MASSACHUSETTS CLEAN ENERGY CENTER®

Offshore Wind Workforce Training & Development in Massachusetts

ANALYSIS AND STRATEGIC RECOMMENDATIONS

SEPTEMBER 2021

[bw] RESEARCH PARTNERSHIP

ACKNOWLEDGMENTS

This report was prepared for the Massachusetts Clean Energy Center by BW Research Partnership.

The Massachusetts Clean Energy Center (MassCEC) is a quasi-public state agency whose mission is to accelerate the clean energy and climate solution innovation that is critical to meeting the Commonwealth's climate goals, advancing Massachusetts' position as an international climate leader while growing the state's clean energy economy.

BW Research Partnership is a full-service consulting and research firm specializing in workforce and economic development for public entities, including workforce investment boards, economic development agencies, cities, counties, and educational institutions, with particular expertise in the energy sector.

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Mr. Jordan is the co-author of the annual U.S. Energy and Employment Report, the landmark study that quantifies job creation, supply chain growth and development, and transition in the U.S. energy sector; The Solar Foundation's annual Solar Jobs Census; Energy Efficiency Employment in Canada for Natural Resources Canada; and numerous federal, state, and local studies on innovation, economic growth, and workforce development related to energy.

EXECUTIVE SUMMARY

The Massachusetts Clean Energy Center (MassCEC) engaged BW Research Partnership to analyze offshore wind (OSW) workforce development in the Northeast, with a specific focus on Massachusetts. This report builds off the work and findings of the *2018 Massachusetts Offshore Wind Workforce Assessment*[1], providing a more detailed understanding of the specific occupations required for all phases of an offshore wind project. This study also includes an overview of the existing, relevant regional training programs, including the grantees awarded under MassCEC's 2018 and 2020 workforce development solicitations. Analysis was conducted to further examine the workforce required to complete Massachusetts' first 1,600 megawatts of offshore wind (with recognition of further offshore wind deployment planned for the Commonwealth and the Northeast), and the state's current ability to supply the necessary workers. The report includes discussion of "priority communities" in which to focus workforce development efforts based on equity, need, and current workforce supply.

For the purposes of this report, the OSW workforce is defined as direct involvement in the planning and development, manufacturing and assembly, construction and installation, operations and maintenance, and other support services of a functioning offshore wind farm. While the study examines Massachusetts' ability to supply all OSW project tasks, the report's gap analysis and recommendations focus primarily on workers involved in the construction and installation and operations and maintenance phases of OSW project development.

For this project, BW Research Partnership completed a comprehensive literature review, interviewed 29 industry stakeholders, and analyzed data from the US Bureau of Labor Statistics, the US Energy and Employment Report (USEER), and the Massachusetts Clean Energy Industry Report.

Offshore Wind Occupations and Training Programs

The research team identified 119 distinct occupations across five phases of OSW project development. Many entry and mid-level occupations require a high school diploma or apprenticeship/postsecondary training, and industry-specific certificates exist for particular jobs. The information compiled for this component of the analysis was utilized by MassCEC and another consultant team to develop an Offshore Wind Career Pathways resource[2] to show the wide array of potential jobs available in offshore wind across the planning, permitting, construction, installation, operation, and maintenance phases.

Forty-five wind training and educational programs operate in the Northeast, with 14 actively hosting offshore wind-specific curricula and another 15 in development. OSW training and educational options are spurred by significant investment from MassCEC to develop a diverse ecosystem of offshore wind workforce development initiatives for the offshore wind industry.

The research team also developed key metrics and identified 284 census tracts as "priority communities" to be served by workforce development initiatives.

[1] https://www.masscec.com/2018-massachusetts-offshore-wind-workforce-assessment

[2] https://cleanenergyeducation.org/career-pathways/offshore-wind/

Gap Analysis

The research team analyzed the gap between the anticipated workforce needed in the near-term to support the first 1,600 MW offshore wind projects and the workforce currently available (as of 2020) to understand the current degree of occupational demand in the OSW supply chain. Across all phases, 37 percent have sufficient workers to meet the anticipated OSW workforce demand, while 27 percent have a *moderate* workforce gap, and 36 percent of occupations were determined to have a *significant* in-state workforce gap. The state is most prepared to meet science, engineering, management, and maritime needs, while least prepared to meet construction and assembly needs.

COVID-19 IMPACTS TO MASSACHUSETTS' OFFSHORE WIND WORKFORCE

This study was conducted during the height of the coronavirus pandemic (COVID-19), which disrupted the global economy and left more than 10,000 Massachusetts clean energy employees out of work as of October 2020.[3] While the nascent OSW workforce did not experience significant short-term impacts, there are medium- and long- term implications around the availability of talent and suppliers.

This report assumes a full recovery to pre-COVID employment for its analyses, but OSW supply chain firms and workforce institutions face uncertainty in the timeline and level at which that recovery will occur. Through 2020, for example, construction and manufacturing occupations in the clean energy industry have been slowest to recover; the sectors remain 16 and 10 percent below pre-COVID employment levels, respectively. Uncertainty around the timing of this workforce availability – and OSW project development – creates unique challenges for strategic planning around workforce development.

Key Findings and Recommendations

This study culminated in several key findings and associated recommendations relating to offshore wind workforce development in Massachusetts and Southern New England. It should be noted that for many of these themes, there are ongoing activities and initiatives in the Commonwealth that will serve as a strong foundation to build on.

KEY FINDING 1 The development and provision of safety and technical training programs are a factor for firms looking to participate in the offshore wind supply chain. Massachusetts should support the identification of developer and Tier I suppliers' specific expected workforce qualifications and the development and offering of the associated programs and necessary courses to prospective supply chain firms.

[3] https://bwresearch.com/covid/

KEY FINDING 2 OSW-specific training for current maritime workers will solidify the Commonwealth's regional expertise in deep-sea navigation. Massachusetts should continue to support the creation of industry-standardized professional requirements and actively market skill expansion opportunities to the fishing community.

KEY FINDING 3 Due to the high cost of building physical training facilities and assets, Massachusetts should continue to support the development of on-demand OSW virtual training resources that allows original equipment manufacturers (OEMs), Tier 1 suppliers, and others to teach their specific processes locally.

KEY FINDING 4 Massachusetts should continue its nation-leading provision of industry-recognized Global Wind Organisation safety and technical training programs.

KEY FINDING 5 Out-of-state or international firms may not appreciate that the Commonwealth has a uniquely robust Vocational Technical High School system. Massachusetts should work to (1) develop and encourage the use of OSW curricula in key occupation degrees, and (2) highlight the Vocational Technical system in marketing and outreach to potential OSW firms.

KEY FINDING 6 Recognizing that the state's university system is establishing itself as one of the leading national sources of offshore wind engineers and professionals, Massachusetts should (1) use the launch of UMass Lowell's training program (in development) to initiate a workforce development collaboration across the members of POWER-US and (2) market MassCEC's Clean Energy Internship program to prospective workers and suppliers.

KEY FINDING 7 Pre-training programs can provide the daily support and resources necessary to help unemployed residents in priority communities reenter the workforce. Massachusetts should (1) work with regional MassHire Workforce Boards and other partners to add initiatives aimed at the provision of transportation, housing, and other basic needs; and (2) expanding pre-apprenticeship programming and marketing to provide low-cost, low-stakes apprenticeship exposure to priority communities.

KEY FINDING 8 Northeast states have an opportunity to develop regional workforce strategies; Massachusetts should continue regional coordination and collaboration efforts and consider the convening of a regional OSW workforce development task force.

KEY FINDING 9 Cataloging and assessing the capabilities of likely in-state supply chain firms will help to quantify and categorize assembly and installation workforce needs. Massachusetts should continue engagement with partners such as Mass MEP, NECEC, regional EDAs, and other entities to identify and strategize efficient and effective measures to address gaps in the supply chain.

KEY FINDING 10 Massachusetts should examine and communicate the long-term, transferable employment opportunities between offshore wind and other industries.

TABLE OF CONTENTS

INTRODUCTION

On behalf of the Massachusetts Clean Energy Center, BW Research Partnership conducted an in-depth analysis of the offshore wind (OSW) labor market in Massachusetts[4]. The results from the research were synthesized to provide a comprehensive picture of the current workforce's ability to meet the current needs of offshore wind industry and support the strategic development of offshore wind training and educational programs in Massachusetts and the Northeast region. This report briefly summarizes best practices in workforce development from across the world and a regional workforce gap analysis.

This report answers the following key questions, among others:

- Can Massachusetts currently supply the offshore wind industry with enough qualified talent for the construction and operations phases of the first 1,600MW of offshore wind developments?
- If not, are there in-state and regional solutions already in place that can be used to quickly and efficiently train workers?
- Are there opportunities for Massachusetts training providers to export trainees to neighboring states for their offshore wind projects?
- To build a diverse, equitable, and inclusive OSW workforce, which Massachusetts groups or communities should be prioritized for training recruitment?
- What new training programs may be required, and how should they be developed and implemented?

This report identifies existing OSW workforce training and educational programs within the state and the broader Northeast region, outlines a roadmap for enhancing existing programs, and offers recommendations for future cooperative opportunities. The recommendations provide immediate and apparent insight into the best strategies for the future of offshore wind workforce development in Massachusetts and the Northeast region.

Methodology

A comprehensive review of existing offshore wind workforce literature – both in the US and abroad – was conducted and consolidated, serving as the basis for much of the background information. A list of the consulted sources can be found in Appendix A.

The literature review was supplemented by interviews with twenty-nine offshore wind stakeholders to gain further insight into the workforce supply chain and development. The project team spoke with representatives of the major project developers, recipients of MassCEC's offshore wind workforce training grants, other regional training providers, Tier I suppliers, labor union leaders, government representatives, and industry groups.

[4] The analysis period for this report was January – September 2020

All occupational data was sourced from the Bureau of Labor Statistics (through the use of the proprietary economic analysis tool EMSI), the US Energy and Employment Report (USEER), and the Massachusetts Clean Energy Industry Report.

BACKGROUND

Throughout the duration of the project, BW Research Partnership refined three of its proprietary datasets to inform strategic recommendations:

1. An **OSW supply chain occupation map**, organizing every occupation directly involved in the life cycle of an offshore wind farm by occupational sector and phase of development. The map also identifies common education, certification, and licensure requirements for each occupation.

2. A **regional wind training inventory**, identifying every known training and educational program in, or near, the Northeastern United States that contains – or will contain – offshore and/or land-based wind energy curricula. The inventory includes the following information for each identified program: program host, location, explanation of program, funding source (where applicable), and duration of each program. It also highlights programs that are directed specifically toward the OSW industry and notes whether the program is still in development.

3. A **list of priority communities** in Massachusetts (identified by census tract) that stand to benefit from targeted workforce development efforts based on metrics for unemployment, income, demographics, education, and language.

Overview: Occupations Required for Offshore Wind

The occupation map - which identifies 119 distinct occupations for OSW - organizes the offshore wind farm development into five phases: Planning and Development, Manufacturing and Assembly, Construction and Installation, Operations and Maintenance, and Support Services. Within Manufacturing/Assembly and Construction/Installation, the processes are further organized by sub-phase, including nacelle and rotor, towers, blades, foundations, array and export cables, and substation structure.

Planning and Development takes at least two years, typically longer, depending on the project.[5] This phase is responsible for an estimated two percent of lifetime costs.[6] As with the Block Island Wind Farm, developers of the early U.S. wind projects will likely import international talent for leadership and supervisory roles in this stage until regional expertise is established. Eventually, this stage will account for an estimated 15% of the direct workforce addition of a United States offshore wind industry.[7] The database currently identifies **47 occupations** within this phase, including engineers, financial analysts, and lawyers.

[5] All time frame estimates were compiled from the UK Offshore Wind Industry: Supply Chain Review and The Workforce Opportunity of Offshore Wind in New York reports.
[6] All lifetime cost estimates were compiled from the UK Offshore Wind Industry: Supply Chain Review report.
[7] All workforce addition estimates were compiled from the New York State and the Jobs of Offshore Wind Energy report.

The **Manufacturing and Assembly** phase takes years - though OSW original equipment manufacturers (OEMs) will likely be involved in supplying multiple projects/orders at once. This phase is responsible for an estimated 44 percent of lifetime costs. It is estimated that job creation in this phase will account for an estimated 7 percent of total job addition from a US OSW industry. The database currently identifies **75 occupations** within this phase, including engineers, metal workers, assemblers, and administrative staff.

Construction and Installation takes two to five years and is responsible for about 12 percent of lifetime costs. Many of the jobs in this phase are temporary in nature but, in total, will account for an estimated 41 percent of direct US workforce addition from OSW expansion. The database currently identifies **68 occupations** within this phase, including crane operators, electricians, line workers, and welders.

The **Operations and Maintenance** phase can be 20 years or more, depending on lease and energy agreements, and accounts for 40 percent of lifetime costs. Workers involved in the regular inspection and repair of turbines, foundations, and cables, as well as vessel crews needed to complete these tasks, are expected to account for 17 percent of direct US workforce addition from an expanded OSW industry. The database currently identifies **59 occupations** within this phase, including administrative staff, wind turbine technicians, marine operators, and plant managers.

Support Services, which include transportation, training, research, and consulting, account for the final 20 percent of estimated direct US workforce addition to arise from an expanded OSW market. These services occur during all phases, with involvement lasting months or years depending upon the project. The database currently identifies **39 occupations** within this phase, including meteorologists, vessel mechanics, lawyers, and policy experts.

Occupations are separately organized into 12 occupational categories. The distribution is as follows:

Occupational Category	Number of Occupations
Admin & Finance	11
Construction & Assembly Workers	19
Consultants, Scientists & Researchers	8
Directors and Executives	4
Education	3
Engineers & Technicians	23
Legal & Permitting	3
Management	10
Maritime, Port & Aircraft Workers	5
PR and Marketing	4
Trade Worker	24
Transport & Logistics	5

Educational requirements have been identified for each occupation and then organized by intensity level. Entry-Level includes high school diplomas, associate degrees, and apprenticeships; Mid-Level includes bachelor's degrees; and Advanced-Level includes master's and doctoral degrees. The distribution is as follows:

Education Level	Share of Occupations
Entry-Level	52%
Mid-Level	38%
Advanced-Level	10%

Finally, the certificates and professional licensures widely recognized as necessary for hiring each occupation were identified. The common certificates include:

OSHA certificates The Occupational Safety and Health Administration has established industry-recognized curricula for general and specific safety trainings of manufacturing, installation, and O&M workers. Certification programs are widespread and hosted by third-party institutions. Common certifications needed in the OSW industry include 10-Hour Training for General Industry, Confined Space Entry Training, and Fall Protection. To note, the Bureau of Safety and Environmental Enforcement has established itself as the primary workforce safety regulator for construction and operations tasks conducted offshore but is still in the process of developing standards or training curricula.[8]

GWO certificates The Global Wind Organization (GWO) had developed a certification for the onshore and offshore wind industries. The training providers are certified by third-party certification bodies, with 12 training providers currently certified in North America. RelyOn Nutec (working with Mass Maritime Academy) and Maersk Training (working with Bristol Community College) are the two largest GWO-certified training providers worldwide. Certificates include Basic Safety Training, Basic Technical Training, and Blade Repair, among others.

Lean Six Sigma certificates The American Quality Society is the principal certifying agency for Lean Six Sigma Green and Black Belt certificates, which focus on team collaboration and efficiency. Six Sigma training is offered through universities, community colleges, for-profit, and not-for-profit businesses, and organizations and is generally readily available.

CCT certificates Certified Composites Technician certification – both Open Molding and Wind Blade Repair – is offered through the American Composites Manufacturers Association. It is widely recognized in the composites industry for the production and/or management personnel working with or producing composite components, such as blades, or nacelle and rotor housings.

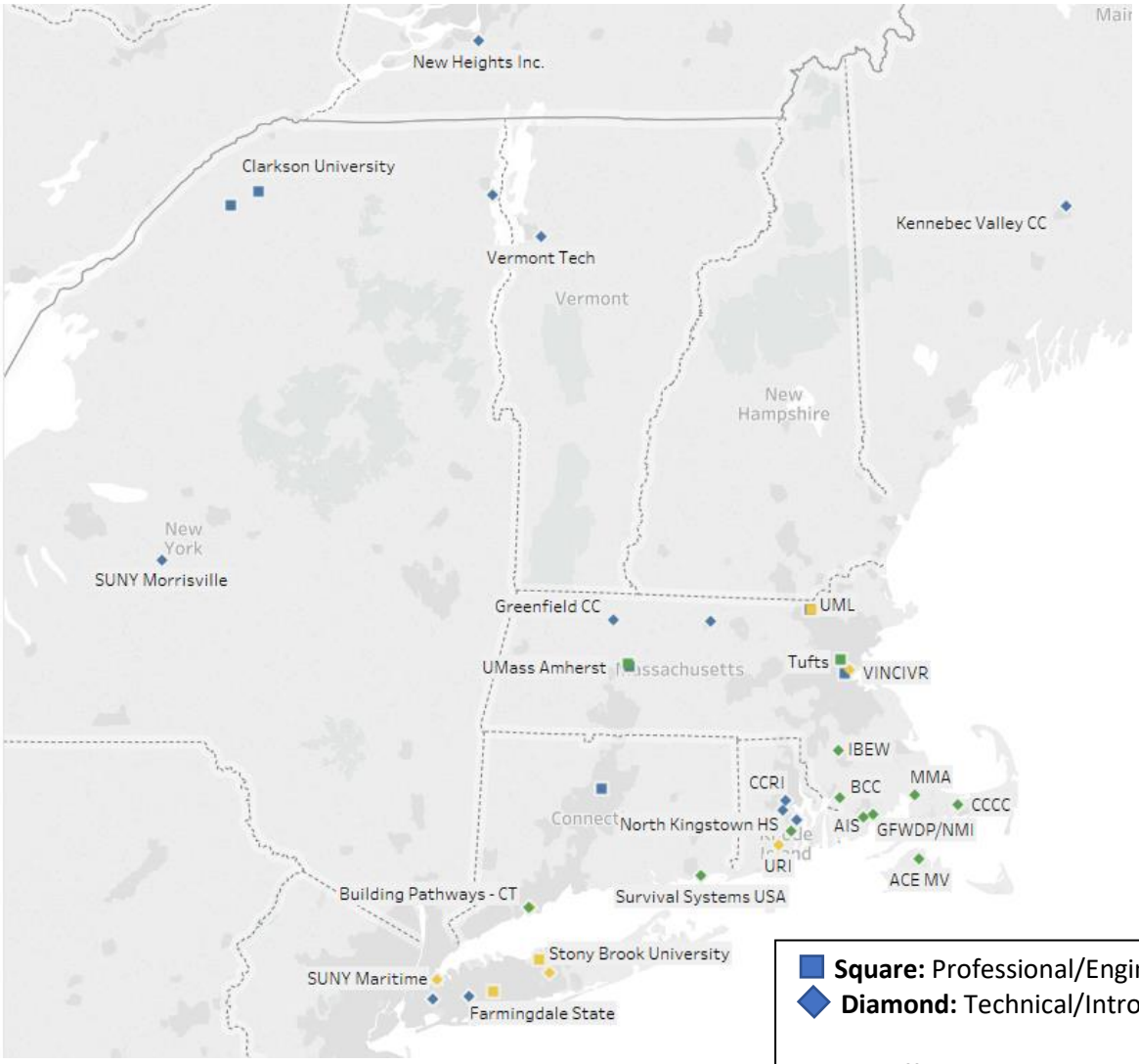
[8] https://www.bsee.gov/what-we-do/renewable-energy/renewable-energy-policy-statement

ISO certificates	The International Organization for Standardization (ISO) has developed global industrial and commercial standards. Third-party training providers host courses on relevant standards like quality management systems (9001) and the newly developed offshore wind energy (29400) standards.
QC Inspector certificates	QC Inspector certification is needed for welding inspection throughout the turbine construction and installation processes. The American Welding Society offers QC Inspector certification, and MassDOT offers Field Weld Inspection certification.
USCG certificates	The United States Coast Guard is the primary worker safety regulator for OSW vessels. They offer certificates and training curricula in accordance with the international Standards of Training, Certification and Watchkeeping (STCW), as well as Captain's licensure.

This occupational database was used by MassCEC to develop offshore wind career pathways maps published at cleanenergyeducation.org. This resource was created to provide job seekers and other interested parties an idea of the potential jobs available in clean energy industries, divided into categories, with specific example jobs across varying levels of education and experience.

Overview: OSW Training and Educational Programs in the Northeast

The training inventory includes known wind training and educational providers in, or near, the Northeast United States (Maine to New Jersey). Data was sourced from executive interviews, WINDExchange, GWO, and other primary and secondary research. Most training curricula do not yet include specific preparation for the demands of offshore wind energy, though multiple offshore-specific programs are in development. The inventory differentiates introductory, technical, and safety education and training programs (those offered by Technical Schools, Community Colleges, and other private or not-for-profit training providers) from advanced educational degree programs offered by 4-year Colleges and Universities.



Of the 45 wind training and educational programs included in the database:

- 22 are currently operating without any specific focus on offshore wind,
- 12 are focused on offshore wind but are not yet offering courses, and
- 11 are currently offering courses focused on offshore wind.

Fifteen of the identified programs cater to students receiving bachelor's degrees or higher, while the other programs are focused on either technical instruction for skills-based labor or introductions to wind energy fundamentals.

The complete training inventory can be found in Appendix C.

MassCEC Workforce Development Grantees

Through two competitive solicitations held in 2018 and 2020, MassCEC has awarded several grants to support offshore wind workforce training and development initiatives in Massachusetts. The following is a description and update on the twelve (12) workforce development investments made by MassCEC in 2019 and 2020:

- ***Adult & Continuing Education, Martha's Vineyard*** has established an Offshore Wind Professional Certificate program (administered by Bristol Community College) for residents of Martha's Vineyard to get trained as operations and maintenance technicians for offshore wind farms.
- ***A.I.S., Inc.*** has developed and is offering a federally recognized Protected Species Observer (PSO) training program, and is working to develop a shorter training program on protected species for offshore wind operations and maintenance workers.
- ***Bristol Community College*** is in the process of establishing medical fitness certifications and Global Wind Organization (GWO) Basic Safety Training and Basic Technical Training programs through their National Offshore Wind Institute (NOWI). Bristol is also offering a 28-credit academic certificate for offshore wind operations and maintenance technicians, as well as an Associate's Degree in offshore wind technology and engineering.
- ***Cape Cod Community College*** is working to build a pipeline of students, workers, and professionals interested in offshore wind careers and opportunities by developing and implementing courses and related activities for K-12 students, college students, and specialized audiences. Introductory offshore wind and renewable energy offerings include: Power of Wind workshops to introduce middle school students to wind technology; professional development workshops on offshore wind for middle school teachers; student field trips to the Block Island Wind Farm; non-credit, customizable Offshore Wind 101 courses (1-3 hours in length) for high schools and specialized audiences; and a stackable certificate in sustainable energy (3 credit-bearing courses).
- ***Fishing Partnership Support Services*** is partnering with the Commercial Fisheries Center of Rhode Island and the University of Rhode Island Fisheries Center to develop a standardized list of safety and inspection standards for vessels and crew providing research, monitoring, security detail, transportation, and other services in consultation with the offshore wind industry, regulatory agencies, and commercial fishing stakeholders.
- ***Gloucester Fishermen's Wives Development Program*** is partnering with the Massachusetts Fishing Partnership to identify and pre-qualify up to 49 Massachusetts-based commercial fishermen for enrollment in, and completion of, dedicated offshore wind training and certification programs at the Northeast Maritime Institute, a United States Coast Guard-approved training center.
- ***International Brotherhood of Electrical Workers, Local #223*** is partnering with offshore wind cable company, JDR Cable Systems Ltd., to establish an offshore technician technical training program for electricians seeking employment in the offshore wind industry. Once established, this program will provide skilled electricians with training relating to electrical cabling work

specific to the offshore wind industry that will qualify them to support the termination, testing, and other scopes of cabling work on an offshore wind project.

- ***Massachusetts Maritime Academy*** has established and is offering all five modules of Global Wind Organisation Basic Safety Training for offshore wind, the first for the U.S. They are also developing a course for Academy cadets, introducing them to offshore wind and potential careers in this industry.
- ***Pile Drivers and Divers, Local #56*** is sending its members and those of other labor unions through Global Wind Organisation Basic Safety Training at the Massachusetts Maritime Academy.
- ***University of Massachusetts, Amherst*** *(UMass Amherst)* has developed and is now offering an interdisciplinary graduate-level Offshore Wind Professional Certificate program, comprising three credit-bearing courses.
- ***University of Massachusetts, Lowell*** *(UMass Lowell)* is examining the needs for undergraduate and graduate-level skill-building for offshore wind and developing curricula and other programming accordingly. The University plans to develop offshore wind pathways within existing undergraduate majors and graduate programs, formally recognize student achievement in offshore wind activities, develop an undergraduate minor in offshore wind, and further support offshore wind skill-development at the university level in a way that caters to the industry's workforce needs.
- ***VINCI VR***, a Massachusetts-based virtual reality start-up, is partnering with offshore wind turbine manufacturer, Siemens Gamesa Renewable Energy, to certify and deliver the Installation module of Global Wind Organisation (GWO) Basic Technical Training, as well as GWO Slinger Signaler Training for heavy lift operations, using virtual reality simulations.

Regional Workforce Development

Massachusetts is currently leading the way on offshore wind training, hosting 7 of the 12 operating offshore wind training programs in the Northeast. Agencies within New York, Connecticut, Rhode Island, and New Jersey have all pledged varying degrees of funding toward OSW workforce development, and most of these programs are generally in development stages.

Rhode Island

Rhode Island, through funds from Ørsted and Eversource, has pledged $4.5 million to OSW workforce development. The Revolution Wind agreement includes a $1.5 million investment into Reals Jobs Rhode Island (hosted by the state's Department of Labor and Training) and a $3 million investment to the University of Rhode Island (URI) for a combination of offshore wind workforce development and technical studies; however, the timing of investments are being reviewed in light of delays in the project permitting and approval process. Despite the delays, each recipient has active programs and plans for expansion when provided the funds.

Real Jobs Rhode Island includes two distinct OSW efforts: (1) proactive high school offshore wind instruction and (2) targeted industry trainings. The high school effort, Wind Win RI, provides an Offshore Wind Energy Certificate (equivalent to nine college credits) with courses on topics such as marine safety and engineering, and including special licenses, marine safety certification, first aid, and more. The

program has been successfully trialed at North Kingstown High School and is ready to scale, touting a specific advantage of recruiting a diverse workforce. The industry effort seeks out potential offshore wind supply chain companies and provides support for targeted training initiatives. In one example, the program trained hundreds of Rhode Islanders to fill maritime manufacturing jobs at Quonset Business Park, which 200 companies call home. Real Jobs Rhode Island is also offering incentive packages to attract out-of-state businesses to Rhode Island.

URI hosted a roundtable of energy and offshore wind industry stakeholders to seek insight on the most needed and effective forms of workforce development; the prevailing conclusions were a need for both hands-on experience and interdisciplinary professional instruction. To that end, URI has decided to focus on two distinct workforce development efforts: (1) an Energy Fellows program that provides technical and professional experience and (2) an interdisciplinary graduate certificate.

The Energy Fellows Program – a two-year program open to both undergraduate and graduate students (though mostly undergraduate students participate) from a large diversity of studies – assigns students to state government offices or various renewable energy businesses to provide 600 hours of practical experience in the renewable energy industry, as well as professional development in the summers (including instruction on networking and dress code). The program – which occasionally sends students to Massachusetts and Connecticut as well – has a strong reputation and finds that 80 percent of alumni secure renewable energy jobs directly out of school. The program is slowly expanding into offshore wind, with two fellows (out of 50 total) currently in the offshore wind industry. Additional funds would be used to hire a faculty member to market offshore wind opportunities to current students and organize the industry partnerships.

URI considered development of a full master's program in OSW renewable energy but, after discussion with industry representatives, decided instead to focus its efforts on a graduate certificate with a less-intensive, interdisciplinary focus to the offshore wind industry. Some undergraduate programs already have renewable energy certificates, which can also be expanded to include offshore wind curricula.

Connecticut

Vineyard Wind's Park City Wind project in Connecticut includes commitments to partner with Connecticut workforce development and educational institutions like Building Pathways CT, Career Resources Inc, and Survival Systems USA. They are specifically focused on bringing workforce opportunities to the City of Bridgeport,[9] which has an ordinance for requiring 20 percent of project hires for publicly funded projects be Bridgeport residents.

Building Pathways – also partnering with Ørsted – recruits women, veterans, and minorities into apprenticeship programs in the building trades and prepares them for successful apprenticeships. Career Resources focused on providing basic resources to ex-offenders seeking to reenter the workforce; this program operates as a pre-apprenticeship support program and funnels participants into Building Pathways. Survival Systems is the only facility in the Northeast able to offer Helicopter Underwater Escape Training, which will be required of personnel transported to offshore wind farms via helicopter. They offer an Offshore Energy Water Survival Course, have also recently constructed a GWO-certified Working at Heights facility, and are preparing to launch GWO safety training for offshore wind.

[9] https://www.parkcitywind.com/press-releases/park-city-wind-will-transform-bridgeport-into-offshore-wind-hub

New York

Stony Brook University and Farmingdale State College are working in tandem to develop an Offshore Wind Training Institute using $20 million of state funding.[10] Programs will mostly focus on research, professional services, and engineering. The two universities are attempting to be intentional with their program development, seeking to quantify employment needs in order to be most efficient with their resources. University representatives expressed support of a focus on a Northeast regional workforce development effort, as opposed to isolating New York initiatives.

Suffolk County Community College, meanwhile, anticipates receiving $10 million from the prospective Deepwater Wind project. A board – consisting of Orsted, Eversource, the Long Island Federation of Labor, the Blue Green Alliance, the Workforce Development Institute, utilities, and labor unions – has set up a relationship with GWO training provider, Maersk Training, to develop GWO-certified training facilities and programs. The board, which works closely with New York State Energy Research and Development Authority, is seeking to develop a training facility off Long Island. They are also actively setting up relationships with existing apprenticeship programs, with the aim of getting Long Island residents and Suffolk County Community College students into the technical jobs of the offshore wind industry. They have expressed an openness to working collaboratively with other New York state grantees and potentially throughout the region.

New Jersey

In August 2019, New Jersey established a council to develop the Wind Innovation and New Development Institute, which aims to be a center for education, research, innovation, and workforce training for New Jersey and the Northeast/Mid-Atlantic region.[11] As of September 2021, the Wind Innovation and New Development Institute is in the initial stages of development.

Summary of Priority Communities

Massachusetts communities experiencing higher rates of unemployment, underemployment and other disadvantages could be targeted for recruitment into offshore wind career pathways. For this report, "priority communities" are geographic areas identified by census tract based on unemployment, income, demographics, education, and language metrics. More information can be found about the methodology for identifying priority communities in Appendix D. The research team also took note of communities identified as Environmental Justice populations[12] and those classified as "Gateway Cities" by the Commonwealth of Massachusetts due to their status as midsize urban centers struggling from the departure of manufacturing and other major industries.

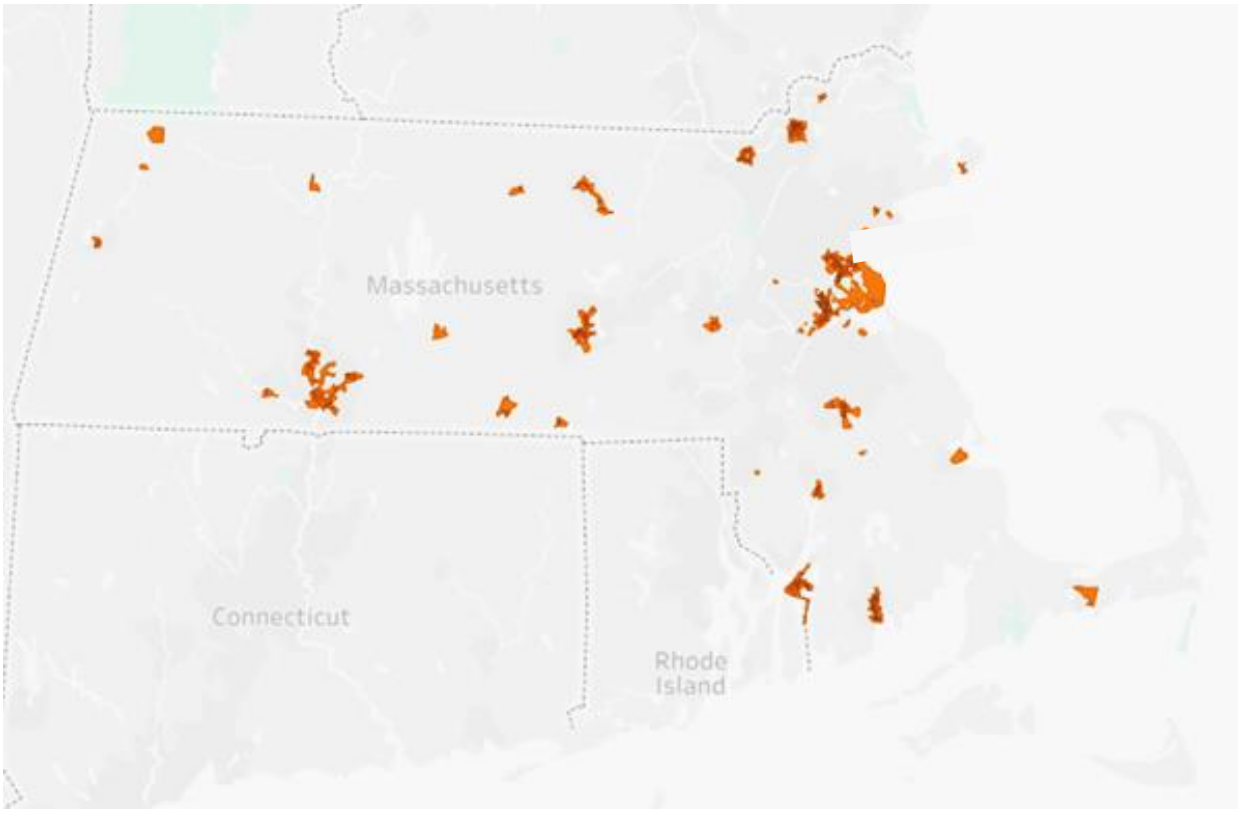
[10] https://greatneckrecord.com/farmingdale-state-college-helps-lead-new-yorks-offshore-wind-training-institute/
[11] https://www.njbia.org/working-group-to-figure-out-how-to-meet-njs-offshore-wind-energy-goals/
[12] https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts

Location of Priority Communities

Two hundred eighty-four (284) census tracts in Massachusetts have been identified as priority communities, representing 19 percent of the state's tracts. Seventy percent of the priority communities are found in Gateway Cities and all are Environmental Justice populations.

The complete list of census tracts identified as priority communities can be found in Appendix E.

Figure 1. Priority communities for workforce development, 2019



While coastal communities lend themselves to be more directly impacted by the offshore wind industry, it was determined that many of the supply chain functions can be conducted throughout the state while maintaining easy land transportation access to coastal ports. Thus, all Massachusetts communities in were considered in analyses.

GAP ANALYSIS

The research team analyzed the gap between needed workforce for the Commonwealth's first 1,600MW of offshore wind and the available workforce to understand the current degree of occupational demand in the OSW supply chain. The gap analysis identifies the strongest occupational needs for offshore wind workforce development. As part of the analysis, the team examined labor supply and skill levels available statewide, as well as occupational profiles of priority communities. Additional assessment should be conducted for Massachusetts examining the state's authorized goal of 5.6 GW and the projected workforce supply.

Occupational Workforce Needs

Relying on existing literature, the research team estimated the annual number of full-time equivalent workers (FTEs) that would be needed within each occupation to fulfill the state's 1600 megawatts (MW) of proposed OSW projects for the next decade. To estimate FTEs, existing workforce studies were translated into a singular OSW industry taxonomy, their occupations were sorted into the most applicable Standard Occupational Classification (SOC)[13], and annual employment estimates were converted to employment per output; these steps allowed for the aggregation and averaging of occupation-based employment estimates by industry phase.

Construction and Installation

The construction and installation phase requires a significant number of construction and assembly, port and maritime, and trades workers. The following is a list of the ten occupations requiring the largest numbers of full-time equivalent workers each year. Other key occupations include welders, inspectors, and wind turbine service technicians.

Occupation	Sector	Annual FTEs
Construction Laborers	Construction & Assembly Workers	55
Plant and System Operators, All Other	Construction & Assembly Workers	36
Sailors and Marine Oilers	Trade Worker	34
Captains, Mates, and Pilots of Water Vessels	Maritime, Port & Aircraft Workers	26
Riggers	Trade Worker	25
Maintenance and Repair Workers, General	Construction & Assembly Workers	18

[13] The Standard Occupational Classification system is a federal statistical standard developed by the U.S. Bureau of Labor Statistics to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 867 detailed occupations according to their occupational definition.

Helpers--Installation, Maintenance, and Repair Workers	Trade Worker	18
Operating Engineers and Other Construction Equipment Operators	Trade Worker	16
Logisticians	Transport & Logistics	14
Structural Iron and Steel Workers	Trade Worker	12

Operations and Maintenance

The occupations and maintenance phase of a wind farm is led by a staff of wind turbine service technicians and supported by transportation and trades workers. Key occupations not already listed below are crane operators, hoist and winch operators, and ship pilots and mates.

Occupation	Sector	Annual FTEs
Wind Turbine Service Technicians	Trade Worker	24
Logisticians	Transport & Logistics	12
Transportation, Storage, and Distribution Managers	Transport & Logistics	12
Heavy and Tractor-Trailer Truck Drivers	Transport & Logistics	11
Plant and System Operators, All Other	Construction & Assembly Workers	8
Riggers	Trade Worker	8
Structural Iron and Steel Workers	Trade Worker	8
Inspectors, Testers, Sorters, Samplers, and Weighers	Construction & Assembly Workers	8
Cement Masons and Concrete Finishers	Trade Worker	8
Welders, Cutters, Solderers, and Brazers	Trade Worker	8

Supply of Occupations

To analyze the strength of the Commonwealth's existing workforce, BW Research Partnership used its occupation map to identify employment estimates, employment change, wages, and location quotients down to the county level. For the table below, location quotients – the ratio of talent concentration in a defined geography to that of the national average – were calculated at the state-level. For instance, a location quotient of 4.0 means that the concentration of the occupation in Massachusetts is four times higher than the concentration of the occupation across the United States.

Here are the top 10 occupations by location quotient (LQ) in Massachusetts:

Occupation	Number Of Employees (2019)	LQ* (2019)
Hoist and Winch Operators	668	4.74
Natural Sciences Managers	3,989	2.30
Sales Engineers	3,791	2.25
Environmental Engineers	2,954	2.21
Financial Managers	34,592	2.05
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	15,954	1.97
Computer and Information Systems Managers	20,212	1.83
Sales Managers	17,906	1.75
Training and Development Managers	2,106	1.74
Architectural and Engineering Managers	8,290	1.71

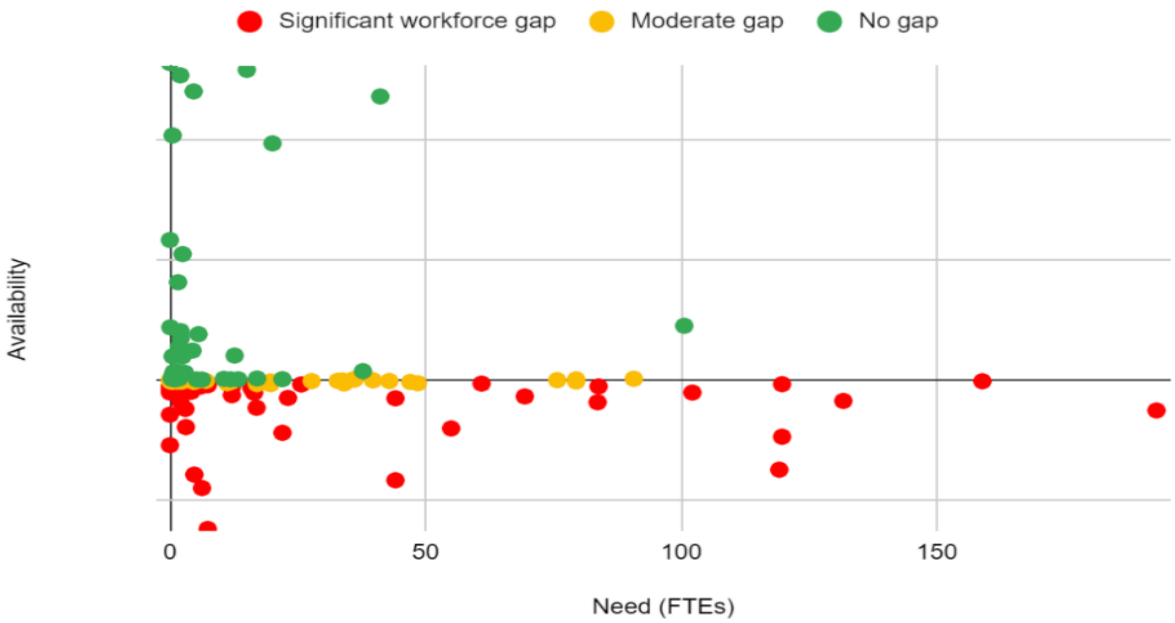
*(LQ = Massachusetts Industry Concentration / National Average). US average = 1

A complete list of the current Massachusetts employment and location quotients of offshore wind workforce occupations can be found in Appendix B. An additional list of the occupations with highest relative supply in each of the identified priority communities can be found in Appendix E.

The research team also examined the available workforce within each occupation. “Available workforce” was defined as the annual surplus of educational completions and short-term unemployed workers over the number of annual job openings (which includes both growth and replacement jobs). Under the assumption that post-COVID OSW workforce supply and demand will mirror pre-pandemic workforce conditions, all data is from 2019.

The *available* workforce was juxtaposed with the *needed* workforce to fulfill the proposed offshore wind projects; the resulting occupational workforce gaps – the difference between needed and available workforce – were identified as either significant, moderate, or nonexistent. Below is a scatter plot displaying the estimated distribution of workforce need by available workforce.

Figure 2. Estimated OSW workforce need v. availability for proposed MA projects



Across all phases, 43 occupations have a significant workforce gap (36 percent), 32 occupations have a moderate workforce gap (27 percent), and 44 occupations have sufficient workers to meet immediate OSW workforce demand (37 percent). The state is most prepared to meet Science, Engineering, Management, and Maritime needs, while least prepared to meet Construction & Assembly needs. Trades occupations had mostly moderate workforce gaps.

Construction & Installation and Operations & Maintenance Available Workforce

Examining the construction and operations phases - assuming the possibility for offset project timelines in which both phases may be proceeding concurrently - the research team found an insufficient number of available workers in multiple key occupations.

Below is a list of key occupations across the phases, in order of total needed workers, identifying whether there is a significant workforce gap (red), a moderate workforce gap (yellow), or no workforce gap (green). Massachusetts' workforce strengths include management and engineering professionals, as well as maritime workers. The state has insufficient availability of construction laborers, transportation workers, and general maintenance workers.

Table 1. MA workforce gaps for construction & operations of proposed wind farms by occupation[14]

Occupation	Workforce Gap
Construction Laborers	
Miscellaneous Plant and System Operators *	
Wind Turbine Service Technicians	
Sailors and Marine Oilers	
Riggers	
Captains, Mates, and Pilots of Water Vessels*	
Logisticians	
Heavy and Tractor-Trailer Truck Drivers	
Structural Iron and Steel Workers	
Inspectors, Testers, Sorters, Samplers, and Weighers	
Cement Masons and Concrete Finishers	
Welders, Cutters, Solderers, and Brazers	
Crane and Tower Operators	
Maintenance and Repair Workers, General	
Helpers--Installation, Maintenance, and Repair Workers	
Operating Engineers and Other Construction Equipment Operators	
Transportation, Storage, and Distribution Managers*	
Elevator and Escalator Installers and Repairers	
Production Workers, All Other	
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	
Financial Managers	
Electrical Power-Line Installers and Repairers	
Hoist and Winch Operators	
General and Operations Managers*	
Industrial Production Managers*	
Commercial Pilots	
Metal-Refining Furnace Operators and Tenders	
Ship Engineers	

*Denotes occupations for which Massachusetts has a surplus of workers that can be supplied to other states.

[14] This includes all occupations expected to need 5 or more full-time equivalent workers annually.

KEY FINDINGS AND STRATEGIC RECOMMENDATIONS

Building off the comprehensive Gap Analysis, the research team examined current workforce development offerings to address existing workforce gaps. The following Key Findings and corresponding Strategic Recommendations incorporate global best practices, opportunities for regional collaboration, and recruitment of priority communities into strategies for addressing remaining workforce gaps.

There are three key populations for which to develop in-state workforce training strategies: (1) incumbent workers, or those already in the workforce but who may require OSW-specific training; (2) workers in the training/education pipeline, or those that are currently enrolled in existing (particularly longer-term) training programs, and (3) workers not currently employed or actively enrolled in education or training.

The following conclusions and recommendations address each of those populations and discuss other opportunities for the development of resources or collaboration efforts. These recommendations build off the strong, nation-leading job MassCEC has already done to identify urgent needs and develop early strategies to train an OSW workforce.

Incumbent Workers

Incumbent worker training is focused on upskilling opportunities for current trades, construction, and maritime workers. These individuals work in general occupations but may need additional safety or technical training/certifications to participate in the OSW industry. This will be most effective for occupations in which Massachusetts already has sufficient, or nearly sufficient, available labor supply.

KEY FINDING 1

The development and provision of safety and technical training programs are a factor for firms looking to participate in the offshore wind supply chain. Massachusetts should support the identification of developer and Tier I suppliers' specific expected workforce qualifications and development and offering of the associated programs and necessary courses to prospective supply chain firms.

OSW developers and Tier I suppliers reported proper safety training as a key qualification for any potential supplier; however, the firms did not relay specific qualifications, which will likely vary across firms. With industry-wide health and safety training – both general and specific to activities – required to be provided by all assembly, construction, and maintenance firms, and most trainings being widespread, MassCEC could provide important support for potential industry participants by directly connecting them with (and potentially funding) OSHA, Lean Six Sigma, CCT, ISO, and QC Inspector certificate training. As with Real Jobs RI, the MassCEC can actively seek out potential supply chain companies, including offering reduced-cost training packages to attract out-of-state businesses to Massachusetts.

KEY FINDING 2

OSW-specific training for current maritime workers will solidify the Commonwealth's regional expertise in deep-sea navigation and leverage it to support OSW. Massachusetts should continue to support the creation of industry-standardized professional requirements and actively market skill expansion opportunities to the fishing community.

The engagement and preparation of ship and port workers will be a significant and critical challenge. Navigation in ports and around wind turbines will require higher precision than typically expected of a general vessel worker. In addition, as electrification of ports and ships continues to grow, there may be a need to retrain workers on new technologies.

While training providers interviewed found industry conversations with fishermen to be challenging and adversarial, Massachusetts has attempted to be proactive in bridging communication gaps, particularly relying on workforce networks in and around the Port of New Bedford. A New Bedford Port Authority representative stressed that the maritime workers of southeastern Massachusetts are highly entrepreneurial and will take advantage of revenue opportunities. With scalloping and certain fishing industries, as well as on-land utilities, currently offering high salaries, the representative believes that the key to industry mediation will be highlighting economic opportunities.

Recent MassCEC funded initiatives through the Fishing Partnership Support Services and Gloucester Fishermen's Wives Development Program to develop industry-standardized professional requirements and pre-qualify commercial fishermen for enrollment in dedicated training and certification programs will prove immensely important in diversifying the skillset of the fishing industry and solidifying Massachusetts as the go-to suppliers of OSW maritime workers. These initiatives can market directly to fishermen and maritime workers as an opportunity to expand one's skillset and earn access into strong wages, benefits, and job opportunities.

KEY FINDING 3

Due to the high cost of building physical training facilities and assets, Massachusetts should support the development of on-demand OSW virtual training resources that allows OEMs, Tier 1s, and others to teach their specific processes locally.

While mobile training facilities – feasible for many land-based preassembly sites – may be impractical in cost and liability, there is massive opportunity in virtual training facilities and assets. The research team commends MassCEC's investment in cutting-edge virtual reality technologies and, if successful, encourages the set-up of a permanent facility in which any potential Tier I supplier (of any major component) could work to implement a training specific to their products. This can serve as a local asset that reduces cost of transporting workers to manufacturer-specific trainings or risking on-site training.

KEY FINDING 4

Massachusetts should continue its nation-leading provision of industry-recognized GWO safety and technical training programs.

All construction and operations positions that work directly on the turbines require GWO Basic Safety Training. Developers consistently identified the OSW-specific safety training of a sufficient number of workers as the number one workforce development priority. Construction laborers (including piledrivers), system operators, welders, and OSW technicians will all require GWO certification.

As first movers, Massachusetts is currently uniquely competitive in providing the skilled labor content for initial projects, but the training exclusivity is set to expire soon as states along the East Coast are launching concurrent programs.

Workers in the Education Pipeline

Massachusetts workers have numerous opportunities to enter relevant fields; the key will be introducing potential workers to the offshore wind industry and connecting them to employment opportunities.

KEY FINDING 5

Out-of-state/country firms may not appreciate that the Commonwealth has a uniquely robust Vocational Technical High School system. Massachusetts should work to (1) develop and encourage the use of OSW curricula in key occupation degrees, and (2) highlight the Vocational Technical system in marketing and outreach to potential OSW firms.

To expand the number of available workers in key construction and trades occupations, there is a need for early engagement of the future workforce. Massachusetts' Vocational Technical (Voc-Tech) High Schools give the state a unique edge in the early introduction, training (including safety), and job-matching of potential workers. These educational assets provide the additional recruitment benefits of high participation in Massachusetts' Gateway Cities—which are all identified as priority communities—as well as free educational pathways into high-earning careers, ultimately assisting in the provision of equal access and upward mobility.

These Voc-Tech programs would mirror the early Wind Win RI success but with expanded capabilities for hands-on experience and infrastructure for safety certification. MassCEC can leverage its Vocation Internship Program to place skilled students from Voc-Tech programs in paid offshore wind internships while still in school, providing early exposure and on-site development. OSW stakeholders expressed that early exposure to the offshore wind industry is key in physically and mentally preparing workers to endure water conditions. (MassCEC can further leverage virtual training, such as that provided by VINCIVR, to reduce liability and costs of exposure, and increase youth excitement.)

Equally important to utilizing the Voc-Tech system is communicating the system to potential OSW suppliers and developers. One potential Mid-West supplier, for example, expressed disappointment in the complete lack of welding programs in Massachusetts community colleges; unaware that – contrary to many states – Massachusetts hosts their welding programs entirely at Voc-Tech high schools, with

353 completions in 2019 alone. The Vocation Internship Program can serve as an attractive feature for suppliers deciding where to set up their services.

KEY FINDING 6

Recognizing that the state's university system is establishing itself as one of the leading national sources of offshore wind engineers and professionals, Massachusetts should (1) use the launch of UMass Lowell's training program (in development) to initiate a workforce development collaboration across the members of POWER-US and (2) market MassCEC's Clean Energy Internship program to prospective workers and suppliers.

Unsurprisingly, Massachusetts' nation-leading university system renders the state uniquely prepared to supply the engineering, professional, and scientific workforce of the emerging industry across the region. Initiatives like the development of a graduate certificate at UMass Amherst and OSW curricular and extracurricular development at UMass Lowell should continue to be supported and advertised.

Because of the high level of experience currently required to secure employment in the limited management, legal, and financial opportunities, the graduate certificate should continue to be aimed at interdisciplinary career transitioning and upskilling of existing or emerging professionals. As at the University of Delaware's Offshore Wind Skills Academy, the program should market itself to professionals in traditional energy industries, potential supply chain companies, regulators, investors, and consultants.

On the engineering and scientific fronts, Massachusetts should encourage and support collaboration efforts across existing university programs.

POWER-US|MA is an academic partnership made up of Massachusetts institutions seeking to develop cohesive strategies, with support from MassCEC, for national innovation in offshore wind energy. The partnership – whose membership includes the University of Massachusetts system, Bristol Community College, the Massachusetts Maritime Academy, Northeastern University, Tufts University, and Woods Hole Oceanographic Institution – can provide impartial assessments to policymakers, maintain a network of technical expertise, and – if expanded – conduct diplomacy between states. Their multidisciplinary research approach has been modeled off of successful national networks in earthquake engineering, ocean science, and composites manufacturing research.

The founding universities in POWER-US|MA have demonstrated a willingness to work collaboratively in a manner that best prepares the region for an offshore wind boom. An organization representative highlighted that the state's current academic landscape is highly complementary in this industry with UMass Dartmouth specializing in fisheries, UMass Boston specializing in policy, UMass Lowell specializing in blade technologies, UMass Amherst specializing in controls, Northeastern specializing in risk analysis, the Woods Hole Oceanographic Institute specializing in marine science, and Tufts University specializing in infrastructure systems. These research niches should be translated into instruction opportunities where possible.

To date, POWER-US – whose participation is entirely voluntary – has lacked sufficient resources to expand much beyond a semi-maintained website and white papers on their five strategic themes.

However, their actively communicative, in-state research network, and vision to expand throughout the region, provides a valuable opportunity to the workforce development space.

One of the founding members, Tufts University, launched a graduate program in Offshore Wind Energy Engineering in 2019, outside of the MassCEC workforce grants. The MS program is intended to operate in cohorts in which each student develops their individual specialty and collaborates in a manner similar to a professional environment. Alumni have gone on to careers working for developers, regulatory agencies (including MassCEC), engineering firms, and other professional service organizations.

Finally, at the undergraduate level, Massachusetts should leverage existing assets to increase offshore wind exposure to future professionals, scientists, and engineers. MassCEC can examine opportunities to partner with undergraduate instructors to provide OSW-related curricula or facilitate speaking opportunities for OSW industry stakeholders. MassCEC should use its Clean Energy Internship program to fund paid opportunities for students to work with development, research, and supply chain firms, as industry stakeholders have identified hands-on experience and professional instruction as important factors in future hiring.

Expanding the Pipeline with a Focus on Equity

Among occupations without the available pre-COVID workforce to supply the proposed offshore wind industry projects, there was no excess of short-term unemployment to fill current and future job openings. Assuming employment in key occupations returns to similar levels in a post-COVID world, Massachusetts is left with three options: (1) expand recruitment and education efforts, (2) recruit workers from outside of the state, or (3) engage long-term unemployed workers.

A full list of the Northeast states best prepared to supply each occupation can be found in Appendix B. Long term unemployed workers in Massachusetts (and nationally) are predominantly ethnic and racial minorities, come from lower-income households and communities, and face multiple barriers to employment, highlighting the support systems necessary to mitigate the challenges these populations face.

KEY FINDING 7

Pre-training programs can provide the daily support and resources necessary to help unemployed residents in priority communities reenter the workforce. Massachusetts should (1) work with a regional MassHire Workforce Boards and other partners to add initiatives aimed at the provision of transportation, housing, and other basic needs; and (2) expand pre-apprenticeship programming and marketing to provide low-cost, low-stakes apprenticeship exposure to priority communities.

Given the low supply of available talent and the imperative to build a more inclusive and diverse workforce, the state must continue to focus on removing barriers to employment, particularly in identified priority communities. Many of the potential workers suffer from the trauma of poverty and may experience food insecurity, housing insecurity, transportation insecurity, substance abuse, etc. A pre-training program – akin to Career Resources Inc. in Connecticut – can combat basic barriers to entry, whether they be the aforementioned poverty-driven barriers, the existence of a criminal background, or a lack of education.

Career Resources in particular has programs to:

- Coordinate homeless, workforce, and childcare services to ensure participants can secure and maintain a job sufficient to maintain their matched rapid rehousing plan;
- Provide case managers to develop individualized employment plans with prospective workers, connecting them to the necessary workshops and trainings;
- Help prepare and file taxes, including providing education on financial literacy and eligible tax credits;
- Job match or industry match based on local employer needs;
- Provide attitudinal job readiness training and mentoring;
- Improve digital literacy to improve marketability and access to an increasingly digital application system;
- Help locate existing programs, services, and benefits
- Provide a mobile job coach and connection service to meet communities where they are;
- Provide professional development;
- Tutor for the General Education Development test;
- Provide scholarships to cover short-term financial needs;
- Provide appropriate clothing; and
- Offer adult education for basic skills.

Currently, various non-profits in Southeastern Massachusetts have informal connections to the offshore wind industry through the Port of New Bedford. For example, the MassHire Greater New Bedford Career Center – in active conversation with MassCEC workforce development efforts – already connects job seekers and employers, offering some of the necessary resources around counseling, education, and technology. The research team recommends investments to include transportation, housing, language, and job readiness assistance to priority communities, specifically aimed at informing and connecting potential workers with opportunities in the emerging offshore wind industry. As with organizations like Career Resources, this program can connect workers with apprenticeship and pre-apprenticeship programs like those currently offered by IBEW.

The research team also recommends the state support a pre-apprenticeship program (like Building Pathways, currently used by the International Brotherhood of Electrical Workers Local 223), aimed at the recruitment and support of women, veterans, and minorities to prepare individuals for success in an apprenticeship.

Additional Resources and Collaboration Opportunities

KEY FINDING 8

Northeast states have an opportunity to develop regional workforce strategies; Massachusetts should continue regional coordination and collaboration efforts and consider the convening of a regional OSW workforce development task force.

Northeast government and non-government agencies responsible for clean energy workforce development have expressed willingness to avoid some duplicate training efforts. Developers have echoed such sentiments, aiming to secure a trusted workforce familiar with their processes that can be used in projects throughout the region. A coalition like this would require workers' participation from every state and would have to be acceptable by Project Labor Agreements. Developers in Europe regularly pay offshore workers to train in other countries in the region. Conversations with union representatives highlighted their cross-border connections as a strength and a willingness to share workers as needed.

While some occupations may always be competitive geographically, occupations with more significant workforce gaps in various states may be better served being supplied by one or two states. This will save each state money by avoiding concurrent and duplicative workforce development strategies and will help the region remain competitive for supplier and developer locations. Under such a system, Northeast states will be able to both recruit out-of-state workers for specific occupations and send in-state workers to train in out-of-state programs. Other states can defer to Massachusetts, for example, to provide maritime workers, engineers, marine scientists, and industry professionals.

In general, Northeast states do not yet have a clear, centralized organization of OSW workforce development strategies; rather, funding is handled project-by-project and even program-by-program. An invitation to each state's energy and workforce governing bodies will lead to the identification of key contacts for cross-border workforce development initiatives. These state representatives will have an opportunity to discuss their relative strengths while identifying programs that may be seen as duplicative and unnecessary to set-up. MassCEC's offshore wind Community of Practice - even if primarily focused on Massachusetts – also has an opportunity to invite representatives of Northeast states to provide their state's insights and learn about Massachusetts development efforts.

KEY FINDING 9

Cataloging and assessing the capabilities of likely in-state supply chain firms will help MassCEC quantify and categorize assembly and installation workforce needs. Massachusetts should continue engagement with partners such as Massachusetts Manufacturing Extension Partnership, New England Clean Energy Council, regional Economic Development Agencies and other entities to identify and strategize the address of gaps in the supply chain.

The manufacturing and assembly phase is the most variable when it comes to developing workforce strategies because significant manufacturing processes can – and are likely to – be conducted out-of-state. In order to target potential supply chain firms with necessary OSW trainings, a publicly available list of in and out-of-state firms and services will increase sourcing and supply-chain efficiencies.

KEY FINDING 10

Massachusetts should examine and communicate the long-term opportunities for transferable employment between offshore wind and other industries.

Many of the offshore wind jobs, particularly in the construction and installation phase, require a high number of workers for a relatively short period of time. Assuming Massachusetts continues to aggressively commit to procurement of OSW, the scale of OSW projects will sustain those jobs for the foreseeable future. However, while the state works to ramp up training and ensure there is a sufficient workforce to complete all offshore wind tasks, there is a concurrent need to ensure these workers have and know their value beyond the OSW industry. Marketing resources should communicate potential next employment steps to current and future OSW workers.

APPENDIX A. LIST OF SOURCES

The following list is not exhaustive of all consulted documents but captures the reports whose findings directly informed the background information:

BVG Associates, The Virginia advantage: The roadmap for the offshore wind supply chain in Virginia (2018)

Environmental Entrepreneurs, Offshore Wind - Generating Economic Benefits on the East Coast (2018)

International Economic Development Council, Analysis of the Offshore Wind Energy Industry (2013)

Massachusetts Clean Energy Center, 2018 Massachusetts Offshore Wind Workforce Assessment

Natural Resources Defense Council, American Wind Farms: Breaking Down the Benefits from Planning to Production (2016)

National Renewable Energy Laboratory, 2017 State of Wind Development in the United States by Region (April 2018)

National Renewable Energy Laboratory, Offshore Wind Jobs and Economic Development Impacts in the United States: Four Regional Scenarios (2015)

New Jersey Board of Public Utilities and the Interagency Taskforce on Offshore Wind, New Jersey Offshore Wind Strategic Plan: Navigating Our Future (2020)

New York State Energy Research and Development Authority, 2019 OSW Jobs Fact Sheet

New York State Energy Research and Development Authority, The Workforce Opportunity of Offshore Wind in New York (2017)

Offshore Wind Industry Council, The UK Offshore Wind Industry: Supply Chain Review January 2019

Rhode Island Office of Energy Resources, 2019 Rhode Island Clean Energy Industry Report

US Department of Energy & US Department of the Interior, 2016 National Offshore Wind Strategy

Workforce Development Institute, New York State and the Jobs of Offshore Wind Energy (2017)

APPENDIX B. MA OFFSHORE WIND OCCUPATIONS DATA

The following table includes all occupations identified in this study as participatory in the life cycle of offshore wind farm, ordered by the annual FTEs needed to supply all phases of the proposed projects in-state. Workforce gaps are the difference between *available* workers (the annual surplus of educational completions and short-term unemployed workers over the number of annual job openings) and *needed* workers (the estimated the annual number of FTEs that would be needed to fulfill the state's proposed OSW projects). Red indicates a significant gap, yellow indicates a moderate gap, and green indicated no gap.

Description	2019 Location Quotient	2019 Jobs	MA OSW Workforce Gap	Neighbor with Highest Supply
Miscellaneous Assemblers and Fabricators	0.5	16,796		New Hampshire
Structural Metal Fabricators and Fitters	0.54	1,056		Rhode Island
Inspectors, Testers, Sorters, Samplers, and Weighers	0.72	10,566		New Hampshire
Maintenance and Repair Workers, General	0.79	30,637		New York
Helpers--Installation, Maintenance, and Repair Workers	0.66	1,653		New Hampshire
Stockers and Order Fillers	0.84	43,841		New Hampshire
Electricians	0.97	18,288		Maine
Plant and System Operators, All Other	1.31	458		Maine
Welders, Cutters, Solderers, and Brazers	0.36	3,832		Maine
Industrial Machinery Mechanics	0.48	4,687		New Hampshire
Shipping, Receiving, and Inventory Clerks	0.83	14,621		Rhode Island
Plating Machine Setters, Operators, and Tenders, Metal and Plastic	0.9	947		Rhode Island
Engine and Other Machine Assemblers	0.17	214		Vermont
Metal-Refining Furnace Operators and Tenders	0.25	107		Rhode Island
Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	1.45	10,459		New Hampshire
Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	0.53	2,229		New Hampshire
Construction Laborers	0.85	31,137		Vermont
Transportation, Storage, and Distribution Managers	0.99	3,433		Maine
Logisticians	0.67	4,383		Rhode Island

Excavating and Loading Machine and Dragline Operators, Surface Mining	0.89	1,190		Vermont
Industrial Production Managers	1.23	5,679		New Hampshire
First-Line Supervisors of Mechanics, Installers, and Repairers	0.9	11,133		New Hampshire
Laborers and Freight, Stock, and Material Movers, Hand	0.59	43,550		Rhode Island
Material Moving Workers, All Other	0.65	555		New Hampshire
General and Operations Managers	1.37	83,422		New Hampshire*
Metal Workers and Plastic Workers, All Other	0.42	267		New Hampshire
Captains, Mates, and Pilots of Water Vessels	0.62	742		Maine
Wind Turbine Service Technicians	0.33	77		Maine
Crane and Tower Operators	0.42	490		Rhode Island
Computer Numerically Controlled Tool Operators	0.64	2,385		New Hampshire
Continuous Mining Machine Operators	0.01	4		New York
Sailors and Marine Oilers	0.36	378		Maine
Riggers	0.88	530		Maine
Hoist and Winch Operators	4.74	668		Maine*
Coating, Painting, and Spraying Machine Setters, Operators, and Tenders	0.67	2,536		Rhode Island
First-Line Supervisors of Production and Operating Workers	0.75	11,827		Connecticut
Heavy and Tractor-Trailer Truck Drivers	0.6	30,944		Maine
Aircraft Service Attendants and Transportation Workers, All Other	0.43	397		Vermont
Architectural and Engineering Managers	1.71	8,290		New Hampshire
Structural Iron and Steel Workers	1.29	2,516		Rhode Island
Cement Masons and Concrete Finishers	0.42	2,143		Maine
Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders	1.03	846		Vermont
Machinists	0.85	8,064		Connecticut
Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	0.47	2,235		Connecticut
Chemical Equipment Operators and Tenders	0.27	576		Rhode Island
Financial and Investment Analysts, Financial Risk Specialists, and Financial Specialists, All Other	1.6	18,767		New York
Financial Managers	2.05	34,592		Connecticut

Operating Engineers and Other Construction Equipment Operators	0.76	7,929		Vermont
Engineers, All Other	0.85	3,638		Rhode Island
Human Resources Managers	1.6	7,217		Connecticut*
Administrative Services and Facilities Managers	1.56	12,138		Vermont*
Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	1.16	731		Rhode Island
Electronics Engineers, Except Computer	1.17	3,891		Rhode Island
Industrial Engineers	1.64	11,807		Connecticut
Elevator and Escalator Installers and Repairers	1.42	1,014		New York
Production Workers, All Other	0.68	4,094		Maine
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	0.64	839		Vermont
Commercial Pilots	0.39	521		New Hampshire
Electrical Power-Line Installers and Repairers	0.75	2,109		Vermont
Stationary Engineers and Boiler Operators	0.93	885		Maine
Purchasing Managers	1.67	3,110		Connecticut
Office Clerks, General	0.89	73,280		New Hampshire
Computer Numerically Controlled Tool Programmers	0.76	487		Connecticut
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	0.98	59,237		Vermont
Ship Engineers	0.34	118		Rhode Island
Commercial Divers	1.34	152		New Hampshire
Drilling and Boring Machine Tool Setters, Operators, and Tenders, Metal and Plastic	0.73	221		New Hampshire
Electrical and Electronic Engineering Technologists and Technicians	1.18	3,697		New Hampshire
Computer Occupations, All Other	1.12	12,400		Rhode Island
Drafters, All Other	0.55	211		Vermont
Bookkeeping, Accounting, and Auditing Clerks	1.19	49,318		Vermont
Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other	0.96	2,196		Maine
Public Relations Specialists	1.11	7,228		New York
Mechanical Engineers	1.26	9,645		New Hampshire
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	1.97	15,954		New Hampshire*
Reinforcing Iron and Rebar Workers	0.72	450		Vermont
Compliance Officers	1	7,959		Vermont

Market Research Analysts and Marketing Specialists	1.27	22,487		New York
Accountants and Auditors	1.09	38,558		New York
Marine Engineers and Naval Architects	1.42	479		Connecticut
Computer and Information Systems Managers	1.83	20,212		Connecticut
Geological and Hydrologic Technicians	0.22	98		Vermont
Human Resources Assistants, Except Payroll and Timekeeping	0.84	2,608		Rhode Island
Human Resources Specialists	1.18	19,879		Rhode Island*
Environmental Engineers	2.21	2,954		Rhode Island*
Mechanical Drafters	1.26	1,784		Maine
Lawyers	1.24	25,501		New York
Paralegals and Legal Assistants	0.87	7,300		New York
Construction Managers	1.01	11,046		Vermont
First-Line Supervisors of Construction Trades and Extraction Workers	0.91	16,465		Vermont
Materials Engineers	1.01	667		Vermont
Aerospace Engineers	0.34	568		Connecticut
Civil Engineers	0.99	8,010		Connecticut
Insurance Underwriters	0.84	2,231		Connecticut
Environmental Science and Protection Technicians, Including Health	0.71	595		New Hampshire
Power Plant Operators	1.05	926		Maine
Environmental Scientists and Specialists, Including Health	1.03	2,198		Vermont
Zoologists and Wildlife Biologists	0.9	467		Maine
Atmospheric and Space Scientists	0.58	182		Vermont
Electrical Engineers	1.52	7,092		New Hampshire
Sales Engineers	2.25	3,791		New Hampshire*
Natural Sciences Managers	2.3	3,989		Maine*
Geoscientists, Except Hydrologists and Geographers	0.9	700		Rhode Island
Occupational Health and Safety Specialists	0.74	1,695		New Hampshire
Anthropologists and Archeologists	0.45	91		New Hampshire
Surveying and Mapping Technicians	0.45	637		Maine
Mining and Geological Engineers, Including Mining Safety Engineers	0.41	67		Connecticut
Mechanical Engineering Technologists and Technicians	0.9	967		New Hampshire
Budget Analysts	1.21	1,629		Connecticut

Cost Estimators	1.16	6,164		New Hampshire*
Buyers and Purchasing Agents	0.89	9,672		New Hampshire
Sales Managers	1.75	17,906		Connecticut*
Training and Development Managers	1.74	2,106		Connecticut*
Postsecondary Teachers	1.47	49,934		New York*
Training and Development Specialists	1.12	8,882		New York
Operations Research Analysts	1.03	2,581		New Hampshire
Personal Service Managers, All Other; Entertainment and Recreation Managers, Except Gambling; and Managers, All Other	0.82	8,255		Connecticut
Bus and Truck Mechanics and Diesel Engine Specialists	0.72	5,101		Maine
Industrial Truck and Tractor Operators	0.39	6,149		Maine

*Massachusetts has greater supply of occupational workforce.

APPENDIX C. NORTHEAST REGIONAL WIND TRAINING INVENTORY

The following inventory contains all known training programs in the Northeast U.S. (Maine to New Jersey) that contain curricula directly pertaining to the wind industry. Yellow programs are those whose OSW-specific curricula are still in development, while green programs are those currently offering courses with OSW-specific curricula.

Program Host	City	State	Funding Source(s)	Program Description	Duration
A.I.S., Inc.	Dartmouth	MA	Massachusetts Clean Energy Center	Protected Species Observer Training and developing a training to improve OSW O&M professionals' understanding of regional protected species	3 days
Adult Continuing Education - Martha's Vineyard	Oak Bluffs	MA	Massachusetts Clean Energy Center	Offshore wind technician certificate program for Martha's Vineyard residents (certificate program administered by Bristol Community College); developing offshore wind and marine science and technology curricula for high school students in the vocational technical rotation program.	2 years
Alfred University	Alfred	NY		Renewable Energy Engineering major that includes a wind energy course and other renewable energy material	4 years
Bramson ORT College	NYC	NY		Renewable Energy Technician Certificate with a "Wind Energy Systems Design and Installation" course	2 years
Bristol Community College	New Bedford	MA	Massachusetts Clean Energy Center	Associate's degree, Certificate program, GWO courses, Basics of Offshore Wind program	n/a
Building Pathways - CT	Bridgeport	CT	Eversource and Ørsted, Vineyard Wind	Union-led Apprenticeship Readiness program designed to prepare women, veterans, and minorities for successful entry into and completion of a multi-year registered Building Trades apprenticeship	7 weeks
Cape Cod Community College	Barnstable	MA	Massachusetts Clean Energy Center	"OSW 101" for a variety of audiences, 2 for-credit courses for community college students, Renewable Energy certificates, workshop for middle school students, teacher workshops	n/a
Career Resources	Bridgeport	CT	Vineyard Wind	providing basic resources to ex-offenders seeking to reenter the workforce	n/a
Clarkson University	Potsdam	NY		Master of Science in Energy Systems features wind energy material	2 years

Clinton Community College	Town of Plattsburgh	NY		Wind Energy and Turbine Technology A.A.S. program	2 years
Community College of Rhode Island	Warwick	RI		Energy Utility Technology Certificate	1 year
Farmingdale State College	Farmingdale	NY	NYSERDA	Developing certificate programs in their Renewable Energy and Sustainability Center, which is focused on workforce training in clean energy and smart-grid technologies	n/a
Greenfield Community College	Greenfield	MA		Renewable Energy/Energy Efficiency associate degree program, with a course on fundamentals of wind energy	2 years
International Brotherhood of Electrical Workers Local Union #223	Taunton	MA	Massachusetts Clean Energy Center	Establishing a high voltage and fiber optic training program for skilled electricians at the IBEW's training facility, in partnership with JDR Cables	n/a
Kennebec Valley Community College	Fairfield	ME		Electrical Technology: Associate of Applied Science Degree program	2 years
Massachusetts Maritime Academy	Bourne	MA	Massachusetts Clean Energy Center	All five modules of GWO basic safety training. Pile Drivers and Divers Local 56 union joining programs; examining feasibility of helicopter transfer, vessel operator, and advanced rescue trainings	6 days
Mount Wachusett Community College	Gardner	MA		Energy Management (EGM) courses	1 semester
Nassau Community College	East Garden City	NY		Certificate in Sustainable Design and Renewable Energy with a "Wind Turbines/Solar Panels Applications" course	2 years
New England Institute of Technology	East Greenwich	RI		Electrical Technology with Renewable Energy (Associate Degree Program)	2 years
New Heights Inc. & Nouvelle Hauteur Inc.	Montreal	QC		GWO Modules: First Aid, Manual Handling, Fire Awareness, Working at Heights	1.5 days
North Kingstown High School	North Kingstown	RI	Rhode Island Department of Labor and Training	Wind Win RI program: offshore wind energy certificate (equivalent to nine college credits) with courses on everything from marine safety to engineering, including special licenses, marine safety certification, first aid and more	4 years
Northeast Maritime Institute	Fairhaven	MA	Massachusetts Clean Energy Center	Variety of online and on-site maritime trainings. MassCEC provided funding to Gloucester Fishermen's Wives Development Program to work with the Massachusetts Fishermen's Partnership and the Northeast Maritime Institute	n/a

				to recruit and pre-qualify commercial fishermen for enrollment in dedicated training and certification programs.	
Northeastern University	Boston	MA		Renewable Energy Graduate Certificate with a "Wind Energy Systems" course	2 years
Offshore Wind Skills Academy	Newark	DE	University of Delaware and the Danish Energy and Climate Academy (ECA)	Targeted for professionals from traditional energy industries, supply chain companies, regulators, investors, consultants and any others wanting an in-depth knowledge of the offshore wind industry. Currently offer "Project Development from A to Z" course, discussing advanced development permitting, vessels, supply chain, deployment, operations and maintenance, and decommissioning.	3 days
Penn State University	State College	PA		Associate degree in renewable energy technology and a distance-based graduate certificate in wind energy engineering, as well as a graduate minor	2 years
Real Jobs Rhode Island	North Kingstown	RI	Rhode Island Department of Labor and Training	Targeted industry trainings, including training hundreds of Rhode Islanders to fill maritime manufacturing jobs at Quonset Business Park. Also offers packages to attract out-of-state potential supply chain companies to Rhode Island	n/a
Rowan College at Burlington	Mt Laurel Township	NJ		Alternative Energy Technologies degree includes wind related courses	4 years
Rowan College at Burlington	Mt Laurel Township	NJ	Ørsted	developing offshore wind engineering clinics	n/a
Stony Brook University	Stony Brook	NY	NYSERDA	developing program related to wind resource assessment, wind turbine and wind farm project design and optimization, offshore wind project economics, public policy, social acceptance and environmental impacts, as well as energy storage and grid integration	n/a
Suffolk Community College	Selden	NY	Eversource and Ørsted	Developing a non-credit wind energy program, intending to be operational in 2021	n/a
SUNY Canton	Canton	NY		degree in Sustainable Energy Technologies	4 years
SUNY Maritime	Bronx	NY	NYSERDA	Offshore Energy Center that will offer training programs for wind-operations technicians, dynamic positioning training, and certification courses for off-shore vessel operators	n/a
SUNY Morrisville	Morrisville	NY		Renewable Energy Bachelor of Technology degree with a Wind Track	4 years
Survival Systems USA	Groton	CT	Vineyard Wind	Offshore Energy Water Survival Course (including Helicopter Underwater Escape Training), two modules of GWO basic safety training almost ready to launch	n/a

Tufts University	Medford / Somerville	MA		M.S. program in Offshore Wind Energy Engineering	2 years
UConn School of Law	Hartford	CT		Energy and Environmental Law Certificate that includes wind related material	12 credits
UMass Amherst	Amherst	MA		M.S. in Mechanical and Industrial Engineering with a Concentration in Wind Energy	2 years
UMass Amherst	Amherst	MA	Massachusetts Clean Energy Center	Wind Energy Graduate Certificate (online)	1 year
UMass Lowell	Lowell	MA		Energy Engineering minor includes wind energy courses as part of its curriculum	4 years
UMass Lowell	Lowell	MA	Massachusetts Clean Energy Center	developing educational content and associated credentialing to fill existing workforce gaps	n/a
University of Maine	Orono	ME		Renewable Energy Engineering minor that features curriculum in wind energy	4 years
University of Rhode Island	Kingston	RI	Eversource and Ørsted	Two initiatives: (1) an Energy Fellows program that provides technical and professional experience and (2) an interdisciplinary graduate certificate	n/a
Vermont Tech	Williston	VT		Wind Energy Professional Online Training Program	n/a
Villanova University	Radnor Township	PA		Renewable Energy Systems course, featuring Wind Power curriculum	1 semester
VINCIVR, Inc.	Boston	MA	Massachusetts Clean Energy Center	developing two GWO courses (Basic Technical Training-Installation and Slinger Signaler) using virtual reality simulations, in partnership with Siemens Gamesa Renewable Energy	n/a

APPENDIX D. METRICS FOR DEFINING PRIORITY COMMUNITIES

To be considered a priority community, a census tract must have met thresholds for at least four of six pre-defined metrics. All census tract data is sourced from the American Community Survey's 5-year estimates, ending in 2018.

Metrics

Economic Characteristics

Two economic measures are used.

The first metric compares a tract's median income to the county-specific Living Wage standard as derived using the MIT Living Wage Calculator. Communities whose median household income is less than their county's minimum household income (2018 dollars) needed to support two adults (one working) and two children were selected.

The second metric compares a tract's unemployment rate with a state-wide threshold for unemployment. Communities whose unemployment rate is at least 20 percent higher than the state unemployment rate were selected.

Demographics

The demographic metric is comprised of two evenly weighted components.

The first component compares a tract's share of non-white residents (including, African American, American Indian, Asian, Hawaiian and Pacific Islander, and Other) with a state-wide threshold. Communities whose share of non-white residents is at least 20 percent higher than the state-wide share of non-white residents were selected.

The second component compares a tract's share of Hispanic or Latino residents with a state-wide threshold. Communities whose share of Hispanic or Latino residents is at least 20 percent higher than the state-wide share of Hispanic or Latino residents were selected.

Social Characteristics

Two social measures are used.

The first metric compares a tract's education level with a state-wide threshold. Communities whose share of residents with less than or equal to a high school diploma or equivalency is at least 20 percent higher than the state-wide share of residents with less than or equal to a high school diploma or equivalency were selected.

The second metric compares a tract's language competency with a state-wide threshold. Communities whose share of residents that speak English less than very well is at least 20 percent higher than the state-wide share of residents that speak English less than very well were selected.

Housing Characteristics

The one housing metric compares the share of renters to homeowners. Communities whose share of renters is at least 20 percent higher than the state-wide share of renters were selected.

APPENDIX E. PRIORITY COMMUNITIES

Census Tract	County	Gateway City?	Environmental Justice Population[15]
1001	Suffolk		Yes
1002	Suffolk		Yes
1003	Suffolk		Yes
1004	Suffolk		Yes
1005	Suffolk		Yes
101.03	Suffolk		Yes
1010.01	Suffolk		Yes
1010.02	Suffolk		Yes
1011.01	Suffolk		Yes
1011.02	Suffolk		Yes
103	Suffolk		Yes
104.03	Suffolk		Yes
104.04	Suffolk		Yes
104.05	Suffolk		Yes
1304.06	Suffolk		Yes
1401.06	Suffolk		Yes
1403	Suffolk		Yes
153	Barnstable	Barnstable	Yes
1601.01	Suffolk	Chelsea	Yes
1602	Suffolk	Chelsea	Yes
1604	Suffolk	Chelsea	Yes
1605.01	Suffolk	Chelsea	Yes
1605.02	Suffolk	Chelsea	Yes
1606.01	Suffolk	Chelsea	Yes
1606.02	Suffolk	Chelsea	Yes
1702	Suffolk	Revere	Yes
1704	Suffolk	Revere	Yes

[15] Defined by the State of Massachusetts, an Environmental Justice Population is a neighborhood where either a) the annual median household income is not more than 65% of the statewide annual median household income; b) minorities comprise 40% or more of the population; c) 25% or more of households lack English language proficiency; or d) minorities comprise 25% or more of the population and the annual median household income of the municipality in which the neighborhood is located does not exceed 150% of the statewide annual median household income.

Census Tract	County	Gateway City?	Environmental Justice Population
1706.01	Suffolk	Revere	Yes
1707.01	Suffolk	Revere	Yes
1707.02	Suffolk	Revere	Yes
1708	Suffolk	Revere	Yes
2043	Essex	Salem	Yes
2052	Essex	Lynn	Yes
2055	Essex	Lynn	Yes
2060	Essex	Lynn	Yes
2061	Essex	Lynn	Yes
2062	Essex	Lynn	Yes
2063	Essex	Lynn	Yes
2064	Essex	Lynn	Yes
2065	Essex	Lynn	Yes
2067	Essex	Lynn	Yes
2068	Essex	Lynn	Yes
2069	Essex	Lynn	Yes
2070	Essex	Lynn	Yes
2071	Essex	Lynn	Yes
2072	Essex	Lynn	Yes
2107	Essex	Peabody	Yes
2108	Essex	Peabody	Yes
2215	Essex		Yes
2216	Essex		Yes
2501	Essex	Lawrence	Yes
2502	Essex	Lawrence	Yes
2503	Essex	Lawrence	Yes
2504	Essex	Lawrence	Yes
2505	Essex	Lawrence	Yes
2506	Essex	Lawrence	Yes
2507	Essex	Lawrence	Yes
2508	Essex	Lawrence	Yes
2509	Essex	Lawrence	Yes
2510	Essex	Lawrence	Yes
2511	Essex	Lawrence	Yes
2512	Essex	Lawrence	Yes
2513	Essex	Lawrence	Yes
2514	Essex	Lawrence	Yes

Census Tract	County	Gateway City?	Environmental Justice Population
2515	Essex	Lawrence	Yes
2516	Essex	Lawrence	Yes
2517	Essex	Lawrence	Yes
2518	Essex	Lawrence	Yes
2524	Essex	Methuen	Yes
2601	Essex	Haverhill	Yes
2608	Essex	Haverhill	Yes
3102	Middlesex	Lowell	Yes
3103	Middlesex	Lowell	Yes
3104	Middlesex	Lowell	Yes
3105	Middlesex	Lowell	Yes
3107	Middlesex	Lowell	Yes
3111	Middlesex	Lowell	Yes
3112	Middlesex	Lowell	Yes
3113	Middlesex	Lowell	Yes
3118	Middlesex	Lowell	Yes
3119	Middlesex	Lowell	Yes
3120	Middlesex	Lowell	Yes
3121	Middlesex	Lowell	Yes
3124	Middlesex	Lowell	Yes
3412	Middlesex	Malden	Yes
3413	Middlesex	Malden	Yes
3414	Middlesex	Malden	Yes
3415	Middlesex	Malden	Yes
3418	Middlesex	Malden	Yes
3421.01	Middlesex	Everett	Yes
3421.02	Middlesex	Everett	Yes
3422.01	Middlesex	Everett	Yes
3422.02	Middlesex	Malden	Yes
3424	Middlesex	Everett	Yes
3425	Middlesex	Everett	Yes
3426	Middlesex	Everett	Yes
3687	Middlesex		Yes
3831.01	Middlesex		Yes
3831.02	Middlesex		Yes
3832	Middlesex		Yes
3834	Middlesex		Yes

Census Tract	County	Gateway City?	Environmental Justice Population
3883	Middlesex	Lowell	Yes
414	Franklin		Yes
4176.01	Norfolk	Quincy	Yes
4178.02	Norfolk	Quincy	Yes
501.01	Suffolk		Yes
502	Suffolk		Yes
503	Suffolk		Yes
504	Suffolk		Yes
505	Suffolk		Yes
506	Suffolk		Yes
507	Suffolk		Yes
509.01	Suffolk		Yes
510	Suffolk		Yes
5103	Plymouth	Brockton	Yes
5104	Plymouth	Brockton	Yes
5105.02	Plymouth	Brockton	Yes
5105.03	Plymouth	Brockton	Yes
5108	Plymouth	Brockton	Yes
5109	Plymouth	Brockton	Yes
511.01	Suffolk		Yes
5110	Plymouth	Brockton	Yes
5112	Plymouth	Brockton	Yes
5114	Plymouth	Brockton	Yes
5115	Plymouth	Brockton	Yes
5116	Plymouth	Brockton	Yes
5302	Plymouth		Yes
5612	Plymouth		Yes
6.02	Suffolk		Yes
607	Suffolk		Yes
610	Suffolk		Yes
611.01	Suffolk		Yes
6136	Bristol	Taunton	Yes
6138	Bristol	Taunton	Yes
6139.01	Bristol	Taunton	Yes
6140	Bristol	Taunton	Yes
6314	Bristol	Attleboro	Yes
6401	Bristol	Fall River	Yes

Census Tract	County	Gateway City?	Environmental Justice Population
6402	Bristol	Fall River	Yes
6403	Bristol	Fall River	Yes
6404	Bristol	Fall River	Yes
6405	Bristol	Fall River	Yes
6406	Bristol	Fall River	Yes
6409.01	Bristol	Fall River	Yes
6410	Bristol	Fall River	Yes
6411.01	Bristol	Fall River	Yes
6412	Bristol	Fall River	Yes
6413	Bristol	Fall River	Yes
6414	Bristol	Fall River	Yes
6415	Bristol	Fall River	Yes
6416	Bristol	Fall River	Yes
6419	Bristol	Fall River	Yes
6420	Bristol	Fall River	Yes
6422	Bristol	Fall River	Yes
6503	Bristol	New Bedford	Yes
6504	Bristol	New Bedford	Yes
6505	Bristol	New Bedford	Yes
6506	Bristol	New Bedford	Yes
6507	Bristol	New Bedford	Yes
6508	Bristol	New Bedford	Yes
6509	Bristol	New Bedford	Yes
6511	Bristol	New Bedford	Yes
6512	Bristol	New Bedford	Yes
6513	Bristol	New Bedford	Yes
6514	Bristol	New Bedford	Yes
6515	Bristol	New Bedford	Yes
6517	Bristol	New Bedford	Yes
6518	Bristol	New Bedford	Yes
6519	Bristol	New Bedford	Yes
6520	Bristol	New Bedford	Yes
6523	Bristol	New Bedford	Yes
6524	Bristol	New Bedford	Yes
6525	Bristol	New Bedford	Yes
6526	Bristol	New Bedford	Yes
6527	Bristol	New Bedford	Yes

Census Tract	County	Gateway City?	Environmental Justice Population
702	Suffolk		Yes
704.02	Suffolk		Yes
7072	Worcester		Yes
7073	Worcester		Yes
7094	Worcester	Leominster	Yes
7096	Worcester	Leominster	Yes
7101	Worcester	Fitchburg	Yes
7105	Worcester	Fitchburg	Yes
7106	Worcester	Fitchburg	Yes
7107	Worcester	Fitchburg	Yes
7108	Worcester	Fitchburg	Yes
712.01	Suffolk		Yes
7304.01	Worcester	Worcester	Yes
7304.02	Worcester	Worcester	Yes
7305	Worcester	Worcester	Yes
7311.01	Worcester	Worcester	Yes
7312.03	Worcester	Worcester	Yes
7312.04	Worcester	Worcester	Yes
7313	Worcester	Worcester	Yes
7314	Worcester	Worcester	Yes
7315	Worcester	Worcester	Yes
7317	Worcester	Worcester	Yes
7318	Worcester	Worcester	Yes
7319	Worcester	Worcester	Yes
7320.01	Worcester	Worcester	Yes
7323.02	Worcester	Worcester	Yes
7324	Worcester	Worcester	Yes
7325	Worcester	Worcester	Yes
7326	Worcester	Worcester	Yes
7327	Worcester	Worcester	Yes
7329.01	Worcester	Worcester	Yes
7330	Worcester	Worcester	Yes
7542	Worcester		Yes
7543	Worcester		Yes
7571	Worcester		Yes
7572	Worcester		Yes
7573	Worcester		Yes

Census Tract	County	Gateway City?	Environmental Justice Population
8001.01	Hampden	Springfield	Yes
8001.02	Hampden	Springfield	Yes
8004	Hampden	Chicopee	Yes
8005	Hampden	Springfield	Yes
8006	Hampden	Springfield	Yes
8007	Hampden	Springfield	Yes
8008	Hampden	Springfield	Yes
8009	Hampden	Springfield	Yes
801	Suffolk		Yes
8011.01	Hampden	Springfield	Yes
8012	Hampden	Springfield	Yes
8014.01	Hampden	Springfield	Yes
8014.02	Hampden	Springfield	Yes
8015.02	Hampden	Springfield	Yes
8017	Hampden	Springfield	Yes
8018	Hampden	Springfield	Yes
8019.01	Hampden	Springfield	Yes
8019.02	Hampden	Springfield	Yes
8020	Hampden	Springfield	Yes
8022	Hampden	Springfield	Yes
8023	Hampden	Springfield	Yes
8026.01	Hampden	Springfield	Yes
804.01	Suffolk		Yes
805	Suffolk		Yes
806.01	Suffolk		Yes
808.01	Suffolk		Yes
8104.03	Hampden		Yes
8106.01	Hampden	Chicopee	Yes
8108	Hampden	Chicopee	Yes
8109.01	Hampden	Chicopee	Yes
8111.01	Hampden	Chicopee	Yes
8111.02	Hampden	Chicopee	Yes
8114	Hampden	Holyoke	Yes
8115	Hampden	Holyoke	Yes
8116	Hampden	Holyoke	Yes
8117	Hampden	Holyoke	Yes
8118	Hampden	Holyoke	Yes

Census Tract	County	Gateway City?	Environmental Justice Population
812	Suffolk		Yes
8120.01	Hampden	Holyoke	Yes
8121.03	Hampden	Holyoke	Yes
8123	Hampden		Yes
8127.01	Hampden	Westfield	Yes
8127.02	Hampden	Westfield	Yes
813	Suffolk		Yes
815	Suffolk		Yes
817	Suffolk		Yes
818	Suffolk		Yes
819	Suffolk		Yes
8201.02	Hampshire		Yes
821	Suffolk		Yes
9001	Berkshire	Pittsfield	Yes
9006	Berkshire	Pittsfield	Yes
901	Suffolk		Yes
902	Suffolk		Yes
903	Suffolk		Yes
904	Suffolk		Yes
906	Suffolk		Yes
913	Suffolk		Yes
914	Suffolk		Yes
915	Suffolk		Yes
916	Suffolk		Yes
917	Suffolk		Yes
918	Suffolk		Yes
919	Suffolk		Yes
920	Suffolk		Yes
921.01	Suffolk		Yes
9213	Berkshire		Yes
9221	Berkshire		Yes
923	Suffolk		Yes
924	Suffolk		Yes
9811	Suffolk		Yes
9901.01	Suffolk		Yes

Priority Community (City)	Occupation of Highest Relative Supply
Acushnet	Painting, Coating, and Decorating Workers
Adams	Hoist and Winch Operators
Allston	Natural Sciences Managers
Andover	Natural Sciences Managers
Attleboro	Plating Machine Setters, Operators, and Tenders, Metal and Plastic
Boston	Postsecondary Teachers
Bridgewater	Hoist and Winch Operators
Brockton	Hoist and Winch Operators
Chelsea	Cargo and Freight Agents
Chicopee	Hoist and Winch Operators
Dorchester Center	Zoologists and Wildlife Biologists
Dorchester	Electrical Power-Line Installers and Repairers
Dracut	Hoist and Winch Operators
East Boston	Cargo and Freight Agents
Everett	Hoist and Winch Operators
Fall River	Hoist and Winch Operators
Fitchburg	Hoist and Winch Operators
Framingham	Hoist and Winch Operators
Gardner	Cutting and Slicing Machine Setters, Operators, and Tenders
Gloucester	Hoist and Winch Operators
Greenfield	Hoist and Winch Operators
Haverhill	Elevator and Escalator Installers and Repairers
Holyoke	Electrical Power-Line Installers and Repairers
Hyannis	Captains, Mates, and Pilots of Water Vessels
Hyde Park	Electrical Power-Line Installers and Repairers
Indian Orchard	Hoist and Winch Operators
Jamaica Plain	Elevator and Escalator Installers and Repairers
Lawrence	Hoist and Winch Operators
Leominster	Hoist and Winch Operators
Lowell	Hoist and Winch Operators
Ludlow	Hoist and Winch Operators
Lynn	Hoist and Winch Operators
Malden	Industrial Engineers
Mattapan	Zoologists and Wildlife Biologists
Methuen	Hoist and Winch Operators
New Bedford	Hoist and Winch Operators
North Adams	Hoist and Winch Operators
Peabody	Cargo and Freight Agents

Priority Community (City)	Occupation of Highest Relative Supply
Pittsfield	Hoist and Winch Operators
Plymouth	Plating Machine Setters, Operators, and Tenders, Metal and Plastic
Quincy	Commercial Divers
Revere	Commercial Pilots
Roslindale	Zoologists and Wildlife Biologists
Roxbury	Career/Technical Education Teachers, Secondary School
Salem	Structural Iron and Steel Workers
South Boston	Elevator and Escalator Installers and Repairers
Southbridge	Mechanical Drafters
Springfield	Control and Valve Installers and Repairers, Except Mechanical Door
Taunton	Hoist and Winch Operators
Waltham	Postsecondary Teachers
Ware	Cutting and Slicing Machine Setters, Operators, and Tenders
Webster	Insurance Underwriters
West Roxbury	Control and Valve Installers and Repairers, Except Mechanical Door
West Springfield	Plating Machine Setters, Operators, and Tenders, Metal and Plastic
Westfield	Hoist and Winch Operators
Worcester	Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders