Offshore Wind Jobs and Economic Development Impact: Four Regional Scenarios

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WINDEExchange Webinar

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Overview

• NREL developed the Jobs and Economic Development Impact (JEDI) tool for fixed-bottom offshore wind projects in the United States
  o JEDI data from a number of sources such as the Navigant Consortium, IMPLAN, and regional experts
  o Assumptions verified through peer review

• We performed analyses of potential offshore wind deployment scenarios using the JEDI model – regional case studies
  o Collaborated with local experts in each region
  o Verified results with regional experts.
Four Regions Analyzed by OSW JEDI Model

• **Southeast Atlantic**
  - Georgia, South Carolina, North Carolina, Virginia

• **Great Lakes**
  - New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota

• **Mid-Atlantic**
  - Virginia, District of Columbia, Delaware, Maryland, Pennsylvania, New Jersey

• **Gulf of Mexico**
  - Texas, Louisiana, Mississippi, Alabama, Florida
Partnerships

• Professor Jonathan Miles, Dane Zammit, and Michelle Kraemer - James Madison University
  o Southeast
  o Mid-Atlantic

• Professor David Loomis - Illinois State University, Great Lakes Wind Collaborative
  o Great Lakes

Photo credit: Gary Norton / NREL PIX #27361
Offshore Wind JEDI
JEDI Background

• Defaults are based on real-world projects or input from project owners, developers, engineers, or other experts.
• IMPLAN input-output model is currently used as JEDI “backbone.”
• Please visit www.nrel.gov/analysis/jedi for the model, user guide, caveats, reports, and other details.
Offshore Wind JEDI Defaults

- Default cost information from the Navigant Consortium
- Some defaults based on a representative project in the Atlantic
- Jacket substructure in 25-m water
- 100 nautical miles from port
- 50 nautical miles from transmission
- Users can modify default costs
- Jacket substructure is the biggest default constraint

Photo credit: University of Maine / NREL PIX # 27462
Interpreting Results and Model Limitations

• JEDI results are gross, not net.
• JEDI does not factor in far-reaching impacts from development such as changes in utility rates, greenhouse gas emissions, property values or public health.
• JEDI cannot estimate impacts from supply-side changes such as technological improvements, price changes, or changes in taxes/subsidies.
• JEDI does not evaluate a project’s feasibility or profitability.
• NREL cannot be not responsible for how the model is used, applied, or results interpreted.
JEDI Results

• Jobs in full-time equivalents (FTEs)
  o Number of people working the equivalent of 40-hour weeks (2,080 hours/year)

• Earnings
  o Income from work
  o Includes wages, salaries, employer-provided benefits (retirement, health)

Photo Credit: Gamesa / NREL PIX #16001
Project Development & Onsite Labor Impacts

Sample job types

- Captains, mates and pilots of water vessels
- Crane or derrick operators
- Truck drivers
- Management, support
- Siting
- Marine engineers
Local Revenues, Turbine, Module, & Supply Chain Impacts

- Foundries
- Component manufacturers
- Equipment sales and financing
- Property taxes, banking, accounting

Photo Credit: Dennis Schroeder / NREL PIX #22569

Photo Credit: John De La Rosa / NREL PIX #26513

Photo Credit: Clipper Windpower / NREL PIX #14932

Photo Credit: Walt Musial / NREL PIX #26982
Induced Impacts

Money from increased revenue is spent in the local area on goods and services: sandwich shops, child care, grocery stores, clothing, other retail, public transit, new cars, restaurants, medical services.
Regional Case Studies
Southeast Atlantic Regional Findings

- Wages, project costs similar to JEDI defaults
- Several large ports well-suited to become offshore wind manufacturing hubs
- Presence of land-based wind manufacturing despite a lack of significant deployment
- 5 scenarios instead of 3 for Southeast.

Photo credit: Siemens AG / NREL PIX #19097
### SE Atlantic Construction Cost Scenarios ($/kW)

#### Three main cost and deployment scenarios*

<table>
<thead>
<tr>
<th>Cost (Scenario)</th>
<th>Capacity (MW) 2020</th>
<th>Capacity (MW) 2030</th>
<th>Construction Cost ($/kW) 2020</th>
<th>Construction Cost ($/kW) 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cost (A)</td>
<td>95</td>
<td>1,695</td>
<td>$5,407</td>
<td>$5,040</td>
</tr>
<tr>
<td>Medium Cost (B)</td>
<td>252</td>
<td>4,027</td>
<td>$5,119</td>
<td>$4,480</td>
</tr>
<tr>
<td>Low Cost (C)</td>
<td>985</td>
<td>9,760</td>
<td>$4,972</td>
<td>$3,920</td>
</tr>
</tbody>
</table>

* For the SE, we created extra scenarios to test local content inputs.

#### Five local content scenarios

<table>
<thead>
<tr>
<th>Local Content (Scenario)</th>
<th>2020 Local Content</th>
<th>2030 Local Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>High local content (D)</td>
<td>28%</td>
<td>75%</td>
</tr>
<tr>
<td>Medium local content</td>
<td>23%</td>
<td>54%</td>
</tr>
<tr>
<td>Low local content (E)</td>
<td>20%</td>
<td>29%</td>
</tr>
</tbody>
</table>
Estimated Total FTE Jobs Supported – SE Atlantic

Low cost, high deployment, high regional content

Scenario
A
B
C
D
E
Great Lakes Regional Findings

- Water depth can vary greatly from site to site.
- Lakes are freshwater, prone to freezing, but also is not as corrosive as the salt water found in the ocean.
- Fewer port options exist in the Great Lakes than in the other regions studied.
- Potential wind sites in the Great Lakes are usually further from shore than potential sites off of the U.S. coast.
- Locks that connect the Great Lakes with the Atlantic Ocean may present logistical challenges. Height and width constraints make transporting large offshore wind equipment difficult.
- Lakes do not experience tides.
- Overall: development in the Great Lakes is more expensive than the Atlantic despite factors that push costs down.
## Great Lakes Cost and Deployment Scenarios

### Three cost and deployment scenarios

<table>
<thead>
<tr>
<th>Deployment (Scenario)</th>
<th>Capacity (MW) 2020</th>
<th>Capacity (MW) 2030</th>
<th>Construction Cost ($/kW) 2020</th>
<th>Construction Cost ($/kW) 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>250</td>
<td>1,000</td>
<td>$6,632</td>
<td>$5,969</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>500</td>
<td>2,000</td>
<td>$6,632</td>
<td>$5,306</td>
</tr>
<tr>
<td>High (C)</td>
<td>1,000</td>
<td>5,000</td>
<td>$6,632</td>
<td>$4,642</td>
</tr>
</tbody>
</table>

### Three local content* scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>2020 Local Content</th>
<th>2030 Local Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>17%</td>
<td>21%</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>14%</td>
<td>41%</td>
</tr>
<tr>
<td>High (C)</td>
<td>28%</td>
<td>57%</td>
</tr>
</tbody>
</table>

*In this case, “local content” means content that is produced within the region.
Estimated Total FTE Jobs Supported – Great Lakes

High deployment scenario with 5GW deployment and 28% (2020) to 57% (2030) regional content.
Gulf of Mexico Regional Findings

- **Existing oil and gas industry**
  - Manufacturing infrastructure
  - Workforce and skills
- **Higher potential in the 30-m depth**
  - 30% of all U.S. potential
  - Lower construction costs
- **Hurricane exposure**
  - Anticipated increase in equipment costs
  - Unknown impact on efficiency

Photo credit: Harland & Wolff Heavy Industries / NREL PIX # 20575
# Gulf of Mexico Scenarios

## Three cost and deployment scenarios

<table>
<thead>
<tr>
<th></th>
<th>Capacity (MW) 2020</th>
<th>Capacity (MW) 2030</th>
<th>Construction Cost ($/kW) 2020</th>
<th>Construction Cost ($/kW) 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>85</td>
<td>1,000</td>
<td>$5,800</td>
<td>$4,930</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>250</td>
<td>4,000</td>
<td>$5,500</td>
<td>$4,125</td>
</tr>
<tr>
<td>High (C)</td>
<td>600</td>
<td>5,000</td>
<td>$5,500</td>
<td>$3,575</td>
</tr>
</tbody>
</table>

## Three local content scenarios

<table>
<thead>
<tr>
<th></th>
<th>2020 Local Content</th>
<th>2030 Local Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>43%</td>
<td>62%</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>47%</td>
<td>72%</td>
</tr>
<tr>
<td>High (C)</td>
<td>52%</td>
<td>80%</td>
</tr>
</tbody>
</table>
Estimated Total FTE Jobs Supported – Gulf of Mexico

High scenario shows 5 GW by 2050 with 52% (2030) to 80% (2050) regional content.
Mid-Atlantic Regional Findings

• Wages, project costs similar to JEDI defaults

• Several large ports well-suited to become offshore wind manufacturing hubs

• States already offering incentives

Credit: Robert Thresher / NREL PIX # 13045
Wind Energy Leasing Areas – Atlantic Coast

Source: Bureau of Ocean Energy Management, 2014
## Mid-Atlantic Deployment Scenarios

### Three cost and deployment scenarios

<table>
<thead>
<tr>
<th>Deployment (Scenario)</th>
<th>2020 Capacity (MW)</th>
<th>2030 Capacity (MW)</th>
<th>2020 Cost ($/kW)</th>
<th>2030 Cost ($/kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>366</td>
<td>3,196</td>
<td>$5,839</td>
<td>$5,460</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>1,982</td>
<td>7,802</td>
<td>$5,604</td>
<td>$4,826</td>
</tr>
<tr>
<td>High (C)</td>
<td>3,900</td>
<td>16,800</td>
<td>$5,362</td>
<td>$4,228</td>
</tr>
</tbody>
</table>

### Three local content scenarios

<table>
<thead>
<tr>
<th>Local Content (Scenario)</th>
<th>2020 Local Content</th>
<th>2030 Local Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (A)</td>
<td>23%</td>
<td>42%</td>
</tr>
<tr>
<td>Medium (B)</td>
<td>29%</td>
<td>69%</td>
</tr>
<tr>
<td>High (C)</td>
<td>39%</td>
<td>79%</td>
</tr>
</tbody>
</table>
The high scenario shows 16.8 GW deployed by 2050 with 39% (2030) to 79% (2050) regional content.
All Scenarios

• Jobs are well-compensated.
• On-site earnings around $130,000/yr. in most regions; $140,000/yr. in the Great Lakes.
• Supply chain earnings of approx. $60,000/yr.
• Induced earnings of approx. $50,000/yr.
## Summary – JEDI estimates on par with others

<table>
<thead>
<tr>
<th>Region</th>
<th>Estimated Total Construction Period FTE/MW – (Low-Moderate-High)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>16-24-31</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>14-17-25</td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>27-28-29</td>
</tr>
<tr>
<td>Mid-Atlantic</td>
<td>16-23-25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>Estimated Total Construction Period Ranges of FTE/MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Insight (2003)*</td>
<td>1.4–2.4</td>
</tr>
<tr>
<td>Flynn and Carey (2007)*</td>
<td>2.0–3.7</td>
</tr>
<tr>
<td>Coad and Antunes (2010)</td>
<td>25–29</td>
</tr>
<tr>
<td>Hagerman et al. (2010)</td>
<td>39</td>
</tr>
<tr>
<td>Bloomberg New Energy Finance (Global Direct)(2012)</td>
<td>17</td>
</tr>
</tbody>
</table>

Source: Lantz et al. 2013

* Global Insight (2003) and Flynn and Carey (2007) anticipated significantly lower construction costs (including labor payments) than those anticipated in later studies.
This presentation provides information contained in an NREL technical report on the offshore wind JEDI model and regional case studies (Keyser et al, 2014).

The report contains additional details including non-proprietary information from industry contacts.

NREL will continue to support offshore wind JEDI model use through technical assistance.

We are currently working on a floating technology JEDI model, to accommodate other U.S. regional offshore wind resources.
Thank You
References


Fact sheets for each region: