11-2021
DANISH ENERGY AGENCY, ROYAL DANISH EMBASSY IN VIETNAM,
ELECTRICITY & RENEWABLE ENERGY AUTHORITY

Study on criteria and regulatory setup for efficient and sustainable offshore wind market in Vietnam

FINAL REPORT

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CONTENTS

Abbreviations

Abbreviation	Term
BoP	Balance of Plant
CfD	Contract for Difference
DEA	Danish Energy Agency
DKK	Danish Kroner, equivalent to 3599 VND / DKK
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EOR	Energy Outlook Report
EREA	Electricity and Renewable Energy Authority
ESIA	Environmental and Social Impact Assessment
EUR	Euro, equivalent to 26763 VND / DKK
EVN	Vietnam Electricity
IFC	International Finance Corporation
LCOE	Levelized cost of energy
LAT	Lowest Astronomical Tide
MARD	Ministry of Agriculture and Rural Development
mLAT	Meters relative to LAT
MOC	Ministry of Construction
MOD	Ministry of National Defence
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOPI	Ministry of Planning and Investment
MOT	Ministry of Transport
MPI	Ministry of Planning and Investment
MPS	Ministry of Public Security
NDC	Nationally Determined Contributions to reduce national emissions and adapt to the impacts of climate change
O&M	Operations and Maintenance
OWF	Offshore wind farm(s)
PDP	Power Development Plan
PPA	Power Purchase Agreement
PWPDP	Provincial Wind Power Development Plan

SEA	Strategic Environmental Assessment
TSO	Transmission System Operator
UK	United Kingdom
USD	US dollar equivalent to 22808 VND / USD
VND	Vietnamese Dong
WTG	Wind Turbine Generator

The following currency conversion rates were used in this study:

- 1 USD to 22950 VND
- 1 USD to 6.13 DKK
- 1 USD to 0.83 EUR

Executive Summary

Vietnam is gearing up to develop the offshore wind market and it is investigating ways to assure an efficient, competitive, and sustainable market for developers and power customers. This work is intended to support their journey and increase their confidence in setting much more ambitious targets than what is currently expected in the next PDP-8.

One of the key requirements for large-scale implementation of offshore wind farms in Vietnam is a transparent and efficient process for handling and approving development applications.

To this end, the Danish Energy Agency and the Vietnamese Electricity and Renewable Energy Authority have jointly commissioned COWI, DTU, and EA Energy Analyses to perform a desktop study which:

- Defines criteria for 'real' offshore wind to attract international developers and financial institutions
- Discusses economic consequences of setting limits for power capacity density and adding seabed lease fees
- Describes efficient regulatory handling

COWI began this task by developing a benchmark for requirements based on European experiences in the reference countries consisting of the UK, Germany, and Denmark, which have proven suitable for the needs of the offshore wind industry over the last 30 years.

This study is investigating the consequences on the overall Vietnamese sea area available for offshore wind as found in the WBG/BVG report [1], as well as for the specific sites in the DEA/COWI report [2].

The recommendations based on the findings in this study are reflected in Figure 1 for 'real' offshore wind criteria, Figure 2 for definition of areas required for offshore wind as well as capacity density, Figure 3 for seabed lease fees and Figure 4 for regulatory setup and application handling as well as condensed in Table 1 and further described in the following subsections as well as in the report.

Figure 1. Recommended criteria for 'real' offshore wind in Vietnam.

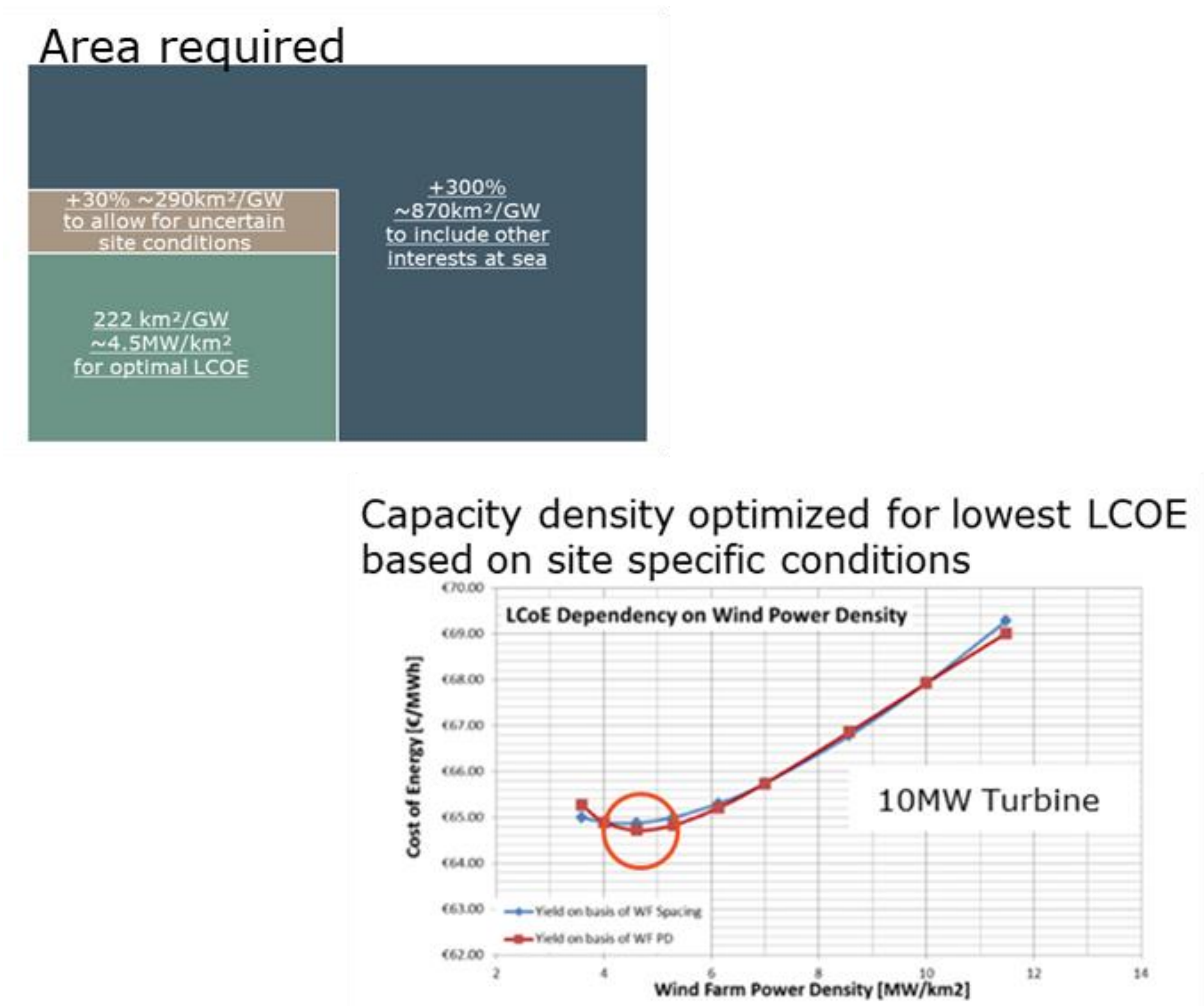

Figure 2. Recommended practice for expected area required in different planning stages and selection of capacity density

Figure 3. Recommendations for seabed lease fees.

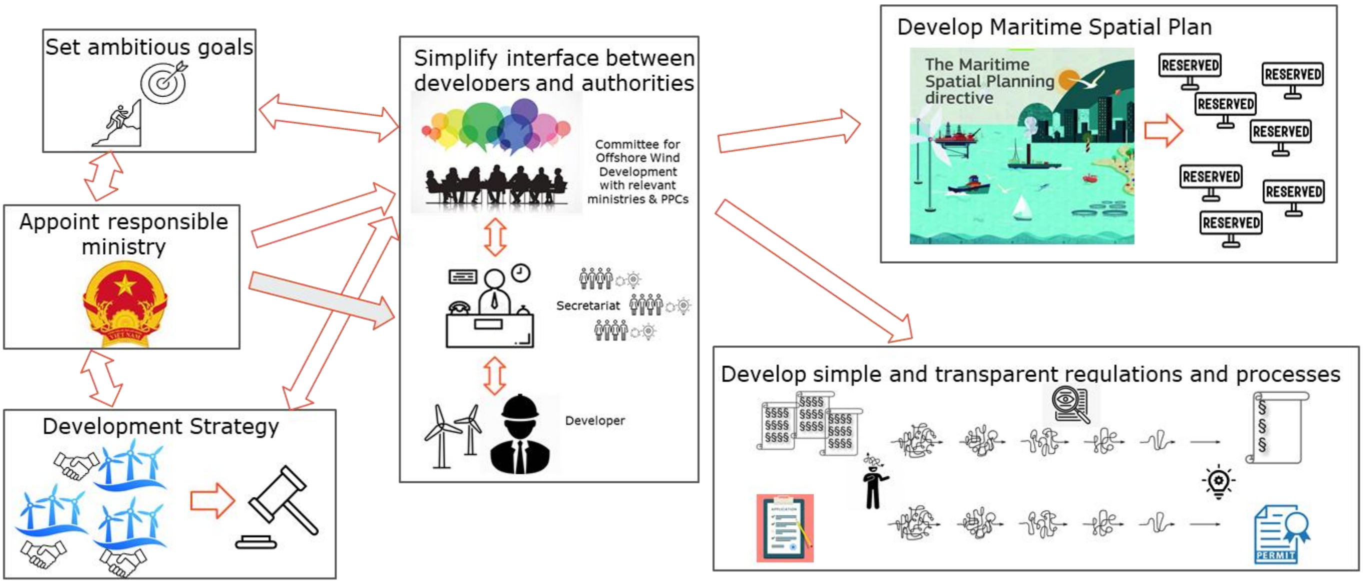

Figure 4. Recommendations for regulatory setup and handling of applications.

Table 1. Summary of recommendation for Vietnam.

Criteria	Recommendation
Boundary between nearshore and 'real' offshore windfarms	6nm
Minimum wind speed	7 m/s is applicable with current technology. Development of low wind speed turbines will lower this boundary
Water depths for bottom-fixed foundations	10m to 60 m, however developers are to decide when fixed or floating foundation technology will apply
Water depths for floating foundations	60 m and above
Seabed lease fees and other fees	Avoid. If implemented, assure it will only be added to the actual wind farm area, with discounts for coexistence and proportional with the energy generated in the area
Capacity Density	Optimized by physical parameters for lowest LCOE. It is expected at 4.5-5MW/km² for the areas with wind speed of 9m/s and above, before adding additional space c.f. section 4.2.2
Planning	Develop Maritime Spatial Plan (MSP) with reservations for offshore wind followed by a site development plan distributing reserved areas into commercial scale concessions
Development Strategy	Set ambitious development targets for offshore wind in PDP-8 incentivising long-term involvement in Vietnam
	Develop a couple of offshore wind sites based on the most promising unsolicited applications from experienced developers based on negotiated terms and conditions to built-up clear regulations, clear distribution of authority responsibilities and gain experience in handling projects efficiently
	Develop reserved concessions areas cf. MSP for tendering in auctions with site pre-assessments and clear terms and conditions including risk sharing to lower developer risk premium
Regulation	Develop transparent regulations, terms, and conditions specifically for offshore wind development
	Incentivise coexistence with other interests at the sites
Handling of offshore wind farms	Appoint a leading ministry to chair a committee for Offshore Wind Development comprising of ministries and PPC's involved in planning and permitting offshore wind development
	Implement a secretariat under the authority of the Committee as a single point of contact for handling interactions between developers and authorities

Criteria for 'Real' Offshore Wind

COWI performed a sensitivity study to better assess the impact of specific offshore criteria on the Vietnamese potential in offshore wind. The outcome of the study is the following criteria, which form the definition of "real" offshore wind in Vietnam:

- Wind speed at 150mLAT (150m above Lowest Astronomical Tide) at minimum 7m/s to utilize the currently available wind turbine technology efficiently
- Water depth of more than 10m below LAT to allow for efficient technology on the installation and O&M vessels
- Setting a water depth boundary between fixed and floating foundations is suggested to be left with the wind farm developer to decide to allow for the optimal foundations under the actual conditions at the site. This will allow to utilize the latest relevant foundation technologies which developers bring to the table

- Water depths less than 1000mLAT for viable anchoring of floating foundations
- Distance from shore at a minimum of 6nm, approximately 11km, with a due assessment of the impact on environmental and social responsibility according to international standards
- Fulfilling international financing standards such as the Equator Principles for environmental and social risk [3], which are adopted by the approximately 123 key financial institutions covering the majority of international project finance debt within developed and emerging markets to attract international funding

These criteria are not found in regulations in the reference countries; however, all currently planned developments in these countries are fulfilling them.

Economic Consequences of Seabed Lease Fees

With abundant potential offshore wind resources available off the Vietnamese coast, these resources should be developed at the lowest cost possible. Therefore, COWI recommend avoiding seabed lease fees and other fees on the developer/operators for Vietnam or other emerging markets, as seabed lease will be an added cost to the developer. This increases the LCOE of a project and the consumers' electricity price. Hence seabed lease fees will make offshore wind less competitive in the Vietnamese power generation mix.

The price of electricity from an offshore wind farm is closely linked to the LCOE for electricity traded through PPAs, or other fixed-price, long-term agreements. The cost of the seabed lease will likely be fully transferred to the consumers or will have to be absorbed by the government through other subsidy schemes.

Regardless of how electricity is traded, the seabed lease will make projects less profitable and increase the need for government funding/subsidies to develop projects.

The seabed lease is a tax on offshore activities. For as long as offshore wind projects need government subsidies to be developed, then seabed leases merely contribute to taxing the government, as the seabed lease will drive up the need for subsidies.

In Northern Europe, the LCOE of offshore wind has dropped significantly over the last 5 years. However, public funding is still needed e.g., by CfD securing a minimum price on the power produced. When subsidies are no longer needed, seabed leases may be a way for governments to extract higher than normal profit from the offshore industry just as is done for, e.g., offshore oil exploration.

Instead, COWI recommend to carefully prepare and pre-develop offshore sites before they are auctioned to avoid interfering with other activities at sea, which would cause unforeseen costs for the developer. This approach will increase the likelihood of projects being consented and hence deliver renewable power to the Vietnamese system that has been planned for.

Finally, if seabed lease fees are applied against our recommendation, sound principles for the scale of seabed leases should include considerations of fairness and proportionality. Otherwise, the seabed lease could lead to a lack of interest or inefficient bidding behaviour from developers. The seabed lease should only cover the actual area occupied by wind turbines, discount for coexistence and should be proportional to the energy generated within the area.

Effect of Setting Power Capacity Density Requirements

COWI suggests that the power capacity density is suited to the actual site conditions, as they are impacted by wind speed, bathymetry, soil conditions, and optimal park layout. For the sites considered in ref. [2] the optimal capacity densities are found to be in the range from 2-5MW/km². Careful modelling of the specific offshore wind sites is required when establishing the capacity density restrictions and it is recommended that this is carried out under the authority of the leading ministry for the offshore wind development.

Not all offshore areas with a suitable wind resource are available for offshore wind. The ocean is used for many other activities, including oil exploration, fishing, and shipping. Thus, the optimal power capacity density should not be applied to all areas with a suitable wind resource. Careful maritime spatial planning is needed to identify areas suitable for offshore wind. If maritime spatial planning is not available, experience from reference countries suggests that only 25% of ocean areas with a suitable wind resource can typically be developed for offshore wind.

Coexistence of maritime activities would contribute to increase the total potential for offshore wind considerably. It may even be economically beneficial to reward coexistence in concession areas e.g., by discounting any seabed lease fees. Fishing within the offshore wind farm is an example of coexistence, which is to be carefully aligned to minimize the risk of collisions with the wind turbines and damage to cables. If the developers were granted a discount on seabed lease or compensated in other ways for allowing fishing within the offshore wind farm, they might be more willing to accept the risk, which would help sustain the local fishers and improve the local acceptance of the wind farm.

As part of the investigation, COWI investigated the power capacity density in the reference countries and Belgium.

In the reference countries, the lowest LCOE ensures that the investments deliver the lowest electricity prices to the consumers. COWI found this to be in the range of 4.5-5.0MW/km² equal to 200-220km²/GW, depending on the turbine technology and for optimal site conditions.

In Belgium, the government is facing limited space resources and has adopted a different strategy and decided to harvest a significantly higher amount of renewable energy from offshore wind. The government is requesting concessionaires to use the lease space as intensely as possible. This results in less efficient wind farms as turbines are impacted by wake and blockage effects. Hence the Belgian projects have a higher cost of electricity for consumers.

Efficient Regulation Handling

Vietnam has developed and deployed regulatory instruments in the permitting process of the nearshore wind farms in the country. The process is lengthy and involves interfaces with several ministries and governmental institutions. Currently, there is no regulatory instruments in place specifically for real offshore wind.

The Vietnamese 'Law of Investment' constitutes that the investment approval authority is at province level for most projects and the draft PDP-8 also states that provinces will be the active partner in any case. COWI recommend changing this setup assuring the offshore wind development is handled from the country's perspective rather than the provinces.

To make the permitting process more efficient and attractive to investors and project developers, COWI proposes some adaptations based on the successful case studies of offshore wind development in Denmark, Germany, and the UK.

In summary, COWI finds that Vietnam can increase the efficiency in regulation handling through:

- Appointing a leading ministry responsible for offshore wind development as well as convening and chairing a Committee for Offshore Wind Development comprising representatives from all relevant state and provincial authorities involved in offshore wind planning and permitting.
- Implementing a secretariat under authority of the Committee for Offshore Wind Development as an access point to handle all communication, licenses, permits, and processing of applications with the relevant authorities for developers and owners of offshore wind farms
- Adjusting the 'Law of Investment' and the PDP-8 formulations regarding approval decisions to the leading ministry or the Committee for Offshore Wind Development to get the country perspective rather than provinces.
- Establishing transparent regulation requirements
- Creating clear and transparent processes for handling applications/tender processes
- Utilizing a permitting system with technology specific offshore wind tenders when carefully planned tenders can be held
- Until such a tender system is in place, allow for a couple of commercial scale projects on negotiated terms, utilizing the consenting experiences from these pilot projects to streamline the permitting processes for auctioned projects
- Initiate a Maritime Spatial Planning project with participation of the main authorities and the military to build a joint understanding of offshore wind site options available to Vietnam, that carry a high likelihood of getting permitted and thereby identify and reserve feasible sites for offshore wind
- Detail the Maritime Spatial Plan in an offshore wind specific Site Development Plan, defining individual concession areas within the areas reserved for offshore wind in the Maritime Spatial Plan.

COWI envisions that the secretariat will work as a single interface point. The project developers submit every required document from the preliminary stages to the decommissioning of the offshore wind farm. From the approval perspective, the secretariat then submits the documents at the appropriate stage to the committee with relevant authorities for efficient appraisal and validation. The single stream of communication renders a smoother process, minimizes interfaces, and consequently reduces non-conformities from the project developers.

Furthermore, the secretariat is responsible for handling the offshore wind tenders, including the site selection based on a more detailed site development plan of some potential areas for the development of offshore wind determined in the Maritime Spatial Plan.

As part of the offshore wind tenders, the secretariat executes a prequalification round with potential participants, invites the prequalified parties for participating in the tender, receives and analyses bids, and announces the winner of the tender. The secretariat's scope also includes preliminary investigations and a Strategic Environmental Assessment, which will serve as the basis for the development of a site-specific environmental and social impact assessment by the project developer during the permitting process.

Handling such a tender and related scope of work requires more than experienced 10 full-time employees in more mature markets such as the Danish market.

Should the Vietnamese Government decide to opt for reverse auctions as the enduring methodology, it is essential that the Government makes early reservations of the most feasible sites to prevent open door applications are occupying these areas.

The tendering process is the preferred permitting system in the longer perspective, as proposed by COWI. Besides the tenders, a system of unsolicited applications, also called "open-door-procedure," could be considered. This procedure allows project developers to implement their projects within areas outside of the ones defined by the Committee for handling offshore Wind development in the Site Development Plan. Nevertheless, although with more flexibility than the former, the open-door process is longer and more complex, as part of the responsibilities from the secretariat are transferred to the project developer, for instance, all requirements and approvals needed besides the main permits and licenses for the effective project development and operation with the different Vietnamese authorities, at least until the secretariat is operation.

As for the permits and required approvals, COWI proposes some adaptations to the original Vietnamese framework. In this regard, the permits are synthesized into five main documents:

- Site survey permit
- Land use permit
- Construction permit
- Operation license
- License to generate electricity

COWI has further detailed requirements, terms, and conditions for obtaining each of those in ref. [4].

1 Introduction

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There is a huge potential and interest for offshore wind power in Vietnam and, at the same time, little experience with the technology from a market and regulatory point of view. To ensure the best take-off for offshore wind power in Vietnam, EREA has strongly requested regulation development and efficient administration. There is particularly strong expertise in the Danish Energy Agency related to regulation development, including project planning, auctioning of wind power in defined sizes (MW) and areas, efficient and transparent processes including a one-stop-shop for approval of projects, environmental impact assessment, delivery of capacity on time and so forth.

The objective of this collaboration between DEA and EREA is capacity development in energy sector planning and policy development, integrating renewable energy, including offshore wind and energy efficiency technologies. This is to assure cost-effective measures are applied to meet the Vietnamese Nationally Determined Contributions (NDCs) to reduce national emissions and adapt to the impacts of climate change, while ensuring national security of supply. It includes presenting sustainable pathways from developed scenarios with increasing shares of renewable energy, including offshore wind and energy-efficient technologies, which can be applied in national energy and power planning and policy development.

This report is part of the output of a study commissioned by DEA and EREA under the DEA offshore wind development framework agreement to accelerate offshore wind development in emerging markets. It was delivered by the renewable energy consultancy consortium consisting of COWI, DTU, EA Energy Analyses, and local consultants in Vietnam Mr. Do Dang Phu, Mr. Saurabh Mathur, and Mr. Le Quang Huy in close cooperation with Erik Kjær from DEA; Camilla Holbech and Viet Tran Hong from the Royal Danish Embassy in Vietnam, and Deputy General Director Pham Nguyen Hung, Director Nguyen Ninh Hai and Ms. Pham Thuy Dung from EREA.

1.1 Purpose

The objective of the current project is to build capacity within the relevant Vietnamese institutions in the cost-efficient development of offshore wind energy. It supports the overall objective by enhancing the data foundation and regulatory experience regarding offshore wind in Vietnam to be incorporated and applied in long-term planning and policy development activities.

It is intended to support the Government of Vietnam in:

- selecting criteria to define the offshore wind market, distinguishing it from the nearshore tidal range wind market,
- defining criteria for power generation density,
- finding consequences of introducing seabed leasing and other fees, as well as
- creating an overview of most critical pre-conditions, elements, and criteria in the evaluation of an application for offshore wind development in Vietnam.

In this way, it is intended to support the Vietnamese authorities' ability to lead and manage a sustainable offshore wind development and roll-out.

1.2 Scope

The scope of work consists of the following main tasks:

- **Definition of 'Real' Offshore Wind and "Nearshore" Wind for Vietnam**
  This is an investigation of the fundamental criteria for 'real' offshore wind vs. nearshore/intertidal wind in Vietnam. These criteria should support the development of a new regulatory framework for offshore wind and help discern which projects should be eligible for it.

- **Considerations of Power Capacity Density (MW/km2) for 'Real' Offshore Wind**
  This is a study of power capacity density in selected reference countries to estimate how much sea area is required for an offshore wind project and an assessment of relevant power density capacity requirements for the Vietnamese sites.

- **Considerations in Relation to Seabed Rental Fees**
  This is a discussion of the consequences of seabed rental fees for the Vietnamese offshore wind market.

- **Critical Elements and Evaluation of Offshore Wind Applications – International Best Practice'**
  This is an investigation of best practices for handling offshore wind in selected reference countries and recommendations for the Vietnamese market.

- **Guidance Note for Authorities' Appraisal of Offshore Wind Applications in Vietnam**
  This is a memo containing a practical 'checklist' of most critical pre-conditions, elements, and criteria in the evaluation of an application as well as ensuring conditions to be included in the permits awarded and examples of consequences in case of non-compliance.

1.3 Vietnamese Offshore Wind Sites

In this study, COWI has focused on the spatial areas for fixed and floating foundations determined by WBG in [1] shown in Figure 5 and the most feasible sites determined by C2Wind in [2].

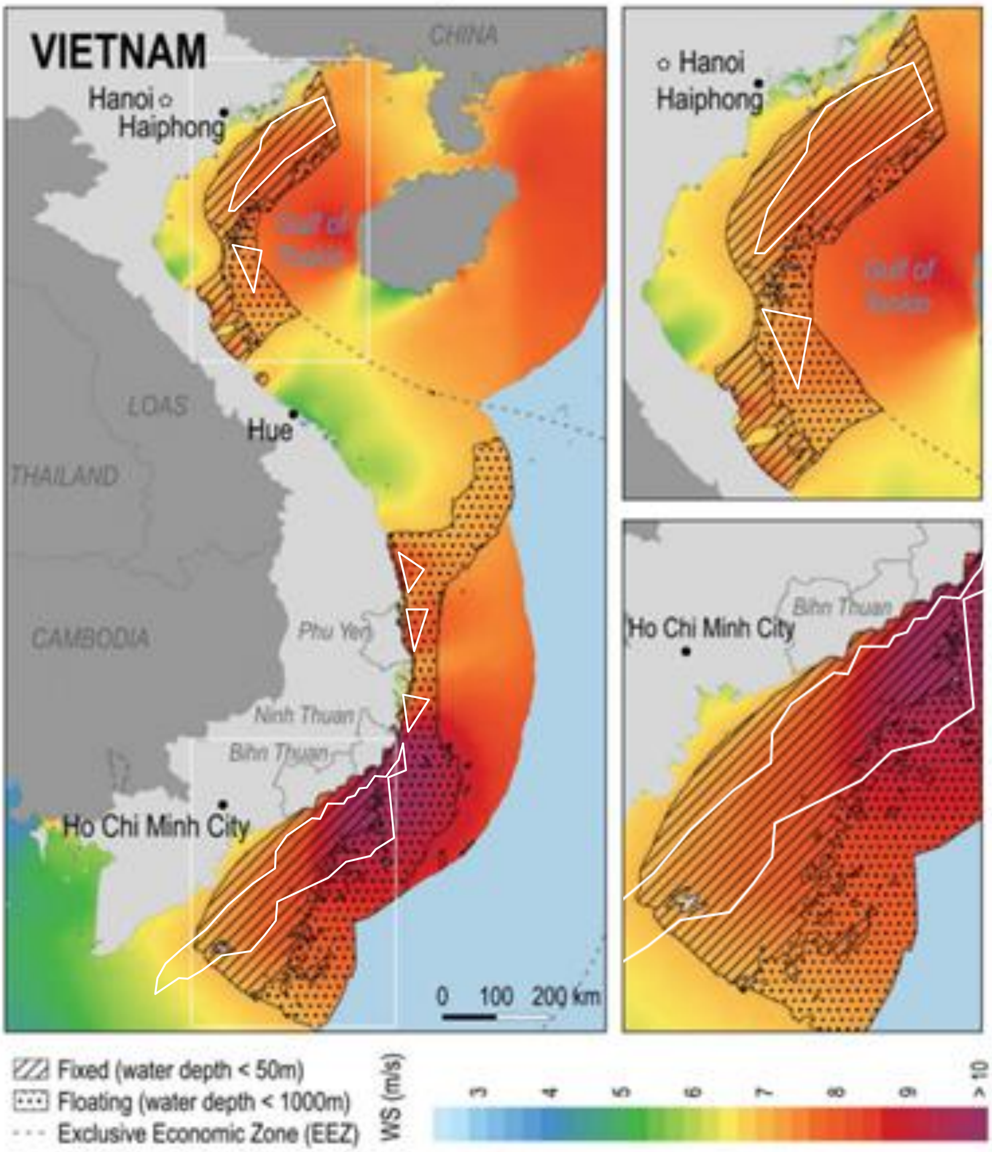


Figure 5. Maps show water depth and wind speed [1] with most feasible sites [2] outlined. Credits for the original background image: WBG

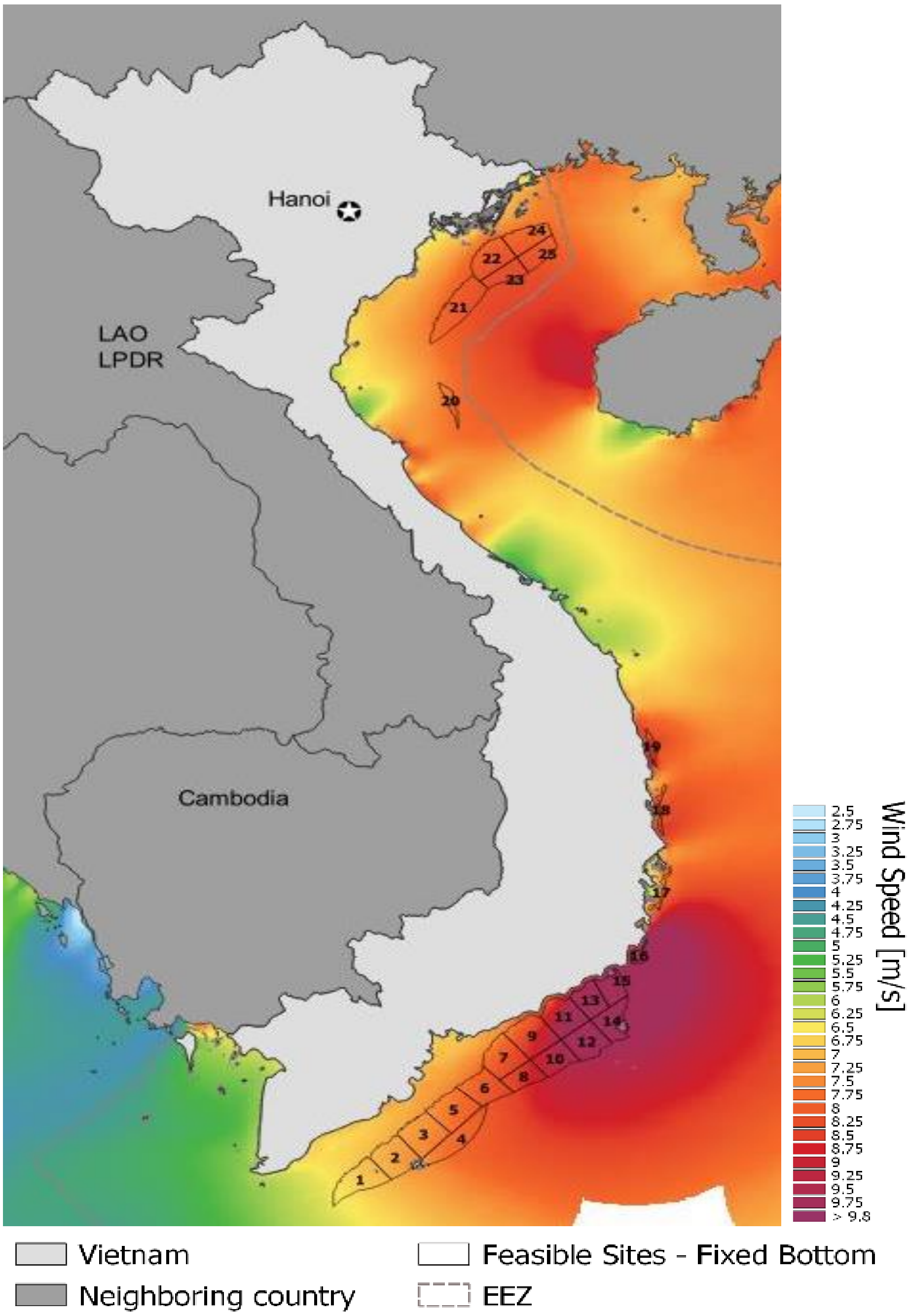


Figure 6. Lowest cost area for the first bottom fixed GWs of offshore wind deployment in Vietnam based on country-wide LCOE ranking incl. grid costs for standalone projects [5]. Credits for the site layout: C2Wind

1.4 Reference Countries

The reference countries for the comparisons and evaluation of best practices are Germany, United Kingdom and Denmark in this project, due to their positions as countries with the most significant experience in developing sustainable offshore wind markets.

2 Nearshore and Offshore Wind Criteria

2 Nearshore and Offshore Wind Criteria

Generally, nearshore wind farms are built and operate close to shore, usually at distances of up to a few kilometres from the shoreline, depending on the local criteria for each country (can be between 0km and 20km). The nearshore farms are also normally situated in shallow waters, from 0-10m deep. These combined circumstances make the construction and operation costs lower compared to offshore wind farms. Expenditures with turbine foundation, electrical systems (e.g., cabling, grid connection), operation, and maintenance are also lower.

Offshore wind farms are built further from the coastline. It is more costly to build and operate offshore wind farms in comparison to nearshore and onshore assets. On the other hand, wind energy conversion benefits from higher and more stable wind speed in the offshore area allowing a higher electricity production. Also, the environmental, visual, as well as social impacts are lower, rendering the overall solution more sustainable, which is more compatible with criteria for international financing.

2.1 International Criteria Experience

2.1.1 Germany

Germany accounts for the third biggest installed offshore wind capacity worldwide, with more than 7.7 GW [1].

The German offshore wind regulatory framework distinguishes nearshore from offshore wind farms. In this regard, the projects located within the territorial sea, i.e., up to 12nm away from the shore, are administered by the federal states (Bundesländer), whereas the ones in the German EEZ (from 12 to 200nm) are administered by the Federal Maritime and Hydrography Agency (BSH). This is understood to be the key criterium distinguishing nearshore from offshore wind in the country.

BSH operates as a one-stop shop for developers' interaction with the authorities in the German EEZ.

Although most wind farms in Germany are located beyond the 12nm boundary, the first few pilot projects were installed nearshore. Only in 2010, the first German offshore wind farm was installed 60km away from the coast, at 30m deep waters [5]. Currently, less than 4% of all the offshore wind installations in Germany are located nearshore, on waters between 0.5m and 23m deep, and up to 16 km from the coastline. The remaining 96% are located on waters of up to 42m deep and up to 115 km from the shore [6].

2.1.2 Denmark

Denmark is the first country in the world to install an offshore wind farm, almost 30 years ago (i.e., 1991 – Vindeby offshore wind farm with 11 x 450 kW wind turbines). Currently, it figures within the top 5 countries with the biggest offshore wind installed capacity in Europe, accounting for 1.7 GW [7].

The Danish Energy Agency regulates the national energy sector, including nearshore and offshore wind farms and act as a one-stop shop for the developers' interaction with the authorities. Within 15km range, municipalities in the coastal areas have veto power on the projects. The agency considers real offshore wind farms to be located outside 20km from the shore.

From the fully commissioned offshore wind projects in Denmark, given the shallowness of the country's EEZ, the deepest foundations barely reach 20m, at sites up to 30km from the shore. Nevertheless, in contrast with the German scenario, there is some balance between the nearshore and offshore installed capacity in Denmark (roughly 55% / 45% respectively), which can be mainly associated with the country's limited EEZ, narrowed down by the EEZs of the neighbour countries [6].

2.1.3 United Kingdom

The UK leads the global ranking of offshore wind installed capacity. The national offshore wind sector is regulated by The Crown Estate, which works as a one-stop shop for developers on behalf of the monarchy in the leasing and permitting process of OWFs.

The Marine Management Organisation is the institution responsible for preparing and issuing the national Maritime Spatial Plan in the UK. According to their criteria, and similarly to the German approach, sites located within 12 nautical miles range from the shore are named "Inshore," whereas the sites located outside that range (and up to the boundaries for the national EEZ) are called "Offshore."

In the UK, around 60% of the offshore wind installations are located within the 12nm range, in waters up to 60m deep, therefore, considerably deeper than the Danish and German territorial seas. The remaining 40% comprise the 'real offshore' category, reaching 120km from the coast at the furthest point and up to 110m deep in the single project-scale floating offshore wind farm so far commissioned in British waters [6]. The future offshore wind farms selected in the round four tender process are all located outside the 12nm boundary.

2.2 Vietnamese Jurisdiction at Sea

The Vietnamese spatial planning hierarchy is defined as per Decree 11/2021/NĐ-CP from February 10th, 2021, as illustrated in Figure 7. The boundary between PPC and MONRE jurisdiction offshore is set at 6nm from the coastline.

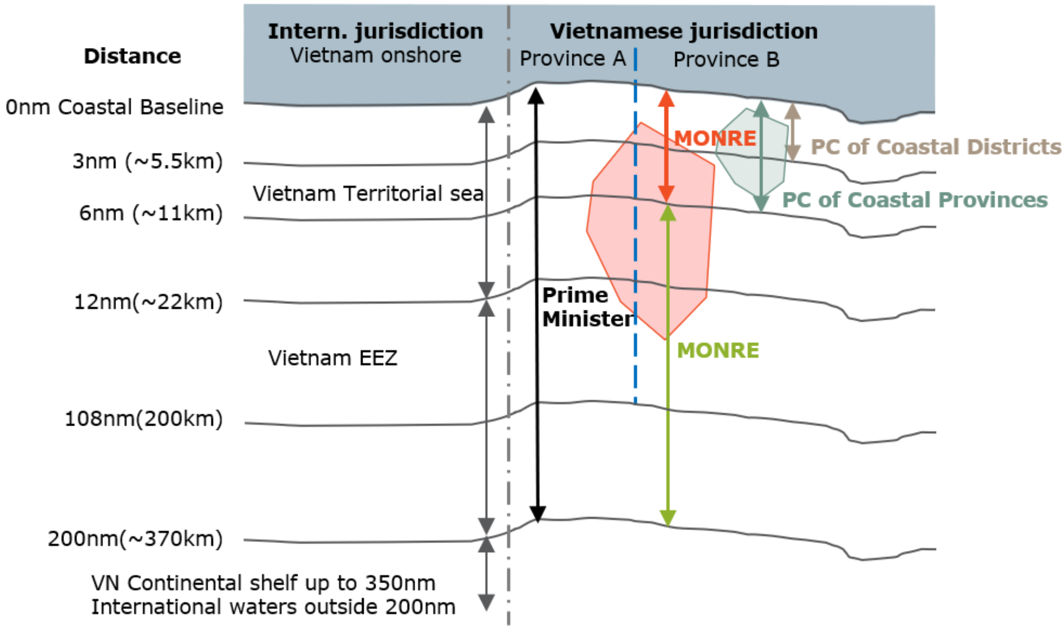


Figure 7. Maritime Spatial planning and hierarchy in Vietnam

The decree defines the following order of priority in terms of governance:

- National assembly and government
- Prime Minister
- MONRE (beyond 6nm): All sites
- MONRE (within 6nm): Sites located in two provinces and sites with foreign investors
- PC of CP:(<6nm): Sites in the province. Shall be registered with MONRE
- PC of CD:(<3nm): Aquaculture only

There is a hierarchy also in terms of the planning itself, as it follows:

- Maritime spatial planning
- Coastal exploration and utilization planning within 6nm from shore
- National sector planning
- Regional planning
- Provincial planning

2.3 International Financial Criteria

Offshore wind is a clean and reliable source of energy that has significant potential to decarbonize the power sector and thereby the consumers of the energy production. However, they are also capital-intensive projects, requiring significant investment in developing the project as well as enabling infrastructure (such as grid improvements and power offtake infrastructure, supply chain improvements, etc.). Therefore, it is considered important that the offshore wind industry in Vietnam has access to various international financing instruments that would allow large capital investments inflows in offshore wind development.

The Equator Principles [3] are adopted by approximately 123 key financial institutions covering the majority of international project finance debt within developed and emerging markets. They are essentially the tools that assist international financial institutions in determining and managing environmental and social risk in financing. These standards are primarily based on the IFC Performance Standards on social and environmental sustainability and on the World Bank Group Environmental, Health, and Safety Guidelines, which consists of 10 environmental and social standards (ESS) as follows:

- **ESS 1:** Assessment and management of Environmental and Social Risks and impacts
- **ESS2:** Labour and working conditions
- **ESS3:** Resource Efficiency and Pollution Prevention and Management
- **ESS4:** Community Health and Safety
- **ESS5:** Land Acquisition, Restriction and Land use and involuntary Resettlement
- **ESS6:** Biodiversity conversation and sustainable management of living natural resources
- **ESS7:** Indigenous Peoples / Sub – Saharan African underserved traditional local community
- **ESS8:** Cultural Heritage
- **ESS9:** Financial Intermediaries
- **ESS10:** Stakeholder Engagement and Information Disclosure

Offshore wind farms by its nature have potential to significantly impact the marine ecology, if they are not carefully planned and constructed adopting the good environmental practices. Internationally, in accordance with Equator Principles, such impacts are avoided by carefully selecting the sites and avoiding areas known to support diverse marine habitats. In most geographies, such habitats are identified and designated, where relevant, as Marine Protected Area (MPAs), Key Biodiversity Areas (KBAs), National Parks (NPs), Nature Reserves, Ramsar and locally protected wetlands and World Heritage Sites. These protected areas are usually not considered for offshore windfarms development unless sustainable solutions for coexistence can be obtained. Further, there are several important natural marine habitats that are sensitive to impacts. These habitats include coral reefs, seagrass beds, mangroves, and nearshore flats. They also provide feeding grounds to resident and migratory bird species. Most of such sensitive habitats occur in shallow coastal waters and are therefore vulnerable to nearshore project development.

Legislation in Vietnam requires developers to prepare an ESIA (Environmental and Social Impact Assessment) for approval by MONRE for all offshore wind projects; however, they are generally not considered a suitable, international, industry standard of ESIA [1]. There is no specific institutional framework for Marine Protected Areas (MPAs). In practice, these areas are often multiple use and managed by Provincial Peoples Committee (PPC) and other provincial sectoral agencies.

COWI recommends Vietnam to apply environmental standards consistent with international standards and aligned with the Equator Principles to the offshore wind development to protect, sustain and potentially improve the environment. This is also necessary to make the offshore wind industry attractive to international investors and financial institutions.

There is currently a clear need for institutional strengthening to ensure that such international environmental standards will be applied in Vietnam and for offshore wind as well.

2.4 Sensitivity Studies of 'Real' Offshore Criteria

The criteria wind speed, water depth, distance from shore investigated for offshore wind are ambiguous in the more mature reference countries. To assess the impact of these criteria, COWI made a sensitivity study of the effect of the different criteria on the available area for offshore wind. The results are shown in Table 2 and Table 3. Maps showing the different criteria are available in Appendix A.

2.4.1 Wind Speed

The wind speed is, in general, very high in the reference countries, being above 9m/s at 100m in all the marine areas.

In Vietnam, the Wind Speed is less intense, varying from about 2.5m/s to approx. 10m/s in limited areas.

With the currently available WTG technology, wind speed above 7m/s is required to have acceptable power production in a wind farm. Therefore, this lower boundary is fixed at 7m/s, which is also the criterion in the WBG report [1].

The area with this wind speed limit and above is shown in Figure 8.

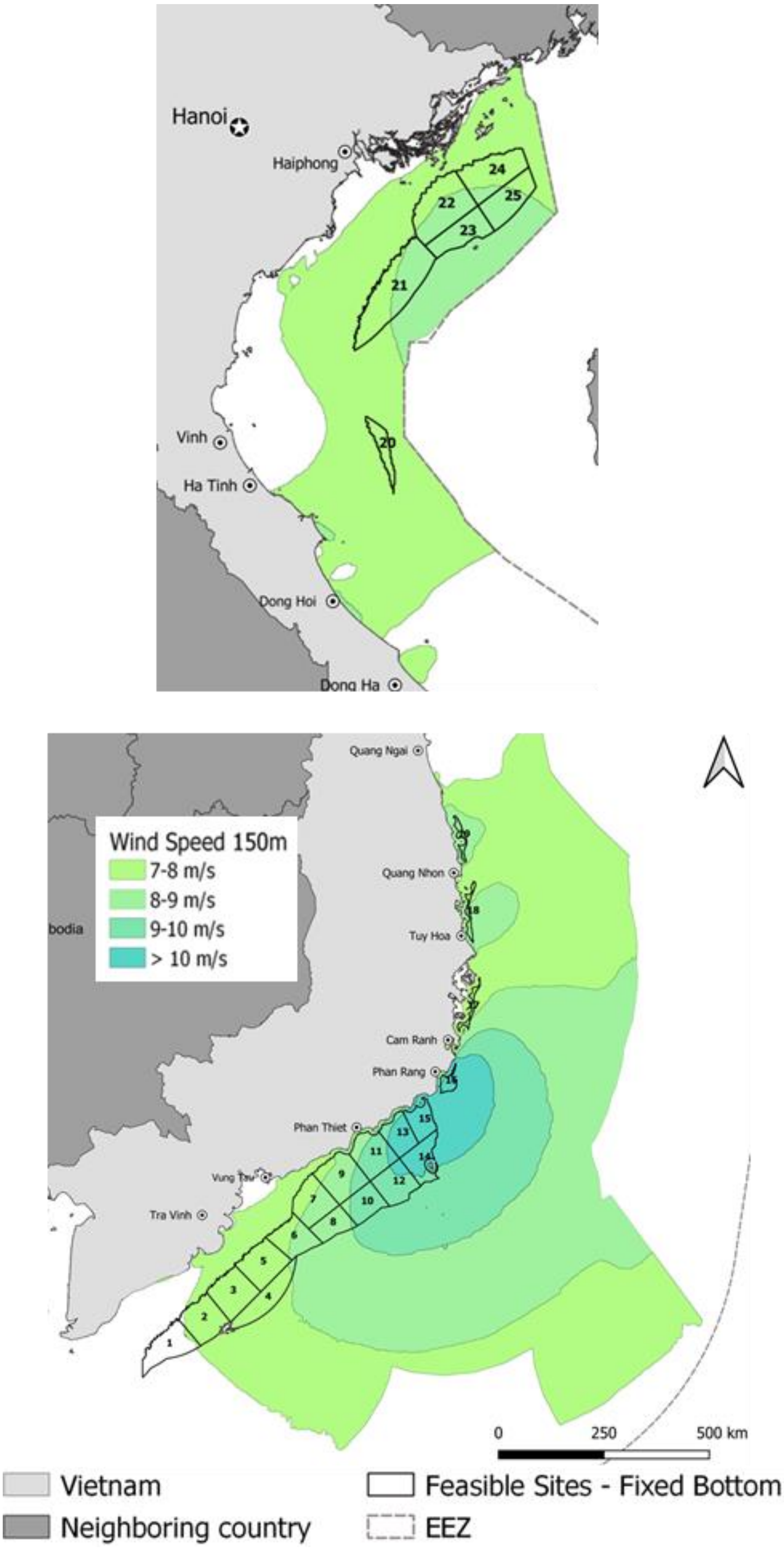


Figure 8. Wind speed map with reference sites for wind speed above 7m/s

It is seen that site one from [2] is outside the wind speed zone, and therefore it is excluded from the areas/sites assessed in this sensitivity study.

2.4.2 Water Depth

The water depths being discussed in this report are all measured from the lowest average tide (LAT) and they are:

- **Minimum Required Water Depth**
  10m and 15m water depth are selected to allow for installation and O&M with traditional installation vessels in the mature industry as well as modern service operation vessels, and at the same time to have a reasonable assumption that marine life is only marginally affected. This is disregarding special breeding areas and the like, which shall be addressed in the EIA to avoid environmental damage and social impact.
- **Transition Water Depth for Fixed and Floating Foundations**
  Transition water depth is set to 40m, 50m, and 60m, as the boundary continues to move to deeper water with more advanced foundation technique and shallower water with increased WTGs.
- **Maximum Water Depth**
  1000m water depth, which is currently expected to be the technically feasible and viable limit for anchoring of floating foundations.

The maps presenting the water depths are shown in Figure 9 and Figure 10.

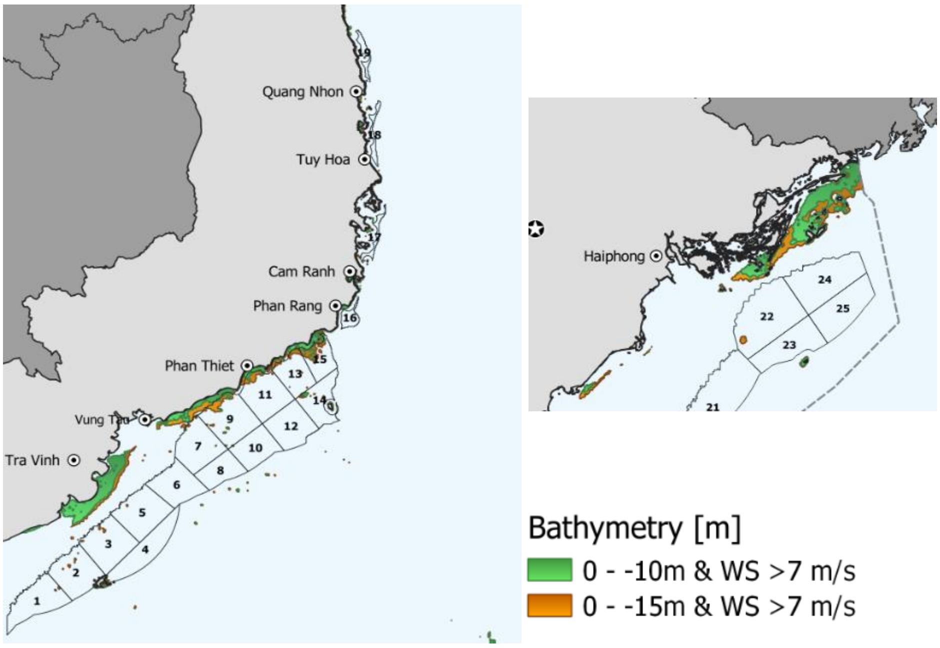


Figure 9. Overview of water depth below 10m and 15m respectively, and wind speed above 7m/s.

According to Figure 5 the 10m water depth has almost no impact on any of the selected sites, however site 9 and 15 are affected by an upper boundary of 15m water depth.

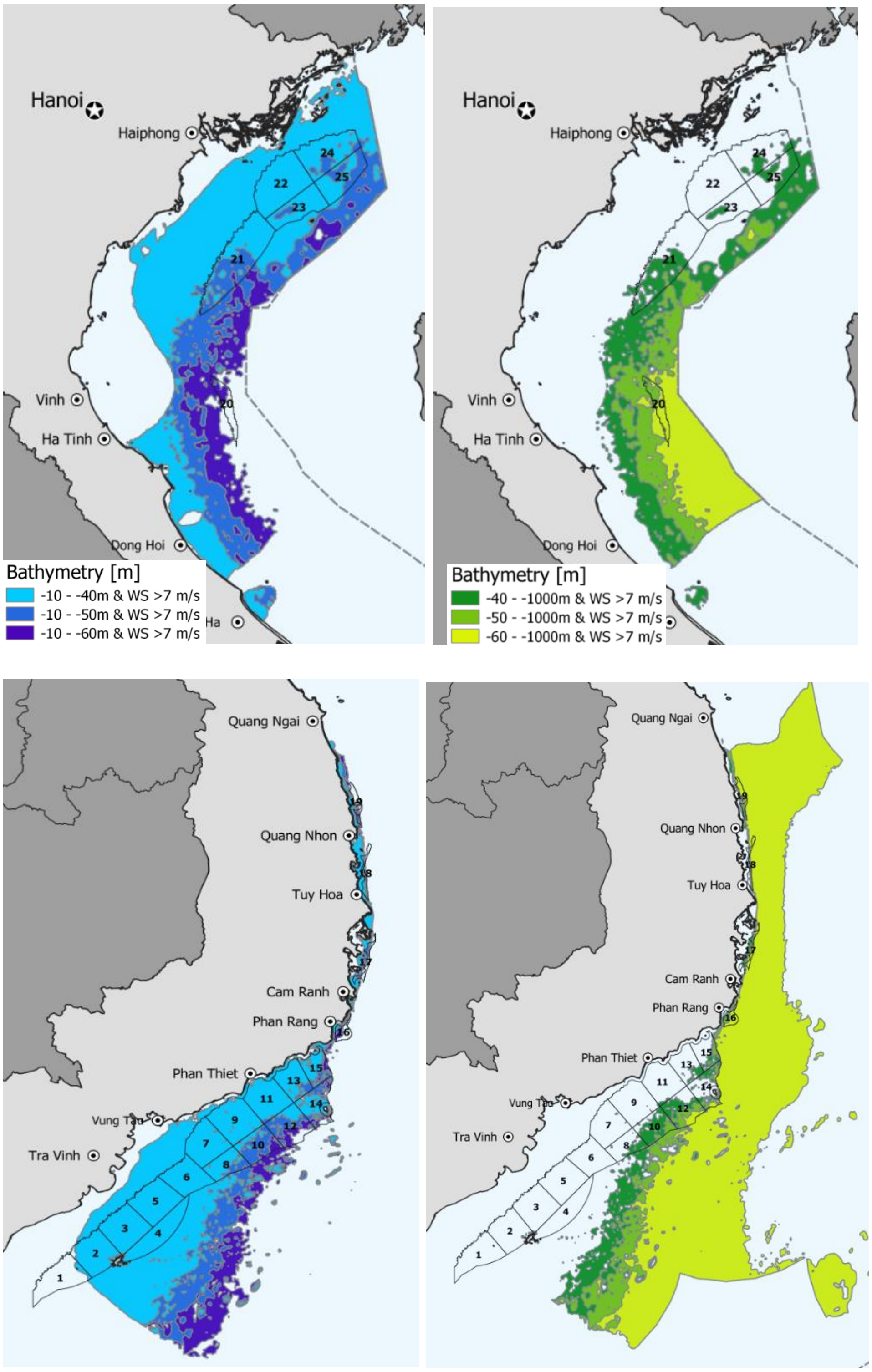


Figure 10. Overview of available sea area within 200nm from shore and wind speed above 7m/s with water depths between 10m and 1000m, including the effect of transition between fixed and floating wind at 40m, 50m, and 60m, respectively.

It is seen that it has effects on some of the sites to set the water depth boundary between fixed and floating foundations. Sites 10, 12, 14, and 20 have sections with water depths beyond 60m. Site 20 is reduced to approximately 40%, and all available area is between 50m and 60m water depth. It could be considered to move the site towards the West to shallower water, as the wind speed is still above 7m/s.

As the foundation technology advances and experience grows, it is difficult to define this transition boundary at a reasonable level, and it should be up to the preferred developer to decide which technologies are applied.

2.4.3 Distance to Shore

The distances to shore in this investigation are the following:

Distance from shore	Jurisdiction cf. section 2.2
0nm-3nm (approximately 5.5km)	Districts for aquaculture
0nm-6nm (approximately 11km)	Provinces with MONRE approval
6nm-12nm (approximately 22km)	MONRE – VN territorial waters
12nm-108nm (approximately 200km)	MONRE

The outer boundary of 200km is selected as it is assessed to be the limit for an offshore wind farm to allow for viable export cable setups. In certain areas the Vietnamese EEZ is closer to shore than 200km, hence the EEZ will be the outer boundary. The maps presenting the distance to shore with wind speed and water depth are shown in Figure 11.

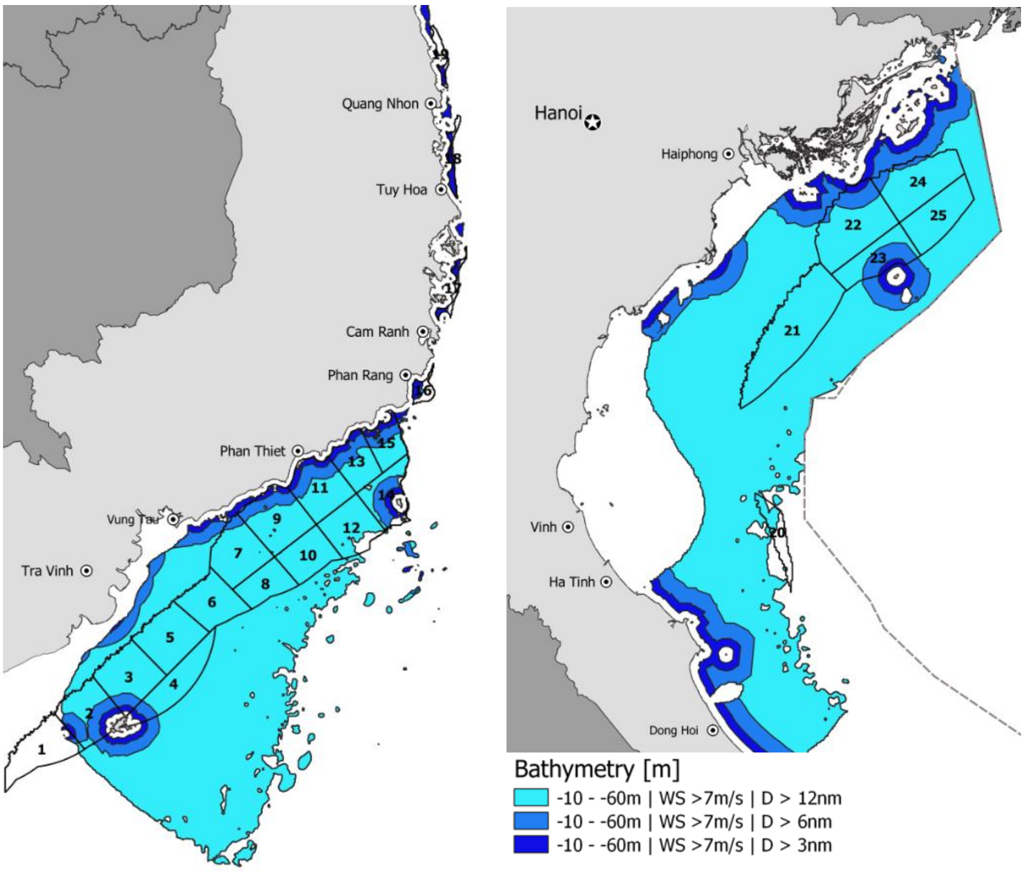


Figure 11. Overview of available sea area wind speed above 7m/s, within 10m-60m water depth at a distance to shore larger than 3nm, 6nm, and 12nm, respectively.

The areas limited by water depth between 10m-40m, 50m, and 60m–1000m, as well as wind speed above 7m/s, are calculated by GIS measurements, and the resulting areas are calculated for the whole area in Table 2 as well as for the feasible sites [2] in Table 3.

Table 2. Areas for fixed and floating foundations with wind speed >7m/s

Areas in x1000 km²		**Distance from shore**		
Type	Water depth	>3nm	>6nm	>12nm
Fixed foundation Lower boundary 10m water depth	0-10m	1.7	0.6	-
	10-40m	63	58	48
	10-50m	84	79	67
	10-60m	101	95	83
Fixed foundation Lower boundary 15m water depth	0-15m	3.5	1.4	-
	15-40m	61	57	47
	15-50m	83	78	67
	15-60m	99	94	83
Floating foundation (inside 108nm & EEZ)	40-1000m	124	121	113
	50-1000m	103	100	93
	60-1000m	87	84	78
Sum	10-1000m	188	180	161
	15-1000m	186	179	160

The difference in total area between 10m and 15 m water depth is approximately 1800km² (approximately 1%) outside 3nm, approximately 900km²(approximately 0.5%) outside 6nm and approximately 200km² (approximately 0.1%) outside 12nm. Hence it will have insignificant effect on the overall available development areas.

Area for fixed foundations is reduced by approx. 4-6000km² (4-%) moving the boundary from 3nm to 6 nm and 10-12000km² (approximately 13-15%) moving the boundary from 6nm to 12nm.

For floating foundations, the area is reduced by approximately 3000km² (approximately 3%) moving the boundary from 3nm to 6 nm and approximately 8000km² (approximately 6-8%) moving the boundary from 6nm to 12nm.

Table 3. Fixed foundations in affected feasible sites [2] in water depth 10-60mLAT and wind speed >7m/s

C2Wind				**Distance from shore**					
>5km				**>6nm**			**>12nm**		
Site ID[1]	Area (1000km²)	Power Capacity (GW)	Density Capacity (MW/km²)	Area (1000km²)	%	Power Capacity (GW)	Area (1000km²)	%	Power Capacity (GW)
2[2]	2297	5	2.13	1824	79	3.9	1016	44	2.2
3	2464	7	2.84	2379	97	6.8	2127	86	6.0
4	2160	6	2.78	1970	91	5.5	1769	82	4.9
5	2440	7	2.87	2440	100	7.0	2440	100	7.0
6	1998	5	2.50	1998	100	5.0	1998	100	5.0
7[2]	2246	6	2.50	2245	100	5.6	2102	94	5.3
8	1381	6	4.34	1381	100	6.0	1381	100	6.0
9	2562	11	4.29	2369	92	10.2	1806	70	7.8
10	1676	7	4.18	1675	100	7.0	1675	100	7.0
11	2244	10	4.46	1937	86	8.6	1359	61	6.1
12	2028	9	4.44	1750	86	7.8	1750	86	7.8
13	1531	7	4.57	1316	86	6.0	905	59	4.1
14	1573	7	4.45	1184	75	5.3	628	40	2.8
15	1198	5	4.17	949	79	4.0	624	52	2.6
20[3]	469	1	2.13	176	38	0.4	176	38	0.4
21	2502	7	2.80	2502	100	7.0	2502	100	7.0
22[2]	1872	5	2.91	1803	96	5.3	1476	79	4.3
23	1030	3	2.91	970	94	2.8	580	56	1.7
24[2]	1477	4	2.63	1477	100	3.9	1322	90	3.5
25	1141	3	2.63	1141	100	3.0	1141	100	3.0
Sum	36289	121	-	33485	-	111	28778	-	94
Remaining				**92.2%**	**91.7%**		**79.3%**	**77.7%**	

Note 1: Site 1 is not included in this assessment as the wind speed is below 7m/s
Note 2: The sites were not included in shortlisted sites in [2]. Capacity has been assessed in this study based on average wind speed and power capacity density in similar sites.
Note 3: Site 20 is reduced as water depth is more than 60m and not due to distances to shore, which is not reflected in [2]. Moving the site towards West could place it in shallower water still with wind speeds above 7 m/s.

The overall area and power capacity for the selected sites is reduced by approximately 8% at the 6nm boundary and approximately 22% at the 12nm boundary compared to the C2Wind study.

3 Seabed Lease

3 Seabed Lease

A seabed lease is a lease that the user of an ocean area pays for the right to use in this section. However, the fundamental mechanism is unchanged – the user of a nation's ocean area is required to pay for the right to use it. Seabed lease can be used to achieve several objectives:

- **Screening of Developers**
  Requiring developers to pay seabed lease and option fees during the development phase can contribute to weeding out developers that lack commitment.
- **Incentivizing Efficient Use of Maritime Space**
  All uses of maritime space bring with it an opportunity cost as it may block other uses. Seabed leases monetize this opportunity cost and may contribute to distribute maritime area rights to the most profitable uses. Seabed leases may also incentivize the coexistence of uses through discounts for allowing other uses to coexist.
- **Taxation of Value Creation from Natural Resources**
  Mining and oil extraction are prime examples of natural resources that would typically be taxed to retain the value of the resource within the country. The same approach could be applied to wind resources.
- **Cost Recovery of Administration**
  Managing the permitting and licensing for large offshore projects not only puts a burden on the developer but also on the relevant government agencies. Seabed lease and other fees can be used as a way of recovering the salary and opportunity cost of having government officials work on the permitting and licensing.

Currently, the seabed leasing process for offshore wind applications in Vietnam occurs within the frameworks of the early project development stages. It includes several steps, as described in the following.

To be able to apply for the seabed leasing process, the project developer needs to have their project listed either in the national PDP or the provincial PWPDP, depending on its location. This can be achieved after the developer submits a pre-feasibility study to the MOIT or the Prime Minister. The process is further described in Section 5.2.

Once the project is listed in one of the plans, the project developer shall execute a feasibility study officially approved by MONRE (or the provincial People's Committee) through a site survey license. Likewise, a marine space assignment is to be granted from the same entity. After approval from the Prime Minister, the surveys can be initiated [1].

Subsequently, the project developer must be granted a seabed lease approval to be entitled to the sea area for the project. Such approval is either granted by the Prime Minister or MONRE (for projects beyond three nautical miles from the shore) or the provincial People's Committee (for projects within the three nautical miles stripe). The latter also needs to provide a land lease decision regarding the use of onshore land for some project facilities (e.g., cabling, onshore substations, etc.) [8].

The current process is subjected to changes or adaptations following the upcoming Maritime Spatial Plan being prepared by MONRE (offshore) and the provincial People's Committees (nearshore), which will arrange the Vietnamese marine territory in a way to allocate zones and organize sectors and fields for the distinct activities being conducted in these areas [8].

The rental fees are set in decree 11 of February 10, 2021, in the range of 3,000,000 to 7,500,000 VND/ha/year (article 34), equivalent to between 128 USD and 319 USD per year for seabed area allocation of one hectare, varying according to MONRE's or the provincial department's decision based on environmental and socioeconomic aspects. Specific information on the incidence of the fee in terms of space and timeframe is, nevertheless, still unclear. It is, for example, unclear whether the rental fee is for the whole wind farm area or just the physical area blocked by the turbines [1]. Assuming it is for the entire wind farm area, a capacity density of 5 MW / km² and a lifetime of 25 years, this is equivalent to between 2600 and 6400 USD/MW/year. Further assuming a capacity factor of 50%, it is equivalent to between 0,6 and 1,5 USD/MWh of added LCOE.

Developers will seek to recoup seabed rental fees by transferring the cost onto consumers by increasing the electricity price. Rental fees also increase the generation capacity density of offshore wind farms, which increases wake and blockage effects and make wind turbines less efficient, further increasing the LCOE [9].

Rental fees for offshore wind could be seen as a tax on renewable and thus as an indirect subsidy to fossil fuels.

Rental fees will make the renewable energy from offshore wind less competitive in the Vietnamese energy generation mix.

3.1 Economic Impact of Seabed Lease

Seabed lease can be designed in numerous ways, as the international experience summarized in the following sections will illustrate. However, regardless of how the lease is designed, there is no way around the fact that a seabed lease will be an added cost to the developer and hence contribute to driving up the LCOE of a project.

The impact on the electricity price depends in part on how electricity is traded and in part on subsidy schemes in place for offshore wind.

Trading electricity on the market, such as the ones used in Europe, means that there is not a direct link between the LCOE of a specific site and the price of electricity. The price of electricity instead depends on the availability and bids of multiple competing IPPs and the demand for electricity. Thus, the individual offshore wind farm is only dispatched for generation if the bid from that farm falls below the cut-off price determined in the market. Therefore, it is not likely that the developer paying a seabed lease will be able to fully transfer this cost to the consumer.

If electricity is traded through PPAs or other fixed price and long-term agreements, then the price of electricity from the offshore wind farm will be closely linked to the LCOE, and the seabed lease will very likely be fully transferred to the consumers or will have to be absorbed by the government through other subsidy schemes.

Regardless of how electricity is traded, the seabed lease will make the project less profitable and hence more likely to need government funding/subsidies to develop.

In Northern Europe, the LCOE of offshore wind has dropped significantly over the last 5 years. However, public funding is still needed e.g., by CfD securing a minimum price on the power produced. When subsidies are no longer needed, seabed leases may be a way for governments to extract higher than normal profit from the offshore industry just as is done for, e.g., offshore oil exploration.

In essence, the seabed lease is a tax on offshore activities within the territorial waters of a nation. If the offshore wind projects need government subsidies to be developed, then seabed leases merely contribute to taxing the government, as the seabed lease will drive up the need for subsidies.

It is important to note that if a country decides to go with a seabed lease despite the identified negative consequences for the LCOE, there are some design choices that can alleviate the negative impacts. Namely the lease should be proportional to the value of the natural resource the lease gives access to. Otherwise, the seabed lease could result in inefficient bidding behaviour from developers or result in a lack of interest from developers. Thus, two guiding principles for a fair seabed lease could be:

› The seabed lease should only be for the actual area, which is used for offshore wind. It should not cover a greater area where other users have access.
› The seabed lease should be proportional to the value of the natural resource. This could take the form of leases that are linked to the actual electric generation from the site.

3.2 International Experience with Seabed Lease

Seabed rental fees are not commonly found for offshore wind. However, they have been introduced to some notable markets, such as the USA, the UK, the Netherlands, as well as Vietnam. Markets such as Germany and Denmark do not have rental fees in place. In addition to leasing fees, there are also option fees found in some markets, which allows the developer to abandon the project for the cost of the option fee. Auctions for these options have received a lot of attention recently. Particularly in the UK, the auctions were criticized for not making enough capacity available, which pushed the price of the auctions to a very high level compared to the rest of the world. There has likewise been criticism of option fees being too low when combined with 1-way CfD-auctions[1], which have led to zero-subsidy bids. The criticism is that developers, in many cases, have an incentive to pay the option fee and withdraw from the project if future offshore wind technology cost reduction and future power spot price increase are not satisfied [10]. The total effect of rents and options on the LCOE for different countries are presented in

[1] CfDs with an established lower bound for the price, which consequently establishes a minimum revenue for the OWF, but without a cap, as for the 2-sided CfDs, meaning a theoretically unlimited revenue for the project developers [44].

Figure 12. The basic LCOE of 101 USD/MWh is based on the expected costs of developing offshore wind in Vietnam [2]. In the referenced countries it is expected to be lower.

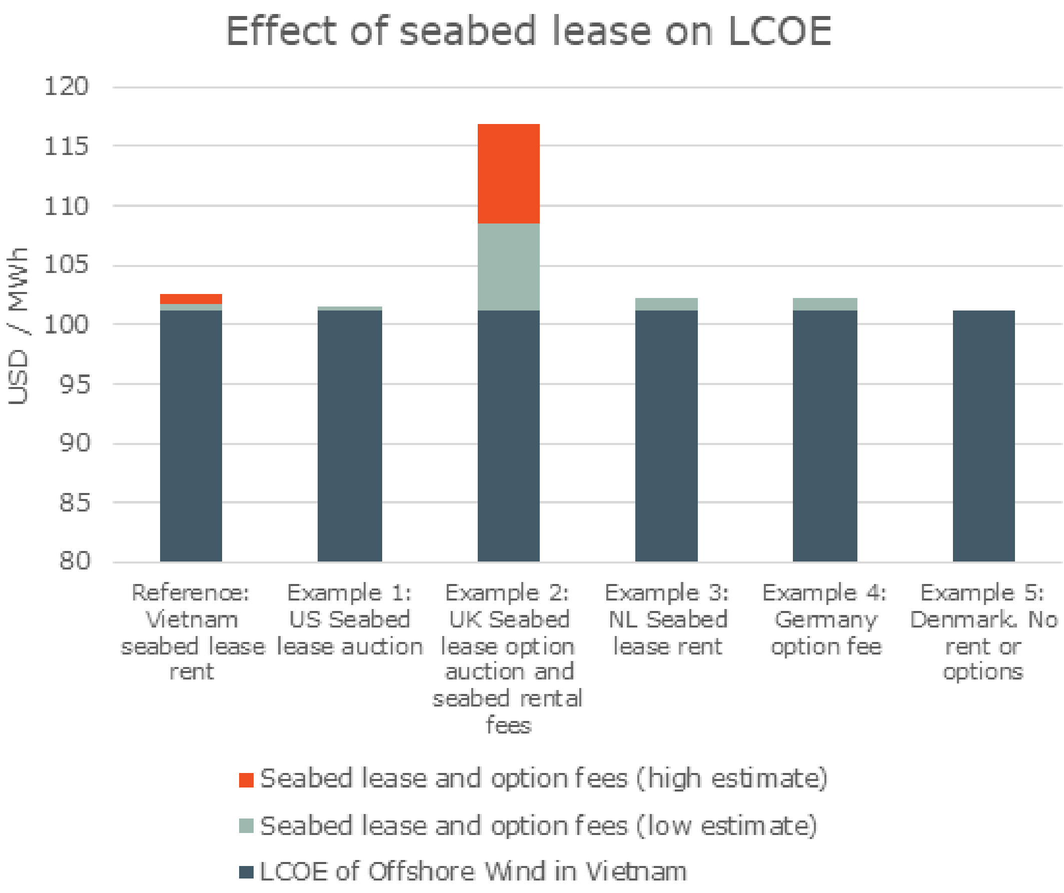


Figure 12. Size and effect of seabed lease and options on LCOE in Vietnam, US, UK, Netherlands, Germany, and Denmark. Source: COWI research for this report.

3.2.1 Germany

The seabed within the German territorial sea, i.e., up to 12 nautical miles from the shore, is owned by the states (Bundesländer) following their respective coastlines. The right of use or seabed lease for OWF installations (WTG and BoP) is granted within the corresponding planning approval, described in Section 5.1.1. For the German EEZ, although the State has some sovereign rights, the seabed has no official owner, meaning that no land rights are needed for developing projects there. The relevant permits for land use are likewise granted within the planning approval framework, in this case, provided by the Federal Maritime and Hydrographic Agency (BSH), which regulates the wind farms in the area [8].

Although there is no seabed rent in Germany, developers must pay an option fee of 100 EUR per kW installed capacity. Assuming a lifetime of 25 years and a capacity factor of 50%, this is equivalent to 1.1 USD/MWh in LCOE terms. The option allows developers to abandon the project, but they must pay the fee whether they abandon it or not.

3.2.2 Denmark

The Danish State owns property rights over the territorial waters and EEZ in Denmark. The right of offshore wind energy production from other parties, i.e., offshore wind developers, is granted through a license issued by the Danish Ministry of Climate, Energy, and Utilities, either via an open-door procedure or tenders, as further described in Section 5.1.2 [8].

Furthermore, the project developer is responsible for eventually compensating local landowners if the onshore cable routes cross their properties, as well as fishermen in the concerned area [8].

The licenses granted through the permitting processes for OWFs in Denmark do not represent ownership to the concerned areas by the developers, meaning that although the right for producing electricity is granted, the territory property remains to the State [8]. Developers pay no rent for leasing the seabed but must pay for preliminary surveys prepared by the Danish electricity TSO Energinet. The total costs of these surveys amount to 151m DKK (24m USD) for the Thor offshore wind tender of 800 to 1000 MW [11].

3.2.3 United Kingdom

The seabed leasing for offshore wind development in the UK is administered by the Crown Estate, an enterprise owned by the British Monarch which holds periodic leasing rounds for OWF developers interested in executing their projects in England, Northern Ireland, and Wales (Since 2017, Crown Estate Scotland manages leasing contracts in the Scottish territorial sea and adjacent areas of the UK's EEZ) [12].

In terms of land rights, the offshore wind project developers shall be granted with an Agreement for Lease from the Crown Estate, which provides seabed rights for the respective site; a Transmission Agreement for Lease, providing seabed rights for the cabling corridors of the exporting cable; and land rights for the onshore cabling corridor, through which the cable is to be connected to the British grid. For the Agreement for Lease, there is an expiry period of 10 years, during which the project developer shall comply with some milestones indicated by the Crown Estate [8].

For the first time in Europe, UK has introduced lease rights to be distributed by auctions. Six areas were made available to develop 8 GW capacity in total. The auction introduced a bidding system that makes developers pay an upfront option fee for the right to develop projects. This fee is to be paid annually until the final planning permission is granted, which could take up to 10 years. However, the expectation is that the permission is granted after four years. A Habitat Regulations Assessment[2] will be carried out after the auction – if mitigation measures are required, this could increase costs for the developer, and in the worst case, the project could be cancelled, and the developer would lose its deposit, equivalent to the first year of the option fee. The fees totalled 879m GBP per year [13]. After this stage, the developer is granted an Agreement for Lease with the Crown Estate and then receives the right to develop the project further. In this period, the developer should apply for and secure planning consent and secure a grid connection, which will take several years. Once the project is ready to begin construction, the

[2] Also known as Environmental Impact Assessment

developer can exercise its option and enter a 60-year lease with the Crown Estate, at which point the annual option fee no longer needs to be paid. However, during construction, around 0.9 GBP/MWh of expected minimum power production must be paid. When the plant is in operation and produces power, 2% of gross revenue must be paid in rent [14]. At a power price of 60 GBP/MWh, this is equivalent to 1.2 GBP/MWh in rent

It is expected that the developers will try to recover the option fee by applying higher bids for subsidy in the CfD-auction. This price will then be passed to consumers, as the CfD-subsidies are funded by a levy on the end-user power bill. This means that the option fee is basically a tax on the end-user.

4 Offshore Wind Capacity Density

4 Offshore Wind Capacity Density

The density of offshore wind farms relates to the cumulative power divided by the area of the wind farm and relates to the spacing between individual wind turbines. Offshore wind farms experience losses by wake and blockage effects which are described in subsections below. These losses have historically been underestimated by the whole offshore wind industry [15]. The effect of wind turbine spacing on wind farm efficiency becomes less with increasing wind speeds. The efficiency of wind farms in terms of minimizing wake and blockage losses increases with increasing wind farm area [16].

Typically, it is in the interest of society to achieve the lowest LCOE possible of offshore wind. Therefore, some countries have introduced regulations regarding the capacity densities in offshore wind tenders to minimize wake and blockage losses. Lower densities will lead to lower losses, but at some point, other effects become more costly, such as the intra-array electrical system, installation, cabling, and operation and maintenance. These effects have been modelled by ECN, showing that the lowest LCOE is achieved at capacity densities of 4.7 and 5.0 for 10 MW and 15 MW turbines, respectively, for the offshore Hollandse Kust 3 site in the Netherlands (Figure 13).

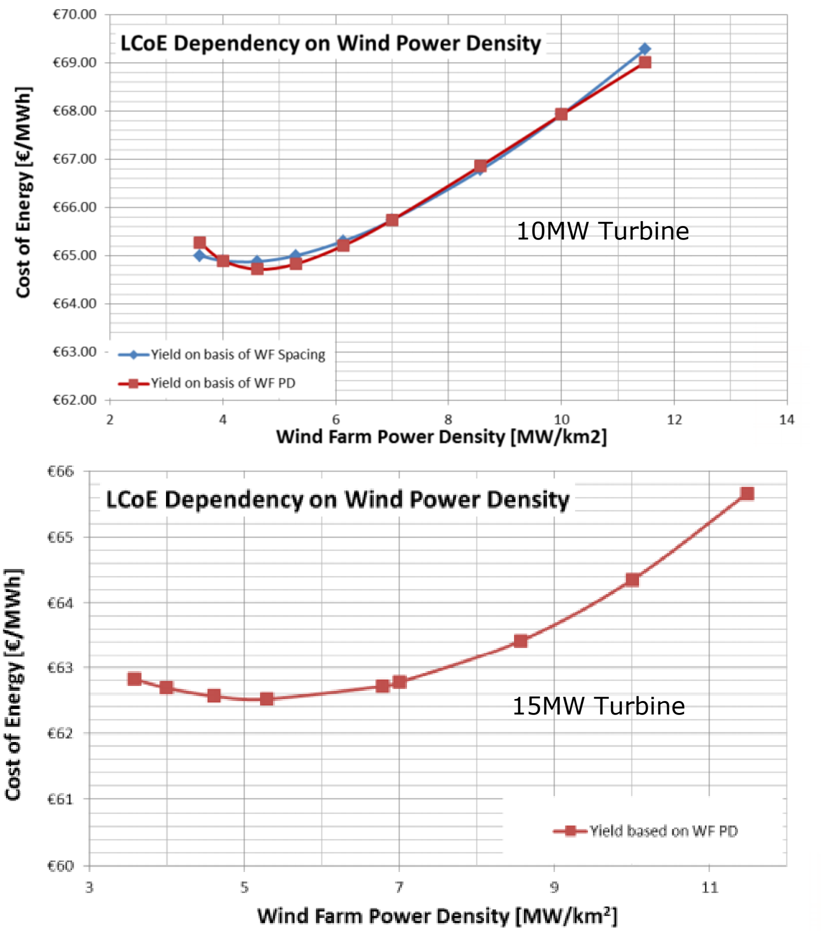


Figure 13. Dependency between LCOE and wind farm power density. The top figure is for 10 MW turbines, the bottom figure is for 15 MW turbines [9].

In Vietnam, there are no density limit regulations for offshore wind. It is up to the developer to define the optimal density based on economic optimization. C2Wind have made calculations for the optimal density for the locations presented in Figure 15 in section 3.

Wake Effect

Wind turbines extract wind, which leads to reduced wind speeds and increased turbulence downstream, causing downstream wind turbines to produce less power. Therefore, wind farms are typically designed with turbine spacing being larger in the prevailing wind direction. The wake effect can extend for tens of kilometres, which makes it an unavoidable effect of wind farms. Even neighbouring wind farms can experience wake losses between them. With turbine spacing equivalent to the diameter of 8 rotors, the wake effect losses are estimated at 16-17 % [16] and optimizing layouts can reduce these losses to less than 10%. The wake effect is illustrated in Figure 14.

Figure 14. Wake effect from wind turbines [16].

Blockage Effect

The blockage effect arises from the wind slowing down as it approaches the wind turbines, as the turbine provides resistance to the wind. There is an individual blockage effect for every turbine position and a global effect for the whole wind farm, which is larger than the sum of the individual effects. This means that downstream wind turbines can block the wind for upstream turbines, while the wake effect is the opposite, in which upstream turbines block the wind for downstream turbines. This effect has been underestimated and further studies indicate that this effect accounts for losses of 1-4% dependent on the chosen park layout.

4.1 Other Uses of Sea Areas

Not all ocean areas with a good wind resource are available for offshore wind farms. There are many other activities and uses of the ocean which compete for the available space, such as fishing, shipping, oil exploration, environmental protection areas, heritage, and tourism. To balance all these different uses requires careful maritime spatial planning. The uncertainty related to these unclear conditions on some of the most promising sites will add to the developers' risk premium.

Maritime spatial planning will impact the potential for offshore wind. The optimal locations for offshore wind are identified as in the map furthest to the right in Figure 15. These are the areas that see the lowest LCOE for offshore wind generation, based on water depth and wind resource availability, as illustrated on the maps to the left. Particularly the circled area off the south-east coast of Vietnam shows promise. However, other activities at sea have not been considered while determining the power generation potential at these sites.

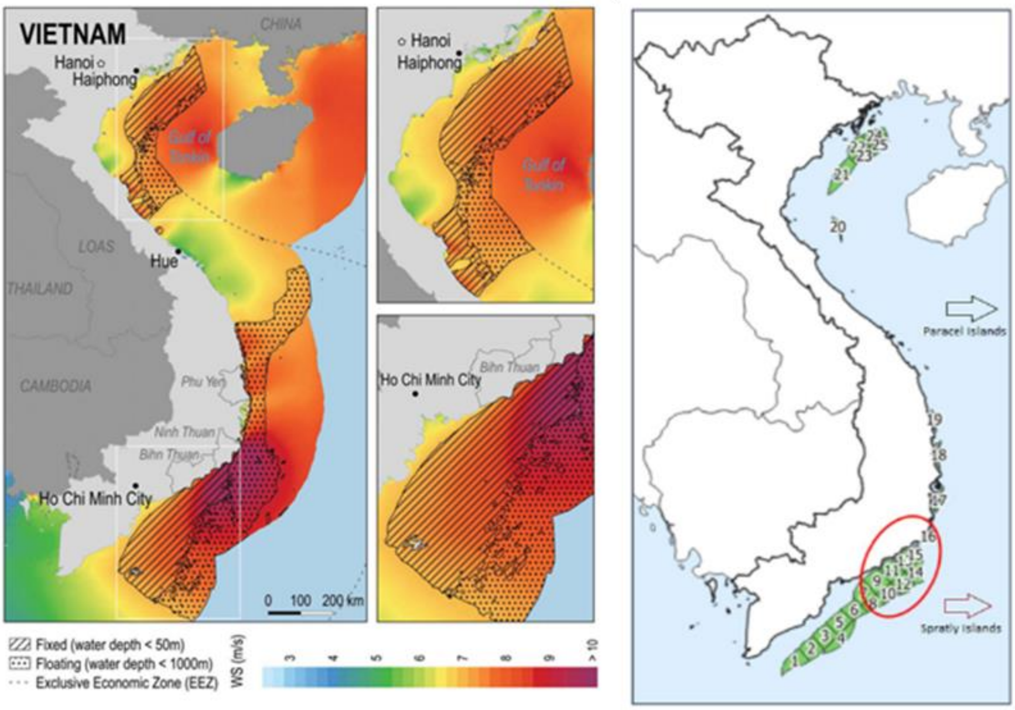


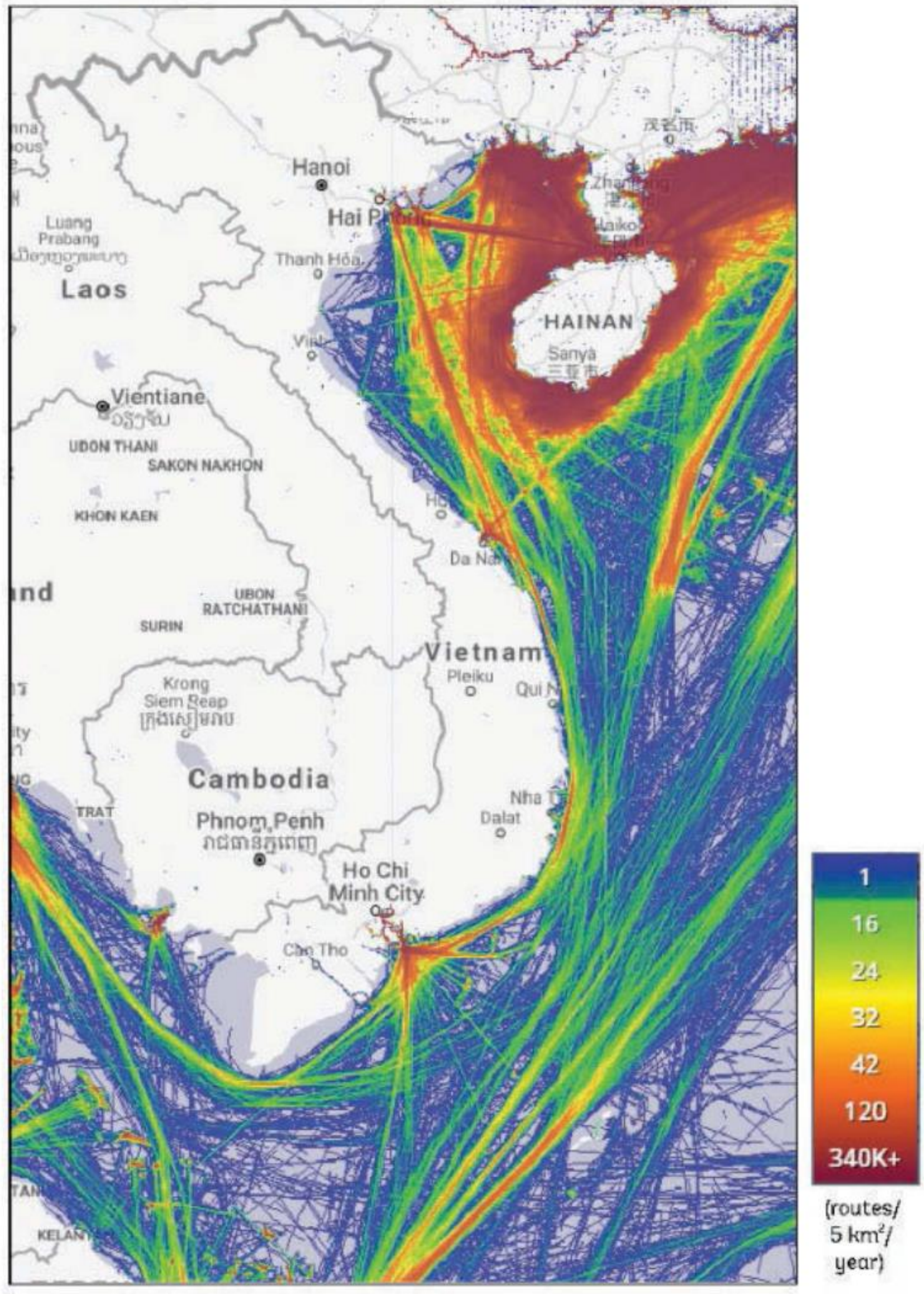
Figure 15. Maps to the left show water depth and wind speed [1]. Maps to the right show the lowest-cost area for the first bottom fixed GWs of offshore wind deployment in Vietnam based on country-wide LCOE ranking incl. grid costs for standalone projects [2]. Credits for the original background image: C2Wind

Among the activities present off the coast are oil and gas concessions, shipping lanes, and fiber-optic cables (Figure 16), which must be considered when developing an offshore wind farm. There are several oil concession blocks covering the area which has been identified as optimal for offshore wind development. Many of these are already licensed and developed, or development is pending, hence it is necessary to renegotiate these blocks to also include offshore wind. The locations of pipelines, wells, and platforms need to be considered while planning for offshore wind projects, as well as the activity of related vessels.

Figure 16. Offshore territory and activities in sea around Vietnam

While developing offshore wind in Vietnam, consideration must also be taken regarding shipping activities off the coast. Offshore wind developers are generally not interested in having foreign vessels passing through offshore wind farms, however coexistence can be implemented by defining shipping lanes to be respected, or by limiting concession areas to the boundaries of the shipping lanes. Optimally, shipping traffic should sail around the offshore wind farms, making it necessary to avoid major shipping routes while planning for offshore wind.

There is considerable shipping traffic along the coast between Ho Chi Minh City, Da Nang, and Hai Phong, as illustrated in Figure 17 and combined with an outline of the most promising low LCOE sites [2] in Figure 18 and it should be considered how coexistence can be implemented and/or how shipping routes can be relocated with as little impact as possible.



Source: Marine Traffic.

Figure 17. Shipping activity in waters around Vietnam [1].

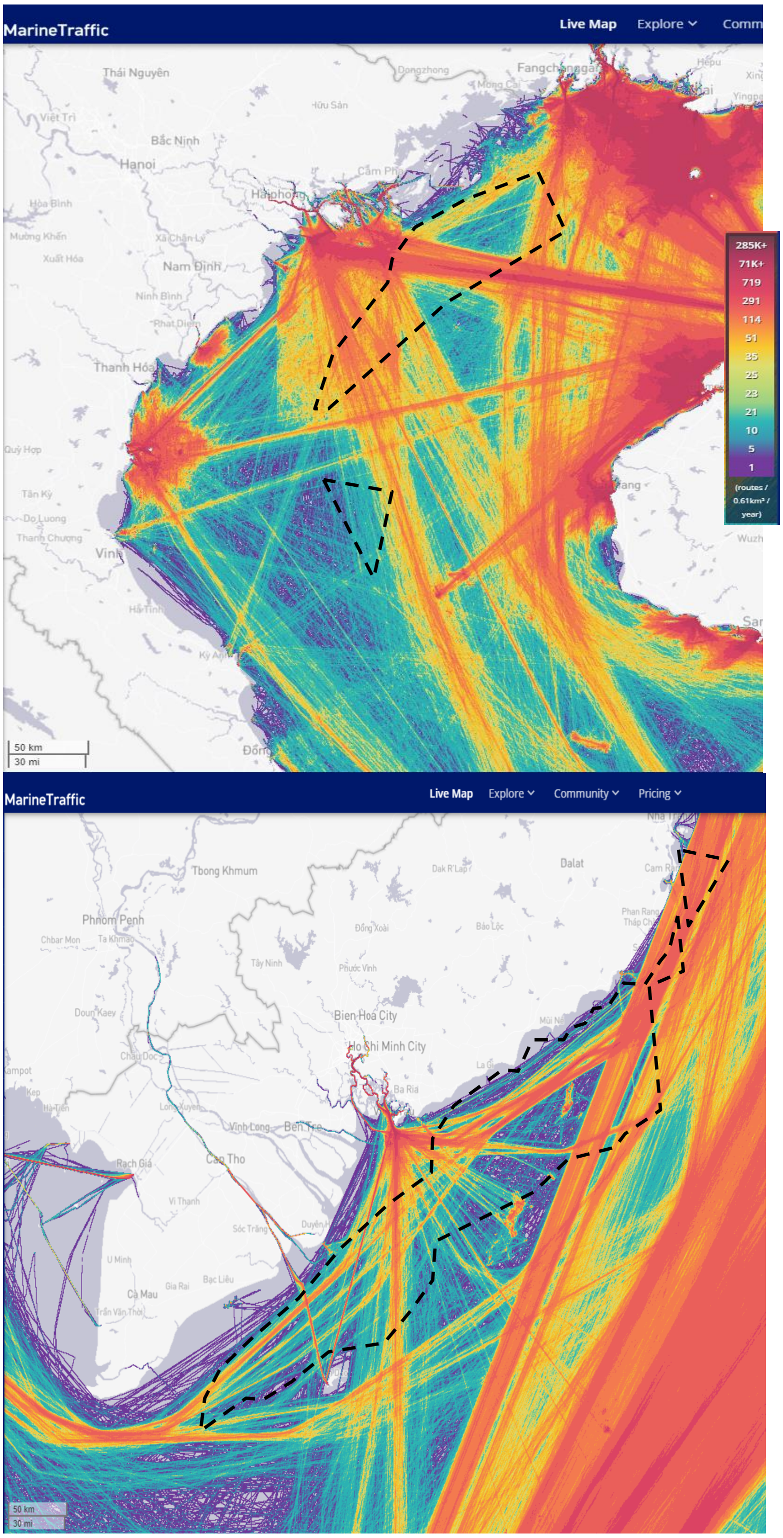


Figure 18. Shipping activity in waters around Vietnam combined with an outline of most promising low LCOE areas [17]

Previous maps have shown the optimal position of offshore wind farms, which considered wind resource, sea depth (Figure 15), oil and gas concession blocks, submarine cables (Figure 16), the Vietnamese EEZ, and shipping activity (Figure 17 and Figure 18).

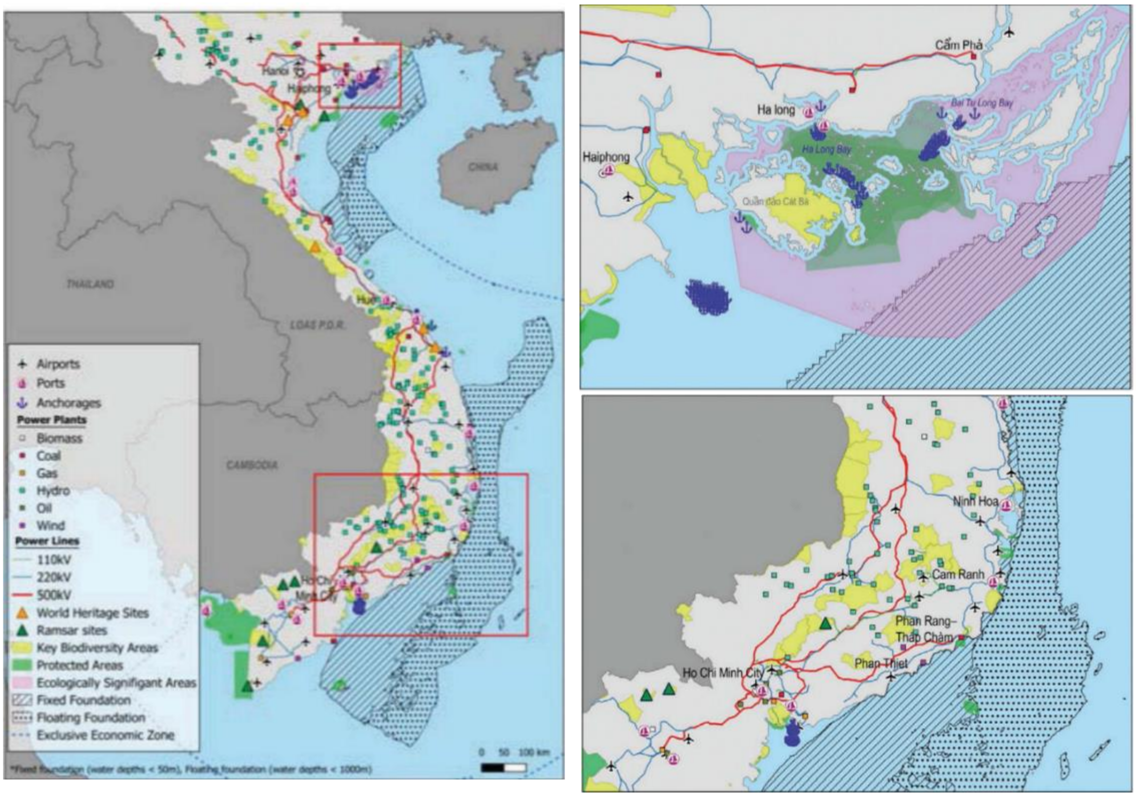


Figure 19. Maps of constraints and relevant infrastructure. Top: Vietnam. Middle: Northern Region of Vietnam close to Hanoi. Bottom: Southern Vietnam close to Ho Chi Minh City

The final map in Figure 19 adds to this by showing environmentally protected areas and ecologically significant areas. The Northern region of Vietnamese waters is close to some ecologically sensitive areas and special permitting practices should be considered for this region. Although the area is not very interesting due to low wind speeds, care must be taken while connecting subsea transmission cables between the shore and the offshore wind farms. Due to a lack of data, the maps do not capture the entirety of protected areas. Few constraints are shown in the Southeast Vietnamese waters, which also have the most interesting locations based on LCOE estimations. However, data is limited for biodiversity, fisheries, indigenous populations, etc., meaning the mapping does not present the full picture [1].

To sum up, the potential for offshore wind is not simply the recommended technical energy density (taking into consideration only wake losses and blocking) times the total area with a good wind resource. There will likely be many other activities, characteristics, and restrictions on the use of the ocean, which will significantly reduce the total potential or make it excessively expensive to make use of an area. For that reason, detailed maritime spatial planning is necessary to assess the total potential for offshore wind and to re-negotiate historical restrictions and activities allowing for coexistence with offshore wind. In the following, international experience on this matter is discussed.

4.2 International Capacity Density Experience

German offshore wind farms are expected to experience relatively large wake effects because they will be located densely due to heavy deployment and scarcity of wind sites, whereas Danish sites are more abundant in the Northern Sea compared to the size of the country.

Table 4. Regulations for capacity density in Germany, Denmark, and United Kingdom in latest offshore wind tenders.

Country	Name	Area	Capacity	Capacity Density
Germany	-	Site-specific, Pre-defined	Site-specific, Pre-defined	Site-specific, Pre-defined
Denmark	Thor	286 km²	Min 800 MW Max 1000 MW	Min 2.8 MW/km² Max 3.5 MW/km²
United Kingdom	Dogger Bank	Up to developer	Up to developer	Min 3 MW/km²

4.2.1 Germany

At the beginning of the German offshore wind development, the size, area, and capacity of the wind farm were up to the developer to decide. Due to the fixed subsidies in the Renewable Energy Act, the developer had an incentive to develop wind farms with high capacity, even though this would raise the LCOE.

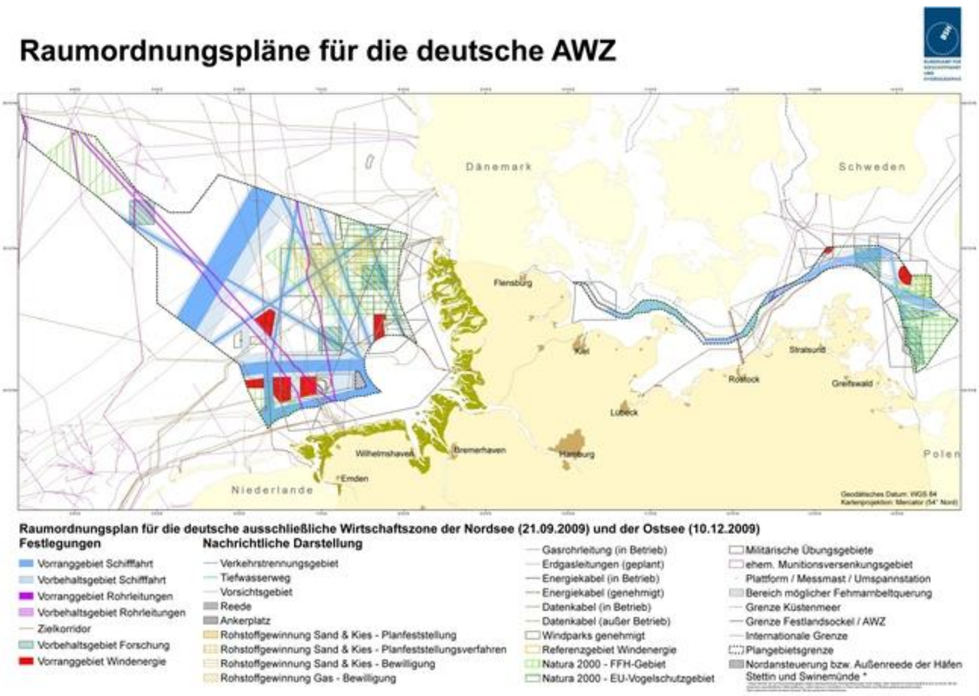


Figure 20. German maritime spatial planning (source: [18])

This practice has stopped since 2017, and new sites up for tender will be pre-developed, with an annual capacity of 700 to 900 MW up for tender. Each site and the capacity of the site will be detailed in a site development plan, which means that the capacity density will be pre-defined before tender. The focus of the new approach is to achieve projects with the lowest LCOE [16]. The map shown in Figure 20 illustrates the detailed maritime planning that goes into identifying sites for offshore wind.

4.2.2 Denmark

For the newest offshore wind farm in Denmark, Thor, installed capacity must be between 800 and 1000 MW. The project has a maximum area of 286 km², which means the given capacity density will be between 2.8 and 3.5 MW/km².

Figure 21 shows an example of how other activities at sea are mapped in Denmark, for which consideration must be taken when developing offshore wind.

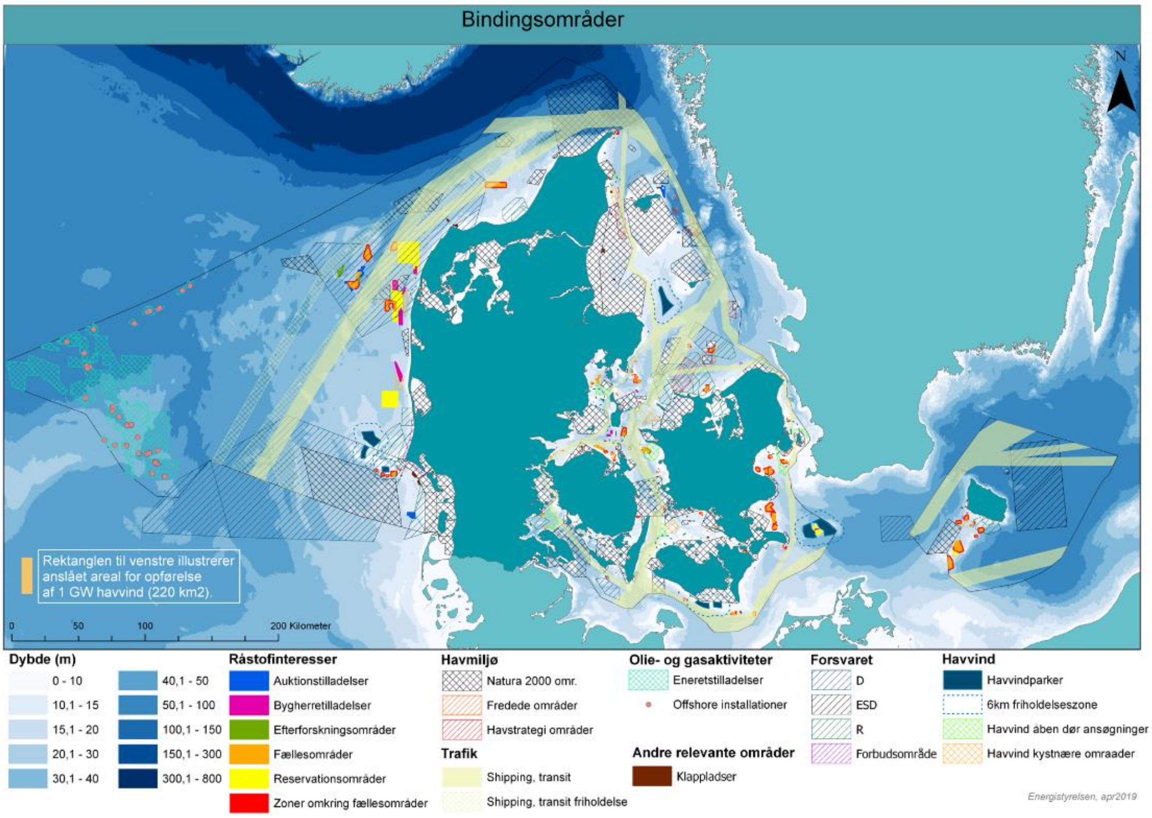


Figure 21. Example of mapping of activities at sea in Denmark (source: [17])

The experience of the Danish Energy Agency is that only a third of a given area can be utilized for offshore wind due to considerations for other activities at sea. Then, an additional 30% space is required to accommodate the developer's optimal distribution of turbines in the wind farm [2].

The DEA has made screening for 12.4 GW of offshore wind in Denmark [17] and found the optimal LCOE at a capacity density of approximately 4.5 MW/km², equivalent to 220 km²/GW. To this is required an 30% additional area due to site-specific conditions such as soil conditions, bathymetry, and optimal park layout, increasing this to 290 km²/GW, and further another 300% additional area requirement for other activities at sea increases it further to 870 km²/GW, which is shown in Figure 22.

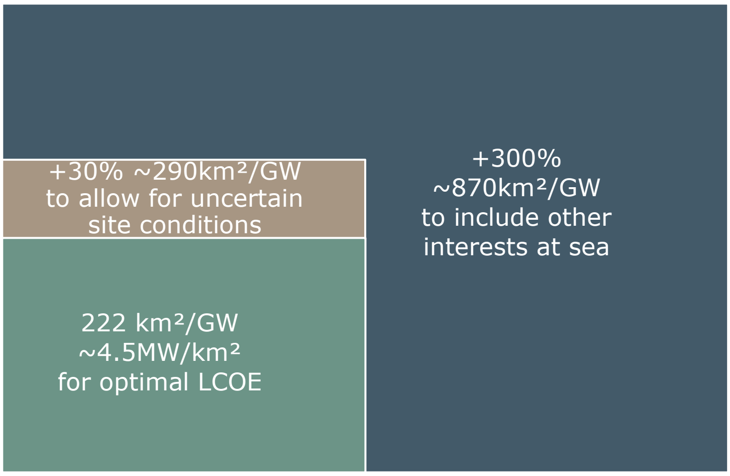


Figure 22. Expected area required for new offshore wind sites in Denmark (source: [17])

Vietnam's current power consumption is 240 TWh per year. With this additional area requirement of almost four times the optimal LCOE area and assuming a capacity factor of 50%, it would require 48.000 km² to produce this much power from offshore wind. The sites identified by C2Wind in DEA's and COWI's roadmap for Vietnam cover 43.000 km2 [2] equal to approximately 90% of the required area, however with an expected lower capacity density in some areas due to lower wind speeds.

4.2.3 United Kingdom

In the latest offshore leasing round in the UK, four sites were made available for development cf. Figure 23:

- Dogger Bank
- Eastern Regions
- South East
- Northern Wales & Irish Sea

Within these areas, the developers were offered the freedom to identify and propose their own project sites and define their optimum capacity, as long as the capacity density was larger than 3 MW/km² [19]. As in Denmark and Germany, these sites have been identified after detailed maritime planning. A GIS tool to visualize all the maritime activities and regulations is available at [20].

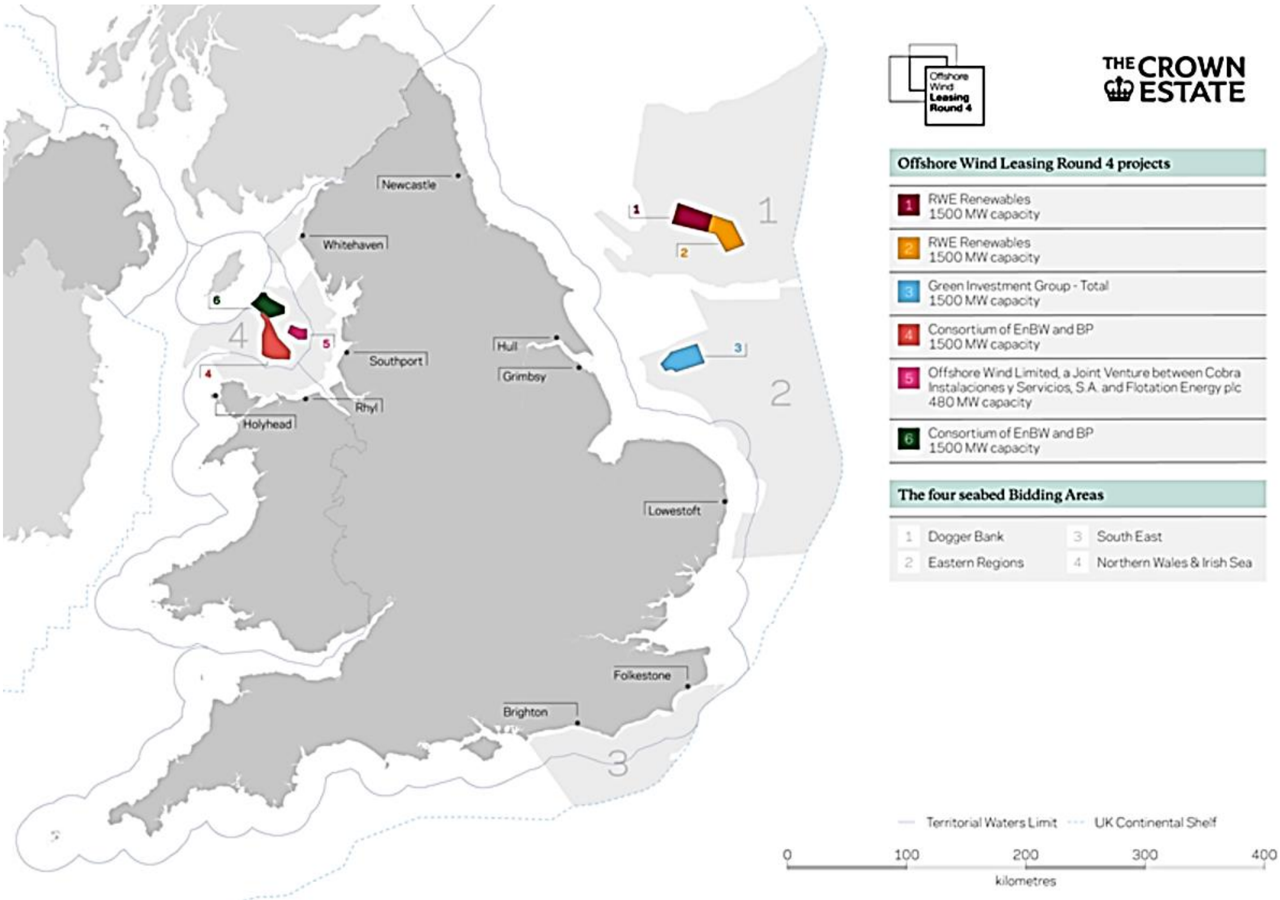
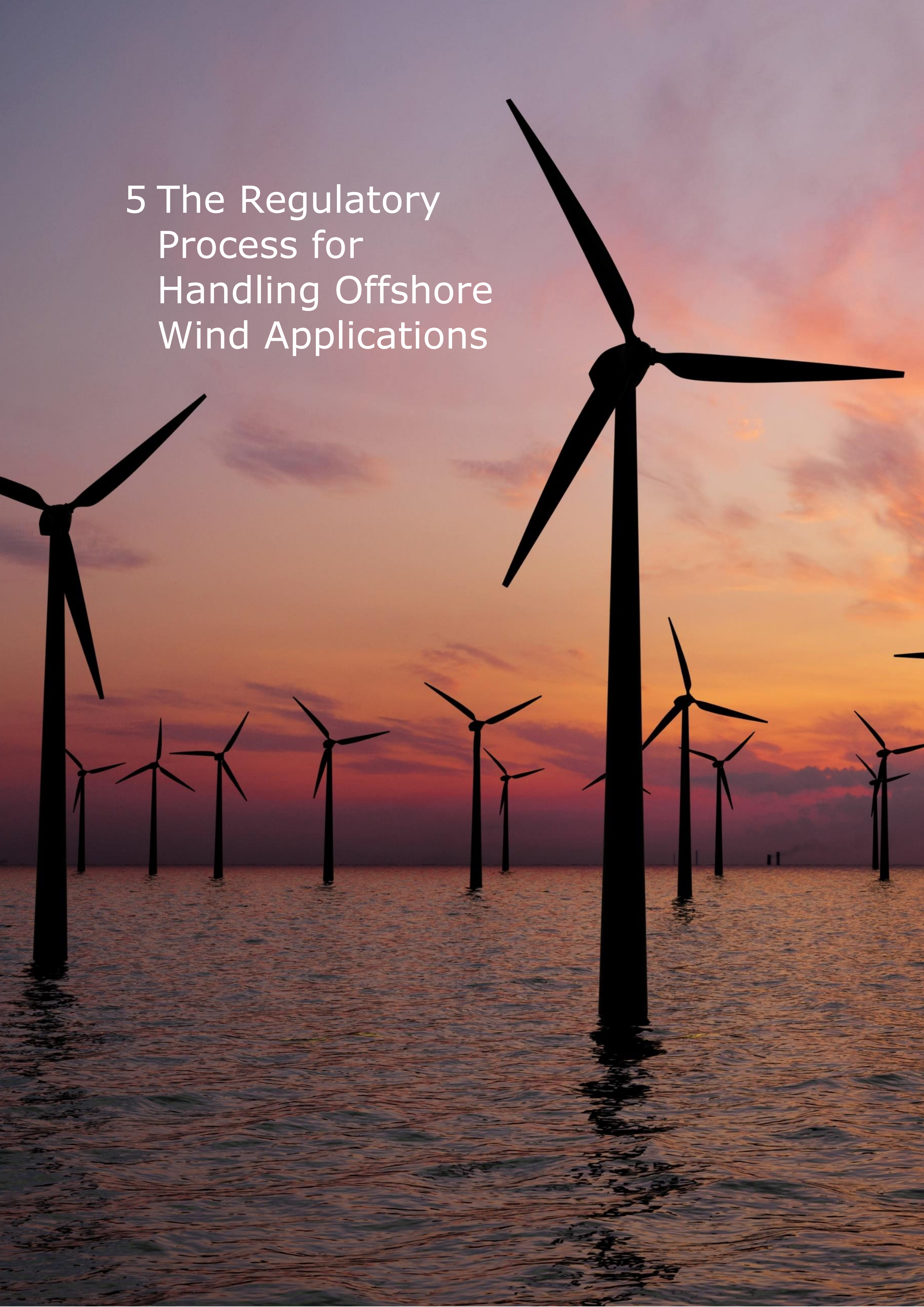


Figure 23. Map of offshore wind areas up for development in the United Kingdom [19]

5 The Regulatory Process for Handling Offshore Wind Applications



5 The Regulatory Process for Handling Offshore Wind Applications

The limited experience in the offshore wind sector in Vietnam is reflected by an extensive and complex regulatory process in terms of leasing and permitting the installation of OWFs in the country. Significant changes are needed to make these processes straightforward and consequently facilitate the exploitation of the highly resourceful shores of the country in terms of wind power, according to the findings of the PDP-8.

Understanding the way, the offshore wind market is configured internationally is an important step towards defining policies and instruments to appropriately adapt the regulatory framework of the Vietnamese offshore wind sector.

In that regard, the regulatory frameworks of three of the major countries in the global offshore wind sector are analysed, and a few main aspects are gathered and presented in the following sections. Likewise, following the description of the leasing process in Section 3, the current framework for permitting OWFs in Vietnam is described, and the main areas of improvement are highlighted. This is detailed further in the memo containing a check list for handling offshore wind applications [4].

Furthermore, the merits of the European policies and regulations and their applicability to the Vietnamese context are discussed, especially with regards to the renewable energy auctions, in the section about insights and recommendations.

5.1 International Regulatory Experience

5.1.1 Germany

As previously mentioned, the German federal states are responsible for administering OWFs installed on the territorial seas at their respective coasts, whereas the Federal Maritime and Hydrographic Agency (BSH) regulates the wind farms in the country's EEZ [21].

Since the installation of the first OWF in German waters in 2009, the country has faced a progressive development of its offshore wind sector. For instance, the Renewable Energy Law (EEG) was the country's main official framework for the sector until 2017. It included a FiT system with a "first come, first served" basis, working with unsolicited applications, i.e., the project developer should apply for the implementation of an OWF at an area of his choice, subject to approval from the BSH according to its availability (the most known example is the Danish "Open-door procedure") [22]. The developer should then execute all preliminary studies necessary in the area, including bathymetric and metocean studies, EIA, geological analysis, and technical properties of the desired OWF [21]. Over the years, the guaranteed FiT (in terms of €ct/kWh) decreased, mirroring the decrease in both onshore and offshore wind power production costs. The great advantage of that FiT system was the long-term certainty it provided to wind farm developers, as this was seen in developments on the German market.

The price decrease in the offshore wind sector has been so intense in Germany that the latest offshore wind tenders were awarded to projects to be built under zero-subsidy contracts, i.e., bidders were willing to implement their projects without being subsidized, therefore submitting bids of 0.00 €/MWh [22].

Under these circumstances, the government has decided to switch the regulation in force by introducing a centralized auction system. The change will start effectively from 2025, although the first auction is scheduled for 2021. The period from 2020 to 2025 is being regulated by a Transition System in which project developers shall apply for a FiT through tender procedures to have their OWFs commissioned within that period [21].

In the new framework, namely defined in the Offshore Wind Energy Act (WindSeeG 2017), the market premium is also determined competitively, although the trend indicates that soon it will have completely vanished. Furthermore, the entity in charge of regulating the national offshore wind market (BSH) is responsible for the permitting and auctioning processes. The auctions are the sole mean of developing offshore wind farms in the new framework, being the former "open-door procedure" discontinued [21].

In the new centralized model, BSH is responsible for issuing a Site Development Plan defining all areas to receive new OWFs, realization periods, as well as access to grid connection for all sites to be tendered in the German EEZ. Within the Plan, the Agency executes preliminary site investigations, defines its suitability for the installation of OWFs, and then opens the auction process for interested project developers [3].

The scope of the preliminary site investigations carried out by BSH includes the assessments of the marine environment, a preliminary study of the soil conditions in the site, and an assessment of the wind and oceanographic conditions of the site, all of which are to be carried out under the BSH standards specifically designated for each activity [23].

In parallel with the preliminary investigations for the Site Development Plan, a Strategic Environmental Assessment (SEA) is to be carried out by BSH under the guidelines defined within the German Environmental Impact Assessment Act (UVPG). The assessment envisages identifying and analysing possible environmental impacts during the Site Development Plan implementation. From that point, it shall propose environmental protection measures to be implemented under consistent principles and public engagement [24].

The latest Site Development Plan, issued in 2019, included two separate SEA reports, each of which was specifically prepared for the two German EEZ clusters (the North Sea and Baltic Sea). The results, thereby published in terms of potential environmental impacts, were taken as key criteria for the overall spatial planning. Nevertheless, a more detailed assessment of the environmental conditions of the sites selected in the Plan is still required for the approval process from the successful bidders after the contract award in the auctions, depending on the level of accessible information at the level of investigation from the SEA [23].

The successful bidder, namely the one offering the lowest price of power production, is granted exclusive right to the so-called planning approval, which is the permit required for construction and operation of WTGs in Germany, as well as the right to an onshore grid connection corresponding to the OWF capacity, agreed on. In principle, all the permits required for approval, construction, and operation of OWFs in Germany are listed and granted through planning approval [8].

From the bid award until the WTGs are ready for operation, a project realization timeline with few milestones is to be successfully followed by the project developers. That includes the submission of permitting documents; submission of proof of financing for construction, thereby requiring contracts for the procurement of the turbines and BoP; proof of initiation of installation services, submission of a specific EIA for the project site, and proof of readiness for operation of WTGs. The non-compliance with the timeline and milestones can be penalized with fines or even the contract withdrawal [8].

In general, the OWF owner can submit a request for planning approval without the completion of an administrative opposition procedure. In this regard, a hard copy of the requested planning approval is placed for two weeks in the municipalities eventually affected by the project for public consultation, where interested parties can consult the document and eventually raise objections. After that period, the permit is usually authenticated and granted [8].

5.1.2 Denmark

As previously mentioned, the DEA regulates the offshore wind sector in Denmark, administering the emission of licenses, as well as holding auction processes. It works as a "one-stop-shop," providing qualified project developers with licenses of investigation, turbine installation, wind exploitation, and electricity production. DEA and the TSO undertakes a site pre-assessment performing preliminary site investigations for a first SEA prior to publishing the tender, which will be followed by a project specific environmental impact assessment [25].

The project developer has access through two different procedures for developing offshore wind farms in Denmark: either via tender processes held by the DEA or via an "open-door procedure". An overview of the process is presented in Figure 24.

For tenders, the winning bidder will be granted exclusivity to develop the wind farm in the tendered site and granted licences according to predefined terms and conditions in the tender material and settled in the Concession Agreement as the project develops accordingly. This is a transparent process which clear sharing of risk and responsibilities between the Danish state and the developer allowing it to significantly de-risk the project and provide lower bids.

Applications via the open-door procedure also follows a transparent process with clear definitions of risks and responsibilities for the developer. However, the project developer takes responsibility and risks to develop a potential site [25].

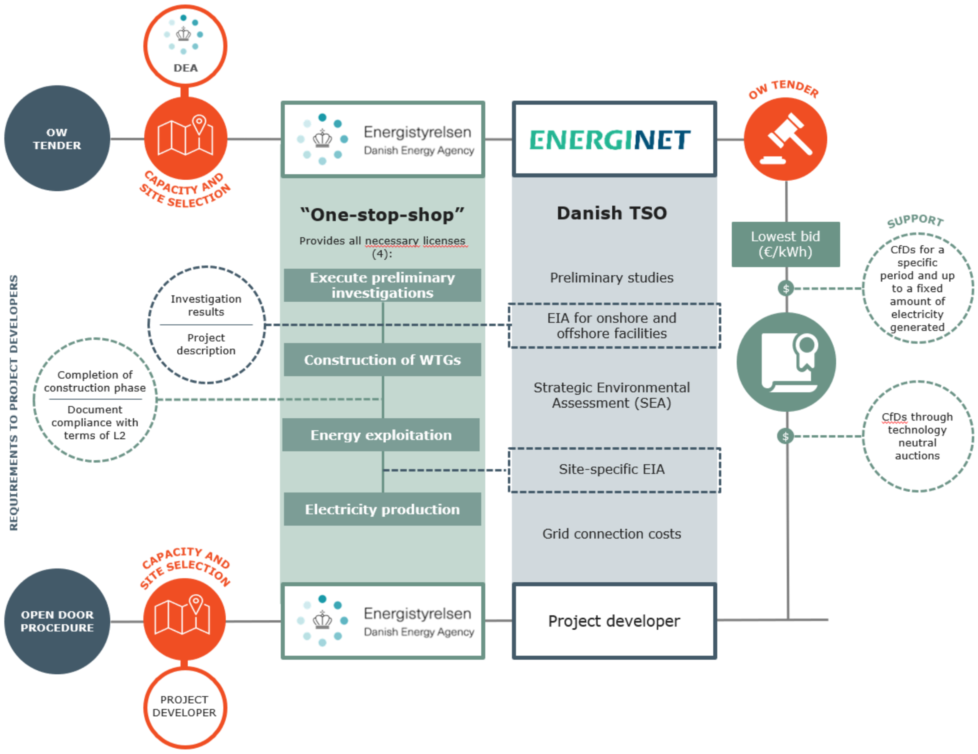


Figure 24. Danish Offshore Permitting System

In both regulatory processes, there are four main licenses needed for the successful establishment of an OWF [8]:

- License to execute preliminary investigations
- License for construction of WTGs, to which the project developer sends results of the preliminary investigations and EIA, as well as a project description
- License for the utilization of energy, issued after completion of the OWF construction phase, documenting the effective compliance with all the terms listed in the license for construction
- License to produce electric energy, according to the results from the EIA for the specific site

For tenders, a site pre-assessment including applying for site survey permit to narrow the optimal location and potential capacity of the wind farm, and the strategic environmental assessment (SEA) for both onshore and offshore facilities as well as cable corridors as well as handling other interests at the sites and their surroundings are carried out by Energinet (Danish TSO) for DEA, while these activities are undertaken solely by the project developer for open-door applications [26].

After tender award the development process for the two procedures are more similar, however terms and conditions for the following licences are specified for the tenders in the Concession Agreement.

In this regard, the Danish framework resembles the German one, with the difference that Energinet executes a SEA of the project plan (i.e., on- and offshore facilities) rather than the whole area designated for offshore wind development in the Danish EEZ, as it is in

Germany. The Danish SEA investigates potential environmental impacts on the implementation of the plan, as well as reasonable alternatives of risk mitigation based on the scope of the plan [26].

Apart from that, Energinet also executes additional environmental assessments to provide as much critical information as possible for the basis of the project specific EIA to be executed by the winning bidder for the tendered project sites [27]. These include:

- Birdlife and nature
- Visual impact
- Safety of navigation
- Impact on radar and radio links
- Fisheries
- Marine archaeology
- Noise impact
- Cumulative effects

In terms of the preliminary investigations, the Danish TSO assesses wind and wave conditions of the site, metocean information, seabed geology, and geophysics, among others. The results of the investigations are published prior to the tender submission. Later, an EIA of the project is also required, in which case the winning project developer assesses the offshore facilities (WTGs, OSS, and offshore cabling), whereas the TSO, together with relevant municipalities, assesses onshore resources [26].

In the public tenders, the DEA defines an area at the sea in which a project of predetermined capacity is to be developed. After a call-for-tender round with draft specifications and a pre-qualification process, the bidders then submit their offers at a fixed price per kWh of electricity produced.

The specific conditions for a project developer to be eligible to participate in the tenders can vary from project to project. For instance, for Thor OWF, one of the OWF being currently tendered in Denmark, pre-qualification criteria included [28]:

- Annual turnover of at least DKK 26.4 Billion
- Equity ratio of at least 20% or high current long-term debt rating from an internationally renowned institution
- At least one reference of an OWF with a capacity of at least 150 MW
- At least one reference of a fully commissioned AC-offshore substation within at least five years
- Up to five references of offshore wind projects commissioned within the previous five years

The awarding criterium is the lowest bid fulfilling the terms and conditions of the tender including wind farm capacity and timeline. The winning bid, i.e., the project owner, is then guaranteed the permit for construction and connection to the onshore grid upon signature. From this point, they are to supply the OWF production to the grid for the power market price together with a subsidy (CfDs) covering the difference between the wholesale price and their fixed bid price.

In addition, there are a several measures included in the tender process to reduce risks for the bidders and subsequently for the winner of the tender, as it is considered the most important tool to have the lowest bids. Such measures include clear processes, clear sharing of risks between the developer and the state, draft licenses from the DEA, preliminary technical dialogues with the tenderers and investors, priority access to grid connection and extended duration of operation licenses [25], which resulted in record-breaking low prices for the Kriegers Flak OWF in 2016.

The prices submitted by the bidders vary from site to site according to environmental conditions, location, current market competition, etc. OWF approved through tenders are entitled to Contracts for Difference, which are calculated on an hourly basis according to the difference between the tendered price and the fluctuating spot price of electricity of the area in which the project is located, except for negative spot price occasions, in which there is no CfD payment, and as long as the electricity produced is supplied to the national grid. The grant is limited to a fixed amount of electricity produced (i.e., a total of full-load production hours), as well as a specific period in years [26].

The open-door procedure allows the project developer to build an OWF by their initiative. To do so, they submit an unsolicited application for the license to execute preliminary investigations in a specific area outside of the areas reserved for tender processes. After the application is submitted, the DEA clarifies possible conflicts of interest with other government bodies which could block the project's implementation. Once the consultation is completed and all possible conflicts are solved, the Agency officially authorizes the project developer to carry out preliminary investigations. Later, depending on the results from the investigations, the license of construction is also released [26].

In terms of price, the power produced by OWFs installed through the open-door procedure can be subsidized via price premium contracts (similar to CfDs) awarded through technology-neutral auctions held by the DEA. In such a system, a budget is predefined and awarded to winning bidders, i.e., prequalified bidders with the lowest bids in terms of DKK/kWh, of an auction engaging solar PV, onshore wind, and/or open-door offshore wind installations within the same process. Tenderers are requested specific documentation depending on the technology of their projects, even though some conditions are general for every participant, such as a max cap for the bids [29]. Given the generally lower generation cost for solar PV and onshore wind installations in comparison to offshore wind farms, the opportunities for the latter are rather limited in these tenders, which consequently renders the offshore wind open-door permitting process economically less attractive than the offshore wind tenders.

Currently DEA is working on technology neutral tenders (applicable for open-door applications). In its draft version it suggests a revenue of 25øre/kWh, which will be very difficult with the current technology for offshore. For comparison, the tender in 2016 for Vesterhav Nord and Syd OWFs was priced at 47.5øre/kWh (one-sided CfD).

5.1.3 United Kingdom

The consenting process for development is conditioned by the award of a leasing contract and has a specific organization in charge of it in each of the U.K. countries.

For instance, in England, several consents are incorporated into a Development Consent Order (DCO), including onshore permits and a marine license. In Wales, this process is administered in a similar fashion by a specific Welsh institution. In Scotland, the Scottish ministers are responsible for issuing the consents according to the evaluation from Marine Scotland. In Northern Ireland, the Marine Strategy and Licensing team within the Department of Agriculture, Environment, and Rural Affairs manage the process. Furthermore, in the case of OWFs of more than 100 MW installed in England and Wales, a special condition applies. In this regard, the national Planning Inspectorate is responsible for assessing the project, classified as a "nationally significant infrastructure project" (NSIP), and the Secretary of State for the Department for Business, Energy and Industrial Strategy grants the consents, including onshore permits for the transmission cables are to be installed [12].

As mentioned in 5.1.3, The Crown Estate is responsible for granting exclusive rights of construction and operation of OWFs in England and Wales, as well as administering tender rounds in the country. In the latest tender round, four main areas were defined for development, whereas bidders shall provide their offers, as well as prove their capabilities and the effectiveness of the proposed project [8].

A generation license for electricity production is also required and is issued by the Office of Gas and Electricity Markets (Ofgem). Also, The National Grid (British TSO) shall provide connection offers to parties interested in supplying electricity to the grid, where they join a bilateral connection agreement with the developer [8].

The consenting process in the UK requires the project developer to produce a scope report in the early stages, as well as execute a series of surveys, such as Environmental Impact Assessment, environmental surveys (e.g., benthic, fishes, birds, sea mammals, onshore environment and human impact), resource and metocean studies, geological and hydrographical investigations, and a Front-End Engineering Design (FEED) study which substantiates the process and provides technical input for the procurement and construction of the OWF in terms of layout, electrical system, grid connection, and therefore potential measures for minimizing the project's LCoE [12]. The latest tender round in the UK also includes a Habitats Regulation Assessment (HRA) to consider the protection of some habitats in Europe, including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) [8].

Aiming at utilizing the national electricity sector, the government implemented in 2014 the Electricity Market Reform (EMR), which introduced a new support scheme for renewables deployment in the United Kingdom, replacing the former ROC quota system: a sliding feed-in premium system with CfDs allocated through auctions with a sealed bid structure. The National Grid oversees the allocation of contracts. The fourth round of auctions is taking place in 2021 and is to award up to 12 GW of new renewable energy projects.

In parallel to the standard electricity market, there are small and medium-scale Independent Power Producers (IPPs) who commercialize their production directly with businesses through Power Purchase Agreements (PPA). In the British structure, the corporate off-taker agrees to buy the energy generated by a specific power plant (or portfolio) by a fixed tariff (£/kWh), often with some indexation on top. The off-taker also has regulatory obligations in terms of metering, which can be undertaken by a licensed electricity supplier as a third party who is thereafter committing to purchase the benefits obtained by the off-taker for the electricity and renewable energy utilized as well as to supply their electricity demand when necessary. The structure gives security to all involved parties and, therefore, is very likely to achieve positive financial and economic conditions [30].

The British government understands the importance of independent electricity production for achieving the national goals established with the EMR, and therefore considers it when defining supporting instruments. In this regard, some stakeholders from the independent market have claimed a few issues they have encountered in the CfD system when it comes to supporting their production, such as uncertainty and barriers to early projects which were inserted in the former quota system, difficulties in pricing and the possibility of low levels of competition in the PPA market [31].

The government has, therefore, introduced an instrument to promote competition and reduce discounts in PPAs: The off-taker of last resort allows the independent power producer to have a backstop PPA with the licensed electricity supplier in case there are no off-takers available in the market. The allocation of these backstop PPAs is carried out through an auction process held by Ofgem, in which the licensed suppliers bid for the electricity produced by a specific tariff below the market price. Furthermore, the eligibility of a power producer in the scheme is subjected to their registration in the CfD system [32].

5.2 Vietnamese Regulatory Experience

Under the current Vietnamese regulatory framework, there are many permits and approvals required from different institutions for a developer to have their project licensed. These are listed in Table 5. It is a complex set of regulations and it is not targeted offshore wind.

This increases the risk significantly, as the developers risk being upheld at many steps and will be on their own to get process moving further. A secretariat under the authority of an appointed leading ministry will be able to act on its behalf towards the relevant other ministries and by its repeated experience and network, it becomes more efficient than the occasional developer can ever be.

Table 5. Documents required in offshore wind permitting in Vietnam

I.	**SITE SURVEY PERMIT**
1	**Decisions on approval of construction investigation**

II.	**PREFEASIBILITY AND FEASIBILITY STUDY** after approval on Site survey permission application
1	**Pre-Feasibility Study (if any)** *for the projects not in approved PDP- only*
1.1	Pre-Feasibility Study Report
1.2	Apply to PDP
1.3	Request for inclusion in DOIT/ MOIT, EREA and 9 ministries/ EVN
1.4	Get the approval for MOIT or Prime Ministry
2	**Decisions on Approval of Investment project**
2.1	Decisions on Approval of Investment project
2.2	Apply for an Investment registration certificate (with foreign investor only)
3	**Feasibility Study**
3.1	Feasibility Study Report
3.2	Others

4	**Appraisal of the Investment Project and Basic Design**
4.1	Design requirements
4.2	Appraisal documents
4.3	Consultation documents by relevant organizations and authorities

III.	**PROJECT AGREEMENTS** agreements with the authorities and EVN
1	**Planning agreements**
2	**Agreement on using or connecting with engineering structures outside project boundaries**
3	**Environmental Impact Assessment**
4	**Safety Management (traffic, safety of adjacent structures)**
5	**EVN Agreements**
5.1	Grid connection
5.2	SCADA and telecommunication
5.3	Electric metering
5.4	Relay and automation
6	**Firefighting**
7	**Other relevant documents**
8	**Power purchase agreement with EVN**

IV.	**LAND USE RIGHT CERTIFICATE**
1	**Legal documents for Planning of land of the project area** *Plans for compensation for land clearance and resettlement construction*
2	**Land acquisition and renting**

V.	**TECHNICAL DESIGN**
1	**Investigation requirements, investigation plans, investigation reports**
1.1	Basic Design stage
1.2	Technical Design stage
2	**Notifications on Acceptance of investigation results**
3	**Technical design**
4	**Results on Review, appraisal of Technical design;** **Approval of Technical design with attachment of:**
4.1	Approved design documents (with list of drawings)
4.2	Technical Specifications
4.3	Review
4.4	Appraisal
4.5	Approval
5	**Acceptance of Technical Design**
6	**Other documents related to the investigation and design of the project**
6.1	Appraisal of Technical Design of Firefighting
6.2	Others

VI.	**CONSTRUCTION PERMIT**
1	**Construction permits granted by MOC / DOC**

VII.	**OPERATION LICENSE**
1	**Operation license for operators and shift leaders**
1.1	Specific training to operators
1.2	Submission of proof of technical qualification of operators
1.3	Approval from Lod Dispatch Centres (A0 and Ax)

VIII.	**ELECTRICITY GENERATION LICENSE**
1	**License to officially operate OWF and initiate commercial activities**
1.1	Submission of all agreements and requirements from previous licenses

An example of one of these processes is provided in Figure 25. In this regard, the permit for site surveying is one of the key approvals required in the overall licensing process for OWFs in Vietnam and currently engages several institutions and procedures by itself.

At first, the project developer shall perform preliminary studies to identify a suitable area for possibly implementing their OWF, prior to applying for and receiving an acceptance letter from the MOIT, the Prime Minister, or the provincial People's Committee, ensuring site exclusiveness for the project [1].

Following that, for the seabed leasing process (which runs in parallel to the permitting), the project needs to be listed either in the national PDP or the provincial PWPDP, which can be achieved after the developer submits a pre-feasibility study to the MOIT or the Prime Minister. Information on the project details, interconnection plan, clearance on possible territorial conflicts of interest, among others, must be approved by the respective entity for the project to be included in the corresponding plan. At that stage, consent on the use of designated marine areas and natural resources exploitation is also to be given by MONRE (or corresponding provincial department) and EVN [1].

Subsequently, the project developer shall apply for a Decision on Investment. The document is granted by the MOPI, the Prime Minister, or the provincial People's Committee after acceptance of investment proposals, a preliminary ESIA, financial statements of the project developer and investors, etc. [1].

After that, the developers and/or investors (foreigners shall be together with a Vietnamese partner) shall obtain an Investment Registration Certificate (IRC) from the MOPI or the provincial Department of Planning and Investment, authorizing the foreign investment in the development of the respective OWF in Vietnamese waters. Later, an Enterprise Registration Certificate is also required from the same entity [1].

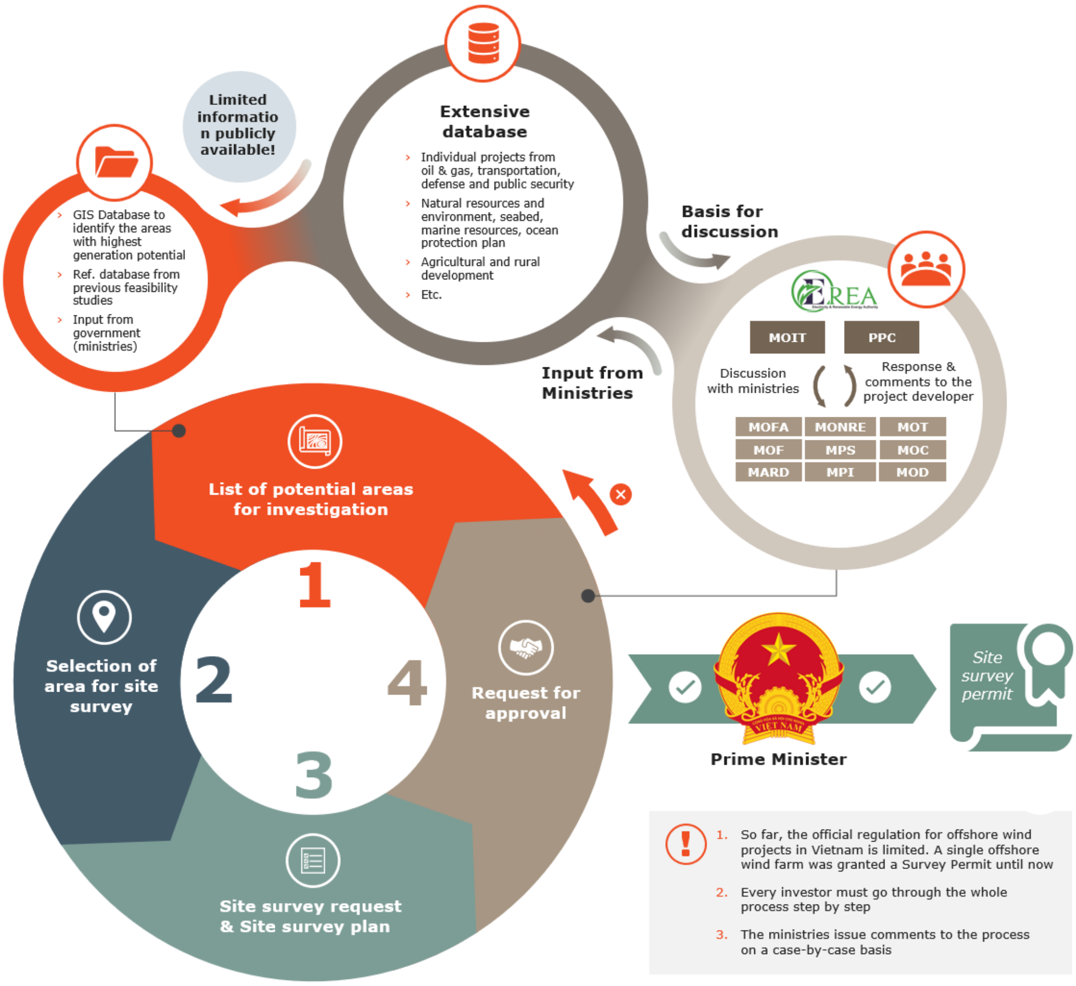


Figure 25 Vietnamese offshore wind Site survey permitting system

At last, a preliminary PPA is to be signed with EVN, granting the right to apply for an exclusive PPA for the project. Likewise, an agreement to the grid connection with the distribution or the transmission company, depending on the foreseen connection [1].

Additional documents required in the process include a decision on the marine space assignment, a certificate of land use rights for the onshore connections from the provincial People's Committee, approval of the ESIA from MONRE or the provincial People's Committee, a construction permit from the provincial department of construction, an operating license from the MOIT, etc. [8].

After all the agreements have been reached, an exclusive PPA is signed between the project developer and EVN. The document is issued by MOIT after submission of all the agreements, as well as the acceptance of the preliminary PPA. It is legally binding, non-negotiable, and currently for wind power consists of a tariff of 1614 VND/kWh [33]. This PPA template will not make offshore wind projects bankable for the international financiers.

The current regulation setup in Vietnam is as follows:

- By the 'Law of Investment' the investment approval authority currently is at province level for most projects.
  - If a wind project is in province master plan for wind, a potential investor will approach the province to get a certificate of investment policy i.e., an approval.
  - If not, the investor will establish a wind project proposal to add the project into PDP-Amendment list. Then the province will ask for the project to be added in PDP-Revision.
  - The province is also authorized to decide fee for seabed leasing within an approve range. So, the province will be a key for investment point of view and the decisive entity.
- MOIT is largely at an oversee role for adding projects into PDP, review and approve the design.
- MONRE will review and approve sea investment, the E(S)IA, grant seabed license or consent about that sea license.
- EVN will be the off-taker, who will have to carry the cost of the renewable power production.

In the current setup due to the current legislation, the PPC should be highly involved because of their active role according to the Law of Investment, which is also clear from the draft approval decision in PDP VIII showing the intend for investment and clearly states that the province will be the active partner in any case.

This setup with the PPC being the active partner shall be changed to assure that the offshore wind development is handled with the perspectives of the country rather than the provinces.

Also, the complex processes, many stakeholders and the current setup will be considered high risks for the developers and COWI therefore recommends simplifying the processes and interactions with the authorities as described in section 6.4

6 Recommendations for Vietnam

6 Recommendations for Vietnam

The recommendations based on the findings in this study are condensed in Table 1 and visualised in Figure 1, 2, 3 and 4 in the Executive Summary and further described in the following subsections.

6.1 Criteria for Offshore Wind Farms

To determine criteria for distinguishing nearshore and 'real offshore' in Vietnam, a thorough analysis of criteria in other leading offshore wind countries compared with the areas with the highest offshore wind potential in Vietnam has been carried out. The study investigated the influence of the water depth and distance to shore for a minimum wind speed of 7 m/s, which is the lower bound for an effective generation potential from WTGs.

The analysis identified the impact on the overall area with potential for offshore wind in Vietnam and the impact on the most feasible sites determined in [2]. The results for both regions are presented in section 2.4 based on maps from GIS studies presented in appendix A.

Setting the lowest water depth at either 10mLAT or 15mLat will have insignificant impact on the total area available for real offshore wind outside the 3nm boundary.

Defining a transition water depth for either fixed or floating foundations will not make much sense, as development of the current technology is expected to give large impact on the most suitable technology. It is therefore better suited for the developers to select their preferred technology at the time of planning/construction.

It is expected that it will be possible to develop real offshore wind farms using bottom-fixed foundations up to 60mLAT with the current available technologies with gravity-based foundation, monopiles and jackets.

Establishing the 12nm distance from shore as a boundary between nearshore and offshore showed that some of the sites with the highest potential in Vietnam would be significantly affected. Some of the sites would be reduced by up to 60% which will then be regulated by nearshore legislations. Consequently, it will reduce the combined areas and potential power generation capacity from real offshore wind farms with more than 20% compared to the area determined by C2Wind in [2] with a 5km (~3nm) boundary. Setting the boundary at 6nm will have less impact with approximately 8% reduction of area and potential power generation capacity.

Initiating the development with a boundary of 6nm is recommended for a start with proper SEA and ESIA assuring that unacceptable impacts are avoided.

In terms of visual impact, development further away from the shore, leads to a considerably smaller impact from the offshore wind installations on the coastline, especially for residents, who are less affected by the visual interference of the WTGs in the landscape.

Noise impact will be negligent for all considered boundaries 3nm, 6nm and 12nm respectively.

The recommended criteria for 'real offshore' in Vietnam are listed in Table 1.

6.2 Seabed Lease Fees

With plenty of potential offshore wind resources available off the Vietnamese coast, the resources should be developed at the lowest cost possible without interfering with other activities at sea. Blocks for offshore wind should be carefully designed with basic criteria for coexistence as the starting point considering shipping activities, gas, and oil explorations, submarine cables, and environmental impact to minimize interference that would increase costs disproportionally or lead to unacceptable environmental or ecological impact.

In this context it is recommended to avoid seabed leasing fees as the leasing fees increases the LCOE of offshore wind in Vietnam. The cost will be passed onto the electricity price by the developer, which is particularly harmful to the Vietnamese industry sensitive to power prices.

The fees also increase the optimal capacity density of offshore wind making the turbine layouts more condensed, leading to increased wake and blockage losses, thus reducing the efficiency of offshore wind farms, and further increasing the LCOE. This is an unwanted side effect, particularly in situations with abundant availability of offshore wind resources as in Vietnam.

Leasing fees on offshore wind can be viewed as indirect subsidies for fossil fuels and tax on renewables and will make offshore wind less competitive in the Vietnamese energy generation mix. With current rental fees of USD 128 to 319 per hectare per annum, this is equivalent to between 0.6 USD/MWh and 1.5 USD/MWh, assuming a capacity factor of 50% and a capacity density of 5 MW/km^2. This is a high fee considering the immature Vietnamese market.

Option fees have been introduced in several countries. Option fees are paid by the developer for the opportunity to develop a specific site. The developer can abandon the project by paying the option fee. The fee will also be paid if they stay in the project. Option fees have been introduced as either a fixed fee based on the capacities of the projects or as auctions. The option fees can lead to lower bids in the CfD-auction, as the developer can assume a lower future technological cost and higher future electricity prices and then abandon the project if these assumptions do not seem to match projections. This reduces the risk for the developer and reduces the cost for the state of the subsidy that is auctioned. The option fee therefore introduces a risk that the project will not be developed.

As any fee, the option fee increases the achieved LCOE, as the fees need to be paid by the developer, and this cost is passed onto the consumer. Therefore, it is not recommended to introduce option fees in Vietnam.

Instead, it is recommended to carefully prepare and pre-develop offshore sites before they are auctioned to avoid interfering with other activities at sea, which would cause unforeseen costs for the developer to increase the likelihood of projects being consented and hence deliver the renewable power to the Vietnamese system that has been planned for.

If seabed lease fees are applied against our recommendation, sound principles for the scale of seabed leases should include considerations of fairness and proportionality. Otherwise, the seabed lease could lead to a lack of interest or inefficient bidding behaviour from developers. The seabed lease should only cover the actual area occupied by wind turbines, discount for coexistence and should be proportional to the energy generated within the area.

6.3 Offshore Wind Capacity Density

The abundant offshore wind resources available off the coast of Vietnam allows for optimizing the capacity density to minimize the LCOE of offshore wind. Wake effects and blockage effects cause the optimal capacity density to typically be in the region of 2-5MW/km², dependent on wind speeds, turbine size, size of the wind farm, fixed project costs, cabling, etc. Careful modelling of the specific offshore wind area up for tender is required when establishing the capacity density restrictions.

It is recommended this modelling and subsequent capacity density definition is carried out by public authorities, such as EREA, to have a good understanding of how much capacity can be expected and to avoid sub-optimal use of the best sites with a given support scheme. It will also be a measure for verifying the developers' claims regarding LCOE based on capacity density. Still the final site layout should remain with the developers based on their further site investigations.

Capacity densities are typically defined for areas exclusively assigned for offshore wind. Thus, capacity densities do not typically take into consideration other maritime activities which will impede the development of offshore wind. When other maritime activities are taken into consideration, the area for offshore wind development may be up to 4 times larger than what the optimal capacity density suggests, as explained in section 4.2 and shown in Figure 22. Coexistence of maritime activities would thus contribute to increase the total potential for offshore wind considerably. It may even be economically beneficial to reward coexistence in concession areas e.g., by discounting any seabed lease fees.

One example of coexistence could be allowing fishing within the offshore wind farm, which is to be carefully aligned to minimize the risk of collisions with the wind turbines and damage to cables. If the developers were granted a discount on seabed lease or compensated in other ways for allowing fishing within the offshore wind farm, they might be more willing to accept the risk, which would help sustain the local fishers and improve the local acceptance of the wind farm.

6.4 Regulation

Several players already demonstrate an interest in the installation of WTGs on Vietnamese waters, given the vast potential they feature in terms of wind power production. Based on the reflections from this analysis, it is recommended to implement some regulatory measures aiming at incentivizing the effective introduction of the offshore wind market in Vietnam.

6.4.1 Policies and Instruments

As a first step for the proposal of policies and instruments for the adaptation of the Vietnamese offshore wind regulatory framework, it is essential to understand the merits of the systems in force in the analysed countries and their applicability to Vietnam.

Planning

The most important tool to get an overview of the available opportunities for real offshore wind development in Vietnam is the Maritime Spatial Plan. This plan aligns all interests at the Vietnamese sea and therefore participation in developing this plan to secure reservations for offshore wind development is of very high importance. This will also build relations to the other stakeholders which will be useful when further development follows.

Once the Maritime Spatial plan is in place, COWI recommends to further detail the reserved areas in a specific site development plan for offshore wind. In this site development plan the reserved areas are distributed into commercial scale concessions with known site conditions and expected power density capacities, which can be awarded on negotiated terms and conditions or tendered in auctions.

Development Strategy

It is important to have ambitious targets for the development of the offshore wind market to attract international developers entering the market with a long-term perspective. The current targets in the PDP-8 draft need to be raised to achieve this benefit.

The system of competitive auctions has been deployed worldwide in the development of renewable sources in general. This is also the case in the offshore wind sector, where most of the leading countries apply an auction system, usually having the lowest bid as award criteria. This might suggest that their success is also the most appropriate means of reaching success in developing the sector in new countries.

However, the main drivers have been technological development and transparent regulations, well-documented site conditions and fair risk sharing terms and conditions in tenders allowing bidders drastically reducing their offers.

The transition to a permitting framework fundamentally based on auctions accompanies the increase of competition within the national offshore wind sector and, consequently, price reductions. Nevertheless, in such a case, there shall be sufficient time for the national regulatory framework to be changed. In other words, project developers shall be provided enough time for adapting to the new system, as a sudden change could bring market insecurity for foreign and domestic project developers, as well as a lack of bankable projects being approved, therefore hindering the further development of the sector in Vietnam [34].

In terms of granting rights of installation for offshore wind projects, an introduction system based on selected unsolicited applications followed by auction rounds is recommended as the most suitable. It is recommended to develop the first couple of offshore wind farms based negotiated terms and conditions until regulations and regulation handling processes are in place and use these to gain further knowledge and experience before entering an auction scheme. With sufficient experience and regulation in place, it is recommended to implement an auction scheme tendering the offshore wind farms based on well-known terms and conditions achieved by site pre-assessments and Strategic Environmental Assessments performed by the Vietnamese authorities.

It is necessary to consider financial support in the growth of the Vietnamese offshore wind power capacity. Even with the strong development of the sector in the leading offshore wind countries during the last three decades which has led to substantial price decreases, new offshore wind farms are still subsidised. For new markets as Vietnam, similar conditions and market prices cannot be expected before at least experience and regulations have matured, and some projects have been commissioned.

Although being the most utilized support scheme worldwide during the first years of offshore wind development, a Feed-in Tariff system is not considered an acceptable solution in the Vietnamese political system. Therefore, it is recommended to apply a negotiated award system for the first Vietnamese OWFs based on transparent qualitative terms and conditions with volume control measures specific for offshore wind installations, as well as specific requirements for environmental and social aspects.

Applied properly this system can provide high-security levels for investors, and according to the prices of offshore wind energy production, given its technology-based feature. To achieve this financial security, the payment level is to be defined according to forecasts of the LCoE of offshore wind in Vietnam during the projects' respective design lifetimes.

As mentioned, a volume control strategy shall be implemented together with the negotiated award to avoid overpayments in case of extraordinary production circumstances. In other words, the support is to be provided up to a limited level of electricity supplied to the grid. At last, to ensure the system's integrity, a thorough assessment of the applications shall be carried out by the secretariat in charge of regulating it to testify the eligibility of a project developer to be granted the support.

The sector tends to be mature enough to be willing to bear higher investment risks, once the first years have passed, after the scheme has been implemented and successfully applied to some OWFs in Vietnam. This will allow for reduction in the support schemes.

Handling of offshore wind farms
Currently, MONRE is the federal body in charge of identifying, demarcating, registering, and regulating the national territory beyond 6nm from the shore. Therefore, it has the final word on the usage of the lots on the Vietnamese territorial sea and EEZ. Being so, they shall be addressed both by project developers intending to implement their OWFs independently and by the offshore wind regulatory institution when a site is intended to be auctioned for offshore wind development. Still several other ministries such as MOD, MOC, MOT and MOIT shall be approached creating uncertainty for the developers if they will be able to get their project approved.

Minimizing risks for developers should take priority when developing the regulation and handling the individual projects.

Therefore, COWI suggest that the Vietnamese Government assigns a ministry to be responsible for delivering the Government's targets for offshore wind in a timely and coordinated manner. Such a mandate could be assigned to MOIT who also will act as the secretariat for receiving offshore wind farm applications.

With such mandate in hand, MOIT should be able to convene and chair a committee, here called “Offshore Wind Development Committee” comprising representatives from all authorities involved in offshore wind planning and permitting, including the military. Also, relevant provincial authorities (PPC) should be included. The setup could be as shown in Figure 26.

Figure 26. Committee and organisational setup for handling offshore wind applications

The purpose of the committee will be to establish a common understanding of the necessity to identify and agree on feasible sites for the country’s offshore wind development, which will be compiled in a Maritime Spatial Plan. The Committee should furthermore seek to streamline and simplify permitting of projects as much as possible, such that the likelihood of a positive outcome of a potential windfarm within a reasonable timeframe is maximized.

The Committee may also be involved in more operational matters such as unsolicited open-door applications, design of an auction scheme, tender management, funding mechanisms, grid connections etc. if so wished.

Hence the responsible ministry MOIT will

- set up and lead a committee with representatives of other relevant ministries and PPC’s for the offshore wind development and approval of projects
- receive and handle unsolicited applications via the secretariat
- develop and handle offshore wind tenders via the secretariat
- act as the single access point towards developers via the secretariat

To improve the investment situation for offshore wind in Vietnam, COWI recommends updating the ‘Law of Investment’ to assure the investment approval authority for all real offshore wind projects is at the appointed leading ministry and therefore becomes the key investment point for offshore wind and responsible for building and maintaining the country's master plan for offshore wind development.

- If an offshore wind project is already in province master plan for wind, it shall be transferred to the country's master plan for offshore wind and a potential investor shall approach the leading ministry to get a certificate of investment policy i.e., an approval.
- Province wind master plans shall only contain the power transmission cables within 6nm boundary and onshore transformer stations for the offshore wind projects.
- If an offshore wind project is not in the country's master plan, the investor shall establish a proposal to add the project into the PDP-Amendment list. Then the leading ministry will ask for the project to be added in PDP-Revision.

If Vietnam decides, against our recommendations, to proceed with seabed leasing fees, the leading ministry shall be authorized to set the fee level. The fee shall be set as modestly as politically possible, and it shall be noted that the fee shall be added to the generated power only (VND per kwh produced) to assure offshore windfarms are developed to achieve an optimal LCOE based on the physical conditions at the site.

This way the leading ministry e.g., MOIT becomes an active player in the offshore wind development on top of their current role for adding projects into PDP, review and approve the design.

MONRE will still review and approve sea investment, the E(S)IA, grant seabed license or consent about that sea license via the committee.

EVN will still be the off-taker, who will have to carry the cost of the renewable power production. They can also be further involved in the development work to increase their interest in developing offshore wind farms.

The leading ministry oversee regulating the sector and handling all the communication between authorities and developers including issuing of licenses for implementation and managing the competitive tender processes.

For the auctions, the leading ministry would work as a single access point for the bidders via the secretariat, providing all necessary licenses and preliminary studies, including a Strategic Environmental Assessment from the areas of the Vietnamese EEZ and territorial sea being tendered for offshore wind development. This secretariat role could be potentially fulfilled by EREA, the MOIT, or even a third institution founded specifically for this purpose.

The leading ministry will also provide consultations to the relevant stakeholders, in a manner that all parties would have equal access to information for defining their bids. It should be noticed that the access to this information does not exempt project developers from being obliged to execute additional investigations at the site, e.g., a detailed EIA, especially by financing institutions and investors who might need them as a means of insurance. This consequently opens possibilities for surveying and environmental engineering companies to join the market through further agreements apart from the one directly with EREA.

It is recommended to put the open-door procedure for unsolicited applications on hold until the Maritime Spatial Plan, clear regulations and processes are in place for the Vietnamese authorities to get in control of the market and assure reservations of the most promising site. When regulations and handling has matured sufficiently, it can be reconsidered, if unsolicited applications shall be allowed again for undiscovered opportunities in the offshore wind market.

However, also for unsolicited applications the appointed leading ministry could act as a single access point for the project developers, where they can submit requests to implement their OWFs on a chosen site. In this case, they should apply for an authorization to execute preliminary investigations at that site, already providing a draft of the main expected characteristics from the project. The leading ministry then examines whether any conflicts of interest could exist in the required site. Like in the case of the auctions, this procedure would involve consultations with the relevant stakeholders. Once all constraints are solved, the permit to realize the investigations is issued. Provided that their results are positive with regards to the feasibility of implementation, the project developer is eligible to apply for a construction license, if some further aspects are also confirmed, such as the economic assets for the construction, including financing structures and/or their eligibility to be granted some financial support.

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7 References

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8 Appendices

8 Appendices

8.1 Appendix A Sea Charts

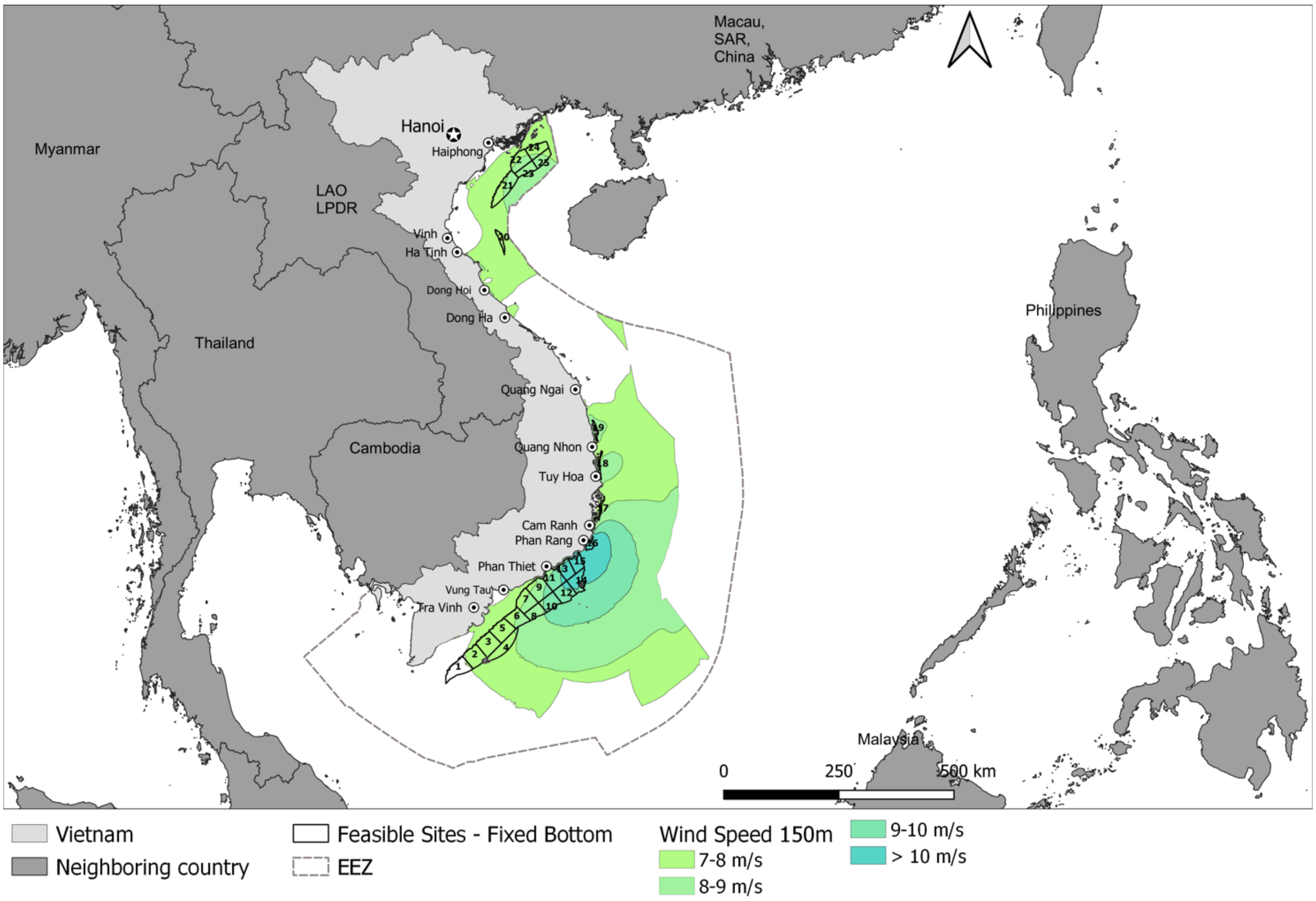

Figure 27. Wind speed classification at Vietnam, based on Global Wind Atlas. Suggested areas from the previous study [2] are also included.

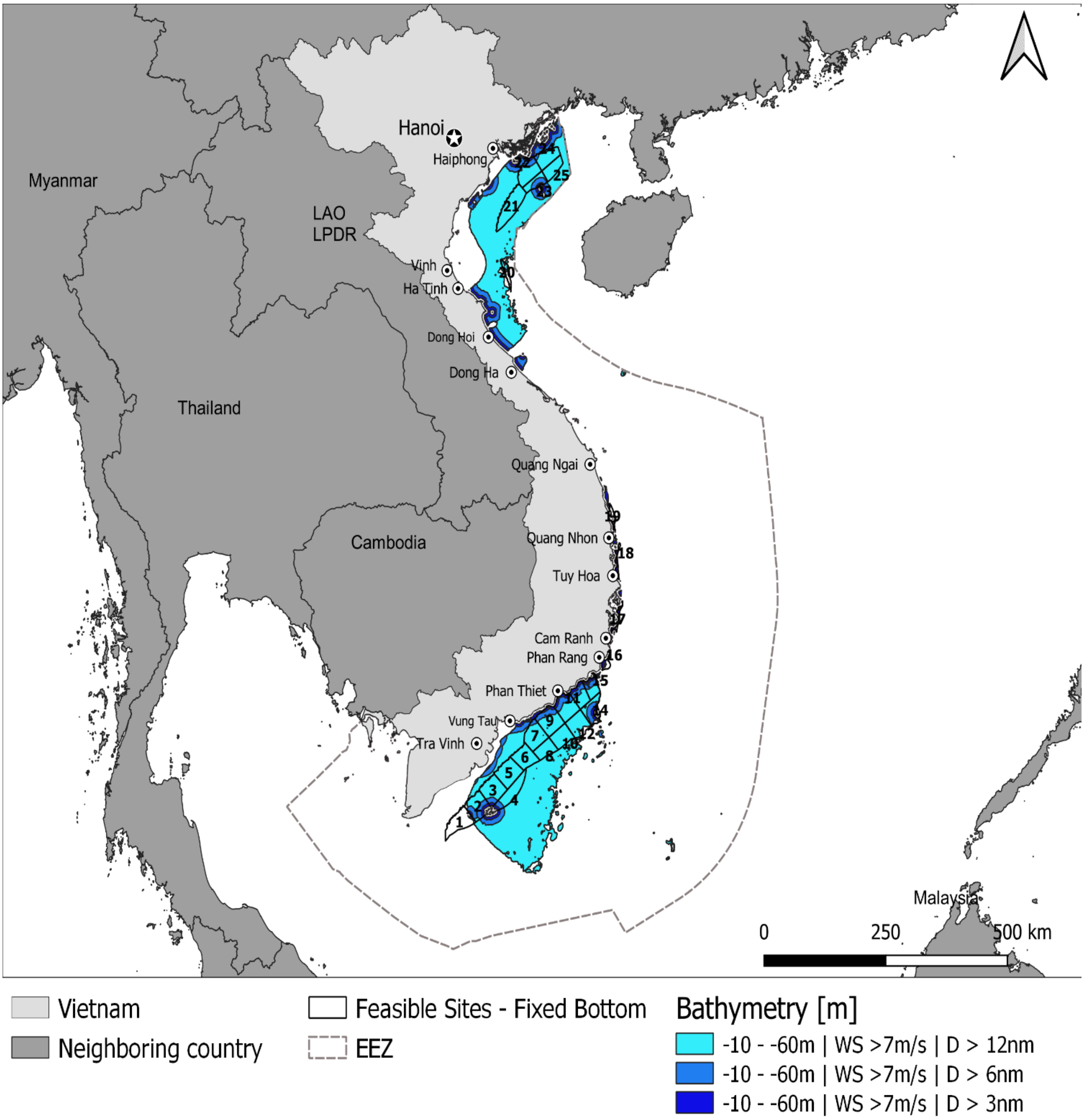

Figure 28. The resulting combination of criteria – water depth, wind speed, and distance to shore. Suggested areas from the previous study [2] are also included.

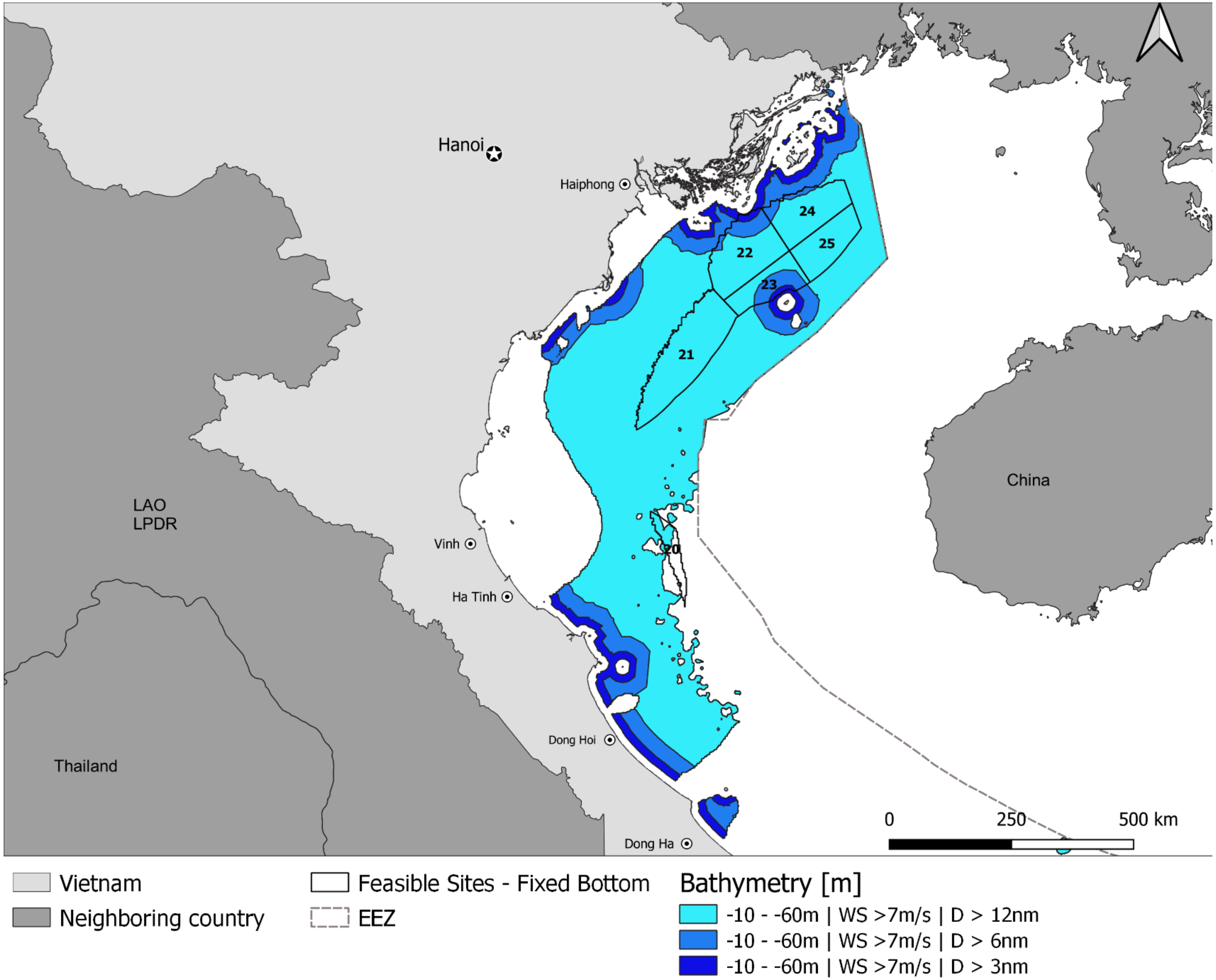

Figure 29. Resulting combination of criteria – water depth, wind speed and distance to shore at North Vietnam. Suggested areas from the previous study [2] are also included.

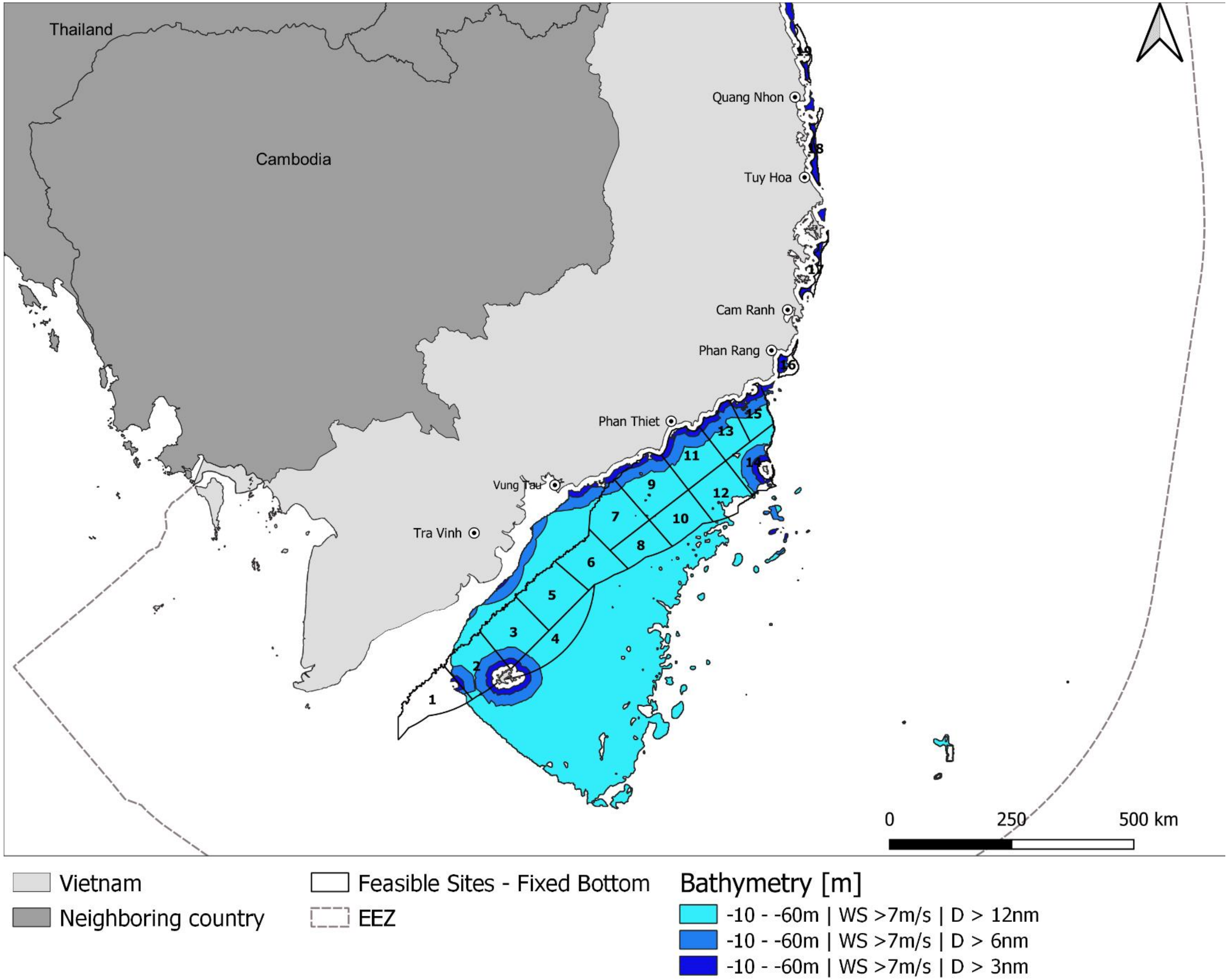

Figure 30. Resulting combination of criteria – water depth, wind speed and distance to shore at South Vietnam. Suggested areas from the previous study [2] are also included.

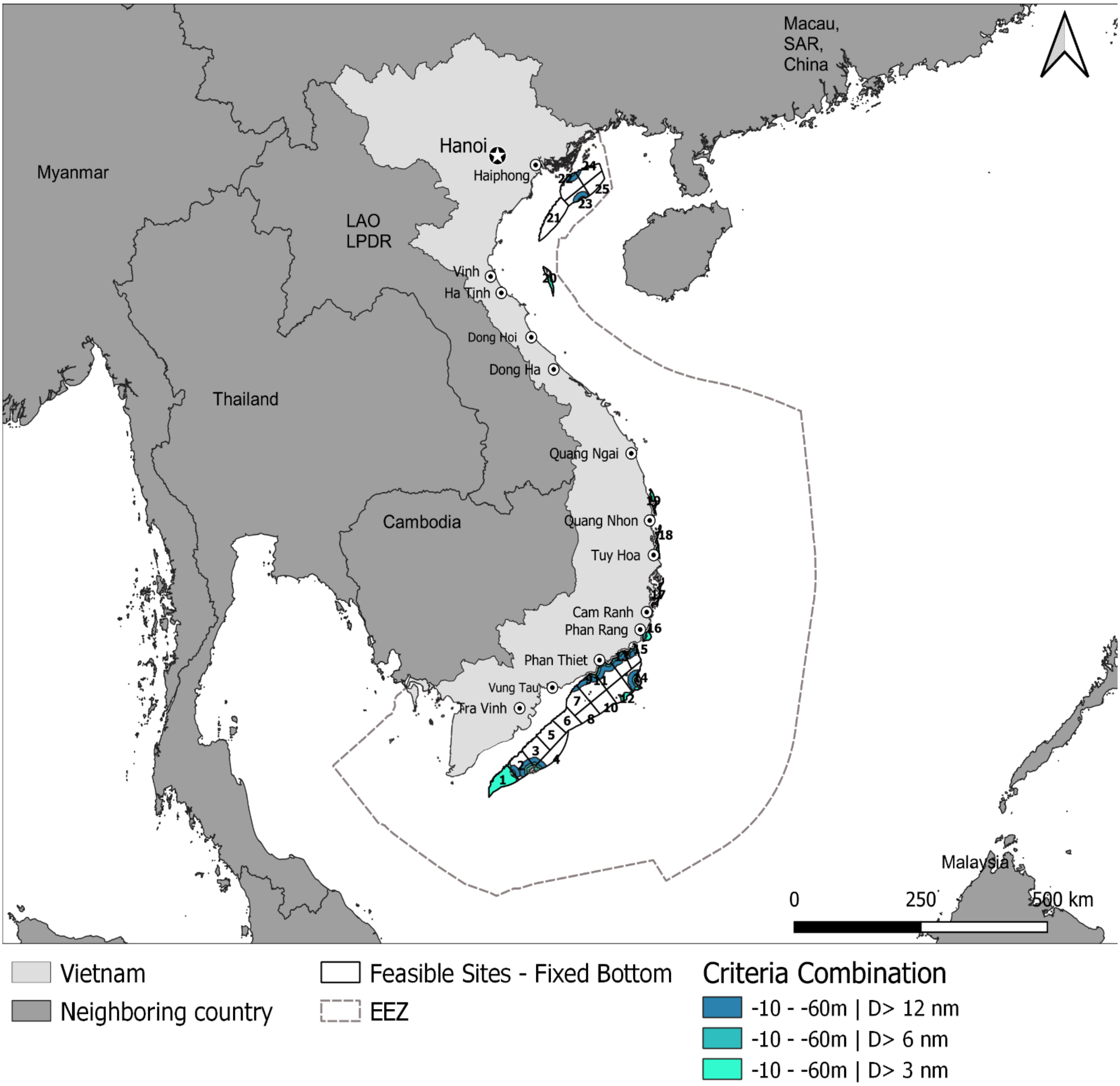

Figure 31. Impact of the combination of criteria on the suggested areas from the previous study [2].

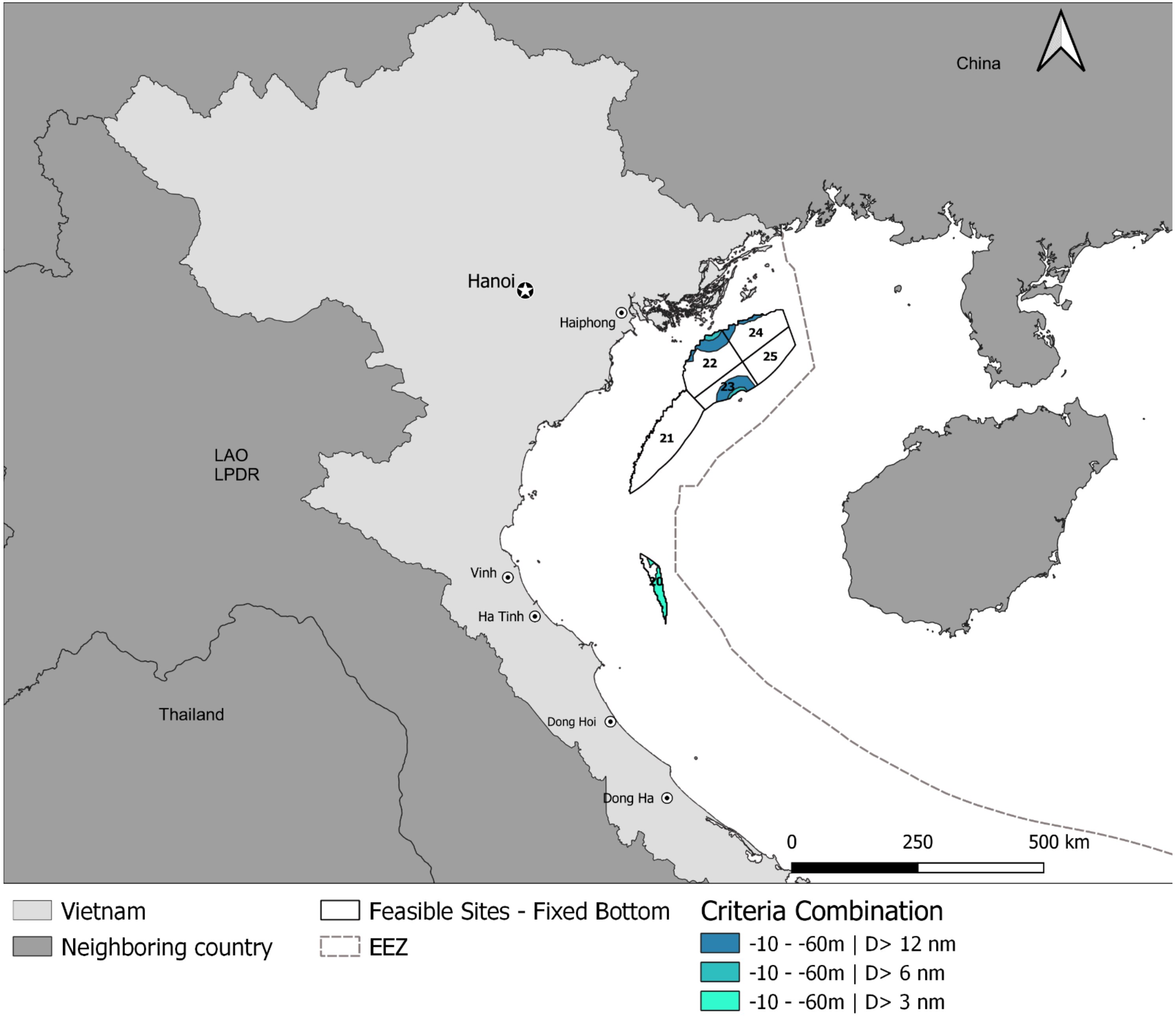

Figure 32. Impact of the combination of criteria on the suggested areas from the previous study [2] – North Vietnam.

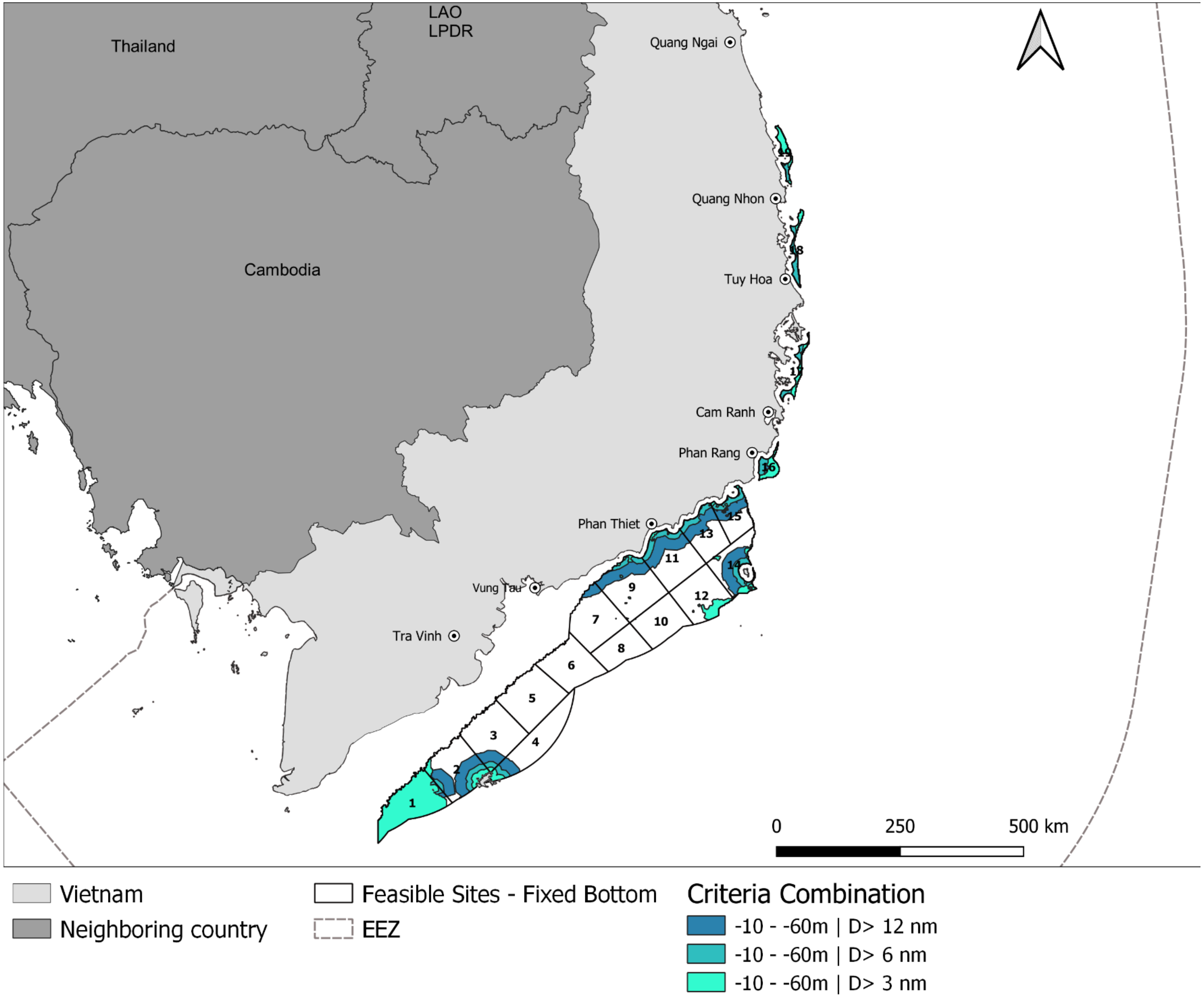

Figure 33. Impact of the combination of criteria on the suggested areas from the previous study [2] – South Vietnam.