2035

AND BEYOND

THE REPORT

OFFSHORE WIND

POLICY PRIORITIES TO ENSURE OFFSHORE WIND PLAYS A CENTRAL ROLE IN OUR NET-ZERO FUTURE

A 2035 3.0 COMPANION REPORT

AUTHORS

Michael O'Boyle, Michelle Solomon,
Energy Innovation

David Wooley, Jamie Matos,
University of California, Berkeley,
Goldman School of Public Policy

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Gary Norton / DOE

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Marty Schwarz
National Renewable Energy Laboratory

Matt Shields
National Renewable Energy Laboratory

Patrick Gilman
Department of Energy

Amber Hewett
National Wildlife Federation

Lara Skinner
Climate Jobs Institute, Cornell University

Emma Rebhorn
Climate Jobs National Resource Center

Sushma Raghavan
Climate Jobs National Resource Center

Juan Guevara
Climate Jobs National Resource Center

Stephanie McClellan
Turn Forward

Sara Parkinson
Turn Forward

Catherine Bowes
Turn Forward

Arne Jacobson
Schatz Energy Research Center, Cal Poly Humboldt

Eddie Ahn
Brightline Defense

Sarah Xu
Brightline Defense

Kathleen Frangione
Orsted

Justin Sharp
Sharply Focused

Beth Treseder
Equinor

Nicole DiPaolo
BlueGreen Alliance

JB Tengco
BlueGreen Alliance

Jessica Eckdish
BlueGreen Alliance

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Maggie Caldwell, Harrison Carpenter-Neuhaus, Danielle Crockett, Tina Li, Eliana Miller, Rene Polanco, Monika Sharma, Elisabeth Soto, Courtney St. John, *Climate Nexus*

Taylor McNair, Ric O'Connell, Casey Baker, Kyra Ngai, Priya Sreedharan, *GridLab*

Greg Alvarez, Todd Fincannon, Anand Gopal, Maddie Kane, Silvio Marcacci, Sarah Spengeman, Shannon Stirone, *Energy Innovation*

Nikit Abyhankar, Jose Dominguez Bennett, Umed Paliwal, Amol Phadke, *Goldman School of Public Policy, University of California, Berkeley*

Catherine Bowes, Pasha Feinberg, *Independent Contractors*

Chani Wiggins, *Winn Strategies*

Annie Dore, *BeeSprings Designs*

Mina Lee, *Mina Lee Design*

Anya Breitenbach, *Forge & Foundry*

Christopher Jylkka, Tom Jones, *Daymark Energy Advisors*

Ann Furbush, Rosie Hayward, Istvàn Heilmann, Dan Hodge, Jon Stenning, *Cambridge Econometrics*

EXECUTIVE SUMMARY

Expanding the United States' offshore wind industry will create vast benefits. Offshore wind could, by 2050, provide 10 to 25 percent of national electricity, create nearly 400,000 jobs, reinvigorate port communities, diversify our power sources, and shrink the area needed for other land-based power sources without significantly increasing wholesale electricity costs, as detailed by *2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future*.[1]

But supplying 10 to 25 percent of the nation's electricity generation in 2050 will be no easy feat—it will require 250 to 750 gigawatts (GW) of offshore wind. However, even the high end of this range is feasible with the right policy support. For example, a commitment to between 400 and 750 GW would bring the U.S. roughly on pace with existing European commitments.

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By advancing this mature global technology, U.S. policymakers can help the offshore wind industry achieve and exceed the cost declines observed in other parts of the world, turning offshore wind into another pillar of affordable, reliable grid decarbonization.

To attain these benefits, new policies and significant public and private investments are needed across the supply chain. Mass deployment of offshore wind turbines faces unique challenges, including availability of ports, ships, and turbine components. Challenges also include limited transmission interconnection points and identification of sites for turbines, ports, and manufacturing facilities. The extent of supply chain needs is addressed in the accompanying *Offshore Wind Supply Chain Technical Report*, referred to here as the "supply chain report",[2] and specific federal and state policy solutions are detailed below.

Fortunately, offshore wind enjoys generally strong coastal community support and has the potential to preserve ecosystems while playing a central role in reducing greenhouse gas emissions. Offshore wind also offers substantial benefits to workers and communities, particularly port communities already overburdened by industry. These benefits include new high-quality jobs and economic development, clean power, and reduced local pollution with the closing of fossil plants. However, intentional steps must be taken to ensure an inclusive process and equitable benefits for these communities. The integration of environmental protections and community benefits into each aspect of offshore wind policy design is vital to accelerating this industry sustainably and reaching our climate goals.

To cost-effectively decarbonize our entire energy system, grid capacity and electricity production will need to double or triple. To avoid falling short, the U.S. needs a diverse energy mix that includes rapidly maturing offshore wind technology. *2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future*, referred to here as the "technical report," demonstrates the quantity and quality of the offshore wind potential off the East and West coasts and in the Gulf of Mexico and the Great Lakes. The technical report also shows that offshore wind can complement U.S. onshore renewables, including both wind and solar. This policy report serves as a companion to the technical report and identifies the actions the federal government and states must take to unlock the potential boon of offshore wind and its cascading economic and climate benefits across the country.

The Inflation Reduction Act (IRA) puts the U.S. on a pathway to consistently reduce electricity sector emissions through 2032,[3] but beyond a decade from this report's writing, the challenge of decarbonizing the whole economy will shift increasingly onto the electricity grid. Electricity generation will need to expand to support the deep electrification of transportation, buildings, and industry, as electricity demand is expected to triple in a net-zero economy. As demand grows, we must diversify and de-risk the set of clean technologies that can meet it. The technical report shows that offshore wind is a viable, scalable resource critical to meeting the growing electricity demand, achieving our climate goals, and reducing the worst impacts of climate change.

The Biden administration has committed to scaling U.S. offshore wind to reach 30 GW by 2030. With assessments of supply chain, workforce, and transmission needs all underway, and a record pace of site identification and leasing on the part of the Bureau of Ocean Energy Management (BOEM), this administration has already advanced the U.S. offshore wind industry. Federal commitments extend even beyond 2030, with a goal of 15 GW floating offshore wind by 2035. With only seven operational turbines in U.S. waters to date, these goals envision an expanded role for offshore wind, which the government predicts will reach 110 GW by 2050 under current policy.

However, the technical report demonstrates we should be setting even larger long-term offshore wind targets that take full advantage of the unmatched offshore wind resource in U.S. waters. This begins with state and national commitments supporting further growth of the industry.

Realizing a level of U.S. offshore wind deployment that can play a substantial role in our clean energy economy will require the federal government and states to bolster turbine deployment and the large infrastructure projects that support offshore wind construction and operation. The most important policy actions include:

- Setting offshore wind goals and procurement targets that align with net zero goals
- Identifying offshore wind sites at scale
- Improving leasing and permitting to reduce deployment timelines and increase support
- Planning for offshore wind transmission holistically
- Preparing the workforce for offshore wind via apprenticeships and upskilling
- Incentivizing and coordinating domestic supply chain
- Preparing ports and vessel infrastructure for offshore wind

Together, these policies and supporting actions have the potential to not only galvanize the offshore wind industry but also sustain communities and the environment. The chief concerns for any industrial build-out are the impacts on communities and ecosystems. In the case of offshore wind, potential impacts to marine ecosystems are a particular concern, even as climate change poses existential threats to ocean life,[4,5] but vital marine resources can still be protected while scaling the industry.

The success of U.S. offshore wind depends on ensuring community benefits. Today, overall community support is high: recent polling indicates a large majority of coastal communities support offshore wind development, with 66 percent of respondents in favor of expanding offshore wind power in places near where they live. More than three-quarters of respondents said visible wind turbines would not decrease their desire to visit the beach.[6] But proactive policies will be needed to preserve and enhance community support. There is a real need to ensure that the communities impacted by development are included in the process to ensure that offshore wind development creates opportunity for all while avoiding harm.

Offshore wind at scale would improve resource diversity and create lasting positive impacts. The technical report shows the potential for a coordinated policy push to help manage the risk that we cannot build fast enough on land alone to meet the demands of a high electrified economy. It also highlights the promise of holistic transmission planning to cut costs 30 percent, shows the industry can employ 390,000 Americans, and offers a vision for growing U.S. manufacturing in response to incentives in the Inflation Reduction Act. This policy companion to the technical report offers the federal government, states, public utility commissions, grid operators, and industry players recommendations for policies to ensure we can achieve the speed and scale we need from offshore wind to reach a stable climate future.


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TABLE 1.

Summary of Policy Recommendations

POLICY	ACTOR
Offshore wind goals and procurement targets	
Set a U.S. development target that rivals the pace of European commitments and recognizes the benefits of much higher offshore wind deployment for the U.S. energy system, bolstering industry ambition and triggering governmental examination of necessary next steps.	Federal
Explicitly link deployment targets with procurement mandates implemented by the utility regulator or renewable energy procurement authority, with enforceable timelines.	State, utility
Pass legislation directing utilities and their regulators to consider community benefits, job opportunities, equity, and environmental protections in utility contracts.	State, utility
Apply environmental protection requirements and labor standards as a condition of offtake contract approvals. Use the contracting process to compel developers to invest in regional science, local workforce, economic, or equity initiatives that help the industry advance.	State, utility
Site Identification	
Coordinate proactively with underrepresented groups and between government agencies.	Federal
Standardize and scale wind area identification methods and tools.	Federal
Institutionalize and expand data collection in cooperation with Regional Science Wildlife Collaborative (and similar initiatives), states, Tribes, and developers.	Federal
Leasing and permitting	
Use leasing to secure stakeholder support and incentivize development of the industry to prepare for long-term success.	Federal
Maximize permitting coordination by increasing funding and use of Title 41 of the Fixing America's Surface Transportation Act and identify ways to increase efficiency of federal and state permitting in concert.	Federal, state
Through permit issuance, secure comprehensive environmental protection by requiring long-term project plans that use environmental best practices.	Federal

POLICY	ACTOR
Holistic transmission planning	
Increase staffing at state and federal agencies tasked with planning the transmission grid, especially state energy offices, public utility commissions, and the Federal Energy Regulatory Commission (FERC).	Federal, state
Empower multi-state entities to coordinate, gather community input, and develop transmission plans that assess and include local benefits agreements aligning with community needs.	State, utility, regional transmission organization (RTO)
Prioritize identification of interconnection points that can be used for planned and potentially future unplanned offshore wind development.	State, utility, RTO
Provide a national forum to convene experts, establish the need, and solicit new approaches to offshore wind transmission.	Federal
Take a proactive approach within regions to design and agree upon new cost allocation approaches that allow for networked, holistic offshore wind transmission development.	Federal, state, utility
Workforce development	
Work with labor unions to expand existing training programs to include more offshore wind training opportunities and dedicate resources to workforce readiness programs with wraparound services for underrepresented groups.	Federal, state
Promote transfer and upskilling of workers from other fields, such as offshore oil and gas and maritime industries.	Federal
Complete offshore wind workforce assessments out to 2050, identifying job needs, including job types and quality as well as workforce gaps, and opportunities for regional coordination.	Federal, state

POLICY	ACTOR
Supply chain preparation	
Increase outreach and education efforts to engage subcomponent and raw materials suppliers, while adjusting tax credits and creating grant funding for these suppliers.	Federal, state
Establish policy and financing instruments needed to build additional specialty steel plants and commercialize additive manufacturing of large iron and steel castings and forgings, including backstop federal steel reserve programs.	Federal
Create a central agency to coordinate interstate supply chain infrastructure.	Federal, state
Reexamine tax incentives and domestic content requirements before the IRA's expiration and consider extension to support scale beyond 2032. Identify U.S. tariff and trade policy changes to support accelerated offshore wind development.	Federal
Ports and vessels	
Scale state port grant programs and public-private partnerships to support critical facets of development, including helping ports accommodate floating offshore wind technologies and larger turbines.	Federal, state
Dedicate additional federal funding for offshore wind port upgrades such as land acquisition, channel dredging, and improved bearing capacity.	Federal, state
Promote regional cooperation, including creation of a central coordination agency and regional project-based metrics.	Federal, state
Provide financial support for offshore wind vessels and shipyards, including backstop funding, grants, and loans.	Federal, state

INTRODUCTION

2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future demonstrates that supplying 10 to 25 percent of the nation's electricity demand with offshore wind in 2050 would provide important benefits to the U.S., including making a net-zero economy with high levels of electrification more feasible. *2035 and Beyond: Abundant, Affordable Offshore Wind Can Accelerate Our Clean Electricity Future*, referred to here as the "technical report," highlights the quantity and quality of the offshore wind potential in East Coast, West Coast, Gulf of Mexico, and Great Lakes waters and shows how offshore wind can complement U.S. land-based renewables. Without significantly increasing wholesale electricity costs, an offshore wind build-out that provides 10 to 25 percent of electricity across the country could create nearly 390,000 jobs in 2050 and diversify our power sources while decreasing the land area needed for onshore renewables.

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However, the U.S. will not achieve this level of offshore wind deployment without new policy. Following the pattern of other clean technologies, offshore wind is an industry that requires scale, experience, and policy to achieve cost reductions. Continued and consistent policy support this decade will yield a mature, cost-effective industry that can get the U.S. to its goal of net-zero emissions by midcentury. Successful offshore wind deployment worldwide has already led to rapid technology improvement, effective models of policy support, and associated cost declines (see Figure 1). The countries where offshore wind is thriving—Denmark, the United Kingdom, and China—have achieved cost reductions and scale because of dedicated industrial policy, and the U.S. should embrace a similar roadmap.

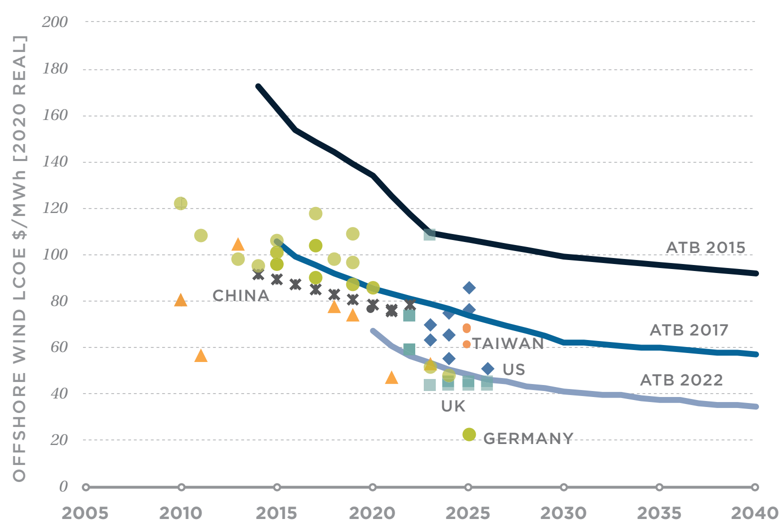


FIGURE 1.

National Renewable Energy Laboratory Annual Technology Baseline Advanced cost projections for years 2015, 2017, and 2022 and levelized cost of electricity for selected offshore wind projects in China, Taiwan, the U.S., the U.K., and Germany.

The U.S. will also need to invest in supporting infrastructure at a massive scale. These investments should focus on grid infrastructure and supply chain development, including manufacturing, port capacity, and new ships. The investments will create both opportunities and challenges for affected communities. This policy report provides recommendations to achieve this scale, while coupling deployment with U.S. public priorities, including equity, environmental protection, workforce development, and community protection.

This paper divides policy assessments and recommendations into two sections:

Section 1 identifies policies that drive offshore wind site identification, procurement contracts, and leasing agreements, particularly those that impact the planning and permitting timeline for offshore wind as seen in Figure 2. These include:

1.1. Setting offshore wind capacity and procurement targets in line with net-zero goals

1.2. Identifying offshore wind sites at scale

1.3. Improving leasing and permitting to reduce deployment timelines and increase support

PERMITTING FOR OFFSHORE WIND PHASES (simplified)

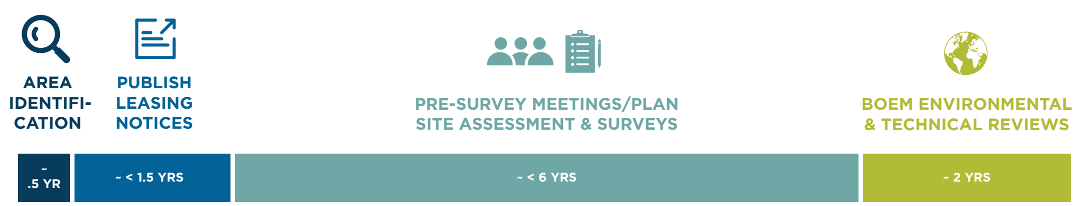


FIGURE 2.

Stages of timeline for offshore wind development as discussed in Section 1 of this report.

Section 2 identifies policies that develop supporting infrastructure, enabling a robust project pipeline and associated cost declines. These include:

2.1. Planning transmission infrastructure holistically

2.2. Preparing the workforce for offshore wind via registered apprenticeships and upskilling

2.3. Incentivizing and coordinating domestic supply chain and manufacturing

2.4. Preparing port and vessel infrastructure for offshore wind

Together, these policy recommendations articulate priorities for state and federal policymakers to scale offshore wind deployment, achieving the resource diversity, feasibility, cost reductions, and workforce development benefits demonstrated in the technical report. We must start now and be bold, focusing on the policy and infrastructure investments we need to scale beyond 2030. This can ensure the U.S. keeps pace with international counterparts and achieves a mature offshore wind industry that protects our marine environment and coastal communities while fighting the existential threat of climate change.

SECTION ONE

DRIVING THE DEPLOYMENT OF OFFSHORE WIND

1.1. SETTING OFFSHORE WIND CAPACITY AND PROCUREMENT TARGETS IN ALIGNMENT WITH NET-ZERO GOALS

Rapid growth in cost-effective offshore wind requires tremendous private and public investment. With so many corresponding infrastructure needs (ports, vessels, shipyards, transmission, etc.), long-term, binding offshore wind deployment targets provide confidence that investments in offshore wind infrastructure will pay off. Across U.S. states and other countries, offshore wind deployment targets are foundational policies that spark infrastructure investment, ultimately supporting offshore wind development at scale.

Firm targets give industry the confidence to invest, and they enable agencies to develop relevant capacity, plans, and processes. Several U.S. states, particularly on the East Coast, have firm targets that direct utilities to procure specific amounts of capacity on a defined timeline. As of January 2023, state procurement targets totaled 77 GW by 2045, with 17.6 GW already contracted. These state-level policies have been key to the U.S. industry's growth to date. Strengthening them will be critical to achieving the grid, consumer, and employment benefits of large-scale offshore wind deployment as outlined in the technical report. While the federal government has set a target of 30 GW by 2030, the U.S. lacks a firm longer-term target. Though not binding, federal commitments help orient federal agencies toward executing the long-term, cost-effective growth of the industry.

Targets and procurement will have to grow substantially if offshore wind is to supply 10 to 25 percent of the country's electricity in a net-zero future. Europe provides an example of achievable scale in a recent agreement between nine North Sea countries to reach 120 GW of offshore wind by 2030, and 300 GW by 2050.[7] Achieving a similar scale for coastal states in the U.S. implies aggregate targets in the 400 to 500 GW range by 2050.[i] Ultimately the most important targets are from the states, which have exclusive jurisdiction to require utilities to sign contracts. These states should envision a larger role for offshore wind, including revitalizing manufacturing and deindustrialized communities by driving supply chain, port, and transmission growth in the next decade.

Ambitious goals do not undermine other public policy objectives like environmental protection or affordability; quite the contrary. Scaling offshore wind into the hundreds of gigawatts requires an inclusive, environmentally sensitive approach where all stakeholders move together with high degrees of trust and collaboration. Agencies can start developing an inclusive vision that supports rapid scaling immediately after long-term goals are set. Procurement policies can support inclusivity and de-risk projects by requiring developers to prioritize public values, include communities in siting and permitting, secure community and labor agreements, and avoid and mitigate environmental damage. Inclusive policies may require more work on the front end but will help meet state and federal imperatives to achieve a just and equitable energy transition and reduce risks of delays due to public opposition.

State offshore wind procurement commitments are most effective when they include the following features:

1. Near-term targets reflecting near-term constraints, and long-term targets reflecting the ability to address barriers to scale
2. Targets requiring utilities to procure offshore wind competitively on a specified timeline
3. Targets codifying local benefits and workforce development requirements into procurement
4. Targets codifying environmental protection into procurement

SETTING NET-ZERO-ALIGNED OFFSHORE WIND TARGETS

Development of offshore wind, from site selection to project operation, can take 10 to 15 years. While near-term commitments are challenged by supply chain, grid infrastructure, port development, and other factors, longer-term commitments

i U.S. coastal states represent 57 percent of U.S. demand, or about 2,200 terawatt-hours (TWh) of electricity sales. In comparison, the nine countries of Denmark, Norway, the U.K., France, Germany, the Netherlands, Belgium, Ireland, and Luxembourg have aggregate load of 1,600 TWh, or 54 percent of European Union + U.K. electricity demand.

allow additional time for offshore wind development and can create momentum starting now. States and the federal government should supplement their current commitments with longer-term targets in the 2040s aligned with U.S. and state net-zero policies that will meet much higher electricity demands from electrified transport, buildings, and industry.

States are the only entities that can set targets that bind utilities, so their commitments to scaling the offshore wind industry over the long term are crucial signals to invest in supporting infrastructure and inclusive processes. Coastal states should build on existing ambition in the 2030 to 2035 time frame with 2040 to 2050 goals that reflect offshore wind's core role in meeting state and federal net-zero economy-wide commitments, which will require a doubling or tripling of electricity demand. As the technical report shows, offshore wind can meet 10 to 25 percent of electricity demand in 2050 with minimal cost impacts, provide resource diversity, support up to 390,000 jobs, and make a net-zero economy more feasible.

Many states across the Northeast have already made long-term commitments. Targeting 11 GW by 2040, New Jersey has the largest offshore wind goal in the country,[8] followed by New York with 9 GW of offshore wind by 2035[9] and Maryland with 8.5 GW by 2031.[10] Several other states have offshore wind goals, including Massachusetts, Connecticut, Rhode Island, Virginia, North Carolina, and Louisiana.[11] Under AB 525, California made realistic commitments to produce 2 to 5 GW offshore wind by 2030, and bolder plans to reach 25 GW by 2045, which University of California, Berkeley, modeling suggests can supply 20 percent of California's projected net-zero electricity supply.[ii] The state recognizes the importance of offshore wind for increasing clean resource diversity to help achieve its goals of 90 percent clean electricity by 2035 and net zero economy-wide by 2045. Still, AB 525 only created a "planning target," not a utility requirement. The California Public Utilities Commission and several other agencies tasked with siting, permitting, and planning will need to publish new rules to assure timely investment and procurement.

The federal government should also set a long-term 2050 target for the offshore wind industry in the hundreds of gigawatts to realize the benefits shown in the technical report and align agency action with states' needs for reliable, clean electricity. Starting now, The U.S. will have 27 years to build out offshore wind to reach a 2050 target—

ii The University of California, Berkeley, used the California Air Resources Board load forecast, which more than doubles electricity demand in 2045 to achieve net zero. This forecast does not consider additional load from hydrogen electrolysis and direct air capture technologies. See generally Umed Paliwal et al., "The Offshore Report: California, Plummeting Offshore Wind (OSW) Costs Can Accelerate a Diverse Net-Zero Grid," 2022, https://gspp.berkeley.edu/assets/uploads/page/CA_OSW_Assessment_Working_Paper_CEPP.pdf.

enough time if policy support remains strong and consistent. Such a target would send clear signals to industry and state policymakers and would prompt private and public examination of the steps required now to achieve this goal. The following sections of the report examine these steps in detail.

LINKING TARGETS TO COMPETITIVE PROCUREMENT

Targets should be linked to procurement requirements to instill confidence in developers, investors, ratepayer advocates, and ratepayers themselves. Competitive procurement is a practice whereby a retail utility, usually a monopoly, issues a request for bids to developers, which compete based on price. The request for bids may include other factors related to equity, environmental benefits, labor, or domestic content.[iii] Linking targets to procurement is a common practice in the Northeast U.S. and in Europe, spurring 17.6 GW of contracts and investment in the U.S. so far. Without a strong connection between targets and procurement, industry lacks the certainty that early investment in these markets will yield real contracts in later years.

In 2016, Massachusetts passed a law requiring utilities to enter into 15- to 20-year contracts for 1.6 GW of offshore wind power by June 2027. At the time, DONG Energy (now Ørsted) hailed the bill as "allow[ing] the creation of a viable offshore wind energy industry here in Massachusetts [and] creat[ing] the right environment for competition between the developers[,] allowing the best value for ratepayers for any offshore wind contracts awarded."[12]

New York began soliciting offshore wind bids in response to legislation that increased its renewable portfolio standard to 50 percent[13] and later to 70 percent[14] by 2030. New York is unique in that it delegates renewable procurement to a state-funded authority, the New York State Energy Research and Development Authority. The Authority determined that 2,400 MW of offshore wind by 2027 was an achievable target and awarded competitive procurements of 1,700 MW of offshore wind solicitations in 2019, at $83 per megawatt-hour (MWh). Following this successful model, in 2019 New York passed a law requiring 9 GW of offshore wind by 2035.

Massachusetts, Connecticut, New York, New Jersey, and Maryland took different workable approaches to competitive procurement that can be models for other states in competitive markets. Massachusetts utilities jointly committed to long-

iii See generally Philipp Beiter et al., "Comparing Offshore Wind Energy Procurement and Project Revenue Sources Across U.S. States" (National Renewable Energy Laboratory, June 1, 2020), https://doi.org/10.2172/1659840.

term contracts for offshore wind power that act as contracts for difference (CFD).[iv] Maryland, New Jersey, New York, and other states require utilities to sign long-term contracts for offshore renewable energy certificates (OREC) indexed to market prices, allowing utilities to claim the renewable attributes of the offshore project and hedge market price exposure. The structure of long-term contracts can be customized based on the risk appetite of states and the maturity of the offshore wind industry, as summarized in a 2020 National Renewable Energy Laboratory (NREL) report.[15]

Over time, similar competitive solicitation approaches have consistently delivered price reductions in the more mature European market. For example, the U.K. uses a CFD mechanism similar to the Massachusetts power purchase agreement and New York indexed OREC structures, leading to a 67 percent price decline between the 2015 auction (£114.4/MWh) and 2022 (£37.4/MWh).[16] Of course, competitive auctions are not the only reason prices fell. The U.K. has enjoyed price declines partly because of sustained policy support, including multi-decade investments in supply chains and transmission infrastructure.

INCORPORATING COMMUNITY BENEFITS AND EQUITY

As discussed throughout this report, offshore wind can create new, high-paying jobs in coastal and industrial communities throughout the U.S. But history demonstrates that equitable distribution of benefits from energy infrastructure development requires intentional policy action. Legislation that requires developers to consider community benefits, job opportunities, and equity will empower regulators and utilities to achieve public policy goals through competitive procurement and help the industry scale with durable public support.

Federal and state regulators can incentivize or require developers to enter into community benefits agreements (CBAs) with host communities. CBAs are a broad class of contract between an infrastructure developer and an impacted community that ensures the community directly benefits from the infrastructure project. In addition, CBAs can address issues such as affordable housing, community and economic development, construction of parks, or other identified needs.[17] Although CBAs may require developers to spend more on projects, thereby increasing costs, CBAs also can de-risk projects by reducing the prospects for community opposition

iv A contract for difference is a mechanism where the buyer agrees to pay the seller the difference between the fixed contract price and the wholesale market price. In effect, this is a long-term contract at a fixed price, but it functions jointly with a competitive wholesale energy market and does not necessarily require actual delivery of the power to the load-serving entity.

later in the project's life. Public utility commissions (PUCs) need guidance on which "benefits" can be counted against costs in a competitive setting, or clear legislative authority on the basis for determining this balance. Legislation can make clear to regulators that imposing the extra upfront cost of negotiating and including a CBA in procurement is in the public interest.

Massachusetts has also codified environmental justice protections and considerations, such as job opportunities and community benefits, into law.[18] An Act Driving Clean Energy and Offshore Wind[19] requires the Department of Public Utilities to promulgate regulations that "include benefits to environmental justice populations and low-income ratepayers" and "include opportunities for diversity, equity, and inclusion, including, at a minimum, a workforce diversity plan and a supplier diversity plan." The Act also requires developers to contract with minority- and women-owned businesses in addition to other workforce considerations. Connecticut, Maryland, New Jersey, and New York all have policies, in either legislation or administrative procurement processes, that (to varying degrees) require protections and ensure benefits for affected communities.

Werner Slocum / NREL

CASE STUDY

Offshore wind over a gas peaker plant in Queens

In "Asthma Alley," a part of New York City whose moniker reflects its high rates of asthma hospitalizations, energy company NRG had big plans to upgrade the Astoria Gas Turbines power plant with different gas technology. The upgrade plans were catalyzed by new legislation and air quality regulations passed in New York in 2019. However, community members argued the upgrade did not in fact meet the new emissions requirements, and they challenged the project during its air quality permitting process at the Department of Environmental Conservation.[20] Simultaneously, they proposed a renewable energy portfolio of offshore wind, solar, and batteries to replace more than 3 GW of gas peaker plants across New York City. The Department agreed and denied the permits for the new gas plant. In early 2023, the site of the gas plant and its connection to the electric grid were sold to the 1.2 GW Beacon Wind offshore wind project. This process followed a similar model to the Ravenswood gas plant just down the street, which is similarly shutting down and will act as a site for offshore wind transmission. At Ravenswood, the plant's union workers will also receive upskilling training for new jobs at the repowered facility.[21] As this example shows, offshore wind can be part of a portfolio that reduces coastal power plant use, reducing local air pollution that can land people in the hospital all while creating high-quality jobs.

PAIRING PROCUREMENT WITH ENVIRONMENTAL PROTECTION

State procurement policies can be effective tools for achieving environmental protection outcomes because these mandates send an early signal to the marketplace. Specifically, state-led competitive processes that require responsible development practices and investments as a condition of the contract can help lock in protections as project economics are evaluated. These requirements should avoid redundancy with federal environmental impact assessments and other environmental regulations under the National Environmental Policy Act (NEPA), Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act.

States can build environmental protection into market practices without duplicating federal requirements through several approaches, including eligibility criteria, mitigation requirements, and investment commitments. While all states that currently have competitive offshore wind markets restrict bids to projects in federal waters to avoid the environmentally sensitive coastal zone, several states also require bidders to provide detailed environmental mitigation plans and environmental protection strategies.[22] States can also require environmental protection as a condition of contracts, ensuring development practices that can help maintain stakeholder support for the projects over time. As an example, New York has included in its ORECs a prohibition on pile driving[v] at night (when whales are more difficult to detect and offshore lighting could trigger coastal opposition). However, these same policies must adapt to changing conditions and understanding of the marine environment. Best practices will need to evolve with scientific advances and mitigation techniques.

States can also use the contracting process to compel developers to invest in regional science, workforce, economic, or equity initiatives that help advance the industry. For example, New Jersey and New York require developers to support wildlife and fisheries research to inform mitigation strategies for each selected project as a condition of their power contract.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
President	Set a U.S. development target that rivals the pace of European commitments and recognizes the benefits of much higher offshore wind deployment for the U.S. energy system, bolstering industry ambition and triggering governmental examination of necessary next steps.
State legislatures; PUCs	Explicitly link deployment targets with procurement mandates implemented by the utility regulator or renewable energy procurement authority, with enforceable timelines.
State legislatures; energy offices; PUCs	Pass legislation directing utilities and their regulators to consider community benefits, job opportunities, equity, and environmental protections in utility contracts.
State legislatures; energy offices; PUCs	Apply environmental protection requirements and labor standards as a condition of offtake contract approvals. Use the contracting process to compel developers to invest in regional science, local workforce, economic, or equity initiatives that help the industry advance.

v Pile driving is a method of fixed-bottom wind foundation installation. It creates loud marine noise that can harm marine species, including whales.

1.2. IDENTIFYING OFFSHORE WIND SITES AT SCALE

According to the technical report, meeting 10 to 25 percent of U.S. electricity demand in 2050 will require 50,000 to 150,000 square kilometers of offshore space in the ocean or in the Great Lakes. The entire region studied in the technical report spans 800,000 square kilometers, an area used by wildlife and humans alike. While there is significantly more offshore wind potential available in this region than in any of the scenarios studied in the technical report, it is not simple to balance scale with competing uses, project viability, meaningful community engagement, and environmental protection. Successfully identifying the space most suitable for offshore wind is the first step in the offshore wind development timeline (see Figure 3) and ultimately depends on a proactive site identification approach through collaboration among industry, government, Tribes, ocean users, communities, environmental groups, and other stakeholders.

FIGURE 3.

Wind Energy Area identification is the first stage in the timeline for offshore wind development.

As of early 2023, developers had leased ocean areas cumulatively expected to support 40 GW of offshore wind, with another 3.6 GW of potential capacity in the Gulf of Mexico proposed for leasing. A record 11.4 GW was leased in 2022, on pace with achieving at least 250 GW by 2050 but far short of what would be needed to supply up to a quarter of electricity demand, as explained in the technical report. Several more gigawatts will be leased in the Central Atlantic, Oregon, and Gulf of Maine by 2025, although lease areas are not yet finalized.[23]

Though 2022 was a banner year, BOEM and states, in addition to agencies such as the National Oceanographic and Atmospheric Administration (NOAA), will need sustained funding increases to maintain or accelerate this pace. A continued effort is also needed to proactively map and evaluate offshore waters to identify low-conflict areas well in advance of leasing. More site identification and leasing processes beyond the initial Central Atlantic, Oregon, and Gulf of Maine lease sales will likely be needed to maintain this pace.

To date, the process to identify offshore wind leasing regions, or "Wind Energy Areas," (WEA) has generally begun with BOEM's designation of a "call area." The confines of that call area are typically determined with input from an Intergovernmental Renewable Energy Task Force. Once the confines are set, BOEM requests information on that call area, collecting comments in addition to datasets on ocean uses and species activity. Recently, BOEM has collaborated with NOAA's National Centers for Coastal Ocean Science (NCCOS) to combine data layers in a model that ranks areas for offshore wind energy suitability based on the available data.

To identify sites for offshore wind deployment on par with the scenarios studied in the technical report, BOEM will need to scale up site identification. To do this, BOEM will need to expand efforts to:

1. Coordinating proactively with stakeholders to build support and compile existing knowledge
2. Standardizing a wind area identification tool and methodology
3. Increasing baseline data collection, particularly for deeper waters

BOEM and states will need increased funding and resources to be able to act on these recommendations, and White House leadership is needed to coordinate agencies across this effort. BOEM will have to identify offshore areas while simultaneously conducting lease sales and completing environmental reviews on proposed projects, with tens of gigawatts in each phase of development at any given time.

COORDINATING PROACTIVELY WITH COMMUNITIES, TRIBES, OCEAN USERS, AND WORKERS

Stakeholder support is essential for successfully selecting offshore wind sites. BOEM currently conducts substantial stakeholder outreach via Intergovernmental Renewable Energy Task Forces made up of representatives from federal, state, and local agencies and Tribal governments; the agency also holds public meetings and workshops and offers public comment periods. But providing additional funding and resources to current Task Force participants and expanding outreach could identify conflicts and increase confidence in site identification earlier while minimizing opposition to projects once they are underway.

Outreach to ocean users, underrepresented groups, and workers and advancing communities' self-identified priorities can generate durable support for projects. However, Tribes and other underrepresented communities often face structural barriers that prevent full participation in public processes. States and the federal government should provide funding for capacity building in impacted communities to ensure underrepresented groups can meaningfully participate. Beyond funding, these communities should be directly included in decision-making bodies and processes.[24] In a step toward inclusiveness, the New York City Economic Development Committee created an Offshore Wind Industry Advisory Council co-led by environmental justice advocates and a civil engineering firm to oversee the implementation of the city's Offshore Wind Vision plan, which focuses on expanding the local capacity to build and install turbines, though the council lacks decision-making power.[25]

The federal government should also look to NOAA's Sea Grant program, a national network of university programs that have existing relationships with ocean users such as Tribes and fisheries in every coastal state, to expand offshore wind stakeholder relationships. Sea Grant has been instrumental in offshore wind stakeholder engagement but lacks funding for this purpose. To better leverage Sea Grant's relationships for offshore wind planning, the U.S. Department of Commerce should allocate funding to Sea Grant to convene ocean stakeholders for marine spatial planning processes.

Federal agency coordination should also improve, with engagement happening earlier in the process. BOEM should work more closely in particular with U.S. Coast Guard and the Department of Defense (DOD) before identifying wind areas to ensure the appropriate datasets are integrated into plans upfront. While many offshore wind projects have successfully shared ocean waters between competing federal uses, earlier engagement can accelerate collaboration to create more certainty for ocean users, affected communities, and lessees.[26]

STANDARDIZING AND SCALING WIND AREA IDENTIFICATION

To date, BOEM has used different processes that rely on marine spatial planning to identify wind energy areas. Marine spatial planning is a holistic management process that simultaneously considers ocean ecosystems, economics, and social and cultural dynamics in a comprehensive and inclusive way.[27] Scaling wind area identification will require a standard approach for marine spatial planning across the U.S. exclusive economic zone (EEZ). BOEM has also leveraged existing datasets to increase the transparency of marine spatial planning for wind area identification by working with partners on marine spatial mapping tools and methodologies. In the Gulf of Mexico and Central Atlantic, BOEM has partnered with NCCOS to combine data available within a call area and to determine relative suitability based on the value of the offshore wind resource, natural and cultural resources, commercial and recreational fisheries, military activity, and more.[28] This process has been largely the same for both regions, with some differences in data used. In the Gulf of Mexico, the final suitability values were determined based on 75 data layers, as seen in Figure 4. In Oregon, BOEM is taking a different approach by partnering with the Oregon Department of Land Conservation and Development to gather data and create the Oregon Offshore Wind Mapping Tool.

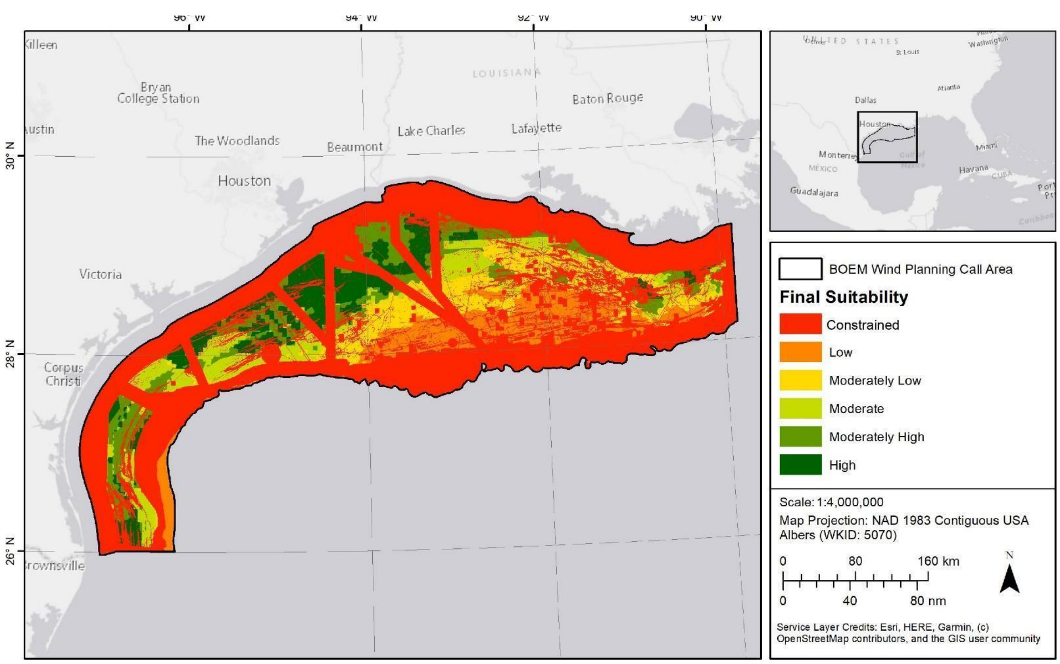


FIGURE 4.

Gulf of Mexico final suitability scores for offshore wind development. Source: BOEM.

While both approaches are viable methods to compile and map existing data, a bespoke approach for each call area and round of wind area identification is likely too slow to scale the industry to hundreds of gigawatts by 2050. While each area will have unique Tribes, conditions, stakeholders, and species that should be involved or accounted for, BOEM should create a standardized approach for mapping and data collection across the entire U.S. EEZ to identify potential sites at a nationwide scale. Such nationwide standardization should still allow for prioritization of regions with strong local demand for offshore wind, given that state and local demand has been instrumental in driving leasing. Local datasets can then be used to assess final site suitability. To ensure datasets evolve with changing ocean use and ecological understanding, they should be periodically updated.

Beyond scaling and standardizing the wind area identification process, the federal government should aim to increase the suitability of sites that are farther from shore. BOEM's analysis of the Gulf and Central Atlantic call areas makes clear that economic factors weigh heavily in the feasibility of sites far from shore due to increases in logistical costs. At the same time, projects sited farther offshore may have lower overlap with wildlife habitat and nearshore ocean users and will be increasingly viable as floating offshore technology improves. Additional research and development are needed to increase these sites' economic viability, such as improved monitoring technology for marine mammals to allow for higher vessel speeds without increasing vessel strike risk. The U.S. Floating Offshore Wind Shot, a research initiative led by the Department of Energy (DOE) that aims to shrink the costs of floating offshore wind to $45/MWh by 2035, is a step in the right direction to prepare wind turbine, mooring, and foundation technology for these deepwater sites.[29] But further research is needed to lower the costs of projects farther from shore and to fill data gaps, including on wildlife activity in these regions.

While the process to identify and lease federal ocean areas for offshore wind is well established, there is less clarity for the Great Lakes. As the technical report shows significant potential to build offshore wind in the Great Lakes, the White House should convene BOEM and state leaders to highlight this resource potential and define a site identification and leasing process.

INCREASING DATA COLLECTION

A consistent mapping tool and suitability methodology is only as good as the underlying data, and the underlying data on ocean use and species impact is spotty. There is only so much existing data that BOEM can access via proactive stakeholder engagement. In fact, only 50 percent of the U.S. EEZ has been mapped,[30] which creates a significant hurdle to identifying areas most suitable for offshore wind. From sea floor, wind speeds, wildlife activity, and cultural resources to fisheries, shipping, and other ocean uses, data collection needs significant improvement.

Expanded data collection is also necessary to speed up project deployment after leasing (see Section 1.3), given that site assessment can take up to half of the 12-year timeline from leasing to operation (see Figure 5). Denmark provides an example of how improved data collection can both increase confidence in early environmental review and prevent delays later in the process. The Danish government uses a "Strategic Environmental Assessment" approach that expands baseline data collection before leasing by focusing on bird surveys, navigational safety, fisheries, marine archaeology, noise, and cumulative impacts of the full offshore wind build-out.[31] These assessments reduce the time needed for developers to study sites while increasing confidence in site suitability early in the process. Assessing impacts of the full wind farm, not just site assessment activities, in advance of leasing in the U.S. would also ease concerns from environmental organizations, communities, and fisheries. In addition to this approach, BOEM should require ongoing monitoring of ocean conditions by developers after a project's construction to continuously reduce environmental impacts. Data collection should encompass meteorological data gathering and creating a centralized, publicly available repository to inform future offshore wind projects and modeling.

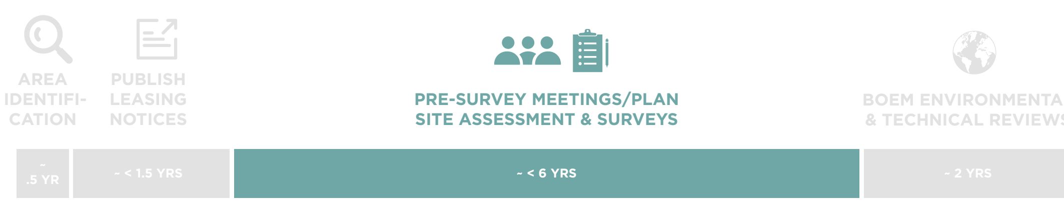


FIGURE 5.

Currently, most site assessments are performed by developers after leasing. To provide more certainty for developers, ocean users, and the environmental community, much of this assessment should occur before leasing as a part of baseline data collection.

The federal Ocean Policy Committee, which leads interagency ocean science and technology policy, has recognized the need to expand ocean characterization activities. Under the Committee's purview, the National Ocean Mapping, Exploration and Characterization (NOMEC) Council recently released strategic priorities for mapping the U.S. EEZ.[32] While offshore renewable energy is a priority within the plan, the areas identified of interest for resources such as offshore wind are limited.[33] The Ocean Policy Committee and NOMEC should use this mapping effort to prioritize collection of offshore wind-relevant data across the entire EEZ to enable site identification.

To complement ocean mapping, improved data is needed to build confidence in offshore wind site compatibility with wildlife, particularly for deep water regions where species activity is relatively unstudied. On the East Coast, BOEM should work with states and developers to support the Regional Wildlife Science Collaborative (RWSC). The RWSC conducts and coordinates monitoring and research of wildlife and marine ecosystems to support offshore wind development, with a focus on the Atlantic Ocean. Support for the RWSC should include both funding and expanding the RWSC to other geographies. BOEM should also support and fund the creation of additional entities to carry out parallel research in the Gulf of Mexico, Great Lakes, and Pacific. Beyond these efforts, BOEM coordination with NOAA on wildlife and fisheries surveys should focus on expanding the relevance of these surveys (which underpin much of the current spatial planning data) to offshore wind, particularly the impacts of offshore wind on wildlife and fisheries, in alignment with the Federal Survey Mitigation Strategy jointly created by the two agencies.[34]

However, early siting decisions will inevitably be made with incomplete data, and developers can help fill the gap with continuous onsite monitoring. BOEM and state regulators should develop data collection standards for offshore wind facilities and transmission infrastructure that require project operators to collect and publicly release data that can inform spatial planning processes going forward. For instance, BOEM should define procedures and requirements for technology such as passive acoustic monitoring[vi] during offshore wind farm construction and operation. With offshore wind representing an unprecedented opportunity to understand the ocean, this is a key venue for data acquisition and an opportunity for trust-building, and BOEM should work with developers to aggregate and synthesize data where needed.

Identifying and mapping cultural resources can advance opportunities for Tribal members in offshore wind, as exemplified by the collaboration between the University of Rhode Island and the Narragansett Tribe in surveying the ocean floor near Block Island.[35] BOEM and developers should work to employ Tribal members in environmental baseline data collection and identification of culturally relevant sites. However, engagement with Tribes must acknowledge Tribal sovereignty and the right to government-to-government consultation, particularly as not all Tribes will want to map sacred spaces or work with researchers in this way.

vi Passive acoustic monitoring uses sound "to study the behavior, movements and distribution of marine animals and their contribution to soundscape ecology." See NOAA Fisheries, "Passive Acoustic Research in the Atlantic Ocean," May 26, 2023, https://www.fisheries.noaa.gov/new-england-mid-atlantic/endangered-species-conservation/passive-acoustic-research-atlantic-ocean.

CASE STUDY

Narragansett Tribe brings traditional knowledge to offshore surveys

The ocean is home to countless species, and it is vital to the lives and livelihoods of millions of people. It is also a keeper of history for Native American Tribes across the country, with many cultural sites submerged thousands of years ago by melting ice sheets. Correctly identifying and protecting these sites is a crucial part of offshore wind data collection, which a partnership between the University of Rhode Island, BOEM, and the Narragansett Tribal Historic Preservation Office has pioneered. This collaboration combines modern scientific methods with Tribal interpretations of features on the seafloor to map culturally important sites. Partnering with Tribes on surveying efforts for both historic preservation and environmental monitoring can protect cultural heritage, create jobs in Tribal communities, and incorporate traditional ecological knowledge into data collection. Despite this partnership, Tribes' expertise has not always been respected, as seen when a transmission cable excavation disrupted Narragansett Tribal artifacts.[36]

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
BOEM	Coordinate proactively with underrepresented groups and between government agencies.
BOEM, NCCOS	Standardize and scale wind area identification methods and tools.
Ocean Policy Committee, NOAA, states	Institutionalize and expand data collection in cooperation with RSWC (and similar initiatives), states, Tribes, and developers.

1.3. IMPROVING LEASING AND PERMITTING TO REDUCE DEPLOYMENT TIMELINES AND BUILD SUPPORT

As it stands, after site identification it still takes years for a site to be leased, assessed, permitted, and constructed (see Figure 6). This includes one to two years to lease sites, up to a year to create a site assessment plan, and up to five years for site assessment. It is during this assessment process that developers can map the seafloor and collect meteorological data for the site to create a construction and operation plan (COP) for the project. Because developers have to start largely from scratch with this assessment, it is typically the longest phase of the process. After BOEM deems the COP "complete and sufficient," the agency conducts project-specific NEPA review—typically in the form of an environmental impact statement (EIS)—and a project obtains federal, state, and local permits, a process that should take about two more years.[vii] After BOEM approves the COP and all permits are granted, turbine installation and commissioning requires another one to two years, for a total time frame of up to 12 years.[37]

PERMITTING FOR OFFSHORE WIND PHASES (full detail)

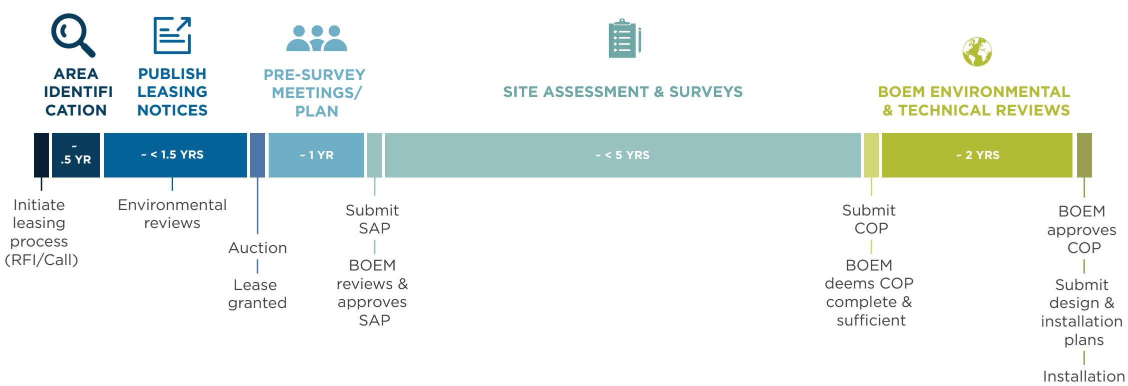


FIGURE 6.

Detailed offshore wind deployment timeline from site identification to construction.

This long timeline is a significant barrier to scaling the offshore wind industry fast enough to meet climate goals. For instance, deploying 100 GW of offshore wind by 2035—20 GW less than the EU is targeting—would require identifying enough offshore space to support an additional 60 GW of offshore wind by the end of 2023, which would be difficult under the current process. Reaching the high end of the technical report's 25 percent offshore wind scenario in a net-zero 2050 economy implies a similar pace. Therefore, meeting our country's potential for offshore wind

vii While the BOEM timeline indicates two years for COP approval, some projects have experienced longer permitting processes. According to the FAST-41 dashboard, the first commercial project, Vineyard Wind, took 3.5 years from COP submission to final approval. See "Vineyard Wind | Permitting Dashboard," accessed June 6, 2023, https://www.permits.performance.gov/permitting-project/other-projects/vineyard-wind.

deployment depends upon accelerating the timeline from leasing to deployment. Simultaneously, guardrails ensuring environmentally and socially responsible offshore wind deployment are essential to maintain support for the industry.

Three steps that can improve and accelerate the leasing and permitting of offshore wind sites while still ensuring responsible development are:

1. Using the leasing process to support communities and drive the industry forward
2. Maximizing permitting coordination with states and Tribes
3. Ensuring protection of the environment and cultural assets through permitting

Beyond these actions, a crucial process improvement would be to shorten the timeline for site assessment and characterization through increased baseline data collection before sites are leased (see Section 1.2) and continued monitoring at finished sites as they come online.

USING LEASES TO DRIVE RESPONSIBLE OFFSHORE WIND DEVELOPMENT

With up to a year and a half needed for environmental reviews and lease sale preparation between site identification and site leasing (see Figure 7), there is significant room for accelerating the leasing stage itself while maintaining the integrity of environmental evaluations. Furthermore, improving leasing now is crucial for setting the industry up for long-term success. BOEM is already acting to refine the leasing process and increase transparency through the Renewable Energy Modernization Rule,[38] which requires publishing a lease schedule for all planned or potential lease sales in the next five years, among other streamlining actions.[39] Beyond this modernization, improving the leasing process can secure further stakeholder support and investment in the industry—both necessary steps to accelerate deployment for years to come. Central to these changes, BOEM should strengthen Tribal engagement throughout the leasing process in accordance with the Tribes' right to government-to-government consultation.

FIGURE 7.

Leasing takes about 1.5 years and is the second phase in the BOEM timeline.

BOEM's leasing tools to build support among the fishing industry, conservationists, communities, labor unions, and Tribes include front-end engagement before leasing, multiple-factor auctions, and lease stipulations. Beyond BOEM, congressional action to direct revenue from offshore wind leases to supply chain investments, wildlife protection, and community benefits can help the industry advance by providing a direct revenue stream for funding supply chain infrastructure projects and environmental conservation.

For the last several lease sales, BOEM has used a multiple-factor auction format to incentivize investments in the offshore wind supply chain and workforce, as well as community benefits. In a multiple-factor auction, non-monetary components of leasing bids can include granting auction participants "bid credits" that are counted toward the final monetary value of the leasing bid. These bid credits could be used for investments in workforce and supply chain development, community benefits, and environmental protection and monitoring.[viii] Bid credits can also promote success in the offshore wind industry by incentivizing the inclusion of supply chain development, community benefits, and environmental objectives in leases; their use should be expanded while minimizing the impact on wholesale electricity prices. To date, workforce and manufacturing have received the largest share of potential bid credits. For example, in the 2022 California Lease Sale, bidders could receive a credit for 20 percent of their cash bid for a "qualifying" investment in offshore wind workforce development or the offshore wind supply chain. While this auction format has been effective, its use has been discretionary by BOEM, and should consider new laws or regulations to ensure its longevity.

A few improvements to bid credits could generate more durable community support and local investment. For one, extending these credits to projects throughout the supply chain would incentivize the manufacture of lower-tier components, such as steel, in the U.S.[40] Furthermore, higher maximum percentages for community benefits and increased transparency and enforcement in proposed CBAs and project labor agreements (PLAs) could substantially incentivize early and meaningful negotiations with communities.[ix] BOEM should also update eligibility criteria for the bid credits to require consultation with labor unions, community groups, and industry

viii The Outer Continental Shelf Lands Act authorizes BOEM to ensure safety, environmental protection, coordination with relevant agencies, preservation of national security interests, and fair return of the market value for leased waters. "Lease Sales and Fair Market Value," Bureau of Ocean Energy Management, accessed June 6, 2023, https://www.boem.gov/oil-gas-energy/energy-economics/lease-sales-and-fair-market-value.

ix Despite significant work on a CBA in the Morro Bay region, Castle Wind did not win any leases in the December 2022 California Lease Sale, which indicates that an increased limit on bid credits allowable for community benefits, above the 5 percent allowed in the California Lease Sale, may be needed to adequately incentivize community engagement. See Joe Mathews, "Do We Care If Climate Projects Partner with the Communities They Impact?," *San Francisco Chronicle*, April 30, 2023, https://www.sfchronicle.com/opinion/openforum/article/california-climate-change-policy-17923803.php.

representatives. This consultation is important to ensure bid credits are applied equitably and result in high-quality, family-sustaining careers.[41]

In addition to maximizing the use of non-monetary bid credits, BOEM should include lease stipulations promoting local good-quality jobs. For example, in addition to requiring developers to make every reasonable attempt to enter into a PLA as BOEM has already done, BOEM could stipulate that developers should endeavor to hire locally to ensure benefits for affected communities.[x] BOEM should also set a preference for domestic content as long as components are available and priced competitively to ensure that developers are supporting domestic manufacturing. Further, lease stipulations should require developers to fund environmental monitoring and research in addition to marine and coastal conservation, and require direct environmental protections such as use of known technology to reduce species impact.[xi]

Beyond forgoing direct lease revenue in favor of investments that support offshore wind deployment through bid credits, Congress could allocate a portion of lease revenue to a fund for the development of the offshore wind industry. This could include funding for marine and coastal conservation, supply chain investments, workforce training, and community benefits. Currently, the Department of the Treasury receives all revenue from offshore wind leases in federal waters.[xii]

MAXIMIZING PERMITTING COORDINATION

The bulk of offshore wind permitting occurs after COPs have been submitted; consistent with NEPA regulations, BOEM prepares an EIS to review the COP. But the permitting process does not end with BOEM review. On the federal side alone, 26 agencies have authority over different aspects of ocean waters and resources under laws such as NEPA, the Endangered Species Act, the Marine Mammal Protection Act, the Migratory Bird Treaty Act, and the Coastal Zone Management Act. At the same time, states generally control coastal waters out to three nautical miles, which

x The technical report finds that jobs will be dispersed across states with varying levels of union membership. For instance, in 2021 New York had more than 22 percent union membership while South Carolina had less than 2 percent union membership. Project labor agreements will be particularly important in states with low union membership to ensure high labor standards on all projects. See Juliana Kaplan Hoff Madison, "This One Map Shows What Union Membership Looks like in the US," Business Insider, accessed June 6, 2023, https://www.businessinsider.com/map-of-what-union-membership-looks-like-in-us-2022-1.

xi The California, New York, and Carolina Long Bay Lease Sales all required the use of Motus telemetry tracking to identify movements of birds and bats.

xii Provisions on redirecting offshore wind revenue to environmental protection have been proposed in legislation, such as the bipartisan Reinvesting in Shoreline Economies and Ecosystems Act. A successful proposal would also include revenue sharing for supply chain investments and community benefits.

implicates transmission onshoring projects as well as service and construction vessel activities.

FIGURE 8.

Most offshore wind permitting occurs in the last stage of the BOEM timeline: environmental and technical reviews.

This robust environmental review reduces the potential negative impacts on communities, wildlife, resources, and other ocean users. However, more efficient coordination among federal agencies and state, local, and Tribal governments could reduce duplication of work, expediting projects without compromising the integrity of the assessment. Notably, increased funding for and use of Title 41 of the Fixing America's Surface Transportation Act (FAST-41) and federal-state coordination on permitting could help accelerate this process while maintaining environmental protection.

FAST-41 created the Federal Permitting Improvement Steering Council (Permitting Council) to maintain project timelines, resolve interagency disputes, and share project data and timelines publicly. FAST-41 is a key tool for BOEM to streamline the permitting process under existing law, with all offshore wind projects to date in the BOEM pipeline opting in.

To accelerate development, the federal government must follow a consistent practice for including state, local, and Tribal governments in the permitting process. The Ocean Policy Committee and the Permitting Council should promote coordinated review with state and local entities via creation of FAST-41 memoranda of understanding (MOU). State, local, and Tribal governments are only included in the FAST-41 process when they choose (or know) to participate. Proactive outreach by the federal government is necessary to parallel-process these otherwise separate activities that could require developers and agencies to duplicate work. This is particularly important because federal processes can be varied and uncertain, and providing more transparency and coordination at the federal level will be necessary for other entities to engage. Ultimately, improving FAST-41 coordination will enable local and Tribal governments to play a greater role in conflict resolution, and federal funding should be allocated to ensure Tribes have the capacity to contribute in depth and exercise their right to government-to-government consultation.

Federal, state, local, and Tribal coordination extends beyond FAST-41, particularly for states like California with thorough environmental reviews. To speed project permitting, states should identify ways to parallelize their processes with the federal permitting process. In California, Assembly Bill 525 on offshore wind generation requires creation of a "Conceptual Permitting Roadmap" that includes developing a single permit application checklist for lessees.[42,43]

BOEM should also increase the use of programmatic EISs (PEIS) for projects located within the same region to avoid duplication of work on similar environmental concerns across projects, as is being done currently for the New York Bight.[44] This PEIS focuses on identifying appropriate avoidance, minimization, mitigation, and monitoring methods for projects in the region. For future projects, BOEM should move the PEIS before the leasing process and prepare the PEIS with the additional intention of significantly reducing the timeline for future project-specific EISs at the COP evaluation stage. If PEISs continue to occur during site assessment, the agency should coordinate with developers to avoid duplication of work between the site assessment and the PEIS.

INCLUDING COMPREHENSIVE ENVIRONMENTAL AND COMMUNITY PROTECTION IN PERMITTING

Project permitting is a critical process for ensuring a comprehensive review of potential site-specific impacts on wildlife and habitats and identifying the mitigation approaches needed during construction, operation, and decommissioning of the project. While some impacts may be unavoidable, applying a mitigation hierarchy that aims to avoid, then minimize, and finally monitor and mitigate impacts is key to ensuring species can thrive alongside offshore wind.

Environmental organizations have thoroughly investigated best practices using currently available technology.[45,46] Application of these practices has been uneven, although many of them are being implemented. Developers can commit to voluntarily protecting wildlife beyond what permitting agencies would require, as illustrated by the voluntary agreement made between the Vineyard Wind farm and several environmental organizations to protect the critically endangered North Atlantic Right Whale.[47]

CASE STUDY

Vineyard Wind pioneering species protection

Clean energy has clear advantages in maintaining the planet's biodiversity, which faces existential climate change threats. Off the coast of Massachusetts, the Vineyard Wind project will act as a pilot project for building an offshore wind industry compatible with species protection. The project's developer worked voluntarily with several environmental organizations to create a plan to use best available species protection practices, test new technology, provide data, and adapt to changing circumstances as more is learned about offshore wind construction and operation and species contact. The developer has committed to ocean noise reduction while building turbine foundations and maintaining vessel speeds of 10 knots or less. It will also employ new monitoring technologies like thermal and acoustic monitoring to inform future projects. This pilot is an important example of how developers can provide data on species behavior to help ensure the best path forward for wildlife and the climate in future offshore wind projects.

For the industry to scale from tens of gigawatts in 2030 to hundreds of gigawatts by 2050, additional technology and research is needed to proactively identify risks and solutions and adapt to unforeseen challenges. For instance, real-time monitoring technology to set vessel speed limits is in development,[48] but no system has yet elicited confidence on the part of the environmental community, and the impacts of offshore wind on oceanographic processes such as upwelling are not fully understood. To reduce environmental impacts on wildlife, DOE should accelerate the development of these new technologies and research methods. States, BOEM, and industry should work with the environmental community and technical experts to implement and regularly update environmental protection standards that use the best available harm reduction strategies.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
BOEM, Congress	Use leasing to secure stakeholder support and incentivize development of the industry to prepare for long-term success.
Permitting Council, BOEM, states	Maximize permitting coordination by increasing funding and use of FAST-41, and identify ways to increase efficiency of federal and state permitting in concert.
BOEM	Through permit issuance, secure comprehensive environmental protection by requiring long-term project plans that use environmental best practices.

SECTION TWO

PREPARING THE INFRASTRUCTURE NEEDED TO SCALE OFFSHORE WIND

2.1. PLANNING TRANSMISSION INFRASTRUCTURE HOLISTICALLY

The technical report confirms what many countries and U.S. states are already finding: reaching a clean grid that enables a net-zero electrified economy requires at least doubling bulk transmission capacity, with or without offshore wind. In the offshore wind scenarios, many of these costs derive from lines and substations connecting offshore wind farms to the grid and reinforcing onshore grid infrastructure. To decrease these costs and reduce community and environmental impacts, the technical report examines a "clustered transmission" or holistic planning approach that trims offshore wind interconnection costs by 35 percent on average. Such an approach would avoid connecting each individual wind farm to onshore grid infrastructure independently, and instead would utilize shared transmission infrastructure such as a single line that connects several farms to shore. Coordinated, proactive planning attempts to answer the question: given the long-term needs for cost-effective offshore wind, what is the lowest-cost, least disruptive transmission solution?

One benefit of this approach is decreased environmental and community impacts. Holistic planning can reduce the number of lines coming onshore by 60 to 70 percent, shrinking the number of proposals for public consideration and enabling long-term decision-making to assess cumulative impacts. Second, because there can be 50 percent fewer underwater cable installations, holistic planning reduces marine.[49] Third, this approach speeds up developments by reducing interconnection- and transmission-related delays. Finally, it enhances consumer outcomes by allowing more projects to compete.

A recent study by the Brattle Group,[50] American Council on Renewable Energy, Natural Resources Defense Council, American Clean Power Association (ACP), and Clean Air Task Force performed a meta-analysis of different planning approaches, demonstrating the value of future-proofed, holistic offshore wind transmission planning. The analysis finds that because changes to transmission planning take at least 10 years to result in new transmission, we must reform transmission planning and cost allocation practices in the 2020s to pave the way for rapid and competitive offshore wind growth from 2035 to 2045. Delaying the process just five years could cut the benefits in half.

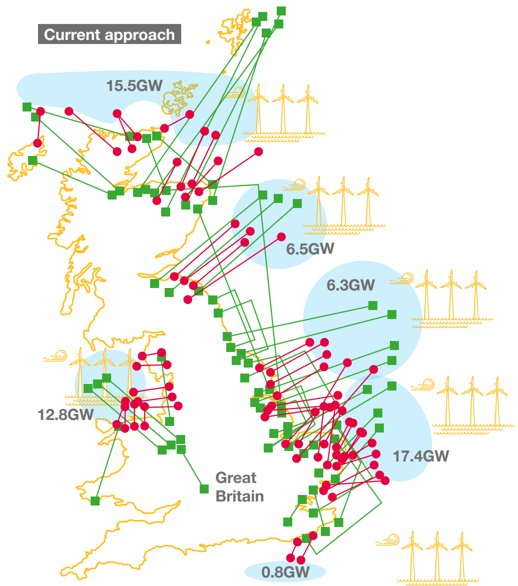
Regional transmission operators must operate their markets without favoring one resource over another, and the need for resource diversity, access to cost-effective generation, and grid resilience co-benefits are enough to justify long-term, large-scale offshore transmission planning. Furthermore, grid planners must consider existing state and utility commitments to offshore wind and achieving net zero greenhouse gas emissions by 2050. While states today have committed to 77 GW of offshore wind by 2045, we will need much more to de-risk the pathway to a carbon-neutral economy, increase grid resiliency, and unlock greater economic benefits. The technical report demonstrates that 250 to 750 GW of offshore wind would meaningfully improve resource diversity and meet the demands of a highly electrified economy without significant cost increases. Based on a review of state and regional decarbonization studies, the Brattle Group similarly projects a need for 220 to 460 GW of nationwide offshore wind in 2050 in a net-zero economy.

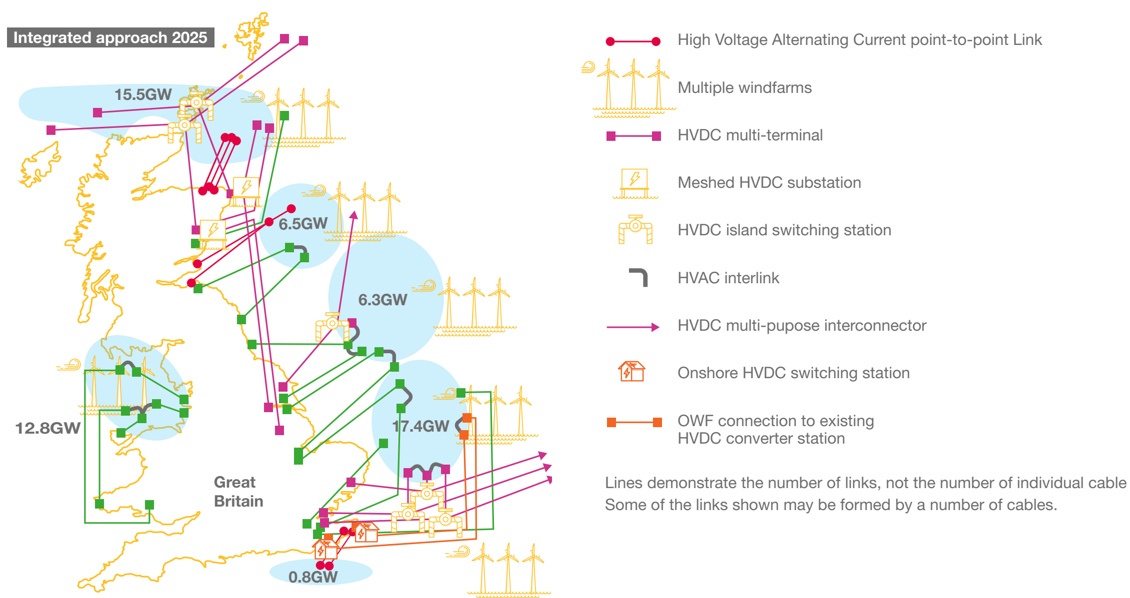
The benefits of holistic planning are clear from the U.K. electricity regulator Ofgem's visual comparison of the current project-by-project approach with holistic network design, including significantly reduced shore crossings and line construction (see Figure 9). Ofgem highlights the urgency of fully implementing this structure by 2025, which would allow maximum cost savings (estimated at $6.3 billion) in achieving the U.K.'s goal of 50 GW by 2030.[51]

FIGURE 9.

Unplanned vs. planned transmission for U.K. offshore wind in 2030.

Source: National Grid ESO





Many other studies demonstrate the cost savings of holistic regional planning, which is not limited to offshore wind. For example, the technical report's transmission study finds holistic planning for 750 GW of offshore wind in the U.S. could reduce offshore spur line transmission costs by 35 percent.[52] The PJM-New Jersey State Agreement Approach reached a similar conclusion: A coordinated transmission plan could reduce costs by 20 to 30 percent and reduce sea cabling by 50 to 60 percent in helping reach

New Jersey's goal of 7,500 MW by 2035.[xiii] Coordinated offshore transmission efforts between states and regions could also include new interregional links offshore, which could further decrease costs and improve grid reliability and resilience.[53]

However, overcoming significant barriers to this approach will require new policies. Holistic planning is not the current practice of regional grid operators and planning authorities, although FERC is trying to remedy this problem through its current Transmission Planning and Interconnection Notices of Proposed Rulemaking. Even if FERC issues strong final rules, regional entities will still need to adopt holistic planning practices for offshore wind and determine who pays for it. And states must establish interstate cooperative governance structures within and between regional transmission organizations (RTOs) and other grid operators to identify shared needs and determine cost allocation for multi-state and interregional projects.

xiii See generally "New Jersey Offshore Wind Transmission State Agreement Approach Overview" (New Jersey Board of Public Utilities, March 22, 2022), https://www.nj.gov/bpu/pdf/publicnotice/3.22.2022%20SAA%20Stakeholder%20Master%20Slide%20Deck.pdf; see also the MISO-SPP Joint Targeted Interconnection Queue Studies and MISO's Long-Range Transmission Planning Effort.

CASE STUDY

New England states work toward offshore transmission backbone

In early 2023, Maine, Massachusetts, Connecticut, and Rhode Island jointly proposed an offshore high-voltage transmission network that reflects the states' shared goals of "minimizing the cost of a reliable, environmentally conscious energy supply that protects our citizens and natural resources from climate change without shifting costs or over-burdening ratepayers." The states, all members of ISO-New England, are seeking funding from DOE's Grid Innovation Program, a grant and loan authority created by the Infrastructure Investment and Jobs Act. The project is eligible because of the novel high-voltage direct current technology being examined. The concept recognizes that a planned approach to offshore wind that includes a shared backbone connecting to multiple wind farms can reduce grid interconnection points, save money, improve regional reliability and resilience, and set the stage for increased transfer of electricity between geographic regions.[xiv]

Later in 2023, six New England states, New York, and New Jersey jointly requested the DOE help them form a "Northeast States Collaborative on Interregional Transmission" to explore ways to increase regional interconnectivity—including for offshore wind.[54] Advanced technology like a backbone that connects to multiple farms can add even greater reliability value when linked to other regions via high-voltage direct current transmission. Under the proposed structure, DOE would lead the states in planning activities that could include investigating mutually beneficial options for increasing the flow of electricity between planning regions in the Northeast and assessing offshore wind infrastructure needs and solutions.

Where local impacts cannot be avoided, transmission planning must not worsen long-standing inequities in energy system planning. Community input is one key pillar, and planning authorities should allocate resources to visit and build relationships with

xiv A 2020 concept paper from the Brattle Group shows how holistic planning, like a method employed in the U.K., could avoid more than $1 billion in onshore transmission upgrades, halve the electric grid connection points, and promote greater competition in the region. See: Johannes Pfeifenberger, Sam Newell, and Walter Graf, "Offshore Transmission in New England: The Benefits of a Better-Planned Grid" (The Brattle Group, May 2020), https://www.brattle.com/wp-content/uploads/2021/05/18939_offshore_transmission_in_new_england_-the_benefits_of_a_better-planned_grid_brattle.pdf.

local community leaders, making sure to understand their needs in the transmission planning process before siting and permitting decisions are made. Local communities hosting onshoring infrastructure should be compensated financially to bolster community revenues and services. Local labor and CBAs (discussed in Sections 1.1 and 1.3), as well as requirements to provide some power to the local grid, can also ensure the local community benefits directly from this infrastructure. In regions like the Gulf of Mexico, where abandoned oil and gas infrastructure is littered across the sea floor, developers could be required to clean up legacy infrastructure when constructing new transmission lines.[55]

The Brattle Group's recent study provides detailed policy recommendations, and we summarize here the most salient for policymakers.

Modifying and bolstering transmission planning practices is resource intensive. Congress and state legislatures must fund additional staffing at relevant agencies. It will take substantial new technical capacity, community engagement staffing, and interagency coordination to develop and socialize holistic offshore transmission plans. Holistic planning also entails interregional coordination; states should create and empower multi-state entities to gather community input and develop transmission plans that include local benefits aligning with community needs. And planning entities should prioritize identification of interconnection points for planned and potential offshore wind development.

FERC should serve as a national forum to convene experts on offshore wind transmission planning to explore policy solutions to enable holistic offshore wind transmission planning and socialize new approaches. This could take the form of a series of technical conferences focused on optimizing transmission planning, interconnection, and technical standards development.

In the next few years, states must proactively design and agree upon new cost-allocation approaches that allow for networked, holistic offshore wind transmission development within their regions. Development of a multistate planning authority including states with complementary offshore wind goals would best facilitate this process. Proactive planning would also prepare states for implementing FERC's two proposed transmission rules in the offshore wind context, which presumably will require improvements to the interconnection and transmission planning process.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
Congress; state legislatures	Increase staffing at state and federal agencies tasked with planning the transmission grid, especially state energy offices, PUCs, and FERC.
Governors; ISO/RTOs	Empower multi-state entities to coordinate, gather community input, and develop transmission plans that assess and include local benefits aligning with community needs.
State transmission authorities; utilities; PUCs; ISO/RTOs	Prioritize identification of interconnection points that can be used for planned and potential future unplanned offshore wind development.
FERC	Provide a national forum to convene experts, establish the need, and solicit new approaches to offshore wind transmission.
State energy offices; PUCs; FERC; ISO/RTOs & transmission planning authorities	Take a proactive approach within regions to design and agree upon new cost allocation approaches that allow for networked, holistic offshore wind transmission development.

2.2. PREPARING THE WORKFORCE FOR OFFSHORE WIND VIA APPRENTICESHIPS AND UPSKILLING

Offshore wind presents a generational opportunity to create sustainable, family-supporting careers. The technical report finds that deploying hundreds of gigawatts of offshore wind could create nearly 390,000 jobs in 2050, mostly in the electricity and manufacturing sectors.

The federal government and some states have already conducted workforce assessments for near-term goals. NREL completed an assessment for the national goal of 30 GW by 2030, and New York completed an assessment for the state's goal of 9 GW by 2035. As a part of the U.S. Offshore Wind Standards Initiative, the American National Standards Institute Board of Standards Review and ACP created the "Offshore Compliance Recommended Practices," which identifies 200 industry standards and guidelines for developing a U.S. offshore wind project.[56] Accordingly, the data needed to define the roles and certifications for these 390,000 workers is mostly in place.

To achieve rapid scaling, we must start now to prepare a workforce equipped to meet the needs of specific times and geographic locations. Offshore wind can be a boon to workers and communities, but only if actions are taken to identify and define roles, ensure high-quality jobs are created, train workers, and prioritize jobs for marginalized communities and workers transitioning out of the fossil fuel industry.

Offshore wind jobs can contribute to a just transition for fossil fuel workers. In 2020, 176,000 people were employed by the offshore oil and gas industry in the U.S.,[57] and up to 90 percent of these jobs and skill sets may be transferable to various clean energy industries, including offshore wind.[58] Offshore wind is particularly compatible, as demonstrated by Equinor's use of the same staff to build the Peterhead offshore wind farm in Aberdeen, Scotland, that it has used to build offshore oil and gas platforms.[59] The oil and gas sector is highly unionized, with wages, benefits, and career opportunities generally superior to those in the renewable energy sector. Ensuring that new offshore wind jobs are of a comparably high quality is essential to a just transition.[60]

To ensure the workforce is ready to support the construction and operation of hundreds of gigawatts of offshore wind, the federal government will need to work with states and labor unions to:

1. Assess the offshore wind workforce
2. Expand offshore wind training opportunities

ASSESSING OFFSHORE WIND WORKFORCE

Of the 113 roles within the offshore wind industry,[61] many are unique to the industry. Even upskilling will often require training, which necessitates well-defined roles and certifications. The first step in developing a workforce that can support high targets is determining workforce needs and gaps. State energy offices should assess their current offshore workforce and gaps, and DOE shouldassess nationwide workforce needs through 2050, assuming high levels of domestic content across the supply chain and acknowledging the potential for 250 to 750 GW of offshore wind deployment. Workforce assessments should also analyze job quality, in addition to job type, and account for reduction in energy generation from existing fossil sources. Assessments should cover existing union workforce training programs that teach transferable skills and consider the demographics of the existing workforce to ensure new training programs can support diversification of the industry.

These assessments also set the stage for the standardization of offshore wind roles and safety certifications. As the NREL workforce assessment highlights, even a job as ubiquitous as "offshore wind turbine technician" can have varying meanings and responsibilities at different companies. Training programs cannot be designed without standard roles. DOE should expand NREL's work and partner with the Department of Labor (DOL), unions, and the offshore wind industry to further define the roles and responsibilities needed, building on existing resources such as the "Offshore Compliance Recommended Practices" manual.[62] To achieve the scale envisioned in the technical report, further assessments for floating offshore training and certifications should begin now.

Finally, regional assessment of the offshore wind workforce can maximize domestic workforce utilization and avoid unnecessary duplication. Coordination of a regional workforce can also foster a continual pipeline of jobs for workers in transient construction roles. The Biden administration has created an implementation task force made up of 11 governors from the East Coast, California, and Louisiana to coordinate offshore wind activities across states.[63] This task force should commission regional offshore wind assessments to identify roles on a regional basis and specialized workforces and worksites in each state that can fill those roles. Assessments should not be limited to coastal states, as inland states will also see employment gains from down-supply chain manufacturing. With potentially hundreds of thousands of jobs to fill on the road to deploying hundreds of gigawatts of offshore wind by 2050, these regional efforts are necessary to prepare this large workforce.

EXPANDING OFFSHORE WIND TRAINING OPPORTUNITIES

While some offshore wind jobs require higher education, like university or maritime academy training, most require specialized skills and safety training typically found in a union apprenticeship program. While interest in offshore wind training is rising, with 44 offshore wind-specific training programs across the country,[64] NREL's workforce assessment identifies training gaps across all education and training levels. This includes safety certifications, community college programs, and registered union apprenticeships in addition to apprenticeship-readiness programs that support groups historically underrepresented in unionized jobs. Further, there is significant opportunity to expand other programs to include offshore wind-related skills. For example, in New York alone, 24 wind-specific training programs could be expanded to include offshore wind, and 758 training programs could be expanded across the construction and manufacturing industries.[65]

DOL, labor unions, industry, and state governments must work together to support multiple pathways into offshore wind jobs via programs that fill these outstanding roles while also promoting high-quality jobs for communities impacted by offshore wind development. These pathways should include programs for new entrants into the workforce and for workers entering offshore wind from entirely different fields via registered apprenticeships, particularly union apprenticeships, and community colleges, as well as upskilling programs for workers in related fields, such as the oil and gas and maritime industries (see Figure 10).

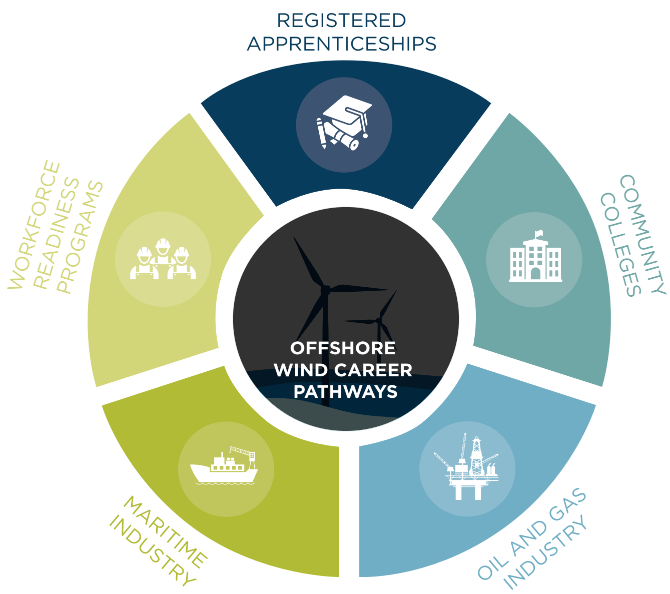


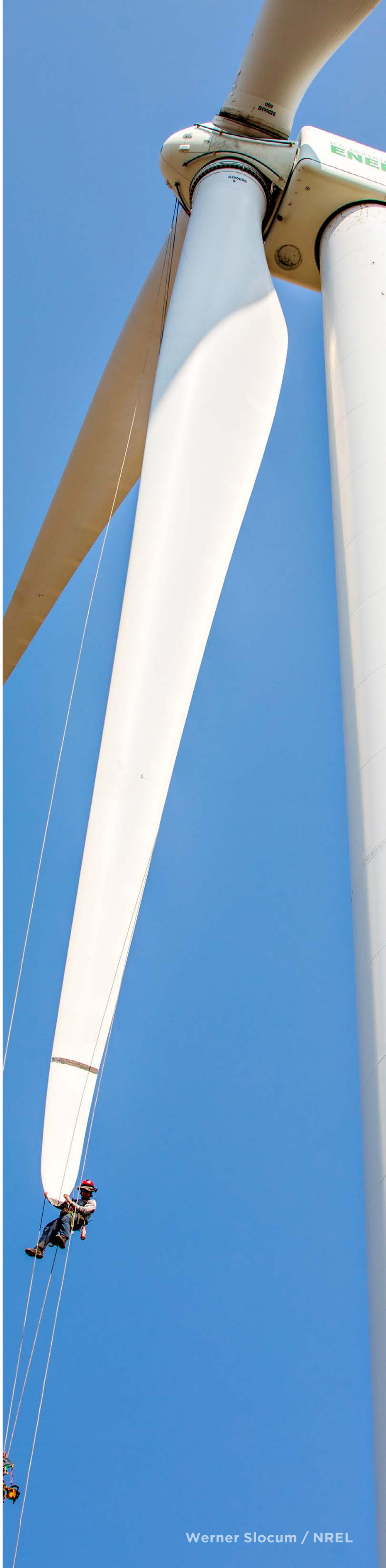
FIGURE 10.

Offshore wind career pathways include registered apprenticeships, particularly through unions, workforce readiness programs that partner with registered apprenticeships, community colleges, and transfer from the maritime and oil and gas industries.

To expand offshore wind training from the existing 44 programs to the thousands needed to support 390,000 new jobs in 2050, DOL should work with the U.S. Economic Development Agency to fund new offshore wind registered apprenticeship programs, with a focus on union apprenticeships. Union apprenticeship programs are well positioned to expand into offshore wind as their numbers and graduation rates rise, a trend that IRA labor standards will support as the workforce scales in the next decade.[66] Union apprenticeships also offer several advantages over non-union programs, such as higher graduation and retention rates and recruitment of underrepresented groups including women and minorities.[67] They also typically are cost free, pay students during their tenure, and help secure or even guarantee placement in a full-time position after graduation.[68]

By taking an approach similar to the Good Jobs Challenge funded by the American Rescue Plan, DOL and state economic development boards can help promote these union opportunities.[69] The $500 million Good Jobs Challenge provided 32 grants expected to lead to more than 50,000 job placements. DOL should also work with the North American Building Trades Union and the AFL-CIO Industrial Union Council and engage other unions to determine how existing training programs can grow to encompass offshore wind, including providing grant funding for expansion. To increase opportunities for underrepresented communities, funded programs should follow the example of the Maryland Works for Wind program, which focuses on employing formerly incarcerated individuals, veterans, disconnected youth, and other underrepresented populations to diversify the state's registered offshore wind sector apprentices.[70] Similarly, the Building Futures program in Rhode Island supported equitable hiring and training for the Block Island Wind Farm and also takes an active role in monitoring all PLAs in the state.[71]

As highlighted in Section 1.3, BOEM has identified job creation for local communities as an eligible use of bid credits, but pathways into those jobs may not exist for residents. Registered apprenticeship programs provide one of the best routes to prepare workers for jobs in the offshore wind industry, but many populations, particularly those from underrepresented communities, may have difficulty accessing them. Apprenticeship-readiness programs, which partner with registered apprenticeship programs and prepare students to succeed in that apprenticeship, are a tried-and-true way to help individuals qualify for apprenticeships even if they otherwise might not meet the entry requirements. When providing funding for apprenticeship programs, DOL should prioritize those with apprenticeship-readiness programs aimed at providing opportunities for underrepresented communities and communities close to offshore wind developments.


Werner Slocum / NREL

CASE STUDY

Apprenticeship-readiness program in Massachusetts creates local opportunities

Since the 17th century, New Bedford, Massachusetts, has been an industrial hub for the whaling industry, then textiles, and then fishing and manufacturing. It will now be the primary port used for construction of the Vineyard Wind project, the first commercial-scale offshore wind project in the U.S. To ensure this new industry brings benefits to the local community, the Building Pathways apprenticeship-readiness program partnered with the Massachusetts Maritime Academy to incorporate offshore wind experience into its "Introduction to Construction" program. Building Pathways programs are designed to help people from diverse backgrounds enter the building trades, and provide case management assistance for childcare, transportation, housing, health care, and more. This work has been supported by grants from the Massachusetts Clean Energy Center in a round of economic development funding aimed at increasing equitable access to offshore wind jobs.

With so many possible careers available in offshore wind, salaries can vary widely. Community college programs focused on offshore wind, while lacking payment for hours worked unlike a union apprenticeship, make high-paying jobs accessible people that cannot afford more expensive education. At Bristol Community College, the National Offshore Wind Institute offers two programs—an associate degree in Offshore Wind Power Technology and an Offshore Wind Technician Certificate.[72] DOL and the Department of Education should work with community colleges across the country to expand offshore wind associate degrees and technical certificates, focusing on regions that expect more development in the coming decade.

Beyond apprenticeship and community college pathways, many similar fields have jobs with skills that are transferable to offshore wind roles, such as construction of offshore platforms and vessel operation. Offshore oil and gas and maritime industry workers may have skills that can be relatively easily transferred to this new industry. DOL and the Department of Education should fund the development of certification and safety programs focused on the transfer and upskilling of workers from other fields.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
DOL, DOE, state economic development boards	Work with labor unions to expand existing training programs to include more offshore wind training opportunities and dedicate resources to workforce readiness programs with wraparound services for underrepresented groups.
DOE, DOL	Promote transfer and upskilling of workers from other fields, such as offshore oil and gas and maritime industries.
State energy offices, DOE, DOL	Complete offshore wind workforce assessments out to 2050, including standardizing certifications and identifying job types and quality, workforce gaps, and opportunities for regional coordination.

2.3. INCENTIVIZING AND COORDINATING A DOMESTIC SUPPLY CHAIN AND MANUFACTURING

Establishing a U.S. offshore wind industry able to provide 10 to 25 percent of electricity supply in a net-zero economy creates opportunities to enhance domestic manufacturing and grow the economy. A key first step is to secure large public and private investment for raw material and component supply chains and for ports and wind turbine installation vessels (and shipyards). As detailed in the supply chain report, offshore wind supply chain development must ramp quickly and then accelerate over the next 15 years. A $22.4 billion investment is needed for manufacturing supply chains, ports, and vessels for just the first 30 GW of installed offshore wind.[xv] We estimate that the public and private investment required for supply chain manufacturing, ports, and vessels to install about 500 GW will be more than $134.4 billion (in 2022 dollars) cumulatively through 2045.[xvi]

xv This figure is from NREL's 2023 Supply Chain Road Map report, which also contains a detailed description of the supply chain and supporting policies needed to achieve the Biden administration's goal to achieve 30 GW of offshore wind installed by 2030. Matt Shields et al., "A Supply Chain Road Map for Offshore Wind Energy in the United States," January 20, 2023, https://doi.org/10.2172/1922189.

xvi See Table 2 in the supply chain report.

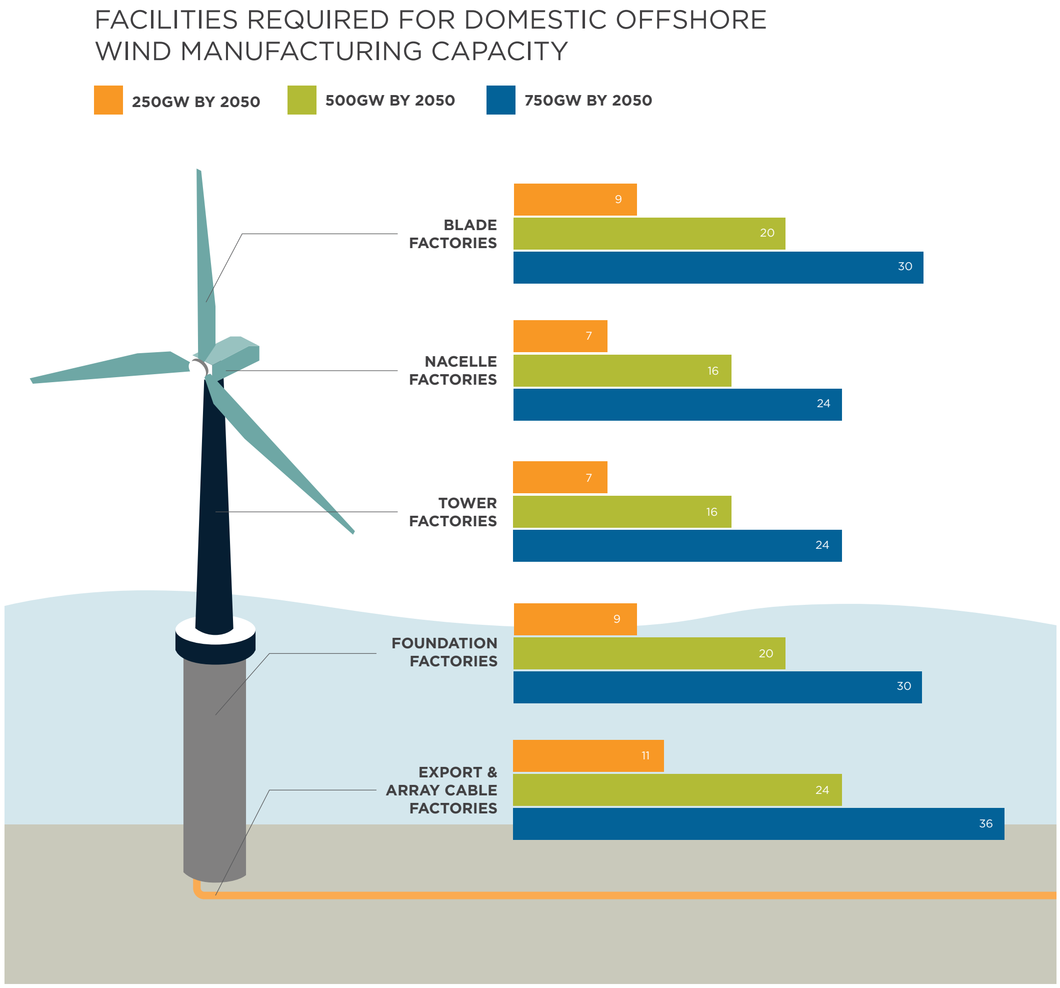


FIGURE 11.

Manufacturing facility needs to domestically support 250, 500, and 750 GW of offshore wind by 2050.

The figures, while daunting, are small in relation to spending on other aspects of the U.S. energy sector. For example, in recent years *annual* U.S. investor-owned electric utility capital expenditures have exceeded $150 billion.[73] And some of the necessary financial support is already on the way in the form of tax credits, grants,[xvii] and research funds from the IRA and the Infrastructure Investment and Jobs Act

xvii For an example of recent port investment on the West Coast, see "State Approves $10.5 Million to Prepare the Port of Humboldt Bay for Offshore Wind," California Energy Commission, accessed June 6, 2023, https://www.energy.ca.gov/news/2022-03/state-approves-105-million-prepare-port-humboldt-bay-offshore-wind.

(IIJA). But key gaps in funding could block the development of this vital new energy resource. Additional funding, public-private partnerships, and policy changes are needed to address the most critical barriers to offshore wind development in the U.S.: ports, vessels, steel, and component manufacturing.

Financial and policy support for floating offshore wind turbines is especially important. DOE has set a floating offshore wind target of 15 GW and $45/MWh by 2035. The offshore developments on the West Coast and further out on the Outer Continental Shelf on the East Coast and in the Gulf of Mexico depend on advancements in floating offshore technology. Meeting this goal will require research, development, and deployment investments to support new, specialized component supply chains for floating wind projects. Cost-effective and scalable deployment of floating technologies will be critical to maintain and accelerate the growth of offshore wind generation and represents an opportunity for U.S. manufacturing to lead globally given its relative nascency worldwide compared to fixed-bottom technology.

To accelerate development, the U.S. must expand policy support for domestic manufacturing, port development, and advanced technology. Pathways toward success will involve regional-scale public-private collaboration, strong research development and demonstration support for emerging manufacturing technologies, interventions to de-risk domestic manufacturing investment, additional state and federal funding to develop marshaling ports, and new vessel construction. Three policy pillars to support private investment in supply chains and manufacturing to scale the offshore wind industry are:

1. Increasing incentives for domestic raw material and subcomponent manufacturers
2. Organizing a central agency to coordinate domestic supply chain infrastructure
3. Prioritizing resolution of offshore wind supply chain constraints in trade and tax policy

INCREASING INCENTIVES FOR RAW MATERIAL AND SUBCOMPONENT MANUFACTURERS

A cost-effective, efficient, and equitable domestic manufacturing supply chain would de-risk individual offshore wind projects while strengthening the economy, creating high-quality jobs, and revitalizing port communities. New domestic offshore wind manufacturing would also minimize reliance on a global supply chain for offshore components and mitigate vulnerabilities.

Robust European and Asian offshore wind development has heightened global demand and competition for offshore wind project components, absorbing nearly the entire existing global offshore wind supply chain. While U.S.-based offshore wind projects slated to be operational by 2024 have component supply contracts with European original equipment manufacturers (OEMs), it will be increasingly difficult for U.S. offshore wind developers to rely on imports of finished components and raw material as offshore wind projects multiply globally. Fortunately, U.S. domestic manufacturing is beginning to ramp up and can likely begin supplying components as global supply chain constraints become more acute in the late 2020s.

Plans have now been announced to build one U.S. blade facility, two nacelle facilities, one tower facility, two monopile facilities, three cable facilities, and one steel plate facility. But these facilities won't be able to support the more than 17 GW of offshore wind projects currently under contract, let alone continued growth. The current rate of public and private investment can support 30 GW by 2030, but the U.S. will need to import some components in the short term until these investments are realized and domestic manufacturing capacity scales up.

In the long run, absent strong policy support, market uncertainty could deter additional U.S. investments in offshore wind component manufacturing, undermining the U.S.'s ability to rely on offshore wind as a major energy resource and job creator in a net-zero economy. While domestic manufacturing of some offshore wind-related raw materials and subcomponents is readily achievable, suppliers are hesitant to adjust manufacturing operations due to the high costs of adapting operations and uncertain timelines for product demand.[74] This points again to the wisdom of setting stronger mandates for long-term offshore wind deployment. In addition, federal or state research development and demonstration funding, low-cost financing through the DOE Loan Programs Office, or other forms of commercialization support could advance development or repurposing of component manufacturing facilities in the U.S. for offshore wind components.[75]

Domestic production of finished components relies entirely on access to the necessary subcomponents, subassemblies, and raw materials. The raw material and subcomponent supply chain offers superior jobs and economic benefits to finished component manufacturing.[76] Further, many raw materials and subcomponents have uses in other industries and can be produced inland, which would allow land-locked states and industries to realize the labor and investment benefits of increased offshore wind deployment.[77]

While tax credits are effective tools to encourage OEMs to expand domestic operations for finished components, the IRA credits for major components are inadequate for incentivizing subcomponent and raw material suppliers.[xviii] Therefore, the federal government should adjust tax credits to directly benefit lower-tier suppliers (e.g., those supplying subcomponents or raw materials) and extend the tax credits beyond 2032. For example, the U.S. steel industry needs substantial investment to produce specialty steel products needed for offshore wind turbine components (particularly for towers, flanges, monopiles, rotor hubs, and nacelle plates).[xix] Fortunately, this investment has begun. Nucor, for example, invested $1.7 billion for its steel mill in Kentucky that will supply the steel plates needed to construct towers.[78,79] According to the supply chain report, however, to adequately support offshore wind expansion, at least two additional steel plants of this magnitude must be operational by 2035, likely on the West and Gulf Coasts.

xviii The IRA offers manufacturing tax credits in the amounts of 2 cents per blade, 5 cents per nacelle, 3 cents per tower, 2 cents per fixed foundation, and 4 cents per floating foundation, where each amount is multiplied by the rated capacity of the completed turbine for which it was designed. See Section 13502 of the Inflation Reduction Act: "H.R.5376 - 117th Congress (2021-2022): Inflation Reduction Act of 2022" (2022), http://www.congress.gov/bill/117th-congress/house-bill/5376/text.

xix Because traditional steel mills are carbon intensive, funding structures should include grant programs designed to encourage low-carbon steel production. See generally "The Pathway to Industrial Decarbonization," Center for American Progress (blog), October 26, 2022, https://www.americanprogress.org/article/the-pathway-to-industrial-decarbonization/ and "Development of Eligibility Criteria Under the Climate Bonds Standard & Certification Scheme" (Climate Bonds Initiative, December 2022), https://www.climatebonds.net/files/files/Background%20paper%20CBI%20Steel%20Criteria_Final.pdf.

CASE STUDY

Offshore wind manufacturing investments can promote high-quality jobs

The Port of Coeymans got its start in brick manufacturing along the Hudson River near Albany, New York. More recently, it has acted as a hub receiving construction debris from New York City. Now, it's shifting to cleaner industry and expanding to create manufacturing sites as it aims to pivot to offshore wind. Already, turbine manufacturers have expressed interest in the site. For instance, GE plans to manufacture turbine blades and nacelles at the port, creating nearly 900 direct jobs at the facility. Even better, GE and the International Union of Electrical Workers-Communications Workers of America reached a labor peace agreement (LPA) for the planned facilities, which will require GE to remain neutral during the union organizing process. LPAs typically make it significantly easier for unions to organize, although they do not guarantee union jobs. Promoting union activity and labor agreements, including LPAs and PLAs, can help ensure that the domestic offshore wind manufacturing industry creates high-quality, family-sustaining jobs.

ORGANIZING A CENTRAL AGENCY TO COORDINATE REGIONAL SUPPLY CHAIN INFRASTRUCTURE

Current state solicitations for offshore wind power are designed to incentivize in-state economic activity. These siloed state policies dissuade regional collaboration and create inefficiencies. In France, top-down local content mandates, enforced through bid processes, required developers to acquire more expensive components from less mature French manufacturers, instead of cheaper alternatives elsewhere in Europe. This drove the cost of offshore wind energy up to about €200/MWh, which is significantly higher than comparable projects in nearby countries.[80]

While local content requirements for turbine construction are crucial to creating benefits for local communities, parochial approaches to supply chain development can be unsustainable and ultimately hurt the long-term growth of the offshore wind industry unless they are carefully coordinated with local supply chain development. Europe has implemented regional collaboration models, such as a series of agreements between nine North Sea countries that include a commitment to reach 120 GW of offshore wind by 2030 and 300 GW by 2050. Prior to this agreement, supply chain constraints had limited the region's build capacity to 7 GWs per year, far short of its target of 20 GW per year.[81] An ancillary agreement focuses on the creation of shared hubs and target capacity, developing a framework that supports shared resources and specialization.[82]

Initiatives are needed to increase communication and coordination across states and regionalize content mandates. This will maximize opportunities for all states while reducing costs. In some locations, multi-state coalitions have been organized to coordinate and optimize both regional and domestic supply chain resources. Examples include the SMART-POWER collaboration[83] and New England for Offshore Wind.[84] Notable federal strategies for regional collaboration include the Federal-State Offshore Wind Partnership[85] and "A Shared Vision on the Development of an Offshore Wind Supply Chain," formulated by BOEM and the states of New York and New Jersey.[86] Collaboration on manufacturing efficiencies among other West Coast and Gulf states, including inland states with subcomponent manufacturing capacity, will be critical to accelerate offshore wind development in those regions. The DOE should convene industry leaders to determine a cohesive national strategy, identify shared market areas, and leverage regional efficiencies. The DOE's Manufacturing and Energy Supply Chains Office could lead a nationwide strategy and allocate federal investment to smaller, regional collaborations.[87]

PRIORITIZING RESOLUTION OF OFFSHORE WIND SUPPLY CHAIN CONSTRAINTS IN TRADE AND TAX POLICY

NREL estimates that reaching the current federal target of 30 GW by 2030 will require approximately $11.4 billion in public and private investment in major manufacturing facilities.[xx] Extrapolating this investment to 500 GW will require roughly $70 billion over the next 20 years.[xxi] To achieve this scale, support beyond the IRA will likely be needed. Congress should monitor progress in the offshore wind supply chain to determine whether market drivers, including state procurement targets, are sufficient to scale offshore wind development as modeled in the technical report. If not,

xx NREL's *2023 Supply Chain Road Map* report estimates that the total investment needed in manufacturing, ports, and vessels is $22.4 billion. Of this, $11 billion is needed for ports and vessels. See Matt Shields et al., "A Supply Chain Road Map for Offshore Wind Energy in the United States."

xxi See Table 2 of the supply chain report. This figure is about 50 percent of the number in the bottom row of Table 2 for 2045, representing the manufacturing share of the total investment described in NREL's *Roadmap Report* (2023) for manufacturing, ports, and vessels.

Congress should extend the IRA tax incentives and Loan Programs Office authority beyond 2032 to support the manufacturing of key offshore wind components. For example, according to the supply chain report, 12 blade facilities or production lines by 2035, and 30 blade facilities or production lines by 2050, are needed to supply 10 to 25 percent of electricity with offshore wind by 2050.

Public investment and policy support should focus on the components and supply chain manufacturing segments that pose the greatest risk to U.S. offshore wind development. Currently, the IRA's domestic content requirements consider offshore wind content to be domestic if 20 percent of the costs is tied to components mined, produced, or manufactured in the U.S. After 2025, this percentage will gradually increase to 55 percent. Congress should evaluate and increase these requirements at a rate consistent with the long-term growth of domestic supply chain capacity and allow the Treasury Department to make temporary exceptions when import of components or raw materials is necessary to compensate for unanticipated domestic production shortfalls.[88]

The U.S. should also retain long-term flexibility in its trade policy to allow imports of specialized components to meet unexpected demand surges that would break offshore wind installation momentum. For example, some raw materials or subcomponents are difficult or less cost-effective to produce domestically at the scale needed (see supply chain report). Additional government-funded research is needed to identify any trade barriers (e.g., tariffs on specialty steel products or castings) that could make turbine production impossible or too expensive. Modifications to U.S. trade policy could ensure offshore wind construction can proceed while planned domestic manufacturing scales up.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
State energy offices; DOE; state economic development agencies	Increase outreach and education efforts to engage subcomponent and raw materials suppliers, while adjusting tax credits and creating grant funding for these suppliers.
Multiple government and private sector actors; U.S. Treasury	Establish policy and financing instruments needed to build additional specialty steel plants and commercialize additive manufacturing of large iron and steel castings and forgings, including backstop federal steel reserve programs.
DOE; state governors	Create a central agency to coordinate interstate supply chain infrastructure.
Congress	Reexamine tax incentives and domestic content requirements before the IRA's expiration and consider extension to support scale beyond 2032. Identify U.S. tariff and trade policy changes to support accelerated offshore wind development.

2.4. PREPARING PORT AND VESSEL INFRASTRUCTURE FOR OFFSHORE WIND

Fully financed, permitted, and operational ports are foundational to offshore wind domestic manufacturing and day-to-day logistics of offshore wind project construction and maintenance. Port development alone can make or break the offshore wind industry.

Nearly 20 East Coast ports and two West Coast ports have been designated for offshore wind development. Yet existing and planned marshaling ports are insufficient to meet demand from existing leased areas. Additional marshaling, manufacturing, and maintenance port capacity is needed to meet long-range offshore wind goals.[89] This is particularly true for marshaling ports, which are used to collect and store wind turbine components before loading them onto wind turbine installation vessels or assembling floating turbines in port. The lack of marshaling ports is a principal barrier to offshore wind development in the U.S.[xxii]

xxii See discussion in supply chain report.

Port improvements require substantial lead times, and costs can vary significantly depending on site-specific characteristics, any associated Tribal, wildlife, or environmental sensitivities, and local permitting requirements. Additionally, any dredging to modify shipping channels requires Army Corps of Engineers involvement and possibly congressional funding.[90] Planning will also be needed to reduce air and noise pollution from heavy-duty trucks[xxiii] and ships during port construction and operations, and to ensure ports enhance economic opportunities for local communities.

Concurrent development of multiple offshore wind leases will increase demand for public and private capital while straining port authorities and coastal agencies.[91] Despite these challenges, the offshore wind industry presents an opportunity to revitalize aging port infrastructure. The South Brooklyn Marine Terminal, a 73-acre proposed wind turbine hub in Sunset Park, New York, is an example of port revitalization. It worked closely with local community groups to ensure a just development plan that retains economic benefits within the community while aiding offshore wind development. Port revitalization is also an opportunity to improve air quality through the electrification of trucking and cargo handling equipment. Revitalizing ports maintains industrial zoning, which can simultaneously increase port-related economic activity and employment, reduce gentrification, and stabilize existing affordable housing.[92]

Beyond policies that create market demand for offshore wind such as site identification and state procurement goals, three policies will develop port and ship capacity to scale the offshore wind industry:

1. Increasing grant funding for port infrastructure and revitalization
2. Promoting regional port collaboration
3. Enhancing incentives to increase shipyard capacity

xxiii A recent analysis from NREL found that drayage trucking in New York and New Jersey could be partially electrified under current technology, and fully electrified with cost savings as battery technology improves electric truck range. See Andrew Kotz et al., "Port of New York and New Jersey Drayage Electrification Analysis," December 5, 2022, https://doi.org/10.2172/1908569.

INCREASING GRANT FUNDING FOR PORT INFRASTRUCTURE AND REVITALIZATION

Some direct federal funding for port development is available through the IIJA and the U.S. Department of Transportation (DOT) Maritime Administration's Port Infrastructure Development Program. The Port of Albany in New York, the Arthur Kill Offshore Wind Terminal in New York, the Portsmouth Marine Terminal in Virginia, and others have all leveraged Port Infrastructure Development Program (PIDP) funding to support offshore wind development.[93] While the IIJA appropriated $450 million to the PIDP for 2022 through 2026, much of this funding is being used for port improvements unrelated to offshore wind. Moreover, funding to date has largely been allocated to the East Coast and will be inadequate to prepare port infrastructure for offshore wind on all coasts. For example, development of the South Brooklyn Marine Terminal has required over $250 million in developer investments, $57 million from New York City, and $25 million from the PIDP.

Additional federal funding for ports is needed immediately, and states can help fill gaps. Funding for port revitalization should be tied to the DOE's *2022 Offshore Wind Report,* which identified more than $1 billion in announced investment in offshore port upgrades, funded through a combination of private developers, state port or energy authorities, and the federal government. This is, however, only a fraction of the needed investment. The funding outlined for the South Brooklyn Marine Terminal is one example of how public-private partnerships can stimulate private capital deployment. Bid credits under offshore leasing agreements are another way to help finance infrastructure, but the caps on these credits limit the amount developers can credit toward the many port investments needed to scale the industry.

Some states have implemented grant programs to help meet high up-front capital needs, but programs would need to scale across the U.S. to support hundreds of gigawatts of deployment by 2050. For example, New York offers $500 million in grant funding for port development and requires recipients to match the allocation by a three-to-one ratio.[94] Public-private partnerships between state governments and project developers have also emerged as a critical policy for East Coast ports, such as the Port of New London.[95] Coastal states must scale these programs to support long-term development needs, like accommodating floating offshore wind technologies and larger turbines.

Beyond the East Coast, planning for marshaling ports is nascent in the Southeast, Gulf, and West coasts. Port planning is also needed for floating turbine ports in Maine and the Great Lakes. The supply chain report estimates that 25 marshaling ports are needed to achieve roughly 450 to 550 GW of offshore wind, but only nine or ten marshaling ports are in construction or advanced planning. Because it takes five to seven years to site and construct a port, it is crucial that states and federal agencies quickly ramp up offshore wind port development in these areas. The supply chain report includes a table describing U.S. marshaling port development needs.

Historically, port communities have been some of the most overburdened by pollution from both ships and vehicles. As states and the federal government work to ramp up investments in ports, funding opportunities should require applicants to commit to electrified infrastructure at ports and other methods to reduce pollution in the surrounding community. To ensure that investments revitalize communities directly, local hiring stipulations and PLAs can help create high-quality jobs for residents of the surrounding areas.

CASE STUDY

Sunset Park envisions a sustainable and just port revitalization

The South Brooklyn Marine Terminal in Sunset Park was originally built in the 1960s as a container port but has been largely dormant for over 20 years. In 2015, after making some initial improvements to the port, the New York City Economic Development Corporation sought proposals on how to revitalize the area. Options included luxury housing, hotels, and a facility to store, build, and maintain offshore wind turbines. Community and environmental justice leaders worked with offshore wind developers on this last proposal—one that would retain the area's industrial nature and decrease the gentrification potential of redevelopment. Those living near ports typically bear increased pollution levels due to vessels and vehicles running on dirty diesel fuel, but the community saw potential for a cleaner industry that could bring jobs and help fight climate change. In 2022, the agreement to turn the 73-acre space into an offshore wind port was finalized. The port project is expected to create 1,000 jobs, and offshore wind developers will create a $5 million fund to prepare community members for offshore wind jobs. Developers will also invest $250 million to upgrade the terminal's infrastructure with low-emission technologies, alleviating the historical air pollution associated with ports.

ENSURING REGIONAL PORT COLLABORATION

Current state power procurement policies can undermine efficient port development. For example, states typically require offshore wind project developers that supply power to the state to use an in-state port to marshal components and to install and operate projects.[96] States should reassess in-state economic activity requirements to optimize regional efficiencies and encourage developers to leverage existing infrastructure in the broader region. For example, six port representatives in Europe formed an alliance to address port capacity challenges and identify opportunities to meet the capacity needs of the region through efficient collaboration and specialization.[97] U.S. states should offer additional funding to port authorities to ensure their participation in similar coalitions.

West Coast, Gulf, Great Lakes, and Southeast states should follow the East Coast model and convene leaders from state energy agencies to align on coastal resources, research port feasibility, and demonstrate state-specific benefits of coordination. These interstate agreements and institutions could piggyback off much-needed interstate offshore transmission planning efforts. California started an in-state port planning process under AB 525, but the state should expand the process to include decision-makers from Oregon and Washington. The task force should identify benefits for each state to encourage buy-in from state leaders and should mobilize resources to minimize reliance on imports, keep jobs domestic, and avoid competition between ports. NREL has announced a West Coast Ports Strategy Study, which will be critical to understanding the costs and benefits of various port strategies across California, Oregon, and Washington.[98] States should also supervise port development and activities to ensure coordination and optimization among project developers. This can lessen the risk that ports will be too small to meet regional needs or will become monopolized and serve only a single project. On the East Coast, developers are rapidly leasing marshaling ports to secure preferred ports for their projects while there is a lack of consideration for how to minimize congestion regionally.[99] Leaders should leverage the existing Federal-State Offshore Wind Partnership and new coalitions to align on efficient strategies for port operations and implement a regulatory framework for offshore wind developers.

ENHANCING INCENTIVES TO INCREASE SHIPYARD CAPACITY

In addition to building out the supply chain, policies must dedicate resources for increasing U.S. capacity to produce Jones Act-compliant wind turbine installation vessels (WTIVs) and heavy lift vessels (HLVs) for fixed foundation wind turbines.[xxiv] While other types of vessels are also needed, lack of WTIVs is the biggest risk to fixed foundation turbine installation. In total, The U.S. will need at least eight new WTIVs operating in the 2030s and up to 43 WTIVs in the 2040s to achieve 240 GW of fixed foundation offshore wind installation. This will require at least two additional shipyard production lines every five years between now and 2045.

WTIVs have received minimal investment due to high capital costs, limited construction space, uncertainty of future projects, and short contract timelines. Only three shipyards in the U.S. have the size and technological capacity to build WTIVs, and they are largely utilized by existing federal contracts with the Navy. To date, only one U.S.-flagged commercial WTIV is planned for production. The DOE should work with the DOD to leverage existing expertise, capacity, and resources for maritime engineering to support construction of offshore wind vessels.[100]

The IRA provides a 10 percent production tax credit on the final sale price of an offshore wind vessel available to the shipyard, although this incentive alone is unlikely to make a large construction vessel like a WTIV or HLV cost competitive with an existing foreign-flagged vessel. Tax credits for ship construction should also be extended, given the long construction timelines for WTIVs.

Though up-front cost is a major challenge, the biggest challenge to WTIV and HLV finance is uncertainty in the project pipeline. WTIVs are contracted on a project-to-project basis and require a consistent stream of projects. While the U.S. has a strong project pipeline, uncertainty remains about the exact installation schedule and the breakdown of fixed versus floating projects. To ensure private investment in ship construction, the federal government should consider backstop revenue guarantees or other financial support to cover the risk that new ships may not be fully utilized due to delays in project permitting or construction schedules.

Floating turbines will require additional vessel types, including anchor-handling tug vessels and semi-submersible barges.[101] The U.S. will need a fleet of these vessels to tow completed turbines from port to call areas and to install mooring chains and anchors. These ships, however, may be available from the deepwater offshore oil

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xxiv The Jones Act requires domestically produced ships to be used for delivering freight between U.S. ports and for moving offshore wind components from U.S. ports to offshore wind sites. Foreign vessels, however, can transport turbine components from an international port to the construction site, and they can transport materials between turbines to complete construction activities. In the near term, European ships could be used to install turbines using feeder barges that bring components from port to the ships in the lease area, but EU-based ships are expected to be unavailable after 2030 due to massive development planned in Northern Europe.

industry. They are also smaller and probably easier to construct domestically than WTIVs and HLVs.

In summary, the U.S. will initially need to rely on EU-owned vessels in the 2020s (using feeder-barge installation systems to comply with Jones Act requirements) but will likely need to secure shipyard commitments to construct new domestic-built vessels to support offshore wind turbine installation by the late 2020s. Policies including federal backstop revenue guarantees and tax credits will help ensure this domestic infrastructure is available to install wind turbines at scale.

WHO CAN GET IT DONE?

DECISION-MAKER	POLICY
State energy offices, port authorities	Scale state port grant programs and public-private partnerships to support critical facets of development, including helping ports accommodate floating offshore wind technologies and larger turbines.
DOE, U.S. Department of Transportation (DOT), DOT Maritime Administration	Dedicate additional federal funding for offshore wind port upgrades such as land acquisition, channel dredging, and improved bearing capacity.
U.S. DOT, DOE, state governors	Promote regional cooperation, including creation of a central coordination agency and regional project-based metrics.
U.S. DOT Maritime Administration, state governors; port authorities	Provide financial support for offshore wind vessels and shipyards, including backstop funding, grants, and loans.

CONCLUSION

The U.S. offshore wind industry's first commercial-scale projects are now under construction, but the nation needs a stronger vision if we are to maximize this renewable energy source's potential and reach a threshold of generating 10 to 25 percent of our electricity with offshore wind. The technical report shows that diversifying our clean energy sources will produce significant domestic job gains, economic development opportunities, and de-risk the transition to a net zero energy system.

To chart a path toward this future, however, both federal and state leadership is needed to set ambitious targets and procurement policies to drive the industry forward. States should increase the ambition of their targets, recognizing they need to scale offshore wind along with land-based renewables and storage to meet the demands of a highly-electrified economy. They should also prioritize long-term holistic transmission planning with other states in the region, increasing the resilience of their power systems and delivering much lower grid and energy costs for consumers. The federal government needs to scale site identification processes while working with communities, environmental organizations, Tribes, and fisheries to optimize shared use of the ocean. BOEM, in particular, should work with other federal and state agencies to build community and environmental protection into leasing and permitting while improving coordination.

The infrastructure to support the nascent offshore wind industry is paramount to the industry's success, and planning and policy can bolster domestic supply chains to meet the need. All of this must be built by people, and fortunately, the offshore wind industry has great potential to increase high-quality employment in local economies and provide new opportunities for transitioning oil and gas workers. Yet this will only happen if thoughtful training programs are designed to bring a diverse set of employees into the field. Additionally, increased support is required to build a domestic supply chain for raw materials and component manufacturing. Policymakers should plan for and help finance sufficient port and ship capacity to avoid risk of construction delays. Bringing the offshore wind industry to fruition will not be easy, but examples from around the world show that the industry is primed for huge cost declines and big impacts. Now is the time to ensure the U.S. can capitalize on offshore wind and help meet the nation's climate goals.

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