Maryland 2021 Clean Energy Industry Report

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Maryland Energy Administration

NASEO National Association of State Energy Officials

[bw] RESEARCH PARTNERSHIP

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Executive Summary

The *Maryland 2021 Clean Energy Industry Report* details employment across five key sectors of the clean energy economy: Energy Efficiency; Clean Energy Generation; Alternative Transportation; Clean Grid and Storage; and Clean Fuels. The data for this report is based on the data collection effort conducted for the annual United States Energy and Employment Report (USEER).[1] The report provides historical clean energy employment data beginning in 2016. Data for Maryland's 2021 Report was collected in the fourth quarter of 2020; all annual comparisons reference the fourth quarter of each year. In future years, clean energy industry reports can build upon the data collected in this first annual assessment of Maryland's clean energy economy. Technology "deep dives" that dig into the needs of specific sectors in the clean energy economy, such as solar or wind, as well as additional research on key issues including job quality, wages, and diversity, equity, and inclusion, are expected to be included in future iterations of these reports.

The following are key findings from this year's report on clean energy employment trends in Maryland:

Clean energy job growth accounted for one in 10 new jobs in Maryland between 2016 and 2019. Prior to the global Coronavirus (COVID-19) pandemic, the clean energy sector grew by 7.7 percent from 2016 through 2019, creating more than 6,300 new jobs. By comparison, the statewide labor market grew by 2.7 percent. Over these three years, clean energy employment growth accounted for 8.9 percent of all new job growth in Maryland—or roughly one in ten new jobs.

Clean energy job losses associated with COVID-19 accounted for about four percent of all jobs lost, which is proportional to their size in the overall labor market. Between the last quarters of 2019 and 2020, Maryland's clean energy sector declined by 7.8 percent, or 6,900 jobs, wiping out the last several years of employment growth. This decline was higher than the statewide labor market average of 6.8 percent, but lower compared to the national clean energy average of 9.1 percent. As of the end of 2020, Maryland's clean energy economy supported about 81,301 workers across the state, slightly below the 2016 baseline level of employment. Overall, at the end of 2020, clean energy jobs accounted for three percent of total employment in the state.

The clean energy labor market is rebounding from the impacts of COVID-19. The peak of job losses occurred throughout the first two quarters of 2020, and clean energy jobs have since rebounded throughout the end of 2020 and into the first quarter of 2021.

[1] To view the 2018, 2019, and 2020 editions of the USEER produced by the Energy Futures Initiative, NASEO, and BW Research, visit https://www.usenergyjobs.org/. To view the 2021 USEER produced by the U.S. Department of Energy, visit https://www.energy.gov/us-energy-employment-jobs-report-useer.

Clean energy employment was mostly concentrated in three counties. About 45 percent of all clean energy jobs in Maryland are found across Montgomery County, Baltimore County, and Prince George's County. Additionally, nearly one in 10 clean energy jobs—9.7 percent of total clean energy employment—are located in Baltimore City.

Intensity-adjusted clean energy employment was growing faster than the overall clean energy labor market. Not all clean energy jobs are fully devoted to clean energy-related activities. Intensity-adjusted clean energy employment data showed that there were just over 57,000 total clean energy workers across the state that dedicated a full work week or all of their labor hours to clean energy-related goods and services. From 2016 through 2019, intensity-adjusted clean energy employment was growing faster than total clean energy jobs. During these three years, there was a 21 percent increase in total intensity-adjusted clean energy workers. (For more information on intensity-adjusted clean energy employment, please refer to Page 7 of this report.)

Many clean energy positions earn higher wages compared to statewide averages. This is particularly true at the entry-level, where clean energy electricians, plumbers, iron and steel workers, and HVAC mechanics earn upwards of 60 percent more than the average entry-level worker in Maryland. (For more information on clean energy wages for select occupations, please refer to Tables 5 and 6 of this report.)

Construction and professional and business services had the highest concentration of clean energy industry employment. Clean energy construction workers represented about seven in ten clean energy jobs, or 54,200 workers, at the end of 2020. Clean energy-related professional and business services, such as finance, consulting, or legal support, accounted for 16 percent of the clean energy labor force—roughly 13,200 clean energy jobs.

The energy efficiency sector is the largest source of clean energy jobs in Maryland. Energy efficiency workers account for more than eight in 10 clean energy jobs across the state, or 82 percent of total clean energy employment. As of the last quarter of 2020, the energy efficiency sector employed more than 65,400 workers. From 2016 through 2019, energy efficiency firms grew by 6.4 percent, creating 4,300 new jobs in three years. These job gains were lost from 2019 through 2020, as energy efficiency businesses declined by 8.3 percent, a loss of more than 5,900 jobs.

Energy efficiency work is largely concentrated in HVAC and renewable heating and cooling technologies. Altogether, these sub-sectors account for 65 percent of total energy efficiency employment in Maryland. There are a total of 24,635 traditional HVAC workers, which spend a portion of their labor hours on energy-efficient HVAC technologies and the majority on traditional HVAC. From 2016 through 2019, traditional HVAC firms added just over 1,600 jobs to the labor force but shed almost 2,100 workers between 2019 and 2020. High efficiency HVAC and renewable heating and cooling workers accounted for 17,900 jobs across the state. This sub-sector grew by five percent, or almost 1,000 workers, between 2016 and 2019. From 2019 through 2020, however, these firms shed nearly 1,600 jobs for a decline of eight percent.

The clean energy generation sector, comprised largely of solar workers, is the second largest source of jobs. Clean energy generation firms accounted for 13 percent, or about 10,700 jobs, of all clean energy employment at the end of 2020. From 2016 through 2019, the sector grew by more than 600 jobs—a growth rate of about six percent. Over 2019 through 2020, clean energy generation firms shed 760 jobs—a 6.7 percent increase in 12 months.

Maryland's solar workforce has mostly declined since 2016, possibly the result of declining annual installed capacities in the state. At 57 percent and just over 6,100 workers, solar accounts for the largest share of clean energy generation jobs. Despite slight growth of roughly 170 jobs from 2018 through 2019, the overall solar sub-sector declined by 16 percent from 2016 through 2020, a loss of roughly 1,200 jobs. Between 2019 and 2020 alone, solar firms shed 530 jobs. These job losses come alongside declining annual installed capacities. Following almost 300 megawatts (MW) of installed capacity in 2016, annual installed capacity declined to under 150 MW in 2018. Installed capacity through the third quarter of 2020 sits below 50 MW.

With two offshore wind projects in the development pipeline, Maryland's wind energy sector is likely to create jobs over the next several years. Between 2016 through 2019, wind energy employment grew by about 60 percent, resulting in 370 new jobs over these three years. Despite the loss of about 70 jobs from 2019 through 2020, the development of two offshore wind projects—the MarWind and Skipjack wind farms, which are set to come online in 2030—indicates the potential for a rebound in wind energy employment following the pandemic-induced job losses. As of the end of 2020, there are roughly 930 wind energy jobs in Maryland.

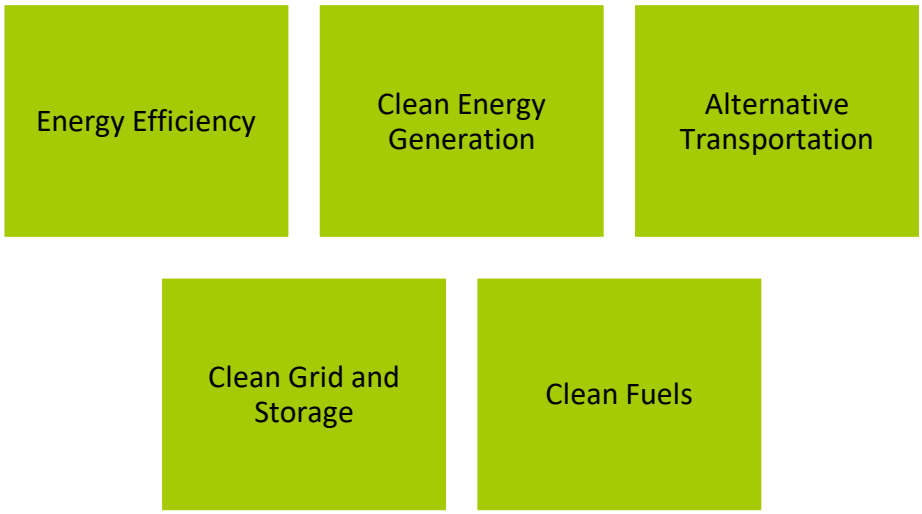
Additional clean energy employment is found across alternative transportation, clean grid and storage, and clean fuels. Though these sectors also experienced job losses from 2019 through 2020, the losses were not as significant as those experienced by the energy efficiency and clean energy generation sectors. Altogether, the three sectors created about 1,400 new jobs from 2016 through 2019 and declined by about 170 jobs from 2019 through 2020—roughly two to four percent each.

The hybrid electric and electric vehicle sub-sectors did not see employment drop between 2019 and 2020—the only sub-sectors without job losses. From 2016 to 2020, these sub-sectors—which largely includes vehicle and parts manufacturing, wholesale trade, and repair and maintenance—grew by a respective 21 and 16 percent, together resulting in 325 new jobs over four years; retail sales and car dealerships are excluded from these jobs. From 2019 through 2020, despite economy-wide downturns, these two sub-sectors saw employment grow. Hybrid electric firms grew by just under a percent, or 12 jobs, while electric vehicle firms grew employment by seven percent, or almost 50 workers in 12 months. At the end of 2020, hybrid electric vehicle firms employed more than 1,300 workers while electric vehicle firms employed about 700 workers.

Introduction

The *Maryland 2021 Clean Energy Industry Report* is the first report that details historical clean energy employment across the state. Report production was funded by a grant from the Maryland Energy Administration (MEA). In addition to tracking overall clean energy employment dating back to 2016, the report provides a breakout of employment by technology sector, sub-sector, and value chain segment. Clean energy employment is broken out into the five major technology sectors described in Figure 1 below. Within each major technology sector are clean energy sub-technologies, such as solar, wind, efficient lighting, microgrid, woody biomass, or electric vehicle employment.

FIGURE 1. CLEAN ENERGY SECTORS



All data are based on the 2021 United States Energy and Employment Report (USEER) data collection effort by the U.S. Department of Energy.[2] For more information on the USEER methodology, please refer to Appendix B. Brief descriptions of each technology sector are included below, but for more information, please refer to each technology chapter or to the sub-technology definitions specific to the state of Maryland in Appendix A.

Energy Efficiency: This sector includes all firms that are involved in the research, manufacture, wholesale trade, installation, repair, or professional service support—which includes legal, financial, engineering, or consulting services—of technologies and services that improve the efficiency of buildings. Examples of sub-technologies include ENERGY STAR® appliances, efficient lighting, advanced materials, and high efficiency HVAC and renewable heating and cooling.

Clean Energy Generation: This sector includes all firms engaged in the support of low and carbon-free electricity generating technologies. Employment estimates include jobs across a range of industries in the value chain, including research, manufacturing, installation, wholesale trade, and professional services as well as multiple clean energy generation technologies, such as solar, wind, geothermal, bioenergy, hydropower, natural gas, and nuclear electric power generation.

[2] The 2021 USEER is available at https://www.energy.gov/us-energy-employment-jobs-report-useer.

Alternative Transportation: This sector is composed of workers that support the manufacture, wholesale trade, repair and maintenance, and professional service support of alternative transportation technologies such as plug-in hybrid, hybrid electric, electric, natural gas, hydrogen, and fuel cell vehicles. Employment estimates in this sector expressly ***exclude*** retail trade, such as car dealerships.

Clean Grid and Storage: This sector includes all jobs that support the deployment (construction), manufacture, wholesale trade, or legal, financial, and engineering services of the following technologies: smart grid, microgrid, and other grid modernization technologies, such as electric vehicle charging infrastructure, as well as clean storage technologies, which includes pumped hydropower storage, battery storage, mechanical storage, thermal storage, biofuel storage, and nuclear fuel storage.

Clean Fuels: This sector includes all workers involved in the research, production, installation, wholesale trade, or professional service support for clean fuels and clean fuel technologies that use woody and non-woody biomass, nuclear fuels, corn ethanol, and other biofuels.

Clean Energy Industry Overview

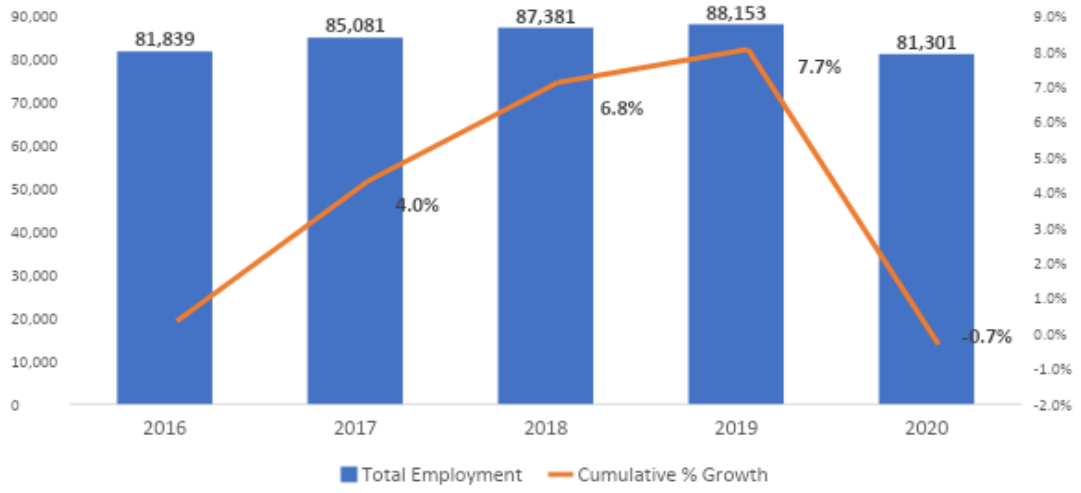
Total Clean Energy Employment

As of the last quarter of 2020, Maryland was home to 81,301 clean energy workers, and clean energy employment accounted for roughly three percent of all jobs in the state. Between 2016 and 2019, prior to the onset of the COVID-19 pandemic, clean energy employment had grown by 7.7 percent across the state, resulting in just over 6,300 new jobs in three years. Over the same time, the state's overall labor market grew by 2.7 percent. Clean energy job growth from 2016 through 2019 accounted for almost one in 10 new jobs, or 8.9 percent of total job growth over three years.[3]

Between the last quarters of 2019 and 2020, clean energy employment in Maryland declined by 7.8 percent—a loss of almost 6,900 jobs. The job losses associated with the COVID-19 pandemic wiped out several years of employment growth in Maryland's clean energy sector; to date, total clean energy jobs sit just below the 2016 baseline level of employment, by 0.7 percent. During this time, Maryland's overall economy shed roughly 183,000 jobs—a decline of 6.8 percent. The clean energy sector accounted for about three percent of total job losses across the state at the end of 2020. Clean energy jobs have, however, begun to rebound, with the peak of job losses concentrated in the first two quarters of 2020. Throughout the end of 2020 and the first quarter of 2021, the clean energy sector has been recovering lost jobs.

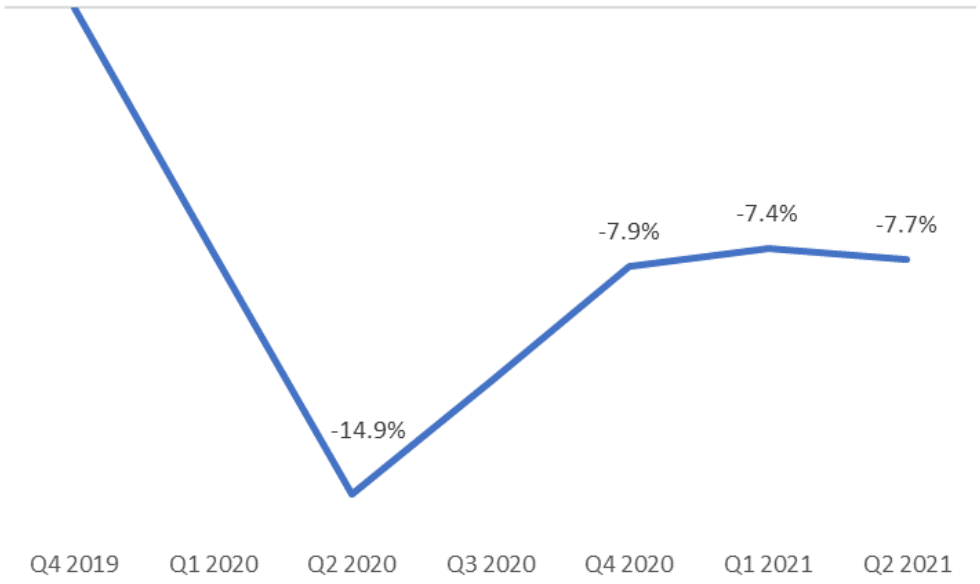
In 2020, just under half—roughly 45 percent—of all clean energy employment in Maryland could be found across the following three counties: Montgomery, Baltimore, and Prince George's. About one in 10 jobs, or 9.7 percent of total clean energy employment, are found in Baltimore City. (For more information on county-level clean energy employment estimates, please refer to Appendix C.)

FIGURE 2. CLEAN ENERGY EMPLOYMENT IN MARYLAND, 2016-2020



[3] Overall statewide employment estimates are from the Bureau of Labor Statistics, Quarterly Census of Employment and Wages. Data was extracted in July 2021.

FIGURE 3. CLEAN ENERGY INDUSTRY COVID-19 RECOVERY, Q4 2019 – Q2 2021



Maryland's clean energy economy fared slightly better in comparison to the national average. Nationally, clean energy jobs declined by nine percent, compared to a decline of roughly eight percent in Maryland. Maryland's clean energy sector also fared better compared to other states, such as Massachusetts and Rhode Island.

Compared to other industry sectors in the state, the clean energy sector in Maryland declined by a smaller percentage compared to retail trade or accommodation and food services, a trend witnessed nationally and in other states as well.

FIGURE 4. CLEAN ENERGY EMPLOYMENT CHANGE BY REGION, 2019-2020

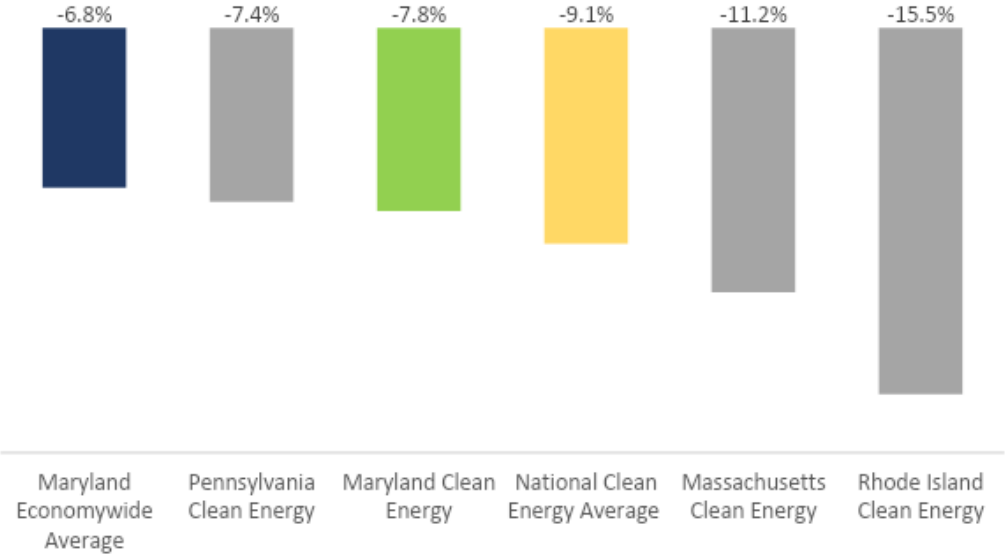
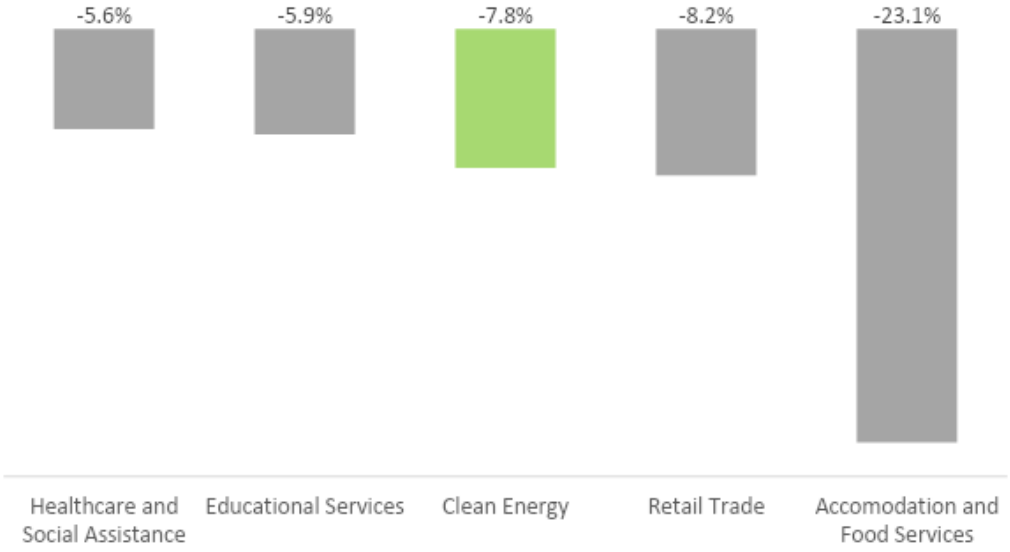


FIGURE 5. EMPLOYMENT CHANGE BY INDUSTRY IN MARYLAND, 2019-2020[4]



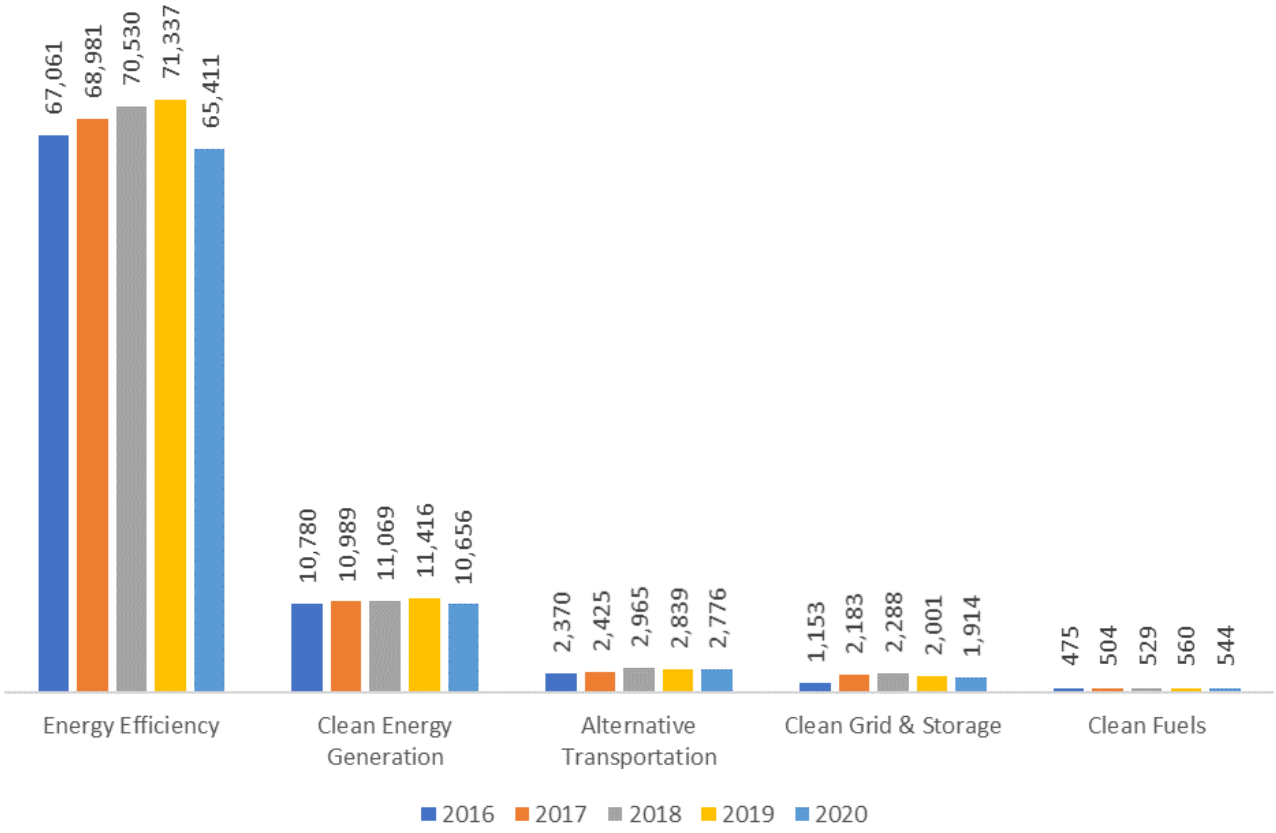
The energy efficiency sector accounted for eight in 10 (82 percent) clean energy jobs in Maryland, making it the largest technology sector. At the end of 2020, energy efficiency firms employed just over 65,400 workers across the state. Between 2016 and 2019, energy efficiency jobs grew by 6.4 percent—or almost 4,300 new jobs. Between 2019 and 2020, these job gains were wiped out, as the sector declined by 8.3 percent, shedding just over 5,900 jobs.

Following energy efficiency, clean energy generation represented the second largest clean energy employer in Maryland. Clean energy generation firms accounted for 13 percent of the clean energy workforce—roughly 10,700 jobs at the end of 2020. This sector grew by almost six percent, or more than 600 jobs, from 2016 through 2019. Over the last quarters of 2019 through 2020, clean energy generation firms shed 760 jobs—a decline of 6.7 percent in 12 months.

The remaining technology sectors of alternative transportation, clean grid and storage, and clean fuels together accounted for about five percent of clean energy jobs in Maryland. Each saw significant growth between 2016 and 2019. Alternative transportation firms grew by almost 20 percent, or 470 jobs, while clean grid and storage firms created almost 860 new jobs for a growth rate of about 74 percent. The clean fuels sector also grew by just under 18 percent, creating 85 jobs. While these three sectors also declined from 2019 through 2020, the employment losses were not as significant as those seen in the energy efficiency and clean energy generation sectors. Collectively, these three sectors shed 166 jobs, declining by roughly two to four percent each.

[4] JobsEQ 2020 Q4.

FIGURE 6. CLEAN ENERGY EMPLOYMENT BY TECHNOLOGY SECTOR, 2016-2020



Intensity-Adjusted Clean Energy Employment

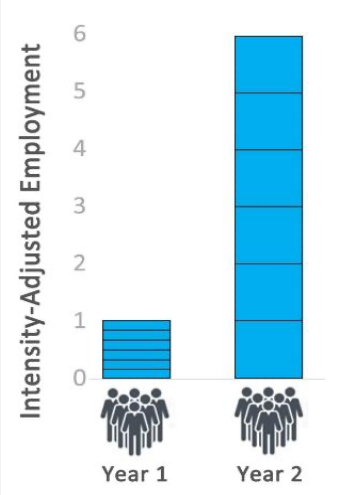
Intensity-adjusted clean energy is used to identify the concentration, or intensity, of clean energy activities, such as construction, manufacturing, or sales. The clean energy employment featured in Figure 2 includes all workers that dedicate any amount of their labor hours or work week to clean energy 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. 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—less than half of their labor hours, half to the majority of their labor hours, or all of their labor hours.[5]

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. If a state began offering rebates in 2017 for efficient heat pumps, that traditional HVAC worker would

[5] These categories correspond with the following delineations: 0 to 49 percent of labor hours, 50 to 99 percent of labor hours, and 100 percent of labor hours. For a full description of this methodology, please refer to Appendix A.

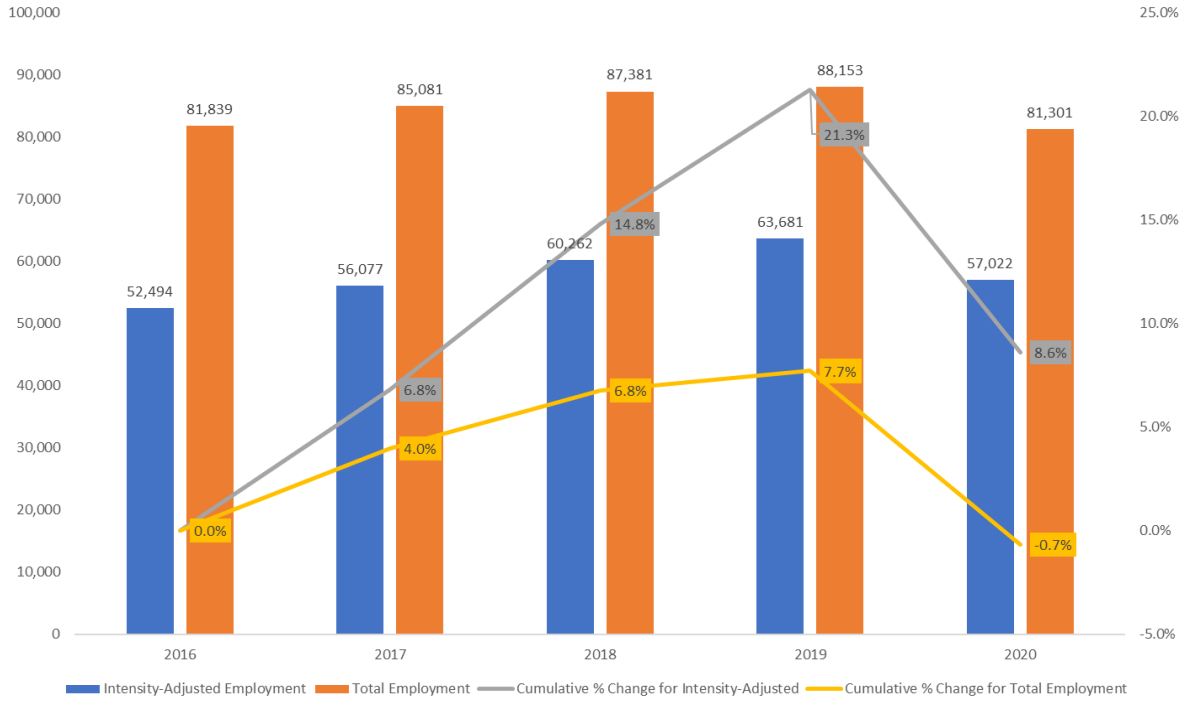
likely be spending more of their labor hours or work week installing high-efficiency heat pumps. This increase in activity per worker would not necessarily result in overall job growth in Figure 2 but would be captured as an increase in intensity-adjusted clean energy employment in Figure 4 below.

An example can illustrate the importance of tracking intensity-adjusted clean energy employment. If an HVAC firm had 6 installers in 2018 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, intensity-adjusted jobs would show a corresponding increase.



In Maryland, intensity-adjusted clean energy employment grew faster than the overall clean energy labor market. From 2016 through 2019, there was a 21 percent increase in intensity-adjusted employment; this compares to a roughly eight percent growth in total clean energy jobs from Figure 2. Growth in intensity-adjusted employment has slowed alongside declines in both the overall and clean energy labor market. It is important to note that 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 intensity-adjusted clean energy job.

FIGURE 7. INTENSITY-ADJUSTED CLEAN ENERGY EMPLOYMENT, 2016-2020



Clean Energy Value Chain Employment

The following section details clean energy employment by value chain segment, highlighting industries in Maryland with high concentrations of clean energy activity. The major value chain segments containing clean energy employment are comparable to the federally-defined industries; these include construction, manufacturing, wholesale trade, professional and business services, other services, and utilities.

With about 54,200 jobs, the construction industry accounts for the majority of clean energy work in Maryland. Almost seven in ten, or 67 percent, of the clean energy labor force are engaged in residential, commercial, and industrial building construction, contracting and electrical work, insulation and weatherization, or plumbing and heating, air conditioning, and ventilation work. The construction industry segment also includes clean energy workers that are engaged in building new renewable power plants or clean electricity generation facilities. From 2016 through 2019, clean energy construction jobs grew by 7.2 percent, or almost 4,000 workers. This job growth was offset by declines from 2019 through 2020, which resulted in a loss of more than 4,600 clean energy construction jobs—a decline of about eight percent.

Following construction, professional and business services accounted for the second largest source of clean energy industry employment; this industry segment includes workers involved in clean energy-related financing, legal, consulting, engineering, research, or architectural services. Clean energy professional and business services accounted for 16 percent of all clean energy employment at the end of 2020. The industry segment saw growth from 2016 through 2019—roughly seven percent or 950 jobs—followed by a decline of about five percent or 660 jobs from 2019 through 2020. To date, there are just over 13,200 clean energy workers in the professional and business services industry segment.

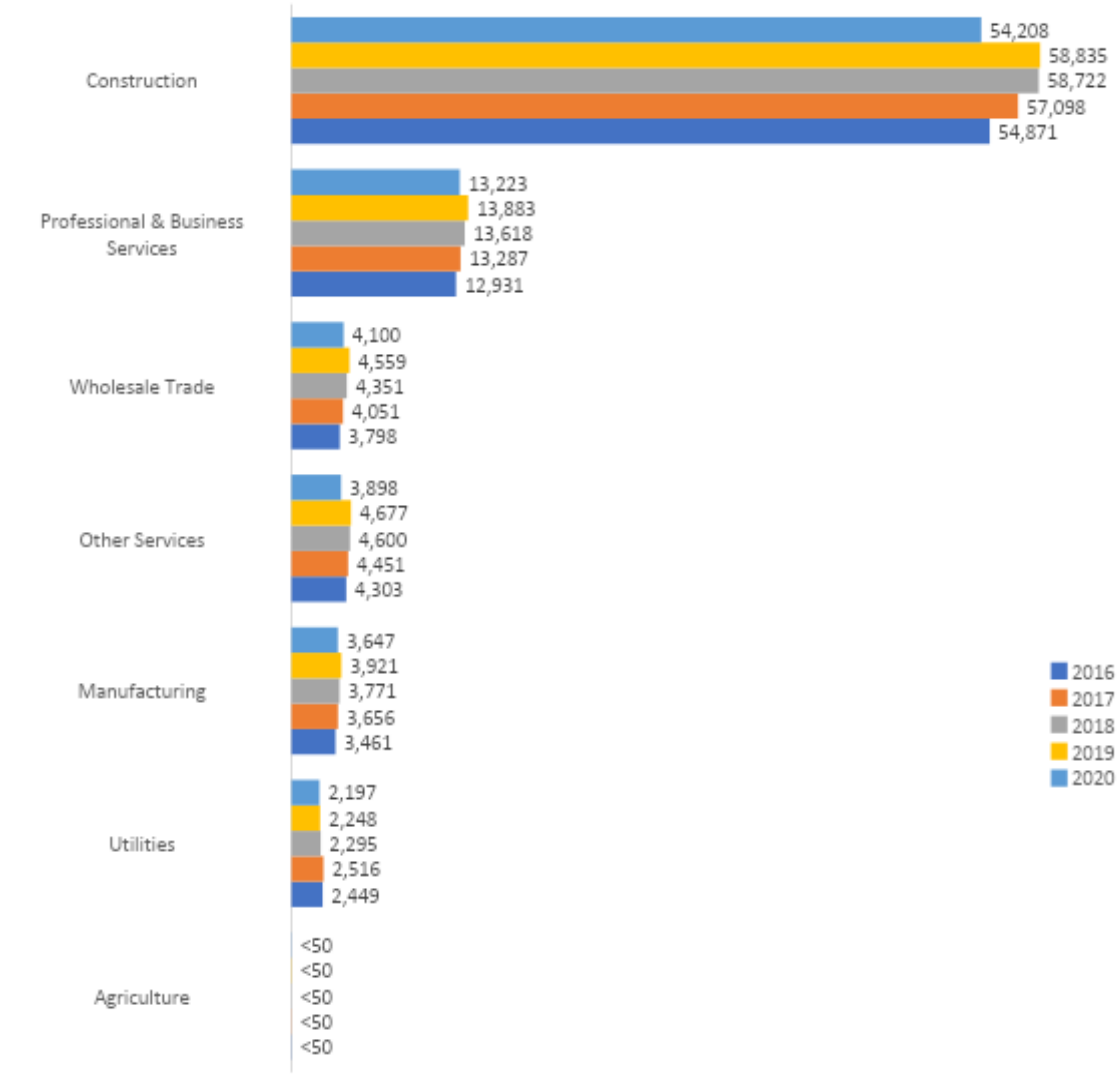
At the end of 2020, wholesale trade, other services, and manufacturing accounted for about five percent each of total clean energy jobs. Clean energy firms engaged in wholesale trade, which includes alternative transportation vehicle and parts wholesalers and electrical equipment and household appliance wholesalers, grew by 20 percent between 2016 and 2019, an increase of 760 jobs followed by a decline of 10 percent, or 460 jobs, from 2019 through 2020. There are 4,100 clean energy workers in the wholesale trade industry.

The “other services” value chain segment is mostly composed of automotive repair and maintenance, but also includes organizational and non-profit work such as environment and conservation organizations, business associations, or advocacy organizations. In 2020, this industry segment supported 3,900 jobs in Maryland, a decline of almost 17 percent, or 780 jobs, since 2019. Clean energy manufacturing supported roughly 3,600 jobs at the end of 2020. This industry segment encompasses heating and air conditioning equipment, engine and compressor, semiconductor, and energy efficiency product, appliance, or lighting manufacturing, as well as alternative transportation vehicle and parts manufacturing. The industry segment grew by 13 percent from 2016 through 2019—an increase of 460 jobs. Between 2019 and 2020, clean energy manufacturers shed about seven percent of their workforce, or 270 jobs.

The utilities segment in Maryland supported almost 2,200 clean energy jobs at the end of 2020. Clean energy employment in utilities has seen continuous declines since 2017. The agriculture industry supports fewer than 50 clean energy jobs. The small number of agriculture-related clean energy jobs is likely due to

the overall size of the agriculture industry in Maryland. Agriculture jobs account for less than half a percent of total employment in Maryland.[6]

FIGURE 8. CLEAN ENERGY EMPLOYMENT BY VALUE CHAIN SEGMENT, 2016-2020



[6] JobsEQ 2021Q2

Detailed Clean Energy Sector Employment

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 sub-technologies included in this sector are: 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 or reduced water consumption products and appliances.

In 2008, the Maryland General Assembly determined that energy efficiency is one of the least expensive ways to meet growing electricity demand in the state. As such, the state has remained committed to energy efficiency initiatives and incentives over the last several years. In 2020, the American Council for an Energy-Efficient Economy (ACEEE) ranked Maryland as sixth in the nation for energy efficiency leadership in energy savings targets, appliance standards, strict building codes, and energy efficiency programs and incentives – one spot higher than its 2019 ranking.[7] In 2020, Maryland enacted HB 662, which requires all state-owned buildings to reduce energy consumption by 10 percent by 2029 compared to the 2018 baseline.[8] The EmPOWER Energy Efficiency Act of comprises programs administered by utility companies in the state, and overseen by the Maryland Public Service Commission, and includes lighting and appliance rebates for homeowners, home energy assessments, insulation and air sealing rebates, commercial lighting rebates, and energy efficiency services for industrial facilities.[9] In 2017, the state extended the EmPOWER efficiency programs through 2023.

In addition to energy savings in public buildings and efficiency programs and rebates, Maryland was the first to adopt the 2018 International Energy Conservation Code (IECC) and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) standard for the construction of new buildings. The state remains active in ensuring code compliance, including conducting training and outreach and county-level compliance studies. The state also invests a portion of cap-and-trade proceeds through the Regional Greenhouse Gas Initiative into energy efficiency programs.[10] Maryland's Smart Energy Communities Program (MSEC) is a grant program that provides energy efficiency funding to local governments who formally adopt and commit to long-term energy savings policies;[11] to date, there are 77 participating communities in the MSEC program.[12]

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[7] American Council for an Energy-Efficient Economy (ACEEE), 2020 State Energy Efficiency Scorecard. https://www.aceee.org/sites/default/files/pdfs/ACEEE_ScrSht20_Maryland.pdf.

[8] Kaplow, Stuart. Maryland Enacts New Environmental Laws in 2020. April 2020. https://www.greenbuildinglawupdate.com/2020/04/articles/codes-and-regulations/state/maryland-enacts-new-environmental-laws-in-2020/.

[9] Maryland Energy Administration (MEA). https://energy.maryland.gov/pages/facts/empower.aspx.

[10] American Council for an Energy-Efficient Economy (ACEEE), 2020 State Energy Efficiency Scorecard. https://www.aceee.org/sites/default/files/pdfs/ACEEE_ScrSht20_Maryland.pdf.

[11] Maryland Energy Administration (MEA). https://energy.state.md.us/govt/Documents/FY17%20MSEC%20FAQ%20%209.28.pdf.

[12] Maryland Energy Administration (MEA). https://energy.maryland.gov/Documents/Maryland%20Smart%20Energy%20Communities%20FY20.pdf.

About four in ten energy efficiency workers—or 38 percent of the energy efficiency workforce—in Maryland spent the majority of their time on traditional HVAC work and a portion of their labor hours on energy efficient HVAC technologies. Between 2016 and 2019, the traditional HVAC sub-sector grew by 6.4 percent—roughly 1,600 jobs. Between 2019 and 2020, the sub-sector shed almost 2,100 jobs for a decline of roughly eight percent in 12 months. As of the end of 2020, there were about 24,600 traditional HVAC workers in Maryland.

Following traditional HVAC, the second largest sub-sector within energy efficiency is high efficiency HVAC and renewable heating and cooling.[13] Unlike traditional HVAC workers, high efficiency HVAC workers spend the majority of their labor hours working with efficient HVAC technologies and only a portion of their labor hours working with traditional, non-efficient HVAC technologies. This sub-sector added almost 1,000 jobs between 2016 and 2019—a growth rate of just over five percent. Between 2019 and 2020, the sub-sector shed almost 1,600 jobs, declining by eight percent in 12 months. High efficiency HVAC and renewable heating and cooling firms employed 17,900 workers at the end of 2020.

ENERGY STAR® and efficient lighting technologies accounted for 17 percent of the energy efficiency workforce—about 11,200 jobs. Between 2016 and 2019, this sub-sector grew by 15.5 percent, or roughly 1,600 workers. However, between the last quarters of 2019 and 2020, ENERGY STAR® and efficient lighting businesses shed 870 jobs for a decline of just over seven percent in 21 months.

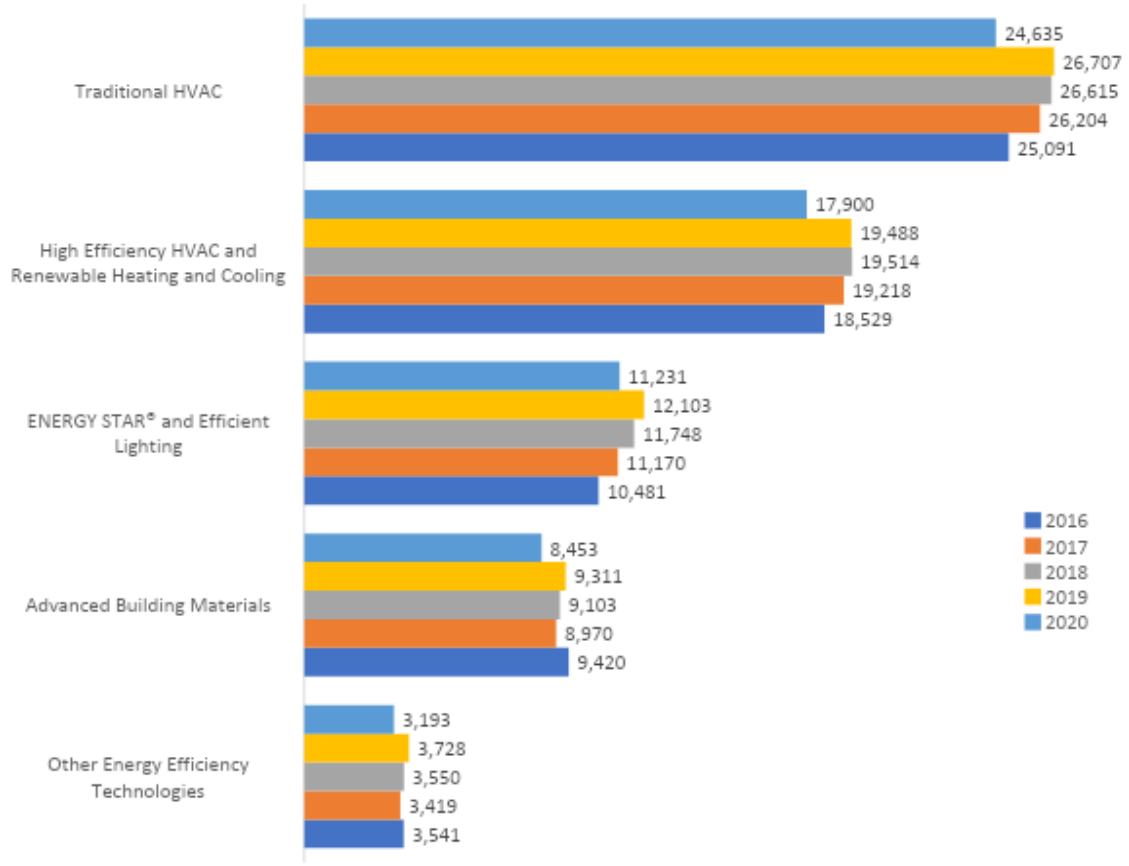
Advanced building materials accounted for nearly 13 percent of energy efficiency work in Maryland. This sector declined by 9.2 percent between 2019 and 2020, resulting in a loss of 860 jobs. This sub-sector saw declines between 2016 and 2017; there was slight growth from 2017 through 2018, followed by employment declines from 2018 through 2020.

Other energy efficiency technologies[14] is the smallest sub-sector within the energy efficiency sector, representing about five percent of total employment, or about 3,200 jobs. This sub-sector saw modest growth from 2016 through 2019—about five percent of 190 jobs. From 2019 through 2020, the sub-sector shed 540 jobs for a decline of 14.4 percent in 12 months.

[13] Renewable heating and cooling workers are involved with heating, ventilation, and air conditioning (HVAC) from renewable energy sources, including solar thermal or geothermal heat pumps, or other work that increases the energy efficiency of HVAC systems.

[14] The other energy efficiency technologies sub-sector includes variable speed pumps, other design services not specific to a detailed technology, software not specific to a detailed technology, energy auditing, rating, monitoring, metering, and leak detection, policy, consulting, and non-profit work not specific to a detailed technology, LEED certification, or phase change materials.

FIGURE 9. ENERGY EFFICIENCY EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020[15]



[15] 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.

Clean Energy Generation

Clean energy generation jobs encompass all workers engaged in the research, development, production, manufacture, sales, installation, maintenance, repair, or professional service support of low and carbon-free electricity generating technologies. Such clean energy generation technologies include solar, wind, geothermal, bioenergy, hydropower, and nuclear electric power generation. In Maryland, natural gas and advanced natural gas electric power generation are also included in the state's definition of clean energy.

Clean energy generation jobs in Maryland were mostly concentrated across solar and nuclear generation firms. Solar accounts for the majority of workers, at 57 percent of the total clean energy generation workforce. Despite modest growth of roughly 170 jobs from 2018 through 2019, Maryland's solar sub-sector has mostly seen continued declines from 2016 through 2020. From 2016 through 2020, solar companies shed almost 1,200 jobs—a decline of just over 16 percent in four years. Between 2019 and 2020 alone, the solar workforce shrank by 530 jobs or about eight percent. In 2020, the Solar Energy Industries Association (SEIA) ranked Maryland as 17th in the nation for solar capacity, two spots lower compared to the 2019 ranking. The declining solar workforce over the last several years may be attributed to the state's declining annual solar installations. From a high of almost 300 megawatts (MW) installed in 2016, annual installed capacity went down in 2017 and 2018 to under 150 MW. There was a slight increase in 2019, which may have contributed to the small growth in jobs from 2018 through 2019. Though the fourth quarter of data for 2020 is not yet available, installed capacity through the third quarter of 2020 sits below 50 MW.[16]

Similar to the solar sector, nuclear electric power generation jobs in Maryland have continued to decline from 2016 through 2020, mirroring the overall nationwide trend. Currently, there is only one operating nuclear power plant in Maryland—the Calvert Cliffs Nuclear Power Plant. Another plant—Peach Bottom Atomic Power Station—is located in Pennsylvania about three miles north of the Maryland border.[17] Between 2016 and 2020 the nuclear electric power generation sub-sector declined by 15 percent, or about 200 jobs. At the end of 2020, nuclear jobs accounted for one in ten clean energy generation jobs in Maryland—about 1,100 workers.

Wind energy is the third largest sub-sector, representing 8.7 percent of clean energy generation jobs or 930 workers. Between 2016 and 2019, these firms grew by 58.7 percent, an increase of about 370 jobs in three years. From 2019 through 2020, the wind sub-sector declined by 6.7 percent, shedding almost 70 jobs. In 2019, wind energy accounted for about 12 percent of Maryland's renewable electricity generation. There is one utility-scale wind farm operating in the western portion of the state with about 200 MW of generating capacity. Two offshore wind projects—the Skipjack Wind Farm to be built by Ørsted Offshore North America and the MarWind Wind Farm proposed by U.S. Wind—are projected to come online in 2023. Together these projects will result in a total of 44 turbines and a combined capacity of more than 400 MW.[18]

[16] Solar Energy Industries Association (SEIA), Maryland Solar Fact Sheet. Data through Q3 2020. Accessed February 2021. https://www.seia.org/state-solar-policy/maryland-solar.

[17] Maryland Department of Natural Resources. Nuclear Power in Maryland: Status and Prospects. January 2020. https://dnr.maryland.gov/pprp/Documents/NuclearPowerinMaryland_Status-and-Prospects.pdf.

[18] U.S. Energy Information Administration. Maryland State Profile and Energy Estimates. October 2020. https://www.eia.gov/state/analysis.php?sid=MD#89.

Natural gas and advanced natural gas account for 17.3 percent of clean energy generation workers in Maryland, a total of more than 1,800 jobs. Though there is little in-state natural gas production, it still represents a significant source of fuel and electricity in Maryland. Between 2015 and 2019, natural gas-fired generation capacity tripled. In 2019, natural gas accounted for 37 percent of the state's net generation. About four in 10 households in Maryland use natural gas for home heating.[19] Natural gas electric power generation jobs grew by 23.5 percent from 2016 through 2019, creating 174 new jobs. Despite declines in most other sectors and sub-sectors, natural gas electric power generation employment continued to grow from 2019 through 2020; employment in this sub-sector grew by two percent of about 20 jobs over these 12 months. The advanced natural gas sub-sector grew by 41.5 percent from 2016 through 2019—about 290 jobs—followed by a decline of six percent, or roughly 60 jobs, from 2019 through 2020.

In 2019, biomass accounted for about 10 percent of renewable electricity generated in Maryland; this includes facilities using landfill gas, municipal solid waste, and wood and wood waste.[20] The bioenergy and combined heat and power sub-sector saw significant growth from 2016 through 2019, creating 300 new jobs. From 2019 through 2020, the sub-sector declined by about six percent, or 25 jobs.

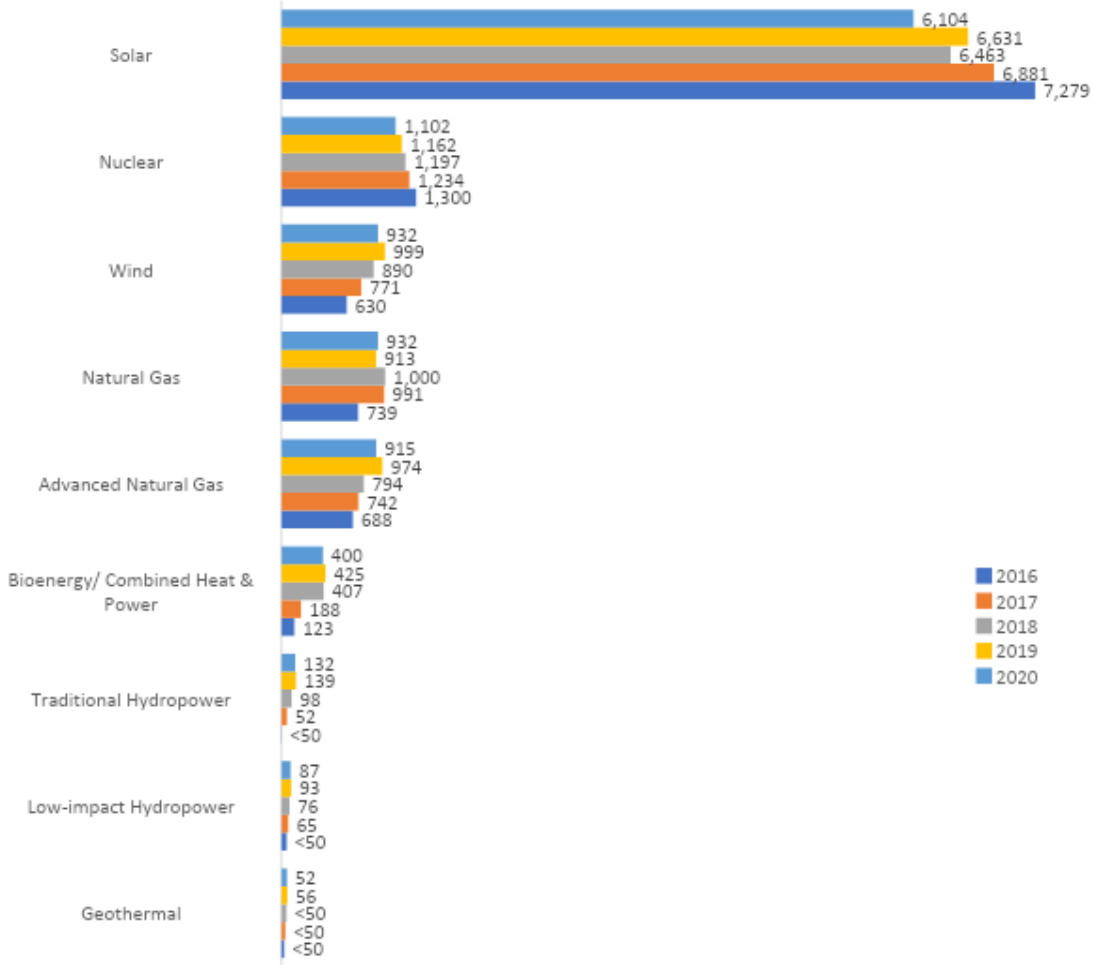
The remaining clean energy generation sub-sectors—traditional and low-impact hydropower and geothermal electric power generation—each accounted for about a percent of employment or less. Despite accounting for about half of the state's renewable electricity generation in 2019, the hydropower sub-sector had a fairly small workforce, totaling about 220 jobs at the end of 2020. With a generating capacity of 572 MW, the Conowingo hydroelectric facility supplies the majority of hydroelectricity in the state.[21]

[19] *Id.*

[20] *Id.*

[21] *Id.*

FIGURE 10. CLEAN ENERGY GENERATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020[22]



[22] Advanced natural gas includes efficient, low emission, leak free natural gas, including systems that use any of the following technologies: high efficiency compressor, advanced low NOx combustion technology, first application of closed loop steam cooling in an industrial gas turbine, advanced turbine blade and vane materials, high temperature TBC and abradable coatings, advanced row 4 turbine blades, 3-D aero technology, advanced brush seal.

Alternative Transportation

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

In Maryland, the transportation sector accounts for about 30 percent of energy consumption in the state.[23] In order to reduce transportation sector emissions, the state offers several incentives for the purchase of electric vehicles, including rebates, tax credits, and reduced electricity charging rates.[24]

As of the end of 2020, the hybrid electric vehicle sub-sector was the largest employer within alternative transportation. This sub-sector supported just over 1,300 jobs, or roughly three in ten alternative transportation workers in Maryland. The hybrid electric vehicle sub-sector did not see job declines from 2019 through 2020; between 2016 and 2020, this sub-sector grew by 21 percent, resulting in 230 new jobs across four years. Between 2019 and 2020, the sub-sector saw modest growth of about 12 jobs—just under a percent.

The electric vehicle sub-sector accounted for about 15 percent of total alternative transportation employment in Maryland. Similarly, this sector did not see job declines in the aftermath of COVID-19. From 2016 through 2020, electric vehicle businesses grew their workforce by almost 16 percent, or 95 jobs total. In fact, between 2019 and 2020, while most other sub-sectors were in decline, the electric vehicle workforce grew by almost 50 jobs—a seven percent increase in 12 months.

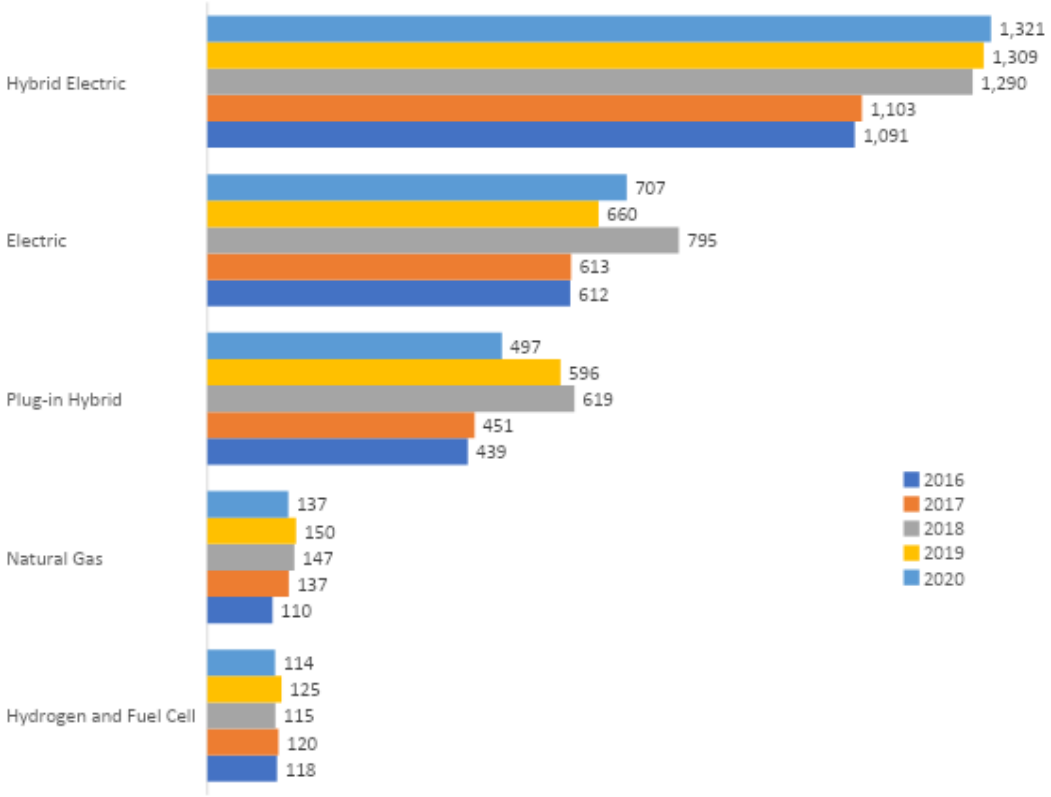
Plug-in hybrid firms account for 10.4 percent of alternative transportation workers. Between 2016 through 2019, these firms grew their workforce by 36 percent—almost 160 jobs. However, from 2019 through 2020, plug-in hybrid employment declined by 16.6 percent, shedding roughly 100 jobs.

The remaining two alternative transportation sub-sectors—natural gas and hydrogen and fuel cell vehicles—each accounted for less than three percent of jobs. Natural gas vehicle technologies employed about 140 individuals at the end of 2020. These firms grew by 36 percent, or 40 jobs, from 2016 through 2019. From 2019 to 2020, the sub-sector shed 13 jobs. Hydrogen and fuel cell vehicles accounted for just over 100 workers at the end of 2020.

[23] *Id.*

[24] Maryland Department of the Environment. https://mde.maryland.gov/programs/Air/MobileSources/Pages/ZEV.aspx#:~:text=Maryland%20offers%20a%20rebate%20of,%241%2C000%20for%20charging%20station%20equipment.

FIGURE 11. ALTERNATIVE TRANSPORTATION EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020



Clean Grid and Storage

For the purposes of this report, clean grid and storage workers include any individuals who supports the deployment (construction), manufacture, wholesale trade, or legal, financial, and engineering services of the following technologies: smart grid, microgrid, other grid modernization technologies, such as electric vehicle charging infrastructure, and clean storage technologies.

Clean storage—which includes pumped hydropower storage[25], battery storage[26], mechanical storage[27], thermal storage[28], biofuel storage (including ethanol and biodiesel), and nuclear fuel storage—accounted for about four in ten jobs (39.6 percent). Between 2016 through 2019, these firms grew their workforce by 38 percent, or just over 200 jobs. From 2019 through 2020, the storage sub-sector remained relatively flat, losing only about 10 jobs over the 12 months. At the end of 2020, there were almost 760 workers engaged with clean energy storage technologies in Maryland.

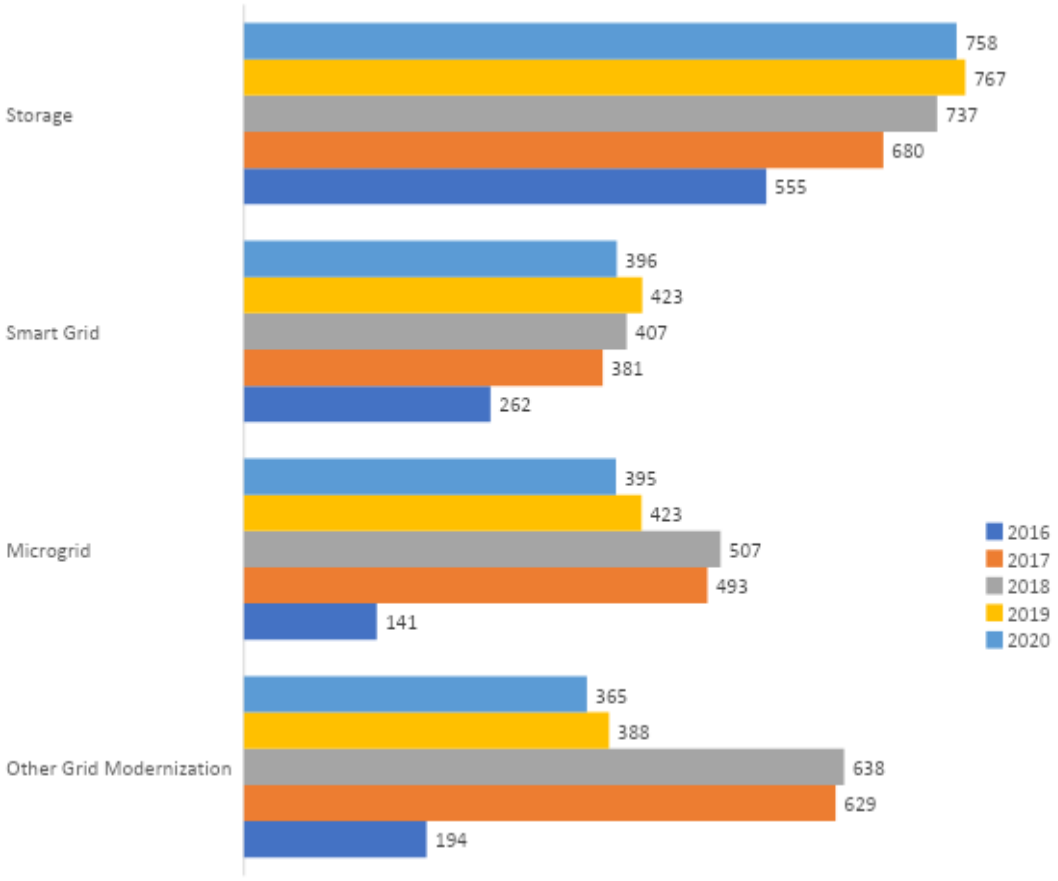
Between 2016 and 2019, smart grid[29] employment grew by 62 percent—an additional 160 clean energy jobs over three years. However, from 2019 through 2020, smart grid firms shed roughly 30 jobs for a 6.4 percent decline in 12 months. The smart grid sub-sector accounts for roughly two in ten clean grid and storage jobs (20.7 percent). At the end of 2020, there were a total of roughly 400 workers in this sub-sector.

Microgrid[30] firms also employed roughly 400 workers at the end of 2020. The sub-sector saw significant job growth from 2016 through 2019, creating about 280 new jobs. In 2020 the state announced funding for 14 new microgrid projects, indicating that this sector has the potential to continue creating jobs over the next couple years.[31]

The other grid modernization sector accounted for just over 360 jobs at the end of 2020, or roughly 19 percent of the clean grid and storage workforce.

[25] 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.
[26] 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.
[27] This includes flywheels and compressed air energy storage.
[28] Temporary storage of energy for later use when heating or cooling is needed.
[29] A smart grid is an electricity supply network that uses digital communications technology to detect and react to local changes in usage.
[30] Microgrids are a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid.
[31] Wood, Elisa. Maryland Announces Funding for 14 Microgrid Projects. June 2020. https://microgridknowledge.com/maryland-microgrid-solicitation/.

FIGURE 12. CLEAN GRID AND STORAGE EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020[32]



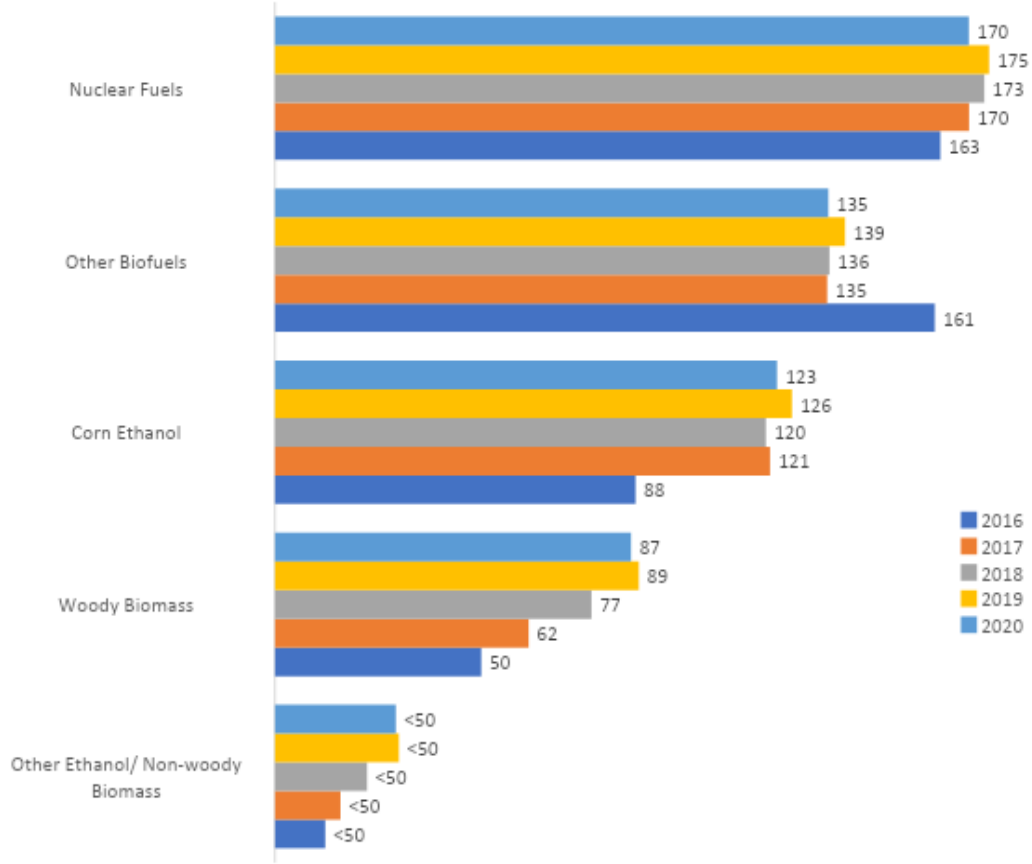
[32] Other grid modernization includes modernization of the nation's electricity transmission distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth.

Clean Fuels

The clean fuels sector includes all workers involved in the research, production, installation, distribution and sales, or professional and business service support for clean fuels and clean fuel technologies that use woody and non-woody biomass, nuclear fuels, corn ethanol, and other biofuels.

Nuclear fuels accounted for about a third of total clean fuels jobs in Maryland—170 workers at the end of 2020. Following nuclear fuels, the other biofuels sector represented about a quarter of the clean fuels workforce, or 135 jobs. At the end of 2020, corn ethanol businesses employed about 120 jobs, followed by woody biomass firms, which employed almost 90 workers, and other ethanol and non-woody biomass firms which had less than 50 jobs. From 2019 through 2020, each of the clean fuels sub-sectors declined by roughly two to three percent, shedding a collective 15 jobs in 12 months.

FIGURE 13. CLEAN FUELS EMPLOYMENT BY SUB-TECHNOLOGY, 2016-2020[33]



[33] Other ethanol/ non-woody biomass includes fuel made from other materials such as straw, manure, vegetable oil, or animal fats.

Clean Energy Hiring and COVID-19 Impacts

Of all clean energy employers surveyed, about seven in ten (72.2 percent) indicated that they have an adequate number of qualified clean energy workers to meet their current needs. A quarter of businesses (26 percent) indicated that they currently do not have an adequate number of workers.

Of employers that reported they do not have an adequate workforce and had recently searched for new hires, just over half (54 percent) reported that they found hiring to be very difficult throughout 2020.

FIGURE 14. ADEQUATE WORKERS TO MEET CURRENT NEEDS, 2020

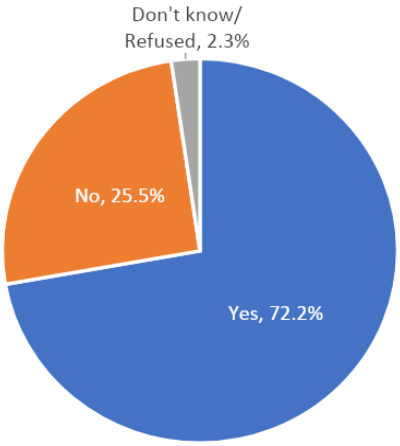
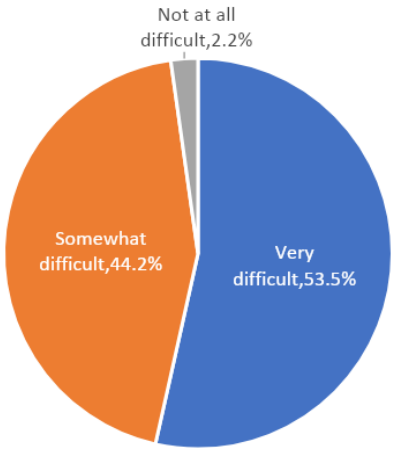


FIGURE 15. EMPLOYER-REPORTED HIRING DIFFICULTY, 2020



Seven in ten surveyed clean energy employers in Maryland (72 percent) reported that they did not have to layoff, furlough, or reduce pay for their clean energy workers as a result of COVID-19 and related-stay-at-home orders. Of the 28 percent of firms that indicated their workforce had been impacted by COVID-19 restrictions, 39 percent of workers were furloughed, 28 had a reduction in pay and benefits, and 19 percent of workers suffered a reduction in hours. Only four percent of employees at affected or impacted firms were permanently laid off.

FIGURE 16. COVID-19 WORKFORCE IMPACTS, 2020

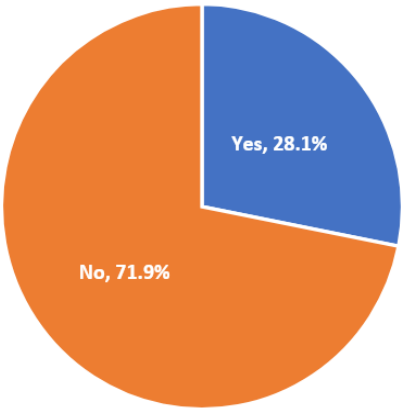
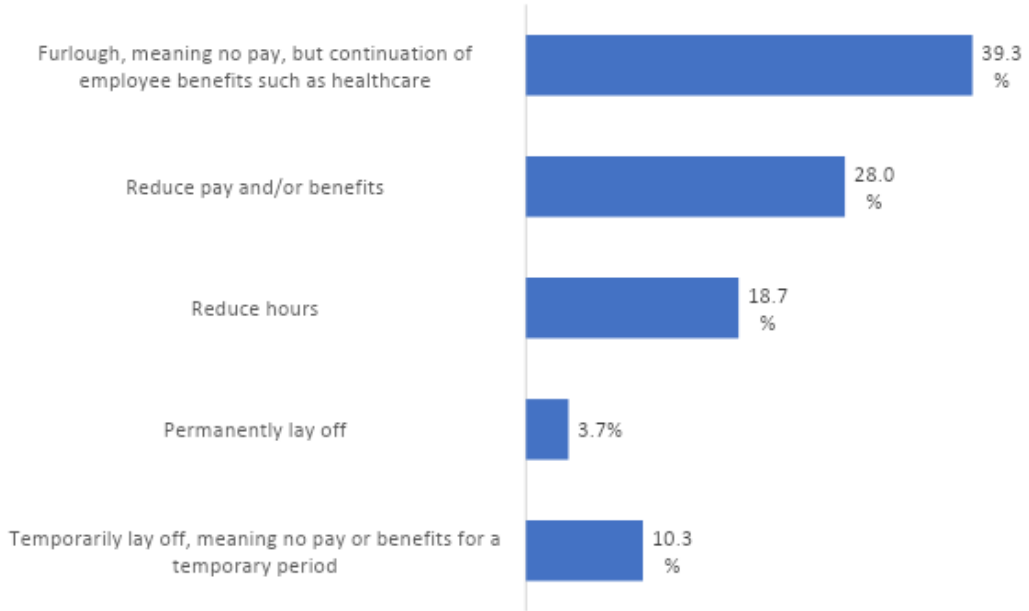


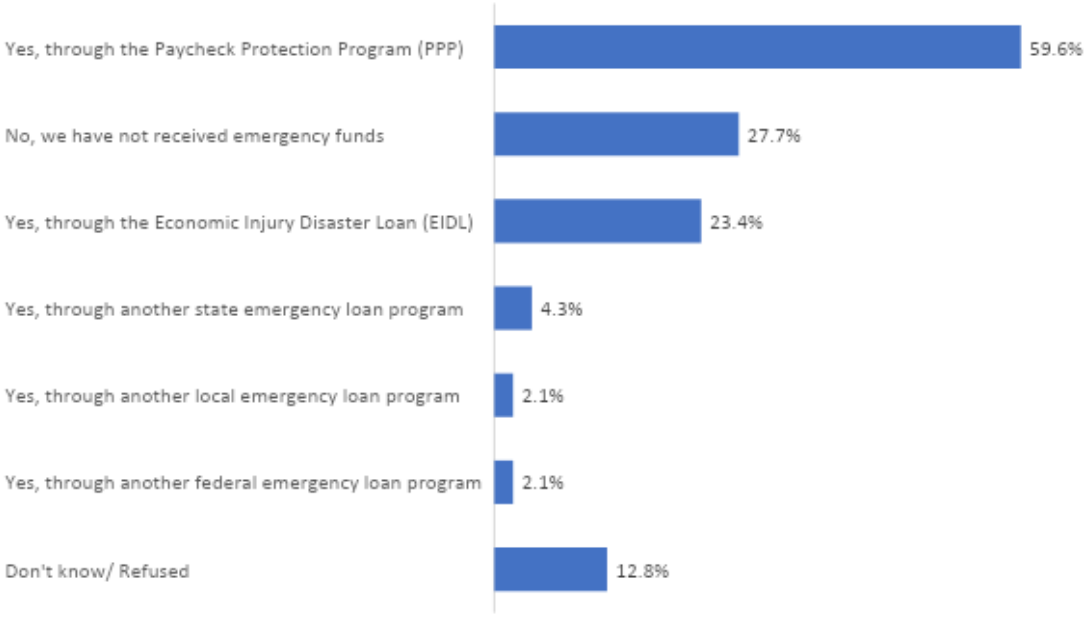
FIGURE 17. COVID-19 WORKFORCE IMPACTS, 2020



Six in ten clean energy businesses in Maryland (60 percent) reported receiving emergency financial relief through the Paycheck Protection Program (PPP). Less than a quarter (23 percent) indicated receiving support through the Economic Injury Disaster Loan (EIDL), and four percent received funds through other state emergency loan programs.

About three in ten clean energy businesses (28 percent) reported receiving no emergency funds over 2020.

FIGURE 18. COVID-19 RELIEF PROGRAMS AND ASSISTANCE, 2020



Maryland Clean Energy Training Landscape

A comprehensive clean energy training inventory was compiled using a thorough review of all publicly-available listings, school programs, and government websites. The inventory contains 148 training programs available for the clean energy workforce in Maryland. The research team separately identified another 707 web-only clean energy training programs, at least 10 of which are hosted in Maryland. The inventory provides a basic understanding of the occupational and geographic distribution of existing clean energy-related training programs across Maryland.

More than a quarter of the identified in-state training programs are aimed at General Clean Energy workers (26.4 percent), followed by HVAC programs[34] (18.9 percent), construction (15.5 percent), and building analysts (12.8percent). Construction programs include workplace safety training such as state-specific OSHA 10- and 30-Hour certification courses, as well as sessions on best practices for building retrofitting. Building analyst programs are mostly focused on preparing industry members to attain their LEED and Building Performance Institute (BPI) certification. Table 1 provides the number of programs offered in Maryland by occupational focus.

TABLE 1. MARYLAND CLEAN ENERGY TRAINING PROGRAMS BY OCCUPATIONAL FOCUS

Occupational Focus	Number of Programs	Percent of Programs
General Clean Energy	39	26.4%
HVAC	28	18.9%
Construction	23	15.5%
Building Analyst	19	12.8%
Solar	13	8.8%
Wind	12	8.0%
Energy Management	7	4.7%
Nuclear	2	1.4%
Engineering	2	1.4%
Biofuels	1	0.7%
Wind and Solar[35]	1	0.7%
Geothermal	1	0.7%

[34] The "General Clean Energy" Occupational Focus category is composed of electrical or other training for multiple clean energy technologies that are not specifically focused on one technology; it also includes introductory or general courses that explore renewable energies and alternative fuels in relation to climate change and the environment.
[35] This program focuses on training and education for both solar and wind technologies.

Most workforce development initiatives in Maryland's clean energy industry are centered in their community colleges, which provide the largest share of identified training programs (50.0 percent). This is followed by private consulting and training firms[36] (23.0 percent) and 4-year college or university (9.5 percent).

TABLE 2. MARYLAND CLEAN ENERGY TRAINING PROGRAMS BY PROGRAM TYPE

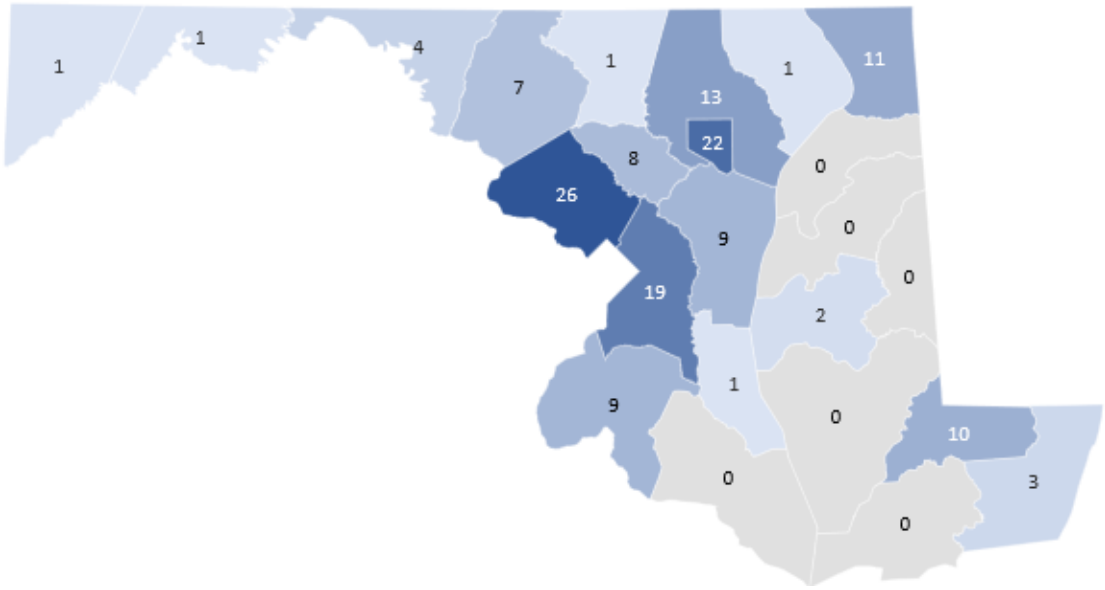
Program Type	Number of Programs	Percent of Programs
Community/ Junior College	74	50.0%
Private Consulting/Training Firm	34	23.0%
4-Year College or University	14	9.5%
Non-Profit Organization	9	6.1%
Vocational High School	7	4.7%
Technical School	5	3.4%
Trade Association	2	1.3%
Apprenticeship	2	1.3%
Government	1	0.7%

Montgomery, Baltimore City, and Prince George's counties offer the greatest number of training programs overall, accounting for 17.6, 14.9, and 12.8 percent of programs, respectively. In addition to the 707 identified web-only programs, at least 27—or 18.2 percent—of the in-state training programs were identified to have developed parallel web versions. Technological advances and the global pandemic are expected to accelerate the adoption of virtual programs. Such changes would increase the geographic accessibility and cost-effectiveness of workforce development opportunities although gaps in equitable access to technology needed to attend virtual workplace development programs will be exacerbated if left unaddressed.[37]

[36] Private Consulting and Training Firms are companies that provide standardized certification programs for industry professionals. Private Consulting and Training Firms in Maryland provide preparation for OSHA Safety, LEED, Building Performance Institute (BPI), and Global Wind Organization (GWO) certifications.

[37] Guterman, Zvi. Fixing the digital skills gap in the Post-COVID-19 workplace. February 2021. https://www.forbes.com/sites/forbestechcouncil/2021/02/08/fixing-the-digital-skills-gap-in-the-post-covid-19-workplace/?sh=7d911664b803

FIGURE 19. MARYLAND CLEAN ENERGY TRAINING PROGRAMS BY COUNTY



Trainings for the clean energy workforce in Maryland cover an array of industry sectors. The majority of trainings (57.4 percent) address energy efficiency improvements to new and existing structures and electrical systems. Many local construction unions across the state also offer energy efficiency internships. The next most common sector is renewable energy generation (37.2 percent), primarily providing training for Maryland workers in the wind and solar industries.

TABLE 3. MARYLAND CLEAN ENERGY TRAINING PROGRAMS BY TECHNOLOGY SECTOR

Technology Sector	Number of Programs	Percent of Programs
Energy Efficiency	85	57.4%
Renewable Energy Generation	55	37.2%
Renewable Energy Generation, Alternative Vehicles	3	2.0%
Clean Fuels	2	1.4%
Alternative Vehicles	1	0.7%
Energy Efficiency, Renewable Energy Generation	2	1.3%

The clean energy industry has many associated degrees and certifications that are both nationally and internationally recognized, such as the aforementioned BPI and LEED programs. Certificates, offered by 50.0 percent of identified in-state training programs, enhance an individual's credibility and knowledge of their field and also improve their job prospects and portability since many certificates are standardized and recognized by companies throughout the United States and globally. Associate's and Bachelor's degrees are the next most common program outcomes, offered by 8.8 and 4.7 percent of programs, respectively. Twenty nine percent of programs offer no tangible degrees or certificates, either operating

as upskilling opportunities or single courses offered within educational institutions. The complete list of degrees and certifications provided is found below in Table 4.

TABLE 4. MARYLAND CLEAN ENERGY TRAINING PROGRAMS BY DEGREE OR OUTCOME

Degree/Outcomes	Number of Programs	Percent of Programs
Certificate	74	50.0%
Associate's	13	8.8%
Bachelor's	7	4.7%
Associate's, Certificate	5	3.4%
Bachelors, Certificate	2	1.3%
Diploma	2	1.3%
Apprenticeship	2	1.4%
None	43	29.1%

Clean Energy Occupational Wages

As part of this year's *Clean Energy Industry Report*, the research team worked in collaboration with the Maryland Energy Administration to select 15 clean energy occupations and highlight how wages for these clean energy-specific positions compare to the statewide economy at entry-, mid-, and senior-level positions.[38] Table 5 below highlights the distribution of clean energy wages for these occupations, while Table 6 indicates either the wage premium or discount for clean energy positions compared to overall statewide wages at the entry-, mid-, and senior-level.[39]

It is important to note that the wages featured in Table 5 represent the subset of workers engaged in clean energy tasks or activities at clean energy firms. For example, while all electricians in Maryland earn a median hourly wage of $27.54[40]electricians who work in part or exclusively with clean energy technologies, such as efficient lighting, grid modernization, or renewable generation, earn $28.79 per hour. In other words, clean energy electricians earn a premium of $1.25 per hour compared to the average electrician in Maryland.

When compared to the overall statewide median wage of $23.43 in Maryland, clean energy electricians earn $5.36 more per hour—a 22.9 percent premium over the statewide hourly median; this is highlighted in blue in the tables below.

In general, all of the 15 clean energy occupations in the tables below earn a premium over the statewide entry-level hourly wage of $11.64, with positions such as chief executives, general and operations managers, electric power-line installers and repairers, power distributors and dispatchers, power plant operators, and plant and system operators earning among the highest premiums.

At the mid-level, nearly all clean energy positions earn a higher hourly wage over the statewide median of $23.43, with the exception of meter readers and insulation workers. This is not surprising as these two occupations overall for both clean and non-clean energy positions earn below the statewide median.

In senior-level positions, clean energy jobs are less likely to earn a premium, with the exception of chief executives and general and operations managers. Overall, at these higher levels, hourly wages for clean energy positions tend to be discounted compared to the statewide wage of $59.68.

[38] Entry-level wages are taken at the 10th percentile, mid-level wages are median hourly wages, and senior-level wages are taken at the 90th percentile.
[39] A "premium" is defined here as the percentage *above* the comparative wage. A "discount" would indicate that the wage is *below* the comparative wage; this would be portrayed as a negative percentage.
[40] According to the Bureau of Labor Statistics, Occupational Employment Statistics dataset, which covers hourly wages for all occupations in Maryland in 2020.

TABLE 5. CLEAN ENERGY HOURLY WAGES BY SELECTED OCCUPATIONS[41]

	Entry-level	Median	Senior-level
National Average	**$ 10.97**	**$ 20.17**	**$ 50.99**
Maryland State Average	**$ 11.64**	**$ 23.43**	**$ 59.68**
Chief Executives	$ 44.33	$ 100.78	$ 171.88
General and Operations Managers	$ 32.06	$ 55.06	$ 109.09
Meter Readers, Utilities	$ 12.98	$ 21.72	$ 35.15
Electricians	$ 19.17	$ 28.79	$ 40.70
Insulation Workers, Floor, Ceiling, and Wall	$ 14.78	$ 20.53	$ 28.91
Plumbers, Pipefitters, and Steamfitters	$ 18.75	$ 28.27	$ 40.95
Structural Iron and Steel Workers	$ 18.82	$ 28.20	$ 40.31
Solar Photovoltaic Installers	$ 15.55	$ 22.74	$ 29.44
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$ 20.54	$ 29.66	$ 41.48
Electrical Power-Line Installers and Repairers	$ 26.16	$ 44.41	$ 55.38
Wind Turbine Service Technicians	$ 13.02	$ 17.32	$ 24.81
Power Distributors and Dispatchers	$ 42.22	$ 51.08	$ 56.27
Power Plant Operators	$ 34.43	$ 46.17	$ 49.83
Plant and System Operators, All Other	$ 25.72	$ 32.88	$ 38.83
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	$ 18.02	$ 28.17	$ 43.00

[41] U.S. and Maryland overall wages are from the Bureau of Labor Statistics, Occupational Employment Statistics (BLS OES), May 2020. Entry-level wages are taken at the 10th percentile while senior-level wages are taken from the 90th percentile. Instances of wage suppression from the BLS state-level data series are supplemented using JobsEQ.

TABLE 6. CLEAN ENERGY WAGE PREMIUMS BY SELECTED OCCUPATIONS

	Premium or Discount Compared to State Entry-level Wage of $11.64	Premium or Discount Compared to State Median Wage of $23.43	Premium or Discount Compared to State Senior-level Wage of $59.68
Chief Executives	280.8%	330.1%	188.0%
General and Operations Managers	175.4%	135.0%	82.8%
Meter Readers, Utilities	11.5%	-7.3%	-41.1%
Electricians	64.7%	22.9%	-31.8%
Insulation Workers, Floor, Ceiling, and Wall	27.0%	-12.4%	-51.6%
Plumbers, Pipefitters, and Steamfitters	61.1%	20.7%	-31.4%
Structural Iron and Steel Workers	61.7%	20.4%	-32.5%
Solar Photovoltaic Installers	39.7%	2.3%	-49.2%
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	76.5%	26.6%	-30.5%
Electrical Power-Line Installers and Repairers	124.7%	89.5%	-7.2%
Wind Turbine Service Technicians	79.0%	22.3%	-29.3%
Power Distributors and Dispatchers	262.7%	118.0%	-5.7%
Power Plant Operators	195.8%	97.1%	-16.5%
Plant and System Operators, All Other	121.0%	40.3%	-34.9%
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	54.8%	20.2%	-27.9%

Appendix A: 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 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.

Clean Energy 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 Hydroelectric Generation
- Nuclear Generation
- Natural Gas Generation
- Advanced Natural Gas Generation[42]

Clean Grid and Storage

Electric Power Transmission and Distribution

- Smart Grid
- Microgrid
- Other Grid Modernization[43]

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
- Biofuels, including ethanol and biodiesel
- Nuclear Fuel

[42] Includes efficient, low emission, leak free natural gas, including systems that use any of the following technologies: high efficiency compressor, advanced low NOx combustion technology, first application of closed loop steam cooling in an industrial gas turbine, advanced turbine blade and vane materials, high temperature TBC and abradable coatings, advanced row 4 turbine blades, 3-D aero technology, advanced brush seal.

[43] Includes other modernization of the nation's electricity transmission distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth.

ENERGY EFFICIENCY

- Traditional HVAC goods, control systems, and services
- 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

CLEAN FUELS

- Other Ethanol/Non-Woody Biomass, including biodiesel
- Woody Biomass/Cellulosic Biofuel
- Other Biofuels
- Nuclear Fuel
- Corn Ethanol

ALTERNATIVE TRANSPORTATION

- Plug-In Hybrid Vehicles
- Electric Vehicles
- Hybrid Electric Vehicles
- Natural Gas Vehicles
- Hydrogen Vehicles
- Fuel Cell Vehicles

Appendix B: Survey Methodology

Employment Data

Data for the 2021 Maryland Clean Energy Industry Report is taken from data collection for the US Energy and Employment Report (USEER). 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 2021 USEER survey in Maryland resulted in more than 9,700 calls and more than 1,500 emails to potential respondents. More than 2,100 business establishments participated in the survey. 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 +/-2.03 percent at a 95 percent 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 percent of their time working on energy-related activities and what percent spends all their time. 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. Intensity-adjusted employment estimates are sum of these products.

Clean Energy Wages

Clean energy-specific wages are derived using a mix of both the United States Energy and Employment data series as well as the Bureau of Labor Statistics Occupational Employment Statistics (OES) May 2020 database. The final wages are a result of clean energy technology-specific weighting and geographic specific weighting. The final wages start with granular (5-digit SOC) occupational wages at the national level from BLS, then we apply the technology-specific weight created from the national level survey data gathered from clean energy firms in the USEER data series, and the geographic-specific weight created from survey data gathered from South-Atlantic clean energy firms in the USEER data series and Maryland wages provided by BLS.

Appendix C: Clean Energy Jobs by County

The following table provides clean energy employment data by county, including Baltimore City, for overall clean energy jobs in 2019 and 2020.

County Name	2019 Clean Energy Jobs	2020 Clean Energy Jobs
Allegany County	430	400
Anne Arundel County	8,113	7,571
Baltimore County	13,526	12,326
Calvert County	1,711	1,546
Caroline County	292	267
Carroll County	2,343	2,161
Cecil County	724	668
Charles County	1,885	1,731
Dorchester County	175	159
Frederick County	4,913	4,534
Garrett County	335	309
Harford County	2,889	2,630
Howard County	6,743	6,300
Kent County	311	282
Montgomery County	14,974	13,646
Prince George's County	11,629	10,605
Queen Anne's County	437	390
St. Mary's County	2,147	2,185
Somerset County	125	100
Talbot County	555	519
Washington County	1,364	1,242
Wicomico County	990	908
Worcester County	460	428
Baltimore City	8,401	7,890
N/A	2,682	2,505
TOTAL	**88,153**	**81,301**

Appendix D: Clean Energy Training Inventory

Program	Provider	Program Type	Occupational Focus	Sector	County
BPI Certification Training	A Hight On Homes	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Calvert
HVAC & Refrigeration Training in Baltimore	All State Career Maryland	Technical School	Building Analyst	Energy Efficiency	Baltimore City
Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology/Technician	ALL-STATE CAREER-BALTIMORE	Private Consulting/Training Firm	HVAC	Energy Efficiency	Baltimore City
Engineering Transfer	Anne Arundel Community College	Community/ Junior College	Engineering	Energy Efficiency	Anne Arundel
Noncredit HVAC Electrical Apprentice	Anne Arundel Community College	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
OCA-358 EPA Section 608 Universal Certification	Anne Arundel Community College	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
Advanced Bimodal Design Training Using Sol-Ark 12k Inverter	Araybeam Corporation	Private Consulting/Training Firm	Solar	Renewable Energy Generation	Charles
GWO On-Shore BST Package	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Off-Shore BST Package	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Fire Awareness	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO First Aid	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Manual Handling	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Sea Survival and Transfer	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Working at Height	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
HVAC Apprenticeship	Associated Builders and Contractors (ABC)	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
"Associated Builders and Contractors Baltimore Metro Chapter Electrical Apprenticeship	"	"Associated Builders and Contractors, Baltimore Metro Chapter			
"	Apprenticeship	General Clean Energy	Energy Efficiency	Anne Arundel	
Section 608 Technician Certification - CFC Refresher Class and Testing	Association of Air Conditioning Professionals	Trade Association	Building Analyst	Energy Efficiency	Montgomery
Apprentice Electrician - Field Services	Beitzel	Private Consulting/Training Firm	General Clean Energy	Renewable Energy Generation	Garrett

BGE Paid Summer Internships	BGE Maryland	Non-Profit Organization	Engineering	Renewable Energy Generation	Baltimore City
Mechatronics Engineering	Capitol Technology University	4-Year College or University	General Clean Energy	Renewable Energy Generation	Prince George's
Heating, Ventilation, & AC	Carroll County Career and Technology Center	Vocational High School	HVAC	Energy Efficiency	Carroll
Renewable Energy Specialist Program	Cecil College	Community/ Junior College	Solar	Renewable Energy Generation	Cecil
Renewable Energy Specialist	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Photovoltaic System Professional	Cecil College	Community/ Junior College	Solar	Renewable Energy Generation	Cecil
Sustainability Professional	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Green Specialist Program	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Senior Sustainability Professional Program	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Alternative Energy Specialist	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Green Interior Design Specialist	Cecil College	Community/ Junior College	Construction	Energy Efficiency	Cecil
NCCER HVAC/R - Level 1	Cecil College	Community/ Junior College	HVAC	Energy Efficiency	Cecil
HVAC/R Apprenticeship	Cecil College	Community/ Junior College	HVAC	Energy Efficiency	Cecil
Plumbing/HVAC Technology	Cecil County School of Technology	Vocational High School	HVAC	Energy Efficiency	Cecil
Environmental Studies Program	Chesapeake College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Talbot
BPI Building Analyst and Envelope Professional	Civic Works	Non-Profit Organization	Building Analyst	Energy Efficiency	Baltimore City
Energy Retrofit Training	Civics Works Center for Sustainable Careers	Non-Profit Organization	Construction	Energy Efficiency	Baltimore City
"Solar Installation Training					
"	Civics Works Center for Sustainable Careers	Non-Profit Organization	Construction	Energy Efficiency	Baltimore City
Solar Installation Training	Civil Works Center for Sustainable Careers	Non-Profit Organization	Solar	Renewable Energy Generation	Baltimore City
Energy Retrofit Training	Civil Works Center for Sustainable Careers	Non-Profit Organization	Construction	Energy Efficiency	Baltimore City
Alternative Energy Sources for Water and Wastewater Facilities	College of Southern Maryland	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Charles

Energy Audit	College of Southern Maryland	Community/ Junior College	Energy Management	Energy Efficiency	Charles
Energy Management - A Small System Approach	College of Southern Maryland	Community/ Junior College	Energy Management	Energy Efficiency	Charles
Electric Wiring Technician	College of Southern Maryland	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Charles
Electrical Engineering	College of Southern Maryland	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Charles
Electric Power Technician	College of Southern Maryland	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Charles
Energy Systems Technology, AAS	College of Southern Maryland	Community/ Junior College	General Clean Energy	Energy Efficiency	Charles
Renewable Energy Classes and Customized Training (available upon request)	Community College of Baltimore County	Community/ Junior College	General Clean Energy	Energy Efficiency, Renewable Energy Generation	Baltimore City
HVAC/R Technician, Continuing Education Certificate	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
Advanced HVAC and Energy Technology Certificate, Credit Certificate	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
Building Automation Systems, Credit Certificate	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
Heating, Ventilation and Air Conditioning (HVAC) & Energy Technology, Associate of Applied Science	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
Basic HVAC and Energy Technology Certificate, Credit Certificate	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
Visible Emissions Evaluator Classes	Community College of Baltimore County	Community/ Junior College	Energy Management	Energy Efficiency	Baltimore
HVAC/R Technician, Continuing Education Certificate	Community College of Baltimore County	Community/ Junior College	HVAC	Energy Efficiency	Baltimore
EPA Prep Class and Testing Section 608 Certification for Air Conditioning and Refrigeration	Cropp Metcalfe Academy	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Montgomery
BPI BUILDING ANALYST/ENVELOPE PRO TRAINING	Elysian Energy	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Prince George's
EnergyScore® BPI Certification Training Classes	Energy Score	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Baltimore
BPI Building Analyst Certification Training	everblue training	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Baltimore City
Electrical Certificate	Frederick Community College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Frederick

Electrical Letter of Recognition	Frederick Community College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Frederick
HVAC Certificate	Frederick Community College	Community/ Junior College	HVAC	Energy Efficiency	Frederick
HVAC Letter of Recognition	Frederick Community College	Community/ Junior College	HVAC	Energy Efficiency	Frederick
Sustainability Studies Minor	Frostburg State University	4-Year College or University	Energy Management	Energy Efficiency	Allegany
Environmental Studies Major	Goucher College	4-Year College or University	General Clean Energy	Renewable Energy Generation, Energy Efficiency	Baltimore
LEED Training Maryland	Green Building Consultants Sustainable Investment Group	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Baltimore
Residential Energy Services Network (RESNET)	Green Training USA	Private Consulting/Training Firm	Energy Management	Energy Efficiency	Montgomery
BPI Building Analyst Training & Certification	Green Training USA	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Montgomery
BPI Envelope Training & Certification	Green Training USA	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Montgomery
Alternative Energy Technology	Hagerstown Community College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Washington
Geothermal Energy Installation and Service	Hagerstown Community College	Community/ Junior College	Geothermal	Renewable Energy Generation	Washington
Solar/Wind Energy Installation and Service	Hagerstown Community College	Community/ Junior College	Wind, Solar	Renewable Energy Generation	Washington
HEATING, AIR CONDITIONING & REFRIGERATION TECHNOLOGY	Harford Technical High School	Vocational High School	HVAC	Energy Efficiency	Harford
Biofuels Research Program	Hood College	4-Year College or University	Biofuels	Clean Fuels	Frederick
Construction Management - Certificate (Career)	Howard Community College	Community/ Junior College	Construction	Energy Efficiency	Howard
Solar Energy System Inspector Certification Course	Howard Community College	Community/ Junior College	Solar	Renewable Energy Generation	Howard
Heating, Ventilation, Air Conditioning & Refrigeration (HVACR)	Howard Community College	Community/ Junior College	HVAC	Energy Efficiency	Howard
"Maryland Offshore Wind Strategic Industry Partnership	"	Humanim	Private Consulting/Training Firm	Wind	Renewable Energy Generation
HVAC Apprentice	James Vito, Inc.	Apprenticeship	HVAC	Energy Efficiency	Montgomery
Welding Training Program to Enter OSW Industry	Jane Addams Resource Corporation	Non-Profit Organization	Wind	Renewable Energy Generation	Baltimore City

Renewable energy Theory and Application:	JATC Local 26	Private Consulting/Training Firm	General Clean Energy	Renewable Energy Generation	Prince George's
Leed Green Associate Training	Leading Green	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Frederick
Air Conditioning, Refrigeration & Heating Technology — Columbia	Lincoln Tech	Technical School	HVAC	Energy Efficiency	Howard
Electrical and Electronic Systems Technology	Lincoln Technical Institute	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Howard
Electrical Engineering Concentration	Loyola	4-Year College or University	General Clean Energy	Renewable Energy Generation, Alternative Vehicles	Baltimore
Virtual Reality Training Program That Simulates The Experience of Piloting Through a Commercial-Scale Offshore Wind Farm	Maritime Institute of Technology & Graduate Studies	4-Year College or University	Wind	Renewable Energy Generation	Anne Arundel
Global Wind Organization Basic Safety Training	Maritime Institute of Technology & Graduate Studies	4-Year College or University	Wind	Renewable Energy Generation	Anne Arundel
LEED v4 Green Associate	Maryland Associated General Contractors of America	Trade Association	Building Analyst	Energy Efficiency	Baltimore
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Anne Arundel County	Government	General Clean Energy	Energy Efficiency	Anne Arundel
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Chesapeake College	Community/ Junior College	General Clean Energy	Energy Efficiency	Talbot
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x College of Southern Maryland	Community/ Junior College	General Clean Energy	Energy Efficiency	Charles
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Ellicott City Community Center	Community/ Junior College	General Clean Energy	Energy Efficiency	Howard
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Hagerstown Community College	Community/ Junior College	General Clean Energy	Energy Efficiency	Washington
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Johns Hopkins	4-Year College or University	General Clean Energy	Energy Efficiency	Baltimore City
Certified Climate Change Professional® (CC-P®) Credential Training Programs	Maryland Climate Leadership Academy x Montgomery College	Community/ Junior College	General Clean Energy	Energy Efficiency	Montgomery
BLDG 186 - Wind Generator Systems	Montgomery College	Community/ Junior College	Wind	Renewable Energy Generation	Montgomery

BLDG 182 - Renewable and Sustainable Energy Technologies	Montgomery College	Community/ Junior College	General Clean Energy	Energy Efficiency	Montgomery
BLDG 188 - Solar Thermal Design and Installation	Montgomery College	Community/ Junior College	Solar	Renewable Energy Generation	Montgomery
BLDG 184 - Solar PV Design and Installation	Montgomery College	Community/ Junior College	Solar	Renewable Energy Generation	Montgomery
BLDG 284 - Advanced Solar PV Design	Montgomery College	Community/ Junior College	Solar	Renewable Energy Generation	Montgomery
Nuclear Engineering	Montgomery College	Community/ Junior College	Nuclear	Renewable Energy Generation	Montgomery
Civil Engineering	Montgomery College	Community/ Junior College	Construction	Energy Efficiency	Montgomery
Electrical Engineering	Montgomery College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Montgomery
Electrical Wiring Area of Concentration, Building Trades Technology Degree	Montgomery College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Montgomery
Electrical Wiring Certificate	Montgomery College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Montgomery
HVAC Area of Concentration, Building Trades Technology Degree	Montgomery College	Community/ Junior College	HVAC	Energy Efficiency	Montgomery
HVAC Certificate	Montgomery College	Community/ Junior College	HVAC	Energy Efficiency	Montgomery
LEED Green Associate Exam Prep	Montgomery College	Community/ Junior College	Building Analyst	Energy Efficiency	Montgomery
Environmental Science Major	Mount Saint Mary's University	4-Year College or University	Energy Management	Renewable Energy Generation	Frederick
Herbert J. Hoelter Vocational Training Center: HVAC/R Training	National Center on Institutions and Alternatives	Non-Profit Organization	HVAC	Energy Efficiency	Baltimore
Building Construction Technology	North American Trade Schools	Technical School	Construction	Energy Efficiency	Baltimore City
Electrical Technology Program	North American Trade Schools	Technical School	Solar	Renewable Energy Generation	Baltimore City
HRVAC Technology	North American Trade Schools	Technical School	HVAC	Energy Efficiency	Baltimore City
OSHA 10 HOUR TRAINING BALTIMORE MARYLAND	OSHA TRAINING BALTIMORE MARYLAND	Private Consulting/Training Firm	Construction	Energy Efficiency	Baltimore City
OSHA 30 HOUR TRAINING BALTIMORE MARYLAND	OSHA TRAINING BALTIMORE MARYLAND	Private Consulting/Training Firm	Construction	Energy Efficiency	Baltimore City
MD 10 Hour Osha Construction Training	OSHA TRAINING BALTIMORE MARYLAND	Private Consulting/Training Firm	Construction	Energy Efficiency	Baltimore City
MD 30 Hour Osha Construction Training	OSHA TRAINING BALTIMORE MARYLAND	Private Consulting/Training Firm	Construction	Energy Efficiency	Baltimore City

10 Hour Osha Construction Training	Osha Training USA	Private Consulting/Training Firm	Construction	Energy Efficiency	Montgomery
30 Hour Osha Construction Training	Osha Training USA	Private Consulting/Training Firm	Construction	Energy Efficiency	Montgomery
MD 10 Hour Osha Construction Training	Osha Training USA	Private Consulting/Training Firm	Construction	Energy Efficiency	Montgomery
MD 30 Hour Osha Construction Training	Osha Training USA	Private Consulting/Training Firm	Construction	Energy Efficiency	Montgomery
Power 52 Energy Institute	Power 52	Non-Profit Organization	Solar	Renewable Energy Generation	Howard
NCCER Introduction to Solar Photovoltaics	Prince George's Community College	Community/ Junior College	Solar	Renewable Energy Generation, Alternative Vehicles	Prince George's
BPI Building Science Principles	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
BPI Building Analyst	Prince George's Community College	Community/ Junior College	Building Analyst	Energy Efficiency	Prince George's
BPI Envelope Professional	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
Maryland Home Improvement Contractor License Exam Preparation	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
ASE L3 Hybrid/Electric Vehicle Specialist Training	Prince George's Community College	Community/ Junior College	General Clean Energy	Alternative Vehicles	Prince George's
Sustainable Energy and Workforce Development Program	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
Carpentry	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
Building Maintenance Engineer	Prince George's Community College	Community/ Junior College	Construction	Energy Efficiency	Prince George's
Electrical and Residential Wiring	Prince George's Community College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Prince George's
HVAC/R	Prince George's Community College	Community/ Junior College	HVAC	Energy Efficiency	Prince George's
Sustainable Energy and Workforce Development Program	Prince George's Community College	Community/ Junior College	General Clean Energy	Renewable Energy Generation, Alternative Vehicles	Prince George's
Advanced PV Installation and Design	REACH! Partnership School (Civic Works)	Private Consulting/Training Firm	Solar	Renewable Energy Generation	Baltimore City
Photovolatic System Fundamentals	REACH! Partnership School (Civic Works)	Private Consulting/Training Firm	Solar	Renewable Energy Generation	Baltimore City
Zero Harm Culture - Vision Zero Campaign	Siemens	Private Consulting/Training Firm	Construction	Renewable Energy Generation	Montgomery
LEED Training	Straughan Environmental	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Howard

Heating, Ventilation, & Air Conditioning (HVAC)	Thomas Edison High School of Technology	Vocational High School	HVAC	Energy Efficiency	Montgomery
Nuclear Engineering (ENR)	United States Naval Academy	4-Year College or University	Nuclear	Renewable Energy Generation	Anne Arundel
Sustainability Studies Minor	University of Maryland	4-Year College or University	Energy Management	Energy Efficiency	Prince George's
Bioprocessing and the Business of Biotechnology	University of Maryland Global Campus	4-Year College or University	General Clean Energy	Clean Fuels	Prince George's
ARCH 430 - Measuring Sustainability in Architecture (3)	University of Maryland School of Architecture, Planning & Preservation	4-Year College or University	Building Analyst	Energy Efficiency	Prince George's
ARCH 289I - Sustainability at College Park (3)	University of Maryland School of Architecture, Planning & Preservation	4-Year College or University	Building Analyst	Energy Efficiency	Prince George's
HVACR technician	Wor-Wic Community College	Community/ Junior College	HVAC	Energy Efficiency	Wicomico
WELDING & METAL FABRICATION	Wor-Wic Community College	Community/ Junior College	Construction	Renewable Energy Generation	Wicomico
EPA-Approved Refrigerant Containment Course and Test	Wor-Wic Community College	Community/ Junior College	Building Analyst	Energy Efficiency	Wicomico
Renewable Energies	Worcester Tech	Vocational High School	General Clean Energy	Renewable Energy Generation	Worcester
Heating, Ventilation, Air Conditioning & Refrigeration	Worcester Technical High School	Vocational High School	HVAC	Energy Efficiency	Worcester
Renewable Energies	Worcester Technical High School	Vocational High School	General Clean Energy	Renewable Energy Generation	Worcester
BPI Certification Training	A Hight On Homes	Private Consulting/Training Firm	Building Analyst	Energy Efficiency	Calvert
HVAC & Refrigeration Training in Baltimore	All State Career Maryland	Technical School	Building Analyst	Energy Efficiency	Baltimore City
Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology/Technician	ALL-STATE CAREER-BALTIMORE	Private Consulting/Training Firm	HVAC	Energy Efficiency	Baltimore City
Engineering Transfer	Anne Arundel Community College	Community/ Junior College	Engineering	Energy Efficiency	Anne Arundel
Noncredit HVAC Electrical Apprentice	Anne Arundel Community College	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
OCA-358 EPA Section 608 Universal Certification	Anne Arundel Community College	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
Advanced Bimodal Design Training Using Sol-Ark 12k Inverter	Araybeam Corporation	Private Consulting/Training Firm	Solar	Renewable Energy Generation	Charles
GWO On-Shore BST Package	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico

GWO Off-Shore BST Package	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Fire Awareness	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO First Aid	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Manual Handling	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Sea Survival and Transfer	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
GWO Working at Height	ARCON Training Center & AIS Training	Private Consulting/Training Firm	Wind	Renewable Energy Generation	Wicomico
HVAC Apprenticeship	Associated Builders and Contractors (ABC)	Community/ Junior College	HVAC	Energy Efficiency	Anne Arundel
"Associated Builders and Contractors Baltimore Metro Chapter Electrical Apprenticeship	"	"Associated Builders and Contractors, Baltimore Metro Chapter			
"	Apprenticeship	General Clean Energy	Energy Efficiency	Anne Arundel	
Section 608 Technician Certification - CFC Refresher Class and Testing	Association of Air Conditioning Professionals	Trade Association	Building Analyst	Energy Efficiency	Montgomery
Apprentice Electrician - Field Services	Beitzel	Private Consulting/Training Firm	General Clean Energy	Renewable Energy Generation	Garrett
BGE Paid Summer Internships	BGE Maryland	Non-Profit Organization	Engineering	Renewable Energy Generation	Baltimore City
Mechatronics Engineering	Capitol Technology University	4-Year College or University	General Clean Energy	Renewable Energy Generation	Prince George's
Heating, Ventilation, & AC	Carroll County Career and Technology Center	Vocational High School	HVAC	Energy Efficiency	Carroll
Renewable Energy Specialist Program	Cecil College	Community/ Junior College	Solar	Renewable Energy Generation	Cecil
Renewable Energy Specialist	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Photovoltaic System Professional	Cecil College	Community/ Junior College	Solar	Renewable Energy Generation	Cecil
Sustainability Professional	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Green Specialist Program	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil

Senior Sustainability Professional Program	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Alternative Energy Specialist	Cecil College	Community/ Junior College	General Clean Energy	Renewable Energy Generation	Cecil
Green Interior Design Specialist	Cecil College	Community/ Junior College	Construction	Energy Efficiency	Cecil
NCCER HVAC/R - Level 1	Cecil College	Community/ Junior College	HVAC	Energy Efficiency	Cecil
HVAC/R Apprenticeship	Cecil College	Community/ Junior College	HVAC	Energy Efficiency	Cecil
Plumbing/HVAC Technology	Cecil County School of Technology	Vocational High School	HVAC	Energy Efficiency	Cecil