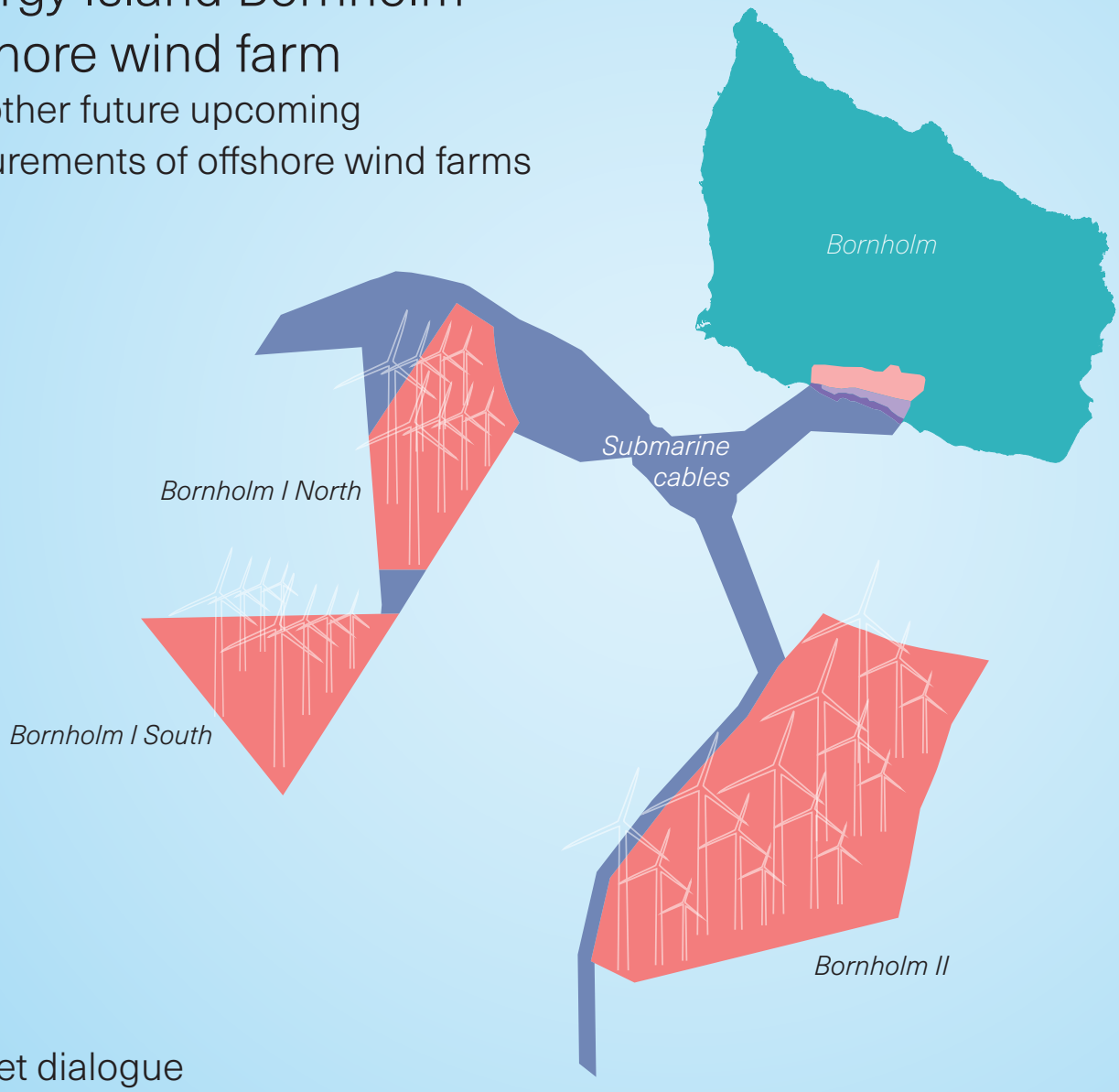
Danish Energy Agency

Invitation to dialogue

Energy Island Bornholm offshore wind farm

and other future upcoming procurements of offshore wind farms



Market dialogue

July 2022

Contents

1. Foreword

The Danish Energy Agency (DEA) and Energinet invite potential tenderers and industrial actors to participate in the first round of market dialogues on the procurement process concerning the offshore wind farms for Energy Island Bornholm and other upcoming offshore wind farms to be established in Danish waters.

The focus of the marked dialogue will mainly be on topics relevant to the preperation of the conditions for the tender of Bornholm Energy Island, but also for other upcoming tenders of offshore wind to be established by 2030 at the latest. It is expected that additional material and questions will we released by august in due time before the market dialogue. The dialogue will be followed by a new market dialogue at the beginning of 2023 focusing on the remaining framework conditions and selected topics from the first dialogue covering all upcoming offshore wind farms, including Energy Island Bornholm.

The DEA is tendering out offshore wind farms on behalf of the Danish Minister for Climate, Energy, and Utilities. The procurement process for all upcoming offshore wind farms is planned to be launched in 2023.

The market dialogue will be an opportunity for the market and potential tenderers to discuss specific elements of the tender framework with the DEA and Energinet – in this case mainly on topics related to Energy Island Bornholm – and to provide input on the framework conditions, including timetables.

It will be indicated if the topic or specific questions are related to Energy Island Bornholm, the framework of the other upcoming Danish offshore wind farms, or offshore wind in general.

The DEA and Energinet are looking forward to receiving your input on the market dialogue.

2. Participation in the market dialogue

The market dialogue will be based on the present invitation to dialogue. The main event will be held on the 30 of August 2022 at 13:00-16:00 and individual meetings between the 1-9 September 2022. The meetings will be held between 09:00-11:00 and 13:00-15:00.

Request for meetings

Potential tenderers or relevant industry associations can also request a confidential physical or virtual meeting with the DEA and Energinet, where the framework for Bornholm OWF can be discussed. Meetings can take place on weekdays between 1-9 September 2022.

Please confirm your participation in the main event and submit your request for individuals meetings by e-mail to Energyislands-EOB-OWF@ens.dk no later than 19 August 2022 at 12:00. Requests for meetings should include the request for a physical or virtual meeting and a draft agenda, which the DEA can supplement with further items before the final adoption of the agenda.

These meetings are offered with a maximum duration of 2 hours as standard. The DEA reserves the right to change the length of the meetings to take into account the proposed agenda for the meeting and the number of total meeting requests.

The DEA will send out a link to a video conference in due time before the meeting.

The DEA reserves the right to reject meeting requests if a high number of requests means that all meetings cannot be held during the seven days allocated to the market dialogue. Furthermore, the DEA can reject requests for meetings if the DEA believes this is justified on objective grounds.

Feedback from the market participants

Participants in the market dialogue are invited to consider the questions posed but are also welcome to send input related to themes that are not mentioned in this material. Written comments or questions to the DEA and Energinet should be sent by e-mail to



Energyislands-eob-owf@ens.dk by no later than 18 of September 2022. Please use the Excel file "Input to market dialogue OWF 2022" on the market dialogue page on www.ens.dk/energy-island-bornholm-procurement to send your input.

Overall feedback report

Following the meetings and written questions and input from the market actors, the DEA will publish an overall feedback report, where topics raised in the market dialogue will be published anonymously along with the DEA's response. The DEA will not necessarily answer all questions individually but expects to respond to the questions and other input given in a summary format sorted by topic. The feedback report will be made available on https://ens.dk/en/our-responsibilities/wind-power/ongoing-offshore-wind-tenders/energy-island-bornholm-owf.

Confidentiality

If potential tenderers request confidentiality on certain information for competitive reasons, the DEA will be able to accommodate such requests, provided that they do not infringe on the obligations of the Danish Freedom of Information Act (Access to Public Administration Files Act), the Danish Public Administration Act and the Environmental Information Act and the Public Procurement rules, in particular the principles of equal treatment and transparency. Under no circumstances will information received be used in any way to provide competitive advantages to a single market player.

3. About Energy Island Bornholm OWF

Energy Island Bornholm is one of two energy islands laid out in the Danish Climate Agreement (June 2020). Energy Island Bornholm will be the very first of its kind and will be the first of the two energy islands OWF. The construction of the Energy Island in the North Sea will be handled in a separate market dialogue. Energy islands are a distinct concept and have never been seen anywhere else before. The concept sees wind turbines connected either directly or through substations to the island from where the power can be distributed between countries. As such, energy islands will enable large-scale sector coupling in Norther Europe and will function as green power plants at sea of tomorrow.

Overall timetable

The location of Energy Island Bornholm was decided as part of the Danish Climate Agreement (June 2020). Furthermore, the agreement stated that 2030 was the deadline for when the wind farm connecting to the island has to be in full operation. The DEA plans to launch the procurement process at the end of 2023, with the expected announcement of the winning tenderer to be at the end of 2024. Given the inherent complexity of the Energy Island, the timetable for Energy Island Bornholm is somewhat condensed compared to traditional offshore wind farms which may affect both the procurement process and the amount of time that the concessionaire has at their disposal to build and fully commission the wind farm.

Site

In May 2020, and later in September 2020 the DEA published a fine screening, conducted by COWI, of the areas in Danish territorial waters around Bornholm for the establishment of new offshore wind farms that can be connected to the Energy Island. The screening reports can be found on the DEA's website. The screening reports are only available in Danish. The screening concludes that it is both possible and desirable to build offshore wind farms in the screened areas in relation to aspects concerning nature, the environment and planning. In October 2021, the screening sites were expanded to accommodate one additional GW of capacity if necessary in addition to the already planned 2 GW. The additional capacity has not yet been politically agreed upon.

The sites at Bornholm (Bornholm I North, Bornholm I South, and Bornholm II) were chosen in light of the fine screening in 2020, the Danish Government's political objective as well as an overall economic analysis of the LCoE (Levelized Cost of Energy).

The sites at Energy Island Bornholm are located in the Baltic Sea south-west of Bornholm. Bornholm I South has a total area of approximately 118 km^2, Bornholm I North has a total area of 123 km^2, and Bornholm II has a total area of 410 km^2. Within these areas, it is possible to install up to 3.8 GW of wind power capacity and the turbines can have a maximum height of 330 m. A total of up to 7 offshore transformer substations can be constructed.

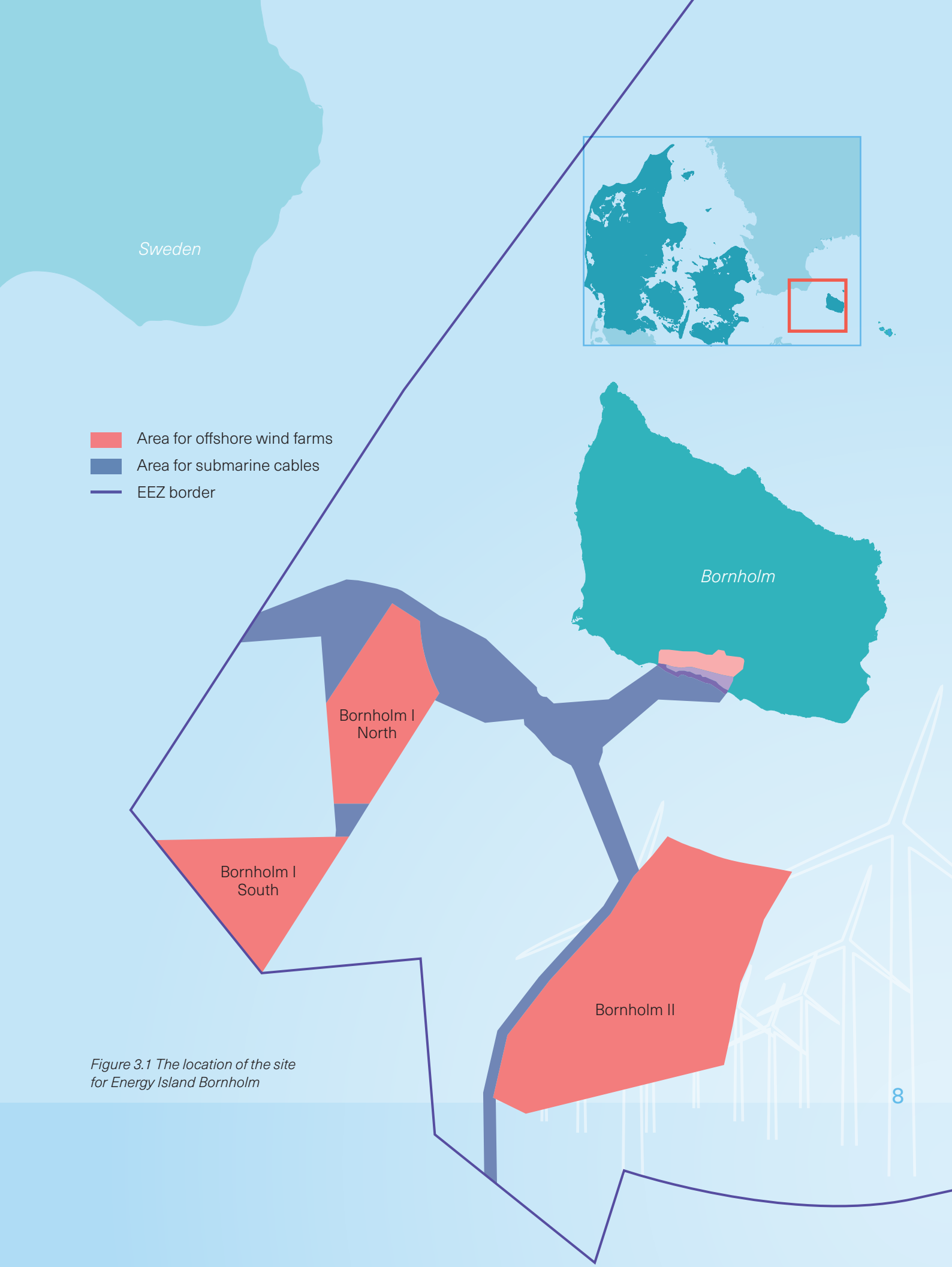


Figure 3.1 The location of the site for Energy Island Bornholm

Characteristics of the site	
Maximum installed capacity	3.8 GW (including overplanting)*
Capacity in the POC fully expanded	2.0-3.0 GW
Distance to shore	Up to 15-20 km from shore
Distance from Bornholm II	23-28 km south west to Rønne habour
Mean wind speed	9.92 m/s (150 m above sea level)
Sea Depth	39.6 m (Bornholm I) and 34.2 (Bornholm 2)
Distance from landfall to POC	Minimum 700 m

**overplanting not yet decided*

Tabel 3.1. Characteristics of the site for Energy Island Bornholm.

Installed capacity, overplanting and utilization of the site

Energy Island Bornholm will have a required installed capacity between 2,000-3,000 MW and will at the time of realization potentially become the largest offshore wind farm in Denmark. The Bornholm sites are relatively limited in size and the shape of the site might limit the design options of the wind farm. However, in order to support optimal utilization of the site, the tender framework could give greater flexibility to market actors with respect to the installed capacity than in earlier procurements.

2,000-3,000 MW can be delivered at the Point of Connection (POC). However, the concessionaire might see an advantage in installing additional capacity, known as "overplanting". Overplanting allows the concessionaire to optimize the use of the export cables, as the additional installed capacity will enable a more continuous flow of power to the POC. The concessionaire can also decide to store or convert (PtX) the additional electricity instead of delivering it to the collective grid. This can be achieved by installing batteries or other temporary forms for electricity storage.

It is important to note, however, that overplanting is not a requirement nor a decided element of the project and the framework for overplanting and PtX will be described in the procurement specifications. Instead, overplanting should be seen as an opportunity for the concessionaire and so should also be spearheaded and paid for by the concessionaire.

It is also important to note that possible overplanting cannot exceed the maximum installed capacity of 3,800 MW. The 3,800 MW corresponds to the maximum capacity defined with regard to the framework for the Strategic Environmental Assessment (SEA) of the plan for Energy Island Bornholm.

Considerations on overplanting is described in further detail in a later section of this document.

The sites may be reduced slightly as a result of the SEA, but the DEA does not intend to reduce the site areas based on the capacity that the concessionaire wishes to install. The size of the Energy Island Bornholm sites will be the same whether the concessionaire chooses to engage in overplanting or not.

Landfall, onshore cables and Point of Connection

The area for the landfall (purple in figure 3.2) covers a maximum of 173 ha and is located approximately 1 km south of Nylars, Lobbæk and Aakirkeby respectively as indicated in figure 3.2 on page 11. The maximum number of landcables is limited to 21 from the landfall area through to the transformation area (green). The placement of inspection wells above cable sleeves between the submarine cables and land cables shall be placed in the landfall area. From the landfall area, the cables are to be located a minimum of 8 meters apart and at a minimum depth of 1 meter up to the transformation area.

The distance to the planned site for the onshore station will be a minimum of 700 m. As the site for the onshore station has not been decided, the distance is based on the area planned for in the municipal plan (draft: https://bit.ly/3OPbC5H).



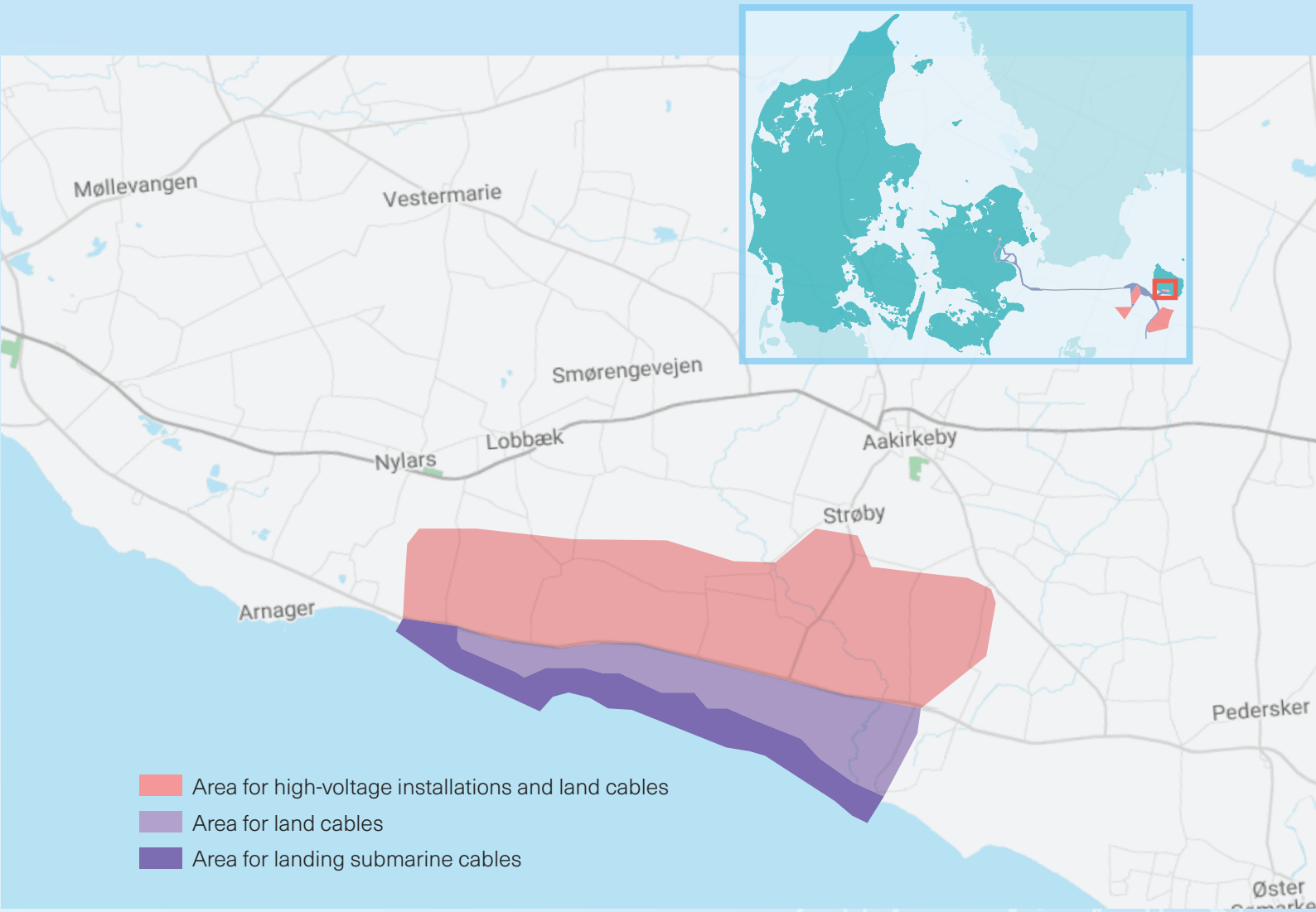


Figure 3.2. Area for landfall

Transfer of costs related to transmission infrastructure

Based on the political agreement on energy islands of 4 February 2021[1], Energinet will establish, own and operate the Danish part of the transmission infrastructure, which is necessary for OWF-concessionaires to get access to the existing transmission network. Congestion income cannot cover the full cost of the transmission infrastructure.

It is a political aim of the Danish Government to avoid, as far as possible, the Energy Island project resulting in increasing consumer tariffs. This implies that Energinet's net costs must be transferred to another actor.

In a political agreement of 1 September 2021[2], it was decided, that Energinet's net cost related to transmission infrastructure for the Energy Islands shall be transferred to the OWF-concessionaires to as great an extent as possible.

The method of payment has not been finally decided but will be described in the final procurement specifications.

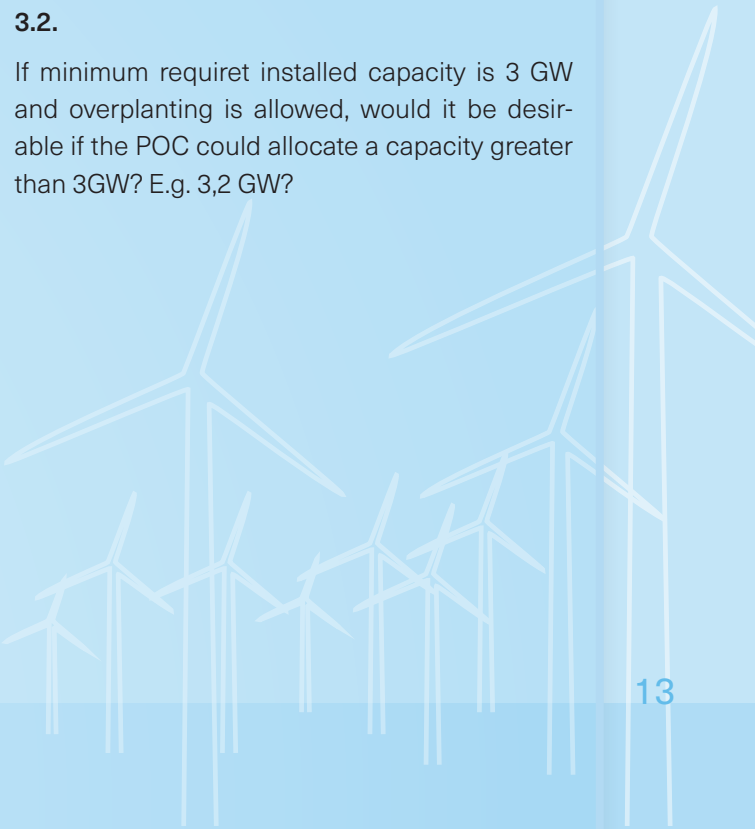
Questions

3.1.

Would you prefer the site in one procurement or divided into two separate procurements for Bornholm I and Bornholm II. Please elaborate why you prefer either one or two procurements?

3.2.

If minimum requiret installed capacity is 3 GW and overplanting is allowed, would it be desirable if the POC could allocate a capacity greater than 3GW? E.g. 3,2 GW?



1. https://bit.ly/3OwKitn

2. https://bit.ly/3a2qZZK

4. Timetable Energy Island Bornholm OWF

The preliminary timetable for Energy Island Bornholm OWF project including the procurement process and the deadlines after the concession is awarded are outlined below. Please note that the timetable may be amended to accommodate possible changes arising from the market dialogue, ongoing analyses, or unforeseen circumstances.

Timetable for the procurement process

A Prior Information Notice specifying the overall nature and scope of work will be published in Q1 2023. Later, in Q4 2023, a Contract Notice describing the terms and conditions for the procurement will be published together with the specifications – this will officially launch the procurement process.

When publishing the Contract Notice in Q4 2023, the DEA will provide information on all relevant data and reports available at the time. Since some of the data and environmental assessments will be published afterwards, the DEA will also provide a list of expected conditions concerning all elements of site investigations and environmental assessments at the time of publishing the Contract Notice (e.g. results of completed geotechnical and geophysical surveys, MetOcean data collection as well as the supplementary environmental assessments).

The final results of the preliminary surveys and site investigations as well as the reporting on the SEA will be made available by the DEA before tenderers have to prepare their BAFO.

Timetable for concessionaire

From the award of the concession contract, the concessionaire will have approximately six years until the deadline for full commission on 31 December 2030 to construct the wind farm and export facility. On 31 March 2029, i.e. four years after the award of the concession contract, and almost two years before the deadline for full commission, the POC will be ready, meaning that this is the date where the concessionaire can deliver first power to the collective grid. Though March 2029 marks the time where power can be delivered to the collective grid, it is vital to note that a 100% uptime cannot be guaranteed at that point in



Timeline

2020	June 2020 – Climate Agreement including Energy Island Bornholm
	November 2020 – Political agreement placing the OWF 20 km from the shore of Bornholm
2022	Ongoing political negotiations concerning increasing the size from 2 to 3 GW and 15 km from the shore of Bornholm
	30 August - 7 September 2022 – Market dialogue on framework for the procurement process
	Q4 2022 – Political decision on procurement conditions
2023	Q1 2023 – Publication of a Prior Information Notice
	Q4 2023 – Publication of the Contract Notice, procurement specifications
	Q1 2023 – Q4 2024 – Energinet procurement process
2024	Q2 2024 – Market condition and EIA finish
	Q4 2024 – Deadline BAFO (best and final offer)
	Q4 2024 – Announcement of the concession winner
2025	Q3 2025 – Transfer of onshore EIA approval to concessionaire
	Q1 2025 – Possible granting of licence for preliminary studies
2026	Q4 2026 – Possible granting of licence for construction OWF
2029	Q1 2029 – First power / POC ready
	Q1 2029-Q4 2030 Energinet test of interconnections
2030	Q4 2030 (latest) – Full commission of the wind farm

time. This is due to tests of the interconnectors that couple the energy island with the countries that are to be connected to the electricity grid being carried out in parallel with the connection of the wind turbines to the grid.

The concessionaire can utilize these six years as it sees best. Shortly after the concession winner has been announced in Q4 2024, the concessionaire will obtain a licence from the DEA to conduct preliminary investigations of the site for the offshore wind farm in order to carry out detailed site investigations and the EIA for the project offshore.

Furthermore, Energinet will transfer the EIA approval for the concessionaire's parts of the onshore export facility to the concessionaire. This will enable the concessionaire to initiate the processes for the onshore project right away. When the concessionaire has completed the EIA process for the offshore part of the project and delivered all other necessary documentation, the DEA will issue the construction licence, provided that the DEA can approve the EIA. DEA will also issue a production licence to the concessionaire, allowing the production of electricity. The concessionaire is thereafter obliged to establish the wind farm before the end of 2030, when 95% of the planned capacity must be connected to the collective grid.

The state aid aspect and legislative amendments

The support scheme for Energy Island Bornholm OWF has not yet been decided, as referred to in section 7. A support scheme including subsidies would represent state aid in line with article 107, no. 1, of the Treaty on the Functioning of the European Union. Notification of state aid to the European Commission, if necessary, will be carried out from Q1 2023 to Q1 2024 on the basis of an ongoing dialogue between the DEA and the European Commission. The DEA expects this approval process, if it should be necessary, to be finalized by the time the final revised tendering conditions are published in 2024.

In addition, the concession agreement will be conditional on legislative amendments with regard to certain conditions for the concession. The DEA expects these legislative amendments to enter into force before the tenderers have to prepare their final bids in Q4 2024.



Questions

Please answer both from a 2,000 and a 3,000 MW capacity scenario

4.1.

In the proposed timetable, the TSO Energinet will have the POC ready by 31 March 2029, when power can first be delivered to the grid. Is it realistic that the concessionaire will be able to use the POC at this point in time?

4.2.

Do the six years from when the concession is awarded to the deadline for full commission of the wind farm provide a realistic timeframe for the concessionaire to establish the offshore wind farm and export facilities?

4.3.

Typically, the market actor is given 2 years from point of connection until full capacity should be realized. What is the minimum amount of time that is required to set up offshore wind and how would a shortening of this period from the traditional two years affect the attractiveness of the procurement specifications? In this case, the amount of time will be two seasons, and therefore not two full calendar years.

4.4.

In your opinion, what is the biggest risk in terms of time in the project?

5. Preliminary Site Investigations Energy Island Bornholm

The purpose of the offshore preliminary site investigations is to identify and investigate the geographical location of the offshore wind farm (OWF), cables, interconnectors to landfall areas at Bornholm, Zealand and a neighbouring country. This includes geophysical, geotechnical and environmental studies and investigations together with collection of metocean data within the site of Energy Island Bornholm. The purpose of this is to reduce the construction risk for the future concessionaire for Energy Island Bornholm and to provide data for the environmental impact assessments of the specific OWF project and also, as far as possible, for the Strategic Environmental Impact Assessment (SEA) of the Plan for Energy Island Bornholm.

Overall, the DEA will use the same approach to environmental impact assessments for OWF for Energy Island Bornholm as for Hesselø OWF and Thor OWF.

The environmental impact assessment process for Energy Island Bornholm will include:

1. Prior to final bids: Completion of a Strategic Environmental Assessment (SEA) of the Plan for Energy Island Bornholm that meets the requirements in the Act on the Danish Environmental Assessment of Plans and Programmes (Danish SEA Act) and approval of the Plan for Energy Island Bornholm.

2. Prior to final bids: Completion of environmental surveys and studies. The environmental surveys will cover Benthic flora and fauna, Fish and fish populations, Birds, Marine mammals, and Bats, while the desktop studies and analyses will cover technical reports on Fisheries, Underwater noise and vibrations, Radio, radio interference and plane traffic and Maritime traffic and safety of navigation.

3. Prior to final bids: An EIA of the specific project onshore from the point of landfall, onshore cables, and transmission station on Bornholm, offshore cables from Bornholm to Zealand and landfall, onshore cables, and the transmission station at Solbjerg on Zealand.

4. After final bids: An EIA of the specific project onshore and offshore cables to Bornholm and interconnectors to a neighbouring country is to be carried out after a concessionaire has been appointed, and a specific project has been described in sufficient detail. The concessionaire is to carry out and complete the project-specific EIA offshore. Cables from windfarm to landfall is owned by the concessionaire. Energinet and possibly another TSO will be the owner of and be responsible for the interconnector cables.

Points 1, 2 and 3 above will be the responsibility of Energinet and will be completed before the deadline for final bids. The environmental studies and surveys for Energy Island Bornholm (point 2 above) are expected to be completed by Q2 2024. All reports and data will be published on the DEA website as soon as they are ready (https://ens.dk/ansvarsomraader/vindenergi/udbud-paa-havvindmoelleomraadet/danmarks-energioeer/preliminary-site-2). After winning the procurement, the concessionaire will carry out the EIA for the offshore windfarm project before construction on Energy Island Bornholm can begin.

The EIA report must comply with current regulations in the Environmental Assessment Act, and there must be carried out relevant consultations, including Espoo-consultations, etc. An approved EIA report is required before the DEA can issue a licence for construction for the offshore wind farm.



Other approvals than the onshore EIA approval for onshore solution on Bornholm and the planning (addendum to the municipal spatial plans and local plans) will be the responsibility of the concessionaire.

In June 2021, the DEA conducted a market dialogue on the offshore survey programme including information on the metocean, seabed investigation and environmental survey program. A summary of the responses from the market dialogue is available on the DEA website: https://ens.dk/en/our-responsibilities/wind-power/energy-islands/energy-island-north-sea/market-dialog-preliminary

Questions

5.1.

Given the scenario in which there is a detrimental impact on migratory species in the Baltic Sea, how could such impact be mitigated? For instance, would it be an option to switch off the wind turbines (partly or fully) in connection with particularly critical periods for migratory birds and potentially bats, and which methods/techniques could be used?

5.2.

If it is a demand to shut down the windfarm during a fixed period, how long would it take for the entire wind farm to restart and to have the turbines up and running again?

5.3.

A question relating to the mitigation of impacts on people and animals from lights on the turbines has been raised: Would it be an option to only turn on light when planes cross the wind farm area, and how could this be operated?

6. Bidding Zone Design for Denmark's Energy Islands

The European market setup is based on bidding zones that should contain no structural grid constraints. Today, Denmark is divided into two bidding zones: Western Denmark (DK1) and Eastern Denmark (DK2).

The introduction of two energy islands, with an initial combined generation capacity of 5 GW and potential capacity of 12 GW, need to be integrated into the European market for electricity. Based on European market rules, the energy islands will be assigned to bidding zones that determine the market price the electricity production may be sold at. The DEA expects that the market design for the Energy Island in the Baltic Sea will be finalized before preparing the BAFO.

Offshore bidding zones – a promising way forward

Today, offshore wind energy is deployed mainly through national projects, where offshore windfarms are connected radially to the shore, as part of the 'home' electricity market, and cross-border interconnectors are developed separately. However, the two energy islands in the North Sea and Baltic Sea are expected to be hybrid projects, which combine offshore wind, grid connection and cross-border interconnection capacity.

According to the European Commission's Offshore Wind Strategy of November 2020, the current approach to offshore wind generation, where generation is considered part of an existing 'home' electricity market, is not necessarily well suited for offshore hybrid projects, and not conducive to the large scale-up necessary to achieve European climate objectives. Hybrid projects in an existing 'home' electricity market would either need to be curtailed, to a large extent, to allow imports and exports over the interconnectors, or the cables would need to be oversized to make capacity available for trade. Thus, an offshore bidding zone will achieve a more cost-effective decarbonisation and provide a level playing field for all forms of energy generation and demand response while ensuring compliance with the cross-border trading rules.

Nevertheless, offshore bidding zones can potentially result in a different incentive structure. Depending on the electricity prices in the existing 'home' electricity market, wind generators might gain either lower or



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higher revenue with offshore bidding zones. Offshore bidding zones will also affect congestion revenue for the transmission owners. The extent, however, depends on the topology.

A further risk to note is the fact that, if offshore energy generation is expanded but the corresponding interconnection cables are not built to schedule, it would result in limited interconnection capacity, and the offshore price could be close to zero until this congestion is relieved.

Ultimately, Energinet's bidding zone review will include an extensive evaluation of the positive and negative effects of different bidding zone configurations for the two energy islands.

Establishment of a new bidding zone

For the establishment of a new bidding zone in the context of the energy islands, the Danish TSO, Energinet, must follow relevant European legislation (the Electricity Regulation (EU) 943/2019 and the Guideline on Capacity Allocation and Congestion Management 1222/2015 (CACM). The detailed procedures and requirements are set out in Articles 32 and 33 of CACM). When the time comes, the bidding zone review will include an extensive evaluation of the positive and negative effects of different bidding zone configurations with respect to overall market efficiency and network security. Before finalizing the bidding zone review Energinet shall hold a consultation in accordance with Article 12 of CACM, where stakeholders, including the relevant authorities of relevant member states are consulted.

Questions

6.1.

Will the creation of an offshore bidding zone affect your ability to participate in the offshore wind procurement process? If the answer is yes, could you please elaborate? Are there any regulatory considerations that DEA could consider in this regard?

6.2.

How would you, as a concessionaire, hedge against price risks, and will the creation of a separate bidding zone affect your hedging options? Are there any regulatory considerations that DEA could consider in this regard?

6.3.

Who should carry the financial risk of the interconnector availability risk and why? Do you see any reasons to 1) split the risk between the transmission system operator, the member state and the wind generators, and 2) to have different risk arrangement on the interconnectors to Denmark and abroad?

6.4.

To what extent does the possibility of a redistribution effect affect your business case in an offshore bidding zone design and to what extent will it affect your incentive to participate in the offshore wind procurement process?

6.5.

In your opinion, does the DEA need to consider any regulatory changes to secure a high engagement by the concessionaire to actively contribute to maintaining a secure energy supply in Denmark? The DEA is considering system adequacy and security in particular.

7. The possibility for overplanting

The DEA is considering allowing the possibility for overplanting in the upcoming procurement specifications. This section presents only initial considerations of the DEA.

The participants in the market dialogue are encouraged to share their points of view and suggestions with regards to these issues with the DEA. The more specific input the DEA can gather, the better the DEA can take into account this information when analysing how these can be realized, while also considering relevant regulations etc.

The term PtX covers various methods of converting electrical energy into liquid or gaseous chemical energy sources through electrolysis and further synthesis processes. With regard to batteries and other temporary forms for storage of electricity, it should be noted that it is considered that they would only be allowed if they are used to stagger supply to the collective electricity supply grid.

The DEA considers allowing the concessionaire to add storage or PtX installations to the electricity production plant or export facility at any time during the length of the concession agreement. If the concessionaire wishes to do so, the concessionaire will have to ensure that the new installations can be covered by the initial EIA approval for the onshore or offshore installation, or carry out a supplementary EIA, if relevant. Please note that, for Energy Island Bornholm, even if allowed, PtX will not be a part of the initial EIAs. The concessionaire must also ensure that changes are in accordance with the relevant licenses and approvals for the particular tender, as well as other relevant legislation.

The advantage could, amongst other things, be the location of batteries or PtX assets behind the meter. A majority of the Danish Parliament recently adopted a new strategy to promote and navigate the future development of Power-to-X (PtX) projects in Denmark (15 march 2022). The bill containing new provisions for direct lines is expected to be introduced into the Danish parliament in the autumn of this year. The bill proposes an application-based permission process that eases access to construct a direct line between electricity production and consumption, e.g. between an offshore wind farm and a PtX plant, provided such connection is sufficiently socio-economically beneficial. If the Danish parliament passes the bill, market participants will be able to apply for a direct line from the beginning of next year.

The participants in the market dialogue are encouraged to share their points of view and suggestions with regards to the possibility of co-locating consumption and production from the wind farm

Questions

7.1.

Is it economically attractive to add consumption before POC in connection with the wind farm? (even though consumption is not part of the procurement specifications). Could you please elaborate your answer?

7.2.

What type of consumption technologies (assets) would you consider installing, if any?

7.3.

To what extent do you believe that there are sufficient market tools, e.g direct lines or geographically differentiated tariffs, to secure the incentive to co-locate production and consumption nearby the wind farms (before or after POC)? If not, do you have any input to regulatory changes the DEA might introduce to secure a higher extent of co-location?

7.4.

How do you imagine the split of ownership between consumption and the wind farm? Do you foresee any advantage in an offshore bidding zone when co-locating consumption and production?

7.5.

In the case of Energy Island Bornholm and an offshore bidding zone what role (if any) does ownership structures for the different production and consumption capacities on the Energy Island have for ensuring a well-functioning bidding zone? How much capacity is it physically realistic and economically attractive to build in the Energy Island Bornholm?

7.6.

If adding a PtX asset, would you do it at the same time as commissioning the wind farm or at a later stage?

7.7.

If batteries or PtX-assets are placed onshore, how large an area would this require? Are there any other technical requirements for this area that you know of at this point?

7.8.

How would you prefer to connect Energy Island Bornholm to the grid if you choose to install a PtX asset?

7.9.

Would you prefer all the turbines to be connected to the grid and use the PtX for the excess capacity of the site? Or would you prefer to have the possibility to choose only to connect some of the turbines to the grid, while the rest of the turbines are dedicated to the PtX?

8. Support mechanism

The outcome of this market dialogue will be analysed by the DEA and taken into account when deciding on the support mechanisms for the framework of future OWF.

The political starting point in the Energy Agreement from 2018 is as follows:

"Offshore wind is expected to be capable of producing green electricity on market conditions and without state subsidies within just a few years [...]. It is necessary to create an optimum market framework for the establishment, operation and innovation of offshore wind. This framework will enable offshore wind to deliver green electricity at a competitive price within the shortest possible time."

Later political agreements and initiatives by the Danish government put further emphasis on the expectations about offshore wind operating without state subsidies within a short timeframe.

Support mechanism/subsidies are nor out of the question though if they are necessary for the specific offshore windfarm. The participants in the market dialogue are therefore invited to share their views on these political objectives and how they can be reached.

Questions

8.1.

Do you think that a support mechanism/subsidies are a condition for participating in the procurement? Please answer both in relation to Energy Island Bornholm and other OWF procurements in generally.

8.2.

How does the transfer of costs related to transmission infrastructure affect the need for a support mechanism/subsidies?

8.3.

In the scenario in which the market actor believes support mechanisms are required, what should a potential support model underpin? Please provide 3-4 examples a potential support model should live up to (compatibility with Power Purchasing Agreement, simplicity, risk sharing etc.) and prioritize the ones that are deemed most important.

8.4.

What would be the upsides and downsides for both the concessionaire and the Danish State with the suggested model?

8.5.

In the opposite scenario in which the market actor believes subsidies are not required, what should a potential "support" model still underpin?

9. Grid connection

The Bornholm topology

For the first step of the Energy Islands, Energinet is considering to develop a topological concept, where the interconnectors can be electrically coupled on either the AC- or DC-side. The topological concept is shown in a simplified single-line-diagram in Figure 9.1. The interconnector system consists of two 525 kV HVDC-VSC bi-pole systems with dedicated metallic return. The converters are connected to substations in Denmark and another country. The two HVDC interconnector systems can be operated in two different modes: AC-coupled mode via the 400 kV HVAC bus, or DC-coupled mode via a double DC-busbar system.

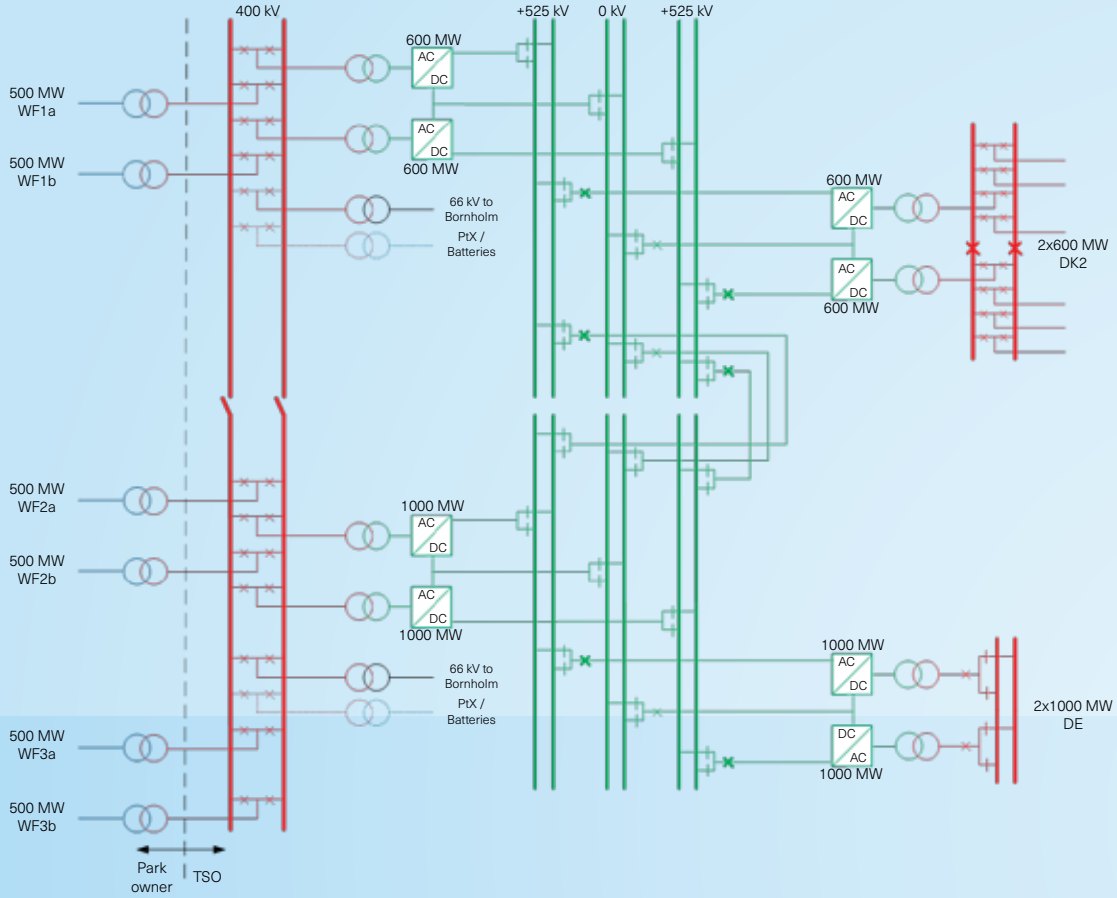


Figure 9.1. Energy Island with interconnection on either the AC- or DC-side and 3 GW of offshore wind connected.

Questions

Commissioning of transmission capacity (HVDC converters) and integration of the wind farm

9.1.

What is the expected timeline for erection of 2GW of wind power? How about erection of 3GW of wind power?

9.2.

Please elaborate on key interfaces to Energinet and the EPC contractors with respect to grid connection.

9.3.

Which interfaces would you consider as being critical?

9.4.

When will you deliver a detailed overall commissioning schedule together with the EPC contractor after placement of the contracts?

9.5.

Will the developer provide the auxiliary power himself, and where will the power come from?

9.6.

Which coordination is required between the parties for testing and commissioning?

9.7.

What is your view of resetting the Trial operation (prolonged commissioning) if terms and conditions are not fulfilled by the EPC HVDC contractor, e.g., unstable operation, too many trips, outages etc.?

9.8.

Energinet expects the wind developer to participate in a joint working group to develop a common interface matrix, e.g., RACI chart. Please clarify your view on such a working group and ways of working.

9.9.

Please elaborate on your view regarding key contractual clauses that need to be coordinated between you and Energinet's EPC HVDC contracts.

9.10.

Please elaborate on the high-level timeline beginning from the installation of the first WTG until complete commissioning of the wind farm.

9.11.

How do you perceive an overlap of the interconnection test phase in 2029 and 2030 for the connectors connecting Bornholm to Zealand and a foreign country with the connection window for wind turbines? Please describe the impact on risk, cost, time and quality.

Questions

Grid connection requirements

9.12.

In your view what are the gaps in the existing grid code requirements (Network Code on Requirements for Generators and national implementation) when connecting to an offshore Energy Island compared to an onshore connection?

9.13.

Which grid code requirements are most influential on the design of the wind power plant?

9.14.

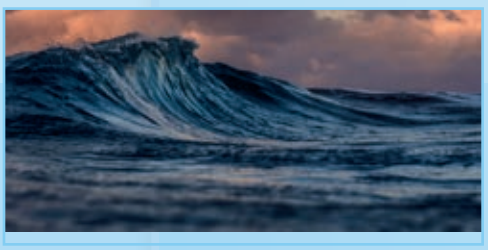
Are there any requirements which the developer sees as hindering for the plant optimization considering connection to an Energy Island?

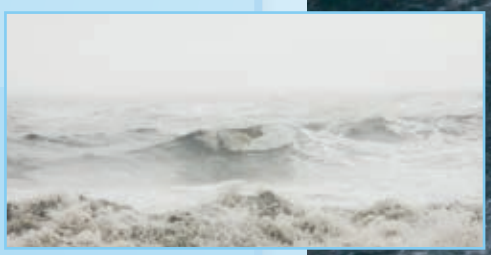
9.15.

It is likely that wind developers will be met with a requirement for sending mFRR down bids to Energinet for all Market Time Units. What would be the maximum available and minimum possible amount of down regulating mFRR-bids?

9.16.

What kind of demand/storage do you intend to build in combination with the generation facility?





Invitation to dialogue: Energy Island Bornholm offshore wind farm

Model requirements and exchange of data and models between stakeholders

Under the current version of the RfG (Requirement for Generators), Energinet requires following models as a part of requirement for model delivery.

- EMT model (Black box)
- RMS dynamic model (Open source)
- Harmonic model (including measured converter frequency dependent impedance considering different operating points)

One of the most challenging issues of multi-party multi-vendor hybrid projects such as the Energy Islands, is the difficulty in efficiently sharing the necessary offline simulation models between the different stakeholders. Traditionally each vendor and connectee is required to deliver models to the system operator, which is Energinet in the case of the Energy Island. However, in order to achieve successful commissioning and future operation of the Energy Island, it will to a large extend be necessary, that all stakeholders are obliged to share sufficiently accurate offline simulation models with each other to conduct the necessary design studies. This has to be done in a way, that does not lead to violation of the intellectual property (IP) rights of each individual stakeholder. The two different flows of model and data sharing is shown in Figure 9.2. If detailed vendor specific models are only delivered to and available to the system operator, it will result in a highly inefficient and non-operational process for conducting essential studies, and it will lead to significant increased risk in the project.

Energinet foresees in all scenarios that controller tuning at each HVDC and coordination of controllers and protection between different vendors of offshore wind farm developer and HVDCs may be the main challenge to succeed with the project. Therefore, Energinet considers the following items as potential new requirements for model delivery and would like to ask each stakeholders opinion about following comments and questions.

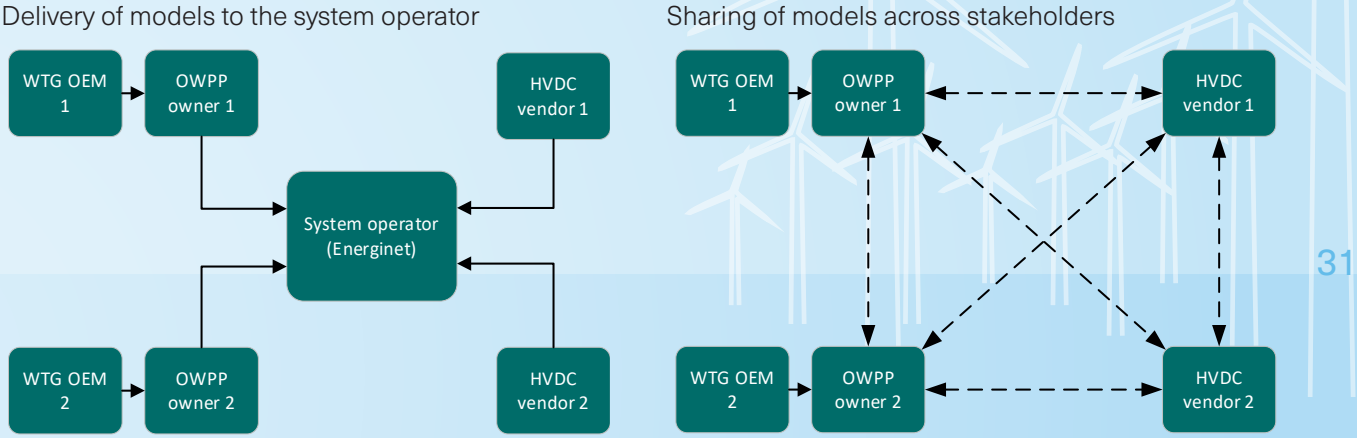


Figure 9.2. Multi-party offline model sharing.

Harmonic model

Readiness level to improve the current harmonic model to extend its use for predicting low-frequency converter-driven instability, i.e., developing multi-input multi-output frequency-dependent impedance models to characterize dynamics within the outer-loop control bandwidth.

State space model (Black box)

Readiness level to share the form of black box -state space model from each vendor, where the purpose is to use the model for detail control tunning of HVDCs at offshore especially together with other vendor models. So, TSO takes a role as arbitrator.

Possibilities to share the black box state space models between different stakeholders (HVDC vendors, WF developers, etc) based on NDA in order to have better communication for control / protection tunings.

Sharing of black-boxed EMT model

Requirement to share black-boxed EMT model with other third-party connectees and vendors through a well-defined project framework. This requirement covers sharing between HVDC vendors, sharing between HVDC vendor and OWPP owner, and between OWPP owners.

Control and protection replicas and hardware-in-the-loop simulation

Due to the novelty of the technology, Energinet is considering to apply control and protection replicas and HIL testing to support the commissioning of the first phase of the Energy Island project. The main purpose of the Energy Island project is to integrate large-scale renewable energy, and thus stable electrical operation of the offshore wind power plants is decisive for the success of the project. If C&P replicas and hardware-in-the-loop simulation is applied in the project, it must be defined how offshore wind power plants should be represented in the real-time laboratory setup.



Questions

9.17.

When and to which extend will you be able to deliver a harmonic model?

9.18.

When and to which extend will you be able to deliver a state space model (Black box)?

9.19.

When and to which extend will you be able to share a black-boxed EMT model?

9.20.

How do you as wind power plant developer best see the involvement in hardware-in-the-loop testing with control and protection replicas?

9.21.

How does the offshore wind power developer picture the ideal process around sharing IP-protected models and data between neighboring and electrically coupled wind power plants and HVDC systems?

Control and stability

9.22.

Which risks does the developer foresee regarding operation of wind power plants in low short-circuit power and low inertia systems such as the Energy Island?

9.23.

What is your view on the feasibility of providing grid forming capabilities from wind power plants?

9.24.

What are the technical challenges, and how does the developer see the optimal distribution of grid forming capabilities across wind power plants and HVDC?

9.25.

In certain situations where a HVDC cable is faulted, or a HVDC converter is tripped, the wind power plant needs to be ramped down quickly to deal with the excessive power. What is the maximum ramp rate in p.u./s, Energinet can consider realistic or feasible for design studies?

Ancillary services

9.26.

What is required for the wind power plant to deliver black start service to the neighboring synchronous areas via the HVDC system?

9.27.

Energinet considers the possibility that offshore wind power plants connected to the Energy Island shall be able to deliver fast frequency reserves to the onshore grid. How will you ensure the control chain for detecting the onshore frequency disturbance and communicate this to the offshore wind power plant?

Voltage level and AC POC on the Energy Island

9.28.

Which voltage level do you as wind power developer consider optimal for transmission of the wind power from the wind power area to the Energy Island Bornholm AC substation?

10. Summary

The questions above in this invitation to dialogue are not necessarily exhaustive. There may be themes that have either not yet been identified or sufficiently addressed. Therefore, the DEA is open to relevant proposals and input to ensure that the procurement specifications reflect current market conditions and the most efficient allocation of risk between the Danish State and the concessionaire.

If it is found necessary changes and further information will be released on the 16 of August at the latest.

When sending your written input, please use the Excel file “Input to market dialogue OWF 2022” on the market dialogue page on www.ens.dk/energy-island-bornholm-procurement.

Energy Island Bornholm offshore wind farm

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