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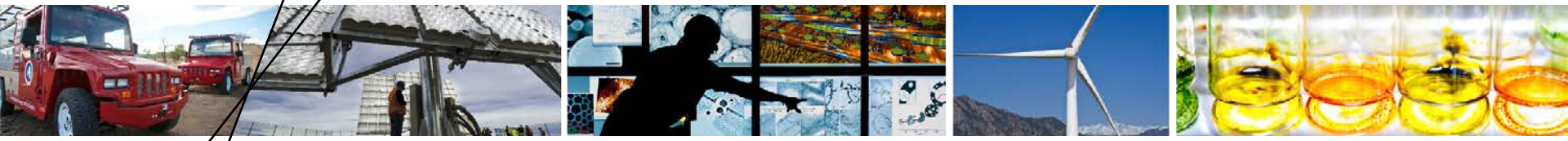
Offshore Wind Jobs and Economic Development Impact: Four Regional Scenarios



Suzanne Tegen, NREL

WINDExchange Webinar

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NREL/PR-5000-61894

Overview

- **NREL developed the Jobs and Economic Development Impact (JEDI) tool for fixed-bottom offshore wind projects in the United States**
  - JEDI data from a number of sources such as the Navigant Consortium, IMPLAN, and regional experts
  - Assumptions verified through peer review
- **We performed analyses of potential offshore wind deployment scenarios using the JEDI model – regional case studies**
  - Collaborated with local experts in each region
  - 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**
  - Southeast
  - Mid-Atlantic
- **Professor David Loomis - Illinois State University, Great Lakes Wind Collaborative**
  - Great Lakes

Photo credit: Gary Norton / NREL PIX #27361

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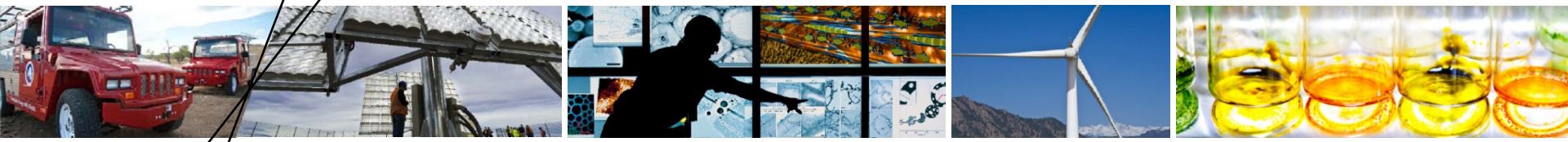

Offshore Wind JEDI

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)**
  - Number of people working the equivalent of 40-hour weeks (2,080 hours/year)
- **Earnings**
  - Income from work
  - 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

Photo credit: University of Maine / NREL PIX #27468

Photo credit: Gary Norton / NREL PIX #27350

Photo credit: Walt Musial / NREL PIX #26994

Local Revenues, Turbine, Module, & Supply Chain Impacts

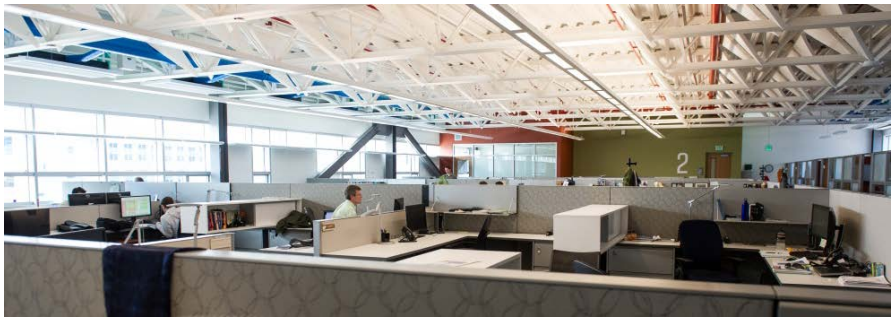

Photo Credit: Dennis Schroeder / NREL PIX #22569

Photo from iStock/4088468

Photo Credit: Walt Musial / NREL PIX #26982

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

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

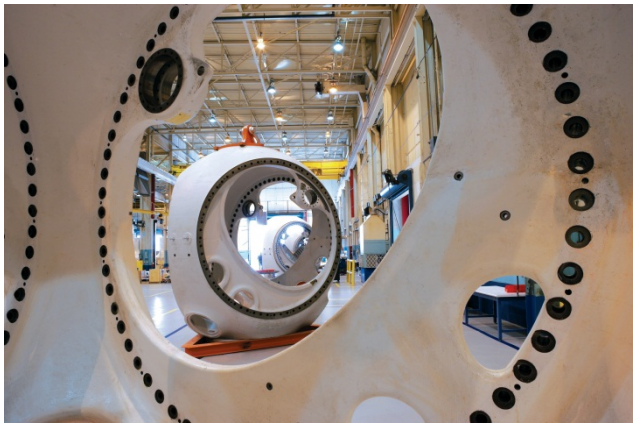

Photo Credit: Clipper Windpower / NREL PIX #14932

Induced Impacts


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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.*


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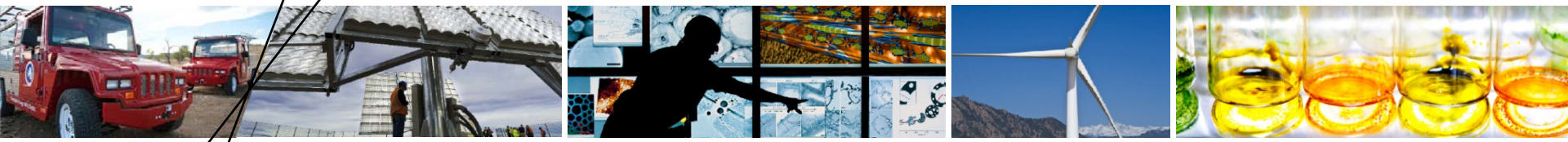


Regional Case Studies

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*

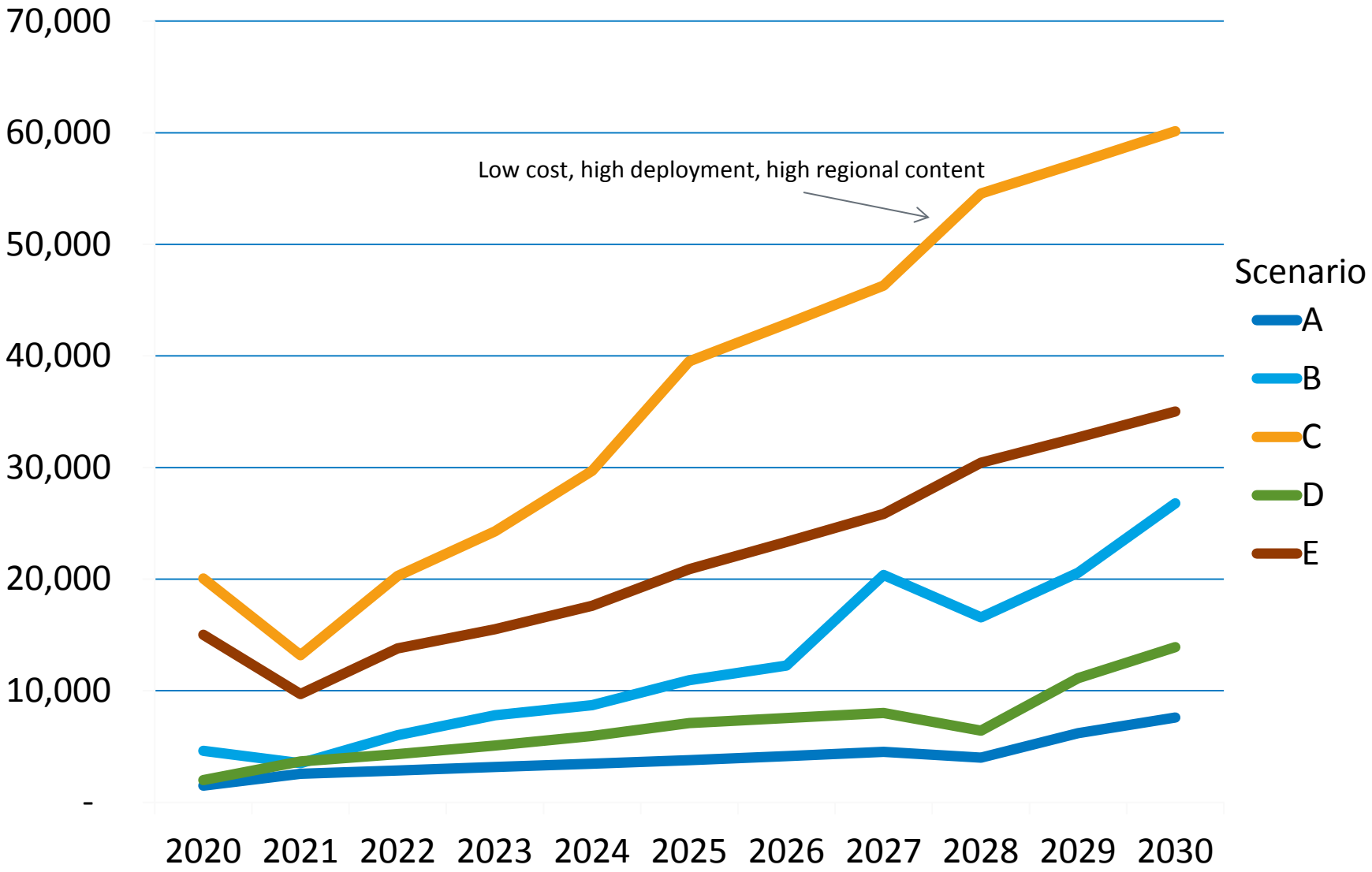
Cost (Scenario)	Capacity (MW) 2020	Capacity (MW) 2030	Construction Cost ($/kW) 2020	Construction Cost ($/kW) 2030
High Cost (A)	95	1,695	$5,407	$5,040
Medium Cost (B)	252	4,027	$5,119	$4,480
Low Cost (C)	985	9,760	$4,972	$3,920

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

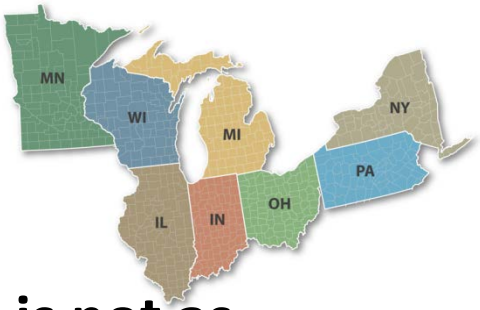
Five local content scenarios

Local Content (Scenario)	2020 Local Content	2030 Local Content
High local content (D)	28%	75%
Medium local content	23%	54%
Low local content (E)	20%	29%

Estimated Total FTE Jobs Supported – SE Atlantic



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

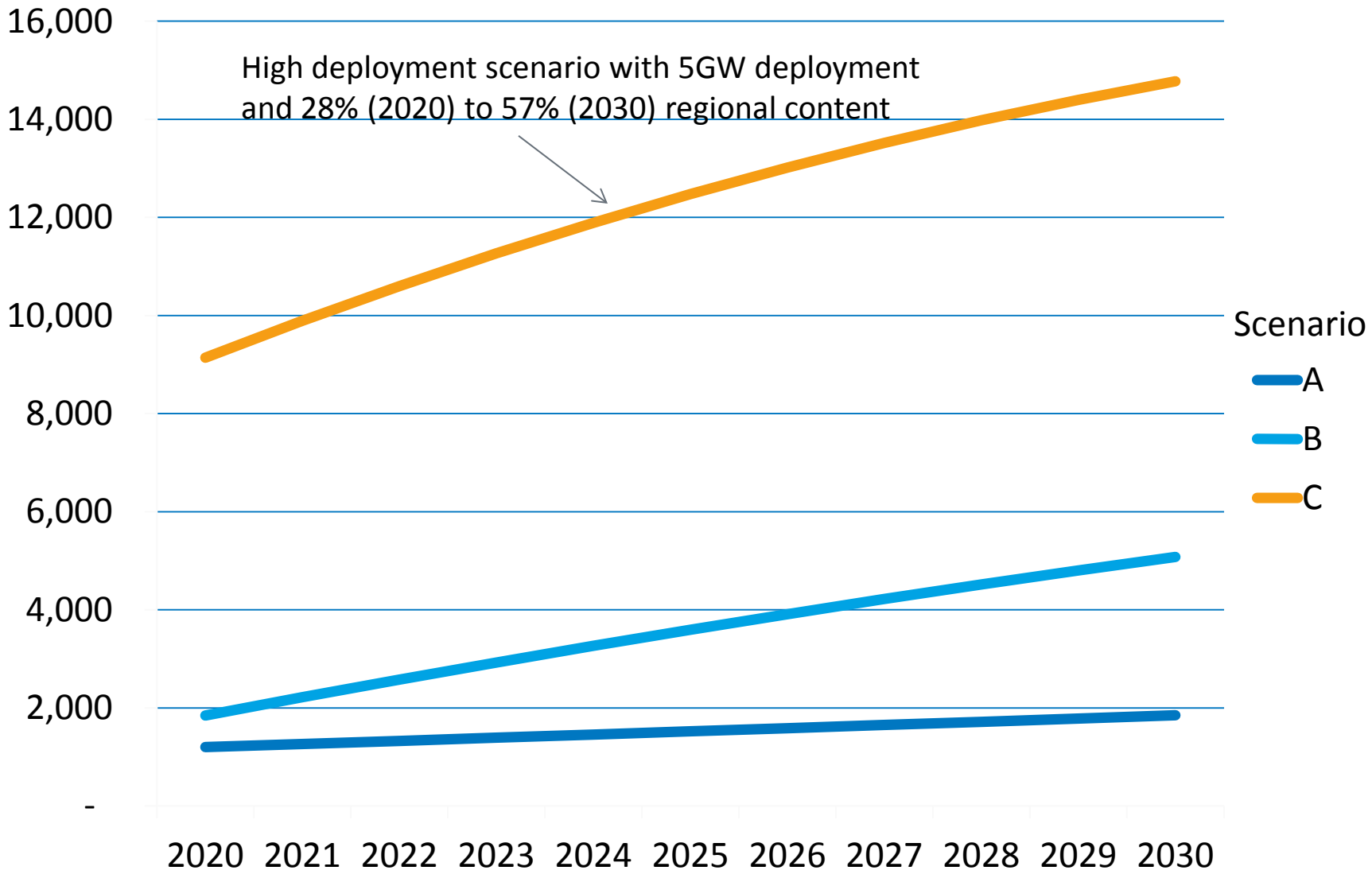
Deployment (Scenario)	Capacity (MW) 2020	Capacity (MW) 2030	Construction Cost ($/kW) 2020	Construction Cost ($/kW) 2030
Low (A)	250	1,000	$6,632	$5,969
Medium (B)	500	2,000	$6,632	$5,306
High (C)	1,000	5,000	$6,632	$4,642

Three local content* scenarios

Scenario	2020 Local Content	2030 Local Content
Low (A)	17%	21%
Medium (B)	14%	41%
High (C)	28%	57%

*In this case, “local content” means content that is produced within the region.

Estimated Total FTE Jobs Supported – Great Lakes



Gulf of Mexico Regional Findings

Photo credit: Harland & Wolff Heavy Industries / NREL PIX # 20575

- **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

Gulf of Mexico Scenarios

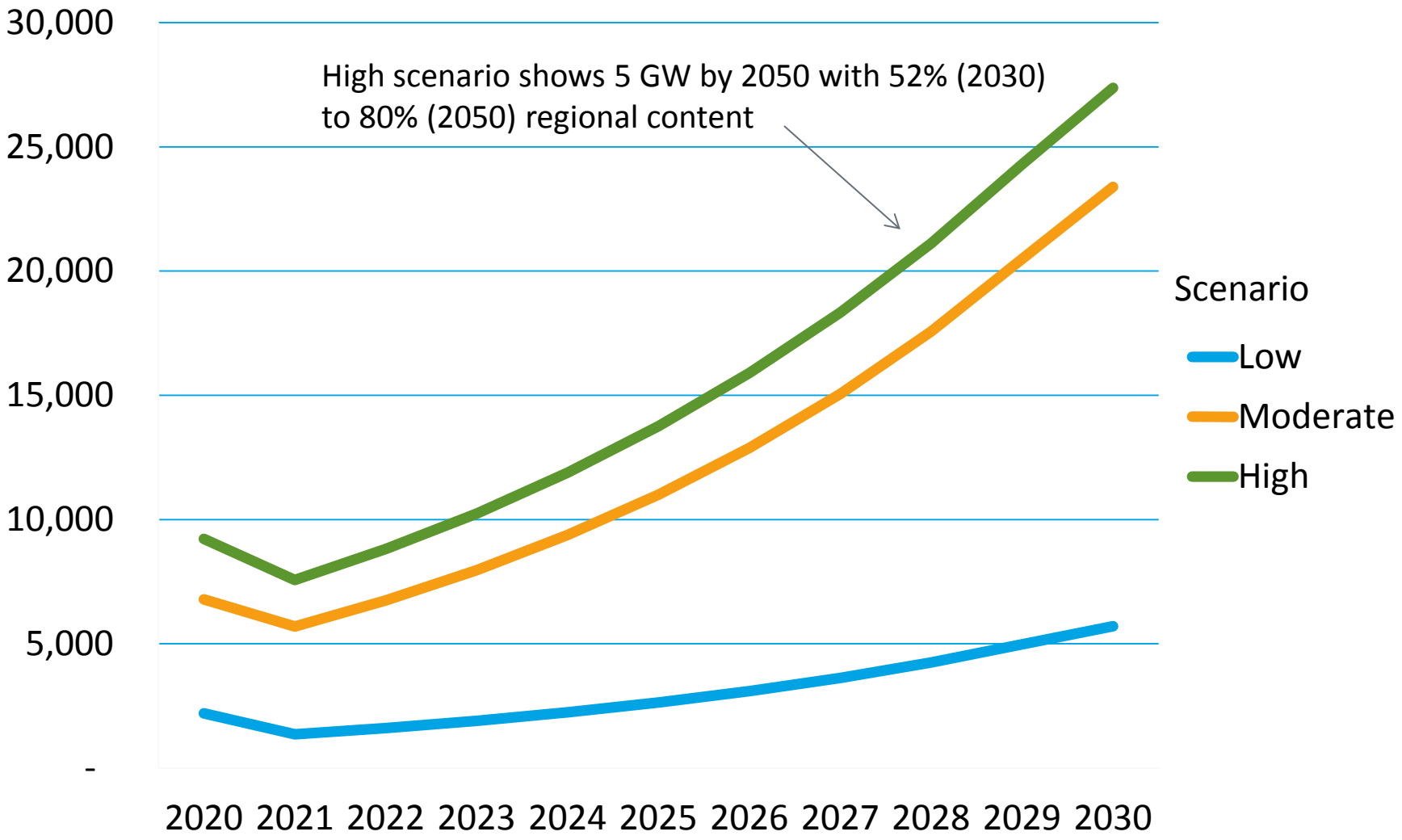
Three cost and deployment scenarios

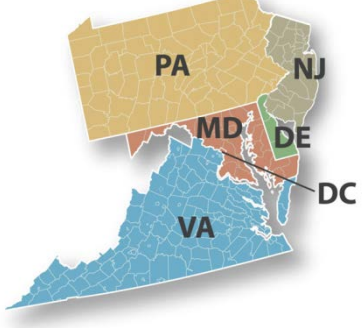
	Capacity (MW) 2020	Capacity (MW) 2030	Construction Cost ($/kW) 2020	Construction Cost ($/kW) 2030
Low (A)	85	1,000	$5,800	$4,930
Medium (B)	250	4,000	$5,500	$4,125
High (C)	600	5,000	$5,500	$3,575

Three local content scenarios

	2020 Local Content	2030 Local Content
Low (A)	43%	62%
Medium (B)	47%	72%
High (C)	52%	80%

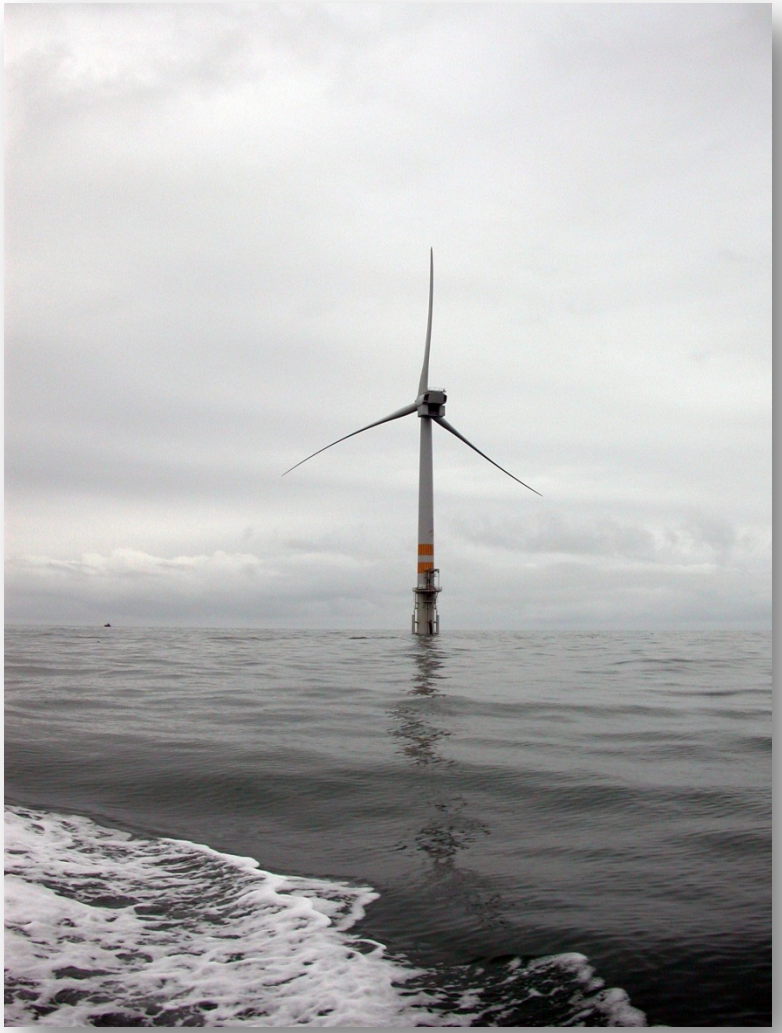
Estimated Total FTE Jobs Supported – Gulf of Mexico





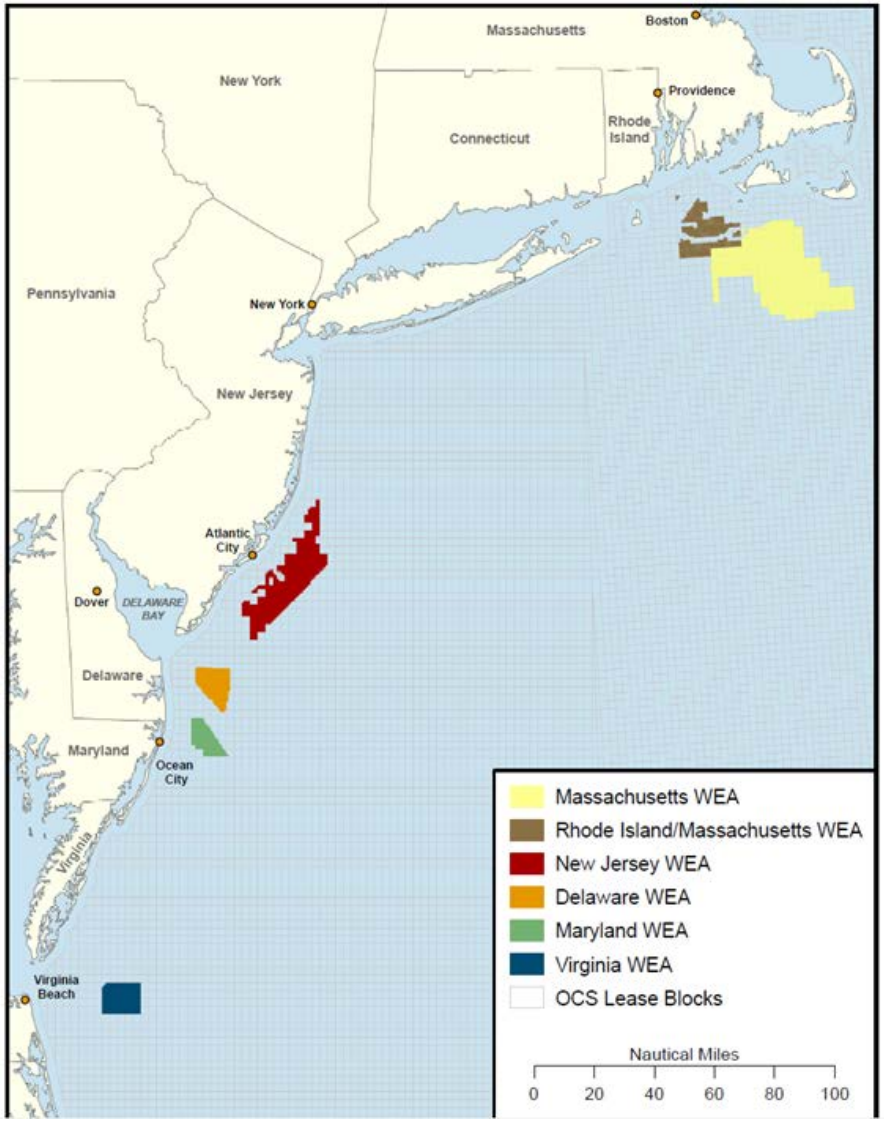
Mid-Atlantic Regional Findings

- **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

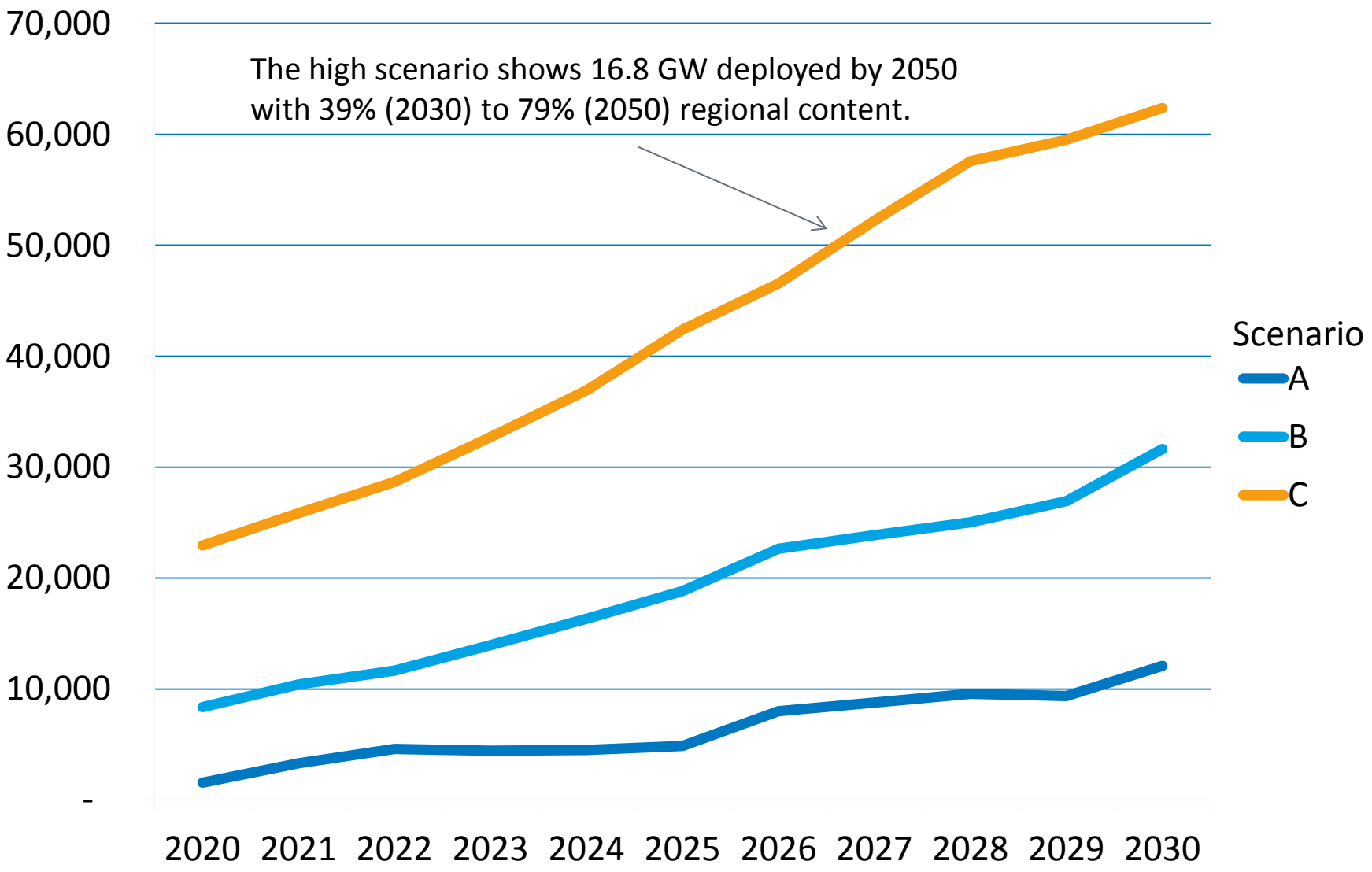
Three cost and deployment scenarios

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

Three local content scenarios

Local Content (Scenario)	2020 Local Content	2030 Local Content
Low (A)	23%	42%
Medium (B)	29%	69%
High (C)	39%	79%

Estimated Total FTE Jobs Supported – Mid-Atlantic



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.**

Credit: HC Sorensun, Middelgrunden Wind Turbine Cooperative / NREL PIX # 17856

Summary – JEDI estimates on par with others

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

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

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.

Report, Technical Assistance, Current Work

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.

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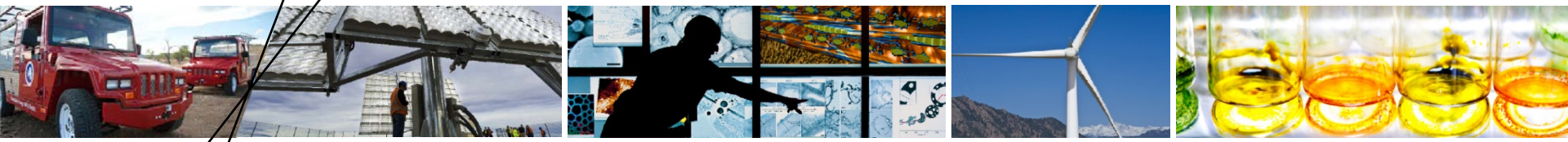

Thank You

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Fact sheets for each region:

Southeast http://www1.eere.energy.gov/wind/pdfs/57565.pdf; Great Lakes http://www1.eere.energy.gov/wind/pdfs/57511.pdf; Gulf Coast http://www.nrel.gov/docs/fy14osti/60418.pdf; Mid-Atlantic http://www.nrel.gov/docs/fy14osti/60445.pdf