Synergistic collaborations and efficiencies for offshore wind clusters in the Northeast

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Abstract

There are nine offshore wind projects currently being developed off the Northeast coast of the United States. These projects will supply Massachusetts, Rhode Island, Connecticut, and New York with multiple gigawatts of renewable energy over the next few years. Each is treated as a standalone project with specific permitting requirements and different ownership structures. There is a strong competition among offshore wind developers to secure state offtake agreements and find optimal locations for port facilities and onshore grid interconnections. Due to this competition, finding synergies between nearby projects has been limited. This research looks into potential synergies between the cluster of offshore wind projects being developed in terms of logistics, operations, as well as environmental and performance monitoring. Synergies among the proposed projects can lower costs for developers by sharing resources while creating local offshore wind hubs of expertise.

Interviews were conducted with industry experts in Europe and the United States to discuss the efficacy of collaboration between clusters of offshore wind projects. The research has found the strongest synergy potential between individual developer portfolios in terms in installation and operational logistics. Policy recommendations such as creating larger port facilities to accommodate multiple projects are considered to allow for lower costs and improved integration. Inter-developer synergies are more difficult to be realized but are possible for non-competitive activities and helping to secure the necessary resources and workforce needed for this industry. Over the next few years there will be additional state offtake agreements which may provide a better view of potential synergies in the Northeast.

Keywords: offshore wind, synergies, northeast

Introduction

The Bureau of Ocean Energy Management (BOEM) identified multiple wind energy areas (WEAs) in federal waters off the coast of Massachusetts and Rhode Island in 2012.[1] These WEAs were offered as seven separate leases to various offshore wind developers. Several of these projects are currently seeking regulatory approval for development to supply electricity to Massachusetts, Rhode Island, Connecticut, and New York. Table 1 shows the current projects being developed in the Northeast along with the state offtaker, owner, port facilities, and expected date of operation.

Project	State	Date of Operation	Capacity (MW)	Owner	Staging Facility	O&M Port
Mayflower Wind	MA	2025-2026	804	Shell/EDP Renewables/ENGIE	New Bedford Marine Commerce Terminal	TBD
Vineyard Wind	MA	2023	800	Avangrid/CIP	New Bedford Marine Commerce Terminal	Vineyard Haven
Park City Wind	CT	2025-2026	804	Avangrid/CIP	Bridgeport	Bridgeport
Revolution Wind	CT/RI	2024	704	Orsted/Eversource	New London State Pier	Port Jefferson
Sunrise Wind	NY	2024	880	Orsted/Eversource	New London State Pier	Port Jefferson
South Fork	NY	2023	132	Orsted/Eversource	New London State Pier	Port Jefferson
Baystate Wind	N/A	N/A	N/A	Orsted/Eversource	TBD	TBD
Beacon Wind	NY	N/A	1,230	Equinor/BP	South Brooklyn Marine Terminal	South Brooklyn Marine Terminal
Vineyard Wind 2	N/A	N/A	N/A	Avangrid/CIP	TBD	TBD

Table 1: Expected offshore wind projects in the Northeast

It is a competitive process for a developer to both win the lease auction and a state offshore wind solicitation. Criteria for state offshore wind solicitations include the lowest-cost bid as well as state economic benefits. While competition between offshore wind developers drive lower offshore wind prices, it also limits collaboration. Collaboration between projects

[1] Bureau of Ocean Energy Management (BOEM). (2012). BOEM Identifies Wind Energy Area Offshore Massachusetts for Potential Commercial Leasing. https://www.boem.gov/newsroom/press-releases/boem-identifies-wind-energy-area-offshore-massachusetts-potential

can allow for synergies and reduce unnecessary redundancies. Realizing synergies between projects can help accelerate this industry from a permitting, cost, and environmental point of view. Collaboration can optimize port facilities, ensure environmental protection of endangered species, and improve logistics. As seen in Figure 1, the projects in the Northeast are in close proximity to each other.

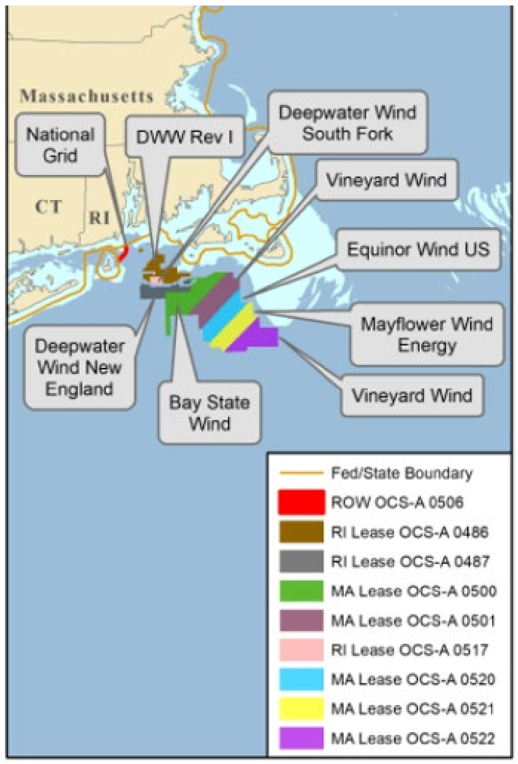

Figure 1: Offshore Wind leases in the MA/RI Wind Energy Area. Bureau of Ocean Energy Management. (2020). Retrieved from: https://www.boem.gov/sites/default/files/images/Map%20of%20Atlantic%20OCS%20renewable%20energy%20areas.jpg

Having a cluster of contiguous projects is advantageous to building out a large offshore wind hub on the east coast. Seeing the group of wind farms being developed off the coast of Massachusetts led me to my research question: *Which synergies and efficiencies can be realized between the multiple offshore wind projects currently under development in the Northeast?*

Methods

Interviews

Data collection included a mixture of literature review as well as interviews with people working in the offshore wind industry. Literature review included research into publicly available data to explore state offtake agreements, port development, and current partnerships with developers.

To learn about potential synergies for projects in the United States, I first conducted interviews with offshore wind experts in Europe. There is a mature offshore wind market in place in Europe which serves as a valuable case study for the United States. To find these experts, I looked up offshore wind clusters shown on the 4coffshore map.[2] I then searched those projects and their respective employees on LinkedIn. I sent a personal message describing my project and asked if they'd be available for an interview. I also reached out to developers with projects in the Northeast cluster and other experts mentioned in news articles. These interviews were semi-structured with open-ended questions. The interviews were held over a video call and lasted approximately 30 to 60 minutes each. Notes were taken throughout the interviews to document these findings. Table 2 shows the list of interviewees and their respective organization, title, and location.

[2] https://www.4coffshore.com/offshorewind/

Name	Position	Organization	Location
Jens Hieronymus Gravgaard	Project Development Director	Ørsted	Copenhagen, Denmark
Tom Harries	Partner	NARDAC	London, United Kingdom
[redacted]	[redacted]	[redacted]	Kolding, Denmark
Remco Streppel	Head of Offshore Wind Operations	Eneco	Rotterdam, Netherlands
Florian Guillebeaud	Operations Consultant	PEAK Wind	Copenhagen, Denmark
Sarah Schweitzer	O&M Preparations Engineer	PEAK Wind	Massachusetts, United States
Jordan Shoesmith	PMO & Bid Development Manager	Copenhagen Offshore Partners	Massachusetts, United States
[redacted]	[redacted]	[redacted]	Massachusetts, United States
Kelsey Perry	Community Liaison Officer	Mayflower Wind	Massachusetts, United States
Juergen Pilot	Program Manager	NOWRDC	Massachusetts, United States
Erik Peckar	General Manager	Vineyard Power	Massachusetts, United States

Table 2: Interviewees for the capstone project

Discussion

Interview Data

Interviews with offshore wind professionals yielded information on synergies being implemented within current developer portfolios as well as possible synergies with other developers. Areas of consideration for collaboration range from project development through installation and operations of projects. Several synergy facilitators and inhibitor trends emerged after these interviews were conducted.

Synergy Facilitators

There are numerous factors involved in order for synergies to occur within a cluster of wind farms as seen in Figure 2. These factors are not absolute but increase the chances of collaboration between projects.

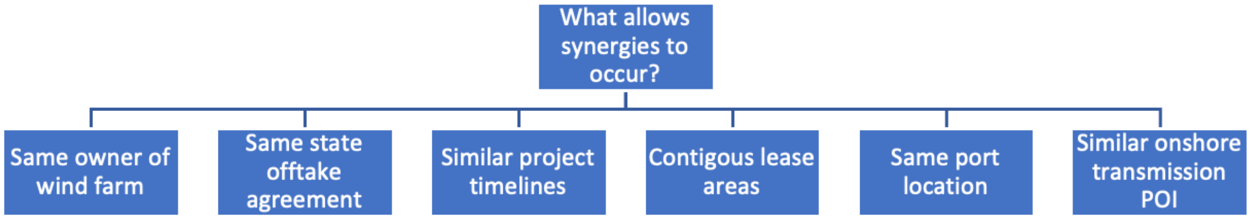

Figure 2: Synergy facilitators for clusters of offshore wind projects

Wind farm proximity

Distance between offshore windfarms is a big factor in determining synergies, making contiguous projects more likely to work together. This is due to the potential to share vessels for activities between sites. It is even more advantageous if projects are sharing the same port location and facilities. Projects that are nearby also have the opportunity to share transmission infrastructure to optimally integrate offshore wind into the grid.

Ownership structure

Perhaps the most important factor in determining synergy potential is the ownership of the wind farm. Having the same owner with multiple projects nearby yields significantly more collaborative potential than having a variety of developers within the cluster. The offshore wind industry is still in its infancy and developers continue to competitively bid for both lease areas and state offtake agreements. Developers have slightly different modes of operation as well as commercially sensitive data, which increases complexity between projects. In the Northeast cluster, some developers have multiple lease areas where synergies can be realized. Many of the individual lease areas are also being split up into separate projects, so developers with only one lease area will likely be able to realize synergies between their own portfolio. Developers may rather focus on finding synergies between their own projects instead of potentially giving their competitor an advantage.

Offtake agreements

Individual states require certain economic benefits for offshore wind projects such as using in-state providers for their supply chain and workforce. Due to these specific economic requirements, projects with the same state offtake agreement yields a better chance of collaboration. Creating dual partnerships with local workforce and service providers can increase offshore wind expertise and become standardized across developers. Projects for each state may also have a similar transmission path for their export cable where collaboration may be possible.

Synergy Inhibitors

After speaking with offshore wind experts, it became apparent that there are also specific inhibitors that affect potential synergies between clusters of wind farms.

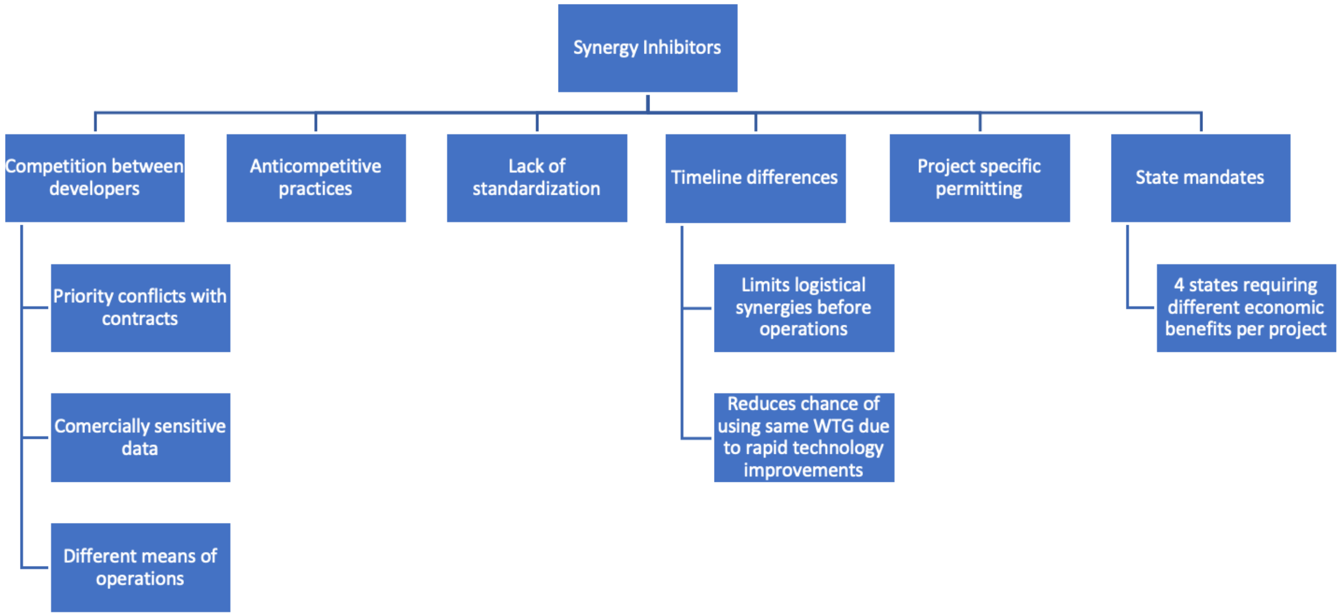

Figure 3: Synergy inhibitors for offshore wind projects

Project timelines

Project timeline differences play a large role in limiting collaboration before projects start their operational phase. If two or more projects have similar timelines, there may be possible synergies from project development through installation. Differences in timelines can also limit synergies in terms of turbine procurement. Projects that are being developed a few years apart are less likely to share similar turbine technology as there are more cost-effective turbines on the market every couple of years. Using the same turbine platforms for multiple nearby projects can improve logistics and simplify operations. However, using larger available turbines yields more cost savings than those realized with procuring the same turbine platform. Offshore wind turbine technology is rapidly improving, most notably is the rated capacity over the last decade. Being able to utilize a larger turbine allows for a greater overall annual energy output while using the same number of turbine positions, foundations, and cables. For example, Vestas announced the V164-10MW turbine in 2018. Just three years later, Vestas has developed the V236-15.0MW turbine. This is a 50% increase in power output from the V164-10MW.[3]

Competition

Competition between developers is a large driving force in helping to lower offshore wind prices. Developers aim to have the lowest possible bid to win solicitations over other offshore wind owners. While this is helpful to expand offshore wind in the future, developers may miss out on possible synergies that can benefit multiple projects. Developers are wary of sharing commercially sensitive data with others and finding ways around this can be difficult. Creating contracts for multiple developers can be problematic due to priority conflicts. Each developer likely wants to be first in line for service repair or some other activity that may cause a problem with their wind farm. However, if the same developer has multiple wind farms in the area they will not run into as many priority conflicts and can service their wind farms in any order that makes sense.

Anticompetitive practices

Anticompetitive practices limits collaboration between offshore wind developers until they have a state offtake agreement in place. Developers respond to state Request for Proposals (RFPs) in which states pick the most economically feasible project. If two developers conspire before the solicitation, it puts an unfair advantage to other developers who have not done so.

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[3] https://www.vestas.com/en/products/offshore%20platforms/v236_15_mw#

Project specific permitting

Offshore wind projects have specific permit requirements, most notably their Construction and Operation Plan (COP) for BOEM. This document defines the proposed construction, operations, and decommissioning of the project.[4] Permits for each offshore wind project are being developed separately and may have different timelines for certain requirements. States also have specific permits for projects which can make synergies harder to realize.

State mandates

In the United States, offshore wind procurement originates from individual states rather than from the national government. States economic benefit requirements of using specific port facilities and workforce can limit synergy potential. With multiple states tapping into the offshore wind resources in the Northeast cluster, project facilities are spread out between Massachusetts, Rhode Island, Connecticut, and New York. The figure below shows the planned O&M and construction facilities for projects in the cluster and the respective offshore wind developer. Having these facilities being spread out can limit the most optimal approaches to realizing synergies. Some projects right next to each other will be serving different states which limits collaboration. While creating synergies may be important to find the most ideal way to construct and operate these wind farms, it is important to make sure individual states receive the economic benefits of implementing this renewable resource.

[4] https://cms7.permits.performance.gov/tools/construction-and-operations-plan

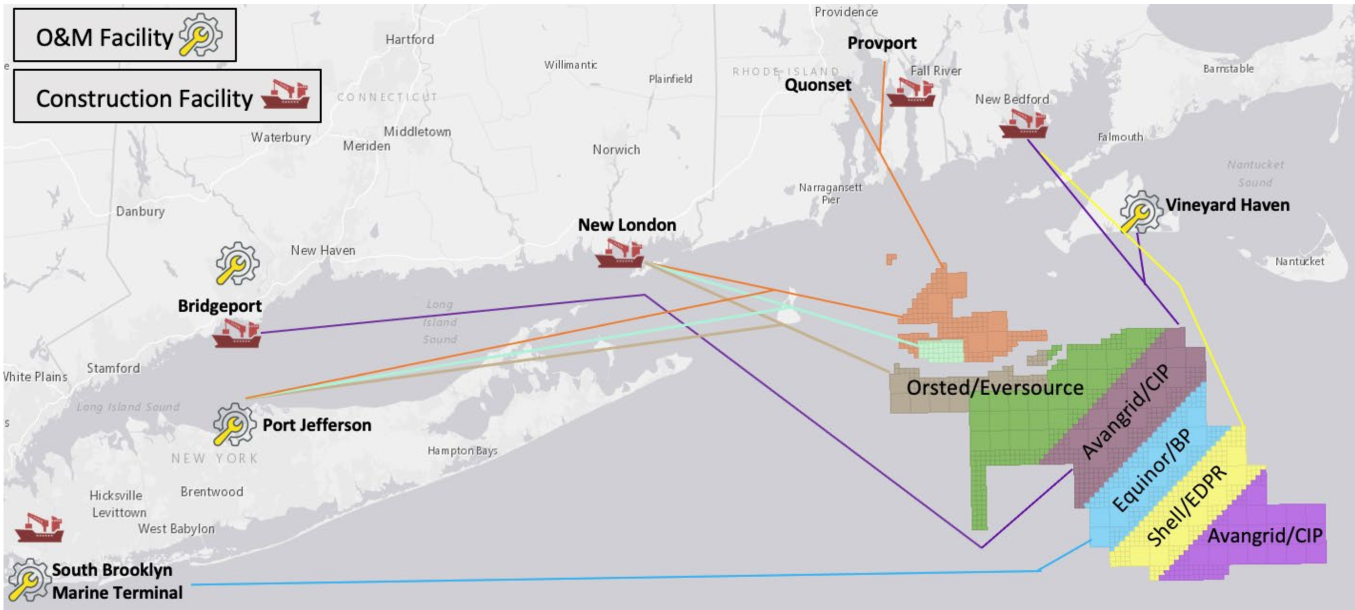

Figure 4: Offshore wind projects and their respective planned facilities

Orsted's Synergy Case Study in Germany

To get a better idea of possible synergies for projects in the Northeast cluster, I first looked for synergies between current clusters of offshore wind projects in Europe. Orsted is a leading market player in the offshore wind industry and served as the primary example of capturing synergies between neighboring offshore wind farms. Orsted's 2018 "Capital Markets Day" describes a regional hub structure implemented across the company's projects in the UK and Germany.[5] Benefits include consolidation for shore-based support, knowledge sharing, standardization of activities, as well as improved operational logistics.

I discussed these synergies with Jens Hieronymus Gravgaard, Project Development Director at Orsted. Offshore wind projects in Germany are a great case study showing synergy potential for projects in the United States. In Germany, Orsted has three projects in close

[5] https://orsted.com/-/media/WWW/Docs/Corp/COM/Investor/CMD2018/CMD-Presentation-2018.pdf

proximity which are all operated by the same facilities in Norddeich.[6] Two additional projects are planned to join this cluster by 2025, permit pending.

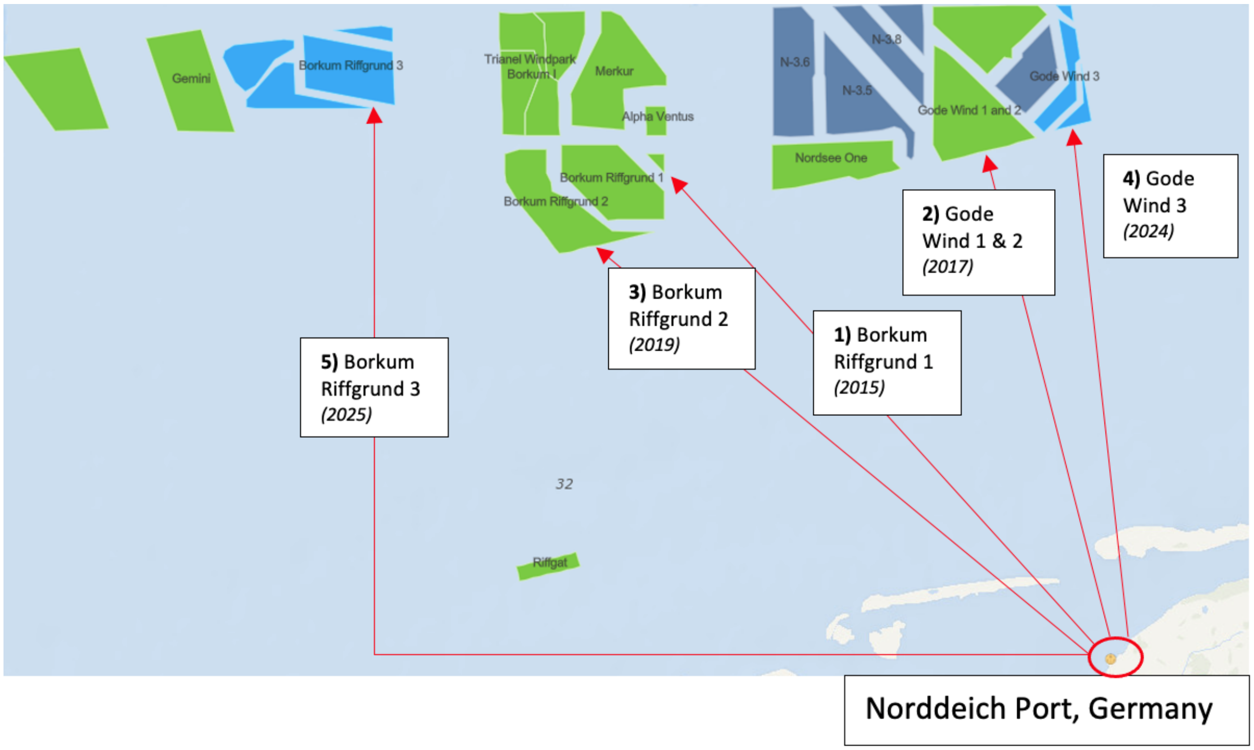

Figure 5: Orsted's offshore wind portfolio in Germany

The facilities were originally constructed in 2015 for the Borkum Riffgrund 1 wind farm but was later expanded upon to accommodate for the additional operational capacity. Having multiple projects per port yields economies of scale and allows the sharing of vessels, staff, spare parts, and general management of the various wind farms. This regional hub approach helps to lower the operations and maintenance (O&M) price per project. Tom Harries estimated that adjacent offshore wind projects utilizing the same O&M facility could cut operational management and marine logistics costs by 50 percent.[7]

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[6] https://www.4coffshore.com/news/%C3%B8rsted-opens-new-wind-farm-facility-nid8050.html
[7] https://www.reutersevents.com/renewables/wind-energy-update/rising-turbine-capacities-set-drive-60-offshore-opex-savings

A growing cluster capacity for Orsted's portfolio in Germany has allowed for a better investment in logistics. When Borkum Riffgrund 2 and Gode Wind 1&2 were built, O&M moved from Crew Transfer Vessels (CTVs) to Service Operation Vessel (SOV) based operations. SOVs have a permanent presence offshore and can service more wind turbines per vessel. It also increases hourly access to the wind farms due to tidal restrictions that can change the effective work hours each day. This is because CTVs had to originally leave from the port each morning at a specific time, using up resources just to get to the wind farms.

Another synergy with this cluster is the procurement and construction of the Borkum Riffgrund 3 and Gode Wind 3 wind farms. These two projects will both be using the Siemens Gamesa 11.0-200 DD offshore wind turbine.[8] Utilizing the same turbine platforms and foundations can lower the cost from the supplier. It also allows the two wind farms to share spare parts and workforce for operations and maintenance. Technicians are typically trained on only one type of turbine, so consolidating the number of different wind turbine platforms simplifies the training and reduces the number of teams on board.

Constructing these two wind farms in a continuous campaign can reduce mobilization and demobilization costs for installation vessels. When installing wind turbines, Jens Gravgaard discussed sea fastening supports that are needed to secure the necessary turbine equipment onto a vessel. Having the ability to mobilize vessels once is more cost and time efficient.

[8] https://www.siemensgamesa.com/en-int/newsroom/2020/03/200304-siemens-gamesa-germany-oersted-offshore-en

Performing a continuous campaign of installation can also optimize and streamline workforce and other supplier contracts into one operation.

There are other synergies that occur between all developers in Germany. For example, offshore wind projects share grid infrastructure. TenneT is the transmission service operator (TSO) that builds out infrastructure before offshore wind projects are developed[9]. This TSO has been under legal obligation since 2006 to connect German offshore wind farms to the mainland grid.[10] This coordinated approach separates the transmission from power generation. Offshore wind developers tie in their projects to the existing grid infrastructure as opposed to developing their own export cable and connecting it onshore. This coordinated approach allows several windfarms to connect to one cable, allowing for minimal environmental impacts from cable installation. Another synergy for offshore wind clusters in Germany is sharing helicopter services for rescue operations. The German Coast Guard has limited capacity, so developers tend to share offshore rescue contracts to split up the expensive cost of on-call emergency services.[11]

Synergies for Offshore Wind Clusters in the U.S.

There are many offshore wind experiences that are transferable from Europe to the United States. However, it is important to note that the U.S. is a completely different market with its own regulatory framework. There are different laws and regulations at play that dictate the requirements in the U.S. for specific permits and operations. One of the main differences

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[9] https://www.cesa.org/event/offshore-wind-transmission-lessons-from-germany-and-regulatory-considerations-for-osw-transmission-in-the-u-s/

[10] https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Germany/2020_From_Sea_to_Land_Webversion.pdf

[11] https://www.offshorewind.biz/2020/06/19/nhc-northern-helicopter-to-the-rescue-at-four-german-owfs/

between the U.S. and European offshore wind markets is that current offshore wind procurements are driven by state mandates in the United States. Many European countries have offshore wind goals with local content and workforce requirements, but they are not always specific to a certain area of a country. State requirements in the U.S. can reduce chances of collaboration due to location specific obligations. For example, when speaking with Remco Streppel, we discussed the offshore wind project cluster that serves both Belgium and the Netherlands. Vestas is a turbine manufacturer supplying equipment and service for the Blauwwind project in the Netherlands. Remco mentioned that Vestas decided to service this project in Belgium, since they already have a large operations and maintenance hub in place.[12] The facilities are relatively close to the Blauwwind project despite being in a different country. It made sense to not establish a new base and rather consolidate their projects from the Belgium facility. Many projects in the United States have stringent state economic requirements that may limit optimal locations for port facilities. Individual states may also have different permit requirements as well that can limit state to state collaboration.

I will first discuss potential synergies in the Northeast cluster between projects with the same owner, as these are easier to become realized. Then I will discuss current and future possible synergies for projects in the cluster between separate owners.

Synergies between similar owners

Orsted is taking a similar programmatic approach for project synergies in the United States as they are in Europe. The joint venture between Orsted and Eversource has multiple

[12] https://www.offshorewind.biz/2021/02/18/borssele-3-and-4-fully-up-and-running/

contiguous lease areas off the coast of Massachusetts and Rhode Island, with three projects currently under development.

Figure 6: Orsted's offshore wind portfolio in the Northeast

Orsted is consolidating their major port facility for these projects at the State Pier in New London, Connecticut. The company is redeveloping the Pier into a heavy-lift facility to stage and assemble offshore wind turbines. They have recently signed a Host Community Agreement (HCA) with the City of New London for the construction of their South Fork Wind, Sunrise Wind, and Revolution Wind projects.[13] Having a centralized staging area for multiple projects improves logistics and reduces the need to get separate HCAs with multiple facilities.

Orsted's projects are staggered in terms of dates for construction, allowing for a near continuous installation campaign. These projects will likely be using the same turbine platforms

[13] https://www.offshorewind.biz/2021/03/02/orsted-eversource-ink-state-pier-upgrade-deal-with-city-of-new-london/

as Siemens Gamesa was conditionally awarded Orsted's three projects under development.[14] Having Siemens Gamesa procure 1.7 GW worth of turbines will likely yield a wholesale discount and reduce logistical congestion for Orsted. Utilizing the same turbine platform allows for using similar strategies for installation as well as operations and maintenance. Last year, Orsted executed an agreement to build an SOV that will perform O&M for Revolution Wind, South Fork Wind, and Sunrise Wind farms.[15] Orsted will also be able to share spare parts and suppliers within their northeast portfolio such as the foundations and cables. Having these parts delivered at once can de-risk scheduling for subsequent projects. Lastly, sharing back-office organization between projects will also help reduce overall costs.

Orsted is not the only developer with multiple lease areas. The joint venture between Avangrid and Copenhagen Infrastructure Partners (CIP) also has multiple lease areas within the Northeast cluster, however they are not contiguous as seen in Figure 7.

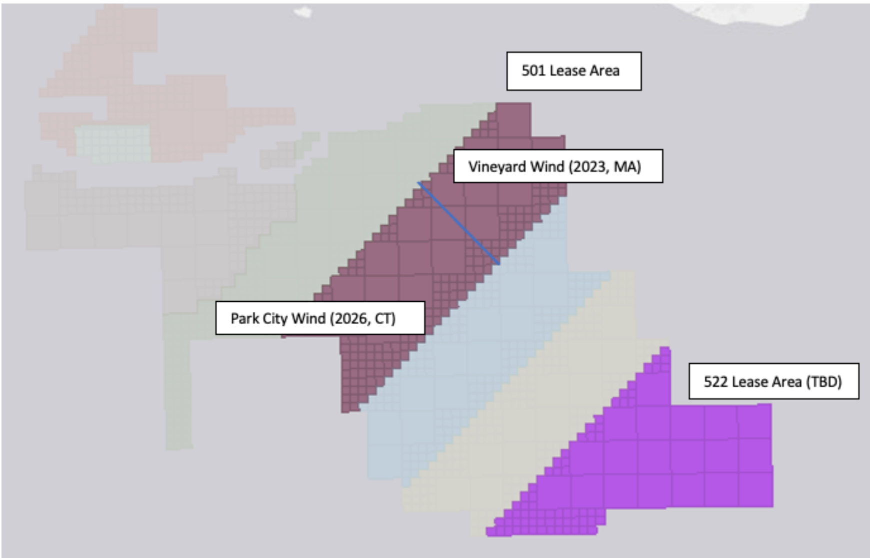

Figure 7: Avangrid/CIP lease locations in the Northeast

[14] https://www.siemensgamesa.com/newsroom/2019/07/190718-siemens-gamesa-offshore-orsted-usa
[15] https://renews.biz/63491/orsted-eversource-ink-jones-act-sov-deal/

Avangrid is currently developing two projects in the Northeast, Vineyard Wind and Park City Wind. Synergies between these projects are less likely than those in Orsted's portfolio, at least in terms of installation and O&M. This is because of differences in timelines and state requirements. The Vineyard Wind project is utilizing port infrastructure in New Bedford and Martha's Vineyard in Massachusetts. Park City Wind on the other hand is focusing on creating an offshore wind hub in Bridgeport, Connecticut. Having separate port facilities limits O&M synergies, despite the projects being in the same lease area. Vineyard Wind is using CTVs for O&M, while Park City Wind plans to use an SOV. With the projects being 3 years apart in terms of their start date of operation, Park City Wind is likely to utilize larger turbines available on the market.

There is potential for synergies between Park City Wind and a new project in the 522-lease area (Vineyard Wind 2), depending on timelines and state procurements. If Vineyard Wind 2 wins a state solicitation for a project to be developed around the same time, the projects could share turbine platforms, foundations, cables, and installation strategies. However, the Vineyard Wind 2 project is not contiguous to their other projects which limits operational synergies unless they share the same O&M port facility.

Synergies between different owners

While developers will first look for synergies between their own projects, there is a lot of potential for them to work with other owners as well. In fact, developers have already started to collaborate. For example, the five New England offshore wind leaseholders proposed a collaborative regional layout for wind turbines in a 1x1 nautical mile uniform grid.[16]

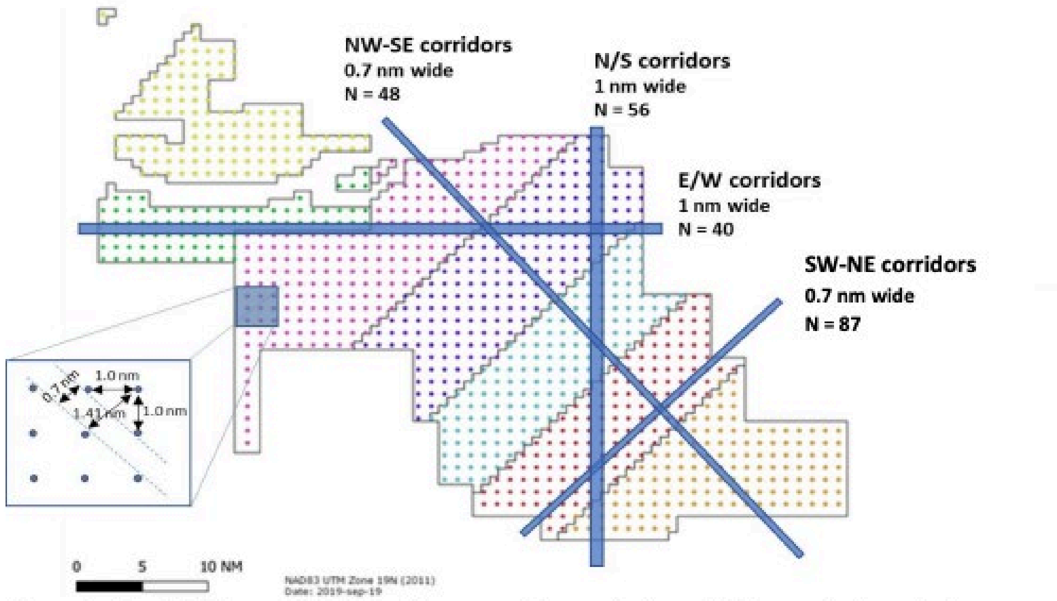

Figure 1: A full 1 X 1 nm E-W, N-S grid creates the equivalent of 231 transit lanes in four different key directions: E-W, NW-SE, N-S and SW-NE.

Figure 8: 1x1 nautical mile grid proposed by developers in the Northeast

The layout has east-to-west rows and north-to-south columns that are 1 nautical mile apart. This grid layout was in response to fishermen requests as well as ensuring navigational safety and facilitating search and rescue operations. This uniform layout was proposed to the Coast Guard by the offshore wind developers. The Coast Guard conducted a Port Access Route Study and accepted that the grid layout would allow for safe navigation throughout the wind farm lease areas.[17]

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16 https://static1.squarespace.com/static/5a2eae32be42d64ed467f9d1/t/5dd3d3e476d4226b2a83db25/1574163438896/Proposed+1x1+layout+from+RI-MA+Leaseholders+1+Nov+19+%281%29.pdf

17 https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf

A lot of collaboration between developers occurs external to their individual projects. For example, all of the developers are members of the National Offshore Wind Research & Development Consortium. This non-profit organization was established by the Department of Energy to "promote R&D activities that remove or reduce technological and supply chain barriers to deployment and lower development risk to investors."[18] I discussed these R&D activities with Juergen Pilot, who is a Program Manager at the Consortium. Offshore wind is still a relatively expensive technology compared to other renewables. The industry needs additional technological advancement to become cost competitive and secure long term domestic content. Projects that are being funded deal with reducing costs for wind turbine technologies, improving site characterization, and accelerating the U.S. Supply Chain. The research areas can be beneficial to each developer's project, as they are not project specific and benefit the industry as a whole.

Another non-project specific organization that all offshore wind developers are a part of is the Responsible Offshore Science Alliance (ROSA). ROSA is a non-profit that researches offshore wind's interaction with fisheries. A recent request for proposals (RFP) from ROSA identifies challenges for better transparency with data sharing between projects, and optimal ways for developers to communicate this information.[19] Finding the best ways to deal with confidential data to improve fishery monitoring can ensure that fishermen and offshore wind developers are in good standing. Both Kelsey Perry and Erik Peckar mentioned that fishery liaisons for each developer communicate and conduct joint outreach efforts. The liaisons meet

[18] https://nationaloffshorewind.org/

[19] https://4d715fff-7bce-4957-b10b-aead478f74f6.filesusr.com/ugd/99421e_d0c70899459c42368ac4c58484090c93.pdf

with commercial and recreational fishermen to discuss their feedback and comments on offshore wind development.[20] Kelsey Perry mentioned, "The scale at which fisheries operate and the location of a single fishermen's activities relative to multiple lease areas means that this particular type of communication lends itself to joint efforts." Fishermen are a key stakeholder in offshore wind development and making sure their livelihood remains intact will ensure compatibility between the two ocean users.

Additional synergies between separate developers are possible, especially for non-competitive activities.

Environmental monitoring synergies

Environmental impacts are important to mitigate when installing and operating offshore wind farms. Careful precautions and considerations must be taken, especially during the loud installation process of installing monopile foundations. Environmental monitoring is non-competitive between developers, making it an opportunity for collaboration. One important endangered species that must be protected is the North Atlantic Right Whale. There are fewer than 400 remaining and they have been sighted off the coast of Massachusetts. The figure below shows the Right Whale Dynamic Management Areas (DMA), where the whales have been visually sited.

[20] https://twitter.com/VineyardWindUS/status/1390003354831577095

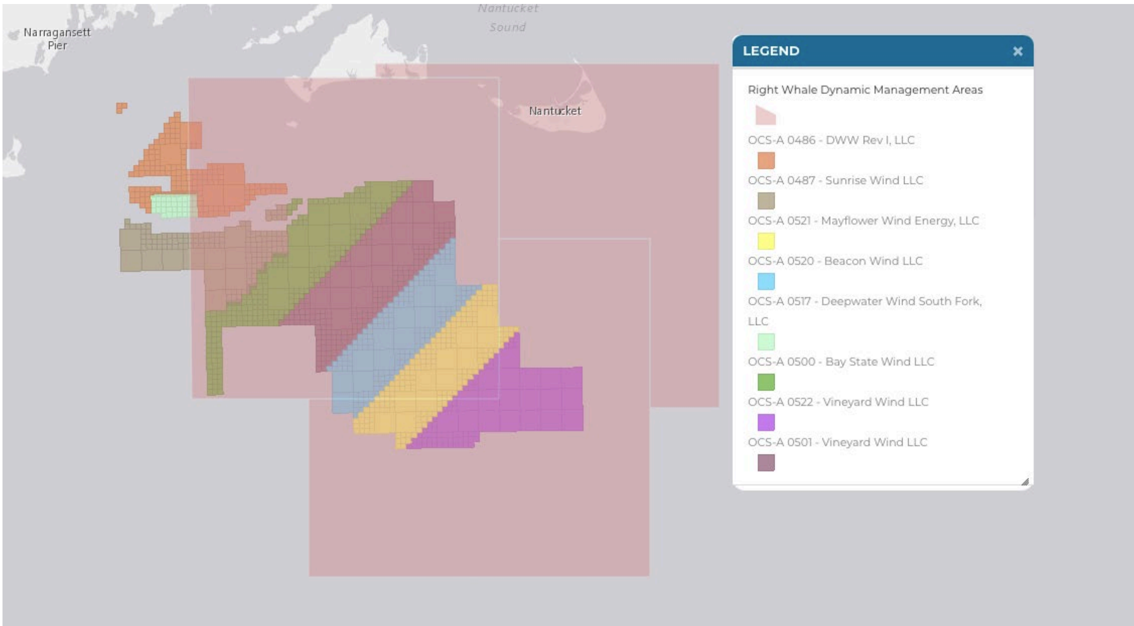

Figure 9: DMA of North Atlantic Right Whale in the Northeast

This DMA includes the entire Northeast cluster, so precautions will be needed for the developers. While projects are pursuing their own abatement strategies, more collaboration between developers could better protect these endangered species. North Atlantic Right Whales and other marine mammals are not bound by lease areas, so a programmatic approach with monitoring could allow for a greater awareness of wildlife in the Northeast Cluster. Developers could share the cost of deploying multiple acoustic monitoring systems, such as Open Ocean Robotics' Unmanned Surface Vehicles that can stay in the ocean for months at a time.[21] There could be a platform developed to connect various monitoring systems within the lease areas that can be shared in real time. This platform could be shared by all the developers as well as other regulatory agencies to optimize current practices for environmental protection.

[21] https://openoceanrobotics.com/

Performance benchmark sharing

Performance data is another area where developers in the Northeast can collaborate to better understand installation and O&M benchmarks. A new market intelligence service called Sea Impact has been developed by PEAK Wind and Lautec.[22] I spoke with Florian Guillebeaud of PEAK Wind about this tool that tracks historical vessel location data for offshore wind farms in Europe. It gives performance indicators for project installation and O&M processes depending on project sizes, location, turbine platforms, and foundation types. This information is beneficial for project management and scheduling to help optimize logistics and utilization rates for vessels. By comparing benchmarks against their competitors, developers will be able to pinpoint any weak links in their marine logistics and procedures. Utilizing this tool will allow for a clear comparison between contractor performance, giving developers a better insight into their best option for future projects. With turbine sizes rapidly increasing, changes in installation and O&M may occur. Benchmarking this data against previous installation times will be valuable to analyze reasons for any differences and optimize projects later on.

As the United States is a different market, there may be differences from current benchmarks in Europe. Being able to compare strategies and differences between the U.S. and European markets would make for a great case study. There is also a great learning opportunity for implementing new technologies and seeing how that affects project logistics.

[22] https://sea-impact.com/

Vessel sharing

There are multiple vessel types used in offshore wind. These include jack-up vessels, crew transfer vessels (CTVs), and service operation vessels (SOVs). Jack-up vessels are used for installation as well as major component replacements. CTVs and SOVs are used for typical operations and maintenance. SOVs are larger and can stay on site for weeks at a time, compared to CTVs being used for daily operations.

Due to the high utilization rate of CTVs and SOVs, sharing these vessels between offshore wind projects with different owners is not a viable option. However, there is an opportunity to share heavy lift jack-up vessels for O&M due to low utilization rates and high costs. Most jack-up requirements for an offshore wind farm are typically during the first 5 years of operation, when serial defects or failures are most common. These first few years are typically operated within the warranty period where an OEM is responsible for operations and maintenance (Crowne Estate, 2014). After this warranty period is an opportunity for developers to share the cost of a jack-up vessel between projects to lower each projects O&M costs. Michiel A.J. uit het Broek, et al. found that cost benefits up to 45% can be achieved by service providers purchasing and sharing the use of a jack-up vessel, compared to a leasing policy (2019).[23]

The Crowne Estate has also looked into increasing collaboration for jack-up vessels on the UK Coast. In a jack-up optimization study (2014), the Crowne Estate concluded that sharing jack-up vessels between owners can potentially save up to 400 million dollars per year in O&M

[23] https://www.sciencedirect.com/science/article/pii/S1364032119301959

costs.[24] The collaboration between operators would be flexible agreements, labeled as a "flexible vessel charter club". In this flexible vessel charter club, "members pre-plan how a vessel could be used and develop standard operating practices in order to facilitate tactical ad-hoc charter of a vessel between two or more club members. This could extend to planning future proactive campaigns to enable shared vessel use to be more practical." (Crowne Estate, 2014). By proactively collaborating and planning for synergies, developers can optimize and lower O&M costs. O&M represents 34.3% of the component level LCOE contribution for fixed-bottom offshore wind turbines.[25] Finding innovative ways to decrease these costs can be beneficial for all of the developers involved.

While sharing jack-up vessels between projects for major O&M repairs is a possibility, Tom Harries mentioned previous failed talks of jack-up vessel agreements between developers in Europe. This was due to priority conflicts in terms of which project gets to use the vessel first if multiple developers need major maintenance at the same time. With improved predictive monitoring and analytics currently being developed, it's possible that there may be more chances for shared use vessels in the future.

Having numerous projects being built out in the Northeast will create the market needed to incentive marine providers to develop Jones Act compliant vessels. The Jones Act is a U.S. federal law that requires vessels that transport cargo to be built and crewed in the United States. There are limited Jones Act compliant vessels for offshore wind, especially as turbine

[24] https://www.thecrownestate.co.uk/media/1780/ei-km-in-om-construction-072014-jack-up-vessel-optimisation.pdf
[25] https://www.nrel.gov/docs/fy21osti/78471.pdf

sizes rapidly increase and outgrow the current vessel capacity.[26] Developers could create contracts with a provider to use the same jack-up vessels for installation if their project timeline allows them to do so.

Contracts

When developing contracts and agreements for service operators and other aspects of a wind farm, careful planning should be considered to not exclude any synergies with neighboring wind farms in the future. Developers can do this by including shorter term options with providers, so they are not locked into long term agreements. Options to include multiple wind farms for non-competitive activities could be useful and more cost effective for developers. Once wind farms are built and operating, there needs to be continued inspections and surveys for non-turbine related equipment. Collaborating on annual scheduled service for non-competitive activities can help standardize these practices for all developers. This can be achieved by developers coming together to create best practices and train a third party specializing in inspection and surveying. A third-party company can then perform inspections in one continuous campaign, reducing mobilization and demobilization costs. By combining vessel travel when possible, this will decrease vessel congestion in the area as well as reduce greenhouse gas emissions.

Partial unitization of lease areas

As offshore wind procurements continue to fill up remaining portions of the lease areas in the Northeast cluster, there may be leftover available turbine positions. As mentioned,

[26] https://www.spglobal.com/marketintelligence/en/news-insights/trending/LPC6P4u-UC9qVTTB4V05Cg2

turbine positions are currently set by the 1x1 nautical mile grid layout that developers have agreed upon. With turbine sizes rapidly increasing over the last few years, there are fewer turbines needed to reach current state procurement goals. Developers may have too few unused positions left that make economic sense to plan a new project by themselves. Limited transmission landfalls around Cape Cod and extensive permitting processes may dissuade developers from creating smaller projects with their remaining available lease areas. Two contiguous lease holders may be able to combine portions of their lease areas if they both have unused positions nearby through a unit agreement. This unitization can be adopted from the offshore oil and gas industry. Through the Bureau of Safety and Environmental Enforcement (BSEE), offshore oil and gas companies can combine portions of leases under the terms of a Unit Agreement to expedite exploration and development.[27] This model can be extended to leasing of blocks for Outer Continental Shelf (OCS) offshore wind development.

Having offshore wind developers join parts of their lease areas could increase the overall energy output and combine transmission infrastructure to make a more economically feasible project. Portions of the Avangrid, Equinor, and Shell lease areas may present an opportunity for lease sharing. Figure 10 below displays the lease areas superimposed on the 1x1 nm turbine grid layout. The purple line represents the 60-meter bathymetry contour on the Outer Continental Shelf. Turbine locations past the 60-meter contour line are represented in orange for these lease areas.

[27] https://www.bsee.gov/guidance-and-regulations/guidance/unitization

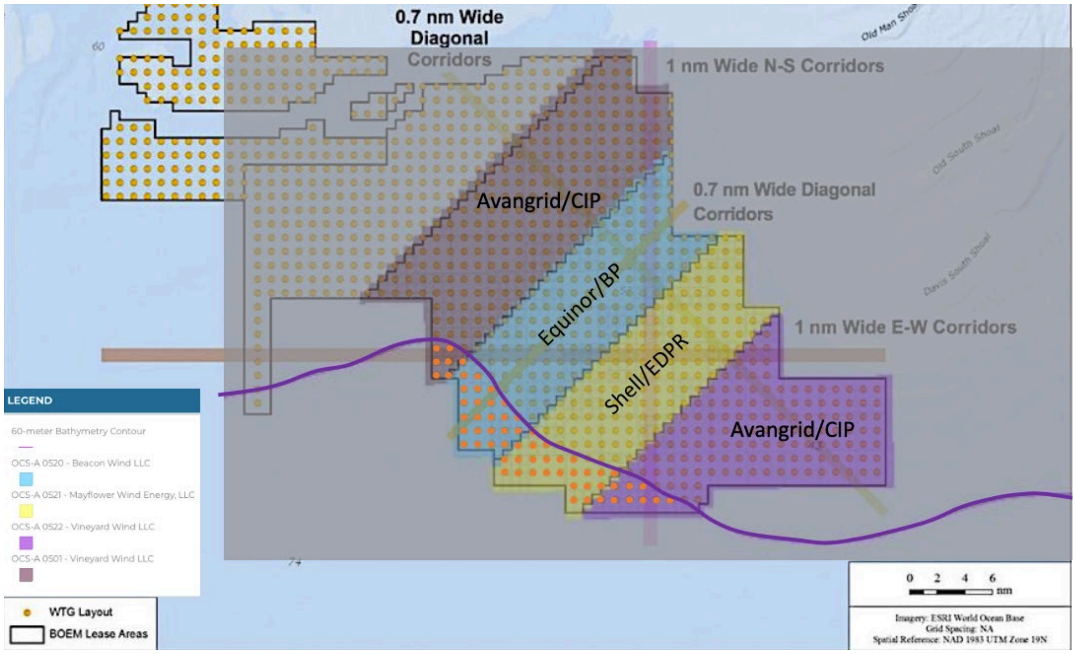

Figure 10: Lease sharing potential for deep water turbine locations

As water depth increases, traditional monopile foundation types become less economic and difficult to use. Past 60 meters of water depth, jacket foundations are typically used instead of monopiles which are generally more expensive (NREL, 2013). There are also floating foundation types being developed that can be used in deeper waters as well as transitional water depths (IRENA, 2016). The floating foundations could be more economical than fixed foundations past 60 meters of water depth (NREL, 2020). These combined lease areas could serve as a test bed for the first commercial scale floating offshore wind project on the East Coast. This could assist in the development of future floating projects by giving valuable data for engineering, permitting, and environmental monitoring. The National Renewable Energy Laboratory (NREL) estimates that 58% of offshore wind resources in the U.S. exists beyond 60 meters of water depth, showing how important floating foundations are to developing as much offshore wind as possible.[28]

While this unitization would require changes to the COP and other permits for these projects, it presents a great opportunity for developers to collaborate and optimize the available offshore wind output in the Northeast cluster. This approach may serve as a feasibility study for developers to share vessels and other equipment across different ownerships to help lower the levelized cost of energy (LCOE) for the offshore wind industry. Having larger floating wind projects with lease unitization can help lower costs through economies of scale for new floating technologies.

Policy Recommendations

Collaboration between offshore wind projects has been mostly developer focused and limited due to competition. In order to realize synergies between offshore wind projects, state and federal governments can play a large role. States can procure larger offshore wind solicitations on similar timelines to allow for a better opportunity of synergies between projects. Past procurements in Massachusetts were staggered with the selection of Vineyard Wind in 2018 and then Mayflower Wind a year and a half later. These projects are on different timelines and synergies are limited until after both projects are operating. Each project has an 800-megawatt (MW) capacity. There are already much larger projects in Europe being built out that allow for even greater economies of scale. For example, the Hornsea Project Three and Dogger Bank wind farms that are being developed in the United Kingdom are 2.4 GW and 3.6

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[28] https://www.nrel.gov/news/program/2020/floating-offshore-wind-rises.html

GW in capacity, respectively. As the Dogger Bank wind farm is using the same GE Haliade-X turbines throughout the project, there will be benefits in terms of turbine procurement and logistics with operations and maintenance.[29]

It would be beneficial for states to require some synergies between projects for a few reasons. One reason deals with transmission and being able to optimally integrate a large amount of offshore wind into the ISO-NE grid. Requiring some cooperation between projects can potentially reduce transmission infrastructure. The Brattle Group found that a planned approach to connect multiple wind farms into the New England grid could avoid more than $1 billion in onshore transmission upgrades.[30] By having a similar transmission infrastructure to Germany, offshore wind developers would have an easier time developing their projects. This is due to needing fewer permits for their export cable and onshore substation. Vineyard Wind has had trouble permitting the landfall of their export cable in the past, with the Edgartown conservation commission previously denying a permit.[31]

Having a state or federal build out of transmission will allow for less developer competition in terms of their electrical infrastructure. With limited onshore capabilities in New England, competition between developers for onshore points of interconnection is fierce. Transmission represents 20-25% of capital expenditure and interconnection locations have large implications on the economics and permitting of projects.[32] Having a planned transmission build out as opposed to multiple project specific approaches will also lead to

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[29] https://doggerbank.com/
[30] https://brattlefiles.blob.core.windows.net/files/18939_offshore_transmission_in_new_england_-_the_benefits_of_a_better-planned_grid_brattle.pdf
[31] https://www.mvtimes.com/2019/07/10/vineyard-wind-suffers-cable-defeat/
[32] https://www.mass.gov/doc/technical-conference-slide-presentations-morning-session-hosted-by-masscec-pdf/download

fewer environmental impacts due to a reduced amount of marine trenching. However, it will take many years to do a feasibility study, permit, and build out the grid infrastructure. States would need to coordinate multiple projects to be built around the same as the transmission system is completed.

States can also encourage clustering and sharing of resources by creating an industrial hub that bring together port facilities, developers, and local businesses. States can do this by revitalizing a great number of port facilities in the area, so developers and service providers will be encouraged to set up offices nearby. The Massachusetts Clean Energy Center (MassCEC) has already assessed various under-utilized waterside facilities capable of being redeveloped and used for the offshore wind industry.[33] Other states in the Mid-Atlantic are already planning large port facilities to prepare for the upcoming offshore wind boom. For example, New Jersey is planning a 200-acre port facility to lure developers and increase local economic benefits. Tim Sullivan, chief executive of New Jersey's Economic Development Authority mentioned, "manufacturers and developers want to be co-located, but you need a lot of space to do it. Co-locating marshalling and manufacturing produces efficiencies that will be hyper-competitive in the marketplace. The opportunities for synergies are very significant."[34] The New Bedford Marine Commerce Terminal in Massachusetts is a 26-acre facility, which is small in comparison to the NJ Wind Port.[35] Improving port facilities in the Northeast will be critical for developers to realize synergies and reduce costs during construction.

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[33] https://files.masscec.com/MassCEC_MOWPIA%20Report_Web_Rev%201.pdf

[34] https://stateimpact.npr.org/pennsylvania/2021/01/04/planned-new-jersey-wind-port-will-help-meet-strong-demand-from-a-growing-offshore-industry/

[35] https://files.masscec.com/MassCEC_%20New%20Bedford%20Marine%20Commerce%20Terminal_Brochure.pdf

By creating policies to incentivize offshore wind industry providers and develop port facilities, there will be a congregation of expertise in the area that will benefit multiple projects. These policies could include tax breaks, cheap debt, or some other subsidy to create an offshore wind hub that benefits all parties involved. One such industrial hub exists in Grimsby, UK. Tom Harries mentioned the benefits of creating offshore hubs like the Port of Grimsby to congregate the industry into one area. Grimsby was once the largest fishing port in the world, but its economy has since declined. Over the last decade, offshore wind has helped revitalize the port with job and economic growth. There are multiple developers positioned in Grimsby, and Orsted alone employs over 370 workers at their East Coast Hub Operations and Maintenance facility.[36] There will be community benefits to these ports and cross pollination of skills as people switch jobs to competing companies. Similar transformations can occur to local port cities in the Northeast with additional investment in offshore wind infrastructure.

Conclusion

The Northeast cluster is unique in the number of developers and the variety of states that are utilizing this offshore wind resource. It is currently the largest group of contiguous lease areas being developed in the United States. Creating synergies between these neighboring offshore wind farms offers many benefits to optimally integrate this resource and help decarbonize the power sector. It requires advanced planning and thought to implement synergies that can benefit developers, grid operators, states, and local stakeholders. It is worthwhile for these groups to carefully examine opportunities for synergies as projects

[36] https://orsted.co.uk/energy-solutions/offshore-wind/transforming-communities

continue to move along in development. Taking the time to examine collaborations can be valuable to reduce costs and create the necessary investments to grow the offshore wind industry in the Northeast.

It became apparent after speaking with experts that synergies in terms of procurement, installation, and daily operations are most likely only going to be realized within the same developers portfolio. This is mainly due to the competitive behavior between offshore wind developers. There is also logistical complexity in daily operations as well as confidential data that limits inter-developer collaboration.

Developers collaborating on local stakeholder engagement can assist the permitting process for each project and ensure continuity and agreements between different projects. Non-competitive activities such as environmental monitoring and inspection surveys may be able to benefit multiple projects within the cluster. Benchmarking performance data can also enhance project planning as well as installation procedures in the United States. Thinking of creative ways to collaborate such as partially combining lease areas can boost the total offshore wind capacity in the cluster, while reducing transmission infrastructure. States can play a role in improving port infrastructure so multiple developers can utilize the same facilities.

Having developers utilize third parties such as the National Offshore Wind R&D Consortium, the Responsible Offshore Science Alliance, the Massachusetts Clean Energy Center, and other institutions can increase collaboration and benefit each project without giving up commercially sensitive data.

Developing multiple projects in a cluster will lure local workforce and expertise to the Northeast region. Cooperation and proper planning of port facilities can lead to regional offshore wind hubs, allowing for more collaborative opportunities. States can play a large role in creating more public-private partnerships as well as requiring some cooperation to reduce transmission congestion for future projects. Over the next few years as states procure more offshore wind from projects, there will be more opportunities for collaboration. It is important to think of the Northeast offshore wind cluster as a whole rather than individual entities. Doing so will optimally and cost effectively integrate this renewable resource into the grid.

Sources

Harries, Tom. (2021, February 12). Personal Interview.

Gravgaard, Jens Hieronymus. (2021, February 19). Personal Interview.

Schweitzer, Sarah. (2021, March 1). Personal Interview.

[redacted] (2021, March 8). Personal Interview.

Pilot, Juergen. (2021, March 8). Personal Interview.

Streppel, Remco. (2021, March 11). Personal Interview.

[redacted] (2021, March 25). Personal Interview.

Shoesmith, Jordan. (2021, March 25). Personal Interview.

Perry, Kelsey. (2021, March 29). Personal Interview.

Guillebeaud, Florian. (2021, April 9). Personal Interview.

Peckar, Erik. (2021, April 12). Erik Peckar.

Peak Wind. (2019). Capturing synergies in operational offshore windfarms. https://peak-wind.com/insights/capturing-synergies-in-operational-offshore-windfarms/

BOEM. (2020). Renewable Energy on the Outer Continental Shelf. https://www.boem.gov/renewable-energy/renewable-energy-program-overview

Sea Impact. (2020). Sea Impact Tool. https://sea-impact.com/tool/

Windpower Engineering. (2019). Why collaboration is critical to offshore wind and port success. https://www.windpowerengineering.com/why-collaboration-is-critical-to-offshore-wind-and-port-success/

4C Offshore. (2020). Vineyard and Mayflower ink leases agreements New Bedford Marine Commerce Terminal. https://www.4coffshore.com/news/vineyard-and-mayflower-ink-leases-agreements-new-bedford-marine-commerce-terminal-nid18995.html

Michiel, A.J. (2019). Evaluating resource sharing for offshore wind farm maintenance: The case of jack-up vessels. Renewable and Sustainable Energy Reviews, Volume 109. https://www.sciencedirect.com/science/article/pii/S1364032119301959

U.S. Department of Energy. (2018). Offshore Wind Technologies Market Report. https://www.energy.gov/sites/prod/files/2019/08/f65/2018%20Offshore%20Wind%20Market%20Report.pdf

Vineyard Wind. (2019). New England Offshore Wind Leaseholders Submit Uniform Layout Proposal to the U.S. Coast Guard. https://www.vineyardwind.com/press-releases/2019/11/19/new-england-offshore-wind-leaseholders-submit-uniform-layout-proposal-to-the-us-coast-guard

Bureau of Ocean Energy Management. (2020). Commercial Wind Leasing Offshore Rhode Island and Massachusetts. https://www.boem.gov/renewable-energy/state-activities/commercial-wind-leasing-offshore-rhode-island-and-massachusetts

National Offshore Wind R&D Consortium. (2020). Webinar – Crossover Opportunities in the Offshore Sector. https://www.youtube.com/watch?v=w_ZpvT6phjM&t=1011s

Greentech Media. (2020). Why 2020 Has Been A Surprisingly Good Year for US Offshore Wind. https://www.greentechmedia.com/articles/read/why-2020-has-been-a-surprisingly-good-year-for-us-offshore-wind

International Energy Agency. (2019). Offshore Wind Outlook 2019. https://www.iea.org/reports/offshore-wind-outlook-2019

Bureau of Ocean Energy Management (BOEM). (2012). BOEM Identifies Wind Energy Area Offshore Massachusetts for Potential Commercial Leasing. https://www.boem.gov/newsroom/press-releases/boem-identifies-wind-energy-area-offshore-massachusetts-potential

Bureau of Ocean Energy Management (BOEM). (2020). South Fork Wind Farm. https://www.boem.gov/renewable-energy/state-activities/south-fork

Responsible Offshore Science Alliance (ROSA). (2021). Request for Proposals Commercial and Recreational Fisheries Resource Data Production, Storage, and Accessibility. https://4d715fff-7bce-4957-b10b-aead478f74f6.filesusr.com/ugd/99421e_d0c70899459c42368ac4c58484090c93.pdf

Orsted. (2020). Transforming coastal communities. https://orsted.co.uk/energy-solutions/offshore-wind/transforming-communities

Massachusetts Clean Energy Center. (2017). 2017 Massachusetts Offshore Wind Ports & Infrastructure Assessment. https://files.masscec.com/MassCEC_MOWPIA%20Report_Web_Rev%201.pdf

Massachusetts Clean Energy Center. (2020). Massachusetts Offshore Wind Transmission Technical Conference. https://www.mass.gov/doc/technical-conference-slide-presentations-morning-session-hosted-by-masscec-pdf/download

MV Times. (2019). Vineyard Wind dealt blows on two fronts. https://www.mvtimes.com/2019/07/10/vineyard-wind-suffers-cable-defeat/

Dogger Bank. (2021). Building the world's largest offshore wind farm. https://doggerbank.com/

The Brattle Group. (2020). Offshore Transmission in New England: The Benefits of a better-planned grid. https://brattlefiles.blob.core.windows.net/files/18939_offshore_transmission_in_new_england_-_the_benefits_of_a_better-planned_grid_brattle.pdf

United States Coast Guard. (2020). The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study. https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf

The Crown Estate. (2014). Jack-up vessel optimization. https://www.thecrownestate.co.uk/media/1780/ei-km-in-om-construction-072014-jack-up-vessel-optimisation.pdf

National Renewable Energy Laboratory. (2020). 2019 Cost of Wind Energy Review. https://www.nrel.gov/docs/fy21osti/78471.pdf

S&P Global. (2019). Global shortage of installation vessels could trouble waters for offshore wind. https://www.spglobal.com/marketintelligence/en/news-insights/trending/LPC6P4u-UC9qVTTB4V05Cg2

Bureau of Safety and Environmental Enforcement. (2021). Unitization. https://www.bsee.gov/guidance-and-regulations/guidance/unitization

ReNews Biz (2020). Orsted inks Jones Act-compliant SOV deal. https://renews.biz/63491/orsted-eversource-ink-jones-act-sov-deal/