

Environmental Assessment of Plan for Thor Offshore Wind Farm report 1



Report 1: Non-technical summary and overall assessment.

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CONTENTS

1.	Introduction	3
1.1	Legal basis	3
1.2	Structure of the report	4
2.	The Thor Offshore Wind Farm Plan	5
2.1	Plan contents	5
2.2	Discarded alternatives	6
2.2.1	Discarded locations for the offshore wind farm based on preliminary and detailed screening from 2018	6
2.2.2	Landfall at Vedersø Klit	7
3.	Timeframe for Thor Offshore Wind Farm	8
3.1	Environmental assessment of the plan for Thor Offshore Wind Farm	8
3.2	First public consultation (calling for ideas)	9
3.3	Consultation with affected authorities	10
4.	Methodology	11
4.1	Reference scenario	12
5.	Links to other plans	13
6.	Non-technical summary of the environmental assessment	16
	People and society	17
6.1	The coastal landscape and offshore turbines	17
6.2	Landscape, visual aspects onshore	19
6.3	Marine archaeology	20
6.4	Archaeology and cultural monuments onshore	20
6.5	Material assets	21
6.5.1	Offshore infrastructure	21
6.5.2	Radio chains and radar systems	21
6.5.3	Marine raw materials	21
6.5.4	Commercial fisheries	21
6.5.5	Land use	22
6.5.6	Flooding	23
6.5.7	Offshore visual impact	23
6.5.8	Noise	24
6.5.9	Shipping and navigational safety	24
6.5.10	Air traffic safety	25
	Biodiversity	26
6.6	Marine flora and fauna	26
6.6.1	Benthic flora and fauna	26
6.6.2	Fish and benthic fauna	26
6.6.3	Marine mammals	28
6.6.4	Birds	29
6.7	Flora and fauna on land	31
6.8	Annex IV species	32
6.8.1	Offshore	32
6.8.2	Onshore	32
6.9	Natura 2000	33
6.9.1	Offshore	33

6.9.2	Onshore	34
Water	36	
6.10	Offshore	36
6.10.1	Hydrography and marine-water quality	36
6.10.2	Seabed conditions and sediment	37
6.11	Onshore	38
6.11.1	Surface water	38
6.11.2	Groundwater	38
Cumulative aspects	39	
6.12	Offshore	39
6.13	Onshore	41
7.	Environmental assessment of offshore and onshore development	43
7.1	Air and climate	43
7.2	Visual impact	45
8.	Assessment of effect on environmental targets	47
9.	Missing knowledge and possible uncertainties	49
10.	Mitigation measures, recommendations and monitoring	50
10.1	Offshore	50
10.2	Onshore	53
10.3	Offshore and onshore development	54

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In case of divergences between the English translation and the original version, the Danish original version is applicable.

1. INTRODUCTION

The Thor Offshore Wind Farm Plan was decided on the basis of a number of political decisions, and environmental and financial considerations. The following describes the key decisions made leading up to the compilation of the Thor Offshore Wind Farm Plan with its related environmental report.

It was decided as part of the Energy Agreement of 29 June 2018 to put out to tender three new offshore wind farms of approx. 800 – 1,000 MW, of which the first, the Thor Offshore Wind Farm, would be connected to the grid between 2024-2027. At that time, no decision had been made on the farm's location, and 'detailed screening' of four selected areas was commenced in the North Sea, the Kattegat and the Baltic. See section 2.2.1 for more details. The detailed screening process showed that it was possible to build offshore wind farms in all four areas. This led to the parties to the Energy Agreement deciding on 28 February 2019 that an offshore wind farm should be located in the North Sea, off Nissum Fjord, at least 20 kilometres from the coast at Thorsminde, which is also where the farm's name is derived, Thor.

The Thor Offshore Wind Farm Plan is subject to the requirement for an environmental assessment according to the Environmental Assessment Act¹, and according to Section 8 (1) no. 1 of the Act, an EIA has to be performed.

This report was compiled in pursuance of the Environmental Assessment Act, to assess the possible major impact on the environment caused by implementation of the plan.

1.1 Legal basis

The Environmental Assessment Act is designed to ensure a high degree of environmental protection, and to contribute to the integration of environmental considerations in the drawing up and implementing of plans and programmes, and permits for projects that can have a significant effect on the environment.

The purpose of a Strategic Environmental Assessment (SEA) is also to take into account, with the involvement of the public and authorities, the likely significant effects of plans, programmes and projects on the environment, and to enhance a sustainable development.

Section 2 (1) of the Environmental Assessment Act states that the Act applies to plans and programmes:

*a) that either **set out the framework for future construction permits for projects**, or apply requirements for the assessment of impact on an international nature protection area with regards to its conservation objectives, and*

*b) that **are compiled or adopted by an authority**, compiled with regard to Parliament's approval of plans and programmes via a legislative procedure and compiled according to acts, administrative legislative provisions or administrative decisions.*

According to Section 22 of the Sustainable Energy Act² the Danish Energy Agency has the authority to designate sites for large-scale offshore wind farms that are reserved for

¹ Consolidated Executive Order no. 973 of 25 June 2020 on environmental assessment of plans, programmes and specific projects (EIA).

² Consolidated Executive Order no. 125 of 7 February 2020 on the Act to Promote Sustainable Energy.

government tenders. This authority provides the opportunity to plan government tender projects, and according to Section 22 (2), cf. Section 23 of the Sustainable Energy Act, the Agency has the authority to conduct tenders for offshore wind farms.³ In practice, the Agency's work on tendering for Thor consists of the implementation of a number of political decisions, which represent a cohesive plan in this context⁴.

1.2 Structure of the report

The environmental report with environmental assessment of the Thor Offshore Wind Farm Plan consists of the following documents:

- Report 1 (this report) contains common chapters for assessments for offshore and onshore. More details of the contents of the report are provided below.
- Report 2 comprises the SEA for the marine area with appendices: Visibility analysis.
- Report 3 comprises the SEA for onshore development.

Report 1 includes a description of the plan for Thor Offshore Wind Farm, non-technical summary of the SEAs for offshore and onshore development, and assessment of environmental targets.

Report 1 also contains the environmental baseline and SEA of the common topics: air and climate, along with the visual impact of onshore and offshore development. Assessment of air and climate are only dealt with in report 1, as neither offshore nor onshore construction will be built without the other, and because it is the overall climate impact of such constructions that is interesting. Assessment of visual impact of *both* onshore *and* offshore development, given that reports 2 and 3 only consider the visual impact of offshore and onshore development respectively.

Report 1 thus contains the following;

- Introduction with legal basis and reading guide
- The Thor Offshore Wind Farm Plan, including discarded alternatives
- Outline timeframe for Thor Offshore Wind Farm
- Description of methods, including the reference scenario
- Non-technical summary of all topics from reports 2 and 3
- SEA of offshore and onshore development, including visual impact from onshore and offshore development, and air and climate
- Assessment of impact on international environmental targets
- Missing knowledge and uncertainties
- Mitigation measures and monitoring

Reports 2 and 3 were compiled on the basis of the Environmental Assessment Act's Annex 4 with regard to assessing the possible major impacts on the environment from implementation of the plan. The reports thus contain the environmental status and assessment of the environmental topics that have been defined as scope of content and extent in relation to the plan for Thor Offshore Wind Farm.

³ Authority is delegated to the Danish Energy Agency according to Executive Order no. 1512 of 15 December 2017 on the tasks and authority of the Danish Energy Agency, Section 3 (1), no. 4

⁴ The Environmental Assessment Act does not contain any formal requirements on plan design.

2. THE THOR OFFSHORE WIND FARM PLAN

2.1 Plan contents

The Thor Offshore Wind Farm will consist of offshore development (offshore wind turbines, transformer platform and cables to landfall) and onshore development (HV station (high-voltage) and underground cables (UGC) running to Idomlund), see Figure 2-1.

The study area for the offshore wind farm is 440 km², located at least 20 km from the coast. The site will be narrowed down as a result of surveys to about half size, approx. 176-220 km². Within the site, it will be possible to locate a wind farm with a capacity of between 800-1,000 MW. Offshore wind turbine types, size, number and positioning patterns are not governed by the plan but will be determined in an expected subsequent design phase. The wind farm will be connected to the existing high voltage grid via a new HV station. The location of the high voltage station is not determined in the plan, but Volder Mark has been proposed as a possible location. Power will be passed on from there and connected to the grid at the existing Idomlund HV station.



Figure 2-1 The Thor Offshore Wind Farm Plan with underground cable route north of Nissum Fjord.

Environmental assessment of the plan covers the entire offshore wind farm, transformer platform at sea, export cables to landfall and up to the new HV station at Volder Mark, and the transmission grid from the new HV station to Idomlund, HV station see Figure 2.2.

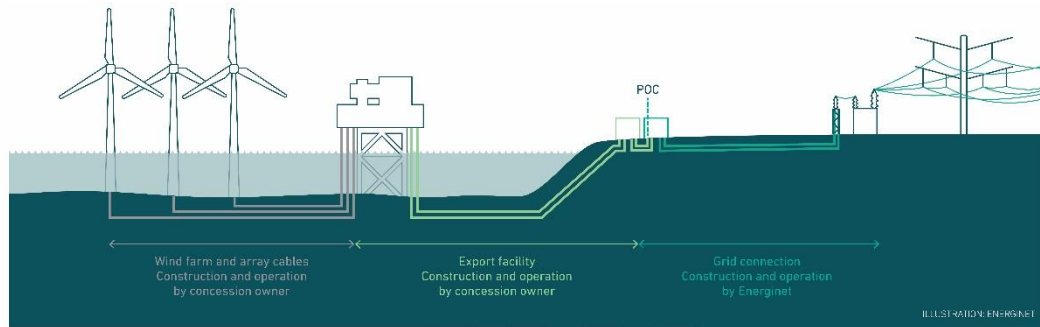


Figure 2-2 The overall Plan for Thor Offshore Wind Farm includes the elements up to Idomlund HV station.

2.2 Discarded alternatives

2.2.1 Discarded locations for the offshore wind farm based on preliminary and detailed screening from 2018

To identify a possible location for the wind farm, a detailed screening of selected areas in the North Sea, Kattegat and the Baltic Sea – referred to as ‘detailed screening’ was initiated in 2018. Detailed screening was performed in 2018, based on four appropriate areas identified by the Danish Energy Agency. The four areas are the North Sea (Ringkøbing), Jammerbugt, Hesselø and Kriegers Flak, all reserved for the tendering of offshore wind farms, see Figure 2-3.

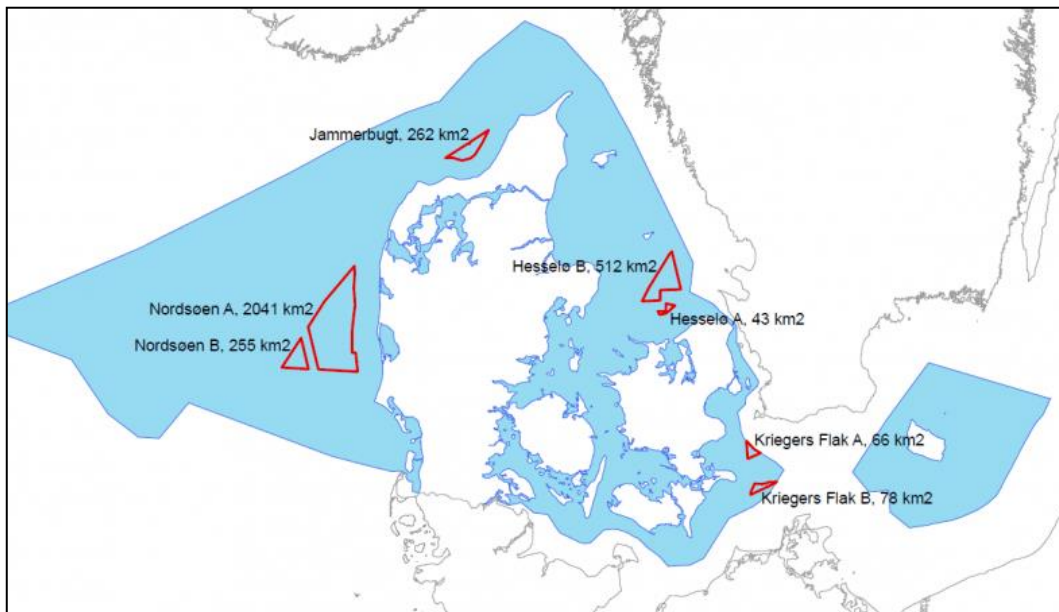


Figure 2-3 The four areas reserved for the tendering of offshore wind farms by the Danish Energy Agency⁵.

The purpose of the detailed screening was to confirm that it is possible to establish an offshore wind farm with a generating capacity of 800 – 1,000 MW in the specified areas with due consideration to nature, environmental protection and planning conditions, and to provide economic estimates that could create a basis for ensuring the optimal sites from an economic perspective.

⁵ <https://ing.dk/artikel/her-kan-de-nye-gigant-havmoelleparker-ligge-214754>

The analysis showed that the areas in the North Sea and Hesselø were the most attractive given the financial considerations.

This led to a decision at a meeting of the parties to the Energy Agreement on 28 February 2019 that the first of the 3 offshore wind farms from the 2018 Energy Agreement should be sited in the North Sea at a minimum of 20 km from the coast, that the farm would be named 'Thor', and that landfall for underground cables leading to the onshore grid should be included in tenders for the offshore wind farm.

2.2.2 Landfall at Vedersø Klit

Initially, two possible landfalls for underground power cables from the Thor offshore wind farm were screened. During planning work, an administrative decision was made to drop one of the power cable landfall locations that was located at Vedersø Klit, south of Øby (South of Nissum Fjord), see Figure 2-4. Cables with landfall south of Nissum Fjord would mean a change to the cable route, and an alternative site for the new HV station.

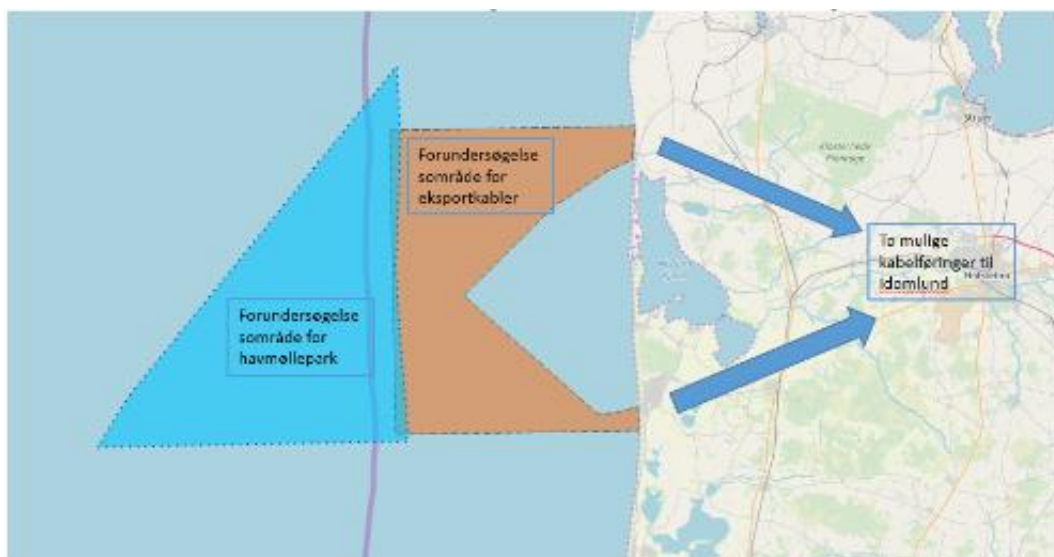


Figure 2-4 Areas originally incorporated in the Thor Offshore Wind Farm Plan showing the discarded southern landfall for the underground cables.

Discarding the southern landfall location was primarily due to the greater socio-economic benefit of a landfall north of Nissum Fjord, where the planned new high voltage station can serve both grid connection of the wind farm and up to 400 MW solar photovoltaic panels, thus supporting transmission of up to 1,400 MW sustainable energy .

In environmental terms, a southern landfall would be feasible, but there are environmental benefits in choosing the northern route in the form of fewer neighbours being affected, and fewer anticipated archaeological finds, fewer watercourses to cross and shorter sections of forests/woodlands. Furthermore, the northern landfall also offered a good location for a new station that would be partly concealed, while a new high voltage station near the coast on the southern route would have been more visually noticeable, due to the terrain and proximity of housing.

3. TIMEFRAME FOR THOR OFFSHORE WIND FARM

The environmental assessment for Thor Offshore Wind Farm is divided into a SEA of the plan and an EIA for the project. The process involves the following steps:

1. An environmental assessment of the Plan for Thor Offshore Wind Farm that fulfils the requirements of the Environmental Assessment Act.
2. Conducting additional environmental surveys to those required for an environmental impact assessment, to obtain critical data and information to be used for a subsequent actual EIA of the actual offshore project.
3. An Environmental Impact Assessment (EIA) of the actual project for onshore development, i.e. cables from landfall to the 400 kV grid. The EIA will be performed by Energinet according to Section 20 of the Environmental Assessment Act, with the Danish Environmental Protection Agency (DEPA) as the EIA authority.
4. An EIA of the actual project offshore and up to the landfall, i.e. offshore wind turbines, transformer platform and power cables to landfall, will first be conducted after the tender deadline (expected to be late 2021), when a concession winner is declared, and an actual project has been developed. As such, it will be the concession winner that compiles the EIA report for the project according to Section 20 of the Environmental Assessment Act, with the Danish Energy Agency as EIA authority.

Of the above, Energinet will be responsible for 1, 2 and 3, while 4 will be conducted later by the winning bidder.

3.1 Environmental assessment of the plan for Thor Offshore Wind Farm

Prior to compilation of the environmental report, the scope of the environmental report was defined, in accordance with Section 11 of the Environmental Assessment Act. This scoping process is intended to define the contents and degree of detail of the environmental report. The scoping is based on the assessment of the likely significant environmental effects of the plan, the public consultation with affected residents and other stakeholders, along with consultation with the authorities affected.

An environmental assessment will be conducted according to the five steps shown in Figure 4 1.

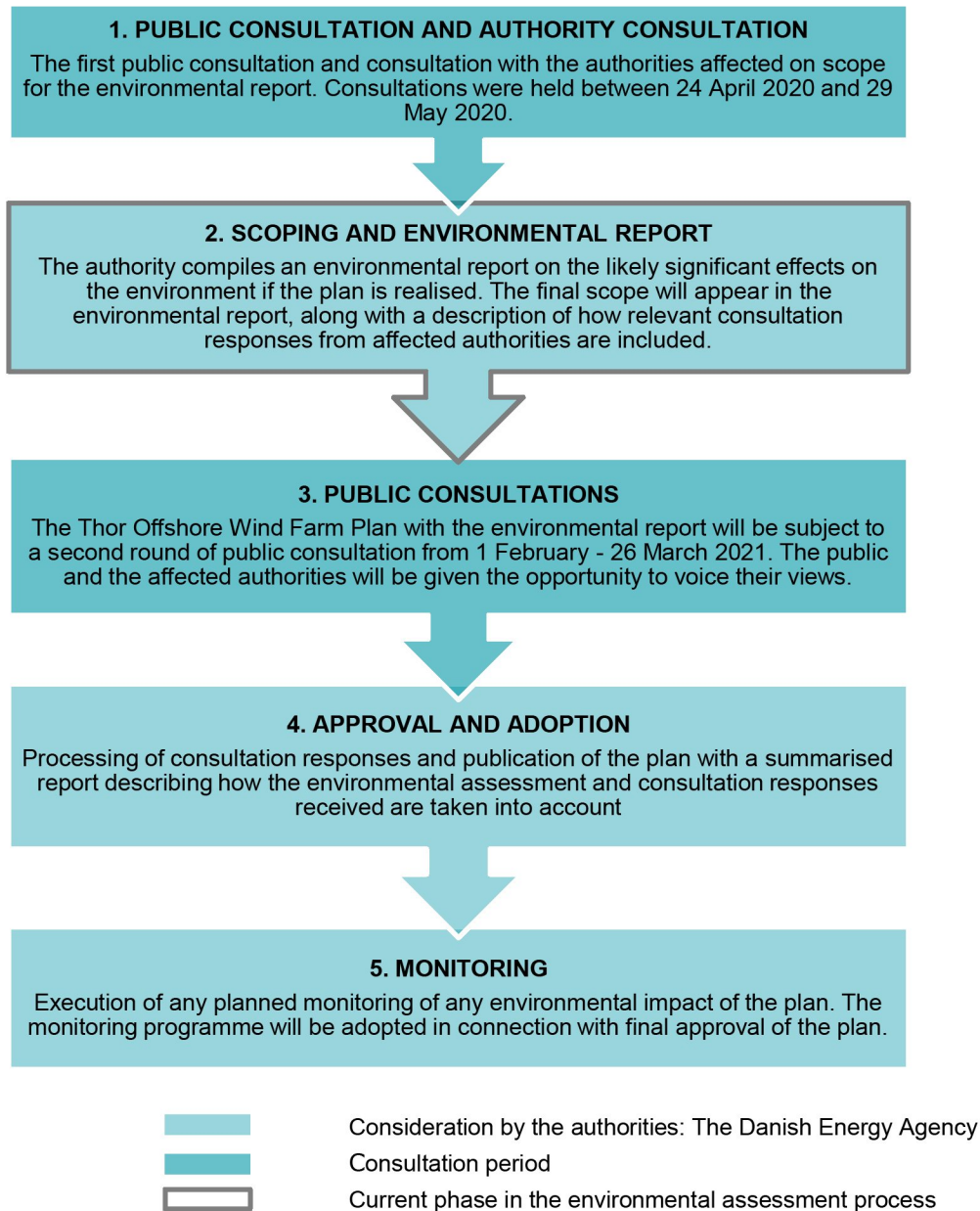


Figure 3-1 Environmental assessment process for the plan for Thor Offshore Wind Farm.

3.2 First public consultation (calling for ideas)

As part of the environmental assessment of the plan for Thor Offshore Wind Farm process and first public consultation for an Environmental Impact Assessment (EIA) of the onshore development, a 5-week consultation period was held between 24 April and 29 May 2020, during which the public and other stakeholders could ask questions and express their views on the consultation documents, as well as suggestions and ideas for topics to be included in the further work.

A total of 66 consultation responses were received during the full consultation process.

The consultation responses primarily addressed marine conditions and the actual offshore wind turbine project, and the Danish Energy Agency expects them to be processed in connection with the compilation of the SEA on marine conditions, and in the EIA for the actual project on land (onshore development).

3.3 Consultation with affected authorities

The affected authorities were also consulted concerning the scoping statement, according to Section 32 (2) of the Environmental Assessment Act, along with the collection of ideas and proposals between 24 April and 29 May 2020.

Affected authorities for environmental assessment of the plan are the municipalities of Lemvig, Holstebro and Ringkøbing-Skjern, the Danish Maritime Authority, Danish Fisheries Agency, Ministry of Environment and Food of Denmark, Danish Environmental Protection Agency, Danish Ministry of Transport and Housing, Danish Ministry of Defence, Danish Coastal Authority, Danish Emergency Management Agency, Danish Business Authority, Danish Safety Technology Authority, Danish Agency of Culture and Palaces, Danish Ministry of Employment and Gender Equality, Danish Ministry of Culture, Danish Defence Estates, Danish Geodata Agency, all of which were consulted.

The consultation also provided an opportunity to make proposals on environmental issues that should be investigated and assessed in the environmental assessment, and proposals for objectives that should also be included in the environmental assessment.

A total of 10 consultation responses from affected authorities were received.

The consultation responses from the affected authorities primarily addressed marine conditions and the actual project, and the Danish Energy Agency expects them to be processed in connection with the compilation of the strategic EIA on marine conditions, and in the EIA for the actual project on land.

The full results from the consultation are provided in the consultation report⁶ for the first public consultation for Thor, July 2020. Comments on or proposals for the process concerning the project and construction work for the Thor Offshore Wind Farm are incorporated in the environmental assessment, as described above. Consultation responses, which were not aimed directly at the scoping statement for the environmental report, but express opinions to the project, for example in relation to the distance from the coast and the possibilities for integration with a future energy island in the North Sea or incorporation of the projects Vesterhav Nord and Vesterhav Syd in the Thor Offshore Wind Farm are beyond the scope of the environmental report.

⁶ The Danish Energy Agency, Draft Consultation report for Thor SME and onshore developments EIA, May 2020.

4. METHODOLOGY

The environmental assessment of the plan for Thor Wind Offshore Farm is divided into an assessment of the offshore development, and an assessment of the onshore development.

Report 1 contains the sections of the environmental report that are common to both. To follow is a description of the criteria, indicators and data used in the environmental assessment.

The environmental assessment in reports 2 and 3 were conducted as an assessment of whether and to what extent initiatives and proposals were expected to have a significant influence on the designated environmental topics identified in the scoping statement.

If there are environmental topics for which major natural development of the surrounding areas of the plan is expected to affect the environmental assessment, this development will be described under each environmental topic and/or under cumulative effects.

The environmental assessment is also intended to assess whether initiatives and proposals could be expected to help or hinder the realisation of the environmental and nature protection objectives set out in national strategies and action plans. The assessment of environmental and nature objectives for offshore and onshore development is reported in report 1.

The environmental assessment of the plan for Thor Offshore Wind Farm will be based on information that can be reasonably requested according to current knowledge and common assessment methods with regard to how detailed the plan is, its content, at what point in a decision-making process the plan is at, and whether certain aspects are to be better assessed at another point in the process, cf. Section 12 (1) and (2) of the Environmental Assessment Act. In connection with the marine environmental report (report 2), more recent and current data from preliminary investigations conducted is included, e.g. on marine flora and fauna, marine archaeology, to the extent results are available. All preliminary investigations will be included for the next stage of the process when compiling the EIA.

The plan for Thor Offshore Wind Farm is a description of the basis for decision concerning the offshore wind farm, and the environmental assessment will therefore reflect the strategic level.

During work on the EIA for onshore development, which is being conducted simultaneously with this environmental report (SEA), a proposal for the location of the new HV station has been proposed at Volder Mark. The location will therefore be included in the SEA for the plan for Thor Offshore Wind Farm as a proposal. Assessment of the new HV station in the environmental assessment will therefore be based on the actual location at Volder Mark, but will also be a general assessment that will be used in principle, if the location of the new HV station needs to be revised.

Because the EIA onshore will be conducted in parallel with compilation of this environmental report (SEA), the cable route will be included in the environmental assessment as a proposed location. An environmental assessment of the cable route will therefore be based on the proposed location and be a general assessment at a general strategic level.

The plan for Thor Offshore Wind Farm may cause effect on the environment, which cannot be isolated to include only the offshore wind turbines or the onshore development, but where the collective effects are considered upon realisation of the full plan. The following environmental topics are expected to have an effect, where it will be relevant to look at the offshore and onshore development: air and climate, and visual impacts. Report 2 for offshore development and report 3 for onshore development, therefore, do not contain separate environmental assessments for air and climate.

4.1 Reference scenario

The 0-alternative in this context comprises the situation that will exist if the plan for Thor Offshore Wind Farm is not completed. That is, where the current land use and planning within the area affected by the plan continues. The 0-alternative comprises the comparable basis for the environmental assessment. The planned changes can thus be compared to the existing environmental status in the description of the expected effects on the environment.

5. LINKS TO OTHER PLANS

The location of a possible new offshore wind turbine area can be in conflict with existing planning. Relevant plans are presented in the following in which the plan for Thor Offshore Wind Farm will have to comply.

Denmark's National Energy and Climate Plan

The EU regulation on a governance system for the Energy Union (the Governance Regulation)⁷, came into effect in December 2018. One of the key elements of the governance system is that Member States have to compile national energy and climate plans for 2021-2030. The plans must define current and future development within the Energy Union's 5 dimensions:

- Reduction of greenhouse emissions and the expansion of sustainable energy
- Energy efficiency
- Security of supply
- The internal energy markets
- Research, development and competitiveness

Denmark submitted its final plan to the EU Commission on 20 December 2019. The plan describes how the proportion of energy from offshore wind turbines is expected to rise over the next few years, with planned projects (Kriegers Flak, Vesterhav North and South) expected to be realised by 2025. The plan for Thor Offshore Wind Farm is considered to be in accordance with the overall targets of further increasing the amount of wind energy offshore.

Proposal for Denmark's Marine Spatial Plan 2021

The Maritime Spatial Plan is being compiled and will form the basis of coordination of the many uses of Denmark's marine area in a way that can support the conditions for sustainable protection and utilisation of marine areas, and growth in the Blue Denmark. The plan will be in public consultation for six months before coming into effect in 2021.

The Marine Spatial Plan will define which maritime areas in Danish territorial waters can contribute to a sustainable development of the energy sector at sea, maritime transport, fisheries and aquaculture, the extraction of raw materials from the sea and the conservation, protection and improvement of the environment, including sensitivity to the consequences of climate change. The plan will also focus on contributing to the promotion of sustainable recreative activities, outdoor activities etc. The designation of maritime areas will thus contribute to better conditions for maritime industries by 2030.

The Danish Marine Spatial Plan⁸ will implement the Marine Spatial Planning Directive⁹. Thor Offshore Wind Farm will be part of the new plan.

⁷ REGULATION (EU) 2018/1999 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the Governance of the Energy Union and Climate Action.

⁸ Act no. 615 of 8 June 2016 on Maritime Spatial Planning.

⁹ Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning.

Danish Marine Strategy II

Water quality in the seas of Denmark is subject to environmental targets in the Marine Strategy Framework Directive¹⁰ and in the Water Framework Directive¹¹, which are described below. The Marine Strategy Framework Directive is implemented in Denmark via Danish Marine Strategy. The Marine Strategy applies to maritime areas from the high tide mark up to the 200 nautical mile limit, and therefore includes all Danish territorial waters and the EEZ. There is a geographical overlap between the Marine Strategy Directive and the Water Framework Directive in the 12 nautical mile zone, and Danish Marine Strategy covers aspects in the area that are not covered by the Water Framework Directive.

The Danish Marine Strategy II will be compiled in three parts over the next few years. The first part, which was published in 2019, is designed to provide an overview of the condition of the sea and its effects, and to set environmental targets for healthy environmental status.

The strategy is part of the implementation of the Marine Strategy Directive and Marine Strategy Act, designed to set out the framework for achieving and maintaining healthy environmental conditions in marine ecosystems, and making sustainable utilisation of the sea's resources possible. The Directive's 11 descriptors are addressed in the strategy: D1 Biodiversity, D2 Non-indigenous species, D3 Population of commercial fish species, D4 Elements of food webs, D5 Eutrophication, D6 The sea floor, D7 Hydrographic alterations, D8 Contaminants, D9 Contaminants in seafood, D10 Marine litter and D11 Underwater noise. Good environmental status is defined for each descriptor, with current status and environmental targets set for achieving good environmental status.

The plan for Thor Offshore Wind Farm is not considered to influence target fulfilment of the Maritime Strategy, as no effect is expected from the plan on the individual descriptors that will obstruct their opportunity of achieving good environmental status.

Water management plans

The Water Framework Directive is implemented via the water management plans. The part of the Water Framework Directive that addresses seawater covers the area between the Danish coastline and the 1-nautical-mile limit with regards to the ecological status of seawater, and out to the 12 nautical mile limit with regards to the chemical status of seawater.

Onshore, the planned conditions are not expected to significantly affect the individual environmental quality criteria for lakes and watercourses and thus prevent the targets of good ecological status pursuant to the water management plans from being met.

In relation to groundwater it is assessed that, neither the quality nor quantity of local (near-surface) or regional (deeper) groundwater resources, nor the recipients that will be discharged to temporarily will be affected. The deep groundwater reservoirs will not be affected.

Overall, no impact is expected that could influence the likelihood of target fulfilment for the water management plans as a result of the plan for Thor Offshore Wind Farm.

¹⁰ Directive 2008/56/EC of the European Parliament and of the Council of 25 June 2008 establishing a framework for community action in the field of marine environmental policy.

¹¹ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

Natura 2000 plans

There are three marine Natura 2000 areas near the site to which the plan relates: N220 Sandbanker ud for Thorsminde, N247 Thyborøn Stenvolde, and N219 Sandbanker ud for Thyborøn with their associated plans.

On land, the following terrestrial Natura 2000 areas are close to the site to which the plan relates: N64 Heder og klitter på Skovbjerg Bakkeø, Idom Å og Ormstrup Hede, N65 Nisum Fjord and N224 Flynder Å og heder i Klosterhede Plantage, with their associated plans.

There is a Natura 2000 plan for each of the Natura 2000 areas with which the plan for Thor Offshore Wind Farm will have to comply. No significant impact is expected on the nearby Natura 2000 areas as a result of the plan for Thor Offshore Wind Farm. There will therefore be no impact on the Natura 2000 plan targets for the areas in question.

Regional and municipal planning

The plan for Thor Offshore Wind Farm covers areas on land that are subject to various types of guidelines and framework provisions in municipal and regional plans, including for raw materials. Relevant plans are addressed in the relevant chapters in reports 2 and 3.

6. NON-TECHNICAL SUMMARY OF THE ENVIRONMENTAL ASSESSMENT

The Thor Offshore Wind Farm will consist of offshore development (offshore wind turbines, transformer platform and power cables to landfall) and onshore development (Underground cables (UGC) and high-voltage station), see Figure 6-1.



Figure 6-1 The plan for Thor Offshore Wind Farm with underground cable route north of Nissum Fjord.

The offshore wind turbine area is located a minimum of 20 km from the coast and consists of a defined area for preliminary investigation and surveys off Thorsminde. As mentioned above, the area will be reduced as a result of the findings from the surveys for a suitable construction area with the option of erecting an offshore wind farm with capacity of between 800-1,000 MW. Offshore wind turbine types, size, number and pattern are not regulated by the plan, but will be determined at the later design phase. The wind farm will be connected to the national grid via a new high voltage station, the location of which is not determined in the plan but is proposed to be located at Volder Mark. Power will be transmitted from there to Idomlund.

The environmental assessment for the plan for Thor Offshore Wind Farm covers the offshore wind farm, transformer platform at sea, landfall of the export cables and onwards to the transmission grid in the new HV station, and underground cables to Idomlund.

The following is a summary of the environmental impacts of the plan for Thor Offshore Wind Farm on the basis of the prepared environmental report, which has been prepared as resp. Report 2 for the marine environment and report 3 for land.

The environmental assessment is divided into three general environmental themes:

- People and society
- Biodiversity
- Water

Furthermore the assessment includes the environmental status and assessment of common topics, including air and climate, visual impact from onshore and offshore facilities

and cumulative aspects. The SEA includes an assessment of the impact on environmental targets, as well as a description of mitigation measures and recommendations along with monitoring.

PEOPLE AND SOCIETY

6.1 The coastal landscape and offshore turbines

A new offshore wind farm will result in visual impacts on the seascape, as well as the coastal landscape. Seen from the sea, the offshore wind turbines will affect the perception of the coastal landscape. The offshore wind turbines will be visible from the various shipping routes, fishing vessels and pleasure boats in the area.

The coastal landscapes along the west coast of Jutland consists mainly of more or less broad sandy beaches, bordered by dune landscapes that vary in width and height, or high dunes where the sea has eroded the coastline. The landscape behind the well-known west Jutland coastal landscape is to a large extent flat but varies in character. The beaches along the coastline are generally considered to be quite vulnerable to visual changes at sea as there are uninterrupted views over the sea and the open horizon.



Figure 6-2 The beaches around Ferring are sometimes rockier between the breakwaters, which serve as coastal protection.

The visual impacts on the landscape will depend on the actual location, the choice of type of offshore wind turbines and the final layout. These factors are not known at this early stage of the planning process, and the assessment of the visual impacts is based on a number of schematic visualisations of a future offshore wind farm. In clear weather, the offshore wind turbines will be clearly visible on the horizon, and perceived as a large, cohesive area with no clear pattern. When weather conditions reduce the visibility to 10 km, the turbines will only be visible from the coastline as blurred silhouettes, marked with white lights, and will not appear intrusive. Because there are only a few days each year with good visibility (over 19 km) the offshore wind turbines are not expected to cause any significant visual impact in general.



Figure 6-3 Section of panorama visualisation – layout A, visibility 19 km, 67 x 15 MW turbines seen from the beach.

In conditions of clear weather the wind farm development will be visible from the beach and due to the curvature of the earth, the proportion of the individual wind turbines visible will be greater when viewed from the top of the dunes along the coast.

Bovbjerg Lighthouse is a landmark in the area and a prominent point in the landscape. It is considered to be highly vulnerable to visual impacts. The dune reaches a height of 41 metres above sea level, which means that a larger part of the turbines will be visible. In clear weather, the impact is expected to be high, but this will only apply for a few days of the year. Overall, the impact is not expected to be significant.

In general, the visual impacts on the land behind the dune coastline will be reduced compared to the impacts on the coastline. This is due to the visual barrier of the terrain, vegetation and buildings. The greater distance to the offshore turbines will also have an effect, and the impact is therefore not expected to be significant.

Light pollution

Currently, the coastal landscape is only affected by light to a limited extent. The lighting in the area is primarily concentrated around Hvide Sande, Søndervig, Thorsminde and Harboøre, whilst the rest of the coastal landscape is largely unaffected by artificial lighting.

Due to the safety of ship traffic and flights there are requirements concerning warning lights on offshore wind turbines, which must have lights and markings according to the guidelines of the authorities. Normally, white flashing lights are used in the daytime, and red flashing lights at night, along with low intensity marker lights. The large distance to the offshore wind turbines reduces the perception of light intensity, and the number of days with good visibility is limited over the year. Light pollution is therefore not expected to cause any significant impact.



Figure 6-4 Section of panorama visualisation from the dunes north of Ferring Lake at night. The warning lights of the planned turbines in “Vesterhav Nord” can be seen in the foreground. The warning lights of the Thor Offshore Wind Farm barely visible in the background.

6.2 Landscape, visual aspects onshore

The visible technical constructions on land will comprise of an extension of the existing Idomlund HV station, and the building of a new station near the coast.

The plan for Thor Offshore Wind Farm includes a connection of the cables to the HV station Idomlund, and that a new HV station will have to be established for the connection of the offshore cables at landfall. The plan does not determine a specific location for the new HV station, but a location at Volder Mark has been proposed in connection with the specific work on the project. By choosing Idomlund HV station as the connection point, a connection to the existing grid is ensured.

The existing HV station at Idomlund has limited capacity. Apart from connecting the Thor Offshore Wind Farm, the planning regulations will ensure the option of connecting other renewable-energy projects, including Vesterhav Nord Offshore Wind Farm, two major solar energy projects, and upgrading of the 400 kV link between Endrup and Idomlund, and on to Germany.

Placing the new high voltage station near the coast is not finalised in the plan, and evaluation of the impact on the landscape is therefore not based on a given site for this station. However, the municipality of Lemvig is already working on a planning supplement and local development plan for the onshore development, placing the station at Volder Mark, which means that the new station is intended to be placed here. The evaluations in this environmental report are therefore to the relevant extent conducted in perspective to placing the station at Volder Mark.

The constructions at the HV station at Idomlund and the new station near the coast will possibly consist of lightning conductor masts, pylons and high voltage masts, that are known to be visible at considerable distances. Such installations are high and narrow, which means they will not appear dominant in the landscape at a distance, despite their high visibility.

It is expected to be possible to find a site for a new HV station without affecting essential landscape elements or conflicting with the coastal zone. The proposed siting of a new HV station outside the coastal zone will have local impacts on the landscape and visual impacts. The landscape elements in the areas where the HV stations will be located, vegetation, existing technical installations and terrain can reduce the visual impacts.

The two HV stations will have a local impact on the landscape and visual impact. However, the landscape elements, vegetation in the areas and the presence of existing technical facilities at both sites can reduce the impact.

As stated in the plan for Thor Offshore Wind Farm, the cables must be underground cables. There will therefore be no visual or landscape impact caused by the cables once they are laid. While they are being laid, excavation work will result in a temporary visual impact in local areas, including designated landscapes near the churches.

The location at Idomlund and the proposed location of the new HV station at Volder Mark are both in areas characterized by existing wind turbines and HV stations. Consequently, the landscapes can be described as being characterised by containing existing technical installations. These characteristics will be increased by implementing the plan with the proposed location of the new HV station at Volder Mark.

6.3 Marine archaeology

The archaeological analysis shows that there could be cultural monuments with archaeological significance, and a theoretical possibility of settlements from the late Maglemosian culture (9,000 – 6,000 BC, early Mesolithic).

Marine archaeological sites will be secured during construction of the offshore wind farm. It is therefore believed that marine archaeological sites will not be affected within the wind farm area, or in the cable corridor during the construction phase. If new, unknown ancient monuments are found during the construction phase, the developer must immediately report them to the Danish Agency for Culture and Palaces, and work will be temporarily stopped until the Agency decides the further process.

6.4 Archaeology and cultural monuments onshore

The area covered by the plan for Thor Offshore Wind Farm has designated cultural history sites classed as conservation-worthy by the municipality, and valuable cultural environments, along with cultural monument areas designated by the Agency for Culture and Palaces. There are also listed ancient monuments in the area, five listed landscapes and several listed churches which the onshore development could affect.

It is assessed to be possible to realise the plan for Thor Offshore Wind Farm without significant impact on listed ancient monuments etc., within the plan area, by revising cable routing.

It will be possible to realise the plan for Thor Offshore Wind Farm without affecting municipal designations for culture history conservation and valuable cultural environments, or the cultural monument areas designated by the Agency for Culture and Palaces.

The Storå and Idom Å are listed for landscape preservation purposes, which also applies to the listed churches. The criteria applied to preserving the landscape are generally also applied to the 'church landscapes'.

The listed Idomlund Gravhøj (barrow) lies in the proposed route for the underground cable. But it is assessed to be possible to find an underground cable route that will not affect the listed site.

The churches at Ramme and Bøvling stand at a distance from the proposed location of the new HV station at Volder Mark, which means it will be visible in the 'church landscape'. But the impact is not expected to be significant, due to the distance between the HV station and the nature of the construction, which is not expected to be prominent at a distance.

It is generally assessed that it will be possible to implement the plan without it resulting in significant effects on cultural heritage and archaeological interests on land. The limitation

of the impact requires a rerouting of the underground cable, based on the considerations mentioned above.

6.5 Material assets

6.5.1 Offshore infrastructure

Thor Offshore Wind Farm will be located taking into consideration the existing cables in the area. Nothing additional is known with regards to the offshore infrastructure that influence the plan. Overall, there is no impact with regard to the offshore infrastructure.

6.5.2 Radio chains and radar systems

There are no radio chain links within the Thor Offshore Wind Farm, and no radio chains are expected to be set up after a permit is granted for the wind farm area.

There are various radar systems within the wind farm area, including the Danish Defence radars at Thyborøn, Hanstholm and Oksbøl, and civilian surveillance radars for air traffic and ship radar systems, all of which can be affected. However, it is expected that mitigating measures can reduce the effects.

Effect on airport radars is expected to be negligible, as reflections and shadows from the offshore wind farm located approx. 20 km from the coast will not have any effect.

Ship radars will also be affected in the same way as the stationary systems, i.e. potential radar shadows and false echoes, which means that the wind farm could interfere with shipping in the area.

A future EIA of the offshore project will need to know the turbine sites, height, number and mutual distance before a concrete assessment of the possible impact on radar systems can be made and mitigation measures can be decided. This must also be seen in relation to risk assessment with regard to ship collisions, and relevant risk-reducing measures for shipping in the area.

6.5.3 Marine raw materials

A number of designated areas for raw material extraction lie close to the survey area, including 'common areas', and areas with 'development permit' and 'reservation'. East of the Thor Offshore Wind Farm is a designated 'potential common area' crossed by the cable corridors, and from which sand can be dredged for coastal protection. Opportunities for extracting raw materials in the 'potential common area' will be affected by the total area for cables, as there is a protection zone of 200 m either side of a cable. If more cables are placed in the corridors, there may be a greater impact on the available raw material resource, depending on the final location and total area affected by cables.

Because there are raw mineral deposits that can be extracted in the wind farm area, impact on these could be limited if the layout of the offshore wind farm takes these areas into account.

6.5.4 Commercial fisheries

Net and trawl fishing take place within the offshore wind farm area. Trawl fishing primarily occurs in the southwestern section of the wind farm area. Net fishing is practiced in most of the wind farm area and in the cable corridor, where trawling is only used to a lesser degree. Trawling is also practiced along the coast.

During the construction and operation phase, fishing can be affected by the laying of temporary and permanent safety zones around turbines and cables. This will apply, especially to trawling in the southwestern part of the wind farm area, where the intensity of bottom trawling is greatest, as well as for beam trawling along the coast around the cable corridor. Net fishing is expected to be affected to a lesser degree, as this technique does not involve towing over long distances and therefore is easier to relocate to nearby areas. It is also expected that net fishing will be permitted to a certain degree within the wind farm area and close to the cables when the offshore wind farm is in operation. Permanent safety zones are expected to affect trawling to a greater degree.

Rerouting trawl fishing can result in higher costs if it must take place further from the coast, or if routes along the coast are cut off by the cable corridor. The actual effect will highly depend on the final outline of the project, and the restrictions that will be applied to fishing. Temporary and permanent safety zones will be restricted to the wind farm area and the cable corridor, and effect on commercial fisheries is therefore expected to be local and negligible.

Fish stocks are only expected to be temporarily affected during the construction phase by the spill of sediment and underwater noise. During operation, fish stocks could be affected by electromagnetic fields around subsea cables, the reduction of seabed areas and noise from turbine rotors. Based on experience from other offshore wind farm projects the effects are expected to be local and negligible. Depending on the design and placement of the turbine foundations, they can develop into artificial reef habitats able to support a diverse fish fauna. The effect is assessed to be local and of little significance to fish stocks and commercial fisheries.

6.5.5 Land use

Municipal planned urban development

The plan mainly concerns areas in a rural zone and therefore has little overlap with urban development. The location of the villages of Bøvlingbjerg and Bækmarksbro and rural zone villages Fjaltring, Fåre, Møborg and Bur will have to be considered when deciding the final route of the underground cables to avoid restricting future urban growth by limiting possible land use over the underground cables. However, it is assessed that it is possible to place the underground cable so that a significant impact on urban development can be avoided.

Municipal planned commercial areas

Municipal development of commercial areas is only planned alongside other urban uses in the area the plan for Thor Offshore Wind Farm covers. It is therefore considered to be possible to place the underground cable to avoid affecting commercial areas. It will not be possible to designate new commercial areas over the underground cable or within its immediate proximity.

Municipal planned technical facilities

The municipality has designated several areas for technical facilities within the planned area for onshore development. It is considered possible that there may be an overlap of areas between the future onshore facility and one or more municipal area designations for technical facilities. Zone 4 Å 0.1 overlaps the current proposal for location of the new HV station at Volder Mark. Hence, an impact cannot be excluded, and further investigation will be needed at a later phase of the project to determine whether the designated area and the existing wind turbines can co-exist.

Municipal planned lowlands

Several areas have been designated as lowland around the village of Linde by the municipality. The most significant lowlands are Lindtorp Mose, Linde Enge and Sivekær, all located approx. halfway between Holstebro and Idomlund. It is considered likely to place the underground cable to avoid affecting lowlands.

Holiday home areas

There are two small areas for holiday homes, Fjaltring Ferieby and Trans Ferieby, north of Nissum Fjord. It is considered possible to avoid an impact on the holiday home areas by locating landfall point and the underground cables.

Raw material areas

There are no raw material areas of interest or extraction areas close to the concerned area for the plan for Thor Offshore Wind Farm.

Farming

When establishing underground cables, a declaration will be registered on the areas around the underground cable, which restricts future use of the areas. The restriction is both in relation to the establishment of new buildings, planting with deep-rooted trees and shrubs, but also in relation to the use of agricultural machinery for tillage.

6.5.6 Flooding

The HV station at Idomlund is not in the areas with a risk of flooding caused by climate-related rises in water level. It is also assessed to be possible to find a location for a new station outside areas with risk of flooding. The proposed project solution according to which the station will be located at Volder Mark is an example of this.

The underground cables are also considered to be impenetrable to flooding, as they will be designed to tolerate water in the ground.

6.5.7 Offshore visual impact

Wind turbines will cause visual impacts and can be visible at long distances in clear weather if they are very high. Assessment of the visual impacts on the population is focused on the interaction between sea and coastline, especially concerning landscape perception seen from the coastal landscape, as the degree of visibility of the turbines is highest seen from here both during the day and at night. Visibility will be reduced in the landscape behind the coastline due to the greater distance, barrier effect of buildings, vegetation, terrain, etc.

The visual impact on landscape perception can be perceived as positive or negative, depending on the views of the population on the landscape and nature compared to the value of offshore turbines as a source of green energy. Similar projects have caused debate, and there is no unanimous conclusion on how large offshore wind turbines affect the population. The perception of offshore wind turbines can be positively and negatively seen from the viewpoint of their neighbours.

The primary visual impact is not assessed to cause significant impacts, due to the considerable distance and relatively few days with very clear weather. The indirect effect on the population as a result of the visual impacts on the recreational landscapes and the residential areas is not expected to be significant, as experience shows that there are both positive and negative attitudes to offshore wind farms, which, in some instances, are located even closer to the coast.

6.5.8 Noise

The land areas for a possible Thor Wind Farm include dwellings in the open land and noise-sensitive area use in the form of residential and holiday home areas. The assessment has considered existing wind turbines on land and the possible noise contribution from the offshore wind farms Vesterhav Nord and Vesterhav Syd.

Airborne noise from shipping and pile driving/ramming (if required) of foundations during the construction phase can cause annoyance. Based on noise estimates made for EIA of the Vesterhav Nord and Vesterhav Syd offshore wind farms, it is believed that the noise will be lower than the usual criterion for noise from construction works of 40 dB(A) at night-time. The noise will also only be for a limited period. The work will be done 20 km or more from land, and the noise is therefore expected to only be heard indistinctly when there is light or moderate onshore wind from the piling site towards land.

During operation, wind turbines create noise mainly from the movement of their rotors. Based on the noise estimates made for the EIAs for Vesterhav Syd and Nord, the total noise level for the Thor Offshore Wind Farm is not expected to exceed 22 dB for total noise and 17 dB for low frequency noise at 8 m/s, which is well under the threshold values. The noise is expected to be reduced by approx. 2 dB at 6 m/s and will therefore still be under the threshold values at this wind speed.

On this basis, it is believed that there is sufficient margin within noise limits for the overall noise from existing and new wind turbines in the area. It will not be possible to confirm this until a detailed analysis is performed. The risk of exceeding the threshold values is considered to be highest in the area around existing wind turbines on land, where the total noise range can be fully or partially utilised already. However, the risk is considered to be low, as it requires the coincidental occurrences of unfortunate circumstances. The risk can be determined by checking permits for existing turbines on land near the coast and to determine their actual utilisation of threshold values.

Overall, it is assessed that the Thor Offshore Wind Farm will not cause noise (including low frequency noise) that will exceed the threshold values and thus represent a significant impact on the population and human health. It will be necessary to investigate whether existing wind turbines may have utilized the limit values for noise from wind turbines to such an extent that there is no noise margin for even a small extra noise contribution from Thor Offshore Wind Farm at individual homes..

Noise from onshore development

The two HV stations that the plan for Thor Wind Farm will require will be in continuous operation around the clock, every day during the year.

Noise calculations have been made at similar facilities, with a location in the open country which shows that the noise impact is significantly lower than the indicative limit values for noise at the nearest homes in the surroundings.

The noise impact is not considered to be significant, and the specific project can be adapted so that the noise impact is minimised.

6.5.9 Shipping and navigational safety

As part of the process of selecting the wind farm area, maintaining key shipping routes was a major parameter. There are six routes that could be affected by the Thor Wind Farm, primarily during the operation phase. The southwestern part of the area is crossed

by the most heavily used shipping route. The Danish Maritime Authority has indicated that it will not necessarily prevent construction of the wind farm.

If it is decided to go ahead with the project, relocation of the dredged channels will have to be discussed with the Danish Maritime Authority. An analysis of the project in relation to navigational safety will also have to be conducted, and navigational safety for shipping crossing the raw material areas near the wind farm will have to be investigated, if there are extraction operations.

6.5.10 Air traffic safety

Impact on air traffic during the operation phase is assessed to be negligible, as the wind farm will be located within the limited obstruction zones of airports or airstrips, intended to ensure room for manoeuvre for take-off and landings. Offshore wind turbines are marked according to the regulation for warning lights, and construction work will be planned in consultation with the Transport, Building and Housing Authority.

No impact is expected on airport radars belonging to e.g. Aalborg, Billund or Aarhus Airports, due to distance to the offshore wind farm.

BIODIVERSITY

6.6 Marine flora and fauna

The existing conditions for marine flora and fauna in the area of the offshore wind farm and cable corridors have been surveyed as part of the field surveys in 2020.

Water depth in the wind farm area is between 21-35 metres, and between 0-30 metres in the cable corridors. The seabed consists primarily of sand and areas with gravel and coarse sand. Small areas of stone reef have also been identified.

6.6.1 Benthic flora and fauna

As expected, surveying flora and fauna in the wind farm area and cable corridor showed that there are no seagrasses or algae on the seabed, except for two registrations of crust-forming algae in the wind farm area. This is due to considerable wave effects and sediment dynamics that makes the west coast unsuitable as a growth area for seagrasses and algae.

The benthic fauna in the wind farm area and cable corridors consists of species that live on the sediment surface (epifauna) and species that live buried in the sediment (infauna). The benthic fauna can be divided into three communities: sandy bottom, hard bottom and mixed sand- and hard bottom communities. The sandy bottom community comprises most of the benthic fauna throughout the project area, with very few species living on the sediment, such as starfish, crabs, sea urchins and local areas with burrows from lug-worms and the *Lanice* sand mason worm. The majority of the benthic fauna community lives in the sediment, dominated by the horseshoe worm (*Phoronis sp.*). The hard bottom benthic community is dominated by tube worms and several species of sea anemones, while the mixed sand and hard bottom community contain species from both community types. No endangered or red-listed species of benthic fauna were found, and the species are primarily robust species with considerable potential for recolonization.

The highest density and biomass of benthic fauna was found in the southwestern section of the wind farm area. The benthic fauna communities found are all common in the North Sea, and similar communities have been found closer to the coast by surveys for other wind farms.

Assessments of benthic fauna are provided under the section on fish below, as some of the impacts will be the same for benthic fauna and fish.

6.6.2 Fish and benthic fauna

Fish fauna on the sandy seabed in the wind farm area is dominated by sand goby, sand eel, plaice, common dab and turbot, and there are large shoals of sprat, herring, cod and whiting within the area. South of the wind farm area are important spawning areas for sand eel. Along the section off the wind farm area, species with special protection status have been registered, including Atlantic salmon, sea lamprey, twaite shad and allis shad. European eels have also been registered, which is a vulnerable species, and red-listed as critically endangered. Salmon and sea trout are found in the area around the cable corridor.

The impact on benthic fauna and fish from a wind farm during the construction phase will potentially occur in the form of sediment spill causing sediment in the water column and sedimentation, underwater noise and habitat loss. During the operational phase for the offshore wind farm potential impacts will be introduction of new habitats, along with electromagnetic fields and heat generated in the seabed near the cables.

Sediment in the water column and sedimentation

The benthic fauna in the wind farm area is generally considered to not be sensitive to sediment in the water column or sedimentation on the seabed, as it consists of robust species such as sand mason worm and shellfish, which are adapted to the highly dynamic environment with large wave activity and natural sediment mobility characteristic of marine environments along the Danish West coast.

Fish are more vulnerable to higher sediment concentrations in the water column, where there is a risk of impairing oxygen intake through their gills, skin and egg membrane, and higher concentrations can lead to constipation of the digestive system with higher numbers of fatalities. The higher concentrations of sediment in the water can also have indirect effects on migration and feeding habits, including fish which use their eyesight to locate prey.

Because the potential effects are expected to be restricted to a limited period of time and to a local area around excavation work, temporarily higher sediment concentrations in the water column is not expected to cause any significant impact on benthic fauna and fish.

Underwater noise

The benthic fauna is not expected to be highly affected by underwater noise during construction or operation of the wind farm. However, underwater noise during ramming the foundations of the turbines into the seabed, traffic from boats and vessels during the construction phase and noise from the turbines during the operation can be detected by most fish species. Fish that are close to activities such as ramming are at risk of significant effects from the underwater noise in the form of fatal injury, permanent hearing loss or behavioural change. Several studies have shown that certain fish species are, however, able to regenerate cells in their ear in the event of non-permanent damage to their hearing apparatus. Based on experience from other wind turbine projects, the impact of noise is not expected to have any significant effect on the fish fauna.

Habitat loss

Based on the survey of the marine flora and fauna in the area for the Thor Offshore Wind Farm, there is no significant seabed flora, and the benthic fauna comprises species with high tolerance of physical disturbance and temporary habitat loss. The species communities also have considerable regeneration potential due to short generation time and high capacity for recruitment from the surrounding seabed. The fish are expected to temporarily leave the affected area and migrate to surrounding areas. The effect of temporary and permanent habitat loss of marine habitats in the area is not expected to be significant.

Introduction of new habitats

The turbine foundations, together with possible erosion protection of turbines and the cable backfill are expected to create new structures that can act as artificial reefs. Hard substrates are often colonised by algae, mussels and other benthic organisms that represent feed for fish and birds. Studies of the biodiversity around wind turbine foundations at Horns Rev showed that the hard substrate led to more species diversity for the fish fauna of the area. Offshore wind turbines can create new marine biotopes with a varied animal and plant life. But any positive effect will be local, and of lesser significance to the overall species diversity in the area.

Electromagnetic fields and heat from cables in the seabed

Electromagnetic fields (EMF) and heat are generated around the cables in the seabed between the turbines and in the cable corridor. The electromagnetic field will be highest

directly above the cable and decrease in line with distance from cable to around 10 m, where it will be more or less undetectable. Regarding the effect of electromagnetic fields, the degree of impact for fish and invertebrates depends on whether the cable is exposed or buried as well as the current. Furthermore, the degree of influence depends on the physiology and sensitivity of the fish species to EMF. An electromagnetic field of 3.7 m T has been shown to have no effect or increased mortality on invertebrates i.e. common shrimp and mussels. It is expected that the cables are buried, but the impact will depend on the specific conditions. Furthermore, the commercial fishing of common shrimp during operation is affected, as within the protection zones there is a ban on any use of gear etc. that is towed on the bottom, due to the cable executive order. Based on fish surveys from nearby offshore wind farms, it is not expected that there will be a large occurrence of sensitive fish species such as sharks and rays in the area of Thor Offshore Wind Farm, and flatfish are not considered to be directly affected. On this basis, impact from EMF and generated heat is expected to be negligible.

6.6.3 Marine mammals

There are three native species of marine mammals in the Danish sector of the North Sea: porpoises, harbour seals and grey seals. Both seal species are listed in Annex II and V of the Habitat Directive¹², which means that special protection areas must be designated for the species. Harbour porpoise are also an Annex II species but also listed in Annex IV of the Habitat Directive, which means that not only should special protection areas be designated to the species, but that they are protected throughout their entire habitual area. Harbour porpoise are the only Annex IV species expected to be regularly found in the offshore wind farm area. The area for the Thor Offshore Wind Farm is not a hotspot area for harbour porpoises, and the nearest hotspot area is at Horns Rev. Monitoring of resting places for harbour seals and grey seals also shows that the area is not part of haul out areas or resting areas for these species.

The primary sources of disturbance of marine mammals are sediment spill causing sediment in the water column during the construction phase, underwater noise and vibrations during the construction and operational phases, plus changes in habitat during the operational phase. Noise from vessel traffic, excavation work and other construction work is expected to be negligible, and with no significant impact on marine mammals.

Sediment spill

Impact on marine mammals from higher concentrations of suspended sediment from sediment spill from the construction work, can potentially include loss of vision and affect behaviour, i.e. avoidance of sediment plumes. Porpoises communicate and find food using sonar, and their behaviour and chances of finding food are therefore not directly dependent on their sight. Neither are seals dependent on their sight to navigate and find food in water. Based on studies from other offshore wind turbine projects, sediment spill is typically limited in both terms of spatial distribution and time. Furthermore, the Thor area is dominated by large hydrographic variability, which often causes high natural concentrations of sediment in the water column, which does not affect the marine mammals. It is therefore expected that there will be no significant impact from sediment spill on porpoises or seals in the area.

Underwater noise and vibrations

If pile driving is used for ramming the turbine foundations in to the seabed, it will possibly be the most critical source of underwater noise that can lead to permanent hearing loss (PTS), temporary loss of hearing (TTS) and behavioural changes, causing habitat displacement for marine mammals.

¹² Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Preliminary modelling of underwater noise for the preliminary studies show that PTS can be expected in harbour porpoises at distances of up to 16 km, and approx. 3 km for seals. The distance causing potential TTS will be up to 50 km. The model calculations were performed without using deterring devices, which can include bubble curtains, seal scarers and pingers etc., and the use of one or a combination of these methods will possibly reduce the impact. Furthermore, it is expected that pile driving, or ramming will be in line with the Danish Energy Agency's guidelines that require softstart/ramp-up¹³, intended to ensure that marine mammals are outside the risk zone for permanent hearing loss (PTS). On this basis, and because the wind farm is more than 70 km from the nearest hotspot for porpoises and does not comprise a resting area for seals, underwater noise and vibrations during the construction phase are not expected to cause significant impact on marine mammals in the area with the risk of affecting behaviour or displacing porpoises and seals.

Studies performed at existing offshore wind farms indicate that operational underwater noise is limited. Monitoring around these wind farms has not shown any displacement effect on porpoises. Similar observations also conclude that seals are not affected by offshore wind turbines in operation. The overall conclusion is that operation of the Thor Offshore Wind Farm will not cause any significant impact in the form of underwater noise and vibrations for marine mammals in and near the wind farm area.

Habitat loss and changed habitats

The construction of offshore wind turbine foundations introduces hard substrates that can reefs over time. Hard substrates attract benthic fauna and fish; the latter can potentially increase feeding potential for marine mammals. Because the feeding potential for harbour porpoises and seals is not expected to be significantly affected by habitat loss, and because artificial reefs can form around turbine foundations, providing more potential feed, changes to habitats are expected to be less important to marine mammals in the area.

6.6.4 Birds

The biggest groups of birds in the wind farm area include divers, northern gannets, gulls and auks in various, but general in low numbers. The birds recorded all feed on the surface and in open waters which are predominantly controlled by currents and tide. The majority of birds are not linked to particular parts of the area, apart from divers, which are especially found in the eastern/south-eastern part at lower water depths.

With a siting at least 20 km from the coast, the Thor Wind Farm is well away from many of the primary migration corridor for birds, which tend to be closer to the coast, and where birds generally travel south-north.

The potential impact on resident and migratory birds within in the Thor wind farm area is described below.

Staging birds

Loss and changes to habitat

Activities during construction can cause temporary loss of habitat for birds, as their potential feeding grounds can be occupied for periods by ships and working areas for the individual turbines while foundations etc. are constructed. Similarly, the installation of turbine

¹³ The procedure for increasing noise levels slowly improves the chances of marine mammals such as harbour porpoises of vacating the area. This will reduce the risk of hearing loss.

foundations and laying cables can mean loss of visibility and make foraging difficult for birds.

Activities during construction are short-term and limited to the local area where foundations are built, and the area occupied by the foundations and erosion protection (if needed) during operation. Because the birds look for food in the water column and are normally used to periods of unclear water, the actual loss and changes to habitats during the construction and operation is overall considered to be modest for the seabirds found in the area. A positive side-effect can be expected from the turbine foundation in the formation of artificial reefs able to support the development of diverse fauna and flora community.

Displacement and disturbance

The presence of vessels etc. during construction can displace birds that are sensitive to disturbance. Because work will take place in one area at a time, and not in the whole wind farm area simultaneously, the impact will be short-term, and because birds are expected to return to the area when the work is finished, the displacement effect in the construction phase will be negligible.

When the wind farm is operating, it will be a disruptive element for sensitive bird species such as divers, which can be affected within a buffer zone extending several kilometres around an offshore wind farm. Divers are expected to be most affected in April, when the highest numbers are present in the area of the wind farm. Displacement of divers will primarily be related to the eastern to south-eastern part of the wind farm area, and the impact can be expected to be reduced if the wind farm is located further to the west within the area. No significant impact is expected as a result of displacement and disturbance for other bird species.

Risk of collision

Vessels and cranes can potentially comprise a risk of collision for resident birds, but the likelihood of collision is considered low, as the birds can be expected to fly around vessels. The impact as a result of collisions in the construction phase is therefore assessed to be negligible.

Recent results from monitoring of the detailed movements of northern gannets and gulls such as great black-backed gull, herring gull and lesser black-backed gull have shown that such birds can react close to the wind farm, even to individual turbines and close to the rotor blades during operation with very low number of collisions recorded. This reduces the risk of collision considerable. Besides auks generally fly low over the water surface, why the risk of collision is generally expected to be low. The risk of collision is generally expected to be reduced in line with a reduction in the overall area for the wind farm. The number of collisions in relation to the size of the population of the respective species means that impact as a result of collision is negligible.

Migratory birds

Risk of collision and barrier effect

An offshore wind farm can cause a barrier effect, resulting in birds flying alternative routes, thus increasing their energy use, or the wind farm can pose a risk of collision for birds being killed being struck by a wind turbine blade if unable to avoid the farm.

Because the Thor Offshore Wind Farm will be located at least 20 km west of the coast, and therefore not in the main migratory corridor for water birds, the number of migratory birds is expected to be limited. The offshore wind farm is therefore not expected to cause

any significant barrier effect for migratory birds. If the turbines are oriented in a south-north line, parallel with the coast, the likelihood of collision may be further reduced.

6.7 Flora and fauna on land

Nature protection

The area between the North Sea, Nisum Fjord and Klosterhede Klitplantage is an area of significant natural interest, Figure 6-5.

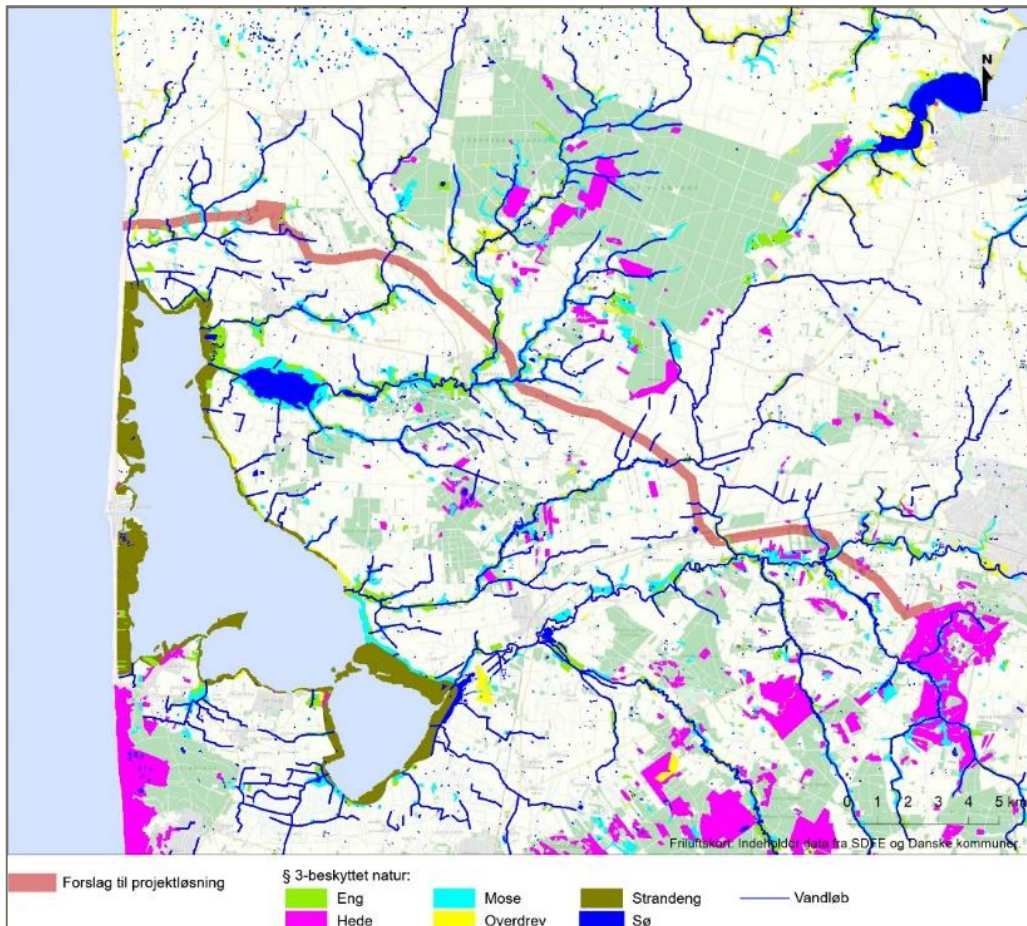


Figure 6-5 Overview of Section 3 protected habitat types. The proposal for the project under consideration has been added to the figure as an example.

The plan for Thor Offshore Wind Farm includes the option of routing the underground cables through protected habitats, including dunes and other habitat types protected according to Nature Protection Act¹⁴ Section 3 (Figure 6-5). The proposed project solution involves crossing dunes and protected streams, which in several cases will be flanked by protected meadows; while other habitats can be avoided. It is assumed that the crossing of dunes and watercourses by horizontal drilling, and thus no significant impact on dunes and watercourses is expected.

Any effects will primarily be related to construction activities. The extent of the effects could potentially be significant if mitigation measures are not implemented. However, with appropriate measures, the effects on protected nature are expected to be local, temporary and of a limited extent. Mitigation measures include quick covering of the cable, horizontal directional drilling and keeping working areas at a minimum.

¹⁴ Consolidated Executive Order no. 1217 of 28. September 2016 on nature protection.

The area between Tuskjær and Idomlund includes a number of woodland conservation areas and woodland according to the Forest Act¹⁵ and no-build zones. A major impact on woodland conservation areas is likely to be avoidable by rerouting the underground cable outside woodland conservation areas or avoiding the felling of trees in woodland conservation areas. The plan is not in conflict with any woodland no-build areas.

Birds

The area for Thor Offshore Wind Farm onshore development is not an internationally important area for birds (IBA). Only one red-listed species, white stork, has been registered and breeds in the area. Apart from white storks, no breeding birds protected via Annex I of the Birds Directive have been registered.

The white stork, (*Ciconia ciconia*), forages on the wet meadows on both sides of Flynder Å. Storks have also been observed on the meadows at Bækmarksbro and west of Bækmarksbro. The species is red listed as critically threatened (CR). The white stork is also protected via the Bird Protection Directive¹⁶ Annex I. A significant impact on its breeding grounds can be avoided by adapting the project to avoid known breeding grounds for the white stork.

6.8 Annex IV species

6.8.1 Offshore

Cetaceans are the only marine species found in Annex IV of the Habitat Directive in Denmark. Harbour porpoises are the only species of cetaceans known to breed in Danish waters. Because harbour porpoises are listed under Annex IV of the Habitat Directive, their breeding areas must be protected to ensure that the ecological function of the species is not weakened.

It is expected that a number of preventive measures will be implemented during construction to prevent permanent hearing injury and to prevent behavioural effects as much as possible, which will ensure minimum impact from underwater noise on porpoises. It must also be stressed that there are no known breeding areas for porpoises in or near the wind farm area, and that the area is far from known hotspot areas for harbour porpoises.

Overall, the construction of the Thor Offshore Wind Farm is not expected to impact the ecological functions of the breeding and habitat areas of harbour porpoises.

6.8.2 Onshore

The following Annex IV species which could be affected by the plan have been recorded on land: European beaver (*Castor fiber*), European otter (*Lutra lutra*), moor frog (*Rana arvalis*), natterjack toad (*Epidalea calamita*), northern crested newt (*Triturus cristatus*), sand lizard (*Lacerta agilis*), green club-tailed dragonfly (*Ophiogomphus cecilia*) and bats.

The underground cable route will cross beach areas, where natterjack toads might be found. The route will also cross river systems where there is a risk of affecting suitable habitats for beaver, otter, moor frog, northern crested newt and green club-tailed dragonfly. However, it is believed that any impact on the ecological functions of these species, and thus a significant impact on these species can be avoided by adapting the project (e.g. horizontal directional drilling).

Local flocks of bats can be affected if the trees they nest in are felled. Affecting the ecological functions of bats can be avoided or limited by adapting the project, e.g. by routing

¹⁵ Consolidated Executive Order no. 1577 of 8 December 2015 on woodlands.

¹⁶ Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

the underground cable around bat trees or by horizontal directional drilling under woodland areas.

6.9 Natura 2000

6.9.1 Offshore

There are three marine Natura 2000 areas near the Thor Offshore Wind Farm and the cable corridors: N220 Sandbanker ved Thorsminde, N247 Thyborøn Stenvolde and N219 Sandbanker off Thyborøn, see Figure 6-6.

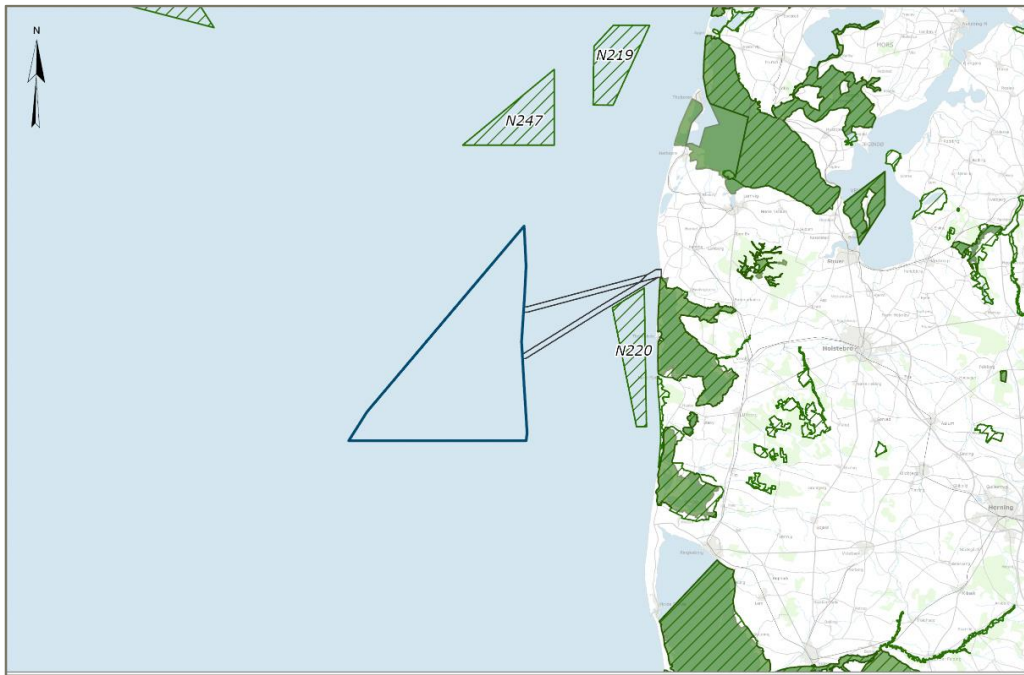


Figure 6-6 Marine Natura 2000 - areas near Thor Offshore Wind Farm and cable corridors.

Table 6-1 shows the designated Natura 2000 areas and their distance from the offshore wind farm and cable corridors.

Table 6-1 Designated Marine Natura 2000 areas and distance from the Thor Offshore Wind Farm.

Natura 2000 area	Designated area	Distance to Thor Wind Farm/cable corridor
N220 Sandbanker ud for Thorsminde	Sandbank (1110)	Approx. 15 km Approx. 350 m
N247 Thyborøn Stenvolde	Stone reef (1170)	Approx. 12 km
N219 Sandbanker ud for Thyborøn	Sandbank (1110) Stone reef (1170) Harbour porpoises	Approx. 20 km

Model calculations from other offshore wind turbine projects generally show that building turbine foundations is a source of increased sediment concentrations, but that they are local and temporary. Because the distance from the three Natura 2000 areas to the Thor Offshore Wind Farm is 12 – 20 km, it is believed that there will be no significant impact as a result of sediment spill on the designated habitat types.

Cable-laying is expected to be performed by jetting and causes greater sediment concentrations in the water column. This means that a modest impact on water quality can be expected in Natura 2000 area N220. Because the effect will be temporary and within the natural variation in the area, it is not expected to cause any significant effect on designated *sandbanks*.

Harbour porpoises are a designated species in Natura 2000 area N219 located approx. 20 km from the Thor Offshore Wind Farm. At this distance, noise from the construction of turbine foundations is not expected to result in any significant effect on harbour porpoises.

Overall, neither the construction of the wind farm nor laying cables are expected to have any significant negative impact with a risk of harm to designated habitat types sandbanks and stone reef, or harbour porpoises in the Natura 2000 areas. An offshore wind farm within the area of the Thor Wind Farm is therefore not expected to influence the chances of maintaining or achieving a favourable conservation status for species and habitat types in the designated Natura 2000 areas (N220, N247 and N219), including protecting their integrity.

6.9.2 Onshore

There are three Natura 2000 areas that are hydraulically linked to the major river systems in the plan area for the Thor onshore development: N64 Heder og klitter på Skovbjerg Bakkeø, Idom Å and Ormstrup, N65 Nissum Fjord and N224 Flynder Å and Klosterhede Plantage, Figure 6-7.

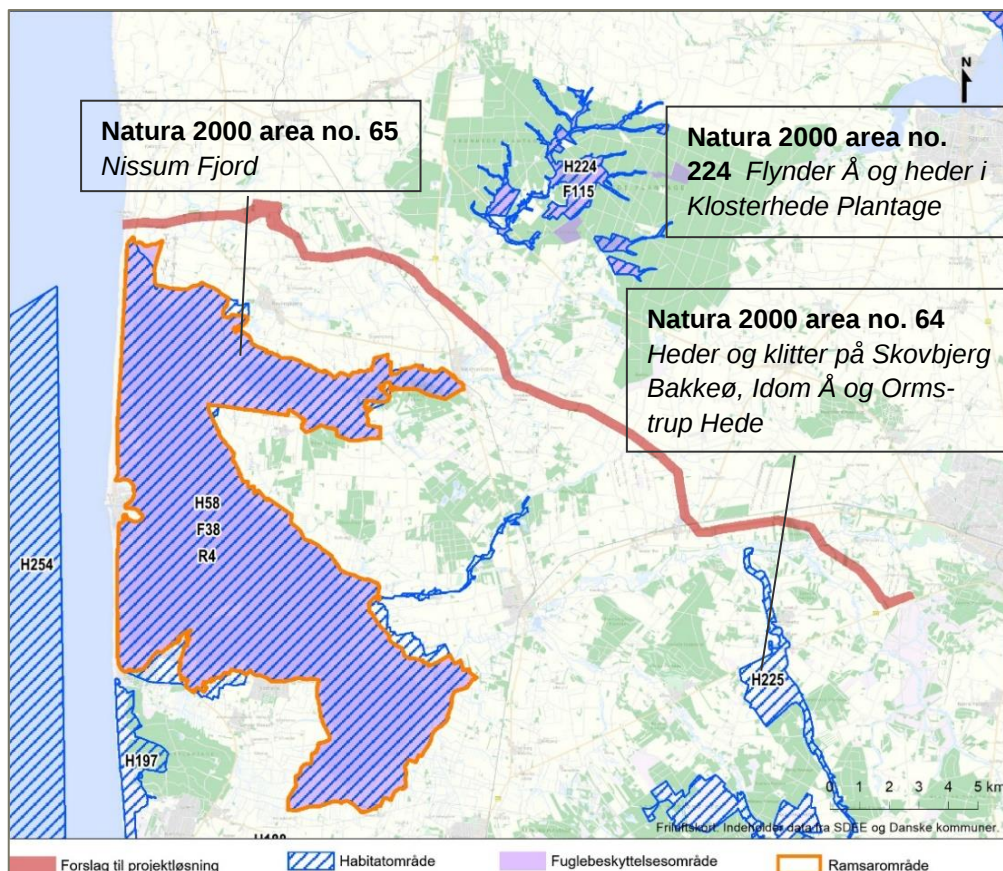


Figure 6-7 Natura 2000 areas. The proposal for the considered project is added to the figure as an example.

There is no overlap between Natura 2000 areas and the HV station at Idomlund. Neither is there any technical nor socioeconomic incentive to locate either the new HV station or the underground cable link through a Natura 2000 area. On this basis, it is believed that there are no specific project solutions on land that will affect Natura 2000 areas directly. The proposed location for a new HV station at Volder Mark and for the underground cable link are examples of the same, see Figure 6-7.

There may be minimal risk of indirectly affecting the Natura 2000 areas in the form of sediment spill from construction activities in the major river systems, which are hydraulically linked to the Natura 2000 areas. But it is believed that any effects as a result of sediment spill will be local and not affect the quality elements for high ecological status in downstream recipients. Overall, it is believed that there will be no impact on Natura 2000 areas and their integrity will be retained.

It is believed that any effects will be local and not affect the quality elements for good ecological status in surveyed lakes, watercourses or coastal waters. Overall, it is believed that there will be no impact on Natura 2000 areas and their integrity will be retained.

WATER

6.10 Offshore

6.10.1 Hydrography and marine-water quality

Hydrography covers water levels, water currents, wave conditions, water exchange, stratification and mixing of the water column. Water quality determines the general environmental status of the sea, and the living conditions for marine flora and fauna.

The area designated for the Thor Offshore Wind Farm is included in the Marine Strategy Framework Directive, which applies to marine areas from the high tide mark to the 200-nautical-mile boundary. The environmental target for the wind farm area in terms of the Marine Strategy Framework Directive is to achieve good environmental status for 11 descriptors: D1 Biodiversity, D2 Non-indigenous species, D3 Commercial fish and shellfish, D4 Food webs, D5 Eutrophication, D6 Sea-floor integrity, D7 Hydrographic conditions, D8 Contaminants, D9 Contaminants in seafood, D10 Marine litter and D11 Energy incl. underwater noise. The current environmental status for the descriptors is either not good or cannot be assessed due to non-existent threshold values.

The area designated for the Thor Offshore Wind Farm lies partially within the 12-nautical-mile zone in Water District Jutland and Funen, 1.4 Nissum Fjord, coastal area 133 North Sea, North. The area is therefore under the legislation of the Water Framework Directive and the environmental target for the wind farm area is to achieve 'good chemical status' up to the 1-nautical-mile zone according to the water management plans. From the 1-nautical-mile zone and to the coastline, the area is also subject to an environmental target of achieving 'good ecological status'. The current chemical status for 133 North Sea, North, is unknown, while the overall ecological status is moderate.

The primary detrimental effects on the marine environment include eutrophication and pollution with contaminants such as metals. The potential impacts on hydrography and water quality from constructing an offshore wind farm are addressed below.

Change of water levels and water currents, reduced wave patterns and changes in stratification

Based on experience from other offshore wind turbine projects, no changes in water levels, currents and wave patterns, nor on stratification are expected from the construction of the Thor Wind Farm. Compared to the natural dynamics of the Danish west coast in terms of waves, currents and sediment transport, the impact from the wind farm is expected to be negligible.

Sediment in the water column, release of nutrients and contaminants

Sediment concentrations in the water column caused by construction work for the Thor Offshore Wind Farm is not expected to cause any major impact on water quality, and impact in general will be limited in terms of time and spatial distribution. This is due to sediment primarily consisting of sand in the wind farm area with a low content of organic substances, and the contribution of nutrients from suspended sediment in the water column during excavation work is therefore expected to be negligible. Similarly, the release of contaminants from suspended sediment in the water column is also expected to be low.

Deposits of discharged NO_x from ships and machinery during the construction and operation of the offshore wind farm can be sources of nutrients but are also expected to be negligible in relation to the run-off of nutrients to the marine environment from land.

Spill of contaminants

Accidents in the form of ship collisions will be the primary cause of possible spill of contaminants to the marine environment. Ships must comply to legal guidelines to prevent and avoid accidents at sea. If an accident does occur, any contaminants will be collected. Any residue will be diluted quickly in the local area and will have negligible effect on the chemical status of marine areas.

Impact on environmental status

Because no major impact on the current water quality in the wind farm area or cable corridors is generally expected from the project, no impact is expected from the construction of the Thor Offshore Wind Farm that could prevent achieving good ecological status and good chemical status with regard to the Water Framework Directive or for achieving good environmental status with regard to the Marine Strategy Framework Directive.

6.10.2 Seabed conditions and sediment

The area designated for the Thor Offshore Wind Farm is primarily sand bottom, with mosaics of areas with gravel, coarse sand and stony seabed, plus smaller areas of clay. There are a few areas with stone reefs, which are primarily linked to areas with stony seabed. The cable corridors consist of mosaics of sand, gravel and stony bottom. The west coast of Jutland is dominated by wind, strong currents and waves with a naturally high sediment transportation.

The potential effects from the construction and operation of the Thor Offshore Wind Farm on seabed conditions and sediment are addressed below.

Sedimentation – deposits of suspended sediment

Effects from sedimentation are expected over a limited period and will have a local distribution around the excavation work during construction. The west coast is naturally very dynamic, with changes of 70 to 100 cm to the seabed floor occurring after a single storm lasting six hours. Sedimentation caused by construction of the Thor Offshore Wind Farm is therefore not expected to have any major impact on seabed conditions and sediment in the area.

Habitat loss and introduction of new habitats

Construction of an offshore wind farm means occupying an area of naturally occurring seabed, which mainly consists of sand. Habitat losses will be small and is therefore not expected to be significant based on the vast occurrence of sandy seabed in the North Sea. Turbine foundations and any stone deposits for erosion protection of foundations and cable corridors will introduce new areas with hard substrate, which potentially can have a positive effect on flora and fauna, as the area of hard substrate increases for benthic flora and fauna, which comprise food for fish, birds, etc.

Changes in seabed conditions, sediment transport and depth

The morphology of the seabed depends to a high degree on the local current and wave conditions, which can lead to changes in seabed morphology when offshore wind turbines are installed, if the turbines create a barrier effect. The west coast is a naturally dynamic coastal area, characterised by considerable sediment transport caused by current and waves. The actual impact of the Thor Offshore Wind Farm on seabed morphology and sediment transport will depend on the specific project, but experience from other wind farms has shown that current and wave patterns are almost unaffected by an offshore wind farm. Because no major impact on current and wave patterns is expected from construction of offshore wind turbines, no major impact is expected on seabed conditions, sediment transport or depth as a result of the Thor Offshore Wind Farm.

Changes in coastal morphology

Impact on coastal morphology during the construction phase can occur from jetting for cables in the cable corridor close to the coast, for example. The impact will be local, but as a result of the naturally dynamic conditions along the west coast, the impact from cable-laying on the coast morphology is expected to be small.

6.11 Onshore

6.11.1 Surface water

The area between the landfall at Tuskær and the connection to the existing HV grid in Idomlund, there are a number of watercourses and lakes.

The underground cable will inevitably have to cross several targeted watercourses. Crossing of watercourses requires a dispensation from section 3 of the Nature Conservation Act and will typically be granted with a requirement that the crossing must take place by horizontal drilling to avoid affecting the watercourse. If the crossing occurs by excavation, it could potentially change the hydro-morphology of the watercourse and thus affect the environmental quality criteria for targeted watercourses or for downstream recipients. It is therefore unlikely that permitting for excavation will be possible if this could adversely affect the environmental quality of the watercourse in question.

It is unlikely that cables will be routed through lakes in the area. On the one hand, the lakes in the area are located so that a route that does not affect lakes can easily be found. Besides, it would be expensive and time-consuming to drill under a lake or by jetting a cable into the lake bottom. Finally, crossing a lake will require a § 3 dispensation just as for streams, and such a dispensation will hardly be granted if it is possible to re-route the cable around the lake. Based on this, it is considered unrealistic that the underground cable will be routed through lakes on the stretch from Tuskær to Idomlund.

By rerouting and use of e.g. horizontal directional drilling under targeted watercourses, no major impact is expected on surface water. The plan will therefore not prevent achieving good ecological status for lakes, water streams and coastal waters according to the water management plan 2016-2021.

The plan for Thor Offshore Wind Farm is not considered to influence the target fulfillment of the marine strategy, as there are no impacts from the plan on the individual descriptors described in section 5, which will prevent the descriptors' achieving good environmental condition.

6.11.2 Groundwater

Based on experience from other similar projects the underground cables are not in themselves expected to cause major impact on the groundwater. If precautions are taken during construction work, e.g. keeping the cable trench dry during construction, along with ensuring sedimentation and oxygenation before discharge, this work is not expected to affect either the quality or quantity of local (shallow) or regional (deeper) groundwater resources. Possible impact must be assessed in detail when planning the actual project.

When assessing environmental conditions on land with the Vesterhav Nord offshore wind farm, transformers and compensation coils were referred to in relation to possible impact from oil-filled tanks. Usually, this type of impact is handled by placing the plant above ground on a dense foundation, which contains a reservoir that can hold the entire amount of oil. This is normal practice, and the associated risks must be assessed in the detailed project.

CUMULATIVE ASPECTS

Cumulative effects can be the result of the combined effect of the plan, i.e. construction of an offshore wind farm in the Thor area within the planned period for construction and grid connection compared with other known plans, programmes or actual projects.

6.12 Offshore

Construction of the Thor Offshore Wind Farm is planned to start in 2024 and continue until 2027. It is likely that operation of the offshore wind farm can start from 2025 and be fully operational in 2027.

The closest offshore wind farms (Vesterhav Nord and Vesterhav Syd) are expected to be built in 2023 and operating in late 2023. There will also be offshore wind turbine projects built by the UK and Germany which can mean cumulative effects.

Based on the schedule for constructing the Thor Offshore Wind Farm in relation to Vesterhav Nord and Vesterhav Syd, no cumulative effects are expected related to the construction phase, as Thor will not be built until 2024 at a time where Vesterhav Nord and Syd will already be operating. The Thor Offshore Wind Farm is also located much further out to sea in relation to Vesterhav Nord. This will mean that cumulative effects can primarily be expected during operation. On this basis, the following wind farms can be involved:

- Vesterhav Nord Wind Farm with regard to birds and the visual impact
- Vesterhav Syd Wind Farm with regard to birds and the visual impact
- A future energy island/hub in the North Sea, e.g. birdlife
- Possible German or Dutch offshore wind turbine projects in the southern part of the North Sea, especially with regard to bird and perhaps affecting marine mammals
- Possible British offshore wind turbine projects, especially with regard to birds.

Marine mammals and Annex IV (harbour porpoise)

Harbour porpoises are listed under Annex IV of the Habitat Directive and are subject to strict protection. The ecological functions for harbour porpoises as a result of the plan for Thor Offshore Wind Farm are expected to be maintained at least the same level after implementation of the plan. And because simultaneous ramming of turbine foundations is not expected in several planned wind farms, the plan will not cause any negative impact on the area's ecological functions for harbour porpoises.

During operation, several large wind farms can potentially reduce the feeding grounds for marine mammals due to occupation of habitat. But surveys and monitoring around established offshore wind farms have shown that marine mammals return to and forage within areas of offshore wind turbines, which is why it is not expected that the Thor Offshore Wind Farm and other wind farms will cause loss of feeding ground habitat. Furthermore, the distance between the planned projects is so great that no barrier effect for marine mammals is expected. It is therefore assessed to be unlikely that there will be any significant cumulative impact on marine mammals as a result of constructing the above projects. It is also expected that ecological functions for harbour porpoises will not be affected, as no significant impact from barrier effect will arise during operation.

Birds

The potential cumulative effects during operation for birds could include barrier effects, risk of collision or displacement.

Migratory marine birdlife

Sited approx. 20 km from the coast, the Thor Offshore Wind Farm is not located in the main migration corridor for water birds. Therefore, the risk of the wind farm creating an enhanced barrier effect or representing a collision risk for migratory water birds is negligible. The Thor Offshore Wind Farm is therefore not expected to contribute to cumulative effects for such birds.

Staging water bird

Thor Offshore Wind Farm will have no effect on diving ducks, e.g. the common scoter, found close to the coast in more shallow waters. There will therefore be no cumulative effects for diving ducks.

Because the number of divers falls with the increase in distance from the coast, no risk of cumulative effect on divers and their numbers are expected from the concurrent operation of the Thor Offshore Wind Farm, Vesterhav Nord and Syd offshore wind farms. A possible future energy island/hub west of the Thor Offshore Wind Farm will be at greater water depth, where divers cannot be expected and therefore no risk of cumulative effect is expected.

The most common bird species in the area for the Thor Offshore Wind Farm are northern gannets and auks, along with gulls, but generally in low densities. Gulls and northern gannet demonstrate considerable flexibility in their choice of food and foraging areas. The Thor Offshore Wind Farm is not expected to contribute to cumulative effects with regard to habitat changes or displacement as a result of the offshore wind farm along with other offshore wind turbines in operation. Furthermore, it has been found that northern gannets and large gulls can react very close to a wind farm, the individual turbines and close to the rotor blades, with very few collisions recorded. The risk of collision and a cumulative effect of increasing the number of wind farms is therefore expected to be of minor importance for these species.

The influence of the cumulative and transboundary effects of offshore wind turbines in the North Sea on seabirds and their populations is only to a limited extent clarified. It is therefore expected that new knowledge will emerge on an ongoing basis, which must be included in subsequent studies and assessments.

Landscape and visual aspects

Implementation of the plan for Thor Offshore Wind Farm will cause cumulative visual impact due to the proximity of the planned wind farms Vesterhav Nord and Syd. The actual extent of the cumulative effect cannot be assessed in more depth until a specific project for the Thor Offshore Wind Farm is developed and the interaction with the planned Vesterhav Nord and Vesterhav Syd can be assessed.

Several wind farms close to each other will cover more of the horizon seen from the coastal landscape, increasing the overall visual impact in the area. Furthermore, it is likely that there will occur visual interaction between the wind farms that can increase the overall visual impact, including if it is difficult to distinguish the two farms from each other visually.

The cumulative effect is assessed to be insignificant, as the Thor Offshore Wind Farm will not result in major visual impacts in itself nor will it result in major visual impact when it is visible in combination with either Vesterhav Nord or Vesterhav Syd. Furthermore, regard-

less of the pattern chosen for the Thor Offshore Wind Farm, the farms will be easy to distinguish visually. In addition, the visibility of the Thor Offshore Wind Farm will be limited to days with good weather conditions.

Construction of the Thor Offshore Wind Farm near Vesterhav Nord and Syd will also result in cumulative visual impacts as a consequence of the warning lights. The effect of the lights is given the current data not expected to result in major cumulative effects. This is primarily due to the large distance to the planning area, which means that the lights from the Thor Offshore Wind Farm itself and in combination with either Vesterhav Nord or Vesterhav Syd seen from the coastline can only be expected to be visible in very clear weather a few days a year.

6.13 Onshore

The existing HV station at Idomlund has limited capacity, and planning has to ensure the option of connecting other wind energy projects, including Vesterhav Nord and Thor wind farms, two major solar energy projects in Lemvig, and upgrading of the 400 kV link between Endrup and Idomlund, which continues to Germany. Linking these could lead to cumulative effects.

Because the plan for Thor Offshore Wind Farm does not regulate the alignment of the cables, assessment is based on the assumption that the alignment of the current cables is reused.

Based on the time schedules for constructing the Thor Offshore Wind Farm in relation to Vesterhav Nord, no cumulative impacts are expected related to the construction phase, as Thor will not be built until 2024, when Vesterhav Nord will already be in operation. Assessment of the cumulative effect is therefore limited to the operational phase.

Given the above, the cumulative effects for the onshore development are based on the following projects:

- The Vesterhav Nord offshore wind farm
- Lemvig solar farm project
- The West Coast Line – upgrading the 400 kV overhead lines between Endrup and Idomlund and continuing to Germany.

Vesterhav Nord and upgrading of the 400 kV overhead lines

In addition to Thor Offshore Wind Farm, there are a number of other projects that will raise the need for increasing the capacity of Idomlund HV station. These include the West Coast Line – a new 400 kV link from Idomlund to the German border; the grid connection of Vesterhav Nord Wind Farm and the grid connection of solar farm projects. Overall, these projects will result in an increase in capacity for the Idomlund HV station in quick succession. Grouping cables and technical installations will minimise the footprint, although the area around Idomlund will experience an increased impact due to the high number and large technical installations. It will also mean that landowners in the area could be affected by cables running from Vesterhav Nord, Thor Wind Farm, as well as the upgrade of the overhead power lines in the form of restricted use of certain areas. Holstebro Municipality has drafted an overall municipal plan addendum for the planned station capacity increase.

The Vesterhav Nord offshore wind farm is planned to be linked to the HV station at Idomlund. Capacity increase is therefore planned for the station in order to connect Vesterhav Nord and Thor offshore wind farms. Grouping the underground cables will minimise the

footprint of the technical facility, although the area around Idomlund will experience an increased impact due to the high number of large technical installations. It will also mean that landowners in the area could be affected by the underground cables running from Vesterhav Nord, Thor Offshore Wind Farm with regard to restricted use of certain areas as well as the actual HV stations.

Solar farms

Lemvig Municipality plans to build solar farms with the capacity of 700 MW. Preparations regarding how to receive power from the solar farms also incorporate receiving power from Thor Offshore Wind Farm, resulting in a reduction of the area needed for new connection stations. However, connection of the solar farms will also mean greater density of the technical facilities, leading to bigger local impacts on the landscape and visually. There are no current plans for the facility, although the municipality called for ideas and proposals for the project and upcoming planning in May 2020. Lemvig Municipality's website states that the council on 24 June 2020 agreed that the process for all proposed solar farm areas should continue. No draft plans have yet been submitted for public consultation.

7. ENVIRONMENTAL ASSESSMENT OF OFFSHORE AND ONSHORE DEVELOPMENT

7.1 Air and climate

This section presents an initial assessment of emissions and emission reduction of greenhouse gases (CO₂ equivalents) and air pollutants (including NO_x, SO_x and dust) in connection with a possible Thor Offshore Wind Farm.

Baseline

Denmark was one of the 196 UN member states that adopted the UN's Climate Convention¹⁷ (UNFCCC) in December 2015. This is a set of binding goals under the Paris Agreement¹⁸ designed to keep the global rise in temperature below 2 degrees C in relation to the pre-industrial level, through reduction of total emissions of greenhouse gases¹⁹. This section reports on national and international climate goals and undertakings in connection with reduction of greenhouse gas emissions in Denmark.

Denmark is committed at the EU level to reduce emissions of greenhouse gases, and a number of climate goals have been defined for the period from 2021 to 2030²⁰. Total emissions will be reduced by 40% from 1990 to 2030. In September 2020, the European Commission proposed raising the goal from 40% to 55% reduction in relation to 1990. A bill for implementation is expected in June 2021.

The Danish Parliament passed the Danish Climate Act in 2020 concerning the reduction of greenhouse gases and climate neutrality²¹. The act legally commits Denmark to reduce emissions of greenhouse gases by 2030 by 70% in relation to emissions in 1990, and to achieve the status of a climate-neutral society by 2050.

Environmental assessment

As a whole, the building of offshore wind turbines is expected to have a positive effect on the air and climate, and there are many good arguments for utilising the Danish wind resources for sustainable energy production. Wind energy is therefore regarded as an eco-friendly sustainable energy source, because energy production from wind turbines does not involve the use of fossil fuels such as oil, natural gas or coal. Energy production from wind turbines therefore implies no emissions the atmosphere of greenhouse gas CO₂ or air pollutant components.

The Thor offshore wind farm will contribute to the Climate Act's target of a 70% reduction of CO₂ emissions by 2030. In connection with the Energy Agreement 2018, the Thor offshore wind farm's annual production equivalent to the electricity consumption of approx. 800,000 to 1,000,000 Danish homes is expected to contribute to an overall reduction of 1.8 million tonnes of CO₂ equivalents by 2030, with CO₂ effects from the export of electricity abroad included. However, an assessment performed in 2020 showed that the Thor offshore wind farm will mean a reduction of 15,000 tonnes CO₂ by 2030 in Denmark, as the wind energy element in the Danish electricity system is expected to change. Thor offshore wind farm will not take full effect until a few years before 2030, but will have

¹⁷ UN Framework Convention on Climate Change, adopted 9 May 1992.

¹⁸ The Paris Agreement on climate change was the first generally applicable, legally binding global climate agreement. It was signed on 22 April 2016 and ratified by the EU on 5 October 2016.

¹⁹ Ministry of Climate, Energy and Utilities, the Paris Agreement 2015. <https://kefm.dk/klima-og-vejr/klimaforhandlinger/parisaftalen-2015>

²⁰ The European Commission. 2030 Climate & Energy Framework. https://ec.europa.eu/clima/policies/strategies/2030_en

²¹ Ministry of Climate, Energy and Utilities, Act no. 965 of 26/06/2020. The Climate Act. <https://www.retsinfor-mation.dk/eli/ta/2020/965>

an effect 30 years henceforward, and will therefore have a positive effect in the long-term perspective.

By commissioning the Thor Offshore Wind Farm, it can be expected that the proportion of wind turbine-generated electricity to Danish consumers will be increased. The offshore wind farm will thus help displace electricity produced from fossil energy sources, and the average CO₂ emissions from electricity will decline even further. The long-term effects of the Thor offshore wind farm in the form of lower electricity prices and higher proportion of wind energy on the Danish electricity market will make green electrification of other sectors possible, which will also contribute to reduction of emissions. Overall, the Thor Offshore Wind Farm will contribute to the reduction of Denmark's CO₂ emissions.

The actual construction of an offshore wind farm affects air and climate, as production of materials creates emissions as a result of the use of raw materials and energy. The main emission contribution is expected to come from production of materials and components for wind turbines, foundations and cables. These emissions will arise from the mining of minerals and production expected to take place abroad, and hence not in Denmark. Transportation and construction machinery during the construction phase, along with operation and maintenance cause emissions of greenhouse gases and pollutants, including NO_x, SO_x and dust particles in the air. During the three-year construction period, emissions from construction work (machinery and transportation) are expected on the sites on land and at sea. In addition to emissions of CO₂, local emissions of air pollutants (NO_x, SO_x and dust) will occur during the construction period from construction machinery, ships, etc. in the construction area. Emissions during the construction period will be relatively short-term, spread over a large geographical area and with good conditions for dispersion. Emissions in the construction period will therefore cause minor impact on local air quality during a limited period of approx. 3 years. Direct emissions of greenhouse gases and air pollutants during the operation phase will occur due to the transportation of personnel and equipment, plus the use of equipment for maintenance work. Overall, such emissions are expected to have negligible impact.

Estimates show that offshore wind farms have a 'Carbon and energy payback time' of under 1 year^{22, 23, 24}. 'Payback time' is defined as the time a farm must be in operation before the negative effects of building it are outweighed by the positive effects related to the production of clean energy. What this means in practice is that the offshore wind farm can be expected to produce CO₂-free electricity after 1 year of operation for the rest of its service life of approx. 30 years. The Thor Offshore Wind Farm will thus quickly contribute to climate-friendly electricity production, which is the objective of the plan for Thor Offshore Wind farm.

Mitigation measures and recommendations

As part of the subsequent Environmental Impact Assessment report (EIA), an assessment of emissions of greenhouse gases and air pollutants from the construction and operation of the offshore wind farm should be performed, based on emissions and calculations for the actual project.

²² Ministry of Foreign Affairs of Denmark The Trade Council, Wind Energy FAQs: Carbon and GHG Payback Period, 2020. <https://www.offshorewindadvisory.com/faqs-ghg-payback/>

²³ Alexandra Bonou, Alexis Laurent, Stig I. Olsen, Life cycle assessment of onshore and offshore wind energy – from theory to application, Applied Energy, Volume 180, 2016, Pages 327-337, ISSN 0306-2619, <https://doi.org/10.1016/j.apenergy.2016.07.058>. <http://www.sciencedirect.com/science/article/pii/S0306261916309990>

²⁴ Siemens Gamesa Renewable Energy. (without references). A clean energy solution – from cradle to grave. Environmental Product Declaration. SG 8.0-167 DD. <https://www.siemensgamesa.com/-/media/siemensgamesa/downloads/en/sustainability/environment/siemens-gamesa-environmental-product-declaration-epd-sg-8-0-167.pdf>

Quantification and assessment of greenhouse gas emissions linked to production and transport of materials must be included in the EIA report for construction at sea, as this is expected to comprise a large part of overall emissions.

7.2 Visual impact

This assessment of the combined visual impact of offshore and onshore development only describes the overall impact of the offshore and onshore development, i.e. the scenario in which both the HV station on land and the offshore wind turbines at sea are visible from a point in the landscape. For assessment of the visual impact of the offshore development, refer to report 2, and for onshore development, refer to report 3.

Baseline

Assessment of the visual impact caused by the Thor Offshore Wind Farm combined with the impacts from the constructions onshore is based on the environmental baseline study covering landscape aspects, as described in reports 2 and 3 of the EIA for the constructions offshore and onshore respectively.

The plan for Thor Offshore Wind Farm contains no guidelines for the specific siting of the new high voltage station. It will also be possible within the framework of the plan to site the HV station with sufficient distance from the coast to avoid any visual interaction between the onshore and offshore development, and therefore causing no internal cumulative effect between the two technical facilities. This is e.g. the case with the proposed location of the new HV station at Volder Mark.

It is theoretically also possible to locate the station within such a distance of the coast that both it and the offshore wind turbines themselves can be visible from a given location a few days a year, where the visibility exceeds 19 km. This would require the station to be located in the coastal zone. As it is cf. the Planning Act's provisions, it is not appropriate to locate new technical facilities in the coastal zone; as it is possible to find a suitable location for a new station outside the coastal zone, it is considered unlikely for the station to be located in the coastal zone.

Environmental assessment

At a location of the new high voltage station, so that this and the offshore wind turbines are visible at the same time, there will be an impact on the coastal landscape by virtue of a higher degree of technical facilities. The underground cables are buried and thus not have any impact.

The constructions will result in changing the landscape into a different character as an area with technical facilities, as both the offshore wind turbines and the HV station are significant facilities that will be visible over greater distances.

Locating the new HV station in the coastal landscape will have to consider the coastal location, both with respect to the selection of the specific location, but also in relation to the design of the facility. A coastal location is in this case characterized by a landscape influenced by the coast, both in conditions for nature and land use.

As the facility is not dependent on a coastal location and the coasts continue to be kept free for plants that are not dependent on a coastal location, it is recommended that the high voltage station placed outside the coastal landscape so that this and the offshore wind turbines will not be visible at the same time, thus avoiding the overall visual effect.

Since the construction is not dependent on close proximity to the coast, it is recommended that the HV station is located outside the coastal landscape, so that this and the offshore wind turbines will not be visible at the same time, thus avoiding the overall visual impact.

It is therefore assessed that implementing the plan will not lead to an internal cumulative effect with visibility of both offshore wind turbines and onshore facilities from the same location.

8. ASSESSMENT OF EFFECT ON ENVIRONMENTAL TARGETS

When defining the parameters for the environmental report, environmental protection targets relevant to the plan for Thor Offshore Wind Farm were considered. Environmental protection targets can be set at international, EU and Member State Level.

A review of Table 8-1 the targets not already covered by the rest of the environmental assessment follows, including assessment on how the plan for Thor Offshore Wind Farm takes them into account, along with other environmental considerations.

Table 8-1: Assessment of environmental targets relevant to the plan.

Topic	Targets	Assessment
UN 17 Sustainable Development Goals	<p>Global goals for sustainable development important to physical planning:</p> <ul style="list-style-type: none"> • Target 7: Sustainable energy <ul style="list-style-type: none"> ○ Target 7.2 By 2030, substantially increase the share of renewable energy in the global energy mix • Target 13: Combat climate change <ul style="list-style-type: none"> ○ Target 13.2 Integrate climate change measures into national policies, strategies and planning 	<p>The plan for Thor Offshore Wind Farm will have a positive impact on combating climate change as the production of electricity from the wind farm is expected to replace that which is produced conventionally using fossil fuels.</p> <p>The Thor Offshore Wind Farm will thus help displace electricity produced from fossil energy sources, and the average CO₂ emissions from electricity will decline even further.</p> <p>These factors will generally contribute to the targets and targets above.</p>
Denmark's Climate Act 2019	Reduction of greenhouse gases (70%) by 2030. Climate neutrality by 2050.	The plan will contribute to the goal of reducing greenhouse gases and climate targets.
The Energy Agreement 2018	<p>At least three offshore wind farms totalling minimum 2400 MW are planned to be built by 2030. Energy from offshore wind turbines will contribute to 55% of Denmark's energy requirements being covered by sustainable energy by 2030.</p> <p>Decision to put the Thor Offshore Wind Farm of approx. 800 MW for connection to the grid by 2024-2027 out to tender.</p>	The plan for Thor Offshore Wind Farm complies with the Energy Agreement
Water Framework Directive (2000/60/EC) with national water management plans	The Danish water management plans describe how Denmark will reach the target of good ecological status for Danish water-courses, coastal waters, lakes and groundwater in accordance with the EU's Water Framework Directive.	The plan is not expected to influence the chances of target fulfilment for water management plan for the area.
The Marine Spatial Plan is expected to come into effect in 2021	It will define which marine areas in Danish territorial waters can contribute to sustainable development of the energy sector at sea, maritime transport, fisheries and aquaculture, the extraction of minerals from the sea and the conservation, protection and improvement of the environment, including resistance to the consequences of climate change.	The plan for Thor Offshore Wind Farm is expected to be part of the Marine Spatial Plan.

Topic	Targets	Assessment
<p>The Habitats Directive (92/43/EEC) with national Natura 2000 plans and special protection of species (Annex IV)</p>	<p>The Habitats Directive obliges EU Member States to conserve certain habitat types and species that are characteristic, rare or threatened in the EU. The Directive provides the benchmark for habitat areas designated to conserve and restore a beneficial conservation status for certain habitat types and species of flora and fauna. The habitat and bird protection areas jointly comprise the Natura 2000 areas, a network of protected habitats in the EU.</p> <p>Annex IV species are those listed in Annex IV of the EU's Habitat Directive, and that also require special protection outside Natura 2000 areas. Cetaceans are listed in Annex IV for Danish territorial waters.</p>	<p>The plan for Thor Offshore Wind Farm does not affect Natura 2000 areas, nor the possibility of creating and achieving beneficial conservation status of habitat areas.</p> <p>The plan for Thor Wind Farm does not imply any impact on Annex IV species, i.e. porpoises, as the ecological functions of breeding and feeding areas will not be affected.</p>
<p>The Birds Directive (2009/147/EC) with national Natura 2000 plans, general conservation of wild birds</p>	<p>The Birds Directive obliges EU Member States to designate and protect habitats for wild birds, referred to as 'bird protection areas'.</p> <p>The habitats and bird protection areas jointly comprise the Natura 2000 areas, a network of protected habitats in the EU.</p>	<p>There are no nearby bird protection areas that the plan for Thor Offshore Wind Farm could potentially affect.</p>
<p>The Danish Energy Agency's guidelines for underwater noise (expected revision in 2021)</p>	<p>Activities that cause impulse sound in the marine environment, and assessed to cause a negative impact, must be performed with relevant mitigating measures or restricted to periods of the year or geographical areas when potential damage to marine organisms will be limited.</p>	<p>In connection with framing of monopiles and other very noisy activities, noise-reducing mitigation measures shall be deployed, e.g. bubble curtains, pingers, seal scarers and soft-start/ramp-up before work begins. Such measures will significantly reduce the impact on marine mammals, a conclusion based on existing guidelines).</p>
<p>Denmark's Maritime Strategy II</p>	<p>The first part of Denmark's Maritime Strategy II has been published. The strategy was developed for implementation of the EU's Maritime Strategy Directive to maintain or achieve good environmental status in Danish maritime areas.</p> <p>The crux of the strategy is 11 different themes: 1) Biodiversity, 2) Non-indigenous species, 3) Population of commercial fish species, 4) Elements of food webs, 5) Eutrophication, 6) The sea floor, 7) Hydrographic alterations, 8) Contaminants, 9) Contaminants in seafood, 10) Marine litter and 11) Underwater noise.</p>	<p>The plan for Thor Offshore Wind Farm is not expected to influence goal fulfilment for the Maritime Strategy, see under the Water Framework Directive.</p>

9. MISSING KNOWLEDGE AND POSSIBLE UNCERTAINTIES

It is assessed that no elements are missing in terms of being able to assess the plan for Thor Offshore Wind Farm at the level of details stipulated by the plan, which therefore also constitutes a baseline for an environmental assessment of the plan, according to Section 12 (2) of the Environmental Assessment Act.

10. MITIGATION MEASURES, RECOMMENDATIONS AND MONITORING

According to Annex 4, item g of the Danish Environmental Impact Assessment Act, an EIA should describe measures planned to prevent, limit and, as much as possible, offset any significant negative impact on the environment from implementing the plan.

According to Section 12 (4) of the Environmental Assessment Act, an authority must monitor the significant environmental impacts of implementation of the plan or programme.

Environmental Assessment of the plan for Thor Offshore Wind Farm shows that at the strategic level at which this environment assessment was performed, corresponding to the level for the plan for Thor Wind Farm, there are no environmental impacts of significance to require special monitoring. No monitoring programme will therefore be implemented as a result of the plan for Thor Offshore Wind Farm.

Sections 10.1, 10.2 with regards to offshore and onshore aspects, plus section 10.3 offshore and onshore development, describe mitigation measures and recommendations for subsequent adjustment of the project and related environmental impact assessment to avoid significant impact caused by the plan.

10.1 Offshore

The following mitigation measures and recommendations can be deployed in connection with the actual offshore project to reduce any impact as a result of implementing the plan:

Table 10-1 List of mitigation measures and recommendations - offshore

Topic	Mitigation measure/Recommendation
Landscape and visual impacts	<ul style="list-style-type: none"> • The visual impact can be reduced by locating the wind turbines in the western part of the wind farm area, ensuring greater distance to the coast and a lesser distribution north-south direction. • To reduce the effects of their lights, the turbines can be placed in the western part of the area, at maximum distance from the coast. Discussions can be opened with the Transport, Building and Housing Authority and other relevant authorities concerning requirements on warning lights.
Marine archaeology	<ul style="list-style-type: none"> • In connection with continuing EIA studies, ways of limiting the total area for subsea cables in the corridors can be looked at with regard to minimising possible impact on archaeological sites. • When the final project for the Thor Offshore Wind Farm is available, the Palaces and Culture Agency will decide whether conditions should be applied on marine archaeological surveys in the four areas with possible late Maglemose culture settlements.
Marine infrastructure	<ul style="list-style-type: none"> • Mitigation measures are not expected to be needed.
Radio chains and radar systems	<ul style="list-style-type: none"> • The offshore wind farm's layout will be designed to disrupt radar coverage as little as possible. • The possible installation of 'gap fill' radars could cover any areas that are affected. • Possible upgrading/reconfiguration of radar systems to improve close monitoring of wind turbines. Danish Defence has stated

Topic	Mitigation measure/Recommendation
	<p>that monitoring of very low-flying aircraft can be difficult despite upgrading/reconfiguration of e.g. Scanter 4000.</p> <ul style="list-style-type: none"> • It is thus necessary to determine the locations and heights of the turbines, their number and distances between them before a specific assessment can be made of their potential impact on radar systems and the mitigation measures to be taken. • It will be necessary to involve Danish Defence in the consideration of mitigation measures. • Studies already started according to Eurocontrol guidelines will be included with the environmental impact assessments of the actual project.
Raw materials and mineral resource	<ul style="list-style-type: none"> • It is recommended to clarify whether part of the wind farm area could be suitable as a mineral resource. • Any impact on the chances of exploiting in the potential common area 7321-00258 (and others) can be mitigated by limiting the total area including protection zones for cables in the two cable corridors when concluding the project. • Any impact on possible mineral deposits in the southern part of the wind farm area can be mitigated by siting the wind farm to ensure they can be accessed for future exploitation.
Fisheries	<ul style="list-style-type: none"> • As part of the subsequent Environment Impact Assessment report (EIA) obtaining VMS data for the last 10-year period is recommended, and analysing fishing for the various types of commercial fishing: bottom trawl, pelagic trawl and net fishing. Economic impact should also be analysed. • In connection with the further EIA studies, ways of limiting the total area for cables in the corridors can be looked at with regard to minimising possible impact on fisheries here.
Noise	<ul style="list-style-type: none"> • A subsequent EIA should include more detailed assessment of noise from construction works based on specific calculations of noise that could reach homes on land. That assessment could be based on guidelines on noise from construction work laid down by the municipalities on land, or generally accepted criteria for noise from construction work. • For the operational phase specific noise calculations should be carried out for the expected wind turbines. The calculations must document that the limit values for noise from wind turbines can be complied with. These calculations must include noise from existing wind turbines offshore and onshore, as noise contribution from existing wind turbines may have reached the limit values to such an extent that there is no margin for even a small noise contribution from Thor Offshore Wind Farm at some residents.
Shipping and navigational risks	<ul style="list-style-type: none"> • The provisional hazard identification and risk assessment will be used as baseline for the next phases of building the Thor Wind Farm. Furthermore, it is expected that users of the water are consulted again, with detailed hazard identification and updated risk assessment when more detail is added to the project during the EIA process.

Topic	Mitigation measure/Recommendation
Air traffic safety	<ul style="list-style-type: none"> • The project must respect warning rules in the construction and operational phases according to applicable procedures. • The aviation authorities and Danish Defence must be consulted as part of the process.
Marine flora and fauna	<ul style="list-style-type: none"> • When selecting areas for wind turbine foundations and cable-laying, areas north-northeast and south with stone reefs and pebbled seabed with kelp forest must be avoided as much as possible, as stone reefs are less common than sandy seabed, and are home to more species, including long-living species. • Limiting the total area for cables in the corridors with regards to minimising the possible impact of sediment spill and length of the construction period could be considered.
Marine mammals and Annex IV species	<ul style="list-style-type: none"> • In connection with detailed planning of the Thor Offshore Wind Farm, we recommend including mitigating measures for ramming (pile driving) monopiles and other very noisy activities to prevent significant effects on marine mammals. Apart from the expected requirements from the authorities on the use of soft-start/ramp-up before work begins, noise-reducing mitigation measures can be bubble curtains, pingers and seal scarers.
Birds	<ul style="list-style-type: none"> • Placing the offshore wind turbines further to the west in the wind farm area may minimise the impact on divers and possibly also on auks. • The turbines can run in north-south lines, reducing the risk of collision for possible migratory birds. • The risk of collision can be reduced in line with a reduction in the overall area of the wind farm. • The future EIA will have to include more details calculations/assessments of collision risk for staging birds, including auks, black-legged kittiwake and northern gannets based on available data, including whether species such as northern gannets could be at more risk of collision with offshore wind turbines in stormy conditions.
Seabed and water quality	<ul style="list-style-type: none"> • Retaining areas north-northeast and south with stone reefs when building offshore wind turbines and cable corridors is recommended.
Hydrography and water quality	<ul style="list-style-type: none"> • The risk of sediment spill in the water column with concentrations over 10 mg/l past the estuary of targeted watercourses with migrating fish during construction phase of cable corridors must be studied. The period of high sediment concentrations cannot seriously affect the window fish have for migration. Mitigating measures can include the construction work being done outside migration period for such species, usually in the spring.

In the process with Thor Offshore Wind Farm, including the subsequent environmental impact assessment, there may be a further clarification of the need for mitigation measures, as there will be greater knowledge of the project.

10.2 Onshore

The following mitigation measures and recommendations can be deployed in connection with the actual project onshore to reduce any impact as a result of implementing the plan:

Table 10-2 List of mitigation measures and recommendations – on shore.

Topic	Mitigation measure/recommendation
Landscape and visual conditions	<ul style="list-style-type: none"> • A shielding planting around HV stations to limit the visual and landscape impact. Terrain modelling could also be performed, or soil embankments raised to screen the construction as much as possible. • The HV station should be sited away from the coastal zone, as it is not dependent on a location close to the coast.
Cultural and archaeological heritage	<ul style="list-style-type: none"> • The underground cable should be routed outside the protected Idomlund Gravhøj and the Storå and Idom Å. • Before excavation starts, archival research should be conducted, and the opinion of Holstebro Museum obtained.
Noise	<ul style="list-style-type: none"> • Adaptation of the final project to minimise noise impact from the project, e.g. using mitigation measures such as planting or other noise shielding around the HV station.
Flora and fauna	<ul style="list-style-type: none"> • In determining the specific project area, affect to protected nature areas (§3) must as far as possible be avoided • Protected nature and protected water streams must in principle be crossed by horizontal directional drilling (HDD) if impact with the underground cables cannot be avoided.
Natura 2000	<ul style="list-style-type: none"> • The cables will be routed outside Natura 2000 areas • Watercourses must be horizontally drilled where these have an outlet to Natura 2000 area no. 64 <i>Nissum Fjord</i>. Alternatively, sediment spill to downstream recipients in Nissum Fjord must be prevented.
Annex IV species	<ul style="list-style-type: none"> • Every attempt must be made to restrict construction activities in the meadows by Flynder Å near Bækmarksbro outside the breeding period for white stork. • Trees suitable for bats should not be felled whenever it can be avoided. If the felling of trees suitable for bats cannot be avoided, they must be felled when the bats are not in residence (September-October). • Construction activities in the areas for moor frog (<i>Rana arvalis</i>), natterjack toad (<i>Epidalea calamita</i>), northern crested newt (<i>Tritus cristatus</i>) and sand lizard (<i>Lacerta agilis</i>) must avoid their breeding seasons and amphibian fences must be erected. • When crossing watercourses, inspections must ensure that the underground cable route is outside areas where beavers are resident and construction activities must avoid the beaver-breeding season. • When crossing water streams, inspection must ensure that the cable route avoids otter breeding grounds.

Topic	Mitigation measure/recommendation
Surface water	<ul style="list-style-type: none"> The project should adapt so that significant impacts from spillage of drilling mud and blowout can be avoided and good ecological condition for lakes and streams can be met.
Material assets	<ul style="list-style-type: none"> The underground cables should maintain a distance from urban zones to allow for further development.

10.3 Offshore and onshore development

The following mitigation measures and recommendations can be deployed in connection with the actual project onshore and offshore to reduce any impact as a result of the plan:

Table 10-3 List of mitigation measures and recommendations – offshore and onshore development.

Topic	Mitigation measure/recommendation
Air and climate	<ul style="list-style-type: none"> As part of the subsequent Environmental Impact Assessment report (EIA), an assessment of emissions of greenhouse gases and air pollutants from the construction and operation of the wind farm should be performed, based on emissions and calculations for the actual project. Quantification and assessment of greenhouse gas emissions linked to production of materials ought to be included in the EIA, as this is expected to comprise a large part of overall emissions.