Gearing Up for 2030:

Building the offshore wind supply chain and workforce needed to deploy 30 GW and beyond

Photo from HC Sorensen 17856

Webinar Logistics

Photo by Dennis Schroeder, NREL 40480

- Webinar will be recorded and posted to the National Renewable Energy Laboratory (NREL) YouTube channel and WINDExchange website
- Question-and-answer (Q&A) session will follow the presentation
- Pose questions using the Q&A function during and at the end of the presentation.

Speaker Bios

Dr. Matthew Shields joined NREL in 2018 and leads the lab's work on offshore wind techno-economic analysis, which involves developing cost models, analyzing market and technology trends, and projecting the future costs of offshore wind. He has conducted analysis on the cost impacts of turbine and plant upsizing, supply chain opportunities for the domestic offshore wind industry, floating wind marine logistics, and the feasibility assessments for novel technological solutions.

Jeremy Stefek is a member of the Technology, Engineering, and Deployment Group at the National Wind Technology Center at NREL. His research areas include workforce, economic, and community development for land-based wind, offshore wind, and waterpower technologies. Jeremy leads the wind workforce analysis efforts which seek to understand the needs of industry, educational institutions, and students. He manages the Jobs and Economic Development Impact (JEDI) models and conducts economic impacts analysis. Jeremy supports stakeholder engagement activities, providing community resources related to economic development from wind energy.

What Will We Cover?

- Introduction to offshore wind energy
- Offshore wind energy supply chain and workforce basics
- Overview of NREL resources.

Photo from Siemens AG 27853

Introduction to Offshore Wind Energy

Biden Administration Offshore Wind Goals

Photo by Gary Norton / DOE 41184

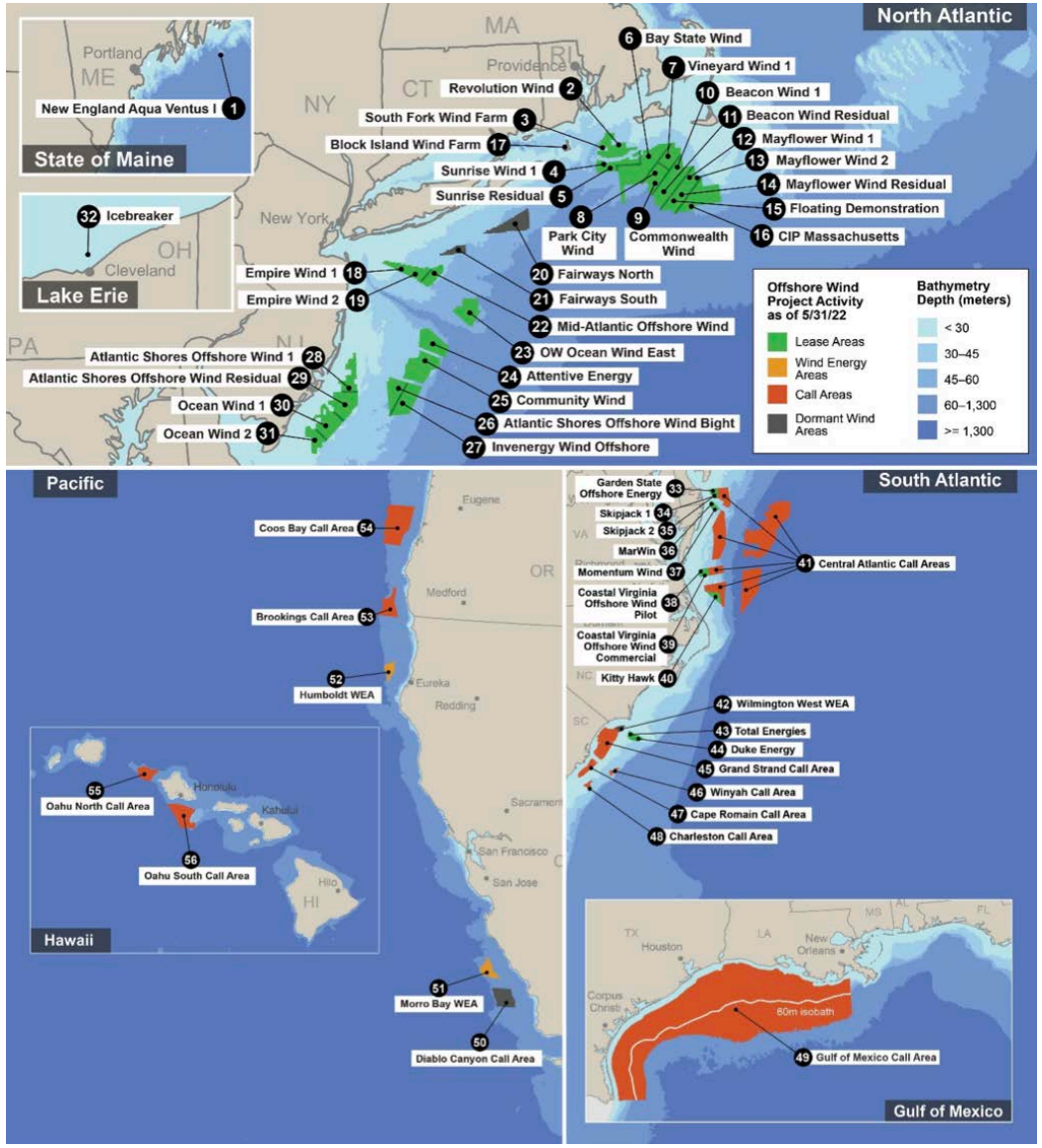
- In March 2021, the Biden administration set a national target of installing **30 gigawatts (GW) of offshore wind energy by 2030.**[1]

- The steps identified to support this target include:
  - Advancing U.S. wind energy projects to create well-paying, unionized jobs
  - Investing in American infrastructure to strengthen the domestic supply chain
  - Supporting critical research and development and data sharing.[1]

[1] The White House. 2021. "FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs." March 29, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

U.S. Planned Projects

- Offshore wind energy planning and development activities are ongoing in the Atlantic, Pacific, Gulf of Mexico, and Great Lakes regions.
- As of March 2023, there are 42 MW of operational offshore wind energy projects in the United States.
- The offshore wind energy capacity in the project pipeline is sufficient to reach 30 GW by 2030.[2]
  - On the Atlantic coast, 19 total offshore wind energy projects are expected to be constructed by early 2028.
  - The Vineyard Wind 1 (800 MW) and South Fork Wind (130 MW) projects are under construction and expected to become operational by the end of 2023.



Graphic by NREL
The graphic represents projects through mid 2022

[2] Shields, M., et al. 2022. *The Demand for a Domestic Offshore Wind Energy Supply Chain.* Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-81602. https://www.nrel.gov/docs/fy22osti/81602.pdf.

Offshore Wind Energy Supply Chain

Introduction to the Domestic Offshore Wind Supply Chain

- A domestic supply chain is critical for the growth of a sustainable, equitable offshore wind industry in the United States.

- However, there is still uncertainty about:
  - Scope of supply chain
  - Development time frames needed to build critical resources
  - The impact of the Inflation Reduction Act and other incentive policies
  - Level of investment required
  - Potential benefits available to local communities and workers
  - Significance of gaps in existing manufacturing, port, vessel, or workforce infrastructure.

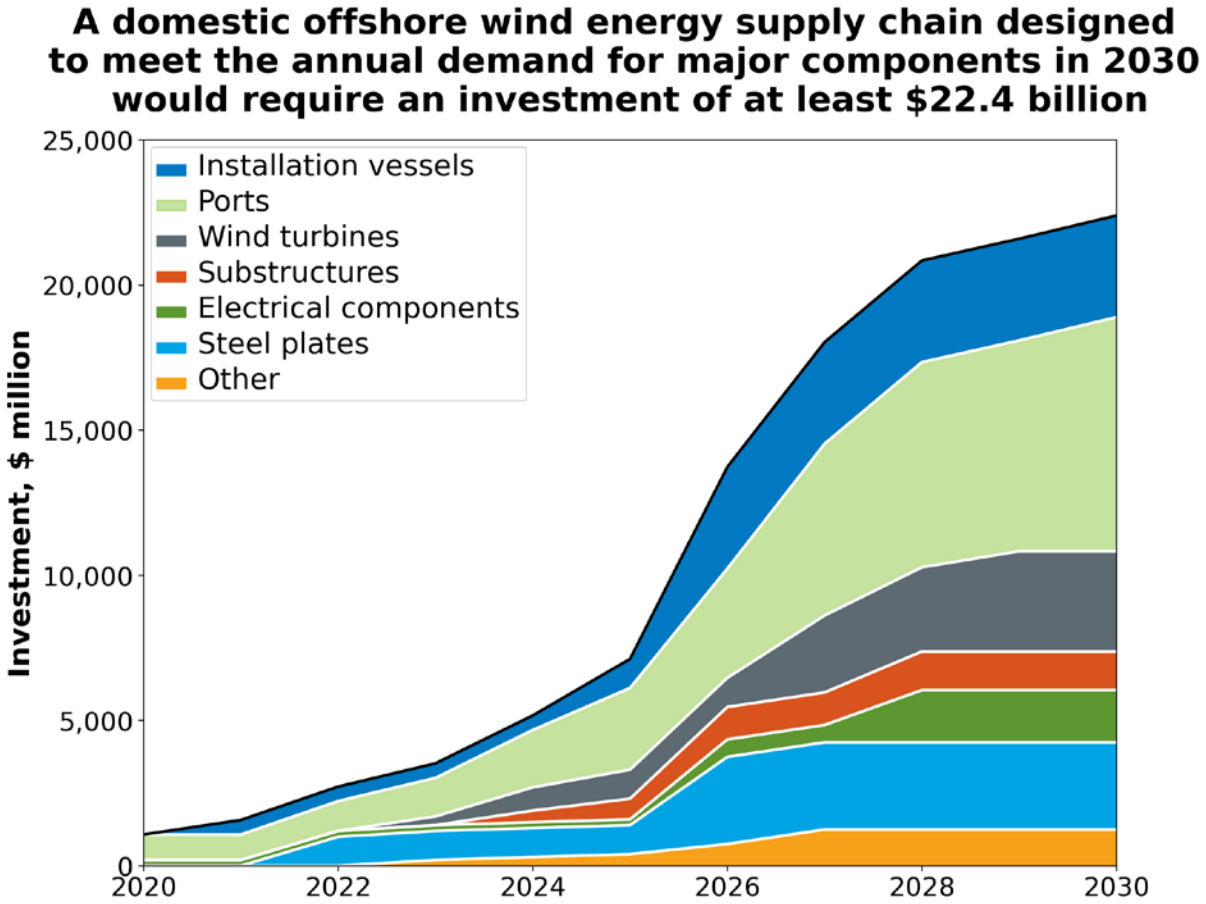
Offshore wind foundations and turbines staged at portside in Germany.

Photo by Gary Norton / DOE 17889

What Are the Requirements of an Offshore Wind Supply Chain?

Developing a domestic offshore wind supply chain by 2030 could require:

- Overall supply chain investment of at least $22.4 billion
  - Includes investment of around $11 billion in ports and large installation vessels
- Installation of more than 2,100 offshore wind turbines
- Development of at least 34 major component manufacturing facilities.[3]



Graphic by NREL

[3] Shields, M., et al. 2023. *A Supply Chain Road Map for Offshore Wind Energy in the United States.* Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84710. https://www.nrel.gov/docs/fy23osti/84710.pdf.

What Are the Requirements of an Offshore Wind Supply Chain? (cont.)

An offshore wind turbine nacelle at a port facility in Denmark.

Photo from Siemens AG, 27863

- Development of a supporting supply chain that leverages existing U.S. businesses
- Recruitment and training of a specialized domestic workforce
- Coordination between industry, community, workforce (including unions), and government stakeholders
- Equitable approach to industry growth, which:
  - Requires engaging community members, mitigating negative impacts, and providing benefits for port communities.

Supply Chain Stakeholders

Offshore wind energy developers

Manufacturing and assembly companies

Businesses in supporting supply chain

Transportation and logistics companies

Port authorities or governance bodies

Federal, state, and local governments

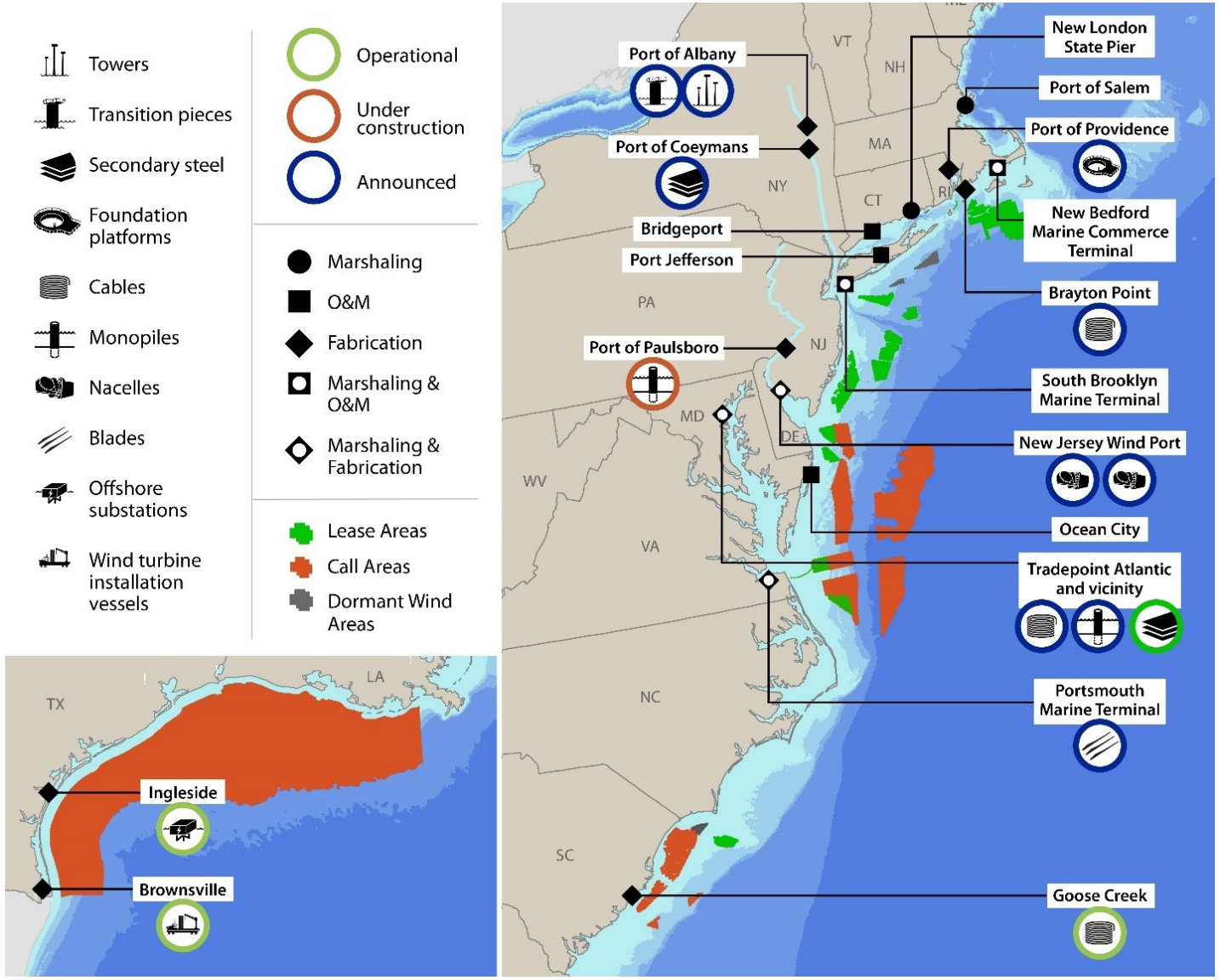
Community members and groups

Labor unions and workers

Workforce training institutions

Photo from Siemens AG 27853

Announced U.S. Manufacturing Facilities



Announced manufacturing facilities for critical offshore wind energy components in the United States, as of January, 2023

Graphic by NREL

Offshore Wind Port Facilities

- Due to their large size, offshore wind turbine components are typically manufactured and staged in port facilities:
  - **Fabrication ports** have manufacturing facilities that produce components of offshore wind energy projects.
  - **Marshaling ports** are used to stage components and load them onto installation vessels.

Offshore wind turbine components at a staging area in Germany.

Photo by Walt Musial, NREL 26988

Developing Port Facilities

Visualization of the New Jersey Wind Port, which will be both a fabrication and marshaling port.

Graphic from New Jersey Economic Development Authority

- Existing port facilities may be modified, or new ports may be constructed.
- Developing offshore wind energy ports requires significant investment and planning:
  - Marshaling ports have more requirements for space and bearing capacity
  - Each facility costs between $200-400 million
  - Permitting and construction of new facilities can take up to 5 years.[3]

[3] Shields, M., et al. 2023. *A Supply Chain Road Map for Offshore Wind Energy in the United States.* Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84710. https://www.nrel.gov/docs/fy23osti/84710.pdf.

Offshore Wind Installation Vessels

Wind Turbine Installation Vessel (WTIV)

Photo from Siemens AG 27858

WTIVs are highly specialized vessels used to transport and assemble offshore wind turbines.

Heavy Lift Vessel (HLV)

Photo by Walt Musial / NREL 26994

HLVs are traditionally used in oil & gas industry and will likely be used to install offshore wind turbine foundations.

Feeder Barge

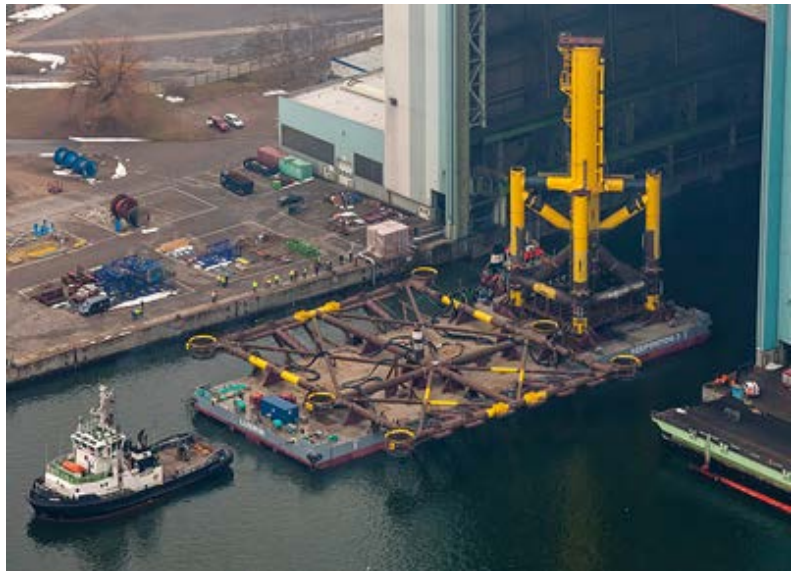


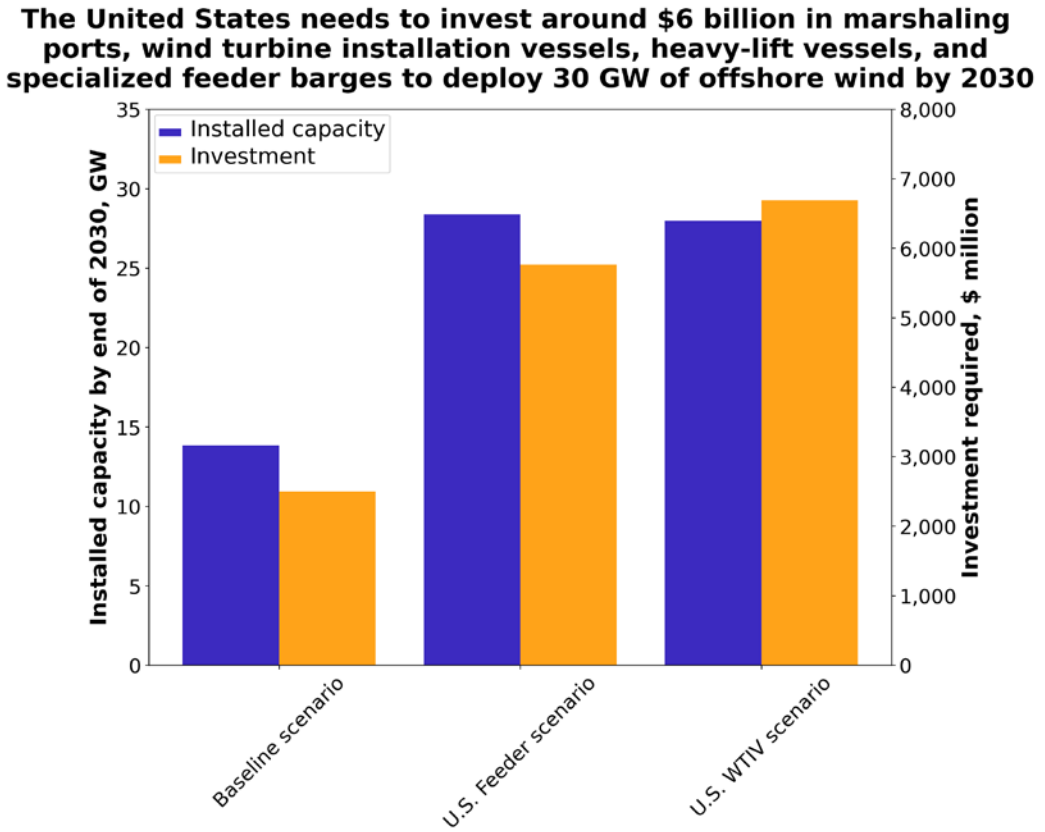
Photo from Siemens AG 27837

Feeder barges are used to transport components from ports to project sites.

There will be a significant additional demand for other installation vessels (survey, guard, tugboats, cable lay) and service vessels (crew transfer, service operation).

U.S.-Specific Vessel Considerations

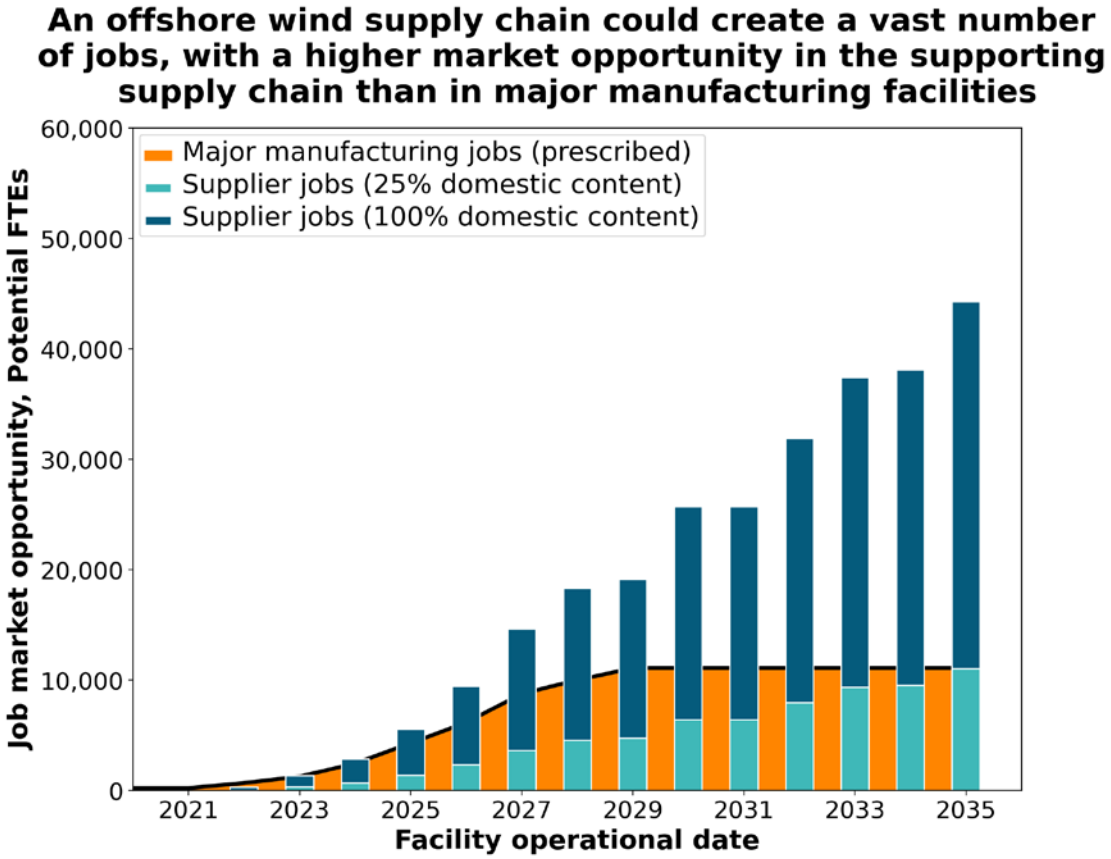
- The Jones Act requires any cargo transported between U.S. ports to be carried by U.S. ships with American crews.
- Possible installation strategies:
  - Construct new WTIVs in the U.S.
  - Use U.S.-flagged feeder barges to transport components to WTIVs or HLVs that are U.S.- or foreign-flagged
- One domestic WTIV is currently under construction, but more are needed
  - Limited number of U.S. shipyards with the capability and motivation to build WTIVs
  - Constructing WTIVs requires at least 3-4 years.
- U.S. offshore wind energy projects will have to compete with European projects for the use of European WTIVs.



Graphic by NREL

Supporting Supply Chain

- Major components (e.g., towers, nacelles) contain subassemblies and subcomponents.
- Many of these supporting components could be produced by existing businesses that work in related industries (e.g., land-based wind, aerospace, shipbuilding, oil and gas).
- There is a larger job market opportunity in the supporting supply chain than for major components.
- Developing a supporting supply chain will require significant investment, coordination, and outreach to manufacturers.



Graphic by NREL

Benefits of a Domestic Supporting Supply Chain

An offshore wind turbine substructure in Germany.

Photo by Walt Musial, NREL 26987

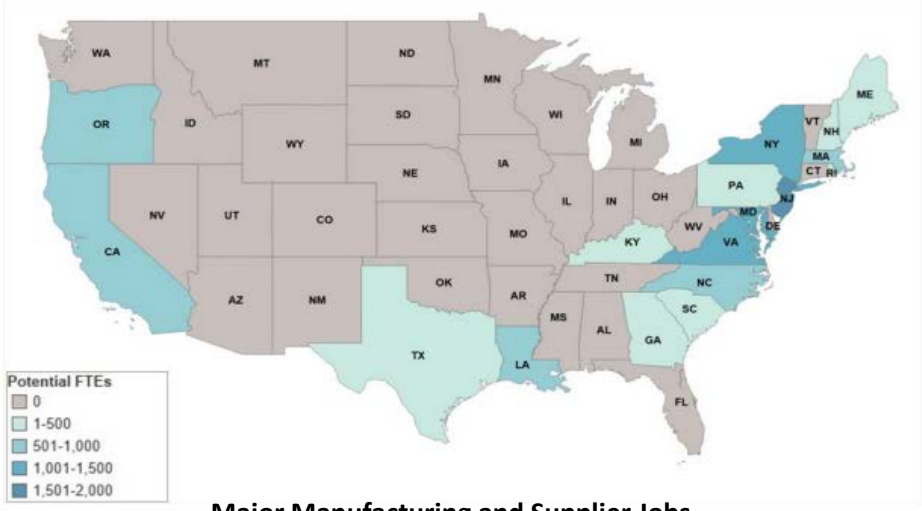
- Reduced reliance on global supply chains
- De-risk offshore wind deployment goals in the U.S.
- Create significant jobs and economic benefits:
  - 10,000 major manufacturing jobs by 2030
  - Opportunity space for up to 50,000 supporting supplier jobs
  - $1.6 - $6.2 billion of annual value added GDP
  - Job potential in both coastal and non-coastal states.[3]
- Understand best technologies, infrastructure, and logistics for the U.S. market.

[3] Shields, M., et al. 2023. *A Supply Chain Road Map for Offshore Wind Energy in the United States.* Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-84710. https://www.nrel.gov/docs/fy23osti/84710.pdf.

Local Economic Impacts from Supply Chain

- Communities near supply chain facilities may benefit from direct, indirect, and induced jobs and economic impacts.
- States, manufacturers, and developers may differ in their requirements or goals for local hiring and contracting.
- Local capacity to meet workforce demand can depend on:
  - Access to training
  - Awareness of opportunities and requirements
  - Equitable opportunities for underrepresented populations to join the industry
  - Coordination between governments, industry, training institutions, and labor unions.

Major Manufacturing Jobs



Major Manufacturing and Supplier Jobs

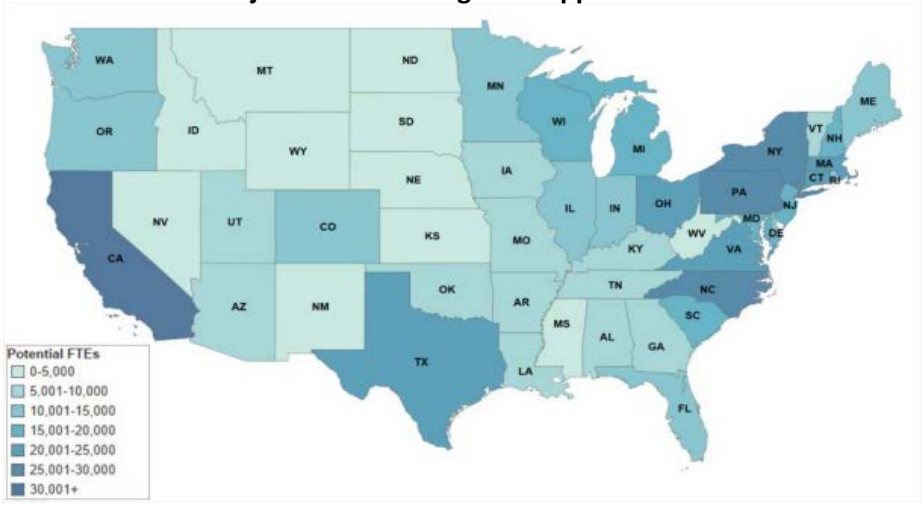
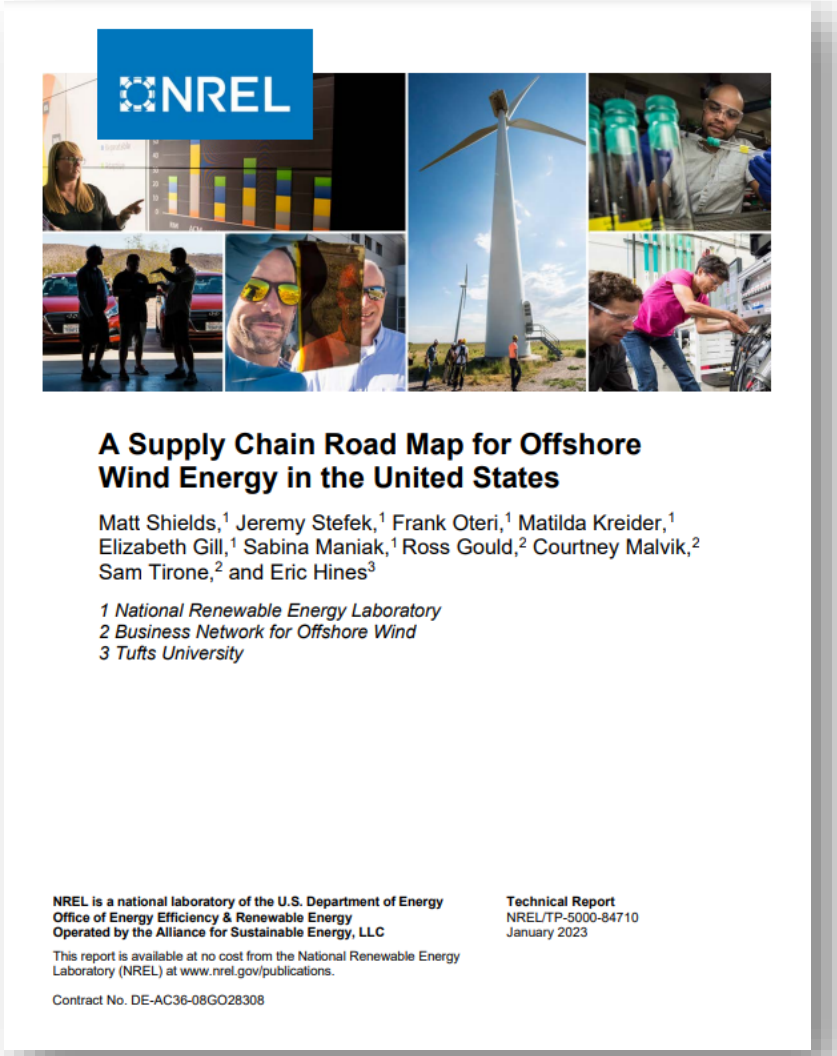


Figure 21. Job market opportunity for major manufacturing jobs (top) and the job market opportunity for major manufacturing and supplier jobs (bottom) for the domestic supply chain scenario by 2035, assuming 100% domestic content

Graphic by NREL

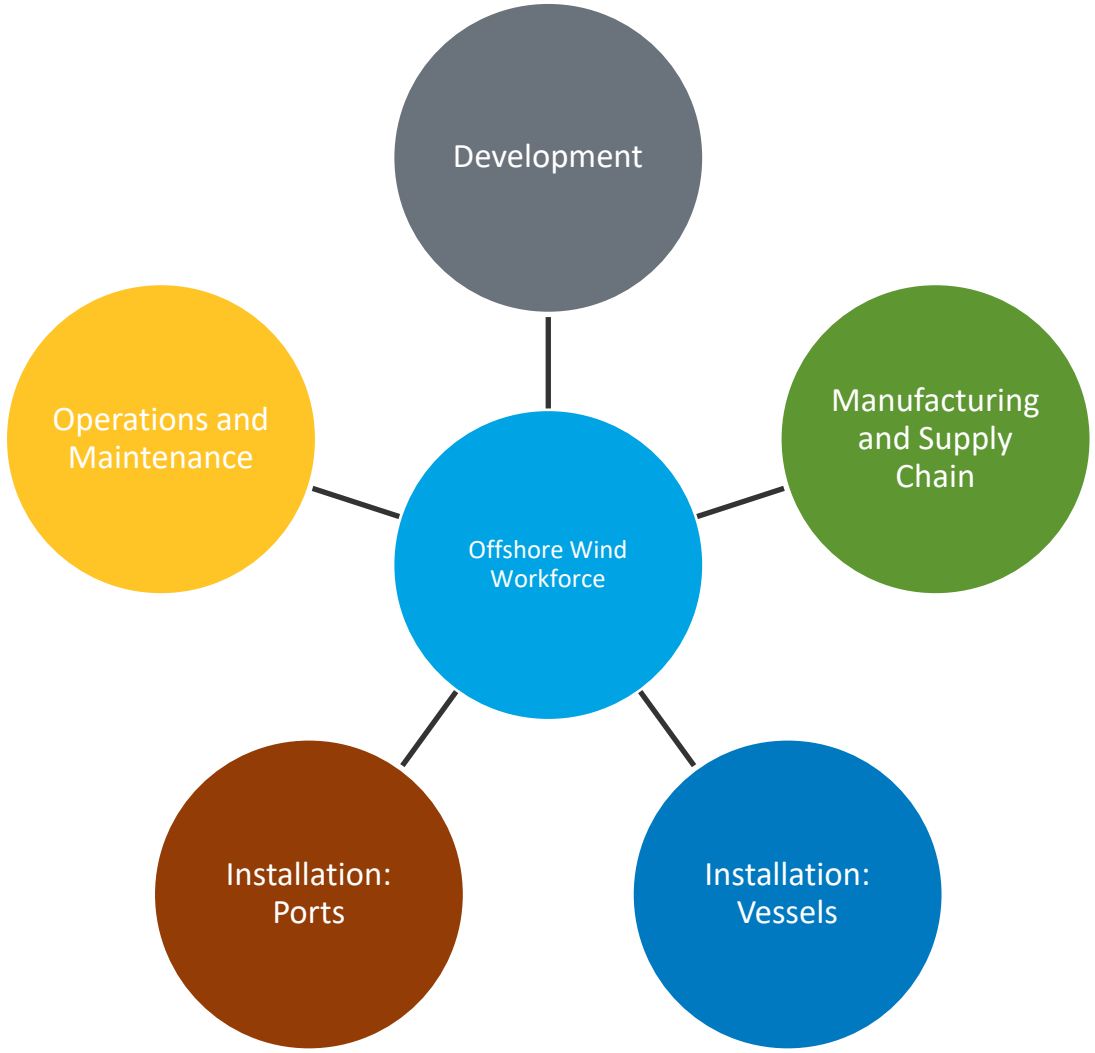
Overview of the Supply Chain Roadmap Report



- A roadmap for developing the supply chain needed to deploy 30 GW of offshore wind energy by 2030, which includes:
  - Major barriers that could prevent or delay supply chain expansion
  - Potential solutions to overcome barriers
  - Major factors that need to be considered, including:
    - Manufacturing facilities
    - Port and vessel infrastructure
    - Workforce development
    - Equity
  - A scenario that estimates the number of manufacturing facilities, ports, and vessels that would need to be developed by 2030 to support an annual deployment of 4–6 GW per year
  - Discussion of next steps for the industry, including expansion to full-scale floating wind supply chains beyond 2030.

Offshore Wind Energy Workforce

Introduction to the Offshore Wind Workforce



- Offshore wind workforce span 5 major areas: development, manufacturing and supply chain, ports, vessels, and operations and maintenance.
- The number and length of the jobs will vary across the development process.
- To meet the target of 30 GW of U.S. installed offshore wind capacity by 2030, average annual employment levels (full-time equivalent) are estimated at **15,000 and 58,000** based on 25% and 100% domestic content scenarios.[4]

[4] Stefek, J., et al. 2022. *U.S. Offshore Wind Workforce Assessment.* Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-81798. https://www.nrel.gov/docs/fy23osti/81798.pdf.

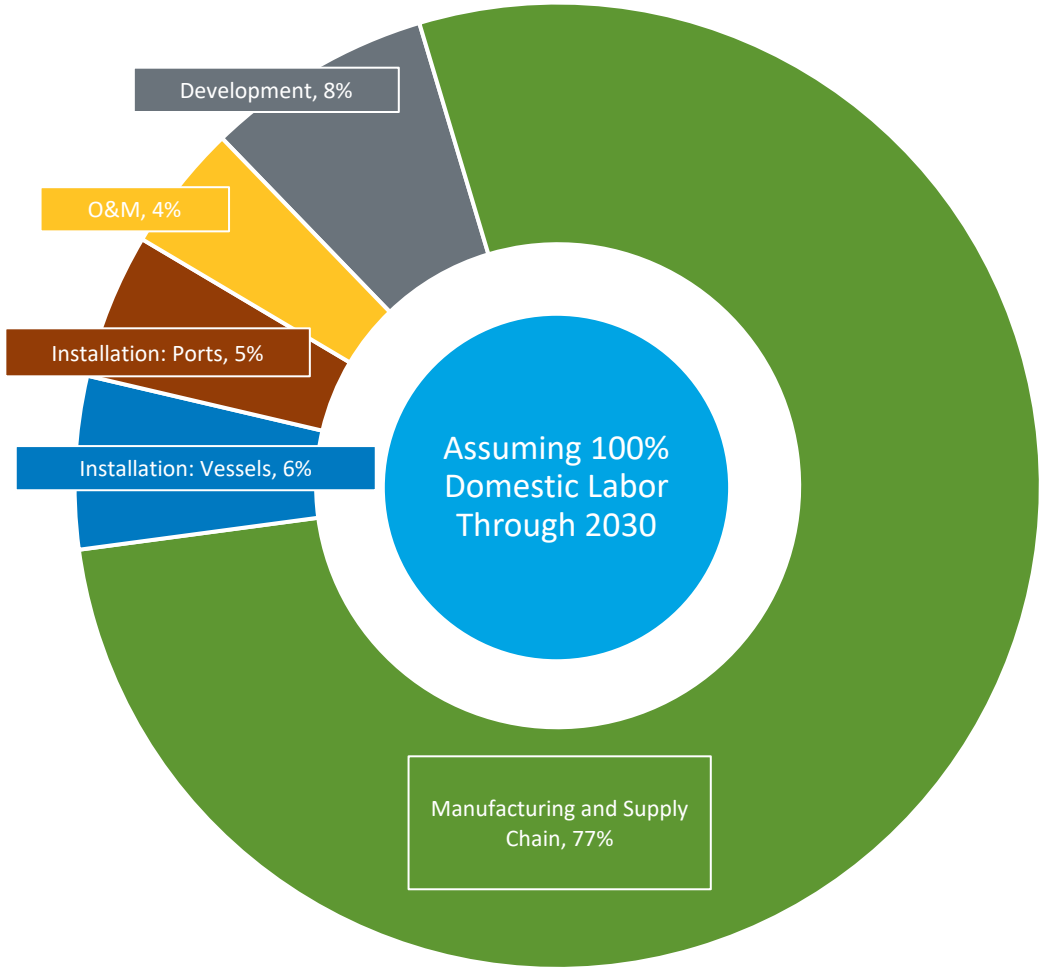
Workforce Magnitude and Timing

The size of the workforce is important to understand. But **equally important is the timing on the supply and demand side.**

	Magnitude	Timing
Demand	Basic and skilled trades to **support manufacturing and installation are largest contribution**.	**Need to understand the workforce peaks and troughs** to efficiently train and hire workers.
Supply	Most roles require specialized training and relevant experience in a skilled trade, while only some roles require advanced degrees.	It can **take several years** to obtain a higher education credential or complete a multi-year apprenticeship program.

Demand

Potential Job Contributions



The largest opportunity for the U.S. workforce is **manufacturing of turbine and balance of plant components while using domestic suppliers.**

There is an **immediate training need** to support development, ports, installation, and eventually operations and maintenance (O&M).

Jobs for **manufacturing and vessels will increase as plants are built, and U.S. flagged offshore wind vessels support installation activities.**

Demand

What Does the Future of the Offshore Wind Workforce Look Like?

- **Manufacturing and Supply Chain:** Roles include jobs to fabricate and assemble components, subassemblies, parts, and materials from multiple tiers of the manufacturing process. Roles range from engineering and component design to factory-level workers working production lines.

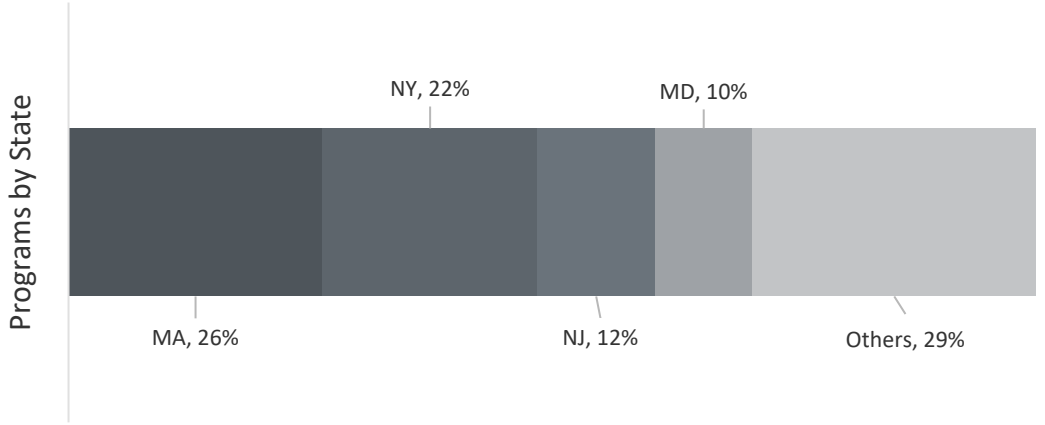
- **Development:** Roles include biologists, engineers, policy experts, project managers, and community planners.

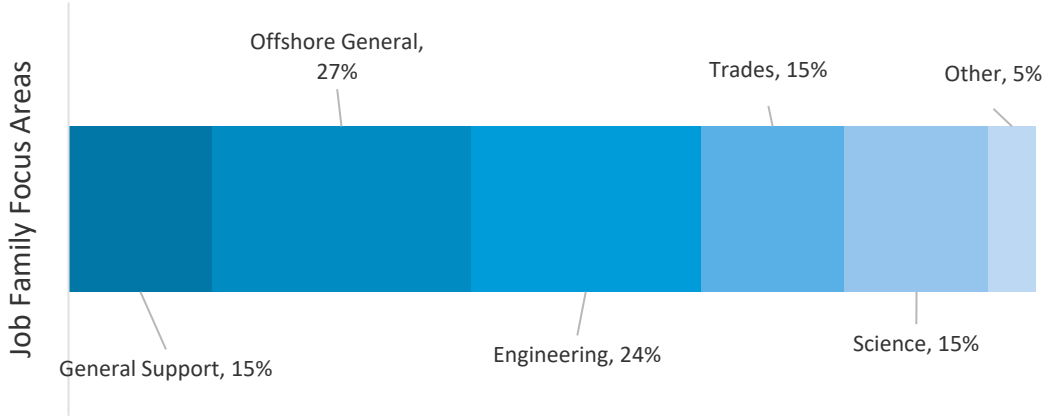
- **Installation:**
    - Ports: Roles include terminal crews, logistics, and management-related roles located portside
    - Vessels: Roles include workers on vessels operating at sea to install offshore wind energy components, including the marine crew, engineers, and construction crews.

- **Operations and Maintenance:** Roles include wind technicians and associated operating plant management.

Education and Training Programs

Identified **44 offshore wind energy focused programs**





Strengths:

- Offshore wind technician programs
- Advanced degree programs

Opportunities:

- Specialized skills training for factory workers and installation crews
- Standardized safety certifications
- Programs to support workers transitioning from other industries.

Awareness of Roles

Background:

- **Workforce roles are often characterized differently by companies, organizations, and stakeholders.** The number of different job roles and skillsets is significant.

Importance:

- **Agreement** on the types and function of roles **is critical to standardize training and education development.**
- Characterizing roles and training requirements consistently **ensures varied workforce needs can be met by the appropriate programs and provides confidence in hiring.**

Call to action:

- Form **consensus on key roles and requirements to effectively communicate** between industry, educational institutions, unions, and other stakeholder groups.

Supply

Workforce Initiatives

Diversity and Inclusion

- High priority for all stakeholder groups
- RFP provisions
- Transparency and tracking goals

Unions

- Support manufacturing and installation
- Existing training and apprentice programs starting to integrate offshore wind

Apprenticeships

- Core pathway to gain necessary skills for trade careers
- Often require multi-year training

Adjacent Industries

- Engage workers and solicit their knowledge
- Ex: oil and gas, fishing
- Involve different geographic regions

Economic Development

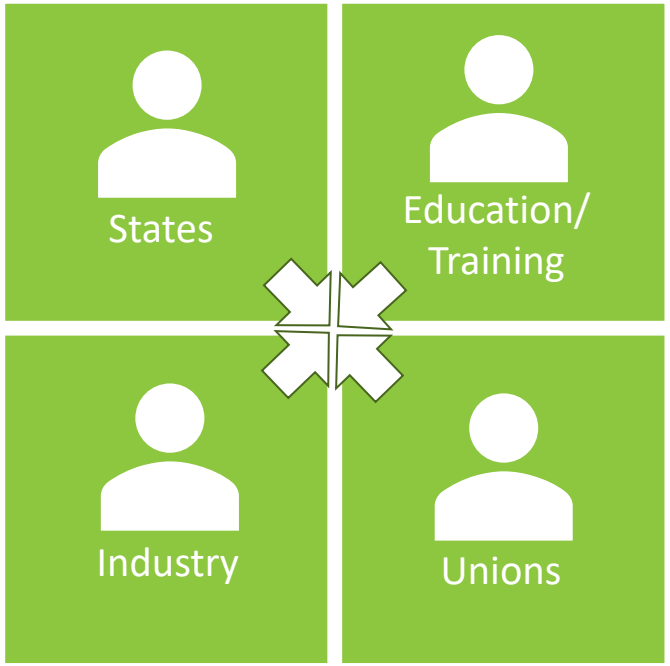
- Earnings from jobs can drive economic growth in communities
- Agencies support is critical

Supply

Partnerships and Collaboration

Successful partnerships can help meet workforce requirements and bridge gaps through:

1. Shared learnings and accelerated program development
2. Standardized requirements and corresponding training
3. Regional efficiencies
4. Diverse funding sources
5. Shared facilities



Partnerships for educational institutions:

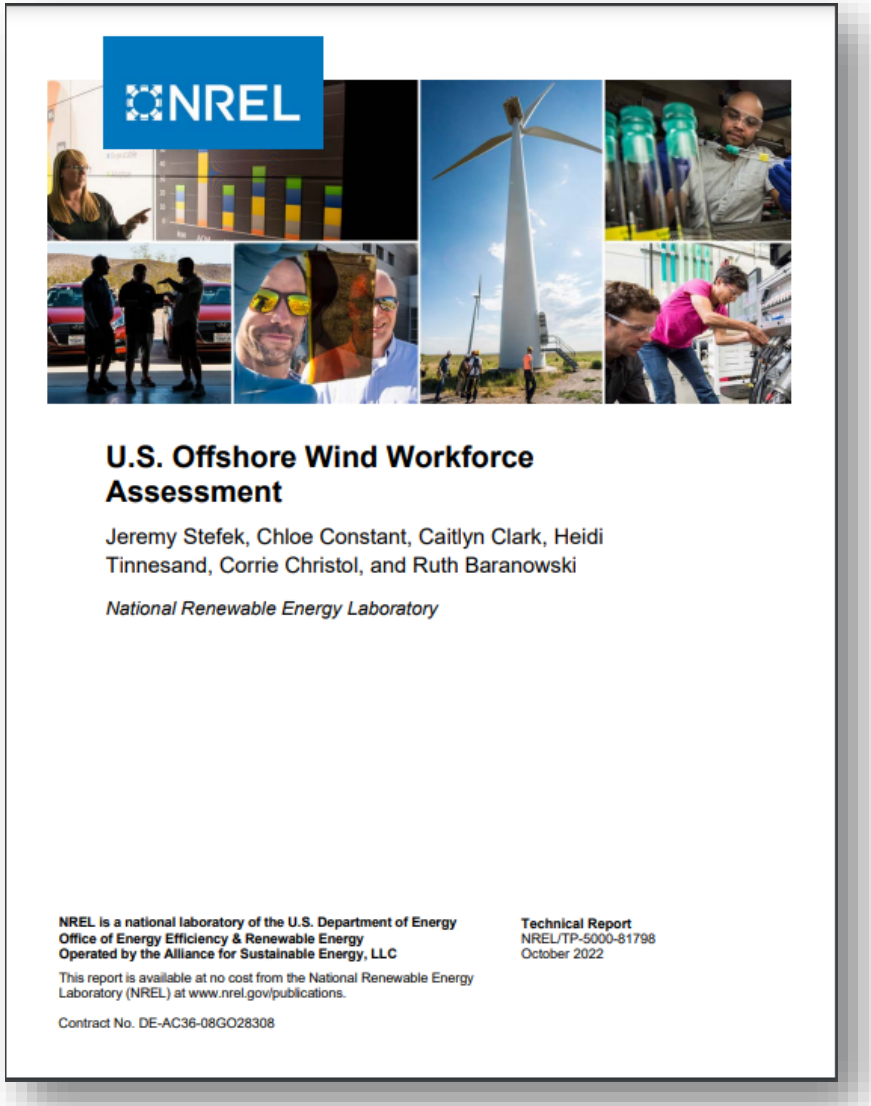
- 75% partnered with industry
- 70% partnered with state or local government
- 66% partner with other educational institutions
- 33% have collaborated with unions

Offshore Wind Workforce Assessment

- More detailed information can be found in the recently released *U.S. Offshore Wind Workforce Assessment.*

- The report covers workforce demand, the workforce needs to meet 2030 offshore wind goals, and supply, developing the offshore wind workforce of tomorrow.

- Report provides recommendations to meet supply chain needs by 2050.



Q&A

Photo by Dennis Schroeder, NREL 40389

Thank You

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