FUTURE WORKFORCE NEEDS OF THE OFFSHORE WIND INDUSTRY IN HAMPTON ROADS

HAMPTON ROADS ALLIANCE

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FEBRUARY 9, 2021

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About Mangum Economics, LLC

Founded in 2003, Mangum Economics is a Virginia based firm that specializes in producing objective economic, quantitative, and qualitative analysis in support of strategic decision making. Mangum Economics is located in the Innsbrook Corporate Office Park, in Glen Allen, Virginia.

Much of our recent work relates to economic development, data centers, renewable energy, tax and regulatory policy, and terrestrial and subsea fiber.

Examples of typical studies include:

- *Potential Impact of the Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia*, September 28, 2020.
- *The Economic Contribution of Utility Scale Solar Development to Virginia*, for the Maryland, Delaware, and Virginia Solar Energy Industry Association, May 2020
- *Potential Impact of Large Data Center Development in Maryland*, for the Maryland Chamber of Commerce, March 2020.
- *The Impact of Data Centers on the State and Local Economies of Virginia*, for the Northern Virginia Technology Council, January 2020.
- *Opportunities for Southern Virginia to Participate in the Cloud Economy*, for Mid-Atlantic Broadband Communities Corporation, April 2019.
- *Spotsylvania Solar Energy Center: Economic and Fiscal Contribution to Spotsylvania County*, for S-Power, February 2019.
- *Potential Impact of a Data Center Incentive in Illinois*, for the Illinois Chamber of Commerce, November 2018.
- *The Economic and Fiscal Contribution that Volvo Group North America made to Maryland, Mississippi, New York, North Carolina, Pennsylvania, Tennessee, and Virginia in 2016*, for Volvo Group North America, April 2018.

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Executive Summary

In this report, we build upon the employment impact projections provided in our earlier *Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia* report to provide an estimate of the near-term and long-term workforce needs of the offshore wind energy industry in Hampton Roads. There are three principal findings from that analysis:

1) The "lockdowns" of economic activity imposed in response to the Covid19 pandemic had a devastating impact on the economy of Hampton Roads, which cause the region's labor force to shrink. Looking forward, that:
    - Means that the regional labor pool available to fill future offshore wind energy jobs will likely be smaller than what it was even as recently as 2019.
    - It is more likely that at least some of the skill sets required to staff future offshore wind energy jobs will have to be recruited from outside of Virginia – most likely from Europe or the Gulf states.

2) A comparison of the likely near-term and long-term demand for offshore wind energy workers in Hampton Roads, with the supply of trained workers in terms of the pipeline of graduates from associated postsecondary education and training programs in Hampton Roads, indicates there may be potential training shortfalls associated with certain occupations. Most particularly:
    - Maintenance and Repair Workers
    - General; Heavy and Tractor-Trailer Truck Drivers
    - Light Truck or Delivery Services Drivers
    - Electricians
    - Aircraft Mechanics and Service Technicians
    - Training and Development Specialists
    - Operations Research Analysts

3) There are specific credentialing requirements for offshore wind energy in areas such as safety training, welding, CNC machining, and composites manufacturing that differ from those required by existing industries, and offered through existing training programs, in Hampton Roads.

As a result, initiatives such as the recently announced Mid-Atlantic Wind Training Alliance – which is intended to develop a pipeline of certified workers to serve the wind energy industry through programs offered at the New College Institute, Centura College, and the Mid-Atlantic Maritime Academy – will be critical to the future growth and development of the offshore wind energy industry in Hampton Roads.

Introduction

Dominion Energy has announced plans to construct the Coastal Virginia Offshore Wind (CVOW) project – a 2.6 gigawatt (GW) offshore wind farm 27 miles off the coast of Virginia Beach. CVOW will be the largest offshore wind installation in the United States, and in combination with Avangrid's proposed 2.5 GW Kitty Hawk project off the North Carolina coast, will provide Hampton Roads with a significant first-mover advantage in becoming a major east coast hub for offshore wind energy development.

This report builds on our earlier analysis, *Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia*,[1] to provide an estimate of the near-term and long-term workforce needs of the offshore wind energy industry in Hampton Roads and how those needs map into the pipeline of graduates from existing post-secondary education programs within the region. As any economic developer knows, the availability of trained workers is a major factor in industry development and growth. As a result, identifying potential gaps between the future demand for trained workers in the offshore wind energy industry and the current pipeline for supplying those workers, is a key step in ensuring that Hampton Roads is able to capture a significant share of the economic activity that will come from the development of offshore wind energy along the east coast of the United States.

The remainder of this report is divided into five sections. In the *Impact of Offshore Wind Energy Development on Hampton Roads* section, we provide a brief summary of our earlier estimates of potential employment impact on Hampton Roads from offshore wind energy development in the *Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia*. In the *Recent Economic Trends in Hampton Roads* section, we discuss how significant recent economic events have altered the available labor pool in Hampton Roads. In the *Offshore Wind Energy Workforce Gaps* section, we map the offshore wind energy employment estimates presented earlier into the pipeline of graduates from existing post-secondary education programs within Hampton Roads to identify potential workforce gaps. While in the *Offshore Wind Energy Workforce Credentials* section, we discuss specific credentialling issues that may arise between existing training programs and the established needs of the offshore wind energy industry, as well as initiatives that have already been undertaken to address those issues. Finally, in the *Conclusion* section, we provide a brief summary and concluding remarks.

This report was commissioned by the Hampton Roads Alliance and produced by Mangum Economics.

[1] "Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia," produce for Hampton Roads Alliance by Mangum Economics, September 2020.

The Impact of Offshore Wind Energy Development on Hampton Roads

In this section we provide a brief summary of our estimates of potential employment impact on Hampton Roads from offshore wind energy development that were developed in our earlier report on the *Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia*. Those estimates took two forms: 1) the near-term employment impact of Dominion Energy's 2.6 GW CVOW project on Hampton Roads and 2) the long-term employment impact that could come from Hampton Roads' evolution into a major hub for offshore wind energy development.

CVOW Project

The employment impact estimates associated with Dominion Energy's CVOW project provide a near-term estimate of employment from offshore wind energy development in Hampton Roads. These estimates are inherently conservative in that they only pertain to the CVOW project and exclude other potential development projects that could also be served from Hampton Roads. In addition, they take into account the fact that the United States effectively does not currently have an offshore wind energy industry and the domestic supply chain for that industry is still very much in its infancy. As a result, many of the components and much of the expertise required to construct the CVOW project will, initially at least, come from Europe where the industry is much more established.

Our estimates of the employment impact on Hampton Roads from Dominion Energy's CVOW project were provided for each of the four phases of the project's development:

- Development
- Manufacturing
- Installation
- Operations and Maintenance

Development Phase

The development phase of the CVOW project is expected to take place between 2020 and 2022. These activities include engineering and design work; environmental, meteorological, and oceanographic studies; and legal and professional work for contracting, leasing, and permitting requirements. Most of the global technical and engineering expertise for offshore wind energy resides with the European firms that currently dominate the industry.

However, some of the technical research is common in the Gulf of Mexico where there is a long history of offshore energy operations and some similar expertise has built up in New England. In addition, a significant amount of managerial, planning, and administrative expertise is available around Dominion Energy's corporate headquarters in Richmond and legal and regulatory expertise is especially strong in the Northern Virginia and Richmond areas. Beyond that, Hampton Roads is home to a significant amount of engineering, design, technical, and professional expertise.

Based on the availability of potential suppliers currently in Hampton Roads, we estimated that $56.3 million of the approximately $464 million that will be spent during the development phase of the project will be spent in Hampton Roads. As shown in Table 1, our analysis indicated that spending could be expected to support approximately 129 direct jobs annually within the region during the development phase.[2]

Table 1: Jobs Supported during the Development Phase

Annual Jobs for 2020-2022	Hampton Roads
1st Round Direct Jobs	129

Manufacturing Phase

The manufacturing phase of the CVOW project is expected to take place between 2023 and 2025. By a significant margin, offshore wind turbines account for most of the cost of constructing an offshore wind facility. Other than turbines, there are expenses for turbine foundations; offshore inter-array and export cables; equipment for offshore electrical substations, an onshore electrical substation, and other electrical network upgrades; and equipment for an onshore base for operations.

Based on the availability of potential suppliers currently in Hampton Roads, we estimated that $82.6 million of the approximately $6.2 billion that will be spent for physical structures and equipment for the CVOW project will be spent in Hampton Roads. Those expenditures are anticipated to include construction of an onshore electrical substation, warehouses and operations buildings, and a wind-turbine assembly staging facility. As demonstrated in Table 2, our analysis showed that spending could be expected to support approximately 335 direct jobs annually within the region during the manufacturing phase.

Table 2: Jobs Supported during the Manufacturing Phase

Annual Jobs for 2023-2025	Hampton Roads
1st Round Direct Jobs	335

Installation Phase

The installation phase of the CVOW project is expected to take place between 2024 and 2026. Most of the expense during installation of the facility is related to installing the inter-array cables that connect the turbines to the offshore substations and the export cables that transmit the electricity from the offshore substations to the onshore substation. Next in magnitude is the cost of installing the foundations for the turbines and then installing the turbines, themselves.

[2] For purposes of this analysis, Hampton Roads is defined to include the counties of Gloucester, Isle of Wight, James City, Mathews, and York; the North Carolina counties of Currituck and Gates; and the Virginia cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg.

Based on the availability of potential suppliers currently in Hampton Roads, we estimated that $190 million of the approximately $1.7 billion that will be spent during the installation phase of the CVOW project will be spent in Hampton Roads. As indicated in Table 3, our analysis showed that spending could be expected to support approximately 326 direct jobs annually within the region during the installation phase.

Table 3 Jobs Supported during the Installation Phase

Annual Jobs for 2024-2026	Hampton Roads
1st Round Direct Jobs	326

Operations and Maintenance Phase

Based on the availability of potential suppliers currently in Hampton Roads, we estimated that approximately $131.6 million will be spent annually in Hampton Roads to operate and maintain Dominion Energy's commercial CVOW development. As shown in Table 4, our analysis found that spending could be expected to support approximately 200 direct jobs annually within the region during the operations and maintenance phase.

Table 4: Jobs Supported during the Operations and Maintenance Phase

Annual Jobs	Hampton Roads
1st Round Direct Jobs	200

1 GW Scenario

Dominion Energy's commercial CVOW project is only part of the total potential offshore wind development on the east coast of the United States. Several recent studies have found that as many as 20 to 30 GW of offshore wind capacity could be operational by the year 2030.[3]

Although offshore wind energy is a mature industry in Europe, it is still in its infancy in the United States and Hampton Roads has an excellent opportunity to develop into one of the main offshore wind energy industry hubs on the east coast. This is in part because:

- CVOW will provide Hampton Roads with a significant first-mover advantage.
- Hampton Roads has one of the largest port areas on the east coast.
- Unlike other ports on the east coast, Hampton Roads port areas have direct access to the open ocean without any air draft restrictions from bridges.
- Hampton Roads is the only major port area well-suited to serve offshore wind energy developments in the southern portion of the east coast of the United States.

[3] American Wind Energy Association, 2020. "U.S. Offshore Wind Power Economic Impact Assessment."

- Virginia has a history of fostering a good climate for business growth, with lower costs of doing business, lower taxes, and less regulation than many of the east coast states that would be competing for offshore wind energy development north of Virginia.

One GW of annual offshore wind capacity development is generally considered an industry threshold to justify investments in new manufacturing facilities to supply new development. Our estimates under the 1 GW scenario assume that one GW of new offshore wind energy capacity is constructed and maintained from Hampton Roads on an annual basis. These estimates are intended to capture the potential long-term impact on Hampton Roads should the region develop into a major offshore wind energy hub with a well-established supply chain for offshore wind energy development.

Employing the same methods and approach used in the CVOW analysis, we estimated that the direct spending in Hampton Roads by developers and immediate contractors to build and support one GW of offshore wind energy capacity could be expected to support approximately 3,100 direct jobs annually within the region.

Table 5: Jobs Supported by 1 GW of New Development

Annual Jobs	Hampton Roads
1st Round Direct Jobs	3,100

Recent Economic Trends in Hampton Roads

In 2020, "lockdowns" of economic activity imposed by executive order of the governor in response to the Covid19 pandemic had a devastating impact on the economy of both Hampton Roads and Virginia as a whole.[4] And it is important to note that those events have significantly altered the available labor pool in Hampton Roads from what it was as recently as 2019. Where in 2019, Virginia and the nation were experiencing unemployment rates that were at half-century lows and labor shortages were becoming a significant concern, in 2020 unemployment rates rose sharply to levels not seen since the Great Depression of the 1930s. That had a profound impact on the available labor pool in Hampton Roads as well as Virginia statewide.

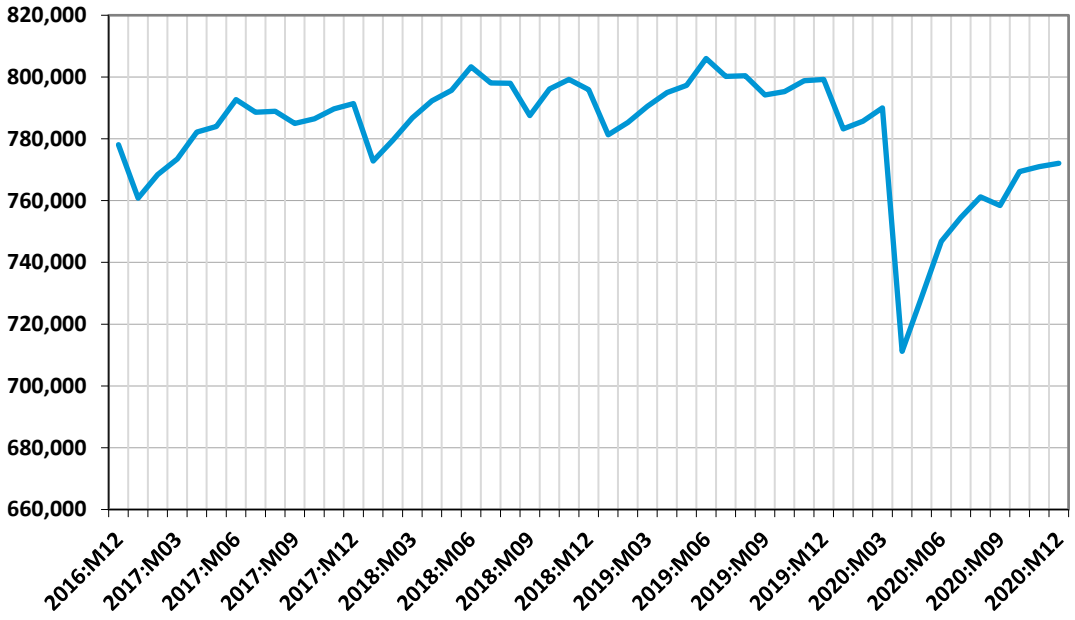
Total Employment

Figure 1 depicts the trend in total employment in Hampton Roads from December 2016 to December 2020. As these data show, total employment in the region slowly trended upward through March 2020. In April 2020, however, as the lockdowns were imposed, it dropped precipitously with a loss of 78,800 jobs or nearly one out of every ten jobs in the region. As of December 2020, regional employment had

[4] For purposes of this analysis, Hampton Roads is defined to include the counties of Gloucester, Isle of Wight, James City, Mathews, and York; the North Carolina counties of Currituck and Gates; and the Virginia cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg.

partly recovered but was still down 27,100 jobs from where it had been a year before in December 2019.

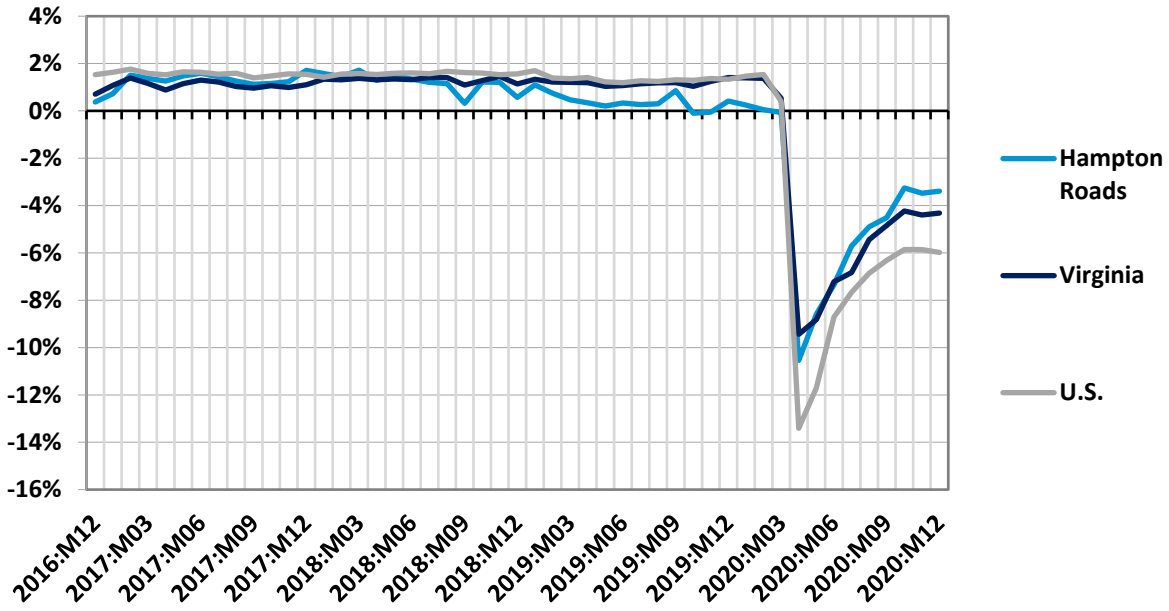
Figure 1: Total Employment in Hampton Roads – December 2016 to December 2020[5]



To control for seasonality and provide a point of reference, Figure 2 compares the year-over-year change in total employment in Hampton Roads to that of Virginia and the nation over the same period. Any point above the zero line in this graph indicates an increase in employment, while any point below the zero line indicates a decrease in employment. As these data show, the year-over-year change in employment in Hampton Roads plummeted from minus 0.1 percent in March 2020 to minus 10.5 percent in April 2020, which was slightly worse than the minus 9.4 percent year-over-year change in employment at the state level that month, but better than the national average of minus 13.4 percent. As of December 2020, the year-over-year change in employment was still minus 3.4 percent in Hampton Roads, minus 4.3 percent statewide, and minus 6.0 percent at the national level.

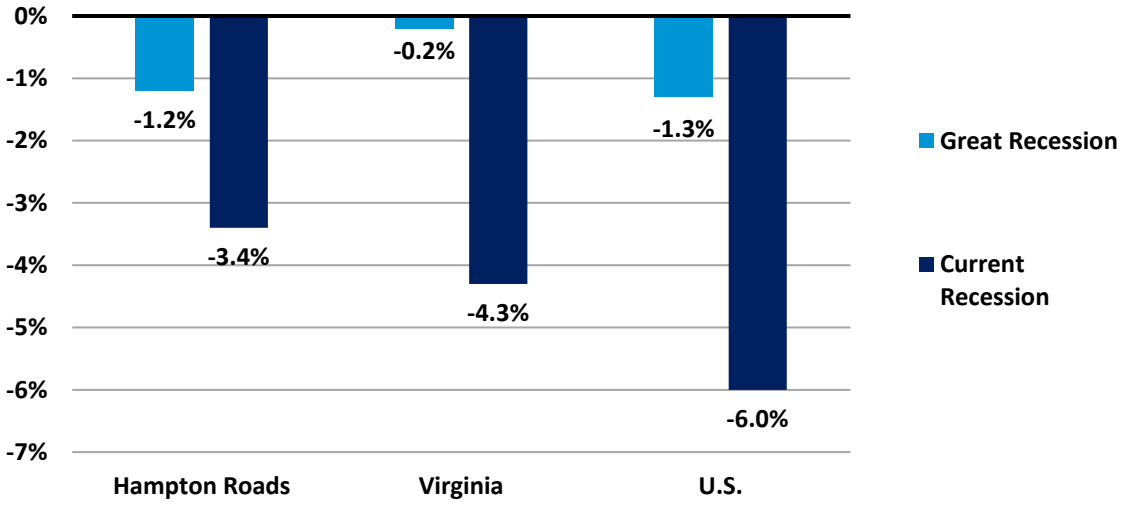
[5] Data Source: U.S. Bureau of Labor Statistics.

Figure 2: Year-Over-Year Change in Total Employment – December 2016 to December 2020[6]



To put these year-over-year employment losses depicted in Figure 2 in better perspective, Figure 3 compares the residual year-over-year employment change experienced in the 11th month of the current recession (*i.e.*, December 2020) to the residual employment change experienced in the 11th month of the Great Recession (*i.e.*, October 2008). As these data clearly show, the lingering economic damage that Hampton Roads, Virginia, and the nation are experiencing in the current recession, far exceeds what was experienced even during the Great Recession of 2007-09.

Figure 3: Year-Over-Year Change in Total Employment in 11th Month of Recession[7]



[6] Data Source: U.S. Bureau of Labor Statistics.

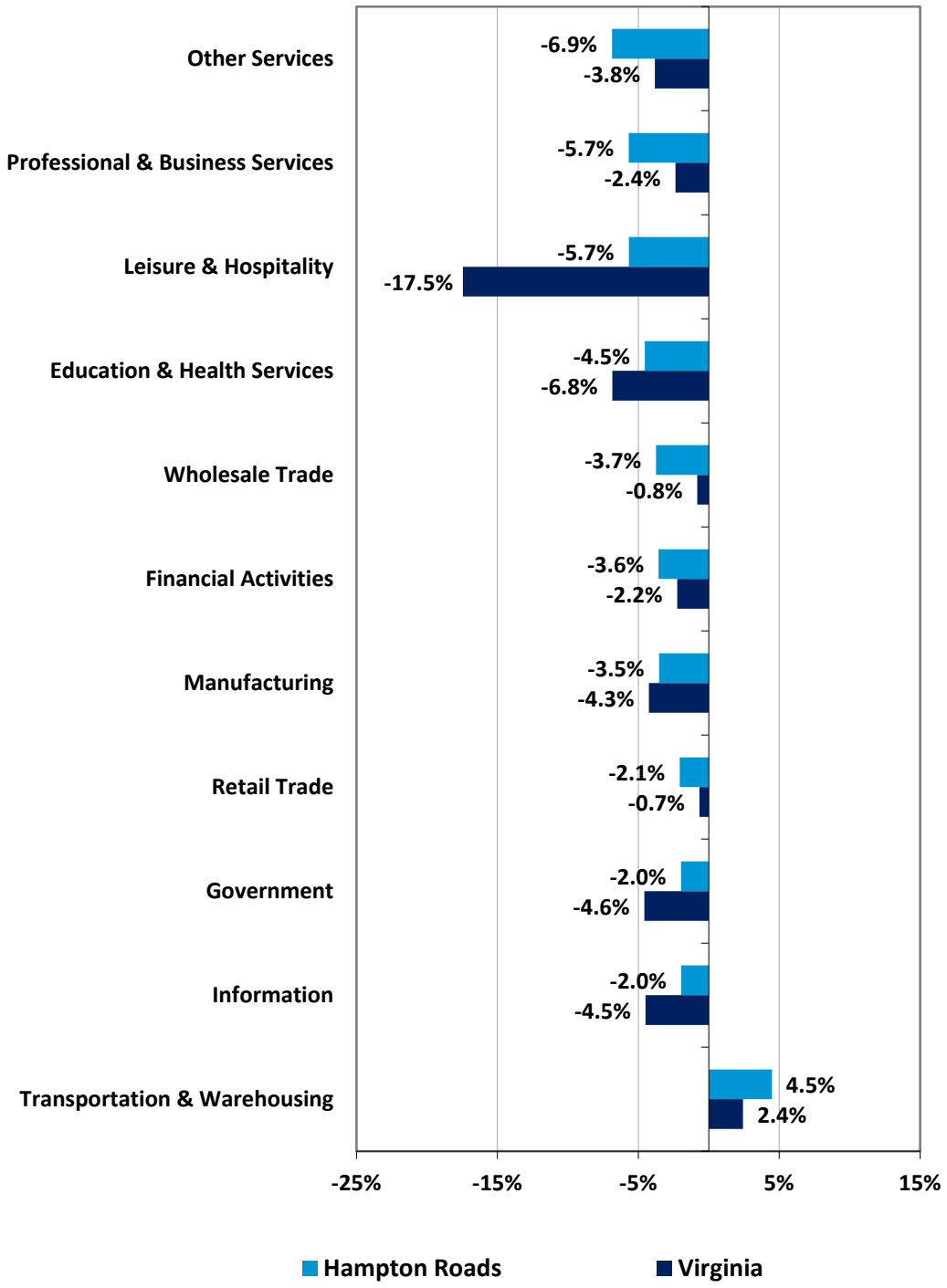
[7] Data Source: U.S. Bureau of Labor Statistics.

Employment by Major Industry Sector

Figure 4 provides a breakdown of the year-over-year change in employment in December 2020 by major industry sector in Hampton Roads and benchmarks those figures against comparable statewide data. As these data show, the only major industry sector that showed positive year-over-year employment growth that month was Transportation and Warehousing (4.5 percent growth in Hampton Roads and 2.4 percent growth statewide). At both the regional and statewide level, all other major industry sectors experienced a year-over-year loss of employment in December 2020.

Notable among those other major industry sectors, Professional and Business Services (down 5.7 percent in Hampton Roads vs. 2.4 percent statewide) and Wholesale Trade (down 3.7 percent in Hampton Roads vs. 0.8 percent statewide) experienced employment losses in Hampton Roads that exceeded the statewide norm, while Manufacturing (down 3.5 percent in Hampton Roads vs. 4.8 percent statewide) was less adversely impacted in Hampton Roads than at the statewide level. All three of these major industry sectors would be heavily involved in the development of offshore wind energy.

Figure 4: Year-Over-Year Change in Employment by Major Industry in December 2020[8]

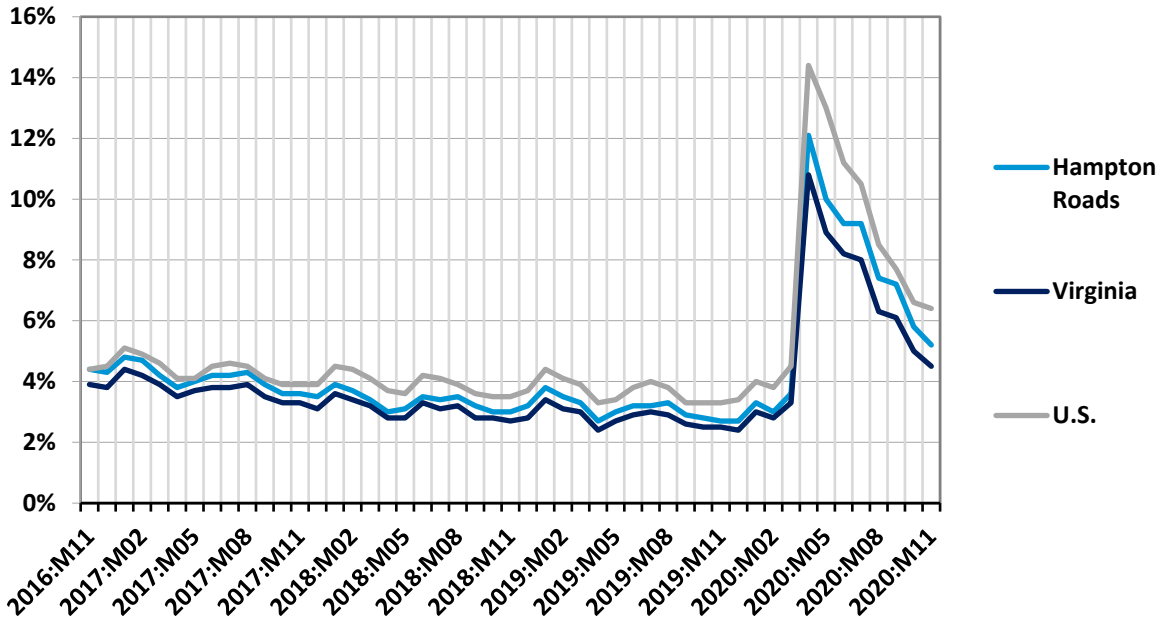


[8] Data Source: U.S. Bureau of Labor Statistics.

Unemployment and Labor Force

Figure 5 compares the unemployment rate in Hampton Roads to that of Virginia and the nation over the period from November 2016 to November 2020 (the most recent month for which sub-state unemployment data are available). As these data indicate, at all three levels unemployment rates were trending downward until April 2020 when they spiked to levels not seen since the Great Depression of the 1930s. In April 2020, the unemployment rate in Hampton Roads hit 12.1 percent, while statewide in Virginia it hit 10.8 percent, and nationally 14.4 percent. Unemployment rates have since partly retreated and came in at 5.2 percent in Hampton Roads in November 2020, 4.5 percent statewide in Virginia, and 6.4 percent nationally.

Figure 5: Unemployment Rate – November 2016 to November 2020[9]



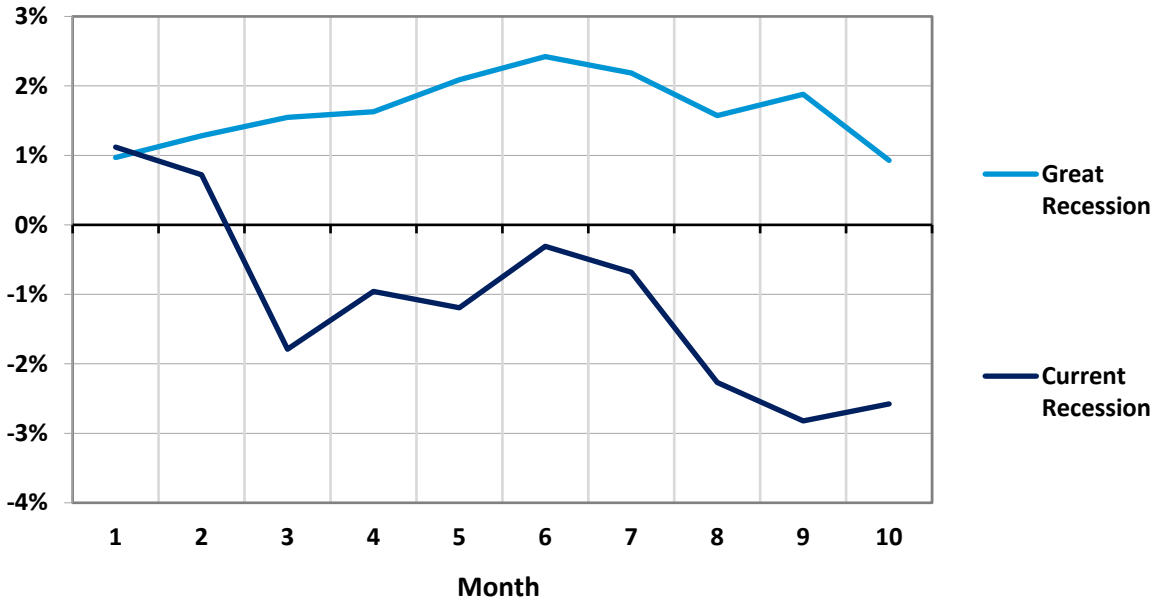
However, as striking as the numbers shown in Figure 5 are, they do not provide information on the more important part of the story, which is that much of the decline in unemployment rates between April 2020 and November 2020 was driven not by an increase in employment, but rather by an increase in the number of people who had dropped out of the labor force and were no longer looking for employment. For example, as of November 2020 the labor force, the overall pool of available labor, in Hampton Roads was down by 31,321 from where it was in March 2020 before the lockdowns. Based on November's employment numbers, had the size of Hampton Roads' labor force not declined but remained at the same level it was in March, the region's November unemployment rate would have been 9.5 percent, not 5.2 percent. Which shows why the region's shrinking labor force is likely to be an even larger problem in filling future jobs than its current unemployment rate.

[9] Data Source: U.S. Bureau of Labor Statistics.

Figure 6 provides some additional insight on this issue by comparing the year-over-year change in the size of Hampton Roads' labor force during the first ten months of the current recession to the first ten months of the Great Recession of 2007-09. As these data show, in contrast to the Great Recession where Hampton Roads' labor force continued to exhibit year-over-year growth in the size of its labor force, the current recession has been characterized by a continuing and generally increasing year-over-year decline in the size of region's labor force.

This decline in in the size of region's labor force has at least two important implications for filling the future regional offshore wind energy jobs that are the focus of this report. First, it means that the regional labor force available to fill those positions will likely be smaller than what it was even as recently as 2019. Second, it will likely exacerbate an already existing issue, which is that at least some of the skill sets required to staff these positions do not already exist in the region and will have to be recruited from outside of Virginia – most likely from Europe or the Gulf states where there are many workers in the offshore oil industry who possess similar skill sets.

Figure 6: Year-Over-Year Change in Hampton Roads' Labor Force – 1st through 10th Month of Recession[10]



[10] Data Source: U.S. Bureau of Labor Statistics.

Offshore Wind Energy Workforce Gaps

In this section, we build on the employment projections presented in the previous *Impact of Offshore Wind Energy Development on Hampton Roads* section, to identify potential gaps in the number of trained workers required to meet those employment projections and the pipeline of graduates from existing post-secondary education and training programs within Hampton Roads. The method used to accomplish this analysis is not new and has been successfully employed in earlier studies conducted in several states.[11]

Demand for Trained Workers

Our estimate of the near-term and long-term demand for trained offshore wind energy workers is based on an industry and occupation specific breakdown of the employment projections presented in the previous *Impact of Offshore Wind Energy Development on Hampton Roads* section for the CVOW and 1 GW scenarios, respectively. To account for competing demands from existing industries in Hampton Roads, however, we also rely on the Virginia Employment Commissions' most recent occupational employment projections for Hampton Roads.[12]

In the next step of the analysis, we use the National Crosswalk Service Center (NCSC) crosswalk described earlier to "map" these occupational employment projections into the prerequisite education and training program(s) necessary for entry into each specific occupation.[13] Through this process, we are able to estimate the occupation-driven demand for graduates from those post-secondary programs within Hampton Roads that serve, or could serve, as a pipeline for training workers for the offshore wind energy industry.[14]

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[11] Similar methods are used in at least seven states (California, Georgia, Idaho, Illinois, New Jersey, Utah, and Virginia) to project anticipated education and training demands. For an excellent exposition of this method see, William J. Drummond and Jan L Youtie, "Occupational Employment, Demand for College Graduates, and Migration: A Statewide View," a report to the Board of Regents, University System of Georgia, 1999. For an example of how this method has been used previously in Virginia see, A. Fletcher Mangum, "System-Wide Needs Assessment for Virginia Education," State Council of Higher Education for Virginia, March 28, 2002, p.90.

[12] Data Source: Derived from Virginia Employment Commission occupational employment projections for 2016 to 2026.

[13] The National Crosswalk Service Center (NCSC) is funded by the U.S. Department of Labor, Employment and Training Administration. The specific NCSC crosswalk used in this analysis is the 2010 Standard Occupational Classification Crosswalk to 2010 Classification of Instructional Programs. This crosswalk identifies the prerequisite instructional programs necessary for employment in 623 specific occupations. Often, these are many-to-many relationships where a given instructional program can serve as an avenue into one of many jobs, or one of several instructional programs can serve as a prerequisite for a given job.

[14] More formally, the demand for education and training programs is calculated as:

$$DCIP_i = \sum Dcip_{ji}$$

Where,

$$Dcip_{ji} = (SOC_j)(GCIP_i/\sum Gcip_{ij})$$

and,

$DCIP_i$ = the annual demand for instructional program i

$\sum Dcip_{ji}$ = the annual demand for instructional program i across all occupation(s) j

SOC_j = the projected employment for occupation j

Supply of Trained Workers

To estimate the likely supply of graduates within those education and training programs identified in the demand analysis, we use data from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) on completions by program in academic year 2018-19 from postsecondary education institutions within Hampton Roads.[15]

Workforce Gaps

By comparing the near-term and long-term demand for workers in Hampton Roads in the offshore wind energy industry, with the supply of workers in terms of the regional pipeline of graduates from associated post-secondary education programs, we are able to identify potential gaps between the two.

CVOW Project

As mentioned earlier, the employment estimates associated with Dominion Energy's CVOW project provide a near-term estimate of employment from offshore wind energy development in Hampton Roads. The data presented in this portion of the analysis identify potential gaps between the threshold employment necessary to meet those employment needs (while still accounting for the ongoing training requirements of existing industries in Hampton Roads), and the pipeline of graduates from associated post-secondary education programs within the region.

As with the employment estimates themselves, we present these data for each of the four phases of the CVOW project's development:

- Development – expected to take place between 2020 to 2022 (*see* Table 6).
- Manufacturing – expected to take place between 2023 to 2025 (*see* Table 7).
- Installation – expected to take place between 2024 to 2026 (*see* Table 8).
- Operations and Maintenance – from 2027 on (*see* Table 9).

$GCIP_i$ = graduates from instructional program i

$\sum Gcip_{ij}$ = graduates from all instructional program(s) i related to occupation j

[15] The institutions included in this analysis are: Advanced Technology Institute, Altierus Career College, Aviation Institute of Maintenance, Bethel College, Bryant and Stratton College – Hampton, Bryant and Stratton College – Virginia Beach, Central School for Practical Nursing, Centura College – Chesapeake, Centura College – Newport News, Centura College – Norfolk, Centura College – Virginia Beach, Christopher Newport University, Eastern Virginia Medical School, ECPI University, Fortis College, Hampton University, Norfolk State University, Old Dominion University, Paul D. Camp Community College, Rappahannock Community College, Regent University, Riverside College of Health Careers, Rudy and Kelly Academy, Sentara College of Health Sciences, South University – Virginia Beach, The Art Institute of Virginia Beach, Thomas Nelson Community College, Tidewater Community College, Tidewater Tech Trades, Virginia Beach Theological Seminary, Virginia Wesleyan University, Wave Leadership College, and William and Mary.

In the tables that follow:

- *Current Average Annual Openings* is the projected number of average annual openings in the associated occupation from growth and turnover in existing industries in Hampton Roads.
- *Estimated OSW Emp.* is our estimate of the additional employment in this occupation that will be necessary to meet the staffing needs of the offshore wind energy industry in Hampton Roads.
- *Threshold Training Demand* is the total of the preceding two, or the total number of trained workers that will be required to meet the regional needs of existing industries and the offshore wind energy industry.
- *Education Req.* is the level of educational attainment typically required for employment in this occupation.
- *Certs. < 4yrs.* is the likely number of certificates of less than four years awarded annually in the region.
- *Assoc.* is the likely number of two-year Associates degrees awarded annually in the region.
- *BA* is the likely number of four-year Baccalaureate degrees awarded annually in the region.
- *MA* is the likely number of Masters degrees awarded annually in the region.
- *Doctoral* is the likely number of Doctoral and First Professional degrees awarded annually in the region.
- *Total Graduates* is the total number of certificates and/or degrees likely awarded annually in the region.
- *Gap* is the shortfall between the likely annual number of completers in associated postsecondary education training programs in the region and the likely occupation-driven demand for those trained workers.

Development Phase

As the data shown in Table 6 indicate, the largest potential shortages of trained workers during this phase of the CVOW project are anticipated to be in the following occupations:

- Heavy and Tractor-Trailer Truck Drivers
- Electricians

Manufacturing Phase

As the data shown in Table 7 indicate, the largest potential shortages of trained workers during this phase of the CVOW project are anticipated to be in the following occupations:

- Maintenance and Repair Workers, General
- Heavy and Tractor-Trailer Truck Drivers
- Light Truck or Delivery Services Drivers
- Financial Managers
- Electricians
- Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products

Installation Phase

As the data shown in Table 8 indicate, the largest potential shortages of trained workers during this phase of the CVOW project are anticipated to be in the following occupations:

- Maintenance and Repair Workers, General
- Heavy and Tractor-Trailer Truck Drivers
- Light Truck or Delivery Services Drivers
- Financial Managers
- Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products
- Electricians
- Aircraft Mechanics and Service Technicians

Operations and Maintenance Phase

As the data shown in Table 9 indicate, the largest potential shortages of trained workers during this phase of the CVOW project are anticipated to be in the following occupations:

- Maintenance and Repair Workers, General
- Heavy and Tractor-Trailer Truck Drivers
- Light Truck or Delivery Services Drivers
- Financial Managers
- Financial Specialists, All Other
- Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products
- Training and Development Specialists
- Operations Research Analysts
- Loan Officers
- Electricians
- Aircraft Mechanics and Service Technicians

Table 6: Workforce Training Gaps – CVOW Development Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Heavy and Tractor-Trailer Truck Drivers	102	1	103	HS	52					52	51
Electricians	39	3	42	Cert	15	11				27	15
Accountants and Auditors	167	1	168			4	130	98		232	0
General and Operations Managers	153	3	155	Assoc		93	251	186	3	535	0
Management Analysts	136	2	138	BA		83	177	96	2	359	0
Software Developers, Applications	94	1	94	BA		20	132			152	0
Human Resources Specialists	87	1	87	BA		8	22	70	72	172	0
First-Line Supervisors of Office and Administrative Support Workers	79	1	80	HS	1	34	63			98	0
Electrical and Electronics Engineering Technicians	75	1	76		83	145	105			333	0
Mechanical Engineers	73	2	75	BA			100			100	0
Engineers, All Other	57	1	58		4	97	21	187	27	336	0
Computer Systems Analysts	46	1	46	Assoc	16	41	42	33	6	138	0
Lawyers	40	4	44	Doc					251	251	0
Market Research Analysts and Marketing Specialists	41	1	42	BA			62			62	0
Paralegals and Legal Assistants	39	2	41	BA	55	58	13			126	0
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	39	1	40		167	18				185	0
Software Developers, Systems Software	38	1	39	BA		8	67	2		77	0
First-Line Supervisors of Construction Trades and Extraction Workers	32	2	34	HS	32	9				41	0
Civil Engineers	27	5	31	BA			48			48	0
Electrical Engineers	26	1	27	BA			29	4		33	0

Table 6: Workforce Training Gaps – CVOW Development Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Cost Estimators	17	1	18	BA		11	51	13		75	0
Construction Managers	11	1	13	BA		8	19	9		35	0
Civil Engineering Technicians	11	1	12	Cert		9	2			11	0
Architectural and Engineering Managers	9	1	11	BA	1	18	51	45	10	125	0

**May not sum due to rounding.*

Table 7: Workforce Training Gaps – CVOW Manufacturing Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Maintenance and Repair Workers, General	135	1	136	HS	69					69	67
Heavy and Tractor-Trailer Truck Drivers	102	4	106	HS	53					53	53
Light Truck or Delivery Services Drivers	103	1	104	HS	51					51	52
Financial Managers	66	1	66				23			23	44
Electricians	39	18	57	Cert	16	12				27	30
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	37	1	38	BA			9			9	29
First-Line Supervisors of Construction Trades and Extraction Workers	32	16	48	HS	38	10				47	1
Accountants and Auditors	167	1	169			4	130	98		232	0
General and Operations Managers	153	6	158	Assoc		94	252	187	4	537	0
First-Line Supervisors of Office and Administrative Support Workers	79	1	80	HS	1	34	63			98	0

Table 7: Workforce Training Gaps – CVOW Manufacturing Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Welders, Cutters, Solderers, and Brazers	55	2	57		211	8				219	0
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	39	8	48		167	18				185	0
Civil Engineers	27	1	28	BA			48			48	0
Cost Estimators	17	4	22	BA		13	60	15		88	0
Construction Managers	11	8	19	BA		11	27	13		52	0

**May not sum due to rounding.*

Table 8: Workforce Training Gaps – CVOW Installation Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Maintenance and Repair Workers, General	135	2	136	HS	71					71	65
Heavy and Tractor-Trailer Truck Drivers	102	10	112	HS	54					54	58
Light Truck or Delivery Services Drivers	103	1	104	HS	51					51	54
Financial Managers	66	1	66				23			23	44
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	37	1	38	BA			9			9	29
Electricians	39	12	51	Cert	16	12				27	24
Aircraft Mechanics and Service Technicians	55	4	59	Cert	42					42	17
Managers, All Other	363	1	364		48	1,015	2,486	423	56	4,028	0
Accountants and Auditors	167	1	169			4	130	98		232	0

Table 8: Workforce Training Gaps – CVOW Installation Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
General and Operations Managers	153	6	159	Assoc		94	254	188	4	540	0
Human Resources Specialists	87	1	87	BA		8	22	70	72	172	0
First-Line Supervisors of Office and Administrative Support Workers	79	3	81	HS	1	34	63			98	0
Automotive Service Technicians and Mechanics	61	1	61		228	41				268	0
Welders, Cutters, Solderers, and Brazers	55	1	56		211	8				219	0
Bus and Truck Mechanics and Diesel Engine Specialists	44	1	45	HS	53	12				64	0
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	39	5	45		167	18				185	0
First-Line Supervisors of Construction Trades and Extraction Workers	32	10	42	HS	35	10				45	0
Market Research Analysts and Marketing Specialists	41	1	41	BA			62			62	0
Civil Engineers	27	1	28	BA			47			47	0
Cost Estimators	17	3	20	BA		12	56	14		83	0
Construction Managers	11	5	16	BA		10	23	11		45	0
Transportation, Storage, and Distribution Managers	9	1	10		1	6	23	12		42	0

**May not sum due to rounding.*

Table 9: Workforce Training Gaps – Operations and Maintenance Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Maintenance and Repair Workers, General	135	10	144	HS	74					74	70
Heavy and Tractor-Trailer Truck Drivers	102	11	113	HS	54					54	59
Light Truck or Delivery Services Drivers	103	4	107	HS	51					51	56
Financial Managers	66	6	71				23			23	48
Financial Specialists, All Other	67	1	67				21			21	46
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	37	7	44	BA			9			9	35
Training and Development Specialists	33	2	35	BA		3				3	32
Operations Research Analysts	46	1	47	MA				17		17	30
Loan Officers	36	1	37	BA			12			12	26
Electricians	39	6	45	Cert	15	11				27	18
Aircraft Mechanics and Service Technicians	55	3	58	Cert	42					42	16
Bookkeeping, Accounting, and Auditing Clerks		13	13	HS		1				1	11
Human Resources Managers	9	2	11	BA		1				1	10
Financial Analysts	9	3	12	BA			4			4	8
Registered Nurses	388	1	389	Assoc	62	543	619	80	34	1,337	0
Managers, All Other	363	4	367		48	1,011	2,476	416	56	4,008	0
Accountants and Auditors	167	9	176			4	130	99		233	0
General and Operations Managers	153	19	171	Assoc		98	263	194	4	560	0
Management Analysts	136	4	140	BA		80	172	93	2	347	0
Software Developers, Applications	94	3	97	BA		19	131			150	0
Human Resources Specialists	87	4	91	BA		8	22	71	72	173	0

Table 9: Workforce Training Gaps – Operations and Maintenance Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
First-Line Supervisors of Office and Administrative Support Workers	79	8	87	HS	1	34	63			98	0
Mechanical Engineers	73	2	76	BA			100			100	0
Welders, Cutters, Solderers, and Brazers	55	19	74		209	8				217	0
Automotive Service Technicians and Mechanics	61	2	63		228	41				268	0
Engineers, All Other	57	1	58		4	97	21	188	27	337	0
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	39	11	50		167	18				185	0
Bus and Truck Mechanics and Diesel Engine Specialists	44	5	50	HS	53	12				65	0
Computer Systems Analysts	46	4	50	Assoc	16	40	42	32	6	135	0
Medical and Health Services Managers	48	1	48	BA		4	196	45		245	0
Market Research Analysts and Marketing Specialists	41	4	45	BA			59			59	0
Lawyers	40	1	41	Doc					251	251	0
Software Developers, Systems Software	38	1	40	BA		8	65	2		75	0
First-Line Supervisors of Construction Trades and Extraction Workers	32	5	37	HS	32	9				41	0
Coaches and Scouts	36	1	36	BA			107	18		125	0
Food Service Managers	33	1	33	<HS	50	10	36			96	0
Electrical and Electronics Repairers, Commercial and Industrial Equipment	30	3	33	Assoc	7	32				39	0
Medical Records and Health Information Technicians	31	1	31	HS	9	46				54	0

Table 9: Workforce Training Gaps – Operations and Maintenance Phase

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Electronics Engineers, Except Computer	29	1	30	BA			32	5		37	0
Network and Computer Systems Administrators	26	2	28	BA	9	136	103	39	3	290	0
Civil Engineers	27	1	27	BA			46			46	0
Electrical Engineers	26	1	27	BA			29	4		33	0
Information Security Analysts	26	1	26	BA		127	92	19		238	0
Computer and Information Systems Managers	19	3	22	BA	7	108	262	32	2	411	0
Cost Estimators	17	2	19	BA		11	53	13		77	0
Computer Network Support Specialists	13	1	14			68	49	10		128	0
Construction Managers	11	2	14	BA		8	19	9		36	0
Graphic Designers	13	1	13	BA	15	45	5			65	0
Public Relations Specialists	13	1	13	BA			136	19	13	168	0
Computer Network Architects	12	1	13		4	65	52	18	2	141	0
Database Administrators	12	1	13	BA	4	10	46	17	1	78	0
Administrative Services Managers	10	2	12	BA		7	15	8		30	0
Sales Managers	9	3	12	BA		7	30	8		45	0
Transportation, Storage, and Distribution Managers	9	2	11		1	7	24	13		44	0
Architectural and Engineering Managers	9	1	10	BA	1	17	51	45	10	124	0

**May not sum due to rounding.*

1 GW Scenario

The 1 GW scenario is intended to provide a long-term estimate of employment from offshore wind energy development in Hampton Roads should the region develop into a major offshore wind energy hub with a well-established supply chain to support the offshore wind energy industry. The data presented in this portion of the analysis identify potential gaps between the threshold employment necessary to meet those employment needs (while still accounting for the ongoing training requirements of existing industries in Hampton Roads), and the pipeline of graduates from associated post-secondary education programs within the region.

As the data shown in Table 10 indicate, the largest potential shortages of trained workers in the 1 GW scenario are anticipated to be in the following occupations:

- Engineering Technicians, Except Drafters, All Other
- Maintenance and Repair Workers, General
- Heavy and Tractor-Trailer Truck Drivers
- Light Truck or Delivery Services Drivers
- Electricians
- Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products
- Financial Managers
- Training and Development Specialists
- Bookkeeping, Accounting, and Auditing Clerks
- First-Line Supervisors of Construction Trades and Extraction Workers
- Aircraft Mechanics and Service Technicians
- Marketing Managers

Table 10: Workforce Training Gaps – 1 GW Scenario

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Engineering Technicians, Except Drafters, All Other	227	1	228			2				2	226
Maintenance and Repair Workers, General	135	16	151	HS	61					61	89
Heavy and Tractor-Trailer Truck Drivers	102	40	142	HS	56					56	85
Light Truck or Delivery Services Drivers	103	28	131	HS	52					52	79
Electricians	39	60	99	Cert	16	12				27	72
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	37	33	70	BA			9			9	61
Financial Managers	66	3	68				23			23	45
Training and Development Specialists	33	2	35	BA		3				3	32
Bookkeeping, Accounting, and Auditing Clerks	x	33	33	HS		2				2	31
First-Line Supervisors of Construction Trades and Extraction Workers	32	55	87	HS	49	10				60	28
Aircraft Mechanics and Service Technicians	55	6	61	Cert	42					42	19
Marketing Managers	5	59	64	BA			47			47	17
Market Research Analysts and Marketing Specialists	41	7	47	BA			35			35	12
Bus Drivers, Transit and Intercity	19	1	20	HS	8					8	12
Human Resources Managers	9	3	12	BA		1				1	11
Security and Fire Alarm Systems Installers	8	2	10	HS	2	1				3	7
Financial Analysts	9	1	10	BA			3			3	7
Architects, Except Landscape and Naval	7	5	12	MA				9		9	2

Table 10: Workforce Training Gaps – 1 GW Scenario

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
First-Line Supervisors of Office and Administrative Support Workers	79	21	100	HS	1	34	63			98	2
Civil Engineering Technicians	11	2	13	Cert		9	2			11	2
First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	10	1	10	HS	6	6				13	0
Interpreters and Translators	13	3	15	BA	6		12			18	0
Electrical Engineers	26	4	30	BA			30	4		35	0
Electronics Engineers, Except Computer	29	1	31	BA			31	4		36	0
Electrical and Electronics Repairers, Commercial and Industrial Equipment	30	1	32	Assoc	7	32				39	0
Mechanical Engineers	73	7	80	BA			89			89	0
Civil Engineers	27	12	39	BA			53			53	0
Bus and Truck Mechanics and Diesel Engine Specialists	44	4	48	HS	53	12				65	0
Cooks, Institution and Cafeteria	36	1	37	<HS	11	43				54	0
Administrative Services Managers	10	7	17	BA		10	20	11		42	0
Social and Community Service Managers	10	1	11	BA		6	18	13		38	0
Education Administrators, All Other	7	27	34					27	38	65	0
Software Developers, Systems Software	38	2	41	BA		8	67	2		77	0
Transportation, Storage, and Distribution Managers	9	5	14		1	8	27	15		51	0
Graphic Designers	13	2	15	BA	15	43	5			63	0
Software Developers, Applications	94	3	96	BA		19	131			150	0
Accountants and Auditors	167	11	179			4	131	99		234	0

Table 10: Workforce Training Gaps – 1 GW Scenario

Occupation	Current Average Annual Openings	Estimate OSW Emp.	Threshold Training Demand	Educ. Req.	Certs. <4yrs.	Assoc.	BA	MA	Doctoral	Total Graduates	GAP*
Human Resources Specialists	87	5	92	BA		8	22	71	73	173	0
Computer Systems Analysts	46	2	48	Assoc	16	40	41	32	6	135	0
Cost Estimators	17	18	36	BA		20	87	23	1	132	0
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	39	30	69		167	18				185	0
Computer Network Support Specialists	13	1	14			70	50	10		131	0
Computer Network Architects	12	1	13		4	66	52	19	2	143	0
Welders, Cutters, Solderers, and Brazers	55	28	83		207	8				215	0
Public Relations Specialists	13	1	14	BA			137	19	13	168	0
Automotive Service Technicians and Mechanics	61	2	63		228	41				268	0
Management Analysts	136	2	139	BA		80	170	92	2	344	0
Electrical and Electronics Engineering Technicians	75	2	77		83	145	105			333	0
Network and Computer Systems Administrators	26	3	29	BA	10	143	108	41	3	305	0
Engineers, All Other	57	2	59		4	99	22	191	28	344	0
General and Operations Managers	153	5	158	Assoc		91	246	184	3	524	0

**May not sum due to rounding.*

Offshore Wind Energy Workforce Credentials

Although the gap analysis presented in the previous section is an important and useful tool for identifying significant gaps between the occupation-driven demand for trained workers and the pipeline of graduates available to meet that demand, it is important to realize that as with any tool, it has limitations. In particular, it is constrained by the U.S. Bureau of Labor Statistic's *Standard Occupational Classification* (SOC) codes and the U.S. Department of Education's *Classification of Instructional Programs* (CIP) codes. These codes are inherently backward looking and may not adequately capture the occupations and required instructional programs associated with rapidly evolving industries such as offshore wind energy. In addition, the classification of instruction at a program level can obscure differences in credentialing requirements, such as the credentialing requirements associated with different types of welding applications.

For those reasons, in this section we look at specific credentialling issues that may arise between existing training programs and the established needs of the offshore wind energy industry, as well as initiatives that have already been undertaken to address those issues.

Industry Credentials

In this portion of the section, we provide a listing of key workforce credentials that are specific to the offshore wind energy industry.

Safety Training

Working offshore presents a challenging environment and numerous hazards. The installation process involves massive equipment and turbine components that increase in size with every newer model. On top of this, the weather conditions offshore can be harsh and constantly changing. For this reason, the major European developers and manufacturers for the wind industry established the Global Wind Organization (GWO), which sets basic training and safety standards for the industry. Developers and turbine manufacturers typically provide additional technology-specific training, but they require their installation and operations and maintenance workers to have already completed the GWO's Basic Safety Training.[16] This training consists of five modules: first aid, manual handling, fire awareness, working at heights, and sea survival.[17]

Currently, there are 14 GWO training providers within the United States, but none are located in the Northeast or Mid-Atlantic. Siemens Gamesa operates a training center in Florida, but it does not include the sea survival module that offshore developers require. Recognizing this unmet opportunity, BEI Maritime plans to construct a maritime training center in Currituck, North Carolina, just south of

[16] Massachusetts Clean Energy Center, "2018 Massachusetts Offshore Wind Workforce Assessment."
[17] https://www.globalwindsafety.org/standards/basic-safety-training-standard

Hampton Roads. The facility would provide training targeted towards the offshore wind industry and become the first training provider on the East Coast to satisfy the GWO's requirements for offshore wind. According to its website, BEI plans to open its facility for business in spring 2021.[18]

For now, there are a handful of educational institutions in Virginia that provide maritime safety training, but none offer specialized training for the offshore wind industry. The Mid-Atlantic Maritime Academy in Norfolk and the Chesapeake Marine Training Institute in Hayes offer maritime training and engineering courses certified under the guidelines of the U.S. Coast Guard. Both provide Standards of Training, Certification, and Watchkeeping (STCW) basic safety courses, which are required for anyone working on a commercial vessel in the United States.

Welding

Because of Virginia's well-established shipbuilding industry, the state has developed a strong network of technical training schools, high school trade programs, and community college programs that provide training and certification for welding. The Advanced Technology Institute in Hampton Roads, for example, prepares students to earn at least one of six certifications acknowledged by the American Welding Society.[19] However, welding requirements differ between the shipbuilding and offshore wind industries. According to a report by BVG Associates produced for the Virginia Department of Mines, Minerals, and Energy, Virginia's training providers will need to partner with developers and operations and maintenance contractors in order to create an adequate training curriculum.[20]

In Maryland, the Offshore Wind Workforce Training Program provides grant funding to training centers associated with the offshore wind industry. For instance, the College of Southern Maryland offers an offshore wind training program for certified structural welders, and the Maryland Energy Administration provides grants to cover tuition, fees, and books for up to 50 students who enroll in the program.[21] In addition, AIS Training announced in early 2020 that it signed a deal with welding specialist ARCON to develop an offshore wind training center in Salisbury, Maryland. The center will train offshore wind workers in essential skills based on the GWO's internationally approved standards.[22]

CNC Machining

Computer numerical control machining, or CNC machining, is a manufacturing process where computer software dictates the movement of the machinery to manufacture goods quickly and with high precision. In the offshore wind industry, CNC machining is used in the manufacture of blades, towers, and foundations.

[18] http://beimaritime.com/#maritime
[19] https://auto.edu/programs/maritime-welding/
[20] BVG Associates, "The Virginia Advantage: The roadmap for the offshore wind supply chain in Virginia," December 2018.
[21] https://www.csmd.edu/programs-courses/non-credit/career-development/construction-and-skilled-trades/welding-grant
[22] https://www.renewableenergyworld.com/2020/01/03/new-offshore-wind-training-center-coming-to-maryland/

Due to Virginia's large shipping industry, many of the state's community colleges and technical institutes offer training and certification for precision machining. In Hampton Roads, Thomas Nelson Community College offers its Precision Machining Computer Numerical Controls Certificate[23], and Southside Virginia Community College offers its Precision Machining Career Studies Certificate.[24]

Composites Manufacturing

The rotor blades used in offshore wind turbines are manufactured from composite materials, most often fiberglass and polyester. According to BVG's report "The Virginia Advantage," 75 percent of the jobs related to blade production in Virginia would require Certified Composites Technician (CCT) training. CCT training is offered through the American Composites Manufacturing Association (ACMA), based in Arlington. Those seeking certification must choose a program, study the course materials, and pass a final exam.

The ACMA website provides a directory of its certified experts.[25] A total of 668 certified technicians are listed in the directory. Most reside in the United States, but others work in Canada, Mexico, Columbia, Denmark, and France; six technicians are based in Virginia. Most of the technicians certified in wind blade repair are based in the Midwest, servicing the region's growing onshore wind industry.

Current Initiatives to Address Offshore Wind Energy Credentials

In October 2020, Governor Ralph Northam announced the formation of Virginia's first wind workforce training collaborative, called the Mid-Atlantic Wind Training Alliance. The program is aimed at providing technicians the training and certifications required by the onshore and offshore wind industries. The Alliance will consist of the New College Institute, serving as the host institution, as well as Centura College and the Mid-Atlantic Maritime Academy. Together, these educational institutions will provide courses certified by the Global Wind Organization (GWO) and the National Center for Construction, Education, and Research. The Alliance plans to start offering programs in early 2021.

Each of the three educational institutions bring unique advantages to the Alliance:

- Starting January 2021, the New College Institute will offer a GWO-certified Basic Safety Training course. The course will provide training in four of the five modules that make up the GWO's Basic Safety Training course: first aid, fire awareness, working at heights, and manual handling (course does not include sea survival). [26] The New College Institute will also offer GWO-certified Basic Technical Training in Mechanical, Electrical, and Hydraulic skills.[27]
- Centura College has seven education centers across eastern Virginia, including Tidewater Tech, which hosts the largest welding training center in the Commonwealth. Specialized training in

[23] https://tncc.edu/programs/precision-machining-computer-numerical-controls-cnc-certificate
[24] http://catalog.southside.edu/preview_program.php?catoid=8&poid=744&returnto=825
[25] https://acmanet.org/certified-composites-technician/#cct-directory-anchor-link
[26] https://newcollegeinstitute.org/gwo-training/gwo-basic-safety-training/
[27] https://nci-ecom.paradisolms.net/product/basic-technical-training/

welding is critical for the manufacturing of offshore wind foundations, both in the production of the main lattice work and the transition piece.[28] Centura College also currently offers a Wind Turbine Technician program "providing students with the technical skills to install, maintain, and repair wind turbines."[29]

- The Mid-Atlantic Maritime Academy is the largest training center for U.S. Coast Guard certifications. The institution offers over 90 deck and engineering courses certified by the U.S. Coast Guard that are essential to the safe operation of maritime vessels.[30] The Mid-Atlantic Maritime Academy also provides STCW basic safety courses, which are required for anyone working on a commercial vessel in the United States.

Conclusion

In this report, we have built upon the employment impact projections provided in our earlier *Potential Impact of Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia* report to provide an estimate of the near-term and long-term workforce needs of the offshore wind energy industry in Hampton Roads. There are at least three key findings that emerged from that analysis.

First, the "lockdowns" of economic activity imposed by executive order of the governor in response to the Covid19 pandemic had a devastating impact on the economy Hampton Roads. Of particular importance is the fact that, in addition to high unemployment, Hampton Roads has experienced a significant and ongoing decrease in the overall size of its labor force.

Looking forward, that decrease has important implications for filling future offshore wind energy jobs. It means that the regional labor pool available to fill those positions will likely be smaller than what it was even as recently as 2019. In addition, it will likely exacerbate an already existing issue, which is that at least some of the skill sets required to staff those positions do not already exist in the region and will have to be recruited from outside of Virginia – most likely from Europe, which is currently the leader in offshore wind energy development, or the Gulf states, where there are many workers in the offshore oil industry who possess similar skill sets.

Second, a comparison of the likely near-term and long-term demand for offshore wind energy workers in Hampton Roads, with the supply of trained workers in terms of the pipeline of graduates from associated postsecondary education and training programs in Hampton Roads, shows that there may be potential training shortfalls associated with certain occupations. Most particularly: Maintenance and Repair Workers, General; Heavy and Tractor-Trailer Truck Drivers; Light Truck or Delivery Services Drivers; Electricians, Aircraft Mechanics and Service Technicians; Training and Development Specialists; and Operations Research Analysts.

[28] BVG Associates, "The Virginia Advantage: The roadmap for the offshore wind supply chain in Virginia," p. 28
[29] https://www.centuracollege.edu/programs/wind-turbine-technician-diploma/
[30] https://mamatrains.com/deck-courses/

Third, there are significant and specific credentialing requirements for many occupations within the offshore wind energy industry that differ from those required by existing industries, and offered through existing training programs, in Hampton Roads. In particular, this applies to: safety training, welding, CNC machining, and composites manufacturing. As a result, initiatives such as the recently announced Mid-Atlantic Wind Training Alliance, which is intended to develop a pipeline of certified workers to serve the wind energy industry through programs offered at the New College Institute, Centura College, and the Mid-Atlantic Maritime Academy, will be critical to the future growth and development of the offshore wind energy industry in Hampton Roads.