ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

Consultancy Services for The Energy Transition Partnership (ETP) of Wind Development in Vietnam

FINAL REPORT

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by

Intelligent Energy Systems (IES)

IES Intelligent Energy Systems

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ACRONYMS

BMI	Bundesministerium des Innern und für Heimat (Federal Ministry of Interior)
BNetzA	Bundesnetzagentur (Federal Network Agency)
BOE	Bureau of Energy
BOEM	Bureau of Ocean Energy Management
BSH	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)
CES	Crown Estate Scotland
CfD	Contract for Difference
COD	Commercial Operation Date
COP	Construction and Operation Plan
EBL	Electricity Business License
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ETP	Energy Transition Partnership
GIS	Geographic Information System
HRA	Habitats Regulation Assessment
ITT	Invitation to Tender
LiDAR	Light Detection and Ranging
MOEA	Ministry of Economic Affairs
MONRE	Ministry and Natural Resources and Environment of Vietnam
MOTIE	Ministry of Trade, Industry and Energy
MSP	Maritime Spatial Planning
OCS	Outer Continental Shelf
Ofgem	Office of Gas and Electricity Markets
OWE	Offshore Wind Energy
PPA	Power Purchase Agreement
PQQ	Pre-Qualification Questionnaire
RE	Renewable Energy
REDA	Renewable Energy Development Act
SAP	Site Assessment Plan
TCE	The Crown Estate
TPC	Taiwan Power Company
UNOPS	United Nations Office for Project Services
VASI	Vietnam Administration of Seas and Islands
WEA	Wind Energy Area
WindSeeG	Offshore Wind Energy Act
ZDA	Zone Development Agreements
ZoP	Zones of Potential

EXECUTIVE SUMMARY

Background

As part of the Southeast Asia Energy Transition Partnership (ETP), the United Nations Office for Project Services (UNOPS) is providing technical assistance to the Vietnam Administration of Seas and Islands (VASI) of the Ministry and Natural Resources and Environment of Vietnam (MONRE) on the identification of a decision-making criteria for evaluating proposals for the development of offshore wind (OWE) farms. The overall aims include:

1) Develop custom course material on international best practices for OWE licensing and permitting, highlight relevant design considerations for the Vietnamese context, and formulate a set of recommendations on technical and legislative criteria for reviewing and granting OWE permits for Vietnam.
2) Carry-out a two-day in-person workshop on the course material in Hanoi,
3) Produce a report on the workshop that includes a summary and key recommendations,
4) Develop a concept note that sets out a roadmap on the requirements for further technical assistance and capacity building that could support the advancement of a licensing and permitting framework for OWE in Vietnam.

Project Objectives

The immediate objective is to assist in resolving the challenges Vietnam currently faces by conducting focused research to provide international experience on some very specific questions related to acceptance of OWE survey requests:

1. Based on developer proposals to conduct surveys of sea areas, how to decide what submissions to accept given that some survey areas overlap?
    a. What criteria should be applied?
    b. If developers survey overlapping areas what issues could arise?
    c. What conditions should be included in developer permits to conduct surveys?
2. For individual survey permit requests, how to appraise the size of the sea area permitted for survey? What is the relationship between the area that is surveyed and the corresponding amount of capacity (MWs) of OWE that would be developed?
3. What would be the lower limit and upper limit of total potential OWE capacity to be surveyed to ensure that 7 GW of OWE potential could be developed by 2030 as per PDP8?
    a. Can the surveys of offshore areas be done progressively over time, in tranches?

Issue 1: Findings on Survey Areas

The approaches to managing overlapping areas observed in international practice to managing overlapping areas include:

- The government conducts high level surveys and assessments of marine areas initially, identifies appropriate non-overlapping areas, and then offer the areas to developers for carrying out more detailed surveys leading to OWE project feasibility studies. The surveys that governments carry out will not be as comprehensive as the would be required by a developer to do a full feasibility study of an OWE project but provide a general indication of feasible areas for OWE development and form the basis of managing marine areas for OWE development. The government-led approach means the government will need to incur the cost of carrying out the surveys, and the government will need to establish the expertise necessary to manage the data and information necessary to make informed decisions about suitable areas for the developers to later consider.
- Where the government allows developers to conduct surveys from the beginning, the options are:
  - Do not allow developers to proceed with survey areas that overlap, where the following general approaches have been implemented in practice:
    - Priority is given to the first developer that proposes an area,
    - Priority is given to the developer that best satisfies some pre-defined conditions such as the one that will have the minimal impact on the ecosystems and environment.
  - Or allow survey areas to be overlapping, but have a process by which to resolve overlapping areas based on the findings and results of developers, with the following approaches been observed in practice:
    - Require the developers with overlapping areas to propose a division of the area where each developer can focus on a sub-area prior to commencing the surveys,
    - Allow developers to proceed with surveys in overlapping areas but make them aware that the government will ultimately require any proposed OWE projects to be developed in areas that are not overlapping, and the government reserves the right to break the areas up as needed for project development.

A disadvantage of having overlapping areas being surveyed by developers is having twice (or more) similar processes of collecting samples and running measurements which increases the impact on the environment, and the need for ensuring a higher level of coordination in the operations of developers in conducting the surveys. On the other hand, if two or more developers are surveying the same area, then the government will gain the benefit of having two (or more) opinions on the potential and viability of OWE development in the overlapping areas.

A final approach that could be considered to reduce instances of overlapping survey areas would be to break the process down into several stages, where for example:

- Stage 1 initially avoids the selection of overlapping survey areas and has a focus on identification of an initial amount of capacity (in Vietnam's case: 7GW – 4 GW in the North and 3 GW in the South), and
- Stage 2 could be done following some work by the government on identification of suitable areas and selecting the applications that are consistent with the government's preferred areas and invite developers to only submit applications for the areas that the government has defined (and select the most suitable applications in each area).

In Stage 1, if there is a concern about competition, then competition could be achieved by ensuring say 10-20 non-overlapping areas are surveyed. This will mean competition will be achieved by having developers looking only at non-overlapping areas rather than having competition to identify wind projects within the one area from multiple developers.

Selection approach for site lease: competitive bidding

International practice suggests that another way of resolving multiple developers being interested in developing OWE projects in the same area is to carry out a competitive auction process for the award of a lease. Various methods / approaches can be implemented ranging from: sealed bidding auctions, ascending bidding auctions, two-stage bidding, and multifactor bidding. The selection criteria need to consider technical and environmental impacts of projects, as well as the expected operating cost of the OWE project that will ultimately be developed. Such approaches depend on the government already deciding on lease areas though, and so they are only relevant to the situation where the government has already conducted some level of surveys themselves as shown in our review of international examples.

Timing / duration of surveys

Surveys generally take 2-3 years to complete. The development time of an OWE project itself once a suitable location has been identified is about 2-3 years as well. Therefore, the lead time of about 4-6 years of surveying and project construction needs to be factored into power development planning processes to have realistic timeframes for integration of OWE projects. These lead times do not consider any additional time that may be required for government approvals or internal assessments, hence in Vietnam's case, the importance of commencing surveys soon, to reach the desired levels of OWE capacity identified in PDP8 by 2030.

Survey data management and sharing

Under the government-led approach, the government can make all data and information they have collected available to developers before they carry out more detailed surveys. This can help to narrow the survey areas of the developer.

In situations where developers conduct the surveys from the beginning, then it is likely that the data and information that the developer collects will be more targeted towards an OWE project and construction approaches that the developer will use for the project, and the data may be of less interest or use to the government or another developer. The developer will also incur high costs in carrying out the surveys and would seek compensation for the data and information that is collected.

One approach that could be pursued would be for the government to define some key basic data that the developer is required to provide to the government as a condition of carrying out a survey – this could be limited to wind speed measurements and information on the seabed, but other data that is highly specific to a project could be left as the developer's own resource.

Issue 2: Findings on Appraising Survey Areas

The GW potential identified in a survey area is difficult to determine with high precision prior to carrying out surveys as there are many uncertainties that impact the feasibility of developing an OWE project within a given marine area and hence the overall OWE potential of a given area. Of a large survey area, typically only a small subset of it can meet all the requirements to be developed into an operational OWE project. The purpose of a survey is to determine the most feasible areas within the large survey area with greater accuracy what the OWE potential is for certain subareas within the surveyed area.

Based on the real-world data from the 50 largest OWE projects, the capacity of an OWE project in the range of 200-500 MW, typically could be developed in an area in the range of 30-100 km^2. As such, a survey area that is of size 200-500 km^2 say, so long as it has high wind speeds (using best available data – which in Vietnam's case may be limited to Global Wind Atlas) and so long as exclusion areas (such as marine systems, shipping lanes/trade routes/fishing zones, unsuitable bathymetry results, etc.) have been removed and are not too significant, then it would be reasonably expected to yield a project of at least 500 MW.

Accordingly, for Vietnam to reach the 7GW level, then this would imply running say up to 20 surveys of area of 500 km^2 each for a total of around 10,000 km^2 of survey area would yield up to 10 GW of OWE (500 MW x 20 surveys = 10 GW). However, it must be noted that this is subject to many uncertainties and depends very much on exclusion zones, the results of real-world wind measurements, the findings of real-world bathymetry, and findings from geotechnical works. Nevertheless, it would be consistent with areas and capacities that have been observed in OWE projects that have been developed in other countries. Thus, as suggested in response to Issue 3, a staged approach over time warrants careful consideration.

Issue 3: Findings on the Lower and Upper Limits of Surveys

Developers in their applications for surveying an area will present an estimated OWE potential that will be based on judgments, data, and information that the developer has been able to obtain on Vietnam's marine areas, and on the application of expert judgment. The potential that is estimated will be subject to a raft of factors that are not knowable until the survey has been undertaken and so the estimated potential may be higher or lower than the developer anticipates.

International experience suggests that to achieve a desired MW level of potential, it is generally better to survey marine areas in an ongoing / rolling process of identifying MW potential, rather than taking a "single shot" which exactly identifies some desired GW target for OWE potential. As more surveys are conducted over time, more viable areas and more OWE potential can be found. Furthermore, experienced gained in an initial round of surveys can be used to fine tune expectations of surveys conducted at a later stage. Most countries pre-evaluate their areas and then set the development/GW targets for the coming years. Having an iterative approach can help with that, since if the expected or required capacity cannot be met by the initially surveyed areas, further/additional rounds of surveys can build upon the first round's information and help reach the desired capacity. Once that capacity is reached, realistic targets can be set for the coming years and the surveyed areas can be leased out to interested developers.

Based on international experience, it is suggested that to address the issue of determining a prespecified GW potential target for OWE, Vietnam undertakes a staged approach to developing the potential, which can manage the risk of surveys falling short of expected MW potential. The approach could be to commit to say 10 surveys initially but require the developers to report on their "best estimate" of potential based on findings to date every 6 months. If the developer's potentials are falling below the levels anticipated, then Vietnam could trigger another round of surveys. Over time, the uncertainty associated with achieving a desired MW potential will reduce, and at the same time, Vietnam will gain greater insight into the relationship between a developer's expected potential and the real MW potential that is identified.

Conclusion

Subject to the successful completion of OWE surveys in a timely manner, Vietnam's goal of developing 7 GW of OWE by 2030 is an achievable target. In this report, three general issues that have been raised by Vietnam in connection to the appraisal of developer applications of surveys have been considered with comparisons given to international practices. In general, allowing developers to carry out an initial round of surveys to identify the most feasible areas for OWE development is a reasonable starting point as it will enable the survey work to be commenced quickly, it will leverage the expertise of developers and the government will avoid the high cost associated with conducting the surveys. Furthermore, given that surveys generally take 2-3 years

to complete, and the construction of an OWE project taking at least another 2 years, then it will ensure the 2030 target in the PDP8 will be achieved.

The overriding recommendation that we make is that an iterative process be adopted to for the surveys, which will firstly address the uncertainty associated with identifying OWE potential within a proposed survey area and it secondly, it will allow Vietnam to gain experience in OWE surveying and OWE project development. If a staged approach is adopted, then it would be possible to commence selecting say 10 to 20 survey applications from developers that have non-overlapping areas initially and require the developers to report on the potential that they have identified every 6 months over the 2–3-year period that surveys take. Based on the results, Vietnam could then proceed with another round of surveys after 6-12 months. This process could be continued until the PDP8's target of 7 GW is identified with better accuracy as compared to present. As there is no harm in exceeding the 7 GW target, any OWE potential that is identified beyond the 7 GW could be used either for the PDP8's longer-term OWE target of 54 GW by 2045, or it become an important input into future revisions of the PDP, which could consider the benefit of increasing the OWE targets.

In parallel carrying out say 2 or 3 rounds of developer-led surveys, it is recommended that Vietnam improve their capacity in OWE surveying and OWE project development, and for the government to consider a longer-term transition towards a system of identifying preferred marine areas and establishing a leasing system. This would bring Vietnam's approach more in line with the approaches used in several international examples that have been considered in this report, namely South Korea and the UK, where they started with a developer-led approach but ultimately transitioned to a government-led model as more expertise had been gained. Having a centrally managed survey process to identify preferred marine areas would be more suitable for running competitive auctions where OWE developers would be put into competition to secure the rights to a lease area.

Next Steps

Based on the understanding of Vietnam's current position with regards to OWE, the recommended next steps that should be taken to ensure that the country can make the most its OWE potential are:

1. Review the governance and institutional arrangements in Vietnam and compare to other countries that manage the OFE surveys and OFE project development process,
2. Develop a more explicit methodology for ranking and prioritising the survey applications, including a scoring system,
3. Formulate a strategy for Vietnam's management of OWE surveys and develop the process steps for future governance of the leases and permits for developers,

4. Undertake in doing a comprehensive review of the legal framework for OFE and formulate enhancements to it,
5. Review and assess previous OFE potential assessments and assist in desktop based OWE zoning, assuming GIS layers and information would be available, and
6. Undertake training and capacity building in OFE development.

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1 INTRODUCTION

1.1 Our Understanding of the Project

As part of the Southeast Asia Energy Transition Partnership (ETP), the United Nations Office for Project Services (UNOPS) is providing technical assistance to the Vietnam Administration of Seas and Islands (VASI) of the Ministry and Natural Resources and Environment of Vietnam (MONRE) on the identification of a decision-making criteria for evaluating proposals for the development of offshore wind (OWE) farms. The overall aims include:

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2) Carry-out a two-day in-person workshop on the course material in Hanoi,
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1.2 Background

The emergence of largescale OWE remains in preliminary planning phases in Vietnam. A recent detailed appraisal of technical potential for off-shore Wind conducted by the World Bank in their 2021 study Offshore Wind Roadmap for Vietnam. This study indicated a total off-shore Wind technical potential of 599 GW for Vietnam, of which 261 GW is fixed capacity and 338 GW is floating capacity. The off-shore roadmap report indicates that a high-growth scenario for Vietnam can see the integration of 40 GW of OWE by 2040, which would deliver almost 30% of electricity in the Country's energy mix.

PDP8 indicates that there will substantial deployment of Wind energy in Vietnam's power system in all scenarios. In the base scenario, 7 GW of offshore wind will be developed from 2021-2030. By 2045 up to 54 GW of off-shore Wind is projected to be built in the base PDP8 scenario. In the advanced renewables scenario, up 74 GW of offshore Wind would be developed by 2045.

The Binh Thuan province has been highlighted in PDP8 as having robust potential for the development of off-shore Wind energy. Around 2200 MW of off-shore Wind is planned in the province over 2026-2030, and an additional 2800 MW from 2031-2035, totalling 5 GW. By 2045 PDP8 expects about 21 GW of total off-shore Wind development in the Binh Thuan – Ninh Thuan region.

Despite the robust potential and significant plans for development, a specific technical and legislative / regulatory framework for issuing permits and governing the development and operations of OWE in Vietnam has yet to be formulated.

1.3 Current regulatory / legislative landscape for OWE in Vietnam

Some examples of key pieces of legislation for OWE in Vietnam include:

- Law of the Sea of Vietnam dated 21 June 2012,
- Law on natural resources and environment of sea and islands dated June 25, 2015,
- Law on Planning No. 21/2017/QH14 dated 24 November 2017,
- Decree No. 11/2021/ND-CP dated 10 February 2021 of the Government stipulating the assignment of certain marine areas to organizations and individuals exploiting and using marine resources:
- Decision No. 37/2011/QD-TTg dated 29 Jun 2011 – implemented initial FIT mechanism for all Wind projects, as well as offered preferential licensing treatment, such as exemptions on corporate income taxes and land lease taxes and/or usage fees.
- Decision No. 39/2018/QD-TTg dated 10 September 2018 – revised the FIT structure and classified a legislative / regulatory distinction between on-shore and off-shore wind plants. Also set other stipulations on land use, resource management, and construction processes.
- Circular No. 02/2019/TT-BCT dated 15 January 2019 – update of guidelines for Off-shore Wind project developments, including requirements for receiving permits, data collection and testing from EVN/ERAV, safety requirements for maintenance, reduced land use rates, and setting of tariff negotiation processes with EVN.
- Report No. 2419/BCT-DL – Indicated the intention of MOIT to switch to a competitive building/auction mechanism for Wind in Vietnam beyond 2023.
- Document No. 8159/BCT-DLL (November 2021) – Alternative tariff rates offered for Off-Shore Wind projects.

Overall, there has been some progress in involving OWE as a distinct category of wind energy. However, there is an identified need for further designing a permitting system and technical criteria for new project developers in Vietnam.

2 SCOPE OF WORK

2.1 Current challenges

Vietnam's PDP8 seeks to develop around 7 GW of Offshore Wind Energy (OWE) by 2030, and another 54 GW by 2045. The World Bank has projected the OWE industry to increase in Vietnam in the coming years, with projections for 2050 showing a potential capacity of up to 70 GW.

To achieve this, Vietnam needs to carry out surveys of the offshore areas to identify where OWE can be feasibly developed. Vietnam's current approach to this is to grant developers exclusive seabed lease to carry out surveys covering a sufficiently large enough area of sea to enable the government to make an informed decision about the areas that would be the most suitable for OWE development.

Developers have submitted proposals for carrying out surveys. Since the survey permit does not automatically permit the said developer to carry out construction and operation in the surveyed area, the government's current challenge is to decide which developer proposals should be selected.

2.2 Objectives of the project

The immediate objective is to assist in resolving the challenges Vietnam currently faces by conducting focused research to provide international experience on some very specific questions related to acceptance of OWE survey requests:

1. Based on developer proposals to conduct surveys of sea areas, how to decide what submissions to accept given that some survey areas overlap?
    a. What criteria should be applied?
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2. For individual survey permit requests, how to appraise the size of the sea area permitted for survey? What is the relationship between the area that is surveyed and the corresponding amount of capacity (MWs) of OWE that would be developed?
3. What would be the lower limit and upper limit of total potential OWE capacity to be surveyed to ensure that 7 GW of OWE potential could be developed by 2030 as per PDP8?
    a. Can the surveys of offshore areas be done progressively over time, in tranches?

3 ISSUE 1: SURVEY AREAS

3.1 Statement of the Issue

The problem is concerned with how to resolve situations where multiple OWE developers propose to conduct surveys in the same marine area, or if a developer proposes to survey an area that is overlapping – what approach or approaches can be used to address this.

3.2 International Experience

The approaches used in other countries can be broadly categorised into:

- Government-led approaches
- Developer-led approaches

Government-led approaches tend to be more common, although the level of detail in which the surveys are done is less than what a developer would do. The government, being responsible for surveys of all offshore marine areas can then by default break them up into lease areas and avoid the issue of having overlapping areas. However, such surveys serve as the first stage of the OWE planning with regards to the site selection and often government-led approaches do not go to the same level of depth as a developer survey would.

Developer-led approaches have allowed developers to specify the area to be surveyed based on their own preference or knowledge. An area identified by a developer will leverage their expertise in development of OWE projects and over the course of completing the survey they will be able to narrow parts of the survey area down to those that will likely yield the best results for OWE developments.

Common international practice for the government-led surveys is to either undertake the task themselves or to recruit specialist consulting firms to undertake the surveys on their behalf, typically for all offshore areas where OWE could be feasible. The surveyed areas are then divided into zones and the private developers are permitted to conduct their own assessments of the areas and develop proposals for OWE projects.

The steps in the process are typically involve the following:

- Surveys of all key ocean areas done by government
- Government appraises, prioritizes, and assesses the areas surveyed – primarily considering the energy production potential and the impact on ecosystems & environment
- Surveyed areas are then divided into a smaller number of “zones” (or license areas) that are the most suitable for OWE
- Data for zones is then made available to interested developers who can develop OWE project proposals, or possibly carry out additional assessments of their own to supplement the government’s surveys

- OWE project proposals are then evaluated like any other power project – using a competitive selection process, or other process of negotiation, after which the winning developer is granted a permit or license to construct and operate the OWE based on their proposal in the zone of interest

The approach taken in some of the other countries is described below:

3.2.1 Germany

Germany's Federal Ministry of Interior (BMI) is responsible for developing the maritime spatial planning (MSP) plans that are used as the references for selecting the sites for OWE development. The MSP are developed to guide and support sustainable development while considering the social and economic requirements of the region and the country, while also keeping the environmental needs in mind. The primary objectives of the MSP are as follows[1]:

- Setting the binding requirements for the development, organisation, and safeguarding of space, and
- Helping prioritise the areas based on their uses and functions

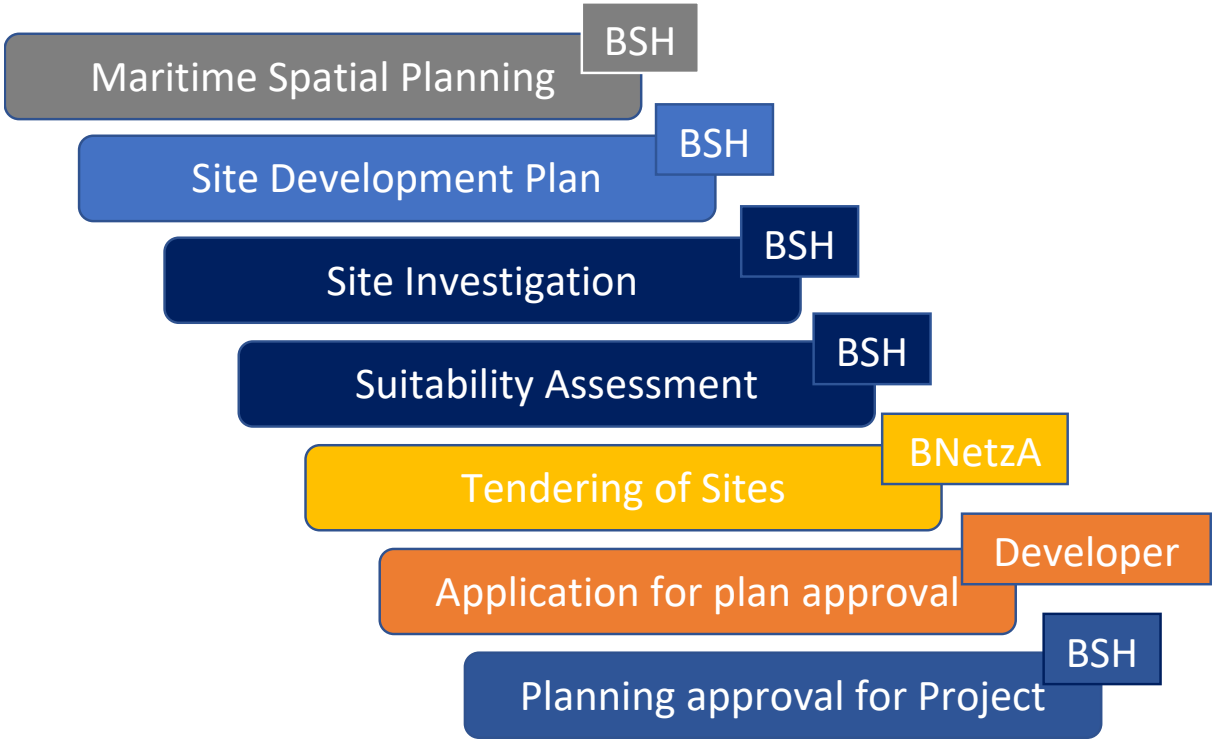
The current MSP plans in Germany cover the following factors:

- Shipping/Navigation routes
- Wind Energy at sea
- Cables and pipelines
- Raw material extraction
- Fisheries and aquaculture
- Scientific uses
- Protection and improvement of the marine environment
- National and NATO defence
- Air traffic
- Recreation
- Underwater cultural heritage

The BMI then consulted with their Federal Maritime and Hydrographic Agency (BSH) to divide the surveyed area into different zones for the development of OWE based on the power generation potential that they offered. The BSH is the main agency responsible for the rest of the process, which can be broken down into the following steps:

[1] https://maritime-spatial-planning.ec.europa.eu/sites/default/files/download/germany_february_2022.pdf

Figure 1 Site Development and Investigation timeline set by the BSH in Germany[2]



BSH investigates specific sites within the zones for data that can be broadly categorised into the following:

- Subsoil
- Wind
- Marine Environment
- Oceanography
- Navigation
- Procedure

Each of the above have multiple other specifics of data, such as the geological models, sediment samples, meteorological data models, navigational risk assessment, suitability examinations, etc. that the BSH collects as part of its preliminary investigation. This information is made available for the interested developers to consider when applying for tenders for those areas[3]. The German law stipulates that the entire preliminary investigation is required to be completed at least one year before the start of the auction for the site to give the interested parties enough

[2] BSH – Site Development Plan 2020 for the German North Sea and Baltic Sea [https://www.bsh.de/EN/TOPICS/Offshore/Sectoral_planning/Site_development_plan/_Anlagen/Downloads/FEP_2020/Site_Development_Plan_2020.pdf?__blob=publicationFile&v=2]

[3] BSH – Data Hub Preliminary Investigation of Sites [https://pinta.bsh.de/?lang=en]

time to analyse the provided data. The winner of the tendering process is free to use the data provided by the government or can conduct their own surveys at the site prior to the construction.

The German WindSeeG has made changes to the tradition reverse auction process by which the leases for the offshore wind development areas were typically distributed. Two types of auctions have been established, depending on the area for which it is being conducted. The types of auctions are as follows[4]:

- The sites that have been pre-evaluated by the government and zoned depending on their wind energy potential will have a point-based auction with specific criteria that the interested developers will be required to fulfil. The 100 possible points are divided as:
  - 60 points are based on their competitive bidding price
  - 40 points are based on the following:
    - Use of green electricity and green hydrogen in the production of wind turbines
    - Education and training quota
    - Conclusion of a power purchase agreement (PPA)
    - Biodiversity and nature protection in the installation process of the OWE project

  The inclusion of criteria other than the bidding price shows the importance that the country is placing on the non-economic factors as well as the protection of the environment while also supporting the development of renewable energy
- The sites that have not been pre-evaluated by the government (BSH) can also be bid upon by interested developers if they themselves identify/recognise the potential that the areas hold. However, this auction is based on negative bidding, where the developer is required to pay the government to develop the specific areas, with the most negative bid (meaning the most revenue for the government) winning the lease. Ideally the negative bids are to be conducted with a price cap on the negative bid amount, but Germany has not yet decided on the cap.

3.2.2 United States of America

The United States' Federal Bureau of Ocean Energy Management (BOEM) is the principal agency responsible for the study and analysis of the country's marine areas with offshore wind energy potential. Although the BOEM pre-evaluates the areas that are then leased, the lessee is required to conduct surveys/assessments of the leased area to formulate a detailed site assessment plan (SAP) and a construction and operation plan (COP), both of which are submitted to the BOEM.

[4] Wind Europe – Negative Bidding in German offshore wind law threatens supply chain [https://windeurope.org/newsroom/press-releases/negative-bidding-in-german-offshore-wind-law-threatens-supply-chain/#:~:text=Germany's%20new%20offshore%20wind%20auction,for%20sites%20not%20pre%2Ddeveloped.]

The BOEM then conducts technical reviews of these plans and, if required, can either ask for more information or approve/reject the application for the construction in the leased site.

The BOEM maintains large databases of information that are valuable in the process of siting an OWE project/installation. The BOEM relies on the information that has been collected in these surveys for at least the preliminary selection of the call areas, and it also encourages the interested developers to use this information as it is made publicly available through Data Portals that are accessible through the government websites. Some of the important databases are listed below:

- Spatial Data for Site Characterization Surveys: This survey has covered the Atlantic Outer Continental Shelf (OCS) and provides a framework for the submission of spatial data from the site characterization surveys.
- Avian Information: Covers the entire country's OCS and is often updated as new information and methods become available. It has been developed in coordination with the US Fish and Wildlife Service along with stakeholder engagements.
- Archaeological and Historic Property Information: Provides guidance about archaeology and historic property identification surveys. The latest version includes recommendations for surveys specific to submissions for SAPs, as well as the use of a gradiometer to improve identification and reduce false positives.
- Geophysical, Geotechnical, and Geohazard Information: Provides guidance geophysical, geotechnical and geohazard surveys. In addition to helping the BOEM in the siting of the potential areas, these are intended to help the applicant gather information about the plan that they develop for the application.
- Fisheries Information: This surveyed information, for now, only covers the Atlantic OCS and provides recommendations for information regarding the fishing practices in the chosen project areas.
- Benthic Habitat Information: This provides information about the benthic habitats in the Atlantic OCS.
- Marine Mammal and Sea Turtle Information: The guidelines provide recommendations for providing information about the impacts that the OWE projects in the Atlantic OCS can have on the marine mammals and sea turtles.

The BOEM has set the following broad timeline for the conduction of all the relevant surveys as shown in Figure 2[5].

[5] BOEM – Data Collection and Site Survey Activities for Renewable Energy on the Atlantic OCS [https://www.boem.gov/sites/default/files/documents/renewable-energy/OREP-Data-Collection-BA-Final.pdf]

Figure 2 Duration of phases involved in BOEM's Wind Energy Planning, Survey, and Authorization processes[6]

Typically, the BOEM grants leases to pre-evaluated WEAs through a competitive bidding process. The lease provides the lessee the right to occupy and investigate the leased area, and subject to further approvals, install, and operate facilities in the leased area for commercial activities or other activities that support or are relevant to the production of RE. The process of competitive issuance of leases is as follows[7]:

- **Step 1**: Call for Information and Nominations: BOEM publishes calls for information and nominations in the Federal Register with a comment period of 45 days. Interested parties are invited to comment on areas that should receive special consideration and analysis.
- **Step 2:** Area Identification: BOEM consults with the appropriate federal agencies, states, local governments, affected tribal communities, and other stakeholders to identify areas for environmental analysis and consideration for leasing.
  - This is based on the BOEM's own knowledge about the areas as well as the comments about nomination/consideration received in the first step.
  - The effect of the lease on the human, marine, and coastal environments is evaluated, leading to measures to help mitigate said impact, including lease stipulations
  - BOEM consults with experts to develop measures, including lease stipulations and conditions specific to each area, to mitigate the adverse impacts on environment.
  - Public hearings are also held to discuss the environmental analysis
- **Step 3**: Proposed Sale Notice: BOEM publishes a Proposed Sale Notice in the Federal Register for invites comments from relevant stakeholders within a period of 60 days.

[6] Source: BOEM – Data Collection and Site Survey Activities for Renewable Energy on the Atlantic OCS [https://www.boem.gov/sites/default/files/documents/renewable-energy/OREP-Data-Collection-BA-Final.pdf
[7] Legal Information Institute – Issuance of OCS Renewable Energy Leases [https://www.law.cornell.edu/cfr/text/30/part-585/subpart-B]

- **Step 4**: Final Sale Notice: Final Sale Notice is published in the Federal Register at least 30 days prior to the date of the sale.

A competitive auction process is used to award the lease, but the type of competitive auction used can vary per the details of each sales notice. The types of competitive auctions used by BOEM are shown in Table 1[8].

Table 1 Types of auctions used in the USA

Type of Auction	Bid Variable	Bidding Process
Sealed Bidding	A cash bonus or an operating fee rate	One sealed bid per company per lease or packaged bidding unit.
Ascending Bidding	A cash bonus or an operating fee rate	Continuous bidding per lease.
Two-stage Bidding (combination of sealed and ascending bidding)	An operating fee rate in one, both, or neither stage and a cash bonus in one, both, or neither stage	Ascending or sealed bidding until: (i) Only two bidders remain, or (ii) More than one bidder offers to pay the maximum bid amount.
		Stage-two sealed or ascending bidding commences at some predetermined time after the end of stage-one bidding.
Multi-factor Bidding	Factors may include, but are not limited to technical merit, timeliness, financing and economics, environmental considerations, public benefits, compatibility with State and local needs, cash bonus, rental rate, and an operating fee rate	One proposal per company per lease or packaged bidding unit.

3.2.3 South Korea

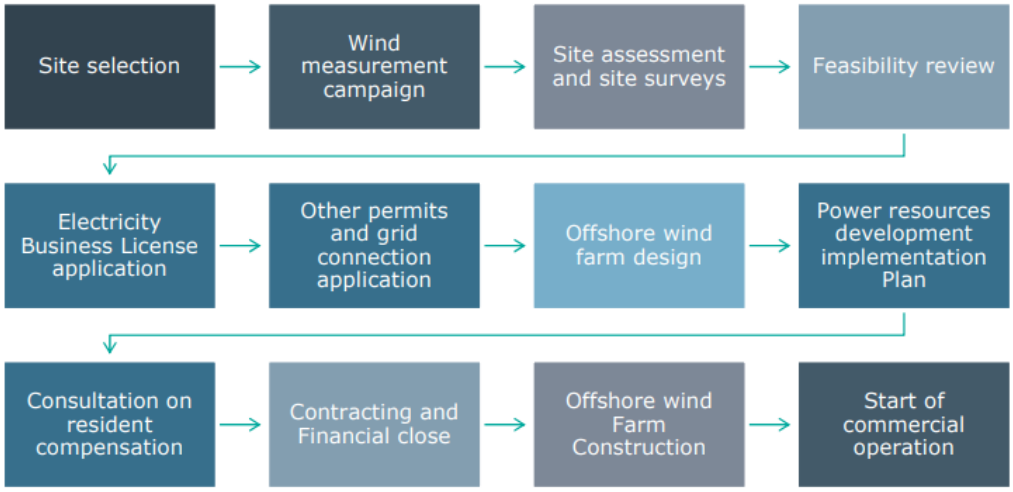
South Korea is an international case which initially adopted the developer-led approach for OWE surveys but then transitioned to the centrally government-managed model. About a decade ago when OWE developments was relatively new, with few projects and applications being submitted to the Ministry of Trade, Industry and Energy (MOTIE), the developers were responsible for the site selection and surveying, either by themselves or with the aid of consultants. At that point,

[8] Legal Information Institute – What bidding systems may BOEM use for commercial and limited leases? [https://www.law.cornell.edu/cfr/text/30/585.221]

the government was not fully aware of the potential that OWE possessed. However, as OWE was slowly internationally recognised as a high-potential source of power for reducing the dependence on fossil fuels, and more developers started showing interest in OWE farms, the South Korean government started taking a more proactive approach towards the development of this technology.

The overall roadmap of an OWE project from site selection to commissioning can be seen as:

Figure 3: OWE project development process/roadmap in Korea[9]



Korea initially had an "open-door" policy and procedure for the development of OWE projects where a project developer initiated the establishment of the project and undertook all the responsibilities for the development procedures necessary to complete the project. It involved the conduction of all the activities required for the development of a project such as the site selection, site verification, application for the necessary approvals and permits, attending to the complaints and doubts of the local communities and industries, etc.

Developers are granted four-year periods of exclusivity starting from the grant of the permit to install the meteorological equipment to measure the wind patterns. Some of the important features of the area that are investigated include:

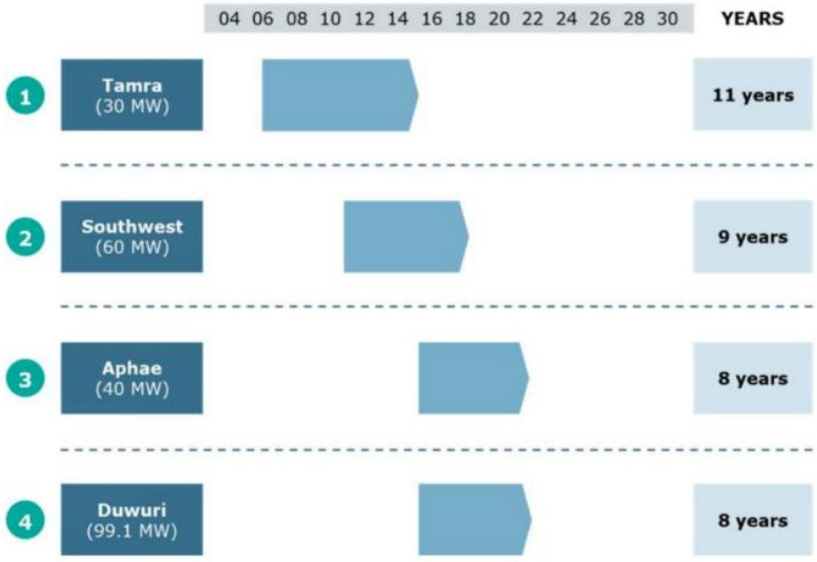
- Offshore wind resource measurement through met masts or floating LiDAR for a period of two years.
- Environmental Impact Assessment – usually through consultants
- Grid connection review
- Wind farm layout plan and model

[9] COWI – Accelerating South Korean Offshore Wind Through Partnerships [https://www.cowi.com/-/media/Cowi/Documents/Accelerating-Offshore-Wind]

After the completion of the wind measurement campaign, the developer applies for the Electricity Business License (EBL) which is the first permit required before continuing with other permits required in the process. During the four-year exclusivity period, the MOTIE does not grant EBLs to any other developers for the same "effective area," which is defined by MOTIE as an area of 100km^2 per piece of measurement equipment permitted.

Figure 3 showed the various major steps involved after acquiring the EBL prior to an OWE project being operational. Figure 4 below gives an idea of the time it can take from the grant of the EBL to the COD of four Selected offshore wind projects in South Korea[9].

Figure 4 Development timeline from acquiring EBL to COD[9,10]



The government has undertaken the following steps to make the development of OWE projects easier in the country:

- Collaboration with the Korea Cadastral Survey Corporation to develop a marine cadastral map that helps identify the marine areas with OWE potential, and with a coordinated marine spatial planning approach.
- Designation of zones within the high OWE potential areas and conducting feasibility studies to determine the size of the OWE projects that can be safely constructed there. Some of the important surveys include for the chosen areas include:
  - Wind Assessment: Currently done with LiDAR and can take up to 24 months to create detailed wind pattern charts if no previous information that that area exists.
  - Environmental Assessment: A vital step to ensure that there are no vulnerable species of flora or fauna in the chosen area

[10] NB: Correction – the name of the fourth project is Duuri.

  - Shipping and Fisheries: South Korea's fishing industry is a major contributor to the country's economy which makes the local fisheries important stakeholders in any OWE project. They are involved in the discussions about the OWE areas and, and if necessary, the government can mandate profit-sharing rules for the developers that develop in specific areas.
- Establishment of a "one-stop-shop" for all the information, permits, and other approvals regarding the OWE projects. This is an important step as it removes the long bureaucratic process that developers are otherwise required to go through which can lead to delays in the projects.
- The government has also introduced plans to develop critical support infrastructure that can help the development of OWE projects such as support docks, demonstration projects, as well as domestic manufacturing and training facilities to promote the domestic manufacture of equipment required for OWE projects.

3.2.4 United Kingdom

The United Kingdom is one of the leaders in the world in terms of OWE capacity. The country had identified and capitalised on the potential of OWE just near the turn of the millennium, which was much earlier than other countries. The Crown Estate (TCE) is the authority responsible for the leasing of the areas for OWE projects in UK, except for Scotland where it is the Crown Estate Scotland (CES). The process of obtaining a lease is the same, be it the TCE or the CES, and requires the interested developers to submit their applications for the seabed lease as well as different consents relevant to their project's specifics.

The TCE/CES had undertaken the task of identifying the areas in the UK waters most suitable for the development of OWE projects. The main steps of the process were as follows[11]:

- **Round 1**: Began in 2000 and involved small-scale pilot sites (18 sites of up to 30 turbines, each covering an area of 10km2) that were heavily subsidized to help boost the uptake and interest in the technology. The leases were prescriptive, with the TCE knowing precisely where each of the projects was to be located.
- **Round 2**: Involved larger commercial-scale development (15 sites with a total capacity of 7.2GW) and was much less prescriptive. Three zones were identified for this large-scale development and the areas required individual surveying by each project developer.
- **Round 3**: In 2009, a total of nine development zones were identified, up from the three in the earlier round. In each zone, a developer or consortium of developers were awarded exclusive rights over the zone – Zone Development Agreements (ZDA), and they were then

[11] https://www.researchgate.net/publication/48776379_Early_experiences_with_UK_Round_1_offshore_wind_farms

responsible for carrying out further surveys and submitting multiple site-level project proposals within each zone.

- **Round 4**: This was built on the details of Round 3, with the addition of four more development zones, and an additional 7GW (or up to 8.5GW) of capacity being awarded.

The Round 4 is currently underway to find developers willing to invest in and develop OWE projects for the capacity and areas made available for development. The Round was developed over a period of 18 months in which the TCE consulted with experts from the industry and engaged with relevant stakeholders, keeping them in the loop to seek their feedback while allocating areas for lease. The TCE conducted the following activities before starting the leasing process[12]:

- TCE identified 18 seabed regions with that could support OWE capacity of about 6GW.
- Initial spatial analysis was conducted in the 18 areas over a period of five months to identify the most technically viable and least constrained areas of seabed for OWE development.
- Stakeholders were invited to provide their feedback over the spatial analysis as well as the pre-identified regions.
- Using data from the spatial analysis and the feedback, the areas of interest were refined to nine regions with depths ≤60m that could support OWE projects of up to 7GW.
- Over the next six months, more detailed spatial analysis and stakeholder engagement was conducted to refine the areas of interest. Reasons for excluding some areas include:
  - Ministry of Defence ranges and exercise areas
  - Potential visual sensitivity within 13km of shore
  - Overlap with busy shipping routes
  - Major consenting risk due to cumulative environmental impacts, particularly ornithological.
- A robust and fair leasing process was designed and launched in late 2019.

The leasing process was through selective a selective bidding process consisting of five stages that are briefly described below:

1. Pre-Qualification Questionnaire (PQQ): Made available to all interested developers to assess the potential bidders' technical experience, financial capabilities, and legal compliance. The selected bidders pre-qualify for the next stage.

[12] The Crown Estate – Offshore Wind Leasing Round 4 Delivering a low carbon future [https://www.thecrownestate.co.uk/media/3921/guide-to-offshore-wind-leasing-round-4.pdf]

2. Invitation to Tender (ITT) Stage 1: Additional information and documents were requested from the pre-qualified bidders to assess their financial and technical strengths. Projects were selected in 2020 and declared "Eligible" for the ITT Stage 2.
3. Invitation to Tender (ITT) Stage 2: A multi-cycle bidding process took place, with the first phase being the issuance of the ITT Stage 2 tender documentation in late 2020, and the second being the Bidding Cycles in early 2021. A total of six proposed projects were won tenders for a cumulative capacity of just under 8GW.
4. Plan-Level Habitats Regulation Assessment (HRA): This step recently concluded with the TCE having undertaken the HRA in its role as a competent authority, and it considered the potential impacts of the above projects on the protected areas, habitats, and species around the UK.
5. Agreement for Lease: After the agreement from the Department for Business, Energy and Industrial Strategy and the lack of any objections from the Welsh government, the Round is currently in the stage of drafting the Wind Farm Agreements for Lease.

The indicative timeline for the projects in Round 4 is represented in Figure 5 below[12].

Figure 5 Indicative timeline for TCE's Round 4 projects[12]

It is interesting to note that the UK's energy regulator, Ofgem, also runs a separate competitive tender to operate the offshore transmission assets, which are assigned to the successful bidder once the OWE project is operational.

3.2.5 Taiwan

Taiwan has some of the most aggressive renewable energy targets in the world, set by its Ministry of Economic Affairs (MOEA) within the provisions of their Renewable Energy Development Act (REDA). Taiwan has set a target of having a total of 45GW of renewable energy by 2030, with 14.7GW of offshore wind energy by 2031[13, 14].

The government's plan for the development of OWE is divided into three phases[15]:

[13] https://www.energy-storage.news/taiwan-will-need-at-least-9gw-of-energy-storage-by-2030/
[14] https://www.rechargenews.com/wind/taiwans-new-policy-can-turn-it-into-a-major-regional-offshore-wind-hub/2-1-1010192
[15] Taiwan Offshore Wind Farm Projects – Jones Day White Paper [https://www.jonesday.com/-/media/files/publications/2021/08/taiwan-offshore-wind-farm-projects-update/files/taiwan-offshore-wind-farm-projects-white-paper/fileattachment/taiwan-offshore-wind-farm-projects-white-paper.pdf]

- **Phase 1**: Demonstration Phase (2013 – 2020):
  - The objective was to have two demonstration turbines commissioned by 2016 and three wind farms commissioned by 2020.
  - The government provided subsidies up to 50% of the installation fees for the turbines, and up to UDS 8.3 million for the capex of the two pilot turbines.
  - Two wind farms were constructed, one with a total capacity of 128MW and the other with 109.2MW and both are currently operational.
  - These projects helped confirm the feasibility of OWE in terms of administration, technology, and finance.
- **Phase 2**: Transition Phase (2015 – 2025):
  - In 2015, Taiwan's Bureau of Energy adopted the strategy that was used by Germany and the UK and realised that zoning their marine areas was crucial in the development of offshore wind energy16.
  - The BOE released 36 zones of potential (ZoP) for the development of future commercial wind farms.
  - The interested developers were required to submit an EIA to the BOE. The objective was to fast track the process by having the applicants obtained their preliminary EIA approval by 2019 and establishment permits by 2019.
  - A total of 5.5GW was allocated to developers, with 3.8GW being given awarded through a selection process and 1.7GW being allocated through an auction held by the Taiwan Power Company (TPC).
- **Phase 3**: Zonal Development Round (2026 – 2035):
  - The government plans to develop 15.GW capacity each year from 2026 onwards for 10 years, with the first phase from 2026 to 2031 being allocated 9GW and the remaining years 6GW.
  - The developers will be able to select their sites of interest from the zonal information that the BOE will be making available for them to decide.
  - The applications for the first period from 2026-2027 are to be selected in 2022 through a points-based qualification process.

Thus essentially, the government pre-evaluates the areas with potential for OWE projects and conducts an elaborate point-based selection system for the interested parties. The selection process is separated into two phases. In the first phase is the Qualification review of the interested developers' technical ability, financial capability, and industrial relevance. The developers are required to score at least 70 points in the technical and financial reviews while

[16] Review of recent offshore wind power strategy in Taiwan: Onshore wind power comparison, Anton Ming-ZhiGao et al, Energy Strategy Reviews, Nov 2021 [https://doi.org/10.1016/j.esr.2021.100747]

also satisfying the criteria of the industrial relevance. The developers who can do that qualify for the second phase which is a competitive auction. The developer proposing the lowest price gets the priority in making an agreement with the MOEA for acquiring the allocated capacity, the developer with the second lowest price gets the second priority for the capacity, and so on until the entire capacity has been allocated.

The developer that wins the rights to develop an OWE project at a particular area is then required to conduct their own environmental impact assessment as well as other surveys either themselves or through contractors/consultants. The geophysical surveys that they are required to conduct are usually for the undersea cables, the seabed mobility, and the potential archaeology inspections to determine the locations of the foundations for the turbines and the cables. All of these are required to be submitted to obtain the construction permit for the said site.

3.2.6 Sweden

Sweden has had to deal with the issue of developers claiming rights over overlapping survey areas and is currently deliberating over a solution that would be made permanent by the end of November 2022. There are three approaches that are being considered, which can be adopted by other countries as well:

1. **Early-bird principle**: The first developer to approach the government get the right to the overlapping area. This approach is used in Sweden's mining industry. However, different OWE developers can provide vastly different economic benefits to the country, hence it is unlike that this approach would be finalised.
2. **Handling applications jointly**: The applications that are claiming right to the overlapping area can be considered jointly. There are two possible ways to do this:
    a. The applications are compared for their merits and the application that is stronger from an economic and public interest perspective would be given the permit
    b. The overlapping area is split between the two developers, but the split can be pro rata depending on the size of the projects.

    There are time limits that apply to ensure that the issues are resolved in a timely manner and to prevent the developers and/or the government from stalling the process.
3. **Following the Environment Act**: The responsible government agency consults with the Environmental Agency (or its marine equivalent) to compare the environmental impact of the projects, and the one with the least impact is given the overlapping area. However, this can also be combined with the second approach when handling the applications jointly.

3.3 Advantages / Disadvantages of the Two Approaches to OWE Surveys

Evaluation of the advantages and disadvantages of government-led approaches compared to developer led approaches to surveys is presented in Table 2.

Table 2 Advantages and disadvantages of government-led vs. developer-led surveys

	Government Led Approach	Developer Led Approach
Advantages	• Provides an independent assessment of areas • Government gains ownership of all data • Government can determine and prioritize zones to be developed over time • Avoids issue of private developers monopolizing an area	• The costs involved in extensive field-surveys are borne by the developers • Developers can potentially choose the areas that they wish to develop • Developers can work on their own timeline/timeframe
Disadvantages	• Government needing to incur the cost of conducting extensive surveys • Government needing to develop expertise to appraise the results and prioritized surveyed areas • Government needs capability to manage survey datasets and supporting interested developers	• Can lead to issues such as overlap of areas, or multiple developers surveying the same interested area • Requires reliance on the government for the data, with the possibility of it being outdated depending on the government agency • Projects can be developed only when government deems it fit

3.4 Conclusions for Issue 1

3.4.1 Country by Country Comparison

Table 3 sets out a country-by-country comparison of the survey process and OWE developments that have results.

Table 3 Country -by-Country Survey Process and OWE Development

Country	Pre-evaluation/Survey Process	OWE Capacities
United Kingdom	The crown estate (gov.) carried out extensive surveys of all offshore areas by hiring specialist consultants – which result in 9 zones that have been subsequently developed Competitive bidding for site lease: Yes	*Installed Capacity*: 24.6 GW (March 2022) *Targeted Capacity*: 50 GW (by 2030)
Germany	The Ministry of Interior set up maritime spatial planning plan after involving relevant stakeholders. It then consulted with the Maritime Agency to categorise the area into three zones within the EEZ according to their potential power generation capacity. Competitive bidding for site lease: Yes	*Installed Capacity*: 7.7 GW (As of 2022) *Targeted Capacity*: 30 GW by 2030 *Licenses granted*: 2.38 GW (As of 2022)
South Korea	The Government initially adopted the developer-led approach for surveys, but since then has taken over the spatial planning / feasibility survey stages. Ministry of Trade, Ministry of Environment, and Ministry of Fisheries have planned to publish a marine cadastral map with OWE consideration zones and conduct feasibility studies therein. Competitive bidding for site lease: Yes	*Installed Capacity*: 124.5 MW (May 2022) *Targeted Capacity*: 12 GW by 2030 *OWE licenses*: 1.5 GW (August 2021)
USA	The Bureau of Ocean Energy Management conducted pre-leasing evaluations by establishing Intergovernmental Task Forces in states with interest in OWE. The expertise from federal, state, and local officials determined the feasibility of potential lease areas. Competitive bidding for site lease: Yes	*Installed Capacity*: 42 MW (March 2022) *Targeted Capacity*: 30 GW by 2030

Country	Pre-evaluation/Survey Process	OWE Capacities
Taiwan	The MOEA conducted extensive surveys of the areas around its coasts and released a list of zones of potential (ZoP) which were areas that had the most potential for OWE. A point-based selective and competitive auction was used to allocate the areas. Competitive bidding for site lease: Yes	*Installed Capacity*: 128 MW (March 2022) *Targeted Capacity*: 14.7 GW (by 2031)

The approaches to managing overlapping areas observed in international practice to managing overlapping areas include:

- The government conducts high level surveys and assessments of marine areas initially, identifies appropriate non-overlapping areas, and then offer the areas to developers for carrying out more detailed surveys leading to OWE project feasibility studies. The surveys that governments carry out will not be as comprehensive as the would be required by a developer to do a full feasibility study of an OWE project but provide a general indication of feasible areas for OWE development and form the basis of managing marine areas for OWE development. The government-led approach means the government will need to incur the cost of carrying out the surveys, and the government will need to establish the expertise necessary to manage the data and information necessary to make informed decisions about suitable areas for the developers to later consider.
- Where the government allows developers to conduct surveys from the beginning, the options are:
  - Do not allow developers to proceed with survey areas that overlap, where the following general approaches have been implemented in practice:
    - Priority is given to the first developer that proposes an area,
    - Priority is given to the developer that best satisfies some pre-defined conditions such as the one that will have the minimal impact on the ecosystems and environment.
  - Or allow survey areas to be overlapping, but have a process by which to resolve overlapping areas based on the findings and results of developers, with the following approaches been observed in practice:
    - Require the developers with overlapping areas to propose a division of the area where each developer can focus on a sub-area prior to commencing the surveys,
    - Allow developers to proceed with surveys in overlapping areas but make them aware that the government will ultimately require any proposed OWE projects to be

developed in areas that are not overlapping, and the government reserves the right to break the areas up as needed for project development.

A disadvantage of having overlapping areas being surveyed by developers is having twice (or more) similar processes of collecting samples and running measurements which increases the impact on the environment, and the need for ensuring a higher level of coordination in the operations of developers in conducting the surveys. On the other hand, if two or more developers are surveying the same area, then the government will gain the benefit of having two (or more) opinions on the potential and viability of OWE development in the overlapping areas.

A final approach that could be considered to reduce instances of overlapping survey areas would be to break the process down into several stages, where for example:

- Stage 1 initially avoids the selection of overlapping survey areas and has a focus on identification of an initial amount of capacity (in Vietnam's case: 7GW – 4 GW in the North and 3 GW in the South), and
- Stage 2 could be done following some work by the government on identification of suitable areas and selecting the applications that are consistent with the government's preferred areas and invite developers to only submit applications for the areas that the government has defined (and select the most suitable applications in each area).

In Stage 1, if there is a concern about competition, then competition could be achieved by ensuring say 10-20 non-overlapping areas are surveyed. This will mean competition will be achieved by having developers looking only at non-overlapping areas rather than having competition to identify wind projects within the one area from multiple developers.

3.4.2 Selection approach for site lease: competitive bidding

International practice suggests that another way of resolving multiple developers being interested in developing OWE projects in the same area is to carry out a competitive auction process for the award of a lease. Various methods / approaches can be implemented ranging from: sealed bidding auctions, ascending bidding auctions, two-stage bidding, and multifactor bidding. The selection criteria need to consider technical and environmental impacts of projects, as well as the expected operating cost of the OWE project that will ultimately be developed. Such approaches depend on the government already deciding on lease areas though, and so they are only relevant to the situation where the government has already conducted some level of surveys themselves as shown in our review of international examples.

3.4.3 Timing / duration of surveys

Surveys generally take 2-3 years to complete. The development time of an OWE project itself once a suitable location has been identified is about 2-3 years as well. Therefore, the lead time of about 4-6 years of surveying and project construction needs to be factored into power

development planning processes to have realistic timeframes for integration of OWE projects. These lead times do not consider any additional time that may be required for government approvals or internal assessments, hence in Vietnam's case, the importance of commencing surveys soon, to reach the desired levels of OWE capacity identified in PDP8 by 2030.

3.4.4 Survey data management and sharing

Under the government-led approach, the government can make all data and information they have collected available to developers before they carry out more detailed surveys. This can help to narrow the survey areas of the developer.

In situations where developers conduct the surveys from the beginning, then it is likely that the data and information that the developer collects will be more targeted towards an OWE project and construction approaches that the developer will use for the project, and the data may be of less interest or use to the government or another developer. The developer will also incur high costs in carrying out the surveys and would seek compensation for the data and information that is collected.

One approach that could be pursued would be for the government to define some key basic data that the developer is required to provide to the government as a condition of carrying out a survey – this could be limited to wind speed measurements and information on the seabed, but other data that is highly specific to a project could be left as the developer's own resource.

4 ISSUE 2: APPRAISING SURVEY AREAS

4.1 Statement of the Issue

The areas that are surveyed are typically large enough to host multiple OWE projects. However, there are exclusionary parameters such as marine systems, shipping lanes/trade routes/fishing zones, unsuitable bathymetry results, etc. Within a surveyed area, zones that zones that satisfy the conditions to support sustainable wind development and can support reasonably scaled projects are identified (sometimes called offshore wind zones). The offshore wind zones are then further divided into smaller areas that are suitable for OWE projects, which are then leased/licensed to interested developers for specific periods of time.

This raises a question about the existence of a relationship between area surveyed and MW potential of OWE. This can be explored by considering various operational OWE projects as well as wind maps that provide a basic idea about the potential that certain marine areas can possess. We can also look at the licensed areas in a country that pre-evaluates the OWE potential of its waters before awarding the license to the developers, such as the USA below.

4.2 Suitability of survey area to support OWE Projects

There are many factors that help determine the suitability of an area to support an OWE project, such as[17]:

- Wind Speed
- Environmental Areas
- Seabed morphology and soil status
- Shipping Routes
- Seismic hazards
- Submarine pipelines and cables
- Geographic boundaries
- Visual and acoustic disturbances
- Water Depth
- Air Density
- Wave developments and patterns
- Fishing Areas
- Hurricane/storm patterns
- Proximity to local ports and electric grid
- Military/Naval zones

Of these, the following are often considered among the most important:

- *Wind Speed*: Turbines are designed to operate within a specific range – between the cut-in speed and the cut-out speed and have a rated speed between the two. The output increases cubically from the cut-in speed to the rated speed.

[17] Spyridonidou S, Vagiona DG. Systematic Review of Site-Selection Processes in Onshore and Offshore Wind Energy Research. Energies. 2020; 13(22):5906. https://doi.org/10.3390/en13225906

- *Air Density*: Air density is directly proportional to generated power. Over the seas, the air density is mainly a function of pressure and temperature – increasing with pressure and decreasing with temperature.
- *Distance from shore*: The distance from shore most importantly affects type of construction used and the ease of connection with the onshore electric grid, which makes near-coast projects more economical. However, coastal communities have also raised issues against the visibility of the wind turbines from the shore, which makes it necessary for the interested party to balance the two factors.

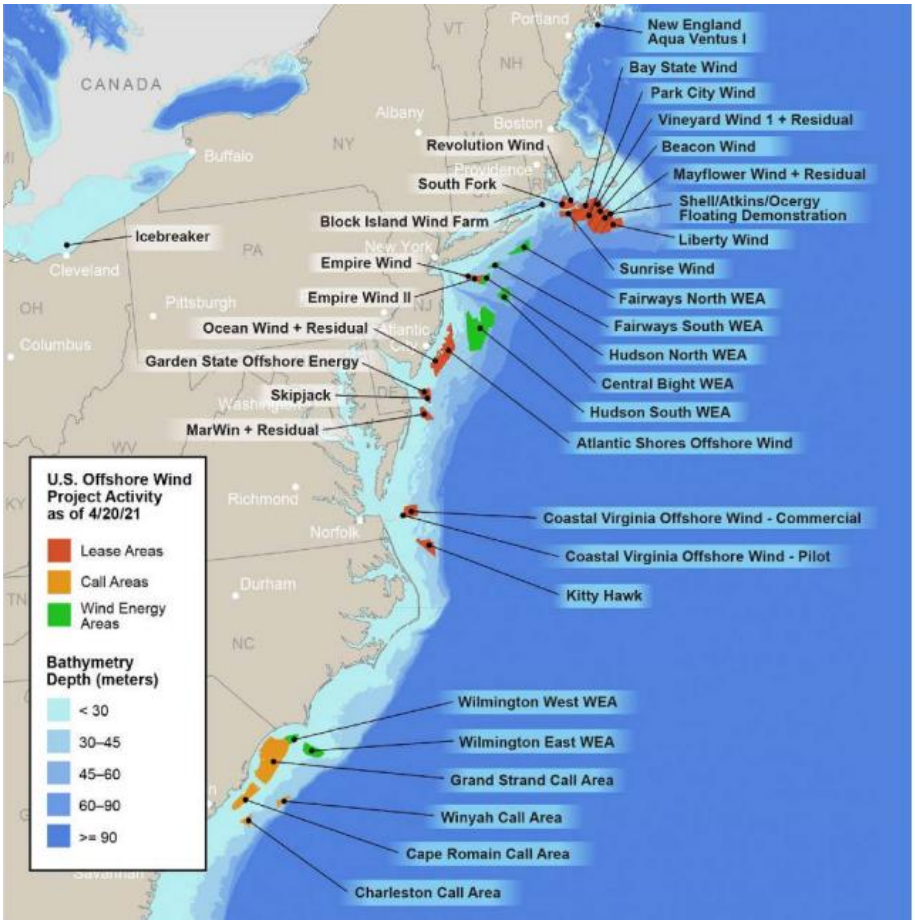
A major issue that developers face is that the conditions and information are uncertain prior to carrying out surveys and taking accurate measurements of for a period of at least 2 years in order to understand wind speeds that could be expected to occur in practice and seasonal variations.

4.2.1 United States of America

As described in the earlier section 3.2.2, the USA selects large marine areas, called Call Areas, that hold OWE potential and explore the levels of interest that developers show in that area. Smaller areas within the call areas are further assessed based on the feedback of the interested parties as well as the BOEM's own database to designate specific WEAs as shown in Figure 6 below[18].

[18] NREL – Offshore Wind Energy Outlook 2021 https://cnee.colostate.edu/wp-content/uploads/2021/07/OffshoreWind-July-2021.pptx.pdf

Figure 6 **Call Areas, Wind Energy Areas, and Leased Areas along the East Coast of USA[18]**



The WEAs are essentially the areas with the highest OWE potential within the Call Area, and they are further split into lease areas that are sold to the developers through an auction process. The lessee is required to carry out further site level assessment of their leased area for the development of the Site Assessment Plans (SAPs) and Construction and Operation Plans (COPs).

4.3 Determining OWE Potential vs. Survey Area

It should be noted that there is no direct correlation between the OWE potential offered and the size of the area surveyed. The OWE potential of any area is a function of a multiple factors such as the wind speed and the air density among others. Furthermore, a surveyed area may have many zones where OWE projects cannot be developed for other factors such as environmental, ecological, social, etc. Despite that, a general understanding of the relationship between surveyed area and MW potential of OWE can be determine using:

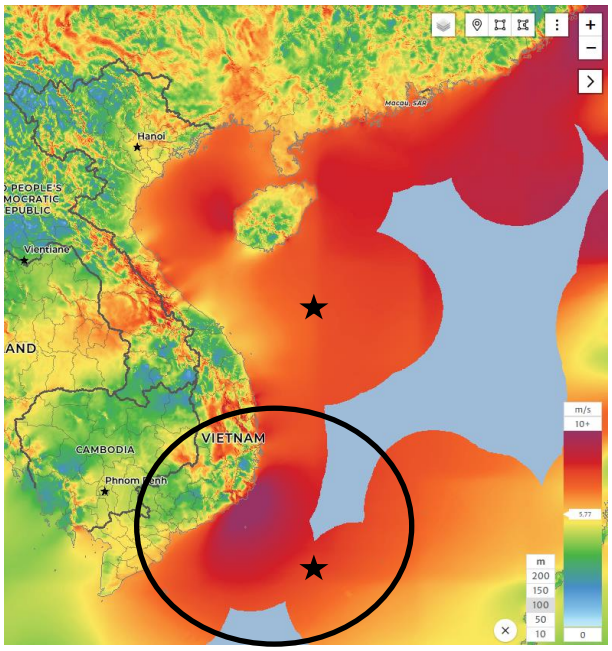
- Unconstrained potential based on tools like Global Wind Atlas
- Benchmark relationship based on actual OWE projects

Neither of the above two is perfect because there are many factors that must be considered in determining the potential but can help provide a rough "rule of thumb."

4.3.1 Unconstrained Potential: Global Wind Atlas

Before a particular area is surveyed, some preliminary research can be conducted with the help of open-source GIS data and tool that has been made available by the World Bank, known as the Global Wind Atlas[19], as illustrated in Figure 7.

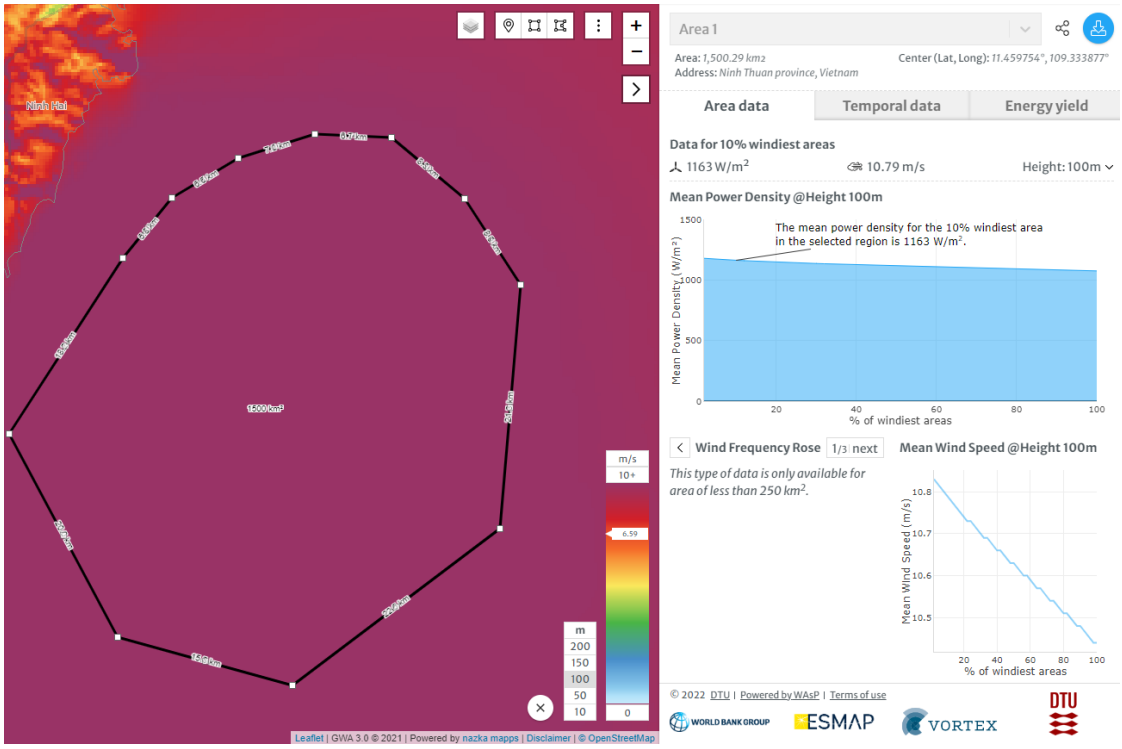
Figure 7 Global Wind Atlas showing the wind speeds around the Vietnam Coast[19]



The Global Wind Atlas can be used to get an assessment of wind speed of the offshore area that is most suitable for OWE projects, given that it is one of the most important factors for wind potential. Clearly for Vietnam this is off the south-east coastline, as seen in Figure 8. The potential is a technical potential, or an unconstrained potential, that does not consider a myriad of real-world issues such as the seabed conditions, actual measured wind speeds and exclusion areas. However, it can serve as a simple check that can be done to obtain an upper bound on wind potential that could technically be developed.

[19] Global Wind Atlas - https://globalwindatlas.info/

Figure 8 1500km² area along SE coast of Vietnam[19]



The GWA can provide the power density for areas smaller than 10,000km². An area of 1,500km² is marked out in the above figure, just off the coast of Ninh Thuan, being one of the windiest areas along the Vietnamese coastline. As shown in Figure 8, this area corresponds to a power density of 1163W/m² for the 10% of the windiest areas within this area. This can be used to convert the power density into the GW potential as:

$$\frac{1163}{10^9} \times (1500 \times 10^6) = 1744\ \text{GW}$$

However, since the power density represents only 10% of the area, the GW potential would be:

$$1744 \times 10\% = \mathbf{174.4\ GW}$$

While this is a very high potential for offshore wind development that would not be realised in practice, it is important to note that this example has only considered wind speed and has not considered the other important factors that limit the area that is feasible for OWE development. However, this does provide us with an idea about which areas can be considered for detailed surveys and potential site development down the line.

4.3.2 Benchmarking Approach: Germany – Area vs. OWE Potential

Germany has designated areas within its Exclusive Economic Zone (EEZ) in the North Sea and Baltic Sea into zones for OWE development based on their potential power density. As seen in the earlier section, power density is a determining factor for finding the expected generation

capacity of an area, and thus sites for high capacity OWE projects. These areas are shown in the Table 4[20].

Table 4: Areas for OWE development within high OWE potential zones in Germany's waters[20]

Site Category	Power Density (MW/km^2)	Area Names
Sites in Zones 1	10.0	N-1, N-2, N-3, N-4, O-1, O-2, O-3
Sites in Zone 2	10.0	N-5, N-6, N-7, N-8
Areas in Zones 1 and 2 with strong shading/wake from surrounding farms	9.5	Investigated on case-by-case basis
Sites in Zone 3	9.0	N-9, N-10, N-11, N-12, N-13

[20] BSH (Federal Maritime and Hydrographic Agency of Germany) – Site Development Plan 2019 [https://www.bsh.de/DE/PUBLIKATIONEN/_Anlagen/Downloads/Offshore/FEP/EN-Flaechenentwicklungsplan2019.pdf?__blob=publicationFile&v=4]

Figure 9 Areas of the German North Sea categorized for OWE projects[20]

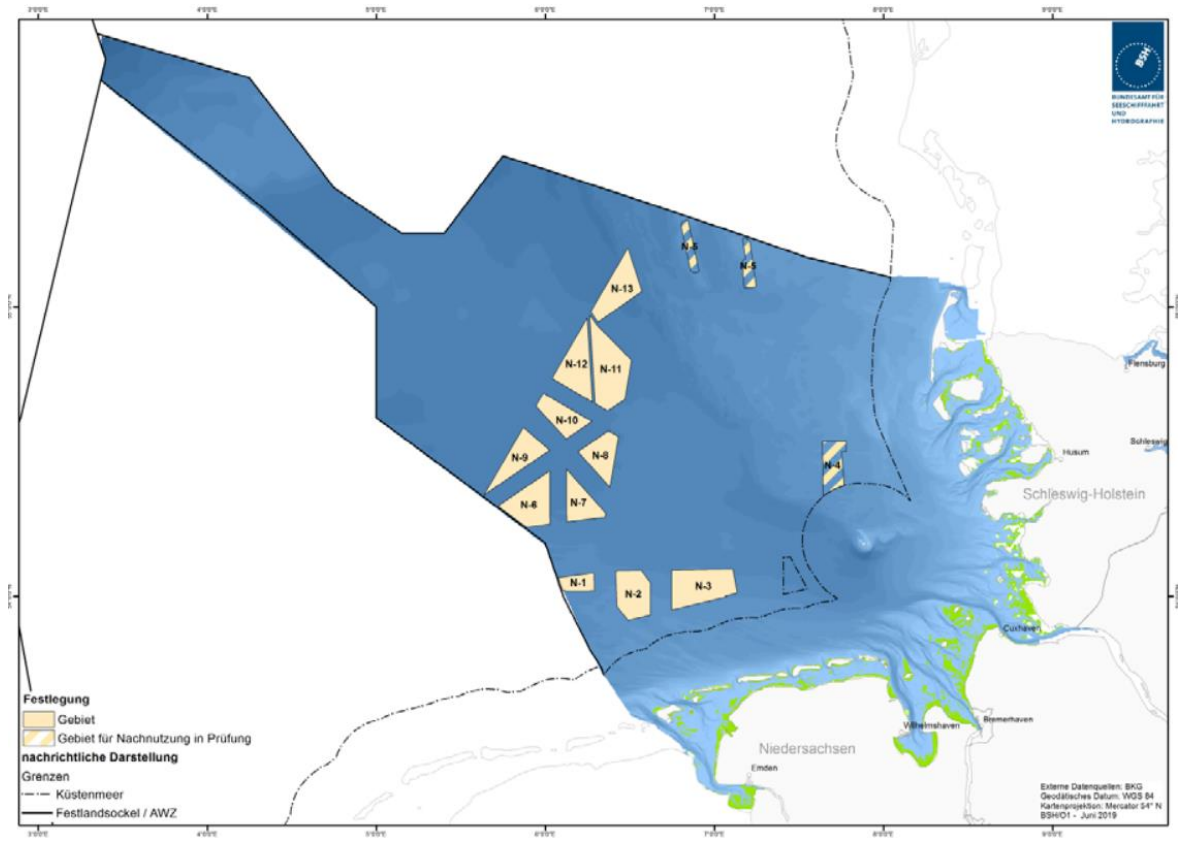


Table 5 Areas for OWE development in the German North Sea and their MW potential[20]

Site Name	Approx. Area (km²)	MW Potential (MW)
N-1	79	790
N-2	223	2,230
N-3	311	3,110
N-4	152	1,520
N-5	125	1,250
N-6	249	2,490
N-7	163	1,630
N-8	170	1,700

Site Name	Approx. Area (km²)	MW Potential (MW)
N-9	196	1,764
N-10	162	1,458
N-11	346	3,114
N-12	237	2,133
N-13	228	2,052

Figure 10 Areas of the German Baltic Sea categorized for OWE projects[20]

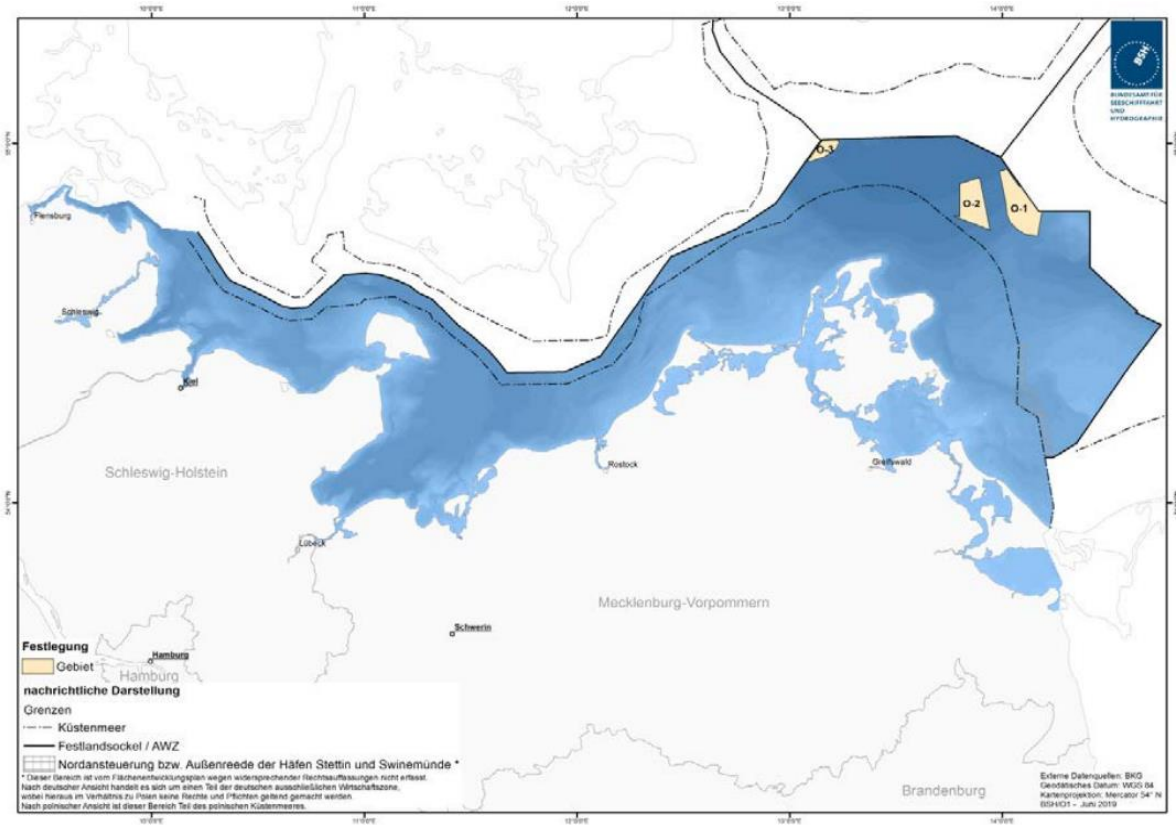


Table 6 Areas for OWE development in the German Baltic Sea and their MW potential[20]

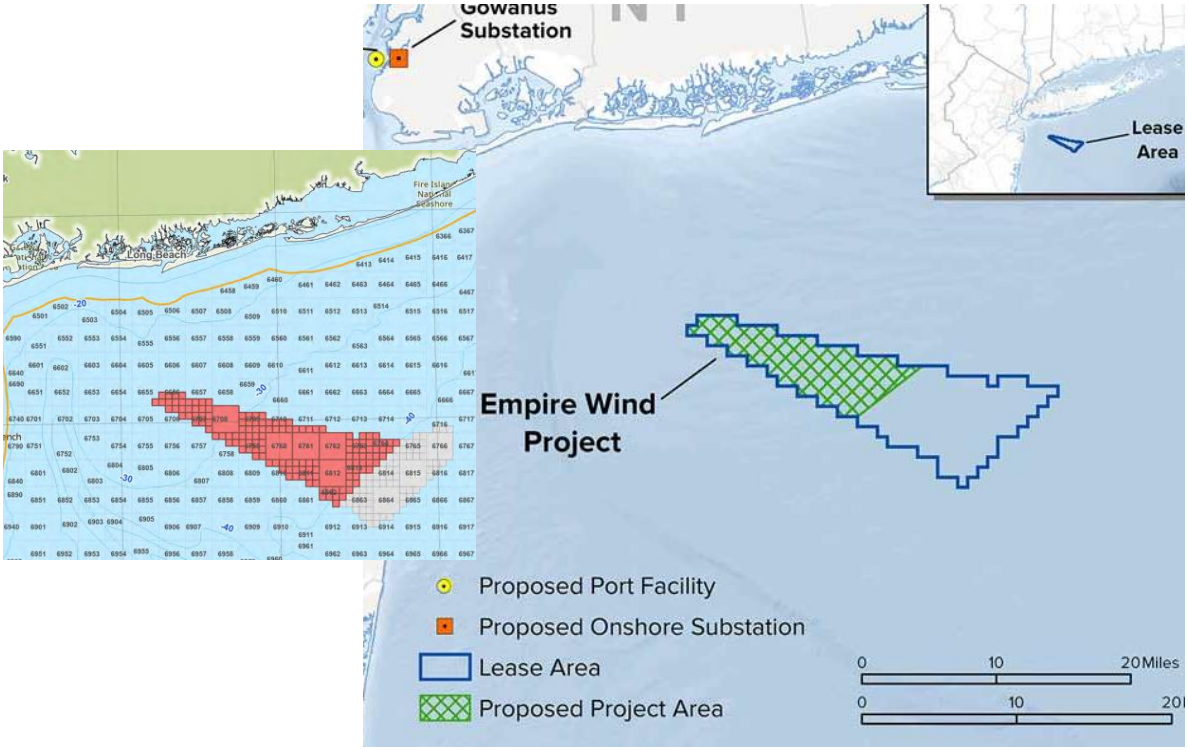
Site Name	Approx. Area (km²)	MW Potential (MW)
O-1	134	1,340

Site Name	Approx. Area (km^2)	MW Potential (MW)
O-2	101	1,010
O-3	30	300

4.3.3 Benchmarking Approach: USA

The BOEM is the authority responsible for awarding the leases to the developers. Lease #OCS-A 0512 covering 321 km^2 of wind area located off the coast of New York, as seen in the Figure 11 below[21,22]. The first project – "Empire Wind Project" 145 km^2 of area within the licensed zone, has been approved and is expected to provide 1050 MW of power by 2026 (7.2 MW / km^2). It is slated to act as the 'first phase', while part 2 of the project covering the remainder of the lease area is under design.

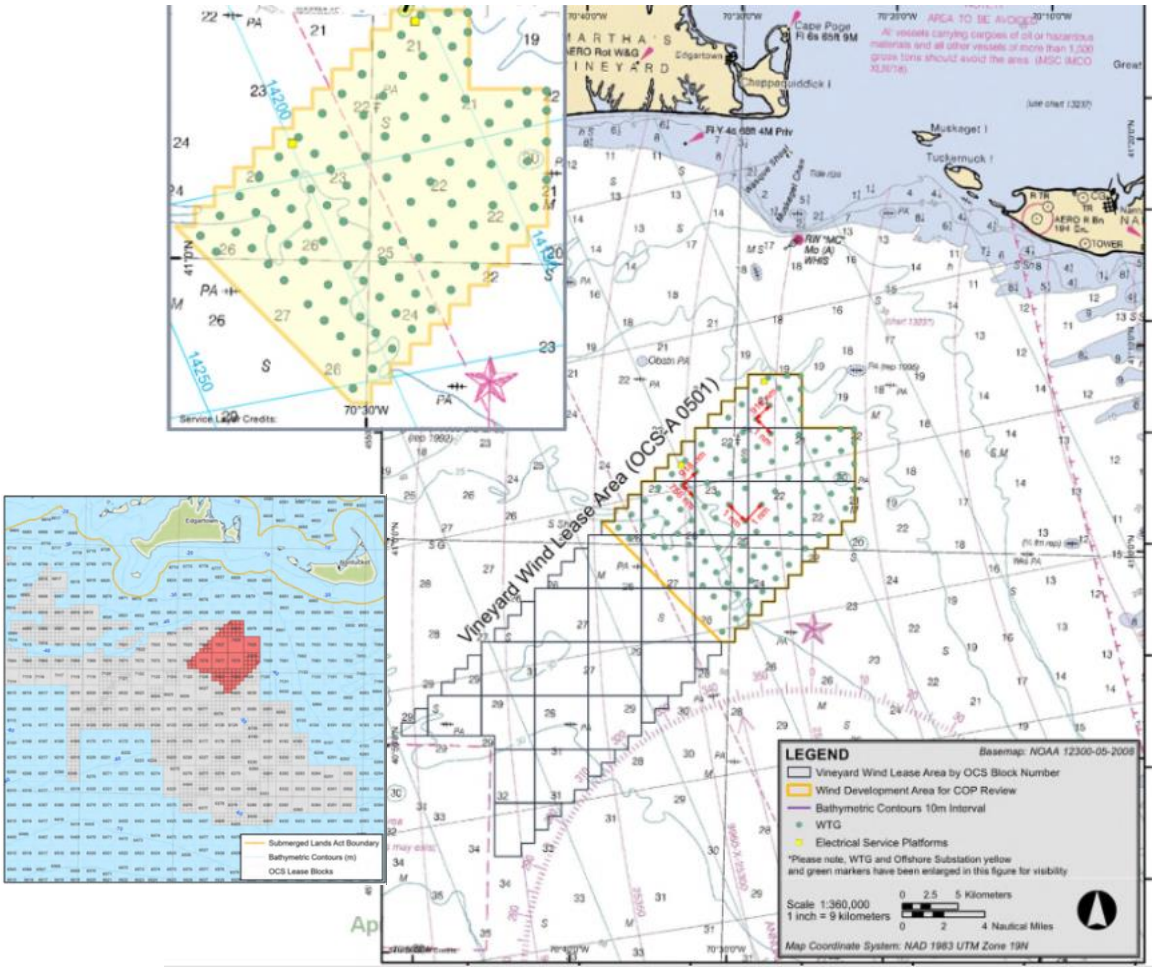
Figure 11 License (L) & Project Areas (R) of the Empire Wind project off the New York coast[21, 22]



[21] BOEM – Map of OSW leases [https://www.boem.gov/sites/default/files/documents/renewable-energy/Leases-Map-Book-July%202022.pdf]
[22] New York State – Offshore Wind Map Library [https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/Focus-Areas/Offshore-Wind-Solicitations/2018-Solicitation/Map-Library]

Similarly, Lease #OCS-A 0501 covering 264 km^2 of wind area is located off the coast of Massachusetts, as seem in Figure 12 below[21, 23]. The Vineyard Wind project is under construction and expected to operational by 2023 with 800 MW of power covering the full licensed area (~3.0 MW / km^2). The remaining licensed area initially was over double the size, however, has now been split into two licenses (awarded to the same developer, only for procedural purposes), that is planning an additional 804 MW and 1,350 MW projects within a 411 km^2 area (~5.2 MW/km^2).

Figure 12 License (L) & Project Site Areas (R) for the Vineyard Wind Project[21, 23]



4.3.4 Benchmarking Approach

Fifty of the largest offshore wind energy projects that are currently operational in the world are shown in the Table 7 below.

[23] Vineyard Wind – Construction and Operations Plan Overview [https://vineyardwind.app.box.com/s/zjpc1dkrh45ykl4v82bi24e90nniep60]

Table 7 50 of the largest operational OWE projects in the world

Project Name	Country	Commissioning Year	Capacity (MW)	Area (km^2)	Foundation Technology
Trianel Borkum West II (Phase 1)	Germany	2015	200	28	Tripod
Rødsand II	Denmark	2010	207	28	Gravity-based
Horns Rev 2	Denmark	2009	209	35	Monopile
Westermost Rough	United Kingdom	2015	210	32	Monopile
Humber Gateway	United Kingdom	2015	219	25	Monopile
Burbo Bank Extension	United Kingdom	2017	258	40	Monopile
Lincs	United Kingdom	2013	270	35	Monopile
Butendiek	Germany	2015	288	34	Monopile
DanTysk	Germany	2015	288	70	Monopile
Baltic 2	Germany	2015	288	27	Monopile
Meerwind Süd / Ost	Germany	2015	288	43	Monopile
Sandbank (Phase 1)	Germany	2017	288	60	Monopile
Nordsee Ost	Germany	2015	295	24	Jacket
Thanet	United Kingdom	2010	300	69	Monopile
Huaneng Rudong	China	2017	300	36	Monopile
Amrumbank West	Germany	2015	302	32	Monopile
Borkum Riffgrund 1	Germany	2015	312	36	Monopile
Sheringham Shoal	United Kingdom	2012	315	35	Monopile
Nordsee One	Germany	2017	332	41	Monopile
Wikinger	Germany	2018	350	34	Jacket
Galloper	United Kingdom	2018	353	114	Jacket
Walney (phases 1&2)	United Kingdom	2012	367	73	Monopile

Project Name	Country	Commissioning Year	Capacity (MW)	Area (km^2)	Foundation Technology
Norther Offshore Wind Farm	Belgium	2019	370	38	Monopile
Arkona	Germany	2019	385	39	Monopile
West of Duddon Sands	United Kingdom	2014	389	67	Monopile
Merkur	Germany	2019	396	47	Monopile
Anholt	Denmark	2013	400	88	Monopile
BARD Offshore 1	Germany	2013	400	60	Tripile
Global Tech I	Germany	2015	400	41	Tripod foundation
Rampion	United Kingdom	2018	400	72	Monopile
Dudgeon	United Kingdom	2017	402	35	Monopile
Veja Mate	Germany	2017	402	51	Monopile
Horns Rev 3	Denmark	2019	407	80	Monopile
Hohe See	Germany	2020	497	42	Monopile
Greater Gabbard	United Kingdom	2012	504	146	Monopile
Race Bank	United Kingdom	2018	573	75	Monopile
Gwynt y Môr	United Kingdom	2015	576	80	Monopile
Beatrice	United Kingdom	2019	588	131	Jacket
Gemini Wind Farm	Netherlands	2017	600	68	Monopile
Kriegers Flak	Denmark	2021	605	179	Gravity-based
London Array	United Kingdom	2013	630	100	Monopile
Walney Extension	United Kingdom	2018	659	145	Monopile
East Anglia Array	United Kingdom	2020	714	300	Jacket

Project Name	Country	Commissioning Year	Capacity (MW)	Area (km^2)	Foundation Technology
Borssele 3&4	Netherlands	2021	732	146	Monopile
Borssele 1&2	Netherlands	2020	752	122	Monopile
Jiangsu Qidong	China	2021	802	115	Monopile
Triton Knoll	United Kingdom	2022	857	145	Monopile
Moray East	United Kingdom	2022	950	295	Jacket
Hornsea Project 1	United Kingdom	2019	1218	407	Monopile
Hornsea Project 2	United Kingdom	2022	1800	462	Monopile

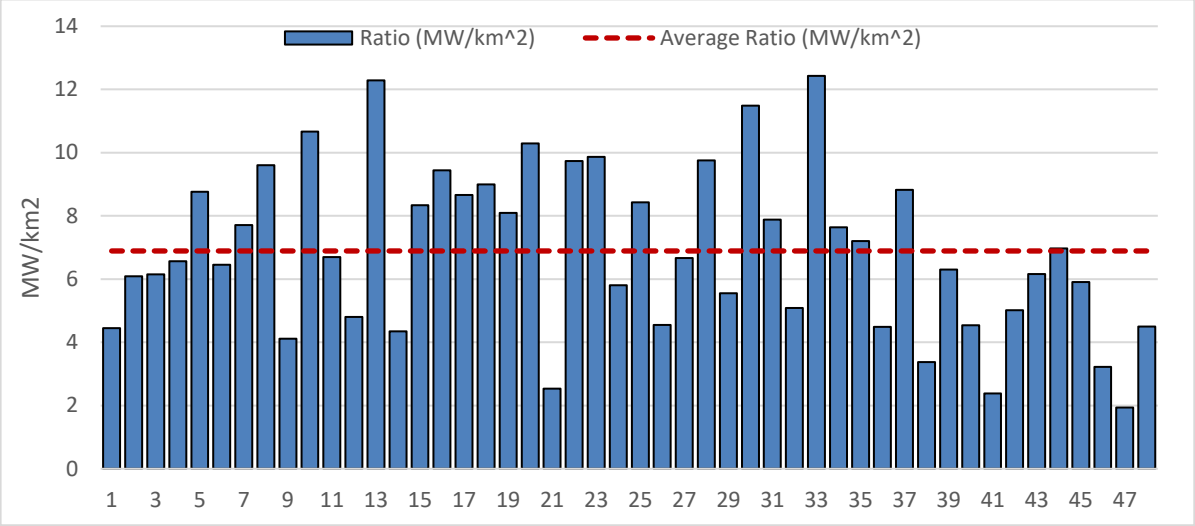
The above operational OWE sites and their size shows a moderate positive relationship between MW of capacity and the relative km^2 of the array which indicates that the MW/km^2 yielded can be expected to decline as the total size of the plant increases. The power density in MW/km^2 of these projects, determined from the capacity and area, is represented in the Figure 13 below. It should be noted that the density shown in the below chart is from within areas that have already been deemed as having high OWE potential. The red dotted line shows the average power density, $7MW/km^2$, which can be used as a benchmark for large OWE sites in the planning stage.

Monopile is the most common type of foundation for near coast installations because of its simplicity and relative ease of installation and production, and economic design[24]. Additionally, making changes in the design in terms of the steel material, pile thickness and profiles and the driven depths, has been easier when compared to other foundation types. 39 of the above 50 projects, representing 78% all use monopile foundations. Jacket type foundations are the next highest with six projects, and the rest are either one or two. The monopile foundation-based projects represent a power density of $6.98MW/km^2$, whereas all the other projects combined represent a power density of $6.37\ MW/km^2$. Since most of the current projects are all near-shore, the monopile foundation projects clearly have the highest power density. However, as near-shore areas start getting crowded with more projects being installed, the developers will be forced to look at deep-shore sites which will make the use of monopile foundations

[24] Arup – Windfarms: has the death of the monopile been greatly exaggerated? [https://www.arup.com/perspectives/windfarms-the-death-of-the-monopile-has-been-greatly-exaggerated]

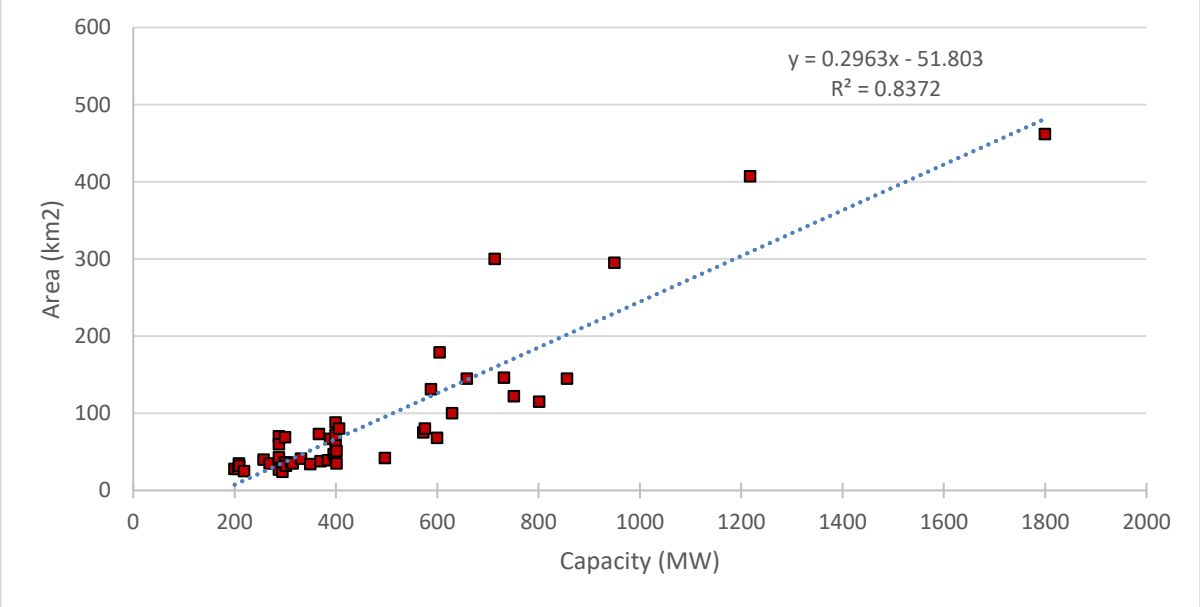
uneconomical and impractical. However, it is unlikely to happen anytime soon, as most of the near-shore potential for offshore wind around the world remains untapped.

Figure 13 Power density in MW/km² of the 50 largest operational OWE projects



Source: consultant's analysis

Figure 14 Capacity (MW) vs Area (km²) of the 50 largest operational OWE projects



Source: consultant's analysis

4.4 Conclusions for Issue 2

The GW potential identified in a survey area is difficult to determine with high precision prior to carrying out surveys as there are many uncertainties that impact the feasibility of developing an

OWE project within a given marine area and hence the overall OWE potential of a given area. Of a large survey area, typically only a small subset of it can meet all the requirements to be developed into an operational OWE project. The purpose of a survey is to determine the most feasible areas within the large survey area with greater accuracy what the OWE potential is for certain subareas within the surveyed area.

Based on the real-world data from the 50 largest OWE projects, the capacity of an OWE project in the range of 200-500 MW, typically could be developed in an area in the range of 30-100 km^2. As such, a survey area that is of size 200-500 km^2 say, so long as it has high wind speeds (using best available data – which in Vietnam's case may be limited to Global Wind Atlas) and so long as exclusion areas (such as marine systems, shipping lanes/trade routes/fishing zones, unsuitable bathymetry results, etc.) have been removed and are not too significant, then it would be reasonably expected to yield a project of at least 500 MW.

Accordingly, for Vietnam to reach the 7GW level, then this would imply running say up to 20 surveys of area of 500 km^2 each for a total of around 10,000 km^2 of survey area would yield up to 10 GW of OWE (500 MW x 20 surveys = 10 GW). However, it must be noted that this is subject to many uncertainties and depends very much on exclusion zones, the results of real-world wind measurements, the findings of real-world bathymetry, and findings from geotechnical works. Nevertheless, it would be consistent with areas and capacities that have been observed in OWE projects that have been developed in other countries. Thus, as suggested in response to Issue 3, a staged approach over time warrants careful consideration.

5 ISSUE 3: LOWER AND UPPER LIMITS TO BE SURVEYED

5.1 Statement of the Issue

Vietnam, in the PDP 8, has set a target of 7 GW of offshore wind energy to be developed by 2030. The country has an immediate potential for 4 GW along its northern shores and 3 GW along its southern shores[25]. The government looking for the development of OWE farms in the 500 MW to 1000 MW range, which while not unreasonable is at the higher end of the range when considering that of the 50 largest OWE projects that have been developed in the world, only about 30% have a capacity exceeding 500 MW.

It is understood that the applications from developers for carrying out surveys for Vietnam's marine areas provides an indication of the expected potential that could be developed, and this raises the question about what would be the amount of developer-proposed MWs require to ensure that 7 GW could be developed, and what would be the maximum Amount of developer-proposed MWs required to ensure that 7 GW could be developed.

Clearly it is desirable to only commit to least number of surveys necessary to reach the 7 GW with high probability.

5.2 Lower/Upper Potential

For issue 2, as detailed in section 3.4, there is no direct relationship between survey area and the MW potential because there are many uncertain factors that influence the potential of a surveyed area. In a similar way, given the large number of uncertainties involved, a developer who has based a MW potential on desktop information prior to doing the survey faces a lot of uncertainties. Thus, a develop may find that following the completion of a survey in the designated area that they identify more or less potential than had been anticipated prior to doing the survey. As the uncertainties are specific to Vietnam's unique conditions and as it depends on the methodology that a developer uses to estimate the MW potential of a survey area ahead of doing the survey, then there are no well-defined rules or methodologies that could be applied to the situation to convert X MW of estimated potential into Y MW of real OWE potential.

It is of course, desirable to not survey too little an area or to survey vastly more area than needed to identify the 7 GW of OWE potential required to be in operation by 2030, under PDP8. Surveying too little area can lead to the entire survey efforts being futile if the surveyed area cannot support an OWE project large enough to meet the targeted capacity. And the surveying of too large an area can result in unnecessary expenditures as the surveyed area ends up being impractically larger than what is required for the targeted capacity and as surveys themselves have

[25] Source: Electricity and Renewable Energy Authority (EREA) – Ministry of Industry and Trade (MOIT) – 7 July 2022.

externalities on the environment and ecosystems – there is additional environmental impacts that could be avoided.

As such, the approach that makes more sense to apply in this situation is a staged approach, as this will allow the risk of not finding enough potential to reach the 7 GW target to be managed. The only other approach is to consider instead consider the question of "how much area needs surveying to yield at least X MW?", which is essentially what Issue 2 was concerned with.

5.3 International Experiences

As seen in section 4.3.4, areas that are most viable for OWE projects have an average power density of about 7 MW/km^2. However, this information can only be reliably obtained after there have been surveys conducted that provide details about the factors that affect the suitability of the selected site for an OWE project. While the data that is available from desktop surveys and research can provide initial assessments of the areas that are suitable for development, it cannot be solely relied upon for OWE projects. A starting point is required from which the collection and recording of this data can start. A staged approach which is often taken is to incrementally conduct surveys over time until the desired potential is identified and if there is a target, the potential to reach the target is identified.

The UK, which is today a world leader in OWE in terms of installed capacity, is an example of a country that took a staged approach to identifying OWE potential. Similarly, Germany, that has a similar approach to the UK has implemented a staged approach. Having a staged approach to undertaking surveys is one way of addressing the uncertainty associated with identifying enough OWE potential from the results of surveys to achieve a desired OWE target. As such, Vietnam could consider this approach to address the fact that the MW potential from a survey is inherently uncertain until after the survey has been conducted.

5.3.1 United Kingdom

The UK had realised the potential that OWE generation held in the growth of renewable energy and the development of the country and required a starting point from which to begin capitalising on that potential. They started a stepwise approach to OWE by first launching the Round 1 which involved small-scale projects spread across 18 sites and having 30 turbines each, with every project limited to covering only 10 km^2. Prescriptive leases were awarded to explore the development and functionality of the technology. This enabled the UK to build their expertise database about their own coastal and territorial marine areas with a better understanding about potential that different areas held. This was followed by Round 2 with 15 commercial-scale larger development sites with a total capacity of 7.2 GW. The government identified three zones that had high OWE potential and the developers themselves were required to conduct the surveys. In the years since then, the country has further developed its own OWE expertise and conducted

two more Rounds and grown the number of zones and the capacity of the OWE farms, and today stands as a world leader with a capacity of 24.6 GW.

The projects that were awarded the 15 development sites in Round 2 are shown in Table 8. These projects represent a total of 6.94 GW of the 7.2 GW capacity that was allocated for that round and occupy a total area of 1,154.5 km^2. While the total area surveyed by the UK/TCE to know that this area would be able to provide 6.9GW is not readily available, we do know that the final total area covered by the said capacity.

Table 8 15 sites allocated to in Round 2 of UK's OWE development process

No.	Project Name	Area (km^2)	Capacity (MW)
1	Westermost Rough	32	210
2	Humber Gateway	25	219
3	Lincs	35	270
4	Thanet	69	300
5	Sheringham Shoal	35	315
6	Walney (Phases 1&2)	73	367
7	Walney Extension	145	659
8	West of Duddon Sands	67	389
9	Dudgeon	35	402
10	Greater Gabbard	146	504
11	Race Bank	75	573
12	Gwynt y Môr	80	576
13	London Array	100	630
14	Triton Knoll	145	857
15*	Docking Shoal	75	500
16	Gunfleet Sands	17.5	172

It is of note, however, that the Docking Shoal project did not come to fruition as its EIA did not pass which caused its application to be rejected.

However, the UK built upon the data gained from Round 2 to then conduct Round 3 where the capacity allocated was 32 GW. An iterative approach like this could be adopted by Vietnam as well, as capacity and experience in OWE surveys is developed and improved upon over time.

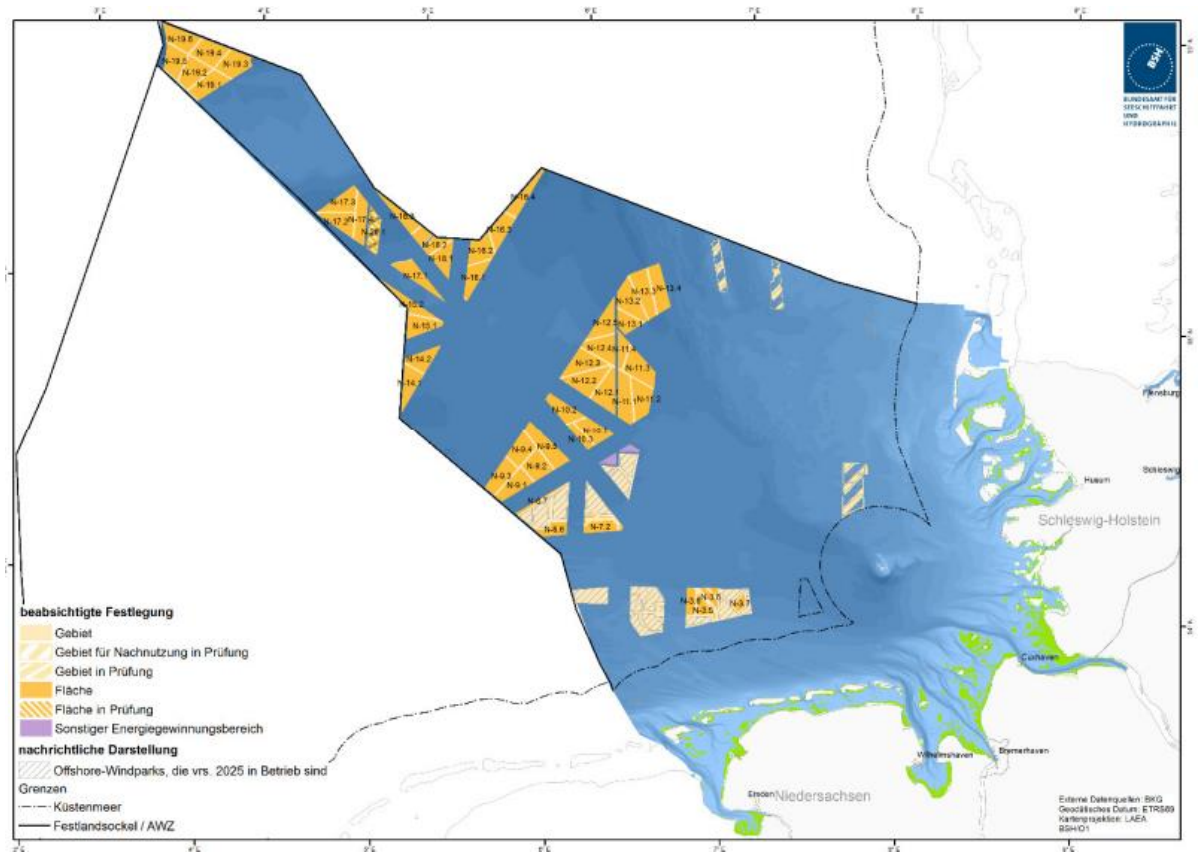
5.3.2 Germany

As mentioned earlier, Germany uses benchmarking to designate areas within its EEZ for the development of OWE projects. The determining factor for the quality of these areas is the potential power density that these areas can offer. The potential power density of an area, as we have seen, can only be reliably obtained by conducting on-site surveys to study the parameters

that can affect it. Germany has used an iterative method to identify more potential OWE areas or zones. The information gathered from a series of surveys conducted in the first step provides the information that can be used to better conduct the following surveys and help identify more and better areas that can be deemed viable for OWE development.

As mentioned in the earlier section 4.3.2, Germany has already identified zones N-1 to N-13 in the North Sea and zone O-1 to O-3 in the Baltic Sea in 2019. The BSH has used those zones as the base to expand upon the potential in the German North Sea and identified more zones, N-14 to N-20, after further surveys. The Figure 15 below shows these and compared to the Figure 9, we can see a significant increase in the number of areas that are now available for development of OWE projects. The BSH is in the process of passing these areas as part of its latest Site Development Plan.

Figure 15 Areas in the German North Sea identified for OWE development after additional surveys[26]



[26] BSH – Preliminary Draft of Site Development Plan [https://www.bsh.de/EN/TOPICS/Offshore/Sectoral_planning/_Anlagen/Downloads/Preliminary_Draft_Site_Development_Plan_EN.pdf?__blob=publicationFile&v=1]

Vietnam could consider using the German model for approaching the OWE development by starting off with a smaller number of areas that are surveyed, and using that information to explore, identify, and categorise more areas in its waters based on characteristics like the potential power density.

5.4 Conclusions for Issue 3

Developers in their applications for surveying an area will present an estimated OWE potential that will be based on judgments, data and information that the developer has been able to obtain on Vietnam's marine areas, and on the application of expert judgment. The potential that is estimated will be subject to a raft of factors that are not knowable until the survey has been undertaken and so the estimated potential may be higher or lower than the developer anticipates.

International experience suggests that to achieve a desired MW level of potential, it is generally better to survey marine areas in an ongoing / rolling process of identifying MW potential, rather than taking a "single shot" which exactly identifies some desired GW target for OWE potential. As more surveys are conducted over time, more viable areas and more OWE potential can be found. Furthermore, experienced gained in an initial round of surveys can be used to fine tune expectations of surveys conducted at a later stage. Most countries pre-evaluate their areas and then set the development/GW targets for the coming years. Having an iterative approach can help with that, since if the expected or required capacity cannot be met by the initially surveyed areas, further/additional rounds of surveys can build upon the first round's information and help reach the desired capacity. Once that capacity is reached, realistic targets can be set for the coming years and the surveyed areas can be leased out to interested developers.

Based on international experience, it is suggested that to address the issue of determining a prespecified GW potential target for OWE, Vietnam undertakes a staged approach to developing the potential, which can manage the risk of surveys falling short of expected MW potential. The approach could be to commit to say 10 surveys initially but require the developers to report on their "best estimate" of potential based on findings to date every 6 months. If the developer's potentials are falling below the levels anticipated, then Vietnam could trigger another round of surveys. Over time, the uncertainty associated with achieving a desired MW potential will reduce, and at the same time, Vietnam will gain greater insight into the relationship between a developer's expected potential and the real MW potential that is identified.

6 OVERALL CONCLUSIONS AND NEXT STEPS

6.1 Conclusions

Subject to the successful completion of OWE surveys in a timely manner, Vietnam's goal of developing 7 GW of OWE by 2030 is an achievable target. In this report, three general issues that have been raised by Vietnam in connection to the appraisal of developer applications of surveys have been considered with comparisons given to international practices. In general, allowing developers to carry out an initial round of surveys to identify the most feasible areas for OWE development is a reasonable starting point as it will enable the survey work to be commenced quickly, it will leverage the expertise of developers and the government will avoid the high cost associated with conducting the surveys. Furthermore, given that surveys generally take 2-3 years to complete, and the construction of an OWE project taking at least another 2 years, then it will ensure the 2030 target in the PDP8 will be achieved.

The overriding recommendation that we make is that an iterative process be adopted to for the surveys, which will firstly address the uncertainty associated with identifying OWE potential within a proposed survey area and it secondly, it will allow Vietnam to gain experience in OWE surveying and OWE project development. If a staged approach is adopted, then it would be possible to commence selecting say 10 to 20 survey applications from developers that have non-overlapping areas initially and require the developers to report on the potential that they have identified every 6 months over the 2–3-year period that surveys take. Based on the results, Vietnam could then proceed with another round of surveys after 6-12 months. This process could be continued until the PDP8's target of 7 GW is identified with better accuracy as compared to present. As there is no harm in exceeding the 7 GW target, any OWE potential that is identified beyond the 7 GW could be used either for the PDP8's longer-term OWE target of 54 GW by 2045, or it become an important input into future revisions of the PDP, which could consider the benefit of increasing the OWE targets.

In parallel carrying out say 2 or 3 rounds of developer-led surveys, it is recommended that Vietnam improve their capacity in OWE surveying and OWE project development, and for the government to consider a longer-term transition towards a system of identifying preferred marine areas and establishing a leasing system. This would bring Vietnam's approach more in line with the approaches used in several international examples that have been considered in this report, namely South Korea and the UK, where they started with a developer-led approach but ultimately transitioned to a government-led model as more expertise had been gained. Having a centrally managed survey process to identify preferred marine areas would be more suitable for running competitive auctions where OWE developers would be put into competition to secure the rights to a lease area.

6.2 Next Steps

Based on the understanding of Vietnam's current position with regards to OWE, the recommended next steps that should be taken to ensure that the country can make the most its OWE potential are:

1. Review the governance and institutional arrangements in Vietnam and compare to other countries that manage the OFE surveys and OFE project development process,
2. Develop a more explicit methodology for ranking and prioritising the survey applications, including a scoring system,
3. Formulate a strategy for Vietnam's management of OWE surveys and develop the process steps for future governance of the leases and permits for developers,
4. Undertake in doing a comprehensive review of the legal framework for OFE and formulate enhancements to it,
5. Review and assess previous OFE potential assessments and assist in desktop based OWE zoning, assuming GIS layers and information would be available, and
6. Undertake training and capacity building in OFE development.