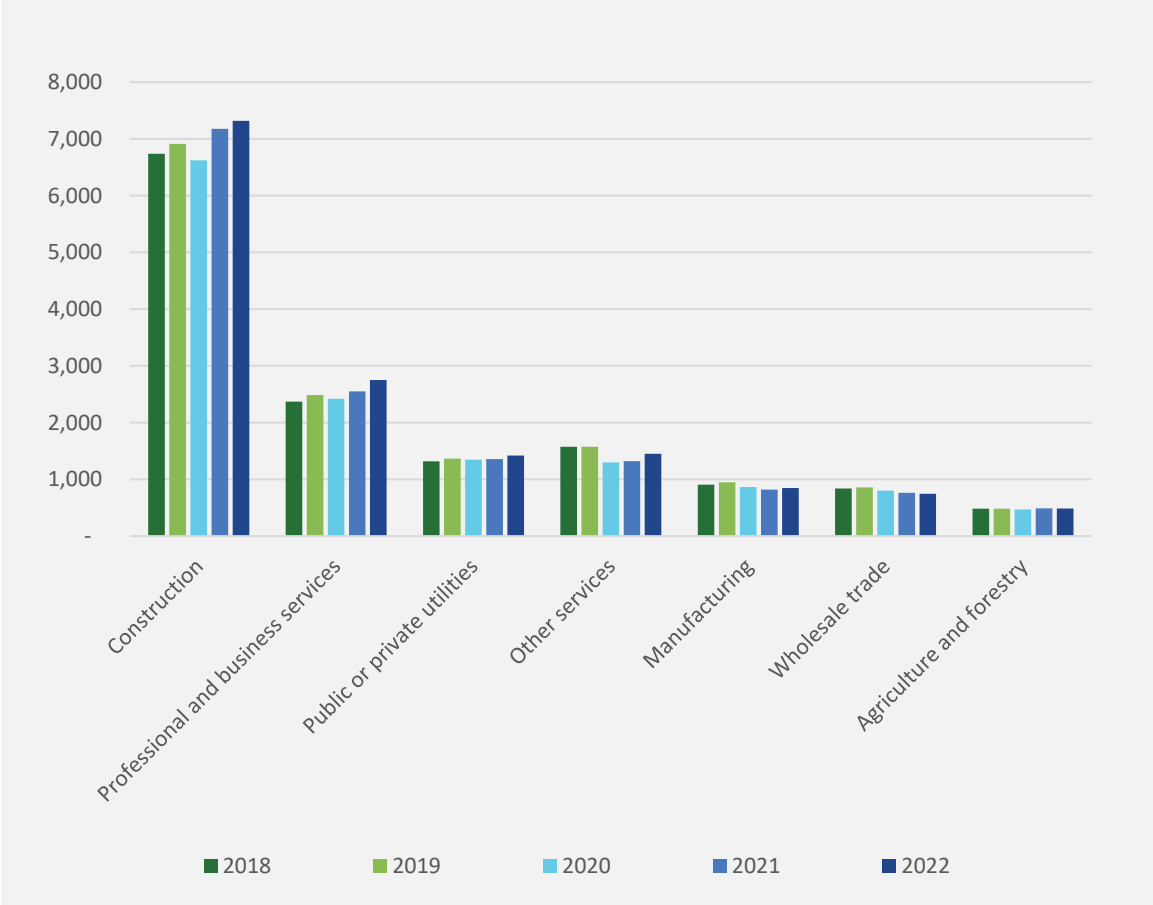
Value chain jobs examine the clean energy economy by identifying the industries in which clean energy activities are concentrated in Maine. Doing so provides context for what type of policy or workforce development assistance is needed to support clean energy employers across the state. For example, a state with a high concentration of research and development activity might signal the need for more early-stage investment funding to support continued prototype development and technology testing. The major value chain segments examined include construction[14], manufacturing[15], wholesale trade[16], professional and business services[17], other services[18], agriculture and forestry, and utilities.

In Maine, construction jobs comprise the largest concentration (49%) of the clean energy workforce, accounting for over 7,300 jobs in 2022. Other services employment, which makes up almost 10% of clean energy jobs, grew at the highest rate (10%) from 2021 to 2022 while professional and business services added the greatest absolute number of clean energy jobs (199) from 2021 to 2022 (Figure 5).

[14] Construction is comprised of all workers engaged in residential, commercial, and industrial building construction, contracting and electrical work, insulation and weatherization, or plumbing and heating, air conditioning, and ventilation work.
[15] Manufacturing encompasses petrochemical, industrial gas, ethyl alcohol, or other basic organic chemical manufacturing as well as heating and air conditioning equipment manufacturing, engine and compressor manufacturing, semiconductor manufacturing, and energy efficient product, appliance, or lighting manufacturing, as well as motor vehicle and parts manufacturing.
[16] Wholesale trade includes fuel dealers, motor vehicle and parts wholesalers, electrical equipment and household appliance wholesalers, and other wholesale related to clean energy products and technologies.
[17] Professional business services include all finance, legal, consulting, engineering, research, or architectural support.
[18] Other services is largely comprised of automotive repair and maintenance, but also includes organizational and non-profit work such as environment and conservation organizations, business associations, or advocacy organizations.

Among the establishments in Maine that are involved with clean energy-related activities, most (51%) are involved in the construction value chain, followed by 23% working in the professional and business services value chain. Manufacturing firms make up the smallest share (2%) of clean energy businesses in the state (Figure 6). Similar to Maine, the largest concentration of clean energy establishments in New York[19] are involved with the construction value chain (46%) while manufacturing firms represent the smallest share (2%).[20]

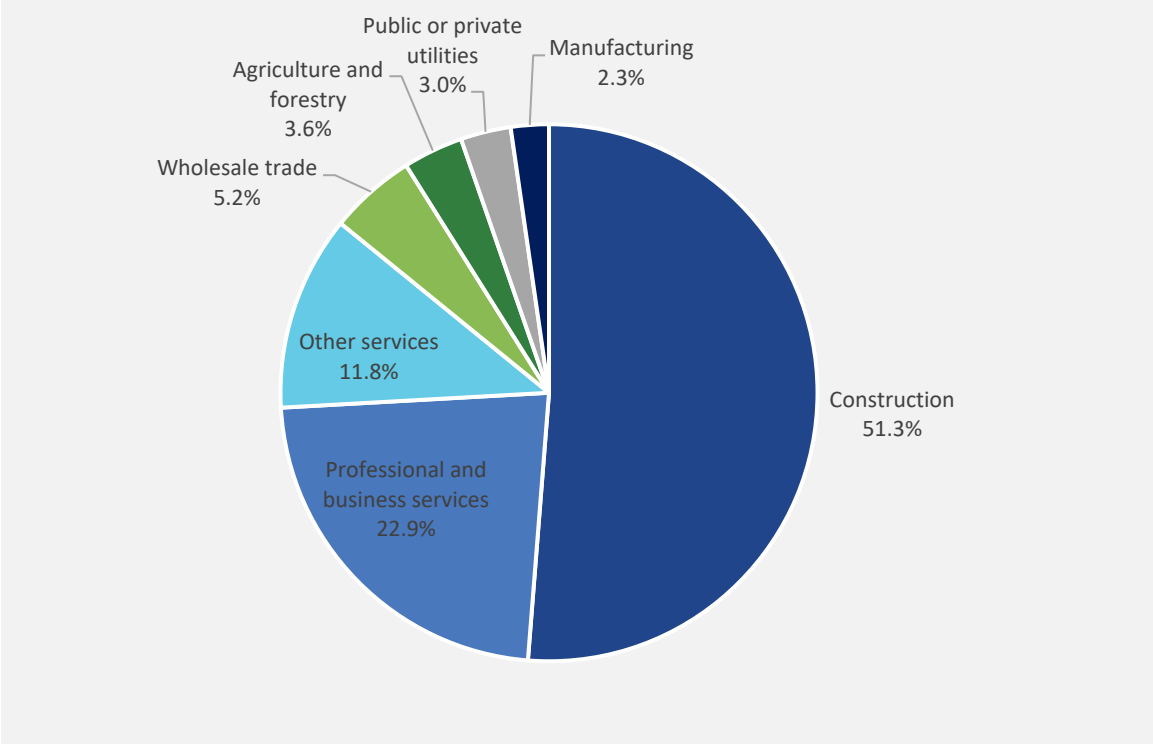
FIGURE 5. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2018-2022



[19] Maine and New York have varying clean energy definitions. Most significantly, Maine includes electric transmission and distribution workers. More details on the states' clean energy definitions can be found in Appendix E.

[20] Clean energy establishment data, Q42022, for New York are sourced from the New York Clean Energy Industry Report, based on the 2023 United States Energy and Employment report (USEER).

FIGURE 6. CLEAN ENERGY ESTABLISHMENTS BY VALUE CHAIN, 2022



Clean Energy Employment Intensity

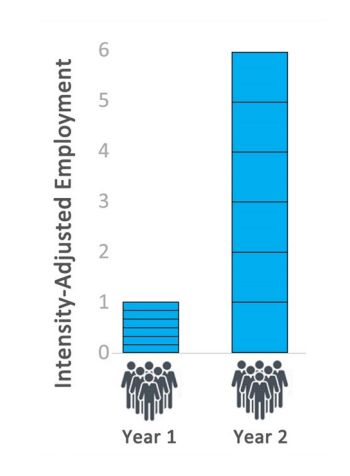
Intensity-adjusted clean energy job metrics are used to identify the concentration, or intensity, of clean energy activities. The clean energy employment featured in Figure 2 includes all workers that dedicate any amount of their labor hours or work week to clean energy goods and services. As such, an electrician who spends only a quarter of their work week installing or servicing solar panels would be counted as a clean energy worker in Figure 2. This definition of a clean energy worker is what is used throughout this report unless otherwise designated. The intensity-adjusted clean energy employment metric weights each of these jobs according to how much time workers were reported to spend on clean energy activities; the categories include less than half of their labor hours, half to the majority of their labor hours, or all of their labor hours.[21]

An increase in total employment would indicate that there are more workers in the labor market overall servicing clean energy technologies, while an increase in intensity-adjusted employment indicates that these workers are dedicating a larger proportion of their work week and labor hours to clean energy-specific activities; this could be the result of increased policy support or financial incentives spurring market demand for clean energy goods and services. For instance, a traditional HVAC worker might have spent only a third of their work week installing or maintaining energy efficient HVAC technologies in 2016.

[21] These categories correspond with the following delineations: 0% to 49% of labor hours, 50% to 99% of labor hours, and 100% of labor hours. For a full description of this methodology, please refer to Appendix D: Research Methodology.

If a state began offering rebates in 2017 for efficient heat pumps, that traditional HVAC worker would likely be spending more of their labor hours or work week installing high-efficiency heat pumps. This increase in activity per worker would not necessarily result in overall job growth in Figure 2 but would be captured as an increase in intensity-adjusted clean energy employment in Figure 7 below.

The following examples illustrates the importance of tracking intensity-adjusted clean energy employment. If an HVAC firm had 6 installers in 2018 who only 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, intensity-adjusted jobs would show a corresponding increase.



Intensity-adjusted clean energy employment (blue line in Figure 8) in Maine has grown at a higher rate than total clean energy employment (green line). Between 2018 and 2022, cumulative intensity-adjusted employment rose by 11% while total clean energy employment expanded by almost 6%. Thus, even as the number of clean energy workers in Maine is increasing, workers are also spending additional amounts of time on clean energy-related activities.

In addition, intensity-adjusted employment remained more resilient to the pandemic-related economic shocks and bounced back at a faster rate than total clean energy employment did after 2020. From 2019 to 2020, intensity-adjusted employment declined by 3% compared to the 6% decline of total clean energy employment. Between 2020 and 2022, intensity-adjusted employment rose by 11% while total clean energy employment grew by 9% (Figure 7), further demonstrating the importance of the clean energy sector to Maine's economy.

FIGURE 7. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT, 2018-2022

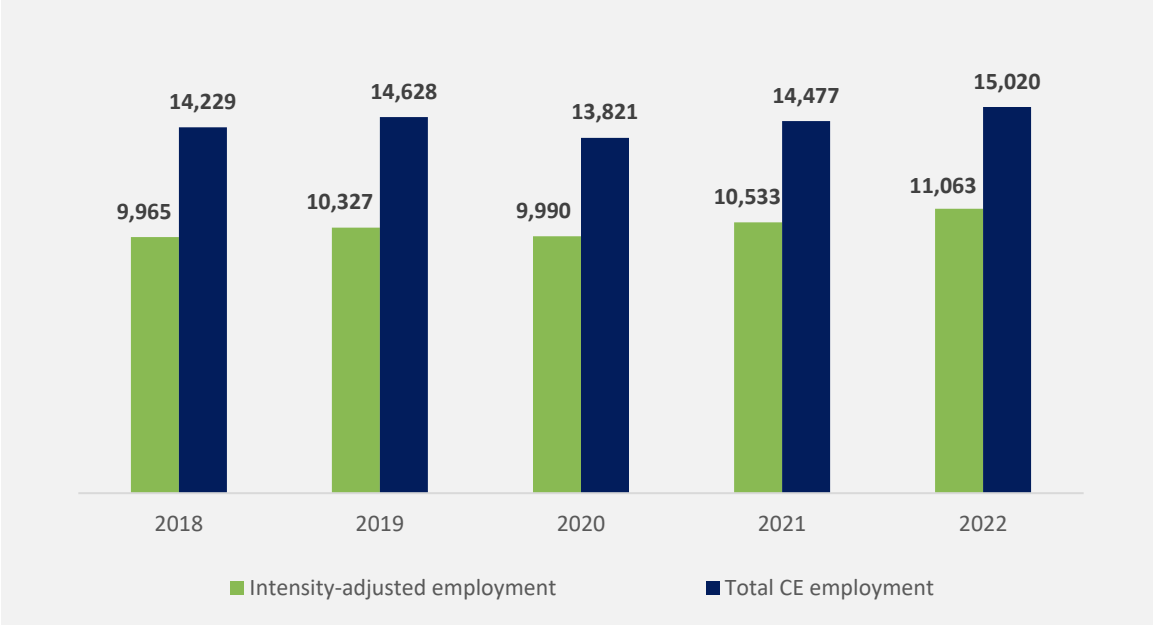
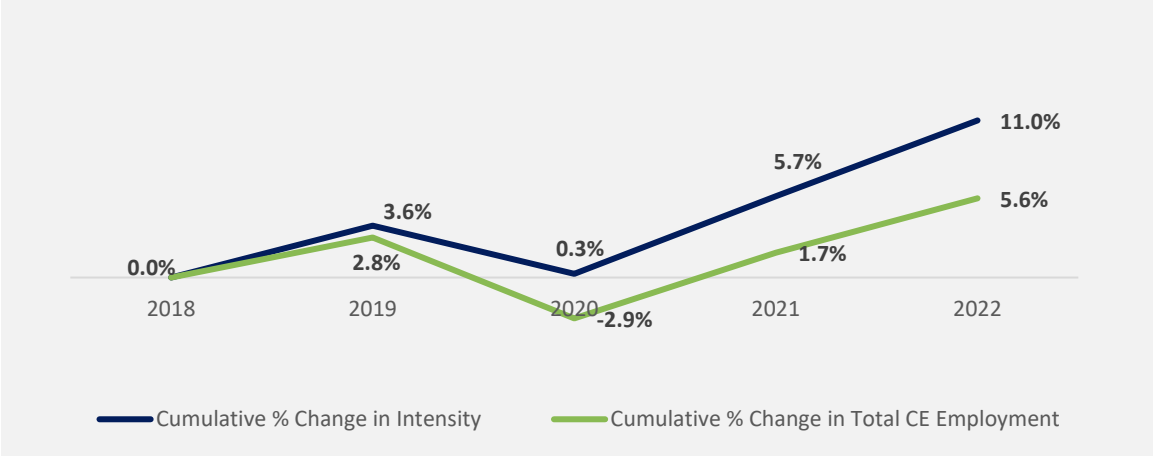


FIGURE 8. CUMULATIVE CHANGE IN INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT 2018-2022



The share of clean energy workers spending at least 50% of their labor hours on clean energy-related activities has risen steadily from 2018 to 2022, increasing by 6.4 percentage-points, or a growth rate of almost 11% (Figure 9). The proportion of workers who spent 100% of their time on clean energy-related activities also grew, but at a less even pace. As of 2022, three-fifths (61%) of workers spent all their time on clean energy-related activities, a gain of 3% from 2018 (Figure 10). In general, clean energy workers are spending an increasing amount of their time on clean energy-related activities, alongside the overall rise in total clean energy jobs in the state.

FIGURE 9. 50% ENERGY-INTENSITY CLEAN ENERGY WORKERS, 2018-2022

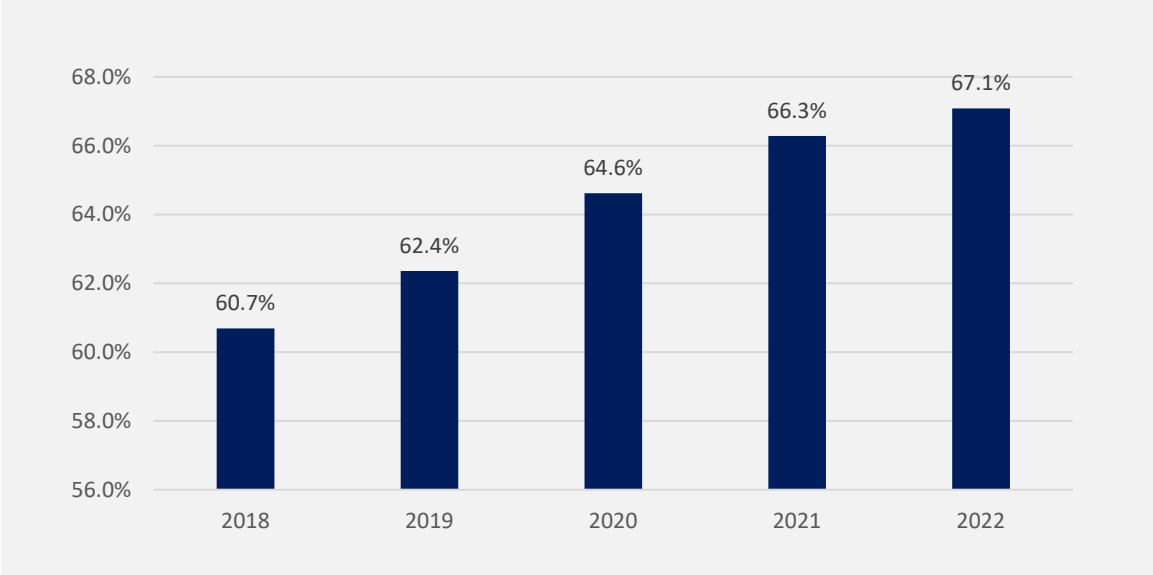
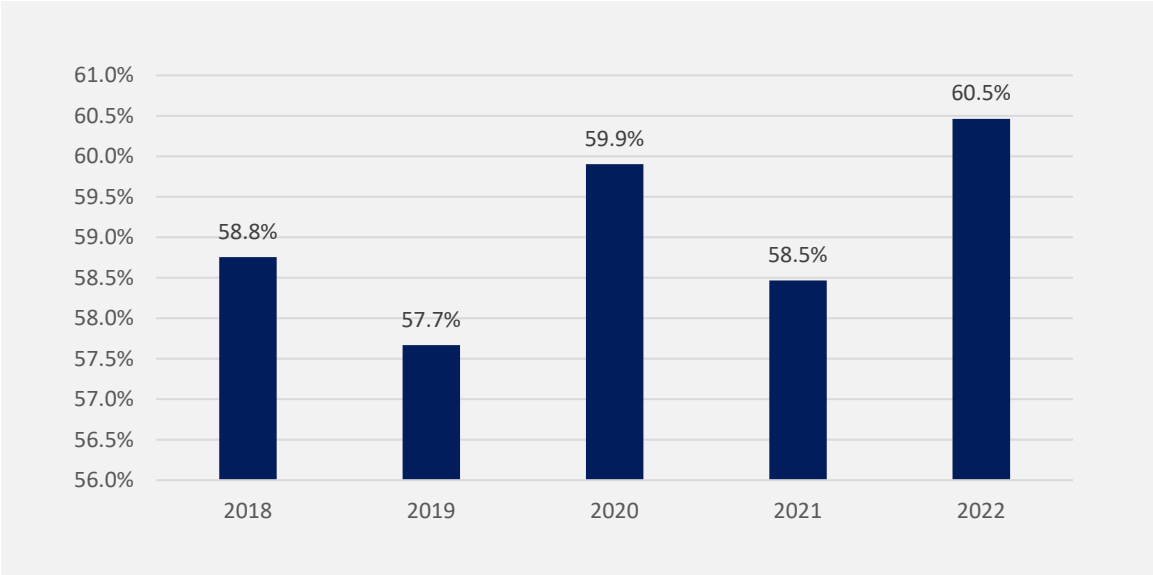


FIGURE 10. 100% ENERGY INTENSITY CLEAN ENERGY WORKERS, 2018-2022



Detailed Clean Energy Sector Employment

For the remainder of this report, employment is reported on a non-intensity adjusted basis.

Energy Efficiency

The energy efficiency sector encompasses all workers that are involved in the research, manufacture, sales, installation, repair, or professional service support of technologies and services designed to improve the efficiency of commercial, residential, and industrial buildings. The following are sub-technologies included in this sector: ENERGY STAR® appliances, lighting, and HVAC systems; advanced building materials and insulation technologies; solar thermal water heating and cooling; and other energy efficient technologies and processes like recycled building materials, heat pumps, or reduced water consumption products and appliances.

Among the energy efficiency sub-technologies in Maine, the high efficiency HVAC and renewable heating and cooling sub-technology remains the largest workforce, employing over 3,700 workers and comprising 43% of Maine's energy efficiency workers in 2022. In fact, this is the largest sub-technology not just within the energy efficiency segment, but among all sub-technologies within Maine's clean energy economy.

The "other" sub-technology accounts for the second largest share (26%) of energy efficiency employment and includes technologies like energy efficient software, energy auditing, etc. Energy STAR and efficiency lighting employment grew the most (23%), adding 180 jobs, between 2021 and 2022 (Figure 12).

FIGURE 11. LOCATIONS OF EFFICIENCY MAINE TRUST (EMT) QUALIFIED PARTNERS AND RESIDENTIAL REGISTERED VENDORS, MAINE[22]

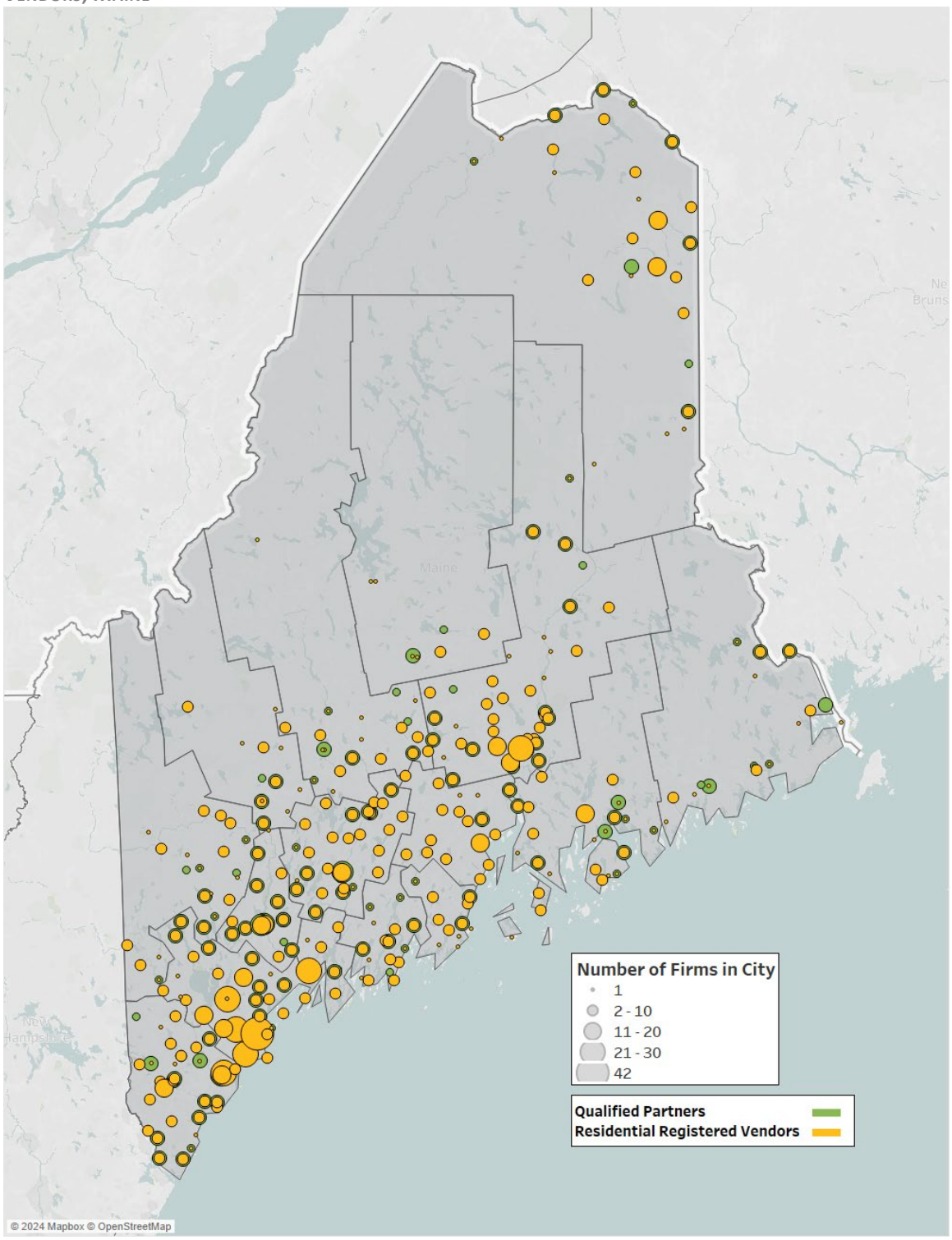
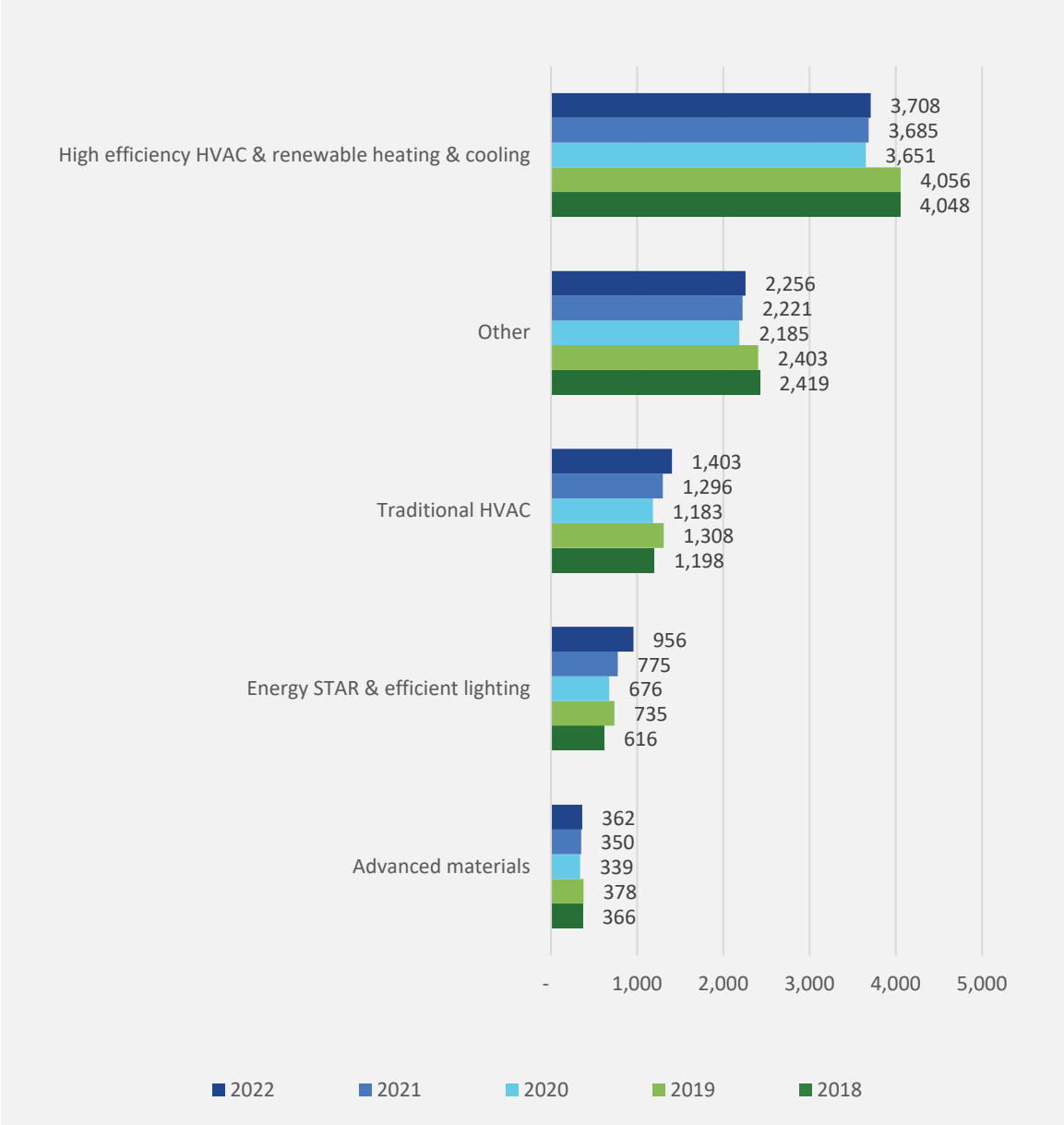


FIGURE 12. ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2018-2022[23]



[22] *Find a Qualified Partner*. Efficiency Maine Trust. https://www.efficiencymaine.com/at-work/qualified-partners/?svc%5B%5D=25%2C13%2C14%2C15&svc%5B%5D=16&zpc=03901&dst=10&srt=3

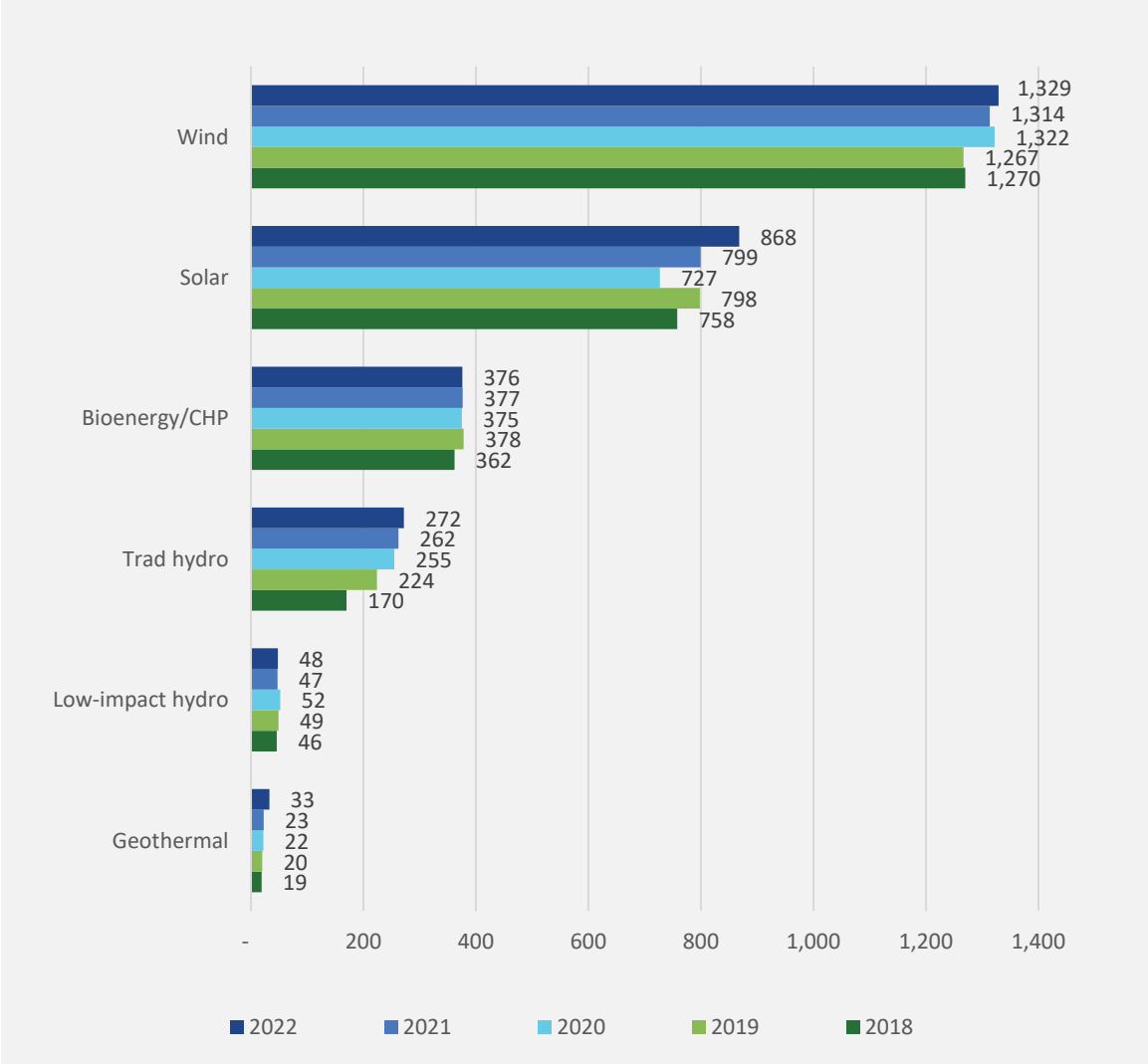
[23] Other energy efficiency technologies include variable speed motors, other design services not specific to a sub-technology, software not specific to a sub-technology, energy auditing, rating, monitoring, metering, and leak detection, energy efficiency policy not specific to a sub-technology, LEED certification, consulting not specific to a sub-technology, and phase-change materials.

Renewable Electric Power Generation

Clean energy generation jobs encompass all workers engaged in the research, development, production, manufacture, sales, installation, maintenance, repair, or professional service support of renewable electricity generating technologies. Such clean energy generation technologies include solar, wind, geothermal, bioenergy, and hydropower.

Excluding bioenergy/CHP employment, all renewable electric power generation (REPG) sub-technologies experienced employment growth between 2021 and 2022. Wind (including onshore and offshore) electric power generation continues to account for the largest share (45%) of REPG employment in 2022, followed by solar (30%). Focusing on developments in the wind energy supply chain will be critical for expanding the clean energy workforce given that a single blade manufacturer can hold up to 900 jobs. The smallest REPG sub-technologies are geothermal and low-impact hydro, which employ less than 50 workers each in 2022 (Figure 13).

FIGURE 13. RENEWABLE ELECTRIC POWER GENERATION (REPG) EMPLOYMENT BY SUB-TECHNOLOGY, 2018-2022[24]



[24] The wind energy employment estimate represents both land-based and offshore wind energy. CHP is Combined Heat and Power.

Alternative Transportation

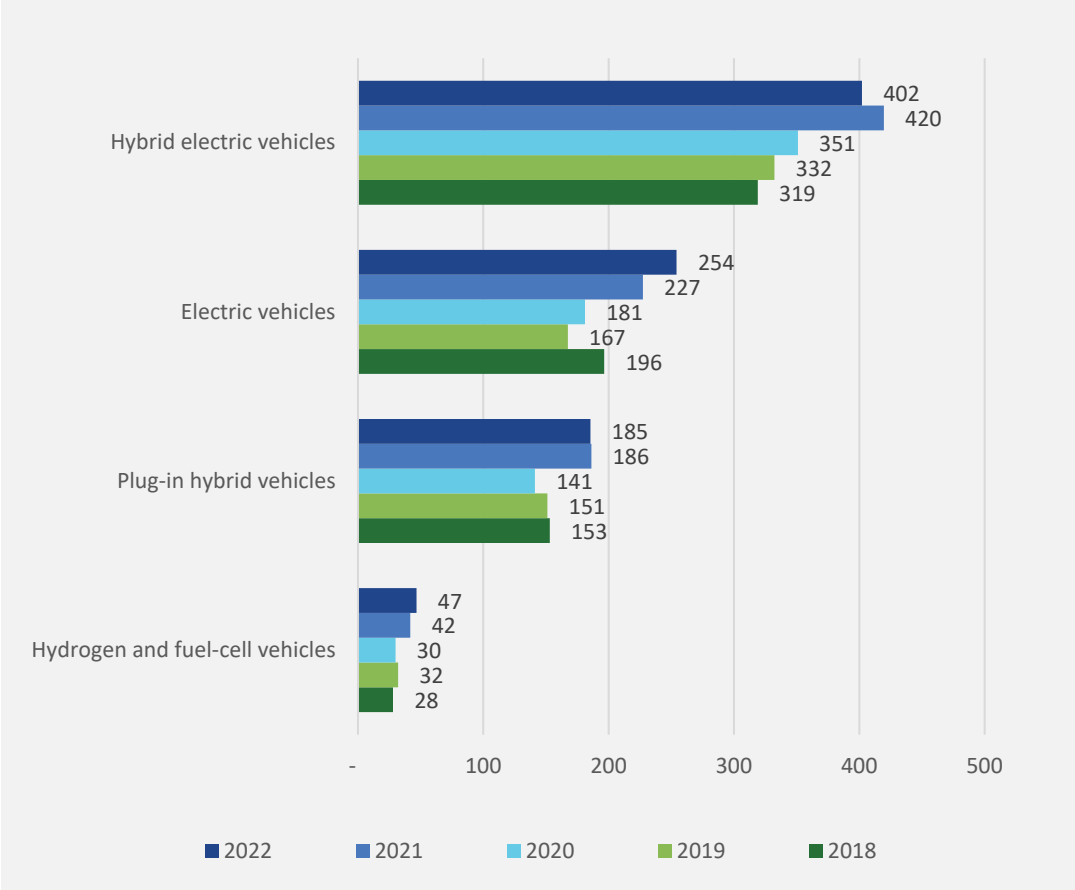
The alternative transportation technology sector is comprised of workers that support the manufacture, sales, repair and maintenance, and professional business support—such as legal, financial, engineering, or consulting services—of alternative vehicle technologies. Alternative transportation includes technologies like plug-in hybrid, hybrid electric, electric, hydrogen, and fuel cell vehicles.

Although employment in hybrid electric vehicles (HEV) declined by 4% from 2021 to 2022, this employment has accounted for the largest share of clean energy alternative transportation jobs overall in Maine since 2016. Regionally, Vermont was the only other state in the Northeast to see a decline (2%) in HEV employment from 2021. Pennsylvania and New Hampshire did not experience any growth while increasing rates in the remaining Northeast states ranged from 8% growth in Rhode Island to 19% growth in Massachusetts. Nationally, there were 7% more HEV jobs in 2022 than in 2021.

Hydrogen and fuel-cell vehicle workers comprise the smallest proportion of the alternative transportation workforce and experienced the largest percent growth (12%) between 2021 and 2022. The electric vehicle (EV) workforce expanded the most in absolute jobs (27) from 2021 to 2022 (Figure 14). Meanwhile, light-duty EV registrations in Maine increased from approximately 3,000 in 2021 to 5,000 in 2022, a growth of 67%.[25]

[25] *Vehicle Registration Counts by State*. Alternative Fuels Data Center. U.S. Department of Energy's Vehicle Technologies Office. 2022 & 2021. https://afdc.energy.gov/vehicle-registration?year=2022

FIGURE 14. ALTERNATIVE TRANSPORTATION EMPLOYMENT BY SUB-TECHNOLOGY, 2018-2022



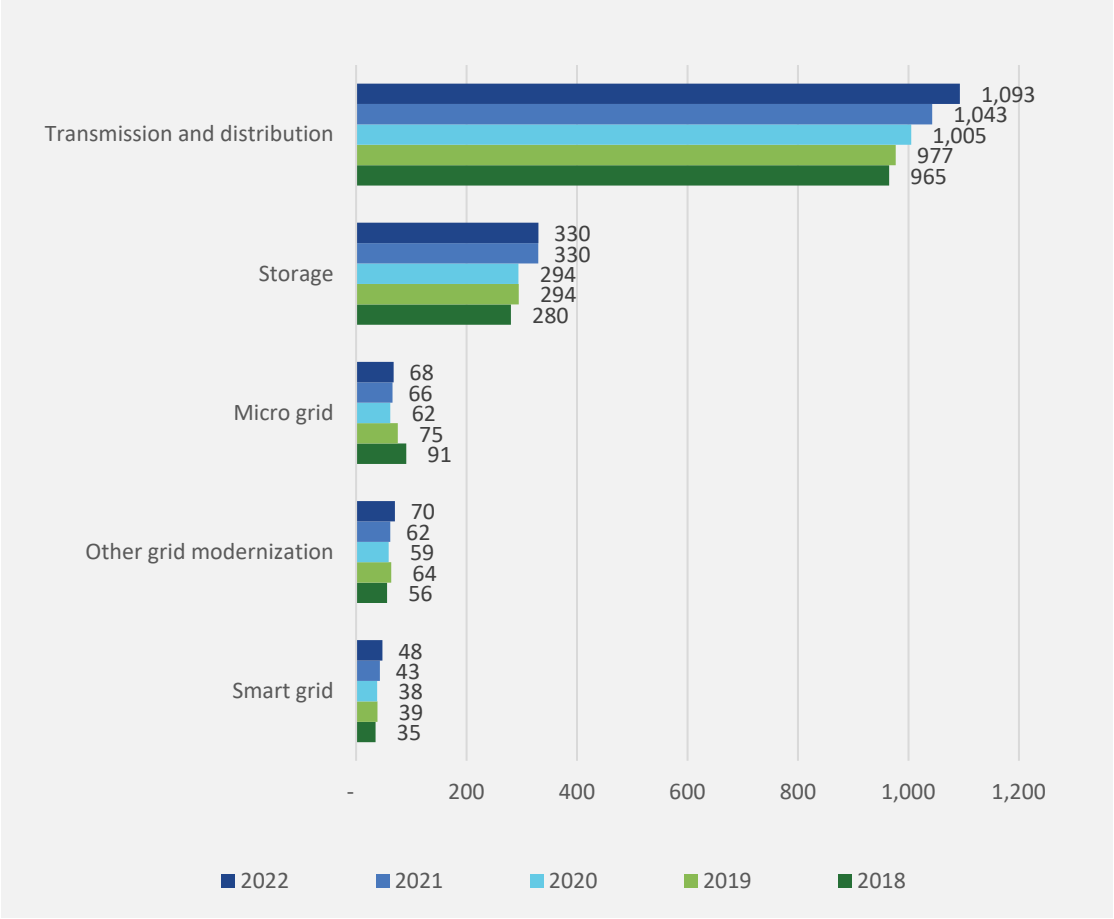
Grid Modernization & Storage

For the purposes of this report, grid modernization and storage workers include any individual that supports the deployment (construction), manufacture, wholesale trade, or legal, financial, and engineering services of smart grid and energy storage technologies. This also includes electrical transmission and distribution[26] workers.

Over two-thirds (68%) of 2022 employment in Maine's clean energy grid modernization and storage sector is found within transmission and distribution jobs. Clean storage—which includes pumped hydropower storage[27], battery storage[28], mechanical storage[29], thermal storage[30], and biofuel storage (including ethanol and biodiesel) – comprises one-fifth (21%) of grid modernization & storage employment. The smallest sub-technologies in this sector are microgrid, other grid modernization, and smart grid, each accounting for less than 5% of this sector's employment in 2022. Aside from clean storage which did not increase in employment between 2021 and 2022, all clean energy grid modernization and storage sub-technologies employment rose from 2021 to 2022 (Figure 15).

[26] This consists of Electric Power Transmission, Control, and Distribution (NAICS 22112) workers.
[27] Hydroelectric energy storage used by electric power systems for load balancing. This method stores the gravitational potential energy of water pumped from a lower elevation reservoir to a higher elevation.
[28] This includes battery storage for solar generation and lithium batteries, lead-based batteries, other solid-electrode batteries, vanadium redox flow batteries, and other flow batteries.
[29] This includes flywheels and compressed air energy storage.
[30] Temporary storage of energy for later use when heating or cooling is needed.

FIGURE 15. GRID MODERNIZATION & STORAGE EMPLOYMENT BY SUB-TECHNOLOGY, 2018-2022

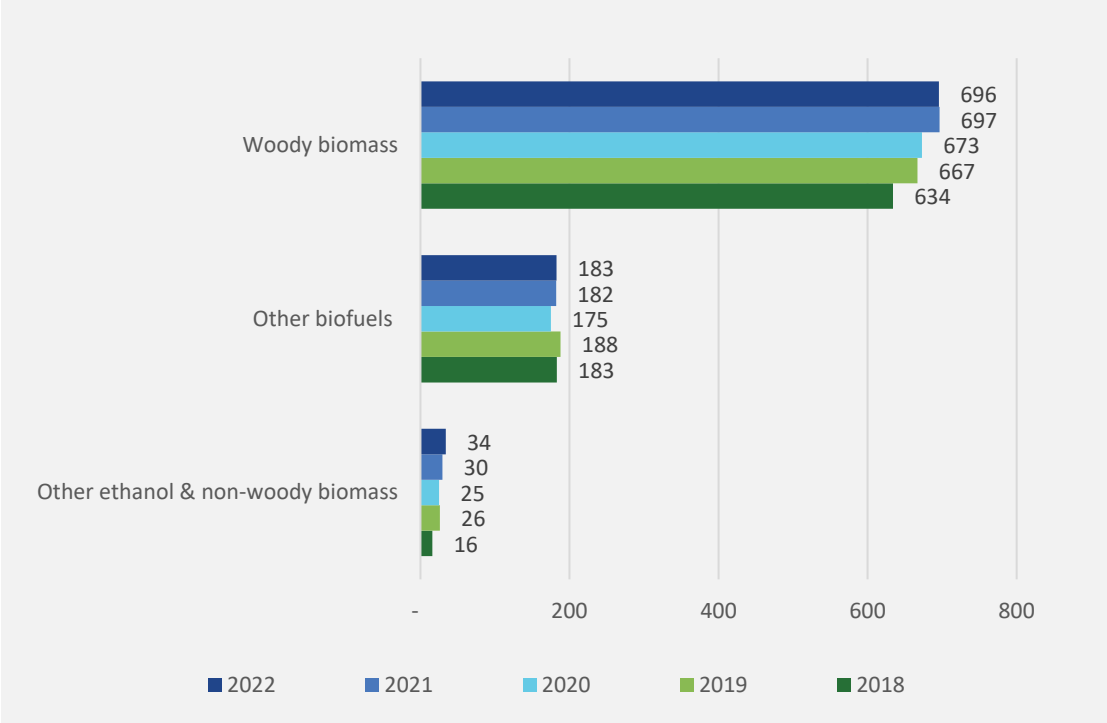


Renewable Fuels

The renewable fuels sector includes all workers involved in the production, distribution and sales, or professional and business service support for clean fuels and clean fuel technologies that use woody (including trees and woody plant parts) and non-woody (this includes fuel made from straw, manure, vegetable oil, and animal fats) biomass.

In total, there are over 900 workers employed in the renewable fuels technology sector of Maine's clean energy industry. Most (76%) of the renewable fuel workers are found working with woody biomass. Since 2018, woody biomass employment has increased by 10%, or 62 workers, and has been a large driver of growth in the renewable fuels sector. Other biofuels makes up one-fifth (20%) of renewable fuels employment while the smallest sub-technology in this sector, other ethanol and non-woody biomass, employed 34 workers in 2022 (Figure 16).

FIGURE 16. RENEWABLE FUELS EMPLOYMENT BY SUB-TECHNOLOGY, 2018-2022[31]



[31] Other biofuels includes other fuel derived directly from living matter.
Other ethanol/ non-woody biomass includes fuel made from other materials such as straw, manure, vegetable oil, or animal fats.

Clean Energy Demographics

Maine has a clean energy workforce that is more representative by race, ethnicity, and veteran status relative to its overall labor pool. Its share of Hispanic or Latino workers (4%) as well as workers of all non-White races (9%) is higher than the 2% and 6% respective representation within the statewide labor force, as well as the construction (2% and 3%, respectively) and manufacturing (2% and 6%, respectively) industries. Veterans make up almost 8% of the state's clean energy workforce and approximately 7% of the overall workforce (Table 1).

On the other hand, women and workers aged 55 years and over are notably underrepresented in Maine's clean energy workforce compared to the state's overall economy. The composition of genders within Maine's clean energy and manufacturing industries (26% female in both) is more representative of females than in the construction industry (15%). Yet, in all three clean energy, construction, and manufacturing industries, the percentage of females employed is much lower than the share in the state's overall labor force (51%). Further, workers aged 55 years and older make up one-fifth (20%) of the clean energy talent while representing 27% to 29% of the state's total workforce and the construction and manufacturing industries (Table 1).

When looking at other states in the region, Maine's concentration of females among its clean energy workers is relatively similar to those of Vermont (27%), New York (26%), and the U.S. (26%), but lower than Rhode Island's (36%) and Massachusetts' (31%) female worker shares. In general, the proportion of White workers in the clean energy workforce is higher in Maine (91%) than in Vermont (88%), Rhode Island (83%), the U.S. (75%), Massachusetts (74%), and New York (72%). This pattern continues among non-Hispanic and Latino workers given that Maine has a smaller share of Hispanic and Latino workers in its clean energy talent pool than the states listed above and the country. Compared to the national average (17%), Maine has a larger percentage of clean energy workers aged 55 years and over (20%). In fact, Maine's clean energy talent pool has the largest composition of workers this age relative to Massachusetts (15%), Vermont (14%), and Rhode Island (7%) as well.[32]

Since 2020, the demographic composition of the clean energy workforce has remained relatively constant.

[32] Demographic data for Massachusetts, New York, Rhode Island, and Vermont are sourced from their respective Clean Energy Industry Reports, based on the 2023 United States Energy and Employment report (USEER). U.S. demographic data are sourced from 2023 USEER. Note that the demographic compositions for each region are based on each region's own clean energy definition. The most significant differences include the U.S.'s inclusion of nuclear energy workers, Maine's inclusion of electric power distribution workers, New York's exclusion of micro grid workers, and Massachusetts' exclusion of traditional HVAC workers. More details on the states' clean energy definitions can be found in Appendix E: State Clean Energy Definitions.

TABLE 1. CLEAN ENERGY WORKFORCE DEMOGRAPHICS, 2022[33]

	Maine Clean Energy Industry[34]	Maine Overall Economy	Maine Construction Industry	Maine Manufacturing Industry
Female	25.6%	51.4%	14.8%	25.8%
Male	74.4%	48.6%	85.2%	74.2%
White	90.8%	93.8%	96.6%	93.7%
Hispanic or Latino	4.0%	2.1%	1.9%	2.0%
Black or African American	3.3%	2.5%	1.1%	2.4%
Asian	2.5%	1.6%	0.5%	2.1%
American Indian or Alaska Native	0.7%	0.6%	0.6%	0.5%
Native Hawaiian or other Pacific Islander	0.2%	0.1%	0.1%	0.1%
Two or more races	2.4%	1.5%	1.1%	1.3%
Veterans	7.6%	6.5%[35]	Insufficient data	
55 and over	20.4%	27.6%	26.6%	28.8%

Demographics for key occupations found in the clean energy industry are included in the below tables. The data is representative of workers across all industries in Maine and is not specific to the clean energy industry. Wind turbine service technicians within the renewable electric power generation technology sector have the highest share of workers aged 55 years and over (30%) compared the other selected occupations while construction laborers who frequently work in building electrification and energy efficiency have the largest proportion of Hispanic and Latino workers (7%). Racial compositions are relatively comparable across these selected occupations (Table 2 and Table 3).

[33] Demographic data for Maine's overall economy, construction industry (NAICS 23), and manufacturing industry (NAICS 31) are compiled from JobsEQ using the average of four quarters ending in Q2 2022.

[34] The demographic estimation for clean energy technology sectors cannot be provided due to low sample sizes.

[35] *Table 6A. Employment status of veterans 18 years and over by state, 2022 annual averages*. U.S. Bureau of Labor Statistics. https://www.bls.gov/news.release/vet.t06A.htm
& *Quarterly and Annual Industry Employment and Wages*. Center for Workforce Research and Information. Maine Department of Labor. https://www.maine.gov/labor/cwri/qcew1.html

TABLE 2. DEMOGRAPHICS OF SELECTED CLEAN ENERGY OCCUPATIONS, MAINE, 2022[36]

	Selected Energy Efficiency Occupations				
	Electricians (47-2111)	Heating, Air Conditioning, and Refrigeration Mechanics and Installers (49-9021)	Construction Laborers (47-2061)	Carpenters (47-2031)	Misc. Construction and Related Workers (incl. Weatherization Technicians) (47-4099)
Female	2.6%	2.7%	5.5%	4.0%	5.5%
Male	97.4%	97.3%	94.5%	96.0%	94.5%
White	97.5%	96.8%	95.9%	96.4%	96.0%
Hispanic or Latino	2.4%	2.1%	7.0%	5.0%	4.3%
Black or African American	0.7%	1.0%	0.9%	0.5%	0.6%
Asian	0.3%	0.3%	0.4%	0.3%	0.3%
American Indian or Alaska Native	0.5%	0.2%	0.8%	0.6%	0.8%
Native Hawaiian or other Pacific Islander	0.0%	0.0%	0.0%	0.0%	0.0%
Two or more races	1.0%	1.7%	2.0%	2.1%	2.3%
55 and over	25.5%	24.7%	22.4%	27.5%	25.7%

TABLE 3. DEMOGRAPHICS OF SELECTED CLEAN ENERGY OCCUPATIONS, MAINE, 2022[37]

	Selected Renewable Electric Power Generation Occupations		Selected Transmission & Distribution Occupation	Selected Alternative Transportation Occupation
	Solar Photovoltaic Installers (47-2231)	Wind Turbine Service Technicians (49-9081)	Electrical Power-Line Installers and Repairers (49-9051)	Automotive Service Technicians and Mechanics (49-3023)
Female	4.9%	5.0%	1.8%	3.4%
Male	95.1%	95.0%	98.2%	96.6%
White	95.8%	96.1%	96.2%	95.2%
Hispanic or Latino	4.7%	2.0%	1.0%	2.8%
Black or African American	0.6%	0.7%	0.4%	0.8%
Asian	0.2%	0.4%	0.1%	0.5%
American Indian or Alaska Native	0.7%	0.3%	0.5%	0.5%
Native Hawaiian or other Pacific Islander	0.0%	0.0%	0.0%	0.0%
Two or more races	2.6%	2.5%	2.8%	3.0%
55 and over	25.6%	30.0%	18.5%	25.7%

[36] Sourced from JobsEQ, as of 2023Q3, based on Place of Residence estimates across all industries in Maine.
[37] Sourced from JobsEQ, as of 2023Q3, based on Place of Residence estimates across all industries in Maine.

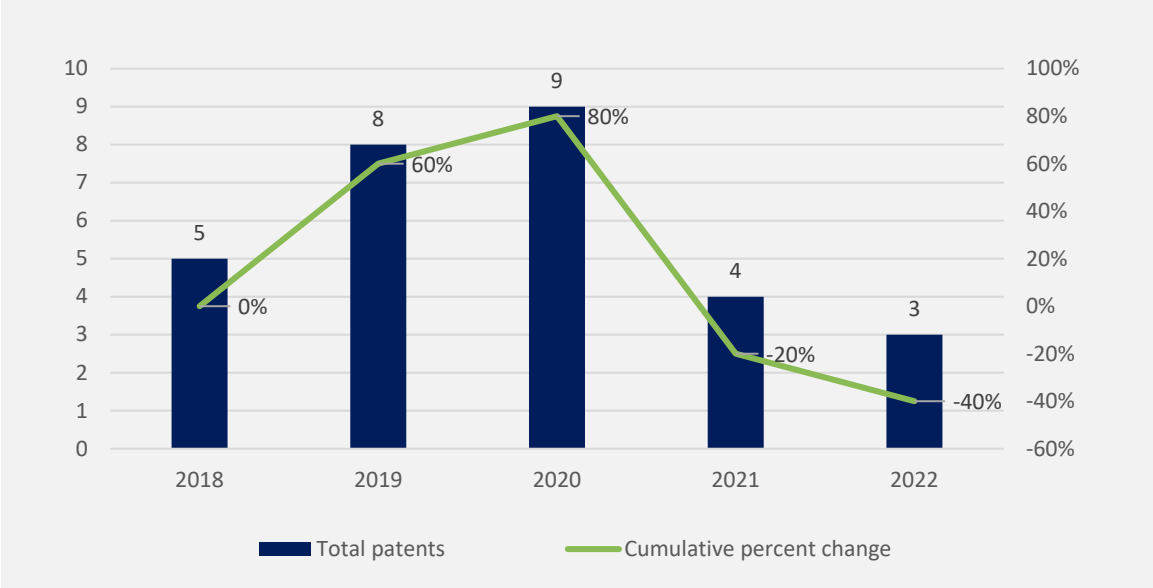
Clean Energy Patents

This section analyzes clean energy-related patents granted to projects or people (or groups of people) in the state of Maine. Appendix A contains the list of technologies that are considered to be clean energy technologies in Maine,[38] which was utilized to classify patent data in this section. Only patents administered from 2018 to 2022 are included in the analysis.

Patents

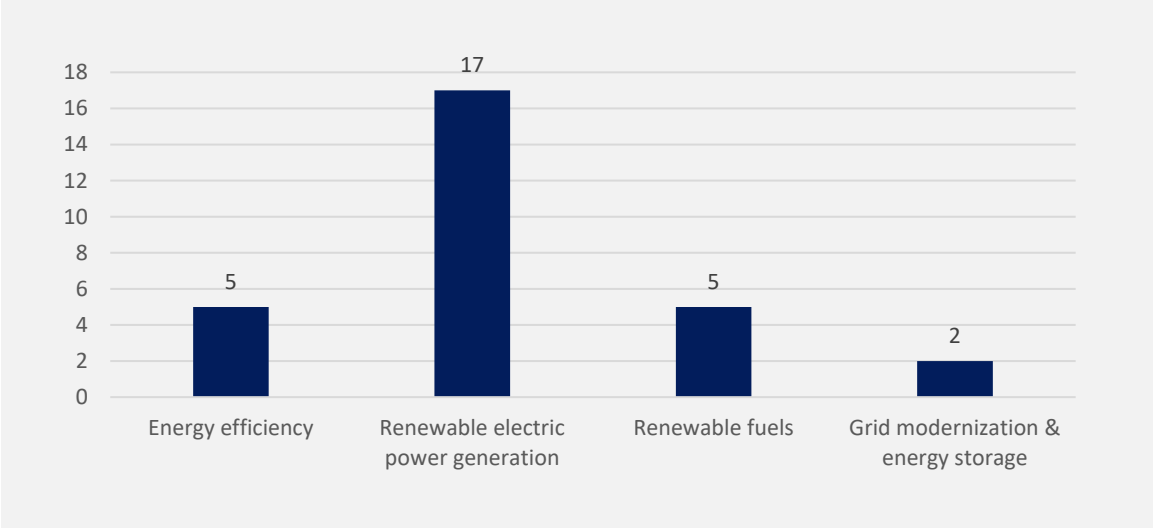
From 2018 to 2022, a total of 29 clean energy patents were granted to entities in Maine.[39] Based on the U.S. Patent & Trademark Office PatentsView data, three patents were assigned in 2022, a decline from four patents in 2021 and nine patents in 2020, the year the largest number of patents were granted (Figure 17). Total patents included those involved with energy efficiency, grid modernization and energy storage, renewable electric power generation, and renewable fuel developments. Most patents (17) were related to the renewable electric power generation technology sector, with over half (53%) supporting the wind industry (Figure 18). In comparison, Massachusetts received more clean energy patents per capita (0.040%) than Maine (0.002%) between 2018 and 2022.[40]

FIGURE 17. CLEAN ENERGY PATENTS IN MAINE, 2018-2022



[38] Appendix A contains the list of technologies to be considered clean energy in Maine.
[39] An additional eight patents from this time period are potentially clean energy-related but are excluded from this analysis due a lack of clarity around the type of fuel source intended to be used in the innovation.
[40] The ratio of total clean energy patents per capita uses the average population from 2018 to 2022 for these states. Note that Massachusetts and Maine have varying clean energy definitions. Most significantly, Maine includes electric transmission and distribution workers, and Massachusetts excludes traditional HVAC employment. More details on the states' clean energy definitions can be found in Appendix E: State Clean Energy Definitions.

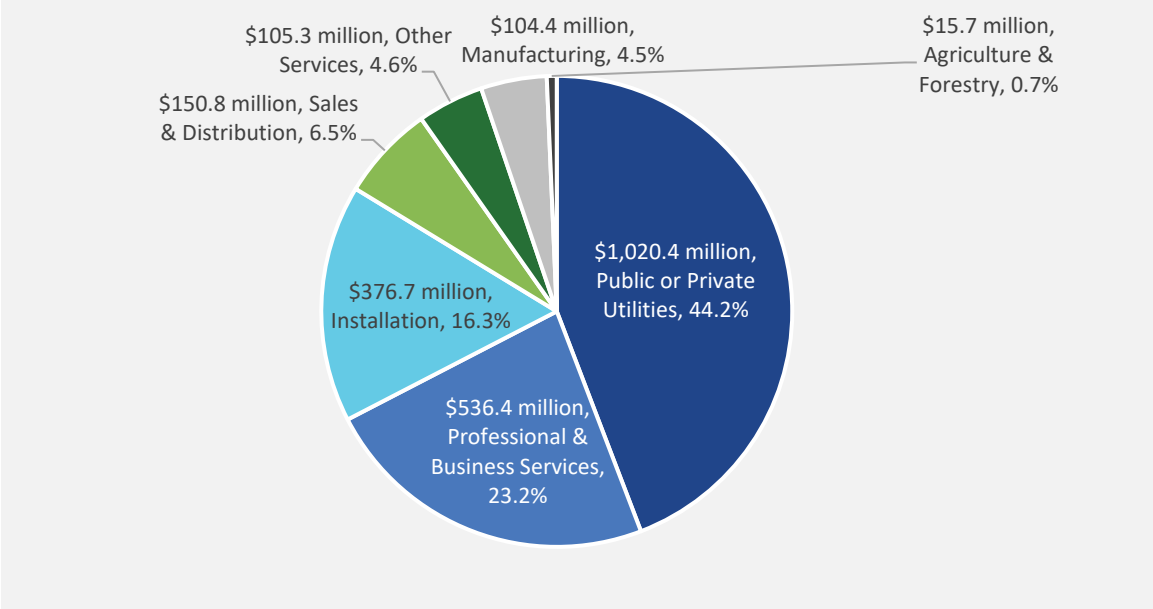
FIGURE 18. CLEAN ENERGY PATENTS IN MAINE, 2018-2022, BY TECHNOLOGY SECTOR



Gross State Product Analysis

In 2022, clean energy contributions to Maine's Gross State Product (GSP) totaled $2.31 billion,[41] or almost 3% of the total overall GSP. Just over two-fifths (44%) of the clean energy economic output came from the utilities sector, approximately $1.02 billion. When compared to the state's total economic output of $84.5 billion, clean energy utilities produced just over 1%. Agriculture and forestry, already the smallest sector in Maine's total economic output, contributed less than 1% to the state's clean energy GSP (Figure 19 and Figure 20). For further comparison, clean energy contributions accounted for just over 2% of Massachusetts' total GSP in 2022 while it reached almost 3% in Maine. With respect to their populations, Maine's clean energy GSP contributions were $1,690 per capita, compared to $2,129 per capita in Massachusetts.[42]

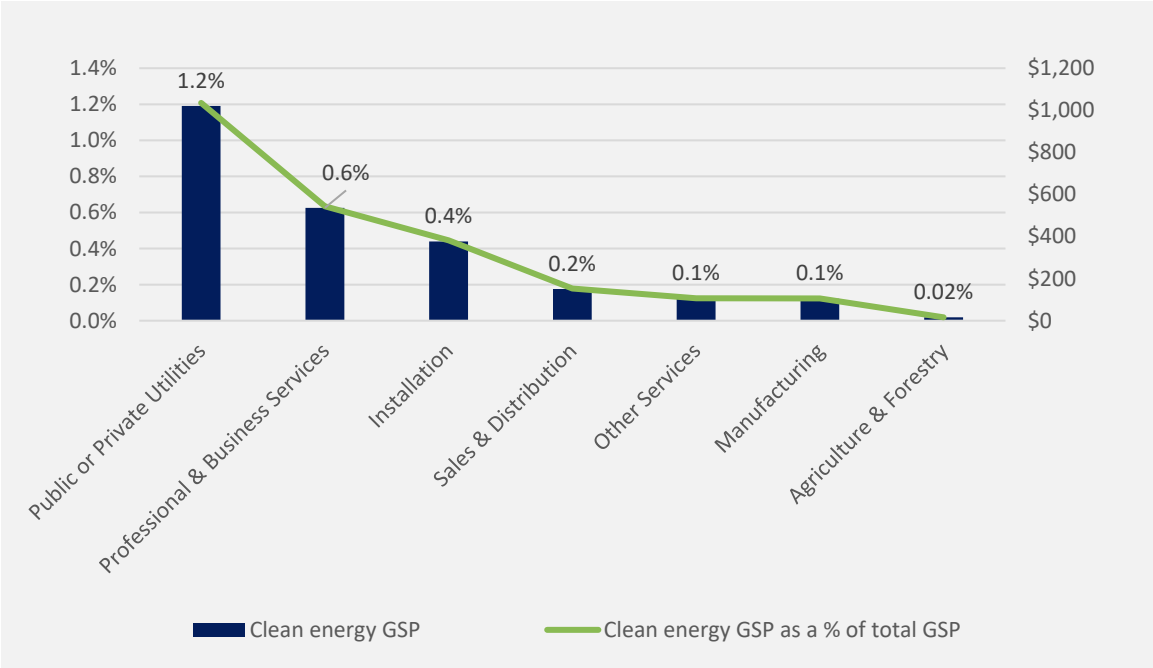
FIGURE 19. MAINE CLEAN ENERGY GROSS PRODUCT, 2022, BY SECTOR



[41] $2,309,606,197

[42] Massachusetts and Maine have varying clean energy definitions. More specifically, Massachusetts does not include workers in electric transmission and distribution, traditional hydro, traditional HVAC, other ethanol/non-woody biomass, hybrid vehicles, plug-in vehicles, and hydrogen and fuel-cell vehicles but does include other grid and other vehicles jobs compared to Maine. More details on the states' clean energy definitions can be found in Appendix E: State Clean Energy Definitions.

FIGURE 20. MAINE'S CLEAN ENERGY CONTRIBUTIONS TO GROSS STATE PRODUCT, 2022, BY SECTOR



Appendix A: Maine 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 technology sectors of clean energy generation; clean grid and storage; energy efficiency; clean fuels; and alternative transportation. These jobs also include supporting services such as consulting, finance, tax, and legal services related to energy.

RENEWABLE ELECTRIC POWER GENERATION

- Solar photovoltaic electric generation
- Concentrated solar electric generation
- Wind generation
- Geothermal generation
- Bioenergy/biomass generation, including combined heat and power
- Low-impact hydroelectric generation, including wave/kinetic generation
- Traditional hydropower generation

GRID MODERNIZATION & ENERGY STORAGE

Electric Power Transmission and Distribution

- Electric power transmission, control, distribution
- Smart grid
- Micro grid
- 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

ENERGY EFFICIENCY

- Traditional HVAC goods, control systems, and services (HVAC firms/employees who work with traditional HVAC goods, systems, and services most of the time but conduct some clean energy HVAC work such as installing high efficiency HVAC systems and components as well.)
- High efficiency HVAC and renewable heating and cooling

    - 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
    - Solar thermal water heating and cooling
    - Other renewable heating and cooling (geothermal, biomass, heat pumps, etc.)
- ENERGY STAR® and 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
    - Recycled building materials
    - Reduced water consumption products and appliances

RENEWABLE FUELS

- Woody biomass
- Other ethanol and non-woody biomass, including biodiesel
- Other biofuels

ALTERNATIVE TRANSPORTATION

- Plug-in hybrid vehicles
- Electric vehicles
- Hybrid electric vehicles
- Hydrogen and fuel cell vehicles

Appendix B: Clean Energy Occupations

The following list contains 27 projected high-growth and high-priority clean energy occupations, based on regional modeling and workforce assessment efforts, and their Standard Occupational Classification (SOC) codes, in order from the largest to smallest employment.

SOC Code	Occupation Name	Employment, Maine Overall Economy[43]
11-1020	General and Operations Managers	13,816
43-9060	Office Clerks, General	11,855
47-2030	Carpenters	6,524
49-9070	Maintenance and Repair Workers, General	6,407
47-2060	Construction Laborers	6,259
51-2090	Miscellaneous Assemblers and Fabricators	5,192
13-1199	Business Operations Specialists, All Other	4,722
49-3020	Automotive Technicians and Repairers	4,405
47-2110	Electricians	3,689
47-1010	First-Line Supervisors of Construction Trades and Extraction Workers	3,515
41-3090	Miscellaneous Sales Representatives, Services	3,156
13-1080	Logisticians and Project Management Specialists	3,113
47-2150	Pipelayers, Plumbers, Pipefitters, and Steamfitters	2,713
47-2073	Operating Engineers and Other Construction Equipment Operators	2,366
49-9090	Miscellaneous Installation, Maintenance, and Repair Workers	2,281
49-9020	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	2,183
13-1050	Cost Estimators	1,025
17-2071	Electrical Engineers	816
51-2040	Structural Metal Fabricators and Fitters	759
47-2180	Roofers	712
49-9051	Electrical Power-Line Installers and Repairers	647
47-4010	Construction and Building Inspectors (incl. Energy Auditors)	631
47-2130	Insulation Workers	526
51-4190	Miscellaneous Metal Workers and Plastic Workers	484
47-4090	Miscellaneous Construction and Related Workers (incl. Weatherization Technicians)	144
47-2230	Solar Photovoltaic Installers	109
49-9080	Wind turbine Service Technicians	50

[43] Sourced from JobsEQ, as of 2023Q3 for total industries in Maine. Based on a four-quarter moving average of place of work estimates.

Appendix C: Regional Clean Energy Employment

The following table and map provide clean energy employment data by county for total clean energy jobs in Q4 of 2022. Waldo County has the highest concentration of clean energy workers in its overall workforce (5%) while Lincoln County has the largest share of energy efficiency workers (3%). In terms of absolute job numbers, the greatest clean energy and energy efficiency employment is found in Cumberland County (Table 4 and Figure 21).

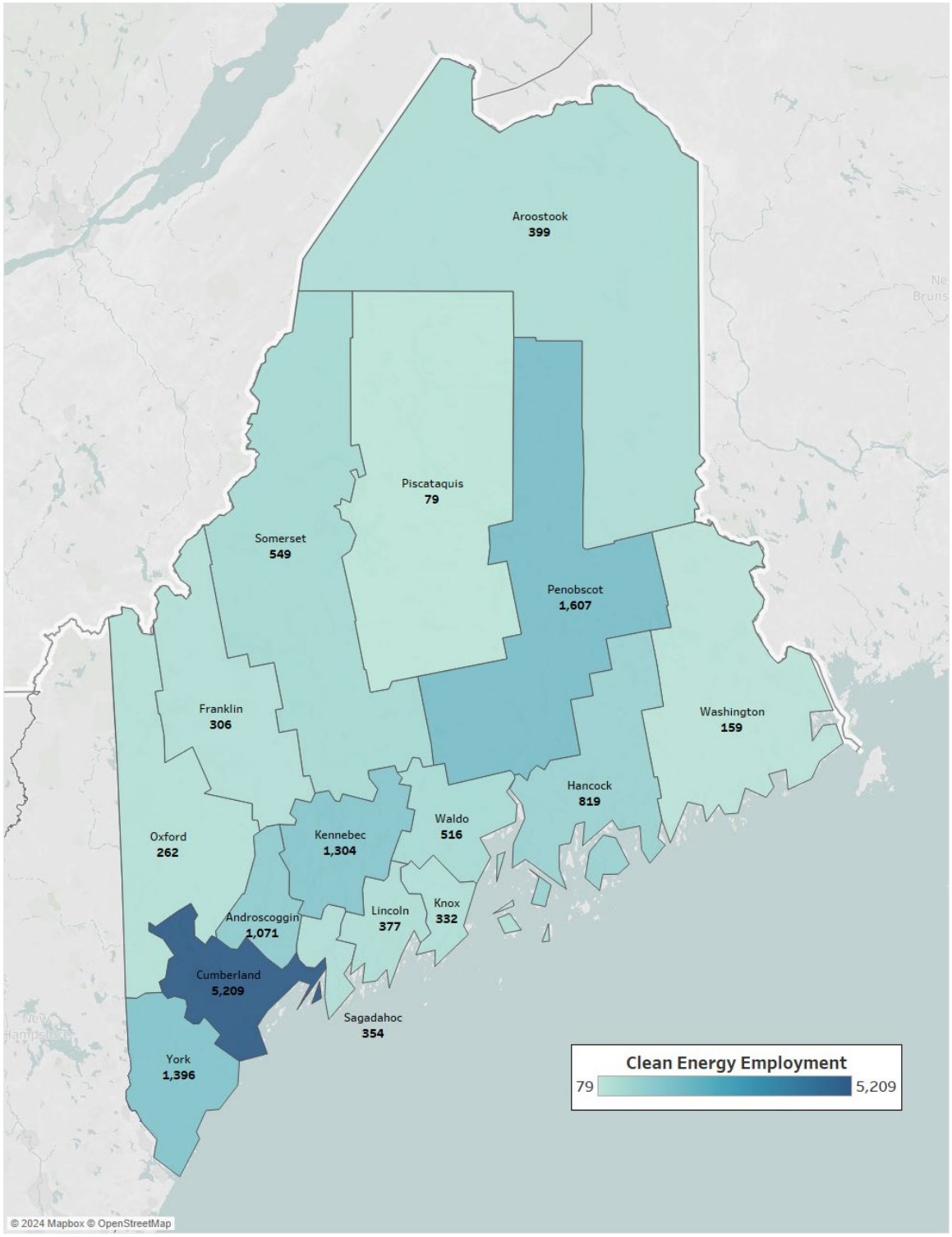
Since the last quarter of 2020, Kennebec County has grown the most (24%) in terms of clean energy jobs, followed by Franklin County (16%) and Sagadahoc County (16%). Only Hancock County and Lincoln County have seen increases in their energy efficiency workforces, with a 2% increase in Hancock County and a 41% increase in Lincoln County since 2020.[44]

TABLE 4. CLEAN ENERGY, ENERGY EFFICIENCY, AND TOTAL EMPLOYMENT BY COUNTY, MAINE, 2022

County Name	Clean Energy Jobs	Jobs in Energy Efficiency	Total Jobs in Overall Workforce[45]
Androscoggin	1,071	642	47,756
Aroostook	399	196	25,761
Cumberland	5,209	3,125	186,635
Franklin	306	97	10,355
Hancock	819	522	22,171
Kennebec	1,304	686	60,787
Knox	332	234	17,043
Lincoln	377	281	10,866
Oxford	262	163	16,892
Penobscot	1,607	879	71,550
Piscataquis	79	41	5,568
Sagadahoc	354	246	16,545
Somerset	549	337	15,796
Waldo	516	153	11,457
Washington	159	75	10,344
York	1,396	852	75,657
N/A[46]	281	154	26,391

[44] Q42020 clean energy employment by county is sourced from the 2021 Maine Clean Energy Industry Report.
[45] Quarterly and Annual Industry Employment and Wages. Center for Workforce Research and Information. Maine Department of Labor. https://www.maine.gov/labor/cwri/qcew1.html
[46] This category includes all clean energy jobs that could not be attributed to a single county. Total jobs in Maine's overall workforce in this category is sourced from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages database.

FIGURE 21. CLEAN ENERGY EMPLOYMENT BY COUNTY, MAINE, 2022



Appendix D: Research Methodology

EMPLOYMENT DATA[47]

Data for the 2023 Maine Clean Energy Industry Report is taken from data collected for the 2023 US Energy and Employment Report (USEER). Each year, the survey was administered by phone and web. The phone survey was conducted by ReconMR, and the web instrument was programmed internally. Each respondent was required to use a unique ID in order to prevent duplication.

The 2023 USEER survey in Maine resulted in 4,048 calls and 688 emails to potential respondents. 304 business establishments participated in the survey. Each year, the 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 for the 2023 USEER survey is +/-5.57% at a 95% confidence level.

INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT

Intensity-adjusted clean energy employment was extrapolated using state employment thresholds by technology weighted on census division and previous year's data. Employment thresholds are survey data from questions asking what percent of a firm's employment spends at least 50% of their time working on energy-related activities and what percent spends all of their time. Using the adjusted thresholds, employment by state is then split into three groups, those that spend all (100%) of their time on energy-related activities, those that spend a majority (50% to 99%) of their time, and those that spend less than a majority (0% to 49%) 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% group. Intensity-adjusted employment estimates are the sum of these products.

[47] For full 2022 USEER methodology, visit https://www.energy.gov/media/275711
For full 2023 USEER methodology, visit https://www.energy.gov/media/299360