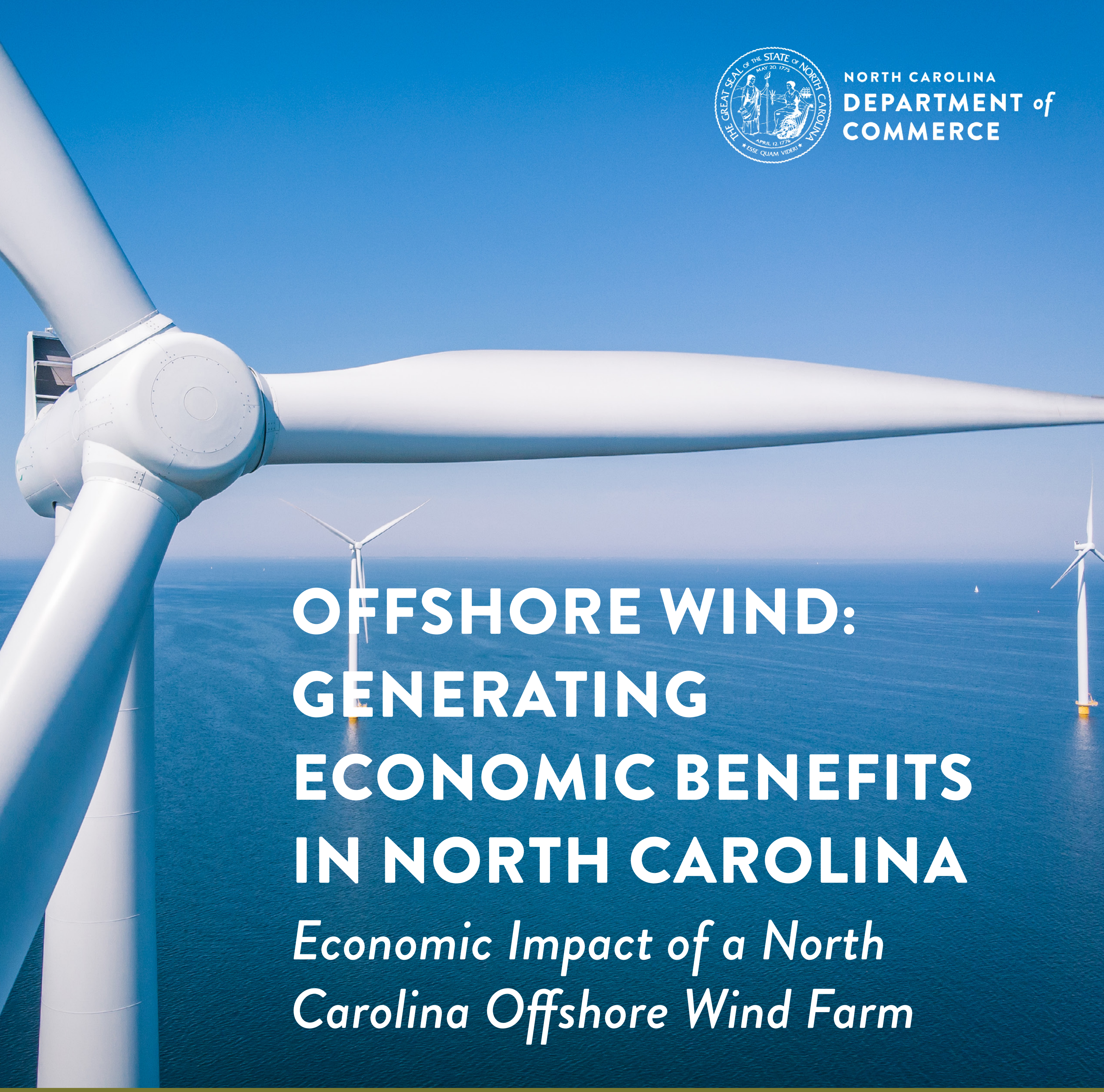


NORTH CAROLINA DEPARTMENT of COMMERCE

# OFFSHORE WIND: GENERATING ECONOMIC BENEFITS IN NORTH CAROLINA

## *Economic Impact of a North Carolina Offshore Wind Farm*


### EXECUTIVE SUMMARY

In addition to capitalizing on the sizeable economic impact from the offshore wind (OSW) manufacturing supply chain that would serve OSW farms along the entire East Coast of the U.S, North Carolina has the opportunity to capitalize on the local economic impact associated with OSW projects developed off its own coast. This analysis demonstrates that the size of that opportunity, while considerable even at conservative low-end estimates, more than doubles at the high-end estimates if North Carolina were to pursue a focused, successful effort to develop a strong OSW supply-chain in the state.

## INTRODUCTION

Offshore wind (OSW) energy development is a key priority for North Carolina. With the second-highest offshore wind net technical energy potential in the United States[1] and the most manufacturing-intensive economy on the East Coast,[2] North Carolina is well-positioned to compete in this rapidly growing global industry.

BVG Associates (BVGA), a consulting company with extensive wind energy experience, forecasts the U.S. East Coast will see a total offshore installed capacity exceeding 40 gigawatts (GW) by 2035. Reaching this level of capacity will require a manufacturing ecosystem to supply component parts for at least two dozen utility-scale wind farms. Applying the best practices and lessons learned from the European Union, the OSW industry is expected to create a $140 billion supply chain and tens of thousands new jobs in the United States by 2035. North Carolina manufacturers can help address these needs and supply equipment for the entire U.S. East Coast market.[3]

To spotlight opportunities more specific to North Carolina OSW sites, this analysis focuses more narrowly on the local economic impact North Carolina can derive from OSW projects developed off the North Carolina coast. To date, three sites have been identified for OSW projects on the outer continental shelf directly offshore of North Carolina: Kitty Hawk (currently being developed by Avangrid Renewables), and Wilmington West and Wilmington East, neither of which have been leased by the federal government.

Avangrid's construction of the Kitty Hawk site will not begin until at least 2025.[4] Any development of the two Wilmington sites will not likely begin until at least 2028, due to the thorough federal leasing and regulatory review process required by law. The three sites differ in area and thus also in potential energy generating capacity. The Kitty Hawk site is projected to generate 2.5 GW of power, Wilmington West could likely generate 1 GW of power, and Wilmington East over 2.7 GW.

To determine the scale of economic impact likely to result from offshore wind energy project development off the North Carolina coast, this analysis assesses the economic contribution (jobs, earnings, output) of the construction and operation of an illustrative hypothetical project beginning in 2028,[5] specifically a 2.8 gigawatt (GW) commercial OSW project roughly 25 miles offshore, at a site located midway between the Kitty Hawk site and the two Wilmington sites.[6]

1. *National Renewable Energy Laboratory. 2016. 2016 Offshore Wind Energy Resource Assessment for the United States. This ranking is for wind speeds greater than 8 meters per second and less than 60m water depth.*
2. *U.S. Bureau of Economic Analysis, 2019.*
3. *BVG Associates. 2021. Building North Carolina's Offshore Wind Supply Chain: The roadmap for leveraging manufacturing and infrastructure advantages. See the report for additional details regarding North Carolina's opportunities to serve the entire East Coast market.*
4. *Avangrid Renewables: http://kittyhawkoffshore.com.*
5. *This hypothetical site is based on key parameters for the existing three and additional for larger sites that may be developed in future years.*
6. *The model's results are not highly sensitive to the location of site or distance to port. The model's results are most sensitive to factors such as the size project size, the turbine size, and the percent of project expenditures that would be spent locally. See the Appendix for more detail on these factors.*

## ANALYSIS MODEL : OVERVIEW

This analysis uses the Jobs and Economic Development Impact (JEDI[7]) model, developed by the National Renewable Energy Laboratory (NREL), to estimate the economic impact of the project. The JEDI model uses project expenditure and local share assumptions based on NREL research, including data gathered from existing offshore wind projects, a literature review, and conversations with energy industry professionals.

The model has been peer reviewed and is widely accepted across the industry.[8] The JEDI model uses an input-output methodology to estimate the economic impact of a project. For every dollar spent on an offshore wind project in North Carolina, the model estimates the total multiplying impact of that spending within the state economy.

Figure 1

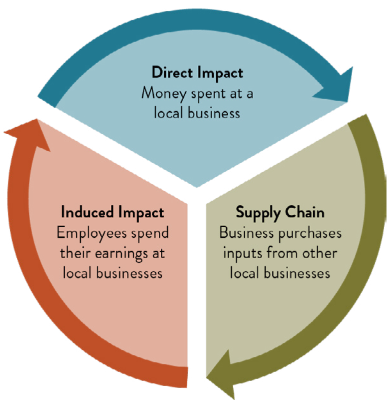



Figure 1 illustrates the multiplicative economic impact that begins when money is spent at a local business (Direct Impact). That local business spends the money again to purchase input materials from local suppliers (Indirect Impact). The original business and the suppliers both spend the money again by paying their employees, who then purchase goods and services at local businesses (Induced Impact). This cycle creates an economic multiplying effect. The presence of a strong supply-chain supporting offshore wind is a significant driver of the model results.

JEDI utilizes baseline assumptions to estimate the total cost of a project and the percent of project expenditures that would be spent locally, in this case North Carolina. Some expenses, such as engineering, legal services, and marine transportation, are expected to be fulfilled locally. Other expenses, such as the construction of the actual turbine, are not expected to be fulfilled locally for projects coming online through 2021 because the manufacturing base for such projects does not widely exist in the U.S. currently. These expectations will change in future years, however, as the OSW manufacturing supply chain develops and matures in the U.S. and in North Carolina.

## ANALYSIS MODEL : SPECIFICS

This analysis used the JEDI baseline assumptions and ran two different future scenarios, Low and High. The Low scenario adjusted the local share expenditure assumptions to 10% for any expenditure category (e.g., turbine equipment, piling and anchors, labor installation) that was set at 0% in the default JEDI model.[9] This scenario is a conservative, modest representation of a North Carolina offshore wind project beginning construction in 2028. The High scenario adjusted the local share assumptions to 75% for any category that was set at 0% in the default JEDI model. This scenario estimates the opportunity available to North Carolina if a focused, successful effort is made to develop a strong supply-chain in the state. Both scenarios use the same starting inputs (outlined in the appendix below).

Notably, a March 2021 supply chain assessment conducted by BVGA details how the manufacturing intensity of North Carolina's economy gives the state a competitive edge in the OSW industry.[10] North Carolina ranks 1st among East Coast states and 5th in the nation in the value of its manufacturing sector's Gross Domestic Product (GDP).

Accordingly, North Carolina has the potential to manufacture a significant, sizable share of the U.S.-based OSW supply chain, particularly if it works to:

- Strengthen anchor companies – build upon strong base of major manufacturing companies already established in North Carolina, and attract additional ones, to grow and

7. *Jobs & Economic Development Impact Model: nrel.gov/analysis/jedi/about.html.*
8. *Core data were reviewed both internally by NREL and the Navigant Consortium and externally by members of the academic community and the offshore wind industry. In addition, model inputs and preliminary results were presented in public on at least three different occasions. In each instance, feedback on both the inputs and preliminary results was solicited and incorporated into the publicly released version of the model.*
9. *The local share assumption allows the model to analyze the economic impact that accrues to the local area, in this case North Carolina. In this way, monetary leakages (spending on goods and services outside the local area) are not included in calculating local impacts. With no significant offshore wind industry or development activity in the U.S. today to draw on, but recognizing that many industries can easily support an offshore market in the future, NREL and the Navigant Consortium developed local content estimates for each expenditure. These estimates suggest that, for projects slated to come online by 2021, total construction period local content is likely to be relatively low, on the order of 10% of total construction period costs, consistent with the Low model used in this analysis. The 75% local content share was selected to serve as an ambitious yet realistic high target if North Carolina undertakes a focused effort to develop and expand its OSW manufacturing supply chain. A small number of expenditure categories (primarily those expected to be fulfilled locally) contained default values set higher than 0%. These values were not changed in the modeling across the two scenarios.*
10. *BVG Associates. 2021. Building North Carolina's Offshore Wind Supply Chain: The roadmap for leveraging manufacturing and infrastructure advantages.*

anchor industrial base and enable acceleration effect on wider supply chain.

- Leverage existing manufacturing strength – build upon North Carolina's manufacturing strengths and nation-leading economic conditions for component manufacturing to supply OSW market along East Coast and beyond.

- Build momentum for a strong pipeline of windfarms – accelerate OSW opportunity by driving North Carolina's offshore wind targets and new windfarm developments to match the significant energy consumption of the Southeast and mid-Atlantic states.

By pursuing those objectives aggressively, North Carolina can grow the opportunity associated with the economic impacts of the OSW development off its coast. This analysis quantifies the magnitude of that opportunity.

## ANALYSIS MODEL : RESULTS

The JEDI model utilizes economic data (multipliers and consumption patterns) derived from IMPLAN, a commonly used economic impact assessment modeling tool.[11] IMPLAN compiles and aggregates national and regional economic and demographic data to calculate inter-industry linkages that create a multiplying economic impact when money is spent within a local economy. Statewide multipliers specific to North Carolina were utilized for this analysis. Consistent with Figure 1 above, the JEDI model results[12] are broken into three categories:

1. Project development and on-site labor impacts refer to the on-site or immediate effects created by project expenditures. In constructing an offshore wind energy facility, it refers to the on-site jobs of the contractors and crews hired to construct the facility.

2. Turbine and supply chain impacts refer to the increase in economic activity that occurs when a contractor, vendor, or manufacturer receives payment for goods or services, and in turn, is able to pay others who support their businesses. This category also includes the manufacturing of offshore wind facility equipment (e.g. offshore wind towers, blades, and nacelles, among others) that is used in the construction of the turbine.

3. Induced impacts refer to the effects driven by spending of household earnings from project development and on-site labor impacts as well as turbine and supply chain impacts. Induced impacts are often associated with increased business at local restaurants, hotels, and retail establishments.

11. *IMPLAN: implan.com/history/.*

12. *JEDI Offshore Wind User Reference Guide: nrel.gov/docs/fy13osti/58389.pdf.*

## ECONOMIC IMPACT: CONSTRUCTION PHASE

As illustrated in Table 1 and Chart 1, during the construction phase of the OSW project, the Low JEDI model scenario conservatively estimates:

- the creation of 14,029 full-time jobs;
- earnings of nearly $1 billion; and,
- economic output of nearly $4 billion.

Earnings include compensation and benefits paid to employees. Economic output is a measure of total production or total economic activity, which is the value of production in the state economy, or the sum of the three model result categories enumerated above.[13]

In contrast, with a strong focus on developing an offshore wind supply-chain in the state, the High JEDI model scenario estimates North Carolina has the potential for:

- the creation of 28,208 full-time jobs;
- earnings of over $2 billion; and,
- economic output over $7.6 billion.

It is important to note that these are one-time impacts generated during the construction phase of the project, which could last between three to six years, depending on how construction is staged.

*A wind turbine blade in the warehouse.*

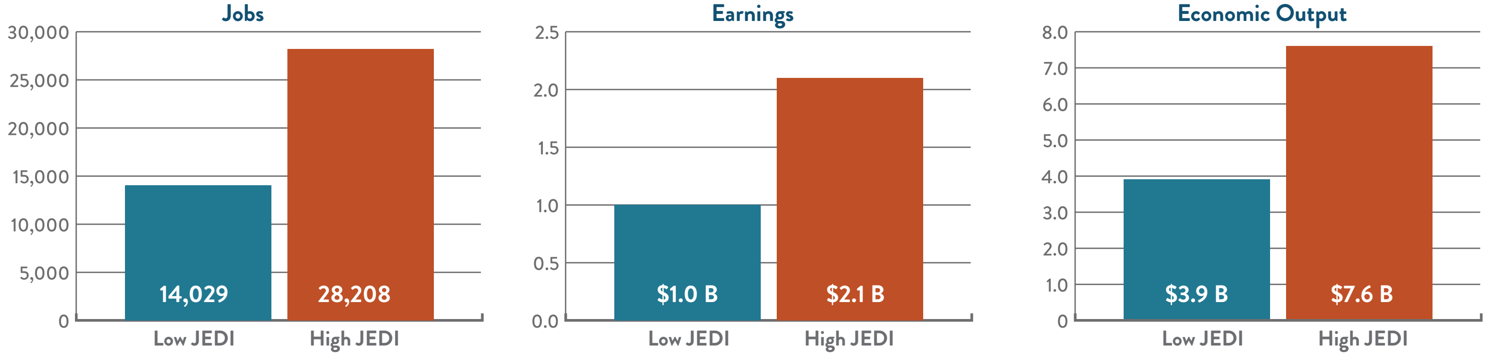
*The shaft end of a wind turbine blade being prepared for use.*

**Table 1. Economic Impact - Construction Phase**

| | Low JEDI | | | High JEDI | | |
|---|---|---|---|---|---|---|
| **During Construction Phase** | **Jobs** | **Earnings** | **Output** | **Jobs** | **Earnings** | **Output** |
| Project Development and Onsite Labor Impacts | 2,110 | $177 M | $425 M | 4,502 | $513 M | $760 M |
| Turbine and Supply Chain Impacts | 7,223 | $528 M | $2,745 M | 15,241 | $1,113 M | $5,545 M |
| Induced Impacts | 4,697 | $258 M | $752 M | 8,465 | $457 M | $1,333 M |
| **Total** | **14,029** | **$963 M** | **$3,922 M** | **28,208** | **$2,083 M** | **$7,637 M** |

*Notes: Earnings and Output values are millions of dollars in year 2021 dollars. Jobs are full-time equivalent for a period of one year. Earnings include wage and salary compensation and benefits. Output refers to total economic activity, the value of total production. All estimates are gross impacts. Construction impacts are one-time impacts.*

**Chart 1: Economic Impact - Construction Phase**




13. *This is gross output, which includes the costs of intermediate goods.*

## ECONOMIC IMPACT: ANNUAL OPERATIONS

Based on the size of the wind turbine and the project, the JEDI model estimates the annual expenditures associated with operating and maintaining the offshore wind facility. As illustrated in Table 2 and Chart 2, during the operating phase of the project, the Low JEDI model scenario conservatively estimates:

- the creation of 1,051 full-time jobs;
- annual earnings of $79 million; and,
- annual economic output of $257 million.

In contrast, with a strong focus on developing an offshore wind supply-chain in the state, the High JEDI model scenario estimates that North Carolina has the potential for:

- the creation of 2,476 full-time jobs;
- annual earnings of $174 million; and,
- annual economic output of $790 million.

For both the Low and High JEDI scenario, these impacts are estimated to occur annually over the operating life of the project, which is expected to be 30 years.

*A jackup rig vessel constructing an offshore wind turbine.*

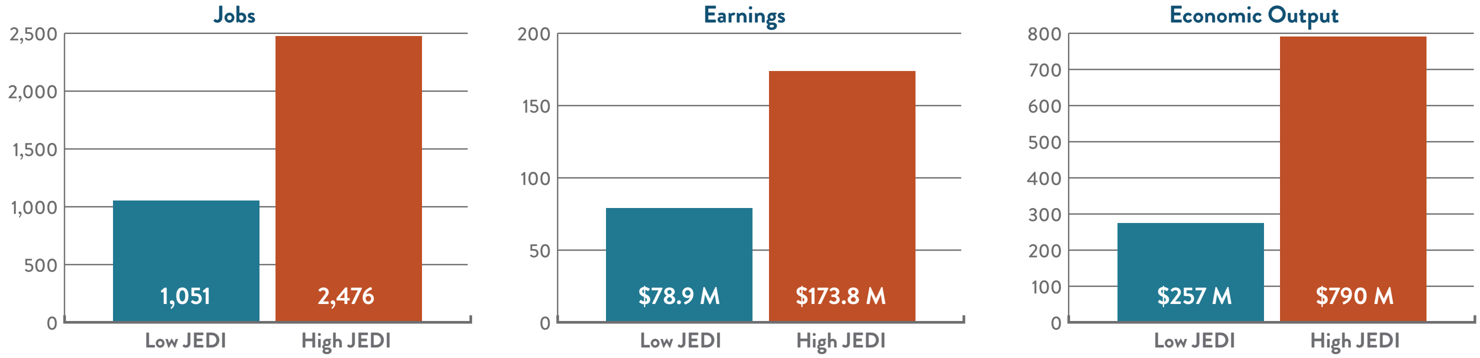
*Wind turbine repair worker rappelling on site.*

### Table 2: Economic Impact – Annual Operations

| | Low JEDI | | | High JEDI | | |
|---|---|---|---|---|---|---|
| **During Operating Years (annual)** | **Jobs** | **Earnings** | **Output** | **Jobs** | **Earnings** | **Output** |
| Onsite Labor Impacts | 172 | $18 M | $18 M | 224 | $27 M | $27 M |
| Local Revenue and Supply Chain Impacts | 575 | $43 M | $186 M | 1,270 | $93 M | $604 M |
| Induced Impacts | 304 | $17 M | $52 M | 982 | $54 M | $159 M |
| **Total** | **1,051** | **$79 M** | **$257 M** | **2,476** | **$174 M** | **$790 M** |

*Notes: Earnings and Output values are millions of dollars in year 2021 dollars. Jobs are full-time equivalent for a period of one year. Earnings include wage and salary compensation and benefits. Output refers to total economic activity, the value of total production. All estimates are gross impacts. Operating impacts are annual impacts.*

### Chart 2: Economic Impact – Annual Operations



## APPENDIX: PROJECT INPUTS

| Input | Value | Rationale |
|---|---|---|
| Project Location | North Carolina | The state under analysis; statewide multipliers specific to North Carolina were utilized for this analysis. |
| Year Construction Starts | 2028 | Date between the predicted construction start date for Kitty Hawk site OSW and other North Carolina OSW sites. |
| Total Project Size - Nameplate Capacity (MW) | 2,800 | Similar to Kitty Hawk site, but allows for increase from future developments. |
| Turbine Size (kW) | 15,000 | Projected industry standard for 2030. |
| Number of Turbines | 187 | Automatically generated by model, based on nameplate capacity and turbine size. |
| Turbine Capital Cost ($/kW) | $716 | Calculated based off of NREL's 2020 Annual Technology Baseline 2030 CAPEX estimation. |
| Owners Average Annual Operations & Maintenance Cost ($/kW) | $73 | NREL's 2020 Annual Technology Baseline 2030 O&M estimation. |
| Foundation Type | Monopile | Industry standard for water depths less than 40m. |
| Average Water Depth (meters) | 30 | Typical water depth 46 km off North Carolina coast. |
| Distance to Port (km)* | 46 | Similar to Kitty Hawk site; sufficiently distant to not be seen from land. |
| Distance to Landfall (km)* | 46 | Similar to Kitty Hawk site; sufficiently distant to not be seen from land. |
| Marine Cable Type (AC or DC) | DC | Automatically generated by model. |
| Number of Substations | 2 | Automatically generated by model . |
| Money Value (Dollar Year) | 2021 | The year this analysis was conducted. |

**25 nautical miles.*

### CONTACT

For more information about this analysis, contact John Hardin, Office of Science, Technology & Innovation, and Lindsay Miley, Division of Workforce Solutions, North Carolina Department of Commerce (nccommerce.com).