



**POTENTIAL  
IMPACT OF THE  
DEVELOPMENT  
OF THE  
OFFSHORE  
WIND ENERGY  
INDUSTRY ON  
HAMPTON  
ROADS AND  
VIRGINIA**



4201 DOMINION BLVD, SUITE 114  
GLEN ALLEN, VA 23060  
804-346-8446

[MANGUMECONOMICS.COM](http://MANGUMECONOMICS.COM)

© 2020 MANGUM ECONOMICS

SEPTEMBER 28, 2020

HAMPTON ROADS  
**ALLIANCE**  **E**



## Table of Contents

Executive Summary.....	1
Dominion Energy’s Virginia Offshore Wind Development .....	2
Coastal Virginia Offshore Wind Pilot.....	2
Commercial Coastal Virginia Offshore Wind Development.....	2
Overview of This Report .....	3
Impact of Dominion Energy’s Commercial Offshore Wind Energy Project .....	4
Commercial Offshore Wind Development Expenditures .....	4
Commercial Offshore Wind Development Impacts.....	5
Development Phase Impacts .....	5
Manufacturing Phase Impacts .....	8
Installation Phase Impacts .....	10
Operations and Maintenance Phase Impacts.....	12
Summary of Impacts of Dominion Energy’s Commercial CVOW .....	13
Potential Market for an Offshore Wind Energy Cluster in Hampton Roads.....	16
Overview of East Coast Offshore Wind Developments .....	16
Development of the Offshore Wind Energy Industry in Northern Europe.....	17
Potential Impact of One Gigawatt of Annual Offshore Wind Activity in Hampton Roads .....	20
Conclusion.....	23
Appendix -- Methods for Analysis.....	25
Hampton Roads.....	25
Input-Output Modeling.....	26



## 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 Henrico County.

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:

- *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.

### The Project Team

David Zorn, Ph.D.  
*Economist*

Nick Norboge, Ph.D.  
*Consultant*

A. Fletcher Mangum, Ph.D.  
*Founder and CEO*

Alexander Nikolov  
*Research Assistant*

## Executive Summary

---

In this report, we assess the economic and fiscal contribution that the construction and operation of Dominion Energy's 2.6 gigawatt commercial Coastal Virginia Offshore Wind project will make to Hampton Roads and to the Commonwealth of Virginia as a whole.

We estimate that, with the roughly \$8 billion of direct investment of Dominion Energy and up to a \$40 million contribution from the State of Virginia for site improvement and readiness at the Portsmouth Marine Terminal, from 2020 through the end of 2026, the project will support about

- 900 direct and indirect Virginia jobs annually (about 60 percent in Hampton Roads), with almost
- \$57 million in pay and benefits, and over
- \$143 million in economic output, generating almost
- \$2 million in revenues for local governments in the Hampton Roads area, and an additional
- \$3 million in Virginia state tax revenues.

This is a reasonable but conservative estimate of the impact. In time, it may prove to be a significant underestimate, if the project attracts new businesses to Hampton Roads or Virginia in order to participate in the offshore wind energy supply chain. Future updates of this report would reflect these additions to the Hampton Roads and Virginia economies.

Beginning in 2027, once construction is completed, we estimate that the annual operation and maintenance of the facility will support over

- 1,100 direct and indirect jobs annually in Hampton Roads, with almost
- \$82 million in pay and benefits, and almost
- \$210 million in economic output, generating almost
- \$6 million in revenues for local governments in the Hampton Roads area, and an additional
- \$5 million in Virginia state tax revenues.

Given the advantages that the port areas in Hampton Roads offer, in time, it is reasonable to anticipate that new businesses will locate in Hampton Roads to serve a growing offshore wind energy industry. If, during the early development of the industry in the United States over the next several years, businesses in Hampton Roads develop industry-specific expertise and manufacturing businesses in the industry supply chain locate in the area, then we estimate that for every one gigawatt of new offshore wind energy development that Hampton Roads businesses service, there will be about

- 5,200 direct and indirect Virginia jobs annually (almost all in Hampton Roads), with about
- \$270 million in pay and benefits, and about
- \$740 million in economic output, generating about
- \$21 million in revenues for local governments in the Hampton Roads area, and an additional
- \$18 million in Virginia state tax revenues.

## Dominion Energy's Virginia Offshore Wind Development

---

Dominion Energy's development of offshore wind energy near Virginia is proceeding in two phases – an initial 12-megawatt pilot project and a subsequent 2.6-gigawatt large-scale commercial project.

### COASTAL VIRGINIA OFFSHORE WIND PILOT

In August of 2018, Dominion Energy filed with the Virginia State Corporation Commission for approval to build two 6 megawatt (MW) offshore wind turbines, 27 miles off the coast of Virginia Beach, on a 2,135-acre tract of federal waters leased from the U.S. Bureau of Ocean Energy Management by the Virginia Department of Mines, Minerals, and Energy. The project was subsequently approved by the State Corporation Commission that following November.

Dominion Energy's 12 MW Coastal Virginia Offshore Wind (CVOW) pilot is only the second offshore wind project to be built in the U.S. The first was the 30 MW Block Island offshore wind project which began operation in 2016 and is located just four miles off the coast of Rhode Island. However, the CVOW pilot is the first offshore wind project to be constructed in federal waters and the first to be owned by an electric utility.

Dominion Energy contracted with Ørsted for the design and construction of the CVOW pilot and L. E. Myers for the onshore electrical construction. The foundations were manufactured by EEW and installed in May of 2020, while the two turbines were manufactured by Siemens Gamesa and installed in June of 2020. After subsequent commissioning and testing it is anticipated that the CVOW pilot will become fully operational in the fall of 2020.

As a first of its kind project, the primary purpose of the CVOW pilot is to enable Dominion Energy to develop the expertise in permitting, design, installation, and operations that will be critical to the build-out of offshore wind energy off Virginia at a much larger scale.

### COMMERCIAL COASTAL VIRGINIA OFFSHORE WIND DEVELOPMENT

Building on the experience gained from the CVOW pilot, in September of 2019, Dominion Energy filed an interconnection request with PJM Interconnection for a commercial-scale offshore wind project. The commercial project would bring an additional 2.6 gigawatt (GW) of offshore wind energy online. This project would be located 27 miles off the coast of Virginia Beach, on an 112,800-acre tract leased from the U.S. Bureau of Ocean Energy Management that is adjacent to the CVOW pilot. If approved, this commercial CVOW project would be the largest offshore wind installation in the United States.

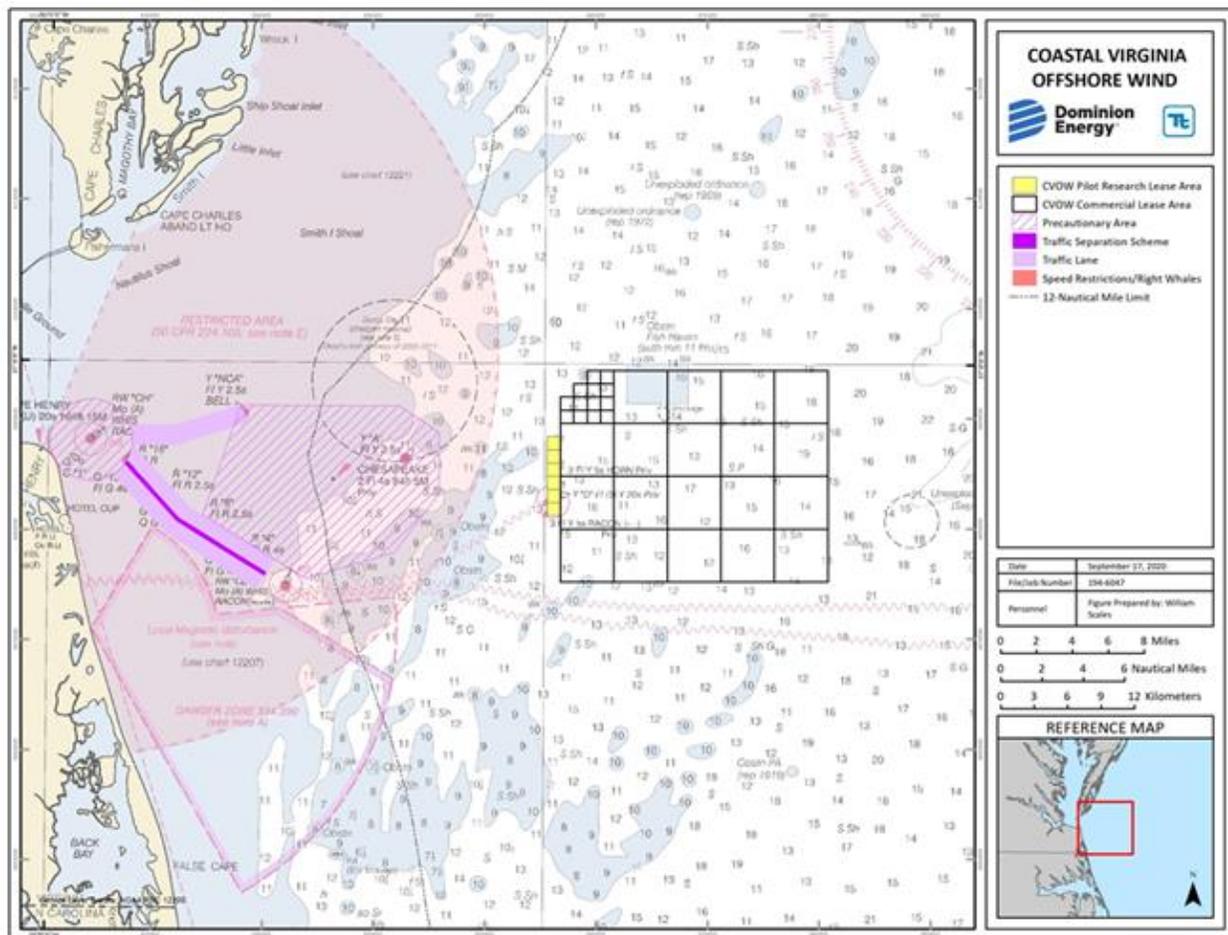
Siemens Gamesa has been provisionally selected to provide the turbines for the project and Ramboll has been designated as the owner's engineer. As currently envisioned, the project will include about 200 turbines and will produce enough electricity to power 660,000 homes. Development work has already begun and should be largely concluded by the end of 2022. Manufacturing of all of the structures and



equipment for the project will largely occur from 2023 to 2025; and, pending approval, installation of the wind farm and other structures is expected to commence in 2024 and reach completion in 2026. These timeframes are rough and general. The phases can and do overlap and may move forward or backward as circumstances unfold.

Figure 1 depicts the lease areas for both the CVOW pilot and the commercial CVOW project.

Figure 1: Lease Areas for Dominion Energy’s Offshore Wind Energy Developments



## OVERVIEW OF THIS REPORT

In this report, we first estimate the impact that the construction and operation of Dominion Energy’s 2.6 GW commercial CVOW project will have on the economies of Hampton Roads and of Virginia. Then, we estimate the impact on the Hampton Roads and Virginia economies if Hampton Roads develops a cluster of businesses that serve the offshore wind energy industry.

## Impact of Dominion Energy's Commercial Offshore Wind Energy Project

---

We have estimated the potential economic and fiscal impact on Hampton Roads and Virginia caused by Dominion Energy's 2.6 GW commercial CVOW. Our estimate shows the impact of the project on the economies of Hampton Roads and Virginia as they were structured in 2018 (the most recent year for which data are available).

This represents the smallest impact that the development of offshore wind energy could have on Hampton Roads and Virginia. The development of other offshore wind projects served by Hampton Roads or Virginia businesses would increase the impact over the baseline scenario, as would the development of new businesses in the offshore wind energy supply chain in Hampton Roads or Virginia.

Our expectation that most spending will go to businesses outside of Virginia is based on the lack of announced offshore wind supply chain investments made at the time of this report. Thus, our estimate is a reasonable but conservative estimate of the impact. In time, it may prove to be a significant underestimate, if the project attracts new businesses to Virginia in order to participate in the offshore wind energy supply chain. Dominion Energy's procurement activities, the requirements of the Virginia Clean Economy Act of 2020, and the efforts of the Hampton Roads Alliance and the Virginia Economic Development Partnership (among others) are coordinated to grow the offshore wind energy supply chain in Virginia. Future updates of this report will reflect those additions to the Hampton Roads and Virginia economies.

### COMMERCIAL OFFSHORE WIND DEVELOPMENT EXPENDITURES

For this project, Mangum Economics made independent, proprietary estimates of the expenditures needed to develop, construct, commission, operate, and maintain Dominion Energy's commercial CVOW project. Our estimates are based primarily on offshore wind energy industry cost information from the United Kingdom (U.K.), the country with the most installed offshore wind capacity in the world.

As of September 2020, Dominion Energy is still early in the process of negotiating contracts with suppliers that will affect the costs of the project. The utility could not responsibly provide us with detailed cost estimates for the project for the purposes of this report while it is in the process of negotiating important contracts. Our proprietary cost estimates are to a degree informed by some details about the commercial CVOW development that Dominion Energy provided to us on a confidential basis. However, Dominion Energy made no attempt to influence or adjust our estimates.

Table 1 shows how our cost estimates break down across the three initial phases of the project (development, manufacturing, and installation) and the two aspects of annual activity (operations and maintenance).

Table 1: Estimated Expenditures for Dominion Energy’s 2.6 GW Offshore Wind Project (2020 dollars)

Stage of Development and Operation	Expenditures
Development	\$464,300,000
Manufacturing	\$6,179,300,000
Installation	\$1,739,100,000
<b>Total One-time Initial Expenditures</b>	<b>\$8,382,700,000</b>
Annual Operations	\$63,200,000
Annual Maintenance	\$68,400,000
<b>Total On-going Annual Expenditures</b>	<b>\$131,600,000</b>

Our proprietary, independent estimate of the total cost of Dominion Energy’s commercial CVOW development is \$8.4 billion by the time of completion in 2026. For comparison, Dominion Energy’s early estimate of the initial cost of the project is \$7.8 billion. We consider a difference of less than 8 percent to be a strong confirmation of the reasonability and accuracy of our independent estimate. We estimate that annual expenditures for operations and maintenance once the project is operational will total almost \$132 million.

## COMMERCIAL OFFSHORE WIND DEVELOPMENT IMPACTS

Using these cost estimates for Dominion Energy’s project, we can estimate the economic and fiscal impact that the development and operation of the project will have on Hampton Roads and Virginia. We report the results in four separate phases:

- Development,
- Manufacturing,
- Installation, and
- Operations and Maintenance.

### Development Phase Impacts

Development activities account for \$464 million, or six percent of the total cost of the project. 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 technical and engineering expertise for offshore wind energy resides with the European firms that 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. Some similar expertise has built up in New England. A significant amount of managerial, planning, and administrative expertise is available around Dominion Energy’s corporate headquarters in Richmond. 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. We estimate that \$56.3 million of total development spending would occur in the Hampton Roads area and an additional \$105.6 million of that spending would occur elsewhere in the state of Virginia. Table 2 shows our estimate of the number of jobs<sup>1</sup> supported by that spending in Hampton Roads and in the rest of the state of Virginia.

Table 2: Jobs Supported by Development

Annual Jobs for 2020-2022	Hampton Roads Jobs	Rest of Virginia Jobs	All Virginia Jobs
<b>1<sup>st</sup> Round Direct Jobs</b>	129	185	314
<b>2<sup>nd</sup> Round Indirect and Induced Jobs</b>	100	169	269
<b>Total Development Phase Jobs</b>	<b>229</b>	<b>354</b>	<b>583</b>

In Hampton Roads, during the development phase most of the first round direct jobs created by Dominion Energy’s commercial CVOW development will be in the fields of industrial construction; engineering, architecture, and similar technical professions; as well as of managerial, administrative, legal, and similar professional services; and maintenance and repair of electronics and precision equipment. Meanwhile, most of the second round indirect and induced jobs derived from that activity will be in the employment service, business support service, real estate, bar and restaurant, and healthcare industries. Similarly, in the rest of Virginia, most of the first round direct jobs created will be in the fields of managerial, administrative, legal, and similar professional services; while most of the second round indirect and induced jobs derived from that activity will be in the employment service, business support service, real estate, bar and restaurant, and healthcare industries.

Table 3 shows our estimate of the amount of additional pay and benefits that will go to workers in Hampton Roads and in the rest of Virginia as a result of development activities.

Table 3: Pay and Benefits Related to Development Activities

Annual Pay & Benefits for 2020-2022	Hampton Roads Pay & Benefits	Rest of Virginia Pay & Benefits	All Virginia Pay & Benefits
<b>1<sup>st</sup> Round Direct Pay &amp; Benefits</b>	\$9,700,000	\$19,900,000	\$29,600,000
<b>2<sup>nd</sup> Round Indirect and Induced Pay &amp; Benefits</b>	\$4,700,000	\$9,600,000	\$14,300,000
<b>Total Development Phase Pay &amp; Benefits</b>	<b>\$14,400,000</b>	<b>\$29,500,000</b>	<b>\$43,900,000</b>

<sup>1</sup> Throughout this report, first round direct jobs are those that are directly involved in the development of the wind farm. Second round indirect and induced jobs are those that benefit indirectly from the spending by those businesses that are directly involved in the development activities.

Table 4 shows our estimate of the amount of additional economic activity that will occur in Hampton Roads and in the rest of the state of Virginia caused by development activities.

Table 4: Economic Activity Related to Development Activities

Annual Economic Activity for 2020-2022	Hampton Roads Economic Activity	Rest of Virginia Economic Activity	All Virginia Economic Activity
<b>1<sup>st</sup> Round Direct Economic Activity</b>	\$18,700,000	\$35,200,000	\$53,900,000
<b>2<sup>nd</sup> Round Indirect and Induced Economic Activity</b>	\$14,800,000	\$27,900,000	\$42,700,000
<b>Total Development Phase Economic Activity</b>	<b>\$33,500,000</b>	<b>\$63,100,000</b>	<b>\$96,600,000</b>

Similar to the job impacts, during the development phase most of the first round direct economic activity generated by Dominion Energy’s commercial CVOW development in Hampton Roads will be in engineering, architecture, and similar technical professions, legal services, and in industrial construction, while most of the second round indirect and induced economic activity will be in apartment leasing, home repair and improvement, real estate services, employment services, insurance, and healthcare. The healthcare, home improvement, and home repair businesses benefit from higher wages, and from people moving and buying and selling homes. In the rest of Virginia, most of the first round direct economic activity will be in the managerial, administrative, legal, and similar professional service industries, while most of the second round indirect and induced economic activity will be in the real estate and home-improvement industries, as well as the banking, healthcare, and restaurant industries.

The development activity directly generated by Dominion Energy’s commercial CVOW project and all of the second round effects from that activity will generate tax revenue for local governments in the Hampton Roads area and in the rest of the state, as well as tax revenue for the State of Virginia. Table 5 shows our estimate of the tax revenue generated from the preconstruction development activities.

Table 5: State and Local Tax Revenue from Development Activities

Annual Revenues for 2020-2022	Tax Revenue
<b>Hampton Roads Area Local Governments</b>	\$700,000
<b>Local Governments in the Rest of Virginia</b>	\$1,800,000
<b>Virginia State Tax Revenue</b>	<b>\$2,300,000</b>

## Manufacturing Phase Impacts

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. We estimate that \$82.6 million of the \$6.2 billion total for physical structures and equipment will be spent in Hampton Roads for the construction of an onshore electrical substation, for warehouses and operations buildings, and for a wind-turbine assembly staging facility. We also estimate that an additional \$21.1 million will be spent to source some materials through wholesalers and distributors located elsewhere in the state of Virginia and to purchase stone directly for scour protection around the base of the turbine foundations and for protecting buried cables.<sup>2</sup> Table 6 shows our estimate of the number of jobs supported by that spending in Hampton Roads and in the rest of the state of Virginia.

Table 6: Jobs Supported by the Manufacturing Phase

Annual Jobs for 2023-2025	Hampton Roads Jobs	Rest of Virginia Jobs	All Virginia Jobs
<b>1<sup>st</sup> Round Direct Jobs</b>	335	101	436
<b>2<sup>nd</sup> Round Indirect &amp; Induced Jobs</b>	161	68	229
<b>Total Manufacturing Phase Jobs</b>	<b>496</b>	<b>169</b>	<b>665</b>

In Hampton Roads, during the manufacturing phase most of the first round direct jobs created by Dominion Energy's commercial CVOW development will be in construction, while most of the second round indirect and induced jobs derived from that activity will be in home & garden stores, and all types of retailers; restaurants; real estate and architectural services, and healthcare services. Similar to the development phase, these derivative impacts are caused by increased pay, people moving into the area, and the buying and selling of homes. In the rest of Virginia, during the manufacturing phase of the project, most of the first round direct jobs that will be created will be in the fields of building materials, wholesale services, and trucking, while most of the second round indirect and induced jobs derived from that activity will be in real estate services, food service, and employment services.

---

<sup>2</sup> The location of new manufacturing facilities supplying the offshore wind energy industry in Hampton Roads and Virginia would have the largest impact on the economies of the region and the state.

Table 7 shows our estimate of the amount of additional pay and benefits that will go to workers in Hampton Roads and in the rest of Virginia because of activities associated with the manufacturing phase.

Table 7: Pay and Benefits Related to the Manufacturing Phase

Annual Pay & Benefits for 2023-2025	Hampton Roads Pay & Benefits	Rest of Virginia Pay & Benefits	All Virginia Pay & Benefits
<b>1<sup>st</sup> Round Direct Pay &amp; Benefits</b>	\$19,300,000	\$5,800,000	\$25,100,000
<b>2<sup>nd</sup> Round Indirect &amp; Induced Pay &amp; Benefits</b>	\$7,600,000	\$4,100,000	\$11,700,000
<b>Total Manufacturing Phase Pay &amp; Benefits</b>	<b>\$26,900,000</b>	<b>\$9,900,000</b>	<b>\$36,800,000</b>

In Hampton Roads, most of the first round direct economic activity generated by Dominion Energy’s commercial CVOW development during the manufacturing phase will be in the construction industry, while most of the second round indirect and induced economic activity will be in home repair and improvement, real estate and architectural services, and food service. These industries benefit from higher wages, and from people moving and buying and selling homes.

In the rest of Virginia, during the manufacturing phase most of the first round direct economic activity generated by Dominion Energy’s commercial CVOW project will be in building materials, wholesale services, and trucking industries, while most of the second round indirect and induced economic activity will be in the real estate, home-improvement, and restaurant industries. Table 8 shows our estimate of the amount of additional economic activity that will occur in Hampton Roads and in the rest of the state of Virginia caused by the manufacturing phase of the project.

Table 8: Economic Activity Related to the Manufacturing Phase

Annual Economic Activity for 2023-2025	Hampton Roads Economic Activity	Rest of Virginia Economic Activity	All Virginia Economic Activity
<b>1<sup>st</sup> Round Direct Economic Activity</b>	\$27,500,000	\$17,700,000	\$45,200,000
<b>2<sup>nd</sup> Round Indirect &amp; Induced Economic Activity</b>	\$25,300,000	\$12,000,000	\$37,300,000
<b>Total Manufacturing Phase Economic Activity</b>	<b>\$52,800,000</b>	<b>\$29,700,000</b>	<b>\$82,500,000</b>

The manufacturing activity directly generated by Dominion Energy’s project and all of the second round effects from that activity will generate tax revenue for local governments in the Hampton Roads area and in the rest of the state, as well as tax revenue for the State of Virginia.

Table 9 shows our estimate of the tax revenue generated from the manufacturing phase of the project.

Table 9: State and Local Tax Revenue from the Manufacturing Phase

Annual Revenues for 2023-2025	Tax Revenue
<b>Hampton Roads Area Local Governments</b>	\$1,000,000
<b>Local Governments in the Rest of Virginia</b>	\$800,000
<b>Virginia State Tax Revenue</b>	\$1,800,000

### Installation Phase Impacts

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. In compliance with the Jones Act, Dominion Energy is investing in the construction of two American-built, American-owned, and American-crewed vessels – one for installation of the turbines and another for the transportation of approximately 150-person installation crews that will operate out of Hampton Roads.<sup>3</sup> We estimate that \$190 million of the total installation spending (\$1.7 billion) will take place in the Hampton Roads area with an additional \$97 million being spent elsewhere in Virginia to upgrade the electrical system grid to accommodate the additional generated electrical output. Upgrades will occur as far away as Chesterfield, Midlothian, and Spotsylvania. Table 10 shows our estimate of the number of jobs supported by that spending for the installation phase.

Table 10: Jobs Supported by the Installation Phase

Annual Jobs for 2024-2026	Hampton Roads Jobs	Rest of Virginia Jobs	All Virginia Jobs
<b>1<sup>st</sup> Round Direct Jobs</b>	326	176	502
<b>2<sup>nd</sup> Round Indirect &amp; Induced Jobs</b>	265	105	371
<b>Total Installation Phase Jobs</b>	<b>591</b>	<b>281</b>	<b>872</b>

In Hampton Roads, most of the first round direct jobs created by Dominion Energy’s commercial development during the installation phase will be in the construction, offshore water and air logistics, and ground transportation industries. Meanwhile, most of the second round indirect and induced jobs derived from that activity will be in the real estate; restaurant and hotel; retail; healthcare; and consumer, commercial, and industrial maintenance & repair industries. Elsewhere in Virginia, during the installation phase, most of the first round direct jobs will be in the construction industry, while most of

<sup>3</sup> See Dominion Energy, “[Dominion Energy Continues to Advance Development of First Jones Act Compliant Wind Turbine Installation Vessel.](#)” August 31, 2020, and Atlantic Wind Transfers, “[Atlantic Wind Transfers Wins Contract to Supply Crew Transfer Services For Offshore Wind Project in Virginia.](#)” May 27, 2020.

the second round indirect and induced jobs will be in the retail, engineering, real estate, restaurant, and hotel industries. Restaurant and hotel industries benefit during this phase from significant numbers of temporary workers coming in from outside of the area.

Table 11 shows our estimate of the amount of additional pay and benefits that will go to workers because of the installation activities.

**Table 11: Pay and Benefits Related to the Installation Phase**

Annual Pay & Benefits for 2024-2026	Hampton Roads Pay & Benefits	Rest of Virginia Pay & Benefits	All Virginia Pay & Benefits
<b>1<sup>st</sup> Round Direct Pay &amp; Benefits</b>	\$21,700,000	\$10,900,000	\$32,500,000
<b>2<sup>nd</sup> Round Indirect &amp; Induced Pay &amp; Benefits</b>	\$13,200,000	\$6,300,000	\$19,500,000
<b>Total Installation Phase Pay &amp; Benefits</b>	<b>\$34,900,000</b>	<b>\$17,200,000</b>	<b>\$52,100,000</b>

Similar to the job impacts, during the installation phase of the project most of the first round direct economic activity generated by Dominion Energy’s commercial CVOW development in Hampton Roads will be in the construction and offshore logistics industries, while most of the second round indirect and induced economic activity will be in home improvement and real estate services; food service and retailing; and healthcare. In the rest of Virginia, the construction industry will be the primary beneficiary of the first round effects, while most of the indirect and induced economic activity will benefit the engineering and food service industries. Table 12 shows our estimate of the amount of additional economic activity that will occur in Hampton Roads and in the rest of the state of Virginia caused by the installation phase of the project.

**Table 12: Economic Activity Related to the Installation Phase**

Annual Economic Activity for 2024-2026	Hampton Roads Economic Activity	Rest of Virginia Economic Activity	All Virginia Economic Activity
<b>1<sup>st</sup> Round Direct Economic Activity</b>	\$63,300,000	\$32,300,000	\$95,600,000
<b>2<sup>nd</sup> Round Indirect &amp; Induced Economic Activity</b>	\$40,900,000	\$19,100,000	\$60,000,000
<b>Total Installation Phase Economic Activity</b>	<b>\$104,200,000</b>	<b>\$51,400,000</b>	<b>\$155,600,000</b>

The installation activity directly generated by Dominion Energy’s commercial CVOW project and all of the second round effects from that activity will generate tax revenue for local governments in the Hampton Roads area and in the rest of the state, as well as tax revenue for the State of Virginia.

Table 13 shows our estimate of the tax revenue generated from the installation phase of the project.

Table 13: State and Local Tax Revenue from the Installation Phase

Annual Revenues for 2024-2026	Tax Revenue
<b>Hampton Roads Area Local Governments</b>	\$1,900,000
<b>Local Governments in the Rest of Virginia</b>	\$900,000
<b>Virginia State Tax Revenue</b>	\$2,700,000

### Operations and Maintenance Phase Impacts

We estimate that \$131.6 million will be spent annually in the Hampton Roads area to operate and maintain Dominion Energy’s commercial CVOW development. Because all of the operation and maintenance activities will occur in or be immediately supported through Hampton Roads, we do not estimate any additional impact in the rest of Virginia during this phase. Table 14 shows our estimate of the number of jobs supported by that spending in Hampton Roads.

Table 14: Jobs Supported by the Operations and Maintenance Phase

Annual Jobs	Hampton Roads Jobs
<b>1<sup>st</sup> Round Direct Jobs</b>	200
<b>2<sup>nd</sup> Round Indirect and Induced Jobs</b>	910
<b>Total Operations and Maintenance Phase Jobs</b>	<b>1,110</b>

In Hampton Roads, during the operations and maintenance phase most of the first round direct jobs created by Dominion Energy’s commercial CVOW development will be maintenance technicians, administrative professionals, and operations management professionals, while most of the second round indirect and induced jobs derived from that activity will be in real estate services and food service. Table 15 shows our estimate of the amount of additional pay and benefits that will go to workers in Hampton Roads because of the operations and maintenance activities.

Table 15: Pay and Benefits Related to the Operations and Maintenance Phase

Annual Pay & Benefits	Hampton Roads Pay & Benefits
<b>1<sup>st</sup> Round Direct Pay &amp; Benefits</b>	\$19,400,000
<b>2<sup>nd</sup> Round Indirect and Induced Pay &amp; Benefits</b>	\$62,200,000
<b>Total Operations and Maintenance Phase Pay &amp; Benefits</b>	<b>\$81,600,000</b>

In Hampton Roads, the first round direct economic activity generated by Dominion Energy’s commercial CVOW development during the operation and maintenance phase will be associated with operation of

the facility itself, while most of the second round indirect and induced economic activity will be in home improvement and real estate services. Table 16 shows our estimate of the amount of additional economic activity that will occur in Hampton Roads caused by operations and maintenance of the project.

Table 16: Economic Activity Related to the Operation and Maintenance Phase

Annual Economic Activity	Hampton Roads Economic Activity
<b>1<sup>st</sup> Round Direct Additional Economic Activity</b>	\$122,300,000
<b>2<sup>nd</sup> Round Indirect and Induced Economic Activity</b>	\$87,500,000
<b>Total Operations and Maintenance Phase Economic Activity</b>	<b>\$209,800,000</b>

The operations and maintenance activity directly generated by Dominion Energy’s commercial CVOW development and all of the second round effects from that activity will generate tax revenue for local governments in the Hampton Roads area and in the rest of the state, as well as tax revenue for the State of Virginia. Table 17 shows our estimate of the tax revenue generated from the operations and maintenance phase of the project.

Table 17: Tax Revenue from the Operations and Maintenance Phase

Annual Revenues	Tax Revenue
<b>Hampton Roads Area Local Governments</b>	\$5,800,000
<b>Virginia State Tax Revenue</b>	\$4,800,000

## SUMMARY OF IMPACTS OF DOMINION ENERGY’S COMMERCIAL CVOW

The following tables summarize the previous tables covering the one-time and the on-going annual impacts of the operation and maintenance of the facility in Hampton Roads and in all of Virginia. As Dominion Energy’s project increases economic activity and spending in Virginia, more people, businesses, and industries benefit than just those directly involved in the construction and operation of the project. As described earlier, the industries (outside of the immediate offshore wind supply chain) that will see the most impact on their businesses are real estate services, home improvement, and architectural services; warehousing and logistics services; and food service.

Table 18 shows the total impact metrics for all of the direct spending that Dominion Energy and its immediate contractors will create in Virginia in order to build and operate the facility, plus all of the other economic activity in Virginia that is stimulated by the increased spending from Dominion Energy.

Table 18: Statewide Total Economic Activity from Dominion Energy’s Commercial CVOW Project

	Total Jobs	Total Pay & Benefits	Total Economic Activity	Hampton Roads Area Local Tax Revenue	State Tax Revenue
<b>Annualized Construction</b>	909	\$56,900,000	\$143,400,000	\$1,500,000	\$2,900,000
<b>Annual Operation</b>	1,110	\$81,600,000	\$209,800,000	\$5,800,000	\$4,800,000

In order to show how Dominion Energy’s offshore wind project will affect the Hampton Roads and Virginia economies on an annual basis, we provide a timeline for that impact. Table 19 shows the total annual impact metrics for all of the economic activity that Dominion Energy’s investment and expenditures will cause in Hampton Roads and in Virginia.

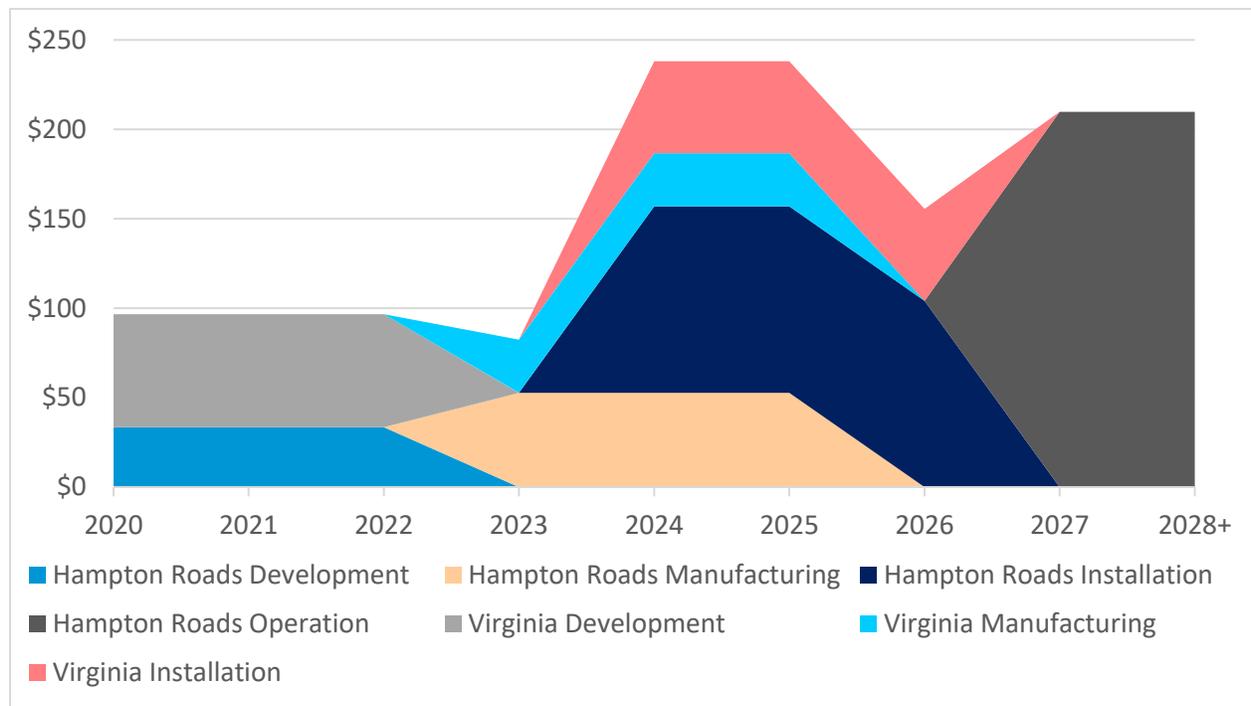
Table 19: Timeline of Total (Direct, Indirect & Induced) Economic Activity from Dominion Energy’s Commercial CVOW Project (\$ millions)

	2020	2021	2022	2023	2024	2025	2026	2027+
<b>HR Jobs</b>	229	229	229	496	1,087	1,087	591	1,110
<b>All VA Jobs</b>	<b>583</b>	<b>583</b>	<b>583</b>	<b>665</b>	<b>1,537</b>	<b>1,537</b>	<b>872</b>	<b>1,110</b>
<b>HR Pay</b>	\$14.4	\$14.4	\$14.4	\$26.9	\$61.8	\$61.8	\$34.9	\$81.6
<b>All VA Pay</b>	<b>\$43.9</b>	<b>\$43.9</b>	<b>\$43.9</b>	<b>\$36.8</b>	<b>\$88.9</b>	<b>\$88.9</b>	<b>\$52.1</b>	<b>\$81.6</b>
<b>HR Output</b>	\$33.5	\$33.5	\$33.5	\$52.8	\$157.0	\$157.0	\$104.2	\$209.8
<b>All VA Output</b>	<b>\$96.6</b>	<b>\$96.6</b>	<b>\$96.6</b>	<b>\$82.5</b>	<b>\$238.1</b>	<b>\$238.1</b>	<b>\$155.6</b>	<b>\$209.8</b>
<b>HR Local Taxes</b>	<b>\$0.7</b>	<b>\$0.7</b>	<b>\$0.7</b>	<b>\$1.0</b>	<b>\$2.9</b>	<b>\$2.9</b>	<b>\$1.9</b>	<b>\$5.8</b>
<b>VA State Taxes</b>	<b>\$2.3</b>	<b>\$2.3</b>	<b>\$2.3</b>	<b>\$1.8</b>	<b>\$4.5</b>	<b>\$4.5</b>	<b>\$2.7</b>	<b>\$4.8</b>



Figure 2 illustrates how the project progresses through the phases of development, manufacturing, installation, and operation.

Figure 2: Commercial CVOW Progression of Economic Activity (\$ millions of economic activity)





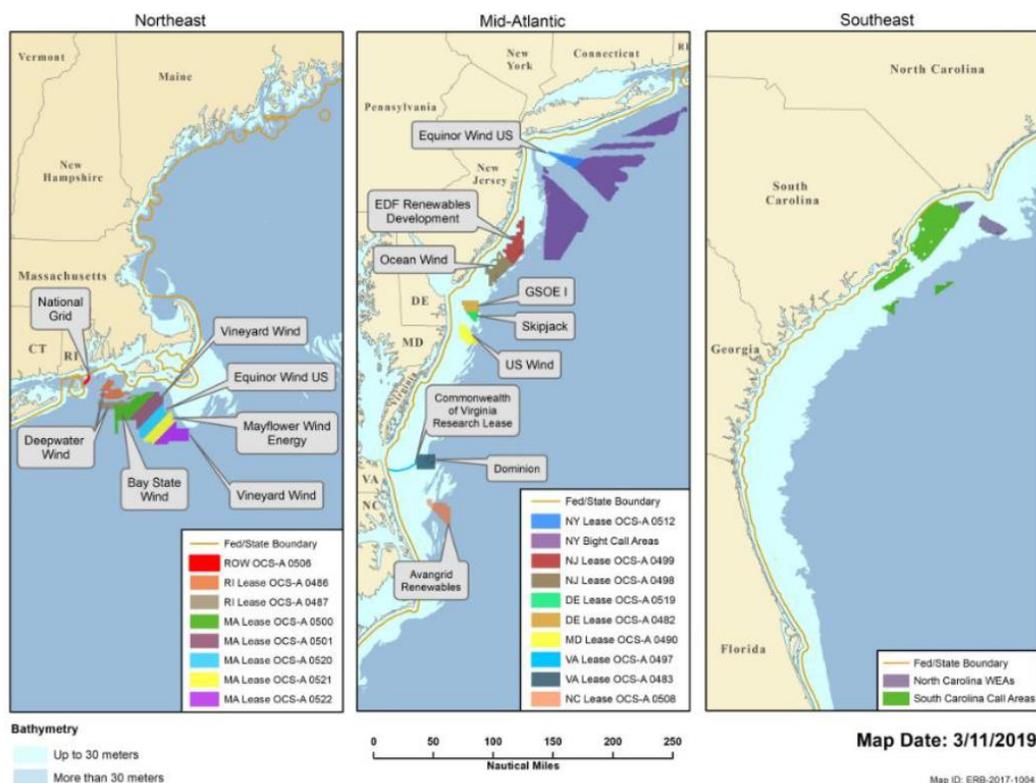
## Potential Market for an Offshore Wind Energy Cluster in Hampton Roads

Dominion Energy’s commercial CVOW project is only part of the total potential offshore wind development on the East Coast of the United States. In this section we describe the greater potential for offshore wind energy development that could justify investment in the offshore wind energy supply chain in Hampton Roads. We then provide an estimate of the impact on the Hampton Roads economy if Hampton Roads were to develop an offshore wind energy industry cluster.

### OVERVIEW OF EAST COAST OFFSHORE WIND DEVELOPMENTS

The U.S. offshore wind industry is showing potential for rapidly accelerating growth. Several recent studies have found that as many as 20 to 30 gigawatts of offshore wind capacity could be operational by the year 2030.<sup>4</sup> In addition, the U.S. East Coast is expected to be a key growth area for the industry. Figure 3 depicts lease areas for offshore wind projects along the U.S. East Coast that have been announced as of March 2020. These announced projects would be potentially serviceable from Hampton Roads, as much as they are serviceable from Europe.

Figure 3: East Coast Offshore Wind Projects and Lease Areas<sup>5</sup>



<sup>4</sup> American Wind Energy Association, 2020. [“U.S. Offshore Wind Power Economic Impact Assessment.”](#)

<sup>5</sup> American Wind Energy Association, 2020. [“U.S. Offshore Wind Power Economic Impact Assessment.”](#)

Table 20 summarizes the maximum potential MW development announced by each east coast state. In reviewing this table, it is important to keep in mind that solicitations required by current and anticipated state policy are not certain projects. Instead, they indicate offshore wind projects that could happen because state government policy calls for their investment to take place. However, the projects in site-assessment and preconstruction planning are likely to be completed in time.

Table 20: Future Potential Offshore Wind Developments on the East Coast<sup>6</sup>

State	Legislated Mandated Procurement MW by 2035	Site Assessment Potential Capacity MW	Preconstruction Planning Committed Capacity MW	Preconstruction Planning Potential Capacity MW	Total Potential Capacity in Development MW
Massachusetts	3,200 <sup>7</sup>	1,200	3,208	2,008	6,416
Rhode Island	1,000 <sup>8</sup>		834		834
New York	9,000 <sup>9</sup>		1,696		1,696
New Jersey	7,500 <sup>10</sup>	2,500	1,100		3,600
Delaware	120 <sup>11</sup>	1,000	120		1,120
Maryland	1,200 <sup>12</sup>		270		270
Virginia	5,200 <sup>13</sup>		2,600		2,600
North Carolina	none <sup>14</sup>			2,500	2,500
<b>Total Capacity</b>					<b>19,036</b>

## DEVELOPMENT OF THE OFFSHORE WIND ENERGY INDUSTRY IN NORTHERN EUROPE

The way that the offshore wind energy industry has developed in Northern Europe holds important lessons for how the industry could develop on the East Coast of the U.S. The first offshore wind farms in Europe were constructed off the coast of Denmark in 1991 and 1992. However, by 2019, 8 GW, or a third of the world’s installed offshore wind energy capacity, was located in the U.K. – the most of any

<sup>6</sup> All data from Reuters Events New Energy Update News (May 30, 2020). *US Offshore Wind Project Pipeline Tracker*. (unless otherwise noted)

<sup>7</sup> Mass.gov (2020.) [“Offshore Wind.”](#)

<sup>8</sup> McClellan, Stephanie. [Supply Chain Contracting Forecast for U.S. Offshore Wind Power](#). University of Delaware, March 2019

<sup>9</sup> Stromsta, Karl-Erik. [“New York Confirms Plan for 1-GW-Plus Offshore Wind Solicitation in 2020.”](#) *Greentech Media*. January 9, 2020.

<sup>10</sup> Grandoni, Dino. (2020.) [“New Jersey aims to lead nation in offshore wind. So it’s building the biggest turbine port in the country.”](#) Jun. 16, 2020.

<sup>11</sup> Lauria, Maddie. (2019.) [“Offshore wind company wants to build on state parkland, offering upgrades in exchange.”](#) Delaware Online. Oct. 2, 2019.

<sup>12</sup> 2019 Maryland Clean Energy Jobs Act calls for 400 MW in 2026 increasing to at least 1,200MW by 2030.

<sup>13</sup> Davidson, Ros. (2020.) [“Virginia to set ambitious offshore wind goal.”](#) Feb. 24, 2020. WindPower Monthly.

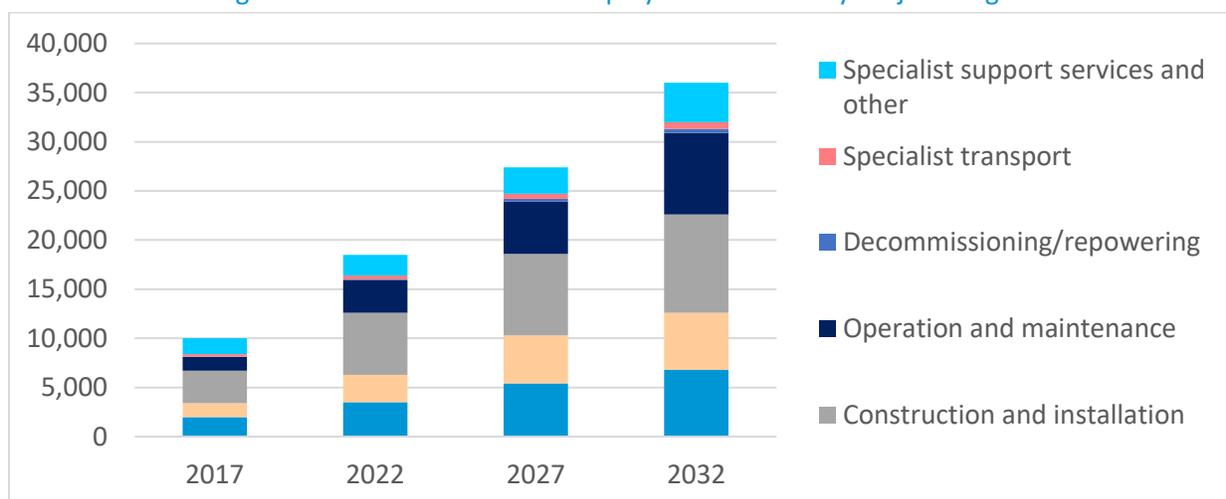
<sup>14</sup>In 2011, North Carolina lawmakers proposed [legislation](#) to set a non-binding state goal of 5,000 MW by 2030. Wood Mackenzie has estimated that auctions of a percentage of wind energy and call areas in federal waters off North and South Carolina could generate 11.5 GW of capacity for development in 2025-2030. Wood Mackenzie. (2020) [Economic Impact Study of New Offshore Wind Lease Auctions by BOEM](#).

nation.<sup>15</sup> In fact, the U.K. has 27 percent more installed offshore wind energy capacity than Germany, the European country with the next largest amount of installed capacity. The U.K.’s first offshore wind farm was commissioned in 2000 (Blyth Offshore, 4 MW) followed by a second facility in 2003 (North Hoyle, 60 MW). Two decades later, experts are projecting that offshore wind will provide 35 percent of the U.K.’s electrical demand by 2030.<sup>16</sup>

An important feature of the development of offshore wind energy in the U.K. has been that, until recently, most of the supply chain supporting that development remained in continental Europe. Because many of these suppliers (located in Denmark, Norway, and Germany) had direct access to the U.K. through the North and Baltic Seas, manufacturers of large components of offshore wind components were able to relatively easily transport those structures to offshore U.K. locations, many of them within 400 nautical miles. As a result, most of the heavy steel parts (baseplates and towers) and complex components (nacelles, rotors, and offshore substations) were designed and manufactured in continental Europe, while the tower foundations were built in U.K. ports.

However, the current and potential size of the offshore wind energy market in the U.K. appears to be driving a change in that calculation. A recent study commissioned by Aura and Green Port Hull reported an extensive pipeline of new projects.<sup>17</sup> Specifically, this study found that by 2032 (subject to constraints in planning consents, financial investment environment, government policy, etc.) the U.K. could potentially see the development of more than 35 GW of offshore wind generating capacity. Based on that assumption, the study estimates that domestic employment in the offshore wind industry and its supply chain could reach as high as 36,000 in the U.K. by 2032. Figure 4 depicts this employment growth, broken down by general categories associated with different stages of the development process.

Figure 4: U.K. Offshore Wind Employment Growth by Project Stage<sup>18</sup>



<sup>15</sup> Global Wind Energy Council, *Global Wind Report 2019*.

<sup>16</sup> Martin Whitmarsh, *The U.K. Offshore Wind Industry: Supply Chain Review*, January 2019.

<sup>17</sup> Energy & Utility Skills. *Skills and Labour Requirements of the U.K. Offshore Wind Industry: 2018 to 2032*. 2018.

<sup>18</sup> Energy & Utility Skills. *Skills and Labour Requirements of the U.K. Offshore Wind Industry: 2018 to 2032*. 2018.

The data shown in this chart for 2017 are based on actuals, while the data for 2022 through 2032 are projected. Consistent with the authors' belief that there is a developing domestic expansion of the offshore wind energy supply chain in the U.K., it is important to note that not all of the jobs listed in 2017 were in operations and maintenance. More specifically, the industry employed 3,300 construction and installation jobs, 2,000 site planning and development jobs, 1,600 specialist support services and other jobs, and 1,400 manufacture and design jobs, while only 1,400, or 14 percent of the total jobs associated with the U.K. offshore wind industry that year, were in operations and maintenance.<sup>19</sup>

Although there are significant differences between the development of the offshore wind energy industry in the U.K. and the potential experience on the East Coast of the U.S. (not the least of which are differences in transportation costs across the North Sea relative to across the Atlantic), a key takeaway from the data is that, although it is likely that initially most major components will almost certainly be manufactured in Europe and transported to the U.S., the large anticipated growth in the U.S. offshore wind energy industry will in time drive the creation of a domestic supply chain and the higher-skilled and higher-paying jobs that are associated with that supply chain.

Another aspect of the experience in Northern Europe that has implications for the development of offshore wind energy on the East Coast of the U.S. is the recent transition of resources away from offshore oil and gas operations and toward offshore wind energy development. Since the 1970s, North Sea ports have been heavily involved in serving the extensive oil and gas operations there. However, the cost of oil and gas production in the North Sea is the highest in the world. Falling prices for fossil fuels have put tremendous pressure on North Sea oil and gas operations and that has led to under-utilization of North Sea ports and unemployment among workers with marine experience.

North Sea ports have large amounts of land, labor, and equipment that are specialized in offshore energy operations and could be fairly easily transitioned from offshore oil and gas operations to offshore wind operations. In addition, many large oil and gas companies with North Sea operations have experience constructing and operating offshore oil platforms and are well-positioned to manage the logistical and technical challenges associated with constructing, operating, and maintaining offshore wind farms. Facing dwindling North Sea oil supplies and a growing consensus among many European countries of the need to move away from fossil fuels and toward renewable energy, many are exploring this conversion. As a result, over time there has been a slow transition of offshore oil and gas operations in the North Sea to offshore wind operations.<sup>20</sup>

This trend has at least two implications for the development of the offshore wind energy industry on the East Coast of the U.S. First, similarly situated resources do not exist on the East Coast where the offshore oil and gas industry has never operated. However, they do exist along the Gulf Coast where an extensive offshore oil and gas industry has existed for quite some time. This points to the Gulf Coast as

---

<sup>19</sup> Energy & Utility Skills. [Skills and Labour Requirements of the U.K. Offshore Wind Industry: 2018 to 2032](#). 2018. The report of 10,000 U.K. jobs in 2017 is corroborated by the 11,000 U.K. jobs reported in 2019 in Martin Whitmarsh, [The U.K. Offshore Wind Industry: Supply Chain Review](#).

<sup>20</sup> Klein, Azbeta. (2020.) "[Winds of Change: can big oil make the transition to offshore wind?](#)" The World Bank.

an immediate source of currently under-utilized equipment, labor, and experience that could be readily adapted for use in the development of offshore wind energy on the East Coast of the U.S.

Second, it is important to realize that North Sea port areas tend to be significantly larger than those on the East Coast of the U.S. Moreover, because of declines in North Sea offshore oil and gas activity those North Sea ports that primarily served that industry were under-utilized and able to quickly shift to offshore wind activity. In contrast, ports on the East Coast of the United States are generally at or near current capacity transporting cargo. In addition, many East Coast U.S. ports lack space to expand, due in part to land encroachments by nearby development and congestion of other infrastructure, such as rail and roadways. As a result, adapting East Coast ports to serve the offshore wind energy industry is likely to be a slower and more involved process that will require sizeable new investment.

The challenges to developing the offshore wind energy industry outside of continental Europe are not insurmountable. Assuming that the projects planned for the East Coast of the U.S. come to pass, it is highly likely that, in time, public policies and the profit motive will draw offshore wind energy businesses will invest in facilities in the most suitable East Coast ports, like Hampton Roads.

## POTENTIAL IMPACT OF ONE GIGAWATT OF ANNUAL OFFSHORE WIND ACTIVITY IN HAMPTON ROADS

This section provides our estimate of the economic impact of one GW of annual offshore wind energy development being supplied to some degree through Hampton Roads. Effectively, the estimates in this section amount to “per new GW” impact estimates. As we reported earlier, inclusive of Dominion Energy’s 2.6 GW commercial project, there are over 19 GWs of additional offshore wind energy projects in development on the East Coast of the United States. While Dominion Energy’s project and timeline are fairly clear, that is not true of the other projects. By providing a per GW estimate of impacts, policy makers can use the results reported here to evaluate the likely impact of future projects of various sizes if they are served by businesses in the Hampton Roads area.

Under the one GW annual scenario, we estimate the impact of one GW of new offshore wind energy capacity being constructed and maintained from Hampton Roads on an annual basis. One GW per year of new capacity would occur when the industry is nearing peak intensity of development. That may be a decade or more into the future. To put one GW per year of new construction into perspective, it will take seven years for Dominion Energy to construct 2.6 GW of offshore wind capacity, or about 370 MW per year. So, to build one GW of capacity per year would require almost three commercial CVOW-sized projects to be in progress in one year. 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 this scenario anticipate that more of the expenditures at each stage of project construction will go to people and businesses in Hampton Roads and elsewhere in Virginia, as skills, experience, and capacity needed by the offshore wind energy industry will have increased during the development of Dominion Energy’s commercial project.

Our baseline estimate of the impact of Dominion Energy's 2.6 GW commercial facility assumes that the project was completed in 7 full years (January 2020 – December 2026) without any new business development in Hampton Roads or in Virginia beyond the essential changes to the electric power industry in the Hampton Roads area needed for the construction and operation of the wind farm. The previous section describes in some detail how we modeled that baseline case. In the one GW scenario, we use the same general model to estimate the expenditures needed to develop one GW of offshore wind energy capacity. However, we assume that by the time that one GW of annual activity on a recurring basis is being served by businesses in Hampton Roads (probably sometime after 2026), the offshore wind energy industry and its supply chain will have developed significantly in the area.

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

- Hampton Roads has one of the largest port areas on the East Coast,
- Hampton Roads port areas have direct access to the open ocean without any air draft restrictions that bridges pose (unlike other ports on the East Coast), and
- Hampton Roads is the only major port area well-suited to serve any offshore wind energy developments in the southern part of the U.S. East Coast and capable of serving projects in the northern part, as well
- Virginia has a history of fostering a good climate for business growth with lower costs of doing business (including lower labor costs), lower taxes, and less regulation than many other states on the East Coast.

However, in the following section, our estimate of the impact of a one GW of capacity served from Hampton Roads incorporates the additional assumptions that:

- Not all of the work (and expenditures) that goes into building and maintaining an offshore wind project in the area will go to Hampton Roads or Virginia businesses, even after the completion of Dominion Energy's commercial project.
- Some of the work (and expenditures) will go to businesses in other port areas on the East Coast of the U.S., the Gulf of Mexico, and Europe.
- The development, funding, permitting and construction of new offshore wind industry manufacturing facilities will take a significant amount of time. The U.K. experience demonstrates that manufacturing facilities are not quickly built, even in locations with a large amount of offshore wind activity.
- Offtake cables for projects in other states will be landed closest to the project, even if much of the work on the development, manufacture, and installation of the project occurs in Hampton Roads.
- Work that is closely related to onshore activities for projects that are near other ports of a significant size will often be done in those ports and states. For example, permitting, project management, and onshore construction will be done in other ports instead of Hampton Roads.
- Local-supply requirements in other states will limit the amount of industry development in Hampton Roads. For example, Maryland and New Jersey both have local supply requirements and commitments have been made to build turbine foundations in those states. Because turbine

foundations are likely to be produced nearby, foundation manufacturing in Hampton Roads will face more competitive pressures.

- Industry-related mechanical and structural engineering expertise and installation equipment and expertise will develop to serve on projects where it would otherwise be supplied from Europe.
- New manufacturing plants will locate in Hampton Roads to supply portions of the industry infrastructure. We assume that Hampton Roads will be most attractive to facilities that produce products that are large and for which transportation under bridges would cause difficulties. Therefore, we assume that eventually Hampton Roads will be home to a turbine tower manufacturer, a blade manufacturer, and an offshore substation manufacturer.
- All maintenance work is done in or from Hampton Roads.
- All operations work is very likely to be done where offtake cables make landfall and not in Hampton Roads.

Table 21 shows impact metrics for all of the direct spending that developers and immediate contractors will do in Virginia in order to build and operate one gigawatt of capacity plus all of the other economic activity in Virginia that is stimulated by the increased spending on the offshore wind capacity.

**Table 21: Impact in Hampton Roads and in Virginia Statewide for Every 1 GW of New Development**

Impact	Total Jobs	Total Pay & Benefits	Total Economic Activity
<b>HR Direct</b>	3,100	\$160,000,000	\$400,000,000
<b>HR Indirect &amp; Induced</b>	1,800	\$90,000,000	\$290,000,000
<b>HR Total</b>	<b>4,900</b>	<b>\$250,000,000</b>	<b>\$690,000,000</b>
<b>All VA Direct</b>	3,200	\$170,000,000	\$430,000,000
<b>All VA Indirect &amp; Induced</b>	2,000	\$100,000,000	\$310,000,000
<b>All VA Total</b>	<b>5,200</b>	<b>\$270,000,000</b>	<b>\$740,000,000</b>

Assuming that current tax rates apply, we estimate that local governments in the Hampton Roads area could receive about \$21 million in tax revenue annually when Hampton Roads businesses are serving one GW per year of new offshore wind energy development. The Commonwealth of Virginia would receive about \$18 million.

These estimates are scalable beyond one GW per year of new offshore wind development. Therefore, once Hampton Roads gets to the position where the area is serving one GW of new development per year with mechanical, engineering, and environmental research services; turbine towers, blades, and offshore substations; and installation equipment and expertise, the economic impact per GW will be much larger than for the commercial CVOW project.

## Conclusion

---

Dominion Energy has announced plans to build the largest single offshore wind farm in the United States. The 2.6 GW project off the coast of Virginia is a significant part of the offshore wind energy development that is planned for the East Coast of the United States by 2035. That amount of development should provide a sufficient demand pipeline to incentivize the offshore wind industry to invest in new facilities and operations on the East Coast of the United States.

In the near term, we expect that most of the \$8.4 billion that it will cost to build Dominion Energy's project by 2026 will go to businesses located outside of Virginia, primarily those in Europe where the offshore wind energy industry began. However, we estimate that \$420 million will go to businesses in Virginia for the construction of Dominion Energy's commercial offshore wind project. That includes the \$40 million contribution of the State of Virginia for port upgrades in Hampton Roads. We estimate that from 2020 through the end of 2026, the project will support about

- 900 direct and indirect Virginia jobs annually (about 60 percent in Hampton Roads), with almost
- \$57 million in pay and benefits, and over
- \$143 million in economic output, generating almost
- \$2 million in revenues for local governments in the Hampton Roads area, and an additional
- \$3 million in Virginia state tax revenues.

Our expectation that most spending will go to businesses outside of Virginia is based on the lack of announced offshore wind supply chain investments made at the time of this report. Thus, our estimate is a reasonable but conservative estimate of the impact. In time, it may prove to be a significant underestimate, if the project attracts new businesses to Virginia in order to participate in the offshore wind energy supply chain. Dominion Energy's procurement activities, the requirements of the Virginia Clean Economy Act of 2020, and the efforts of the Hampton Roads Alliance and the Virginia Economic Development Partnership (among others) are coordinated to grow the offshore wind energy supply chain in Virginia. Future updates of this report will reflect those additions to the Hampton Roads and Virginia economies.

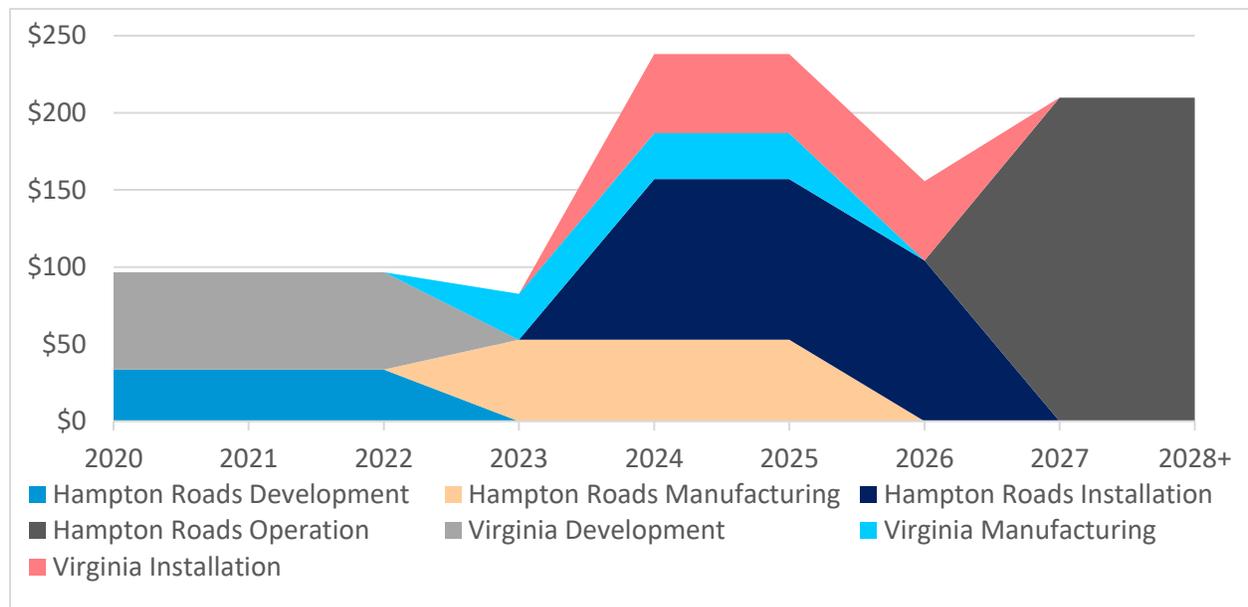
Beginning in 2027, once construction is completed, we estimate that the annual operation and maintenance of the facility will support over

- 1,100 direct and indirect jobs annually in Hampton Roads, with almost
- \$82 million in pay and benefits, and almost
- \$210 million in economic output, generating almost
- \$6 million in revenues for local governments in the Hampton Roads area, and an additional
- \$5 million in Virginia state tax revenues.



Figure 5 illustrates how the project progresses through the overlapping phases of development, manufacturing, installation, and operation.

Figure 5: Commercial CVOW Progression of Economic Activity (\$ millions of economic activity)



Because of Hampton Roads’ advantageous position on the Mid-Atlantic Coast, it has the strong potential to benefit from the offshore wind energy development and to see the development of a cluster of businesses in Hampton Roads and Virginia that serve the offshore wind energy industry. Also, during the construction of the commercial CVOW project, businesses in Hampton Roads will have developed more skill, experience, and capacity to supply the needs of the offshore wind energy industry. We assume that Hampton Roads will be most attractive to manufacturing facilities that produce products that are large and for which transportation under bridges would cause difficulties. Therefore, we assume that eventually Hampton Roads will be home to a turbine tower manufacturer, a blade manufacturer, and an offshore substation manufacturer.

Given the advantages that the port areas in Hampton Roads offer, it is reasonable to anticipate that, in time, new businesses will locate in Hampton Roads to serve a growing offshore wind energy industry. If, over the next several years during the early development of the industry in the United States, businesses in Hampton Roads develop industry-specific expertise and manufacturing businesses in the industry supply chain locate in the area, then we estimate that for every one gigawatt of new offshore wind energy development that Hampton Roads businesses service, there will be about

- 5,200 direct and indirect Virginia jobs annually (almost all in Hampton Roads), with about
- \$270 million in pay and benefits, and about
- \$740 million in economic output, generating about
- \$21 million in revenues for local governments in the Hampton Roads area, and an additional
- \$18 million in Virginia state tax revenues.



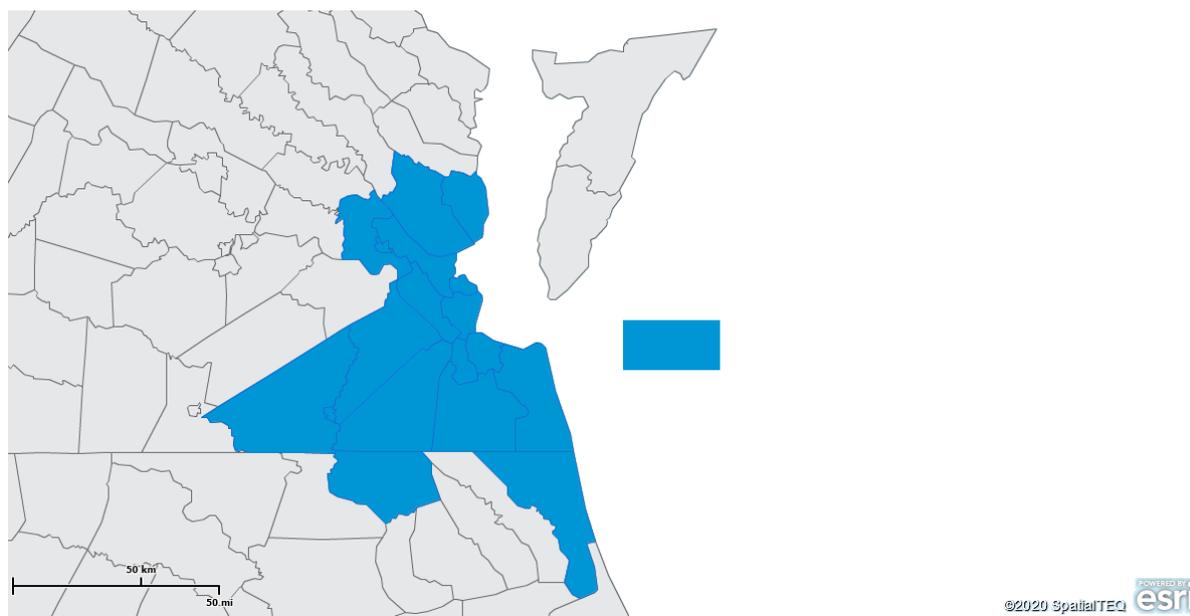
## Appendix -- Methods for Analysis

Our analysis is dependent on definitions and modeling methods. We describe the most important ones in this section.

### HAMPTON ROADS

There is no single, universally accepted definition of the Hampton Roads area. For the purposes of this report, we have defined Hampton Roads as all of the localities that are part of the Virginia Beach–Norfolk–Newport News, VA–NC, Metropolitan Statistical Area (as of early 2020)<sup>21</sup> plus Southampton County and Franklin City, Virginia which are part of the Hampton Roads Alliance. We include all of these localities because wind energy development off the coast of Virginia is likely to impact all of them to some degree. We will count economic activity that occurs within these localities as a result of offshore wind energy development as Hampton Roads activity. Most of the wind energy activity off the coast of Virginia will impact the cities and counties in Virginia. However, U.S. Bureau of the Census research shows that residents and businesses in Currituck and Gates counties in North Carolina interact closely with the nearby businesses and residents of Virginia, so it is important to include these two counties in order to estimate the full impact of the development. When we report results for the state of Virginia, we only include economic activity that occurs within the Virginia state borders. Figure 6 shows that localities included in this definition of Hampton Roads and their proximity to the commercial Coastal Virginia Offshore Wind project.

Figure 6: Hampton Roads Localities in Relation to the General Location of the Offshore Lease Area



<sup>21</sup> The Virginia 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.

## INPUT-OUTPUT MODELING

To empirically evaluate the regional and statewide economic impact attributable to the offshore wind farm development, we employ a commonly used, regional input-output model called IMPLAN.<sup>22</sup>

Regional input-output modeling measures the ripple effects that an expenditure generates as it makes its way through the economy. For this report, spending by Dominion Energy would have a direct economic impact on Hampton Roads and the state economy in terms of people hired as to work on the wind farm, the pay and benefits that they receive, and economic activity in Hampton Roads and in the rest of the state of Virginia for expenditures such as utilities, construction, and equipment. That direct spending by Dominion Energy and the businesses that it hires for development, construction, installation, and operation of the wind farm creates the first ripple of economic activity.

As Dominion Energy and its immediate vendors/contractors on this project spend the money that came from the project, they create another *indirect* ripple of economic activity that is part of the second-round effects of the offshore wind farm.

In addition to the economic effects in Hampton Roads and in the economy elsewhere in Virginia of the business-to-business transactions, there are also the second-round economic effects associated with employee-to-business transactions that ripple through local economies. These effects occur when the employees of the businesses directly involved in the project buy groceries; pay for rent, entertainment, and schooling in Virginia; or make other local purchases. Additionally, there are the second-round economic effects of business-to-business transactions further back in the supply chain between the direct vendors to Dominion Energy and their suppliers.

The total impact is simply the sum of the first round direct and second round impacts. These categories of impact are then further defined in terms of employment (the jobs that are created), labor income (the pay and benefits associated with those jobs), and economic output (the total amount of economic activity that is created in the economy).



<sup>22</sup> [IMPLAN](#) is produced by IMPLAN Group, LLC.