Netherlands Enterprise Agency

An Analysis of the Offshore Wind Innovation Ecosystem along the Northeast U.S. Coast

Key Takeaways and Recommendations for Dutch Industry and Entrepreneurs

By Craig Vis, Junior Innovation Officer, Netherlands Innovation Network in Boston

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Abstract

With the goal of generating 30 gigawatts of offshore wind energy by 2030, the U.S. aims to take significant steps towards becoming increasingly more reliant on clean energy for a sustainable future. As of the time of writing, the country still finds itself in the early stages of procurement, manufacturing, and deployment, with only little amounts of offshore wind energy being generated. Hence, there might be various opportunities for ambitious Dutch entrepreneurs to drive and progress innovation within the U.S. offshore wind energy industry. For that reason, this report analyses the offshore wind innovation ecosystem along the northeast coast of the U.S. specifically. It outlines several of the leading organizations, research institutes, incubators, and other parties to sketch the existing innovation ecosystem within the region. It also illustrates how this innovative ecosystem operates, with insights extracted from a multitude of interviews with experts from the industry. Finally, it provides several recommendations to the Dutch industry and its entrepreneurs for entering and participating in the U.S. offshore wind innovation ecosystem.

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Executive Summary

With the goal of generating 30 gigawatts of offshore wind energy by 2030, the United States (U.S.) aims to take significant steps towards becoming increasingly more reliant on clean energy for a sustainable future. As of the time of writing, the country still finds itself in the early stages of procurement, manufacturing, and deployment, with only little amounts of offshore wind energy being generated. In contrast, the Netherlands is a country that has progressively profiled itself as one of the world leading nations in terms of offshore wind technology. Specifically, they have proven to be a key player in areas such as the supply chain, foundations, installation, maintenance, and related operational processes. In light of this, Dutch entrepreneurs might be looking for opportunities to drive and progress innovation within the U.S. offshore wind industry.

Part of the remit of the Netherlands Innovation Network in Boston is looking to match Dutch entrepreneurs the innovation ecosystem to help strengthen the international partnership between both countries. For that reason, this report has analyzed the offshore wind innovation ecosystem along the northeast coast of the U.S. It is intended to help Dutch entrepreneurs identify strategic opportunities to enter or expand their business in offshore wind technologies. Through an extensive literature review on government documents, road maps, and progress reports, in addition to a series of interviews with offshore wind experts in the U.S., this study has surfaced various patterns and developments within the offshore wind innovation ecosystem in the U.S. that may be of use to Dutch entrepreneurs looking to expand their horizons.

For example, the U.S. offers platforms such as the National Offshore Wind Research and Development Consortium (NOWRDC), or incubator- and accelerator programs at for instance the Offshore Wind Innovation Hub, Greentown Labs, and SeaAhead, which may offer valuable starting points to study or grow offshore wind technologies and innovations. In addition, since the U.S. offshore wind sector is still in a developmental phase, Dutch entrepreneurs have more than one technological avenue to explore. Yet, certain technologies may yield more valuable outcomes than others. Based on the research, ventures specifically in the direction of supply chain, installation, maintenance, and operations, in addition to floating offshore wind and transmission appear particularly promising.

The Netherlands Innovation Network in Boston can assist Dutch entrepreneurs with potential overseas ventures towards the U.S. The Netherlands Innovation Network also has a rich network with various actors within the clean and offshore wind industries and can help with matching Dutch innovators to the offshore wind innovation ecosystem.

Introduction

Climate change has initiated an indisputably relevant societal debate about the consumption of fossil energy resources and green alternatives. On a worldwide scale, governments, companies, research institutes, and other parties tackle this issue using a wide range of instruments and initiatives, several of which aim to stimulate the generation of sustainable energy. The ocean specifically provides ample opportunities for the generation of 'blue energy'; as for instance highlighted by a recent Netherlands Enterprise Agency (RVO) report written by the Netherlands Innovation Network on the Blue Economy in the New England region of the U.S.[1]. Several of these offshore resources include solar energy, wave energy and of course, wind energy.

Whereas wind energy is frequently encountered on the mainland, the potential for offshore wind is unparalleled for several reasons[2]. Firstly, the ocean provides a suitable location for wind farms in terms of scale and openness, allowing for a large deployment of turbines. Secondly, higher wind speeds and consistency in direction at sea make offshore turbines more efficient which, paired with a high turbine density, foster increased energy generation compared to onshore wind. Thirdly, the environmental impact of offshore wind energy is (generally) understood to be smaller compared to onshore wind, considering challenges such as for instance noise pollution.

Despite these advantages, the offshore wind sector faces several challenges compared to its onshore counterpart[2]. For example, offshore wind farms require more complex infrastructure to support and are therefore more expensive to construct. Also, maintenance and repairs are more difficult to perform considering reduced accessibility in terms of distance and ocean conditions. Moreover, the circumstances of coastal areas frequently differ between territories and countries, meaning that the respective technologies launched in these coastal areas will also differ.

In addition to the above-described challenges and the need for the advancement and optimization of existing technology, the offshore wind sector like any industry sector requires a continuous stimulation of technological innovation[3]. Whereas several coastal countries such as China, the United Kingdom, Germany, and the Netherlands are frontrunners in terms of offshore wind technology, the U.S. is in a developing phase in comparison, despite recent large scale wind park procurement[4].

Indeed, the Netherlands - a coastal country with a strong affinity with blue technologies – has acquired plenty of experience within the offshore wind sector. The Netherlands profiles itself as being particularly strong in terms of its well-developed and internationally oriented supply chain, with promising market penetration[3]. The country is home to various companies and knowledge institutes with expertise in most

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[1] Netherlands Enterprise Agency. 2023. *Exploring the Blue Economy in Coastal New England: Opportunities for Collaboration with the Netherlands*.

[2] NationalGrid, *Onshore vs offshore wind energy: what's the difference?*, retrieved from https://www.nationalgrid.com/stories/energy-explained/onshore-vs-offshore-wind-energy#:~:text=Offshore%20wind%20farms%20generate%20electricity,human%2Dmade%20objects%20can%20present

[3] Adriaan van der Loos, Simona Negro, Marko Hekkert. 2021. *Offshore Renewable Energy: Threats and Opportunities in the Post-2030 Netherlands. A report commissioned by the Netherlands Enterprise Agency (RVO).* Copernicus Institute of Sustainable Development, Utrecht University

[4] Wind&Water Works. 2022. *Dutch Offshore Wind Guide, Your Guide to Dutch Offshore Wind Policy, Technologies, and Innovations.*

facets of classic offshore wind technology. A recent offshore wind guidebook for international entrepreneurs by Wind&Water Works elaborates on these strengths, highlighting that the Netherlands has widespread expertise across various disciplines within the sector including the design, development, construction, engineering, transportation, installation, and maintenance of offshore wind turbines and parks[4]. Specifically, as highlighted by a contact at the Holland Home of Wind Energy, the Netherlands is particularly apt at designing, engineering, and adopting vessels for offshore wind purposes (e.g., SeaJob). In addition, they are leaders in terms of providing monopile foundations (e.g., Sif Group), in addition to providing piling equipment, particularly those that are silent (e.g., Cape Holland, IQIP). Installations, operations, and maintenance were similarly highlighted as other strengths of the Dutch offshore wind sector.

As said, the offshore wind sector in the U.S. is currently in a more developmental phase. While a multitude of wind parks have been procured for deployment, only a small amount of offshore wind energy is currently generated[5]. Considering the early stages of the sector's development in the U.S., the industrial landscape provides plentiful opportunities for offshore wind knowledge institutes, maritime contractors, and suppliers to carry existing technology overseas with the goal of further penetrating the U.S. market, drive more technological, industrial, and economic progress, and increase the share of the Dutch contribution within the world offshore wind industry. To better understand the opportunities for the Dutch offshore wind industry in the U.S., it is of interest to acquire an in-depth understanding of the American offshore innovation ecosystem which aims at stimulating the development of offshore technologies in the region.

Box 1. The Netherlands Enterprise Agency (RVO) and the Netherlands Innovation Network

The Netherlands Enterprise Agency (RVO) is an executive body of the Dutch Ministry of Economic Affairs and Climate Policy. RVO helps business owners run competitive, sustainable, agricultural, innovative, or international businesses. To assist these business owners beyond the borders of the Netherlands, RVO has set up a multitude of overseas networks, otherwise known as the Innovation Attachés, which together form the Netherlands Innovation Network.

The Netherlands Innovation Network is the science and technology arm of the Dutch diplomatic network in the U.S. This network has offices in Washington D.C., Boston and San Fracisco. Like other Innovation Attachés, the Netherlands Innovation Network in Boston fulfills several key roles, such as matching Dutch innovators to the Greater Boston area, identifying emerging trends in innovation and R&D, coordinating innovation missions and delegations, and engaging in partnerships with leading international actors. Hence, the Netherlands Innovation Network is a valuable partner for companies with high technology and R&D, start-ups, and scale-ups; knowledge institutions, such as universities and institutes for applied research; and governments, both regional as national.

In line with the above, this report studies the offshore wind innovation ecosystem of the northeast U.S. coastline. This includes the states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut,

[5] New England for Offshore Wind, "States Overview", retrieved from https://www.newenglandforoffshorewind.org/states/overview/

and New York. Particular attention goes out to the current state and future development of offshore wind technologies and innovations in these states. By providing an overview of current trends and perspectives from the sector, this report aims to reveal relevant insights, observations, and make recommendations for the Dutch offshore wind industry actors who are considering future engagement or expansion towards the northeast U.S.

This study is based on a literature review, combined with interviews with various actors from the offshore wind sector along the northeast U.S. coast. Interviewed parties were identified and approached based on their expertise within the sector. The final pool of interviewees represents a diverse selection of organizations, including members from state government, research institutes, non-profit organizations, start-ups, incubators, and more (a list of interview candidates including a short description of their background can be found in Appendix A). The interviews – and the report for that matter - are driven by three overarching themes: the development of offshore wind technologies and innovations, the stimulation of an innovation ecosystem, and opportunities for the Dutch offshore wind industry in the U.S. Interviews were transcribed anonymously, and emerging patterns were paraphrased and cross-referenced with the final goal of illustrating an overarching image as to how the northeast U.S. offshore wind sector has developed.

The structure of the report looks as follows: First, the context surrounding the offshore wind policies of both the Netherlands and the U.S. is described. This is done to provide a baseline comparison between the Netherlands and the U.S. in terms of progress within the sector. Secondly, with the goal of setting the scene for the reader, an overview of key players within the offshore wind ecosystem along the northeast United State coastline is provided. This inexhaustive overview includes some (but not all) of the biggest, most important, or promising organizations that emerged throughout this study. Thirdly, emerging patterns from the interviews are discussed, followed by a description of who stands at the forefront of the technological innovations and the interactive processes that underlie this advancement. This should provide the reader with an overview of the focus areas within the offshore wind sector in northeast U.S. Finally, based on the above-described analyses, recommendations are provided for the Dutch industry as to how they may participate in the American offshore wind industry. The latter section may be of particular interest to Dutch stakeholders looking to make strides towards the U.S.' market.

A Description and Comparison of the Offshore Wind Policy in the U.S. and the Netherlands

This section describes the offshore wind policy in both the U.S. as well as the Netherlands. It is relevant for the reader to understand the context in which both countries operate. This section is based on a literature review from government reports, roadmaps, and guidebooks, outlining each country's goals, projected pathways, and areas of focus for the future. A brief comparison of both countries' policies follows toward the end of the section, helping the reader understand how the offshore wind technology and innovation ecosystem are stimulated in both regions.

The U.S. of America

The U.S. Department of Energy (DOE) is the executive department of the U.S. federal government and oversees the U.S. national energy policy, including offshore wind energy generation. The U.S.

government aims to deploy 30 gigawatts (GW) of offshore wind energy by 2030[6]. Reaching this goal should support 77,000 jobs, power 10 million homes, and reduce 78 million metric tons of carbon emissions. Generating 30 GW should also establish a pathway to deploy an additional 110 GW of energy or more by 2050. Considering the limited number of available shallow coastal areas, at least 15 GW should be made up of floating offshore wind by 2035[6]. The DOE often collaborates with U.S. agencies, of which the most important one is the Bureau of Ocean Energy Management (BOEM). BOEM facilitates the economically and environmentally responsible development of renewable energy on the Outer Continental Shelf.

BOX 2. U.S. POLICY FOR LEASING OFFSHORE WIND PROJECTS

BOEM plays a key role in leasing offshore wind projects in the U.S.[7]. BOEM identifies suitable areas for leases by engaging with stakeholders, tribes, and State and Federal government agencies. Once areas are made available, lessees may apply with a proposal to develop plans for an offshore wind park based on a Site Assessment Plan (SAP), containing a detailed proposal for the construction of measuring systems for wind resource, geophysical conditions, and other factors on the leasehold. BOEM reviews the SAP, eventually approving or disapproving it. If approved, the lessee assesses the site further in terms of meteorology and other characteristics (e.g., marine mammal, avian, archeological), after which the lessee submits a Construction and Operations Plan (COP) which contains a detailed plan for the design, construction, and operation of a wind energy project on the lease along with its environmental impacts. BOEM reviews the environmental and technical quality of the COP through an Environmental Impact Assessment (EIA) in consultation with other federal agencies, after which the facility may be constructed and operationalized. During construction, grid connectivity and infrastructure becomes decentralized, meaning the lessee is responsible for the connection to the shore.

In addition to federal policy, the offshore wind energy deployment in the U.S. is also driven by considerable autonomous state policies. These states often align themselves with the Biden-Harris Administration's goals of generating 30 GW of offshore wind energy by 2030, but are not required to[8]. In fact, each state holds individual considerations and perspectives for the development of offshore wind energy.

So far, Connecticut, Maine, Massachusetts, and Rhode Island have respectively procured 1158 megawatts (MW) (1,16 GW), 11 MW (0,01 GW), 3241 MW (3,24 GW) and 430 MW (0,43 GW) and are currently developing a collective energy deployment of 4,84 GW al-together[5]. The New England for Offshore Wind (NE4OSW) coalition aims to unite these state policies within New England to responsibly advance offshore wind procurement. NE4OSW has set the goal of having New England produce 20 GW of offshore wind energy by 2030, meaning that the northeast coast would make up for two-thirds of the required energy generation to achieve the 2030 U.S. targets.

[6] U.S. Department of Energy (DOE). 2023. *Advancing Offshore Wind Energy in the U.S., U.S. Department of Energy Strategic Contributions Toward 30 Gigawatts and Beyond*

[7] Bureau of Ocean Energy Management. 2021. *Wind Energy Commercial Leasing Process, Fact Sheet.* Retrieved from https://www.boem.gov/sites/default/files/documents/about-boem/Wind-Energy-Comm-Leasing-Process-FS-01242017Text-052121Branding.pdf#:~:text=The%20Process,(4)%20construction%20and%20operations.

[8] National Offshore Wind Research & Development Consortium. 2023. *Research and Development Roadmap 4.0.*

Despite suggestions that more than 40 GW of wind energy may be generated in U.S. federal coastal areas, only several turbines have been deployed as of 2023 that in total generate 42 MW (0.042 GW) of offshore wind energy. As of 2023, 932 MW (0.93 GW) of commercial projects are under construction[8], with a total of 4,84 GW being procured on the northeast coast[5] (New England for Offshore Wind). Several organizations and parties aim to accelerate the development of technologies and innovations required to achieve the above-described targets. The National Offshore Wind Research and Development Consortium (NOWRDC), established in 2018, is a not-for-profit public-private partnership that aims to advance offshore wind technology in the U.S. through R&D. The NOWRDC has awarded 53 research projects in total, providing funding to various companies, organizations, and universities to conduct research within one of three pillars to stimulate the technologies required for achieving the abovementioned goals. They received funding from the DOE and the New York State Energy Research and Development Authority (NYSERDA), each providing $20.5 million in addition to $53 million worth of investments from the Commonwealths of Virginia and Massachusetts and the States of California, New Jersey, Maryland, and Maine. The NOWRDC generates roadmaps to communicate the required research agenda to accelerate the U.S. offshore wind industry in support of the U.S. energy policy, considering recent industry progress and the changing geopolitical landscape. Released in April 2023, Roadmap 4.0[8] is the most recent version.

These roadmaps reduce the required technological advancements to three 'research pillars' which underline the DOE technological focus: offshore wind farm technology advancement; offshore wind power resource and physical site characterization; and installation, operation and maintenance and supply chain[8]. The first theme, offshore wind farm technology advancement, focuses primarily on wind turbine and system component innovation for both fixed bottom but in particular floating wind technologies specific to U.S. offshore conditions. The second theme focuses on technology relevant to measuring the conditions under which wind farms would be deployed, including atmospheric, oceanographic, and hydrologic data. The third theme aims to advance the supply chain, manufacturing and installation process, in addition to operation and maintenance to reduce levelized costs of energy and maximize economic benefits.

The Netherlands

Like the U.S., the Netherlands also aims to benefit from offshore wind energy to meet target goals by 2030. Indeed, offshore wind energy plays one of several key roles in the Netherlands' transition to a sustainable energy system, specifically because of the North Sea's relatively shallow waters, favorable wind climate and proximity to ports and energy consumers[9]. The Dutch Government also recognizes offshore wind as one of, if not the cheapest large-scale source of green energy. To underline the national importance of this transition to a sustainable energy system, this mission is defined as one of ten 'topsectors', which constitute areas in which the Dutch industry and research institutes exceed on a worldwide scale[10]. Within this topsector for 'energy', there are four 'Top Consortia for Knowledge and Innovation' (TKI), which are conglomerates of Government representatives, entrepreneurs, researchers, and organizations. One of these TKI's is the TKI 'Wind op Zee', or in other words, offshore wind energy[11].

[9] Rijksoverheid. *Offshore Wind Energy*. Retrieved from https://www.government.nl/topics/renewable-energy/offshore-wind-energy

[10] Topsector Energie. Retrieved from https://topsectorenergie.nl/en/

[11] TKI Offshore Energy. Retrieved from https://topsectorenergie.nl/en/maak-kennis-met-tse/tki-offshore-energy/

This TKI stimulates the development of offshore innovations through research, development, and demonstrations to enable energy to make a significant contribution to the energy transition.

The Netherlands similarly aims at deploying offshore wind energy to meet their target goals as documented in the Dutch Climate Agreement (i.e., 'Klimaatakkoord)[4]. This agreement constitutes the foundation of Dutch climate policy and holds that greenhouse gas emissions must be reduced by 49% by 2030, accommodating 75% percent of total Dutch electricity consumption. Progress towards this goal is, in part, dependent on the deployment of approximately 21 GW's worth of offshore wind farms within the North Sea by 2030. Between 2020 and 2023, two wind farms to the south-west of the Netherlands have been constructed which should generate at least 4.5 GW's worth of offshore wind turbines by 2023. In April 2023, a Dutch Offshore Wind Market Report[12] stated that the Government and industry are on track to meet the goals by the end of the year. This amount of energy would supply 3.3% of all energy in the Netherlands. By 2030, an approximate total of 21 GW's worth of offshore wind farms should be in operation, enough to supply 16% of all energy consumption in the Netherlands.

Box 3. Dutch policy for leasing offshore wind projects

The Netherlands has documented its offshore wind policy in a recent report by Wind&Water Works[4], a collaboration between the Netherlands Enterprise Agency and the Dutch offshore wind industry. Its policy learns from previous practices up until 2013 when wind farm developers were individually responsible for site selection, investigation, permitting process and grid connection. Nowadays, Dutch offshore wind policy follows a step-by-step approach in which the Government embodies an active role by regulating conditions for the deployment of wind farms. The Ministry of Economic Affairs and Climate Policy and the Ministry of Infrastructure and Environment allocate areas for future offshore wind farms in the Dutch territory of the North Sea, after which environmental impact assessment and geophysical site studies are conducted by the Netherlands Enterprise Agency (RVO) on behalf of said ministries. Connections to offshore grids are facilitated by the Dutch national electricity Transmission System Operator (TSO) TenneT, standardizing technology design and application throughout the North Sea territories. After this, a Wind Farm Site Decision (WFSD) is published, which is a permit that must be issued prior to the wind farm may be built. It specifies the location of the wind farm and the conditions under which it may be constructed and operated, considering the environment, and decommissioning of the wind farm. Once the WFSD becomes irrevocable, the RVO coordinates the tender process, with three distinguished tender models to select from: the tender based on lowest subsidy bid, best feasibility offers or highest auction price. After the tender is handed over, the permit for construction, operation and removal of the wind park is granted by the Government, after which its planning, construction, and operation is monitored by the Directorate-General for Public Works and Water Management (Rijkswaterstaat). After construction, Rijkswaterstaat continues to monitor the operations management and maintenance activities. This top-down policy approach has driven the construction of offshore wind parks considerably in recent years.

Aside from offshore wind park construction, the Dutch Government aims at stimulating offshore wind technology innovation through R&D financing. The TKI 'Wind op Zee', like the NOWRDC, largely focuses

[12] Netherlands Eterprise Agency, *Dutch Offshore Wind Market Report 2023,* retrieved from https://www.rvo.nl/sites/default/files/2023-05/Offshore-Wind-Market-Report.pdf

on three themes, also described as areas of interest: cost reduction and optimization, energy system integration and integration into the environment[13]. Within cost reduction and optimization, focus is laid on limiting production failures due to malfunctions, repairs, and maintenance; optimizing wind farm design; optimizing wind farm components excluding turbines; technology for next generation wind turbines (25 MW), and floating solar energy. Energy system integration regards the generation, storage, transportation, and conversion of large quantities of energy towards land. The third theme concerns the development of methods for building wind farms in such a way that the negative effects of wind park construction on the North Sea are mitigated as much as possible.

Comparison

There are several notable differences regarding the development of the offshore wind sectors in both the Netherlands and the U.S. The first difference regards the contrast in offshore wind energy generation. The Netherlands have deployed more wind turbines than the U.S., generating roughly 8,714 MW (8,7GW) and 42 MW (0,042GW) respectively. While the U.S. have recently procured roughly 4,8 GW to develop wind farms, this is just about half of what the Netherlands has deployed to date. The most obvious reason for this difference is that the Netherlands simply has been involved in offshore wind development for several decades and has had a lot of experience in building, operating, and maintaining offshore wind farms. The U.S., on the other hand, started exploring offshore wind much later.

The second difference regards the policy approach used to orchestrate offshore wind in both countries. The Netherlands takes a strong top-down approach, with much of the leasing process being streamlined by the Government. Prior to the leasing, it defines conditions for offshore wind areas, conducts environmental and geophysical research and standardizes the transmission process to the coasts, and coordinates the tendering process (see Box 3). In contrast, the federal government and agencies at the U.S. only apply top-down policy to a limited extent. While BOEM partially coordinates the leasing, the process is partially decentralized, requiring a back-and-forth process of submittance and assessment by lessees, BOEM and other federal and state agencies (see Box 2). This fragmentation is in part due to the nature of the U.S. federal system. Different states have individual targets and incentives for offshore wind development, meaning that policy in the U.S. is by and large bottom-up driven while trying to fit in with the existing policy regulations defined by BOEM. As a result of this regulatory environment, it is more complex to streamline policy on a federal level as seen in the Netherlands. Permitting processes, environmental assessments, and other regulatory hurdles significantly impact the pace of offshore wind development.

The third difference regards the focus on technology. According to the NOWRDC, the focus of technology in the northeast U.S. is on the development of technology for turbines and system components, environmental and geophysical site analysis, and supply chain development[8]. In contrast, the Dutch TKI 'Wind op Zee' emphasizes technology in the Netherlands in terms of maintenance, cost reduction and optimization of existing technology, and the integration of existing technology in the environment[11]. This difference in technology focus implies that whereas the Netherlands is currently optimizing and finetuning existing technologies, the U.S. are still researching and producing the necessary technology for launching offshore wind. Moreover, whereas the U.S. aim to stimulate technology for environmental and geophysical site analysis, the Dutch government has this technology

[13] Wind op Zee. *Innovatie voor wind op zee.* Retrieved from https://windopzee.nl/onderwerpen/wind-zee/innovatie/

readily available and actively uses it in preparation of offshore wind sites. Hence, the U.S. prioritizes more fundamental technologies because of the early developmental phase in which it is situated compared to the Netherlands. This focus on fundamental technologies is exacerbated by the fact that the coastal conditions along the U.S. differ vastly from those found in Europe, meaning that offshore wind technologies need to be tailored specifically to the U.S.' coastal conditions. For instance, hurricanes are more prevalent, soil conditions vary, and water depths reach beyond 100 meters in certain waters making fixed offshore options impossible. As a result, the country is largely focused on developing technologies related to turbine technology, related to for instance hurricane resistant turbines and floating offshore wind to circumvent excessive water depths.

The Offshore Wind Innovation Landscape along the Northeast U.S. Coast

This section is dedicated to sketching the offshore wind innovation landscape along the northeast U.S. coastline. This is done by outlining several key organizations that play a big role in stimulating technological innovations within the offshore wind sector. These organizations operate at various levels. They include federal and state agencies, academic institutes, research institutes, incubators, and accelerators. Note that this overview is not exhaustive; it draws on those organizations that stand out most within the field at the time of writing.

Federal and State Agencies

National Offshore Wind Research and Development Consortium (NOWRDC)[14]

The NOWRDC is a collaborative initiative focused on advancing offshore wind technology in the U.S. It was established to accelerate the development of offshore wind projects and address key challenges in the sector. The NOWRDC serves as a platform for collaboration by facilitating meetings, workshops, and conferences, and aims at bringing together public and private stakeholders, including industry participants, research institutions and government agencies to pool resources and expertise. By promoting R&D activities and data sharing, the consortium seeks to drive innovation, increase the efficiency of offshore wind technologies, and reduce the costs associated with these projects.

New England for Offshore Wind (NE4OW)[15]

New England for Offshore Wind is a growing regional coalition of environmental and justice organizations, academic and research institutions, business alliances, and labor unions. By stimulating the sector, NE4OW aims to create jobs and drive economic development, improve health outcomes in communities

[14] National Offshore Wind Research and Development Consortium, retrieved from https://nationaloffshorewind.org/

[15] New England for Offshore Wind, retrieved from https://www.newenglandforoffshorewind.org/

that are subject to the brunt of fossil fuel pollution, stimulate regional collaboration between states, organizations, and more, and stimulate offshore wind in a responsible manner.

Massachusetts Clean Energy Center (MassCEC)[16]

MassCEC is a state agency in Massachusetts, focused on fostering the growth of the clean energy industry within the state, including offshore wind. The key focus areas for MassCEC in terms of offshore wind are supporting the development and deployment of offshore wind projects, advancing offshore wind technology through research and development, fostering a skilled workforce for the offshore wind industry, and promoting a robust but sustainable offshore wind supply chain in Massachusetts. Additionally, MassCEC aims to collaborate with stakeholders, address environmental considerations, and facilitate the growth of infrastructure essential for offshore wind development. MassCEC completed a Wind Technology Testing Center in 2011, and since then 35 distinct blade testing programs have been run, entailing hundreds of individual blades test[17].

New York State Energy Research and Development Authority (NYSERDA)

NYSERDA is a public authority in New York State, responsible for promoting clean and renewable energy solutions. In terms of offshore wind energy, NYESRDA leads the development and procurement of offshore wind projects in New York waters[18]. They collaborate with offshore wind developers, conduct feasibility, environmental and impact assessments, and issue solicitations to attract private investment in offshore wind energy. For instance, NYSERDA played a key role in supporting the development of the South Fork Wind Farm, an offshore wind project off the coast of Long Island, New York by providing funding, technical assistance and regulatory support to Ørsted, the project developer[19].

Maine Governor's Energy Office (GEO)

The Maine Governor's Energy Office (GEO) is Maine's government agency committed to advancing clean energy initiatives and policies. It launched the Maine Offshore Wind initiative in 2019 to explore opportunities for thoughtful development of offshore wind energy in the Gulf of Maine. As a result of this initiative, the office published a Roadmap in which they document their plans to stimulate floating offshore wind technology along the Gulf of Maine and how Maine can contribute to advancements in the broader U.S. offshore wind sector. They identify opportunities for Maine (e.g., companies, workforce, R&D) to

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[16] Massachusetts Clean Energy Center, retrieved from https://www.masscec.com/

[17] Massachusetts Clean Energy Center, *Wind Technology Testing Center,* retrieved from https://www.masscec.com/sites/default/files/documents/WTTC_Brochure_3.14.19.pdf

[18] New York State Energy Research and Development Authority, retrieved from https://www.nyserda.ny.gov/All-Programs/Offshore-Wind

[19] New York State Energy Research and Development Authority, *South Fork Wind Installs First Offshore Wind Turbine Foundation and U.S.-Built Substation in New York State,* retrieved from https://www.nyserda.ny.gov/About/Newsroom/2023-Announcements/2023-06-22-Governor-Hochul-Announces-Major-Milestone-For-South-Fork-Wind

contribute to, and benefit from the offshore wind sector beyond the Gulf of Maine, both regionally, nationally, and internationally. In addition, the roadmap also covers topics such as renewable energy market projections; economic development strategies; supply chain analyses; and what research is needed to avoid, minimize, and mitigate impacts to existing marine users[20]. The office collaborates frequently with various stakeholders, including the University of Maine, the NOWRDC, BOEM and more, leading to initiatives such as for instance New England Aqua Ventus.

Academic Institutes

University of Maine

The University of Maine is a public research university located in Orono, Maine. In terms of offshore wind energy, the university is at the forefront of research and development, particularly through its involvement in the development of floating offshore wind technology[21]. They are the lead institution behind the New England Aqua Ventus project, an innovative offshore wind demonstration project on the coast of Maine, involving the development and deployment of a floating wind turbine platform known as VolturnUS. Through their expertise in floating offshore wind, the university collaborates with industry partners, government agencies and other research institutions to advance the understanding and deployment of floating offshore wind farms.

University of Massachusetts Amherst (UMass Amherst)

The University of Massachusetts Amherst is a public research university located in Amherst, Massachusetts. The university's Wind Energy Center (WEC) - a renowned research facility dedicated to advancing the field of wind energy - conducts research on various aspects of offshore wind, including turbine design, materials, environmental impact assessments and grid integration[22]. The center's work extends beyond theoretical aspects, as they actively engage in real-world demonstrations. In addition, UMass Amherst contributes to the development of skilled professionals in the offshore wind sector through educational programs and workforce training, helping to meet the growing demand for a skilled workforce in the industry.

Tufts University

Tufts University is a private research university located in Medford, Massachusetts. With traditions in civic engagement, collaboration and use-inspired research, Tufts has been an international leader in environmental sustainability, providing the foundation for cutting-edge research in offshore wind energy through the advancement of offshore

[20] State of Maine Governor's Energy Office, *Maine's Offshore Wind Roadmap,* retrieved from https://www.maine.gov/energy/initiatives/offshorewind/roadmap
[21] The University of Maine, *Advanced Structures & Composites Center,* retrieved from https://composites.umaine.edu/oee/
[22] The University of Massachusetts Amherst, *Wind Energy Center,* retrieved from https://www.umass.edu/windenergy/home

wind infrastructure, supply chain and transmission[23]. Based on experience with industry, government and innovation through research, their faculty is bridging the technology-policy interface to help create jobs and protect the environment. In addition, Tufts faculty led the structural design of the Wind Technology Testing Center completed by MassCEC[24].

Research Institutes

Woods Hole Oceanographic Institution (WHOI)

The WHOI is a research organization located in Woods Hole, Massachusetts[25]. WHOI is dedicated to advancing knowledge and understanding of the ocean and its interactions with the Earth's systems. Emphasizing interdisciplinary collaboration, the institute is one of the leading oceanographic research institutions, conducting a wide range of studies related to marine science, oceanography, geology, climate change and marine technology. In terms of offshore wind energy, WHOI conducts research to assess the potential environmental impacts of offshore wind projects, to study the wind patterns and potential energy yields at various offshore sites, to test and evaluate technologies such as innovative wind turbine designs, foundations, and mooring systems, to collect oceanographic and meteorological data at offshore wind project sites, and more. They also provide scientific expertise and research findings to inform policy and regulatory decisions related to offshore wind.

National Renewable Energy Laboratory (NREL)

The NREL is a U.S. government research laboratory located in Golden, Colorado. Associated with the DOE, the NREL specializes in renewable energy and energy efficiency, including offshore wind. It is one of the world leading institutions in advancing clean energy technologies and solutions. It performs research and development to accelerate the deployment and optimization of offshore wind technology, specializing in resource assessment, (floating) turbine, material and component design, environmental impact studies, grid integration, policy and market analysis, and validation and testing[26]. NREL's research and expertise support government agencies, industry partners and policymakers in making informed decisions and driving the adoption of renewable energy and energy-efficient technologies.

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[23] Tufts University Offshore Wind, *Advancing an Equitable Energy Transition*, retrieved from https://offshorewind.tufts.edu/

[24] Tufts University Offshore Wind, *Wind Technology Testing Center,* retrieved from https://offshorewind.tufts.edu/our-story/wind-technology-testing-center

[25] Woods Hole Oceanographic Institution, *Who We Are,* retrieved from https://www.whoi.edu/who-we-are/

[26] National Renewable Energy Laboratory, *Offshore Wind Research,* retrieved from https://www.nrel.gov/wind/offshore-wind.html

Incubators and Accelerators

Greentown Labs

Greentown Labs is North America’s largest climatetech startup incubator with locations in Somerville, Massachusetts, and Houston, Texas[27]. It provides connections, resources, equipment, and lab and office space to startups focused on developing innovative solutions to decarbonize the key greenhouse-gas emitting sectors and build resilient communities. In terms of offshore wind energy, Greentown Labs plays a key role in fostering the growth and advancement of startups and companies in the sector. They provide a collaborative and supportive environment for entrepreneurs to develop and accelerate their offshore technologies and to bring them to the market. As of 2023, Greentown Labs, Vineyard Wind, and MassCEC collaborate on an accelerator program called GreentownGo Energize 2023, in which several start-ups, including Blue Atlas Robotics, FutureOn, HyperKelp, Lobster Robotics and SeaDeep participate to advance their companies’ growth and bring sustainable solutions to the offshore wind market[28].

The Offshore Wind Innovation Hub

The Offshore Wind Innovation Hub is an initiative led by Equinor in partnership with bp, and functions as a coworking community and accelerator program launched specifically to help startups develop new technologies for the offshore wind industry[29]. Based in New York City, the hub has opened its first round of applications for start-ups to apply. By connecting innovators, local partners, investors and industry, the hub aims to foster demonstration opportunities, safety awareness, knowledge transfer, innovation, and job creation.

SeaAhead

SeaAhead is an innovation-focused organization that operates at the intersection of sustainability, ocean health and technology. Their primary mission is to support and promote startups, companies, and projects that aim to create sustainable solutions for ocean-related challenges, including offshore wind energy. SeaAhead hosts an incubation program, and both identifies and selects promising startups working on innovative offshore wind technologies and solutions[30]. SeaAhead evaluates the startup’s technology, business model and potential impact on the offshore wind industry. Once selected for the program, the start-up becomes part of a collaborative ecosystem, gaining access to experienced mentors, industry experts and potential investors.

[27] GreentownLabs, retrieved from https://greentownlabs.com/about/
[28] GreentownLabs, *Go Energize,* retrieved from https://greentownlabs.com/go-energize/
[29] The Offshore Wind Innovation Hub, retrieved from https://www.offshorewindnyc.com/
[30] SeaAhead, *Our Mission,* retrieved from https://www.sea-ahead.com/mission

New England Ocean Cluster (NOEC)

The NOEC is an incubator for Blue Economy related startups and companies based in Portland, Maine. Located in the co-working environment known as the Hús, various collaborative parties aim at realizing the cluster's mission to create value in the blue economy and discover new opportunities for sustainable growth by connecting purpose-driven people and organizations. The cluster houses various Blue Economy related companies, including several involved in offshore wind. With a diverse portfolio of events and programming, the NOEC offers its members and clients unique ways to grow their businesses by connecting with others in an intentional way.

Interview Outcomes and Recommendations

From the conducted interviews, this study was able to construct a narrative of themes to help Dutch innovators and entrepreneurs comprehend and engage with the offshore wind innovation ecosystem along the northeast U.S. coast. The interviews, conducted via videoconferencing or in-person, were recorded and transcribed depending on the preference and availability of each stakeholder. The transcriptions were reviewed to determine commonality and patterns between each interview. Themes that emerged were reviewed against the interview transcripts and literature review to ensure they fit in relation to the scope of the report.

The themes were grouped into four sections:

1. The NOWRDC drives offshore wind innovation.
2. Large developers and normative technology dominate, while startups and innovations struggle.
3. Immature supply chain, manufacturing process and infrastructure inhibit progress.
4. Floating offshore wind and transmission as key technologies.

After elaborating on these four themes, the closing section of this chapter will conclude the report by providing several recommendations for Dutch entrepreneurs that have come forward based on these interviews.

The NOWRDC drives offshore wind innovation.

Almost all interviewees made mention of the NOWRDC. To reiterate, the NOWRDC's goal is to drive offshore wind innovation based on a collectively constructed roadmap by representatives from government, research, and industry. Through this roadmap, it funds R&D projects across a multitude of organizations. The NOWRDC includes many organizations, such as state agencies, research institutes, universities and both large and small companies. Each R&D project is overseen by a tailored selection of advisory board representatives who are appointed based on their expertise and direct relevancy to the project.

The interviewees all had some form of direct connection and/ or experience with the NOWRDC[31]. For instance, UMass Amherst is currently participating in a project regarding the development of mooring and foundation systems. The same goes for other universities and research centers, including the earlier mentioned (but not interviewed) Tufts University, Northeast University, University of Maine, NREL and WHOI. Particularly interesting is that the Maritime Research Institute of the Netherlands (MARIN) and Belgian contractor DEME also participate in NOWRDC's research projects. Specifically, at the time of writing, MARIN completed the R&D project on "Comparative Operability of Floating Feeder Solutions". This project sought to identify and better understand various floating feeder solutions to transport offshore wind turbine components to wind turbine installation vessels (which is the case because the Jones-Act requires goods shipped between U.S. ports to be transported on ships that are built, owned, and operated by U.S. citizens or permanent residents). While it is important to note that certain conditions and agreements should be met for international research to be conducted, one of the NOWRDC representative encourages oversea companies to engage in joint solicitations by for example partnering with an U.S. based international institution. Another interviewee explains that the NOWRDC succeeds because it's one of the few available external funding sources; direct industry funding is, in contrast, rather rare.

In addition to conducting the R&D projects, several interviewees are also represented on the various solicitation and advisory boards that supersede these projects, including the Governor's Energy Office at the State of Maine and MassCEC. These boards are often very diverse and allow representatives to leverage ideas through funding, in addition to voicing their opinion on matters related to the project. By doing so, the above-mentioned state agencies may communicate their needs to the federal government but may also foster closer relationships and collaborations. One interviewee at the NOWRDC explains how the consortium facilitates discussion sessions for states to freely discuss so they may accelerate regional coordination. Another interviewee elaborates how these efforts pay off by explaining how the states of Massachusetts, New Hampshire and Maine now partake in a regional supply chain project.

In recent years, the Consortium has also engaged in other activities with partners, including joint industry projects with SeaAhead and by providing support to incubators such as the Offshore Wind Innovation Hub. They also closely collaborate with state agencies such as MassCEC and NYSERDA. One interviewee further elaborates how in addition to regional collaborations, the NOWRDC has also recently worked together with Innovate UK, the United Kingdom's national innovation agency. It once again underlines the possibility for international collaboration between agencies to drive innovation.

All interviewees with any (past) connections to the NOWRDC are extremely positive. One explains how it is a great example of industry, government and other stakeholders getting together, developing roadmaps, and collective agenda. Other interviewees explain how it stimulates network building and allows for forums to discuss future regional collaboration. Yet, another interviewee states that there are also other collaborations aside from the NOWRDC that stimulate synergies and collaborations around various other elements of interactions with the marine environment.

[31] National Offshore Wind Research & Development Consortium, *Project Database,* retrieved from https://nationaloffshorewind.org/project-database/

Large developers and normative technology dominate, while startups and innovations struggle.

According to an interviewee, the offshore wind industry is unique in terms of developing innovation. This is due to the comparatively large scale of infrastructure projects, which in turn are often conducted by the same established renewable energy developers in the world. Because the offshore wind industry is largely dominated by these big developers, it has become difficult for startups to break into the industry. Startups are required to have solutions that fit very precisely with the regulations, engineering conditions and business models of the industry. This required level of sophistication in developing a solution is different in offshore wind compared to other renewable energy industries (e.g., solar) with more regulatory flexibility, a wider array and both more and varying types of customers.

One of the factors that several interviewees independently used to explain why startups cannot penetrate the offshore wind industry regards the lack of piloting, testing and demonstration facilities. Such facilities are often extremely expensive. Hence, these technologies cannot easily be tested or demonstrated, and they also cannot be publicly verified by larger companies and developers. This results in such technologies to be considered both expensive and a risk which developers are not necessarily willing to take. One of the interviewees advocates for large developers to take more risks in commercializing R&D instead of keeping a more conservative approach: "[developers] are looking at what is safer rather than what is new, we must break the barrier of trying to do more of the same. Progress is dependent on the change of culture, and if we do not break that cycle, nothing will change". Another interviewee expresses the concern that the U.S. simply has not figured out how to effectively transform research and design to commercialization. Hence, there may be opportunities in collaborating with startups to demonstrate, test and pilot their technology either in the Netherlands or the U.S.

Aware of these difficulties, the northeast U.S. offshore wind ecosystem aims at providing startups with several platforms to take off innovations and adopt them by the main stakeholders in the industry. The Offshore Wind Innovation Hub, established and funded by Equinor and bp, is one example which aims at providing such support. One interviewee elaborates how on the one hand, it operates as an accelerator program by pairing startups and innovators with offshore wind industry experts for a duration of six months, where they receive close mentorship and tailored support. On the other hand, it also functions as an incubator by bringing together innovators in a physical office space to facilitate contact sharing, community building and knowledge exchange. Applications to the hub are, however, not completely straightforward: startups who had prior affiliation with Equinor receive more credibility to be permitted to the cohort.

Another platform that similarly aims to accelerate clean technologies is Greentown Labs[27], North America's largest climatetech incubator based in Somerville, Massachusetts and Houston, Texas. In addition to providing a physical workspace in which startups may network, share contacts, and facilitate knowledge exchange, Greentown Labs launched an Offshore Wind Challenge in the past and is currently running the GoEnergize 2023 accelerator program[28] in collaboration with Vineyard Wind and MassCEC. Throughout the latter, a cohort of five startups receive mentorship and support for six months with the goal of advancing their technologies and breaking into the offshore wind industry. Lobster Robotics[32], a Dutch company, is part of the cohort regarding the GoEnergize 2023 cohort. This demonstrates the

[32] Lobster Robotics, *Home*, retrieved from https://www.lobster-robotics.com/

possibility for overseas startups to also participate in these accelerator programs. In comparison to the Offshore Wind Innovation Hub however, the startups require no direct association with any developer or company.

This overview is not an exhaustive list of hubs that help startups within the offshore wind sector. For instance, the New England Ocean Cluster[33] in Portland, Maine is a similar platform that brings together various startups in the blue economy sector. While not of the same scale as for instance Greentown Labs, the cluster provides a similarly effective and closely knit hub for networking, contact sharing and knowledge exchange. In fact, the cluster houses FINSULATE USA[34], a Dutch startup which has recently expanded overseas and has now entered the U.S. industry. FINSULATE USA is only one of the few Dutch companies who, partially because of a rich environment and access to resources, have been able to carry their product overseas.

Immature supply chain, minimal manufacturing process, and poor infrastructure inhibit progress.

Throughout all interviews it was unequivocally echoed that the main bottlenecks that hold back the U.S. offshore wind industry are found in its supply chain, manufacturing process and (port) infrastructure. These bottlenecks exemplify the developmental stage in which the U.S. is currently in terms of offshore wind generation: while 4.84GW worth of offshore wind areas has been procured, only 42 MW is now generated. This discrepancy between planned and actual energy generation illustrates a clear disconnect between the ambitions and reality of technology deployment. Indeed, various interviewees share concerns about the pace at which the supply chain has currently been established in relation to the goals that are to be reached by 2030.

One interviewee describes two key factors that may progress the supply chain in the near future. Firstly, the industry requires standardization in the form of an agreed basic set of technologies that are to be widely applied across the construction, installation, and deployment of offshore wind technology. This factor goes hand-in-hand with the second key factor: repeated serial manufacturing. While the required components could be imported from abroad – say, steel for turbines from South Korea - the levelized costs of energy would be too high for the technology to be profitable. The interviewee therefore calls for an immediate industrialization of the offshore wind components. A different interviewee similarly calls for serial production of components through innovation. For example, they explain while steel floating offshore wind turbines are state of the art quality components, semi-submersible models made from concrete could function just as well. The interviewee elaborates that such concrete components can be constructed in a typical construction industry instead of a highly specialized one in steel, while also having a lower carbon footprint because it is locally constructed. This example holds true for both fixed as floating offshore wind: if there is a common foundation of skills sets from which the industry can build and then diverge into both floating and fixed, the U.S. does not require two separate industries. Even more so, the supply chain could particularly be improved once states would differentiate their supply chain activity instead of being duplicative to each other. In summary, the supply chain for the offshore wind industry may experience significant progress once at least a portion of the most essential technology is both standardized as serially produced. Efficiency and cost-reduction may also be facilitated once the supply chain for both floating as fixed technologies follow from the

[33] New England Ocean Cluster, *Home*, retrieved from https://www.newenglandoceancluster.com/
[34] FINSULATE USA, *Home,* retrieved from https://www.finsulateusa.com/

same foundation. Moreover, further progress may be noticeable once individual states specialize in specific areas of the supply chain process that complement rather than compete with other states.

In terms of a lack of sufficient port facilities, immature supply chain, and manufacturing, the NOWRDC Roadmap 4.0 provides several activities that may lower the cost and time of U.S. offshore wind project fabrication, construction, installation, and operation and maintenance costs. This could be achieved through the development of innovative deployment strategies, logistics, and critical supply chain elements. For example, there is a large need for the design, construction, and adaptation of vessels into wind turbine installation vessels that comply with the Jones Act, the earlier mentioned legislation that requires any vessel transporting merchandise between two points in the U.S.-built, U.S.-flagged, and U.S.-owned. Dutch entrepreneurs specialized in the design and adaptation of vessels into Jones Act-compliant vessels could benefit from this opportunity. Other attempts to circumvent the Jones Act have also been done in the earlier study by the NOWRDC and MARIN, where they investigated the feasibility of float-out turbine and foundation concepts that eliminate the need for heavy-lift vessels, or alternative logistic solutions that reduce the uncertainty and cost of heavy-lift vessels. These are only few examples in which the Dutch offshore wind industry may enter the U.S. industry.

Floating offshore wind and transmission as key technologies.

From the literature review it has become apparent that the various organizations in the offshore wind innovation ecosystem in the U.S. do not specifically focus on a few technologies, but rather on a broad range spanning across the entire offshore wind domain. The NOWRDC, for instance, facilitates a wide variety of R&D projects that range from turbine advancement to environmental analysis, in addition to maintenance, installation and operation. This more generalist approach is also taken by several of the interviewees that work at consortia and incubators. One interviewee states that this broad scope is a testimony to the fact that there are many gaps in the offshore wind innovation ecosystem.

However, there are several technologies that have been mentioned significantly more than others, these being floating offshore wind and transmission. Floating offshore wind specifically has been recognized as a key technology for future offshore wind energy generation. For instance, the Gulf of Maine yields considerable energy potentials for floating offshore wind to generate; it has the highest, most consistent wind speeds of any area along the U.S. East Coast. Yet, the industry requires major development if the goal of 30 GW is to be met by 2030, and a total of 35 GW floating offshore wind energy is to be generated by 2035[35]. This is especially the case considering the lack of a standardized manufacturing and installation process that signifies a premature supply chain for floating offshore wind, let alone fixed offshore wind. One interviewee implores the offshore wind industry to redirect more resources to floating technology because a large part of the industry considers floating offshore wind to be the technology of tomorrow, while in fact, it should be a technology of today. However, the dominant focus of the current industry is on fixed offshore wind technology. This suggests that there may be several opportunities for Dutch industry and entrepreneurs specialized in floating offshore wind to enter the U.S. industry and progress the sector.

A second technology that has been frequently mentioned includes transmission. Unlike the Netherlands, transmission in the U.S. is not standardized but rather the individual responsibility of the developers. However, since interconnection points near coasts are limited, space for developers to connect future

[35] State of Maine Governor's Energy Office, *Maine Offshore Wind Roadmap.*

wind parks is running out. One of the interviewees mentions that more effort should be directed into regional transmission. Another interviewee briefly discusses an innovation otherwise known as an offshore backbone, which functions as an offshore connection to which multiple projects share one export table.

Recommendations and conclusion

By means of an extensive literature review and several informative interviews with a diverse range of experts, this report has identified several recommendations that may be of value to Dutch entrepreneurs who are thinking about taking the next step towards the U.S. offshore wind industry. There are various directions that Dutch entrepreneurs may want to explore.

Firstly, the NOWRDC consistently runs various R&D projects relating to a wide variety of technologies and innovations across the offshore wind sector. We recommend Dutch entrepreneurs to familiarize themselves with the NOWRDC's most recent roadmap[8], which is a key document that outlines the many technological avenues in which R&D projects are sponsored. While it is currently most common for American organizations to participate in these projects, foreign entities, including those from the Netherlands such as MARIN, have engaged with the NOWRDC in the past. Joint solicitations, as an example, appear a potential venue for entrepreneurs to explore collaboration with the NOWRDC.

A second way in which Dutch innovators may penetrate the U.S. offshore wind industry is by targeting incubators and/ or accelerator programs. Some platforms, such as the Offshore Wind Innovation Hub, are specifically targeted at companies in offshore wind, while others like Greentown Labs and the New England Ocean Cluster provide opportunities for the broader clean energy community. While listing all incubators and accelerators falls outside of the scope of this report, similar hubs have manifested along the northeast coast of the U.S. which may tailor to the interests of ambitious Dutch entrepreneurs. In addition, entrepreneurs may also want to keep a close eye on any accelerator programs that are regularly run by developers such as Vineyard Wind and Equinor. These organizations have often welcomed application proposals for collaborative programs in the past.

Because the offshore wind industry in the U.S. is still situated in a developmental phase, it means that there is a large need for a wide variety of technological innovations as outlined in the NOWRDC's roadmap. Still, certain aspects of the industry are less developed than others. As of the time of writing, most progress needs to be made in terms of the supply chain, including the manufacturing infrastructure related processes to both fixed as floating offshore wind. Dutch entrepreneurs specialized in this sector may seriously encounter several potential business opportunities in this regard. Moreover, Dutch entrepreneurs with expertise in terms of floating offshore wind and transmission technology may also want to further consider exploring the U.S. landscape and possibilities for potential future expansion.

To conclude, the future of the offshore wind industry along the northeast coast of the U.S. is close to taking off. Due to the specific developmental phase in which the country finds itself, there are innumerable opportunities for ambitious Dutch entrepreneurs to take the next step overseas. This report has aimed at sketching the context in which the U.S. offshore wind industry operates. Moreover, it has elicited a wide number of organizations that play a key role in the sector, with the goal of providing the reader with a preliminary understanding of the innovation landscape. Finally, it has identified emerging patterns and provided several recommendations for entrepreneurs ambitious enough to participate in the offshore wind industry in the U.S.

The Netherlands Innovation Network in Boston, also known as the science and technology arm of the Dutch diplomatic network in the U.S., is able to assist Dutch entrepreneurs with potential overseas ventures towards the U.S. The Netherlands Innovation Network has a rich network with various actors within the clean and offshore wind industries and can help with matching Dutch innovators to the offshore wind innovation ecosystem.

Appendix

Appendix I – Interviewees

Nils Bolgen (MassCEC, Program Director)

Nils Bolgen is the Program Director at Massachusetts Clean Energy Center (MassCEC). In this role, he oversees MassCEC's program offerings and related activities designed to advance offshore wind energy development in Massachusetts. Nils has plentiful experience in government-sponsored energy efficiency and energy programs. Prior to joining MassCEC, Nils worked in a similar capacity at the Massachusetts Technology Collaborative. Before that, he served in a variety of roles in energy efficiency and renewable energy programs at the Massachusetts Division of Energy Resources. Nils has a BSc in Physics from North Adams State College and a Master of Environmental Planning from Arizona State University.

Bruce Carlisle (MassCEC, Managing Director Offshore Wind)

Bruce Carlisle is the Managing Director of Offshore Wind for the Massachusetts Clean Energy Center (MassCEC). Bruce leads efforts to advance the successful and responsible development of the offshore wind sector in the Commonwealth. He directs programs and initiatives for MassCEC including planning and siting stakeholder engagement, supply chain support and growth, workforce development, ports and infrastructure assessment and utilization, marine studies and environmental characterization, transmission, and research and innovation in offshore wind development, technology, and operations. Prior to this, he was the Director at the Massachusetts Office of Coastal Zone Management. Bruce received a master's degree in environmental policy, Coastal Zone Management, Environmental Planning and Environmental Law at Tufts University.

Julia Dombroski (National Offshore Wind Research & Development Consortium and Offshore Wind Innovation Hub, Innovation Hub Associate)

Julia Dombroski is the Innovation Hub Associate at the Offshore Wind Innovation Hub for the National Offshore Wind Research & Development Consortium (NOWRDC). She aims to drive offshore wind innovations and technologies with the goal of scaling these up to enter the industry. Moreover, Julia is deeply rooted in research and has published several articles on the cutting edge of ecology, bioacoustics, marine biology, and conservation. Julia holds a PhD in Biology at Syracuse University, with her dissertation on noise exposure and behavioral effects of noise on Florida manatees. She received her BSc in Biology at the Universidade Presbiteriana Mackenzie in addition to a MSc in Physiological Pscyhology at the Universidade Federal do Rio Grande do Norte.

Kori Groeneveld (National Offshore Wind Research & Development Consortium, Senior Program Manager)

Kori Groeneveld is a Senior Program Manager at the National Offshore Wind Research & Development Consortium (NOWRDC). She coordinates several R&D projects funded by the consortium, specifically in terms of floating offshore wind technology and transmission. Before she joined the NOWRDC in 2021, Kori was a Technology Development Program Administrator at Massachusetts Clean Energy Center (MassCEC). At MassCEC, she co-managed grant programs that focused on accelerating early-stage clean energy technology to fill early-stage investment gaps in technologies critical to meeting Massachusetts's climate goals. She acquired a BA in Environmental Studies and Hispanic Studies at Lewis & Clark College.

Michela Grunebaum (Greentown Labs, Director of Programs)

Michela is the Director of Programs for Greentown Go, Greentown Labs' innovative corporate-startup partnership accelerator program. She is dedicated to scaling climate solutions and driving decarbonization in greenhouse gas-emitting sectors. Michela oversees the entire delivery lifecycle of concurrent Greentown Go programs, fostering impactful corporate-startup relationships and collaborations. Her role involves close collaboration with corporate venture capital teams, startups, and key ecosystem players, all working together to achieve decarbonization goals. Since joining Greentown Labs in 2018, Michela has played a pivotal role in its growth, contributing to organizational and programmatic evolution, process improvement, team building, and more. She holds a BSc in Environmental Studies with a concentration in International Environmental Policy from the University of Vermont.

Bernard Hidier (FINSULATE USA, Director)

Bernard Hidier is the founder of FINSULATE USA by Ocean Innov Maine, a start-up developing non-toxic, durable, cost-effective antifouling solutions inspired by nature for the maritime industry. He is also the founder of Ostrea Capital, a US based independent consulting firm operating at the intersection of renewable energy and sustainable food production sectors. He is also the co-founder and president of HGY-Karrgreen, a French company dedicated to the production and distribution of green energy from organic waste and other renewable local resources. Bernard holds an MBA in Management at the ESCP Business School, in addition to a master's in finance at the London Business School.

Matthew Lackner (University of Massachusetts Amherst, Director of the Wind Energy Center, and Professor)

Matthew Lackner is the Director of the Wind Energy Center at the University of Massachusetts Amherst (UMass Amherst), the U.S.' preeminent wind energy program. This center has been at the forefront of conducting research, education, and training in wind energy. He is also the Director of the ELEVATE program, a graduate training and research program focusing on the technical, equity, and climate challenges in the energy transition. He also teaches and researchers in areas related to offshore wind energy, including topics such as wind turbine aerodynamics, load control of offshore wind turbines, floating wind turbines, and more. Matthew received his BSE in Mechanical and Aerospace Engineering from Princeton University, followed by an MSc at the Massachusetts Institute of Technology (MIT) in Aerospace Engineering. He also holds a PhD in Mechanical Engineering from UMass Amherst. His dissertation studied how wind energy site assessment could be streamlined using ground-based remote sensing devices, uncertainty analysis, wind energy economics, and decision making.

Stephanie Watson (State of Maine Governor's Energy Office, Offshore Wind Program Manager)

Stephanie Watson is the Offshore Wind Program Manager for the State of Maine Governor's Energy Officer. She coordinates Maine's various efforts to drive offshore wind energy, specifically focused on floating offshore wind. One of her recent contributions includes the publication of the Maine Offshore Wind Roadmap, documenting the State's future steps to progress floating offshore wind by 2030. Before, Stephanie fulfilled various positions within the offshore sector, from ocean policy and management consultancy to being the Associate Director at the MS RESTORE Act Center of Excellence at the University of Southern Mississippi. She holds a double MSc degree in Spatial Information Science and Engineering, and Ecology and Environmental Sciences at the University of Maine.

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