Miljøministeriet
Naturstyrelsen

ENERGI STYRELSEN

Vesterhav Syd Offshore Wind Farm

Environmental Statement

Part 0: Non-Technical Summary

April 2015

Miljøministeriet
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What is EIA?

EIA is an acronym for Environmental Impact Assessment.

The regulations for environmental impact assessments are intended to ensure that power production facilities at sea, which may be assumed to substantially impact the environment, can only be erected following a so-called Environmental Statement (ES). The goal of producing an ES is to provide the best possible foundation for both public debate and the final decision to implement the project. In the ES the direct and indirect impacts of the project on the environment are investigated, described, and assessed. This includes impacts on:

- People, animal and plant life
- Soil, water, air, climate, and landscape
- Material goods and cultural heritage
- The synergy between these factors

The ES is published and provides basis for public debate. Based on the ES and the comments received during the public hearing The Danish Energy Agency (Energistyrelsen) evaluates whether the project is accepted with the described environmental impact and makes the final decision on the project's implementation.

The ES is published alongside an appendix to the municipal plan, which sets forth guidelines and/or framework for the future municipal development planning as it pertains to the project.

The appendix to the municipal plan is also subject to an environmental assessment in accordance with the 'Bekendtgørelse af lov om miljøvurdering af planer og programmer'.

The two environmental assessments have been carried out as an integrated report. Below, the combined Environmental Statement and Environmental Report will be referred to as the 'ES '.

Read more about environmental impact assessments and ES at:

http://naturstyrelsen.dk/planlaegning/miljoevurdering-og-vvm/

Based om the ES and the comments received during the public hearing the EIA authorities (the Danish Energy Agency, Energistyrelsen and the Danish Nature Agency, Naturstyrelsen) evaluate whether the facility is acceptable with the described environmental impact.

Table of Contents

Part 0 Non-Technical Summary

This Environmental Statement for Vesterhav Syd Offshore Wind Farm consists of five parts:

- Part 0: Non-Technical Summary
- Part 1: Introduction and Background
- Part 2: The Marine Environment
- Part 3: The Onshore Environment
- Part 4: Summary and Conclusion.

This report, the 'Non-Technical Summary', is Part 0 of the Environmental Statement for Vesterhav Syd Offshore Wind Farm. For additional details about the structure of the report in its entirety, please refer to the readers guide in Part 1 of the Environmental Statement: Introduction and Background.

Offshore Wind Farm (Photo: Energinet.dk).

1 Introduction

Like many other countries, Denmark has a significant energy policy challenge in terms of securing energy supply, while helping to reduce global warming by reducing emissions of greenhouse gasses.

To meet the challenge, on March 22, 2012, a broad political majority in the Danish parliament, Folketinget, passed an Energy Policy Agreement for the period 2012-2020.

The goal is that Denmark's entire energy supply (power, gas, heating) and transportation will be based on sustainable energy in 2050. The energy policy agreement will ensure that wind power will produce 50 percent of the total Danish power demand by 2020. As part of the implementation of the energy policy agreement, it was decided that 450 MW of nearshore offshore wind turbines divided into 6 wind farm areas must be erected before 2020.

On July 14 2014 a large majority of the parties in Folketinget joined the government in a growth package agreement. As a result, the call for tenders for nearshore wind turbines was reduced from 450 MW to 350.
The analyses and research, which forms the basis of this Environmental Statement, are based on the intention to establish a total of 450 MW nearshore wind turbines. Subsequently, it has been assessed that this reduction will not affect the assessments and conclusions of this Environmental Statement, because the goal of establishing a 50 MW offshore wind farm in the area covered in this Environmental Statement remains unchanged.

In November 2012 the government and the parties to the agreement decided that research and calls for tender for erecting nearshore wind farms as well as planning for cable landfall and necessary improvements to the power grid on land must be completed for six areas for nearshore wind farms. The six areas are: Vesterhav Syd, Vesterhav Nord, Sæby, Sejerø Bugt, Smålandsfarvandet and Bornholm. In each area a maximum of 200 MW offshore wind turbines may be erected, however, in the Bornholm area, the maximum is 50 MW. The locations of the areas are shown on Figure 1-1.

The call for tender for all six areas will be issued by the Danish Energy Agency (Energistyrelsen) and bids received for all areas will compete against each other. The expectation is not to establish offshore wind farms erected to the maximum capacity allowed in all six areas, since only a total of 350 MW will be awarded.

In order to strengthen local ownership, the parties to the energy policy agreement have decided that the option-to-purchase agreement, which is in force for wind turbines onshore, will also be in force for nearshore wind turbines. The option-to-purchase agreement allows local citizens to by equity shares in a future wind turbine project thus owning a part of any future profits. The offshore wind farm developer is required to offer at least 20 % of the project for sale to local citizens.

Figure 1-1. Locations of the six nearshore wind turbine project areas.

In addition, the Danish Loss of Value to Residential Properties Program (Værditabsordningen) also covers the nearshore wind turbines. This program allows for claims for compensation for loss of value on residential properties resulting from the erection of wind turbines. The amount of the loss is determined by the Valuation Authority (Taksationsmyndigheden) based on an individual assessment.

In order to establish the offshore wind farms permits are required which are dependent on completing so-called environmental impact assessments, including completing any necessary pre-investigation to form the basis of the environmental impact assessments.

The Danish Energy Agency (Energistyrelsen) is the permitting EIA Authority and coordinates the government processing of the project. The Danish Energy Agency will grant the actual construction license for the offshore wind farm including the inter array cables and the submarine cables which deliver the power to shore and to the Danish power grid.

In January 2013, Energinet.dk, the Danish Transmission System Operator (TSO) was instructed by the Minister of Climate, Energy and Building to manage the preparation of Environmental Statements for the six nearshore wind farms preceding the issuance of calls for tender for construction and operation of the nearshore wind farms. Energinet.dk is an independent public company owned by the Danish Minister of Climate, Energy and Building and with its own board of direc-

tors. Energinet.dk owns, operates and expands the main power grid, which serves as the energy 'motorway'.

The environmental impact assessment was begun in January 2014 by issuing a call for ideas and suggestions from the public. Subsequently, input received from the public and the results of preliminary investigations have been processed and this Environmental Statement presents the overall assessment.

2 Vesterhav Syd Offshore Wind Farm

The framework for the investigation of the project was given in the instructions from the Climate, Energy, and Building Ministry, and accordingly 200 MW has been investigated as the maximum production for Vesterhav Syd Offshore Wind Farm. The offshore wind farm must deliver this production no later than 2020.

The investigated area for Vesterhav Syd Offshore Wind Farm is shown in Figure 2-1. The area is located at a distance of no less than 4 km from the coast between Hvide Sande and Søndervig.

Vesterhav Syd Offshore Wind Farm will be placed inside an investigated area measuring approximately 60 km². In the investigated area, an area measuring a maximum of 44 km² will be used to erect the offshore wind farm, if a 200 MW wind farm is erected. If a wind farm of less than 200 MW is erected, the area permitted for erecting offshore wind turbines will be reduced proportionally, so that e.g. a 100 MW wind farm would be permitted to use a maximum area of 22 km² in the investigated area.

The power that is produced by the wind turbines will be delivered by submarine cables to shore and connected to the Danish power grid.

The export cables will be routed to shore either from the northern part of the offshore wind farm to the coast south of Klegod and/or from the southern part of the offshore wind farm to the coast south of Tyvmose (see Figure 2-1).

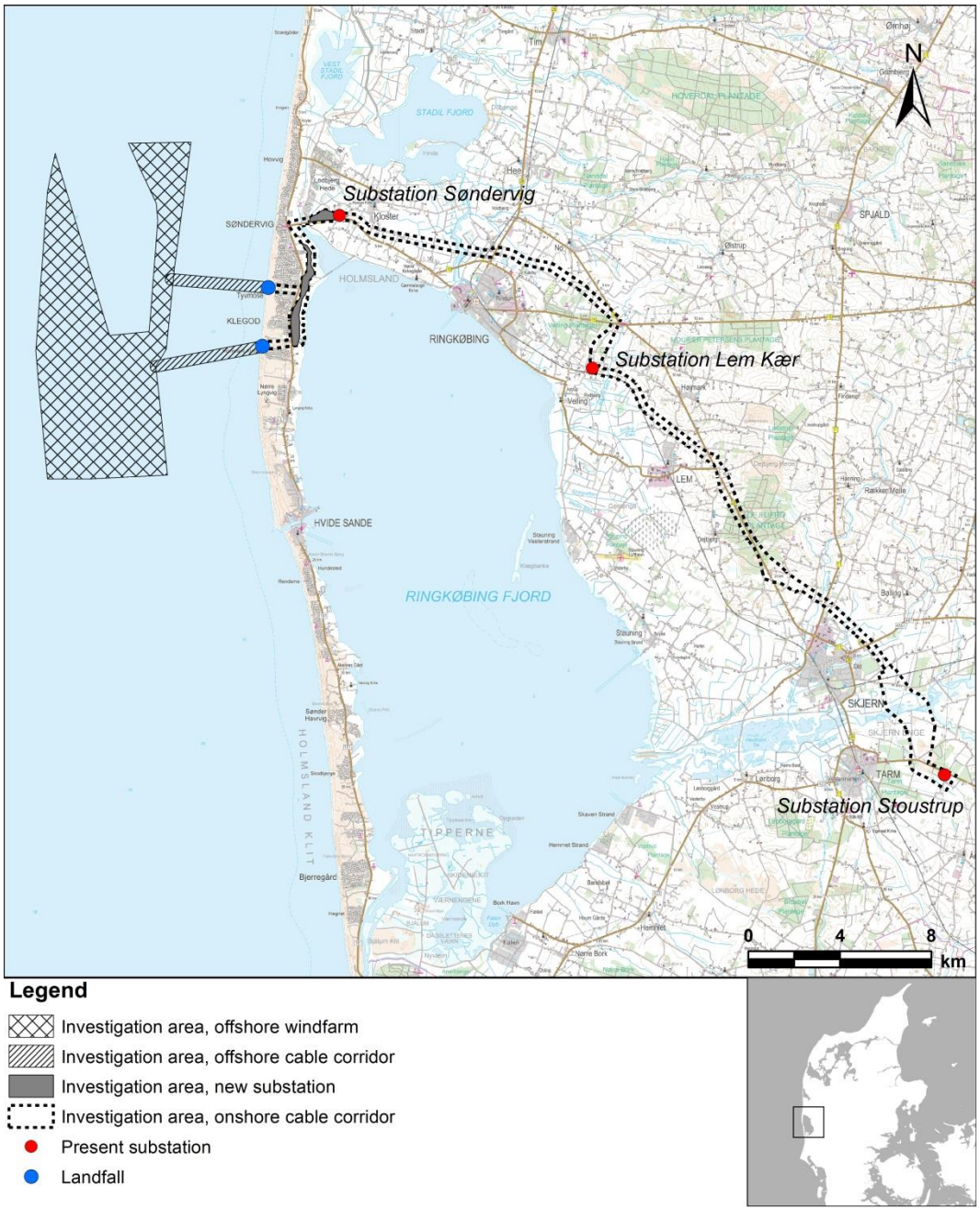

Figure 2-1. Investigated area for Vesterhav Syd Offshore Wind Farm.

The design of the offshore wind farm is not finalized, but will be decided by the future owner and developer of the offshore wind farm.

Construction of the array cable to shore which will ensure transportation of the power produced to the existing power grid onshore.

Figure 2-2. Main elements of the project, which are covered in the environmental impact assessment. (Photos: Energinet.dk).

2.1 Design of the Offshore Wind Farm

The future owner and developer of the offshore wind farm will be responsible for construction of the offshore wind farm. Accordingly, the design, wind turbine type, and foundation type will be determined by the future owner and developer while taking into account the energy utilization in the area and the requirements of the Danish authorities among other things. Therefore, the final decisions regarding the size of the offshore wind farm (the maximum power production) and the number and type of wind turbines will depend on who is awarded the Danish Power Agency's EU-tender, which will be decided in 2016.

Accordingly at this time it is not known, which type or size of wind turbine will be erected. One option is to erect many small turbines (e.g. up to 66 3MW wind turbines). Alternatively, fewer larger wind turbines (e.g. 20 10 MW wind turbines) could be used. Finally, wind turbines between those two sizes could be used.

Table 2-1. Overview of wind turbine sizes (examples in the interval from 3 to 10 MW).

Wind Turbine Type, MW	Number of Offshore Wind Turbines	Rotor Diameter, m	Total Wind Turbine Height, m
3	66	112	137
6	33	154	179
10	20	190	220

Regardless of the size and design of the offshore wind turbines, the area required by the offshore wind farm will be approximately the same, since larger wind turbines will require more space between the wind turbines than smaller wind turbines.

The offshore wind turbines consist of a round tower, with a rotor and a nacelle at the top. Three rotor blades are attached to the rotor, and the nacelle contains a generator and a gear box, among other things.

The wind turbines begin producing power in light winds (3-5m/s). Maximum power production is reached in strong winds (12-14 m/s). To protect the wind turbine from overload, the wind turbine stops when the wind speed reaches gale force (24-25 m/s).

Examples of possible site layouts for 3 MW, 6 MW and 10 MW offshore wind turbines respectively are shown in Figure 2-3.

These site layouts illustrate the maximum area usage in the area which is being investigated for erection of offshore wind turbines in this environmental impact assessment.

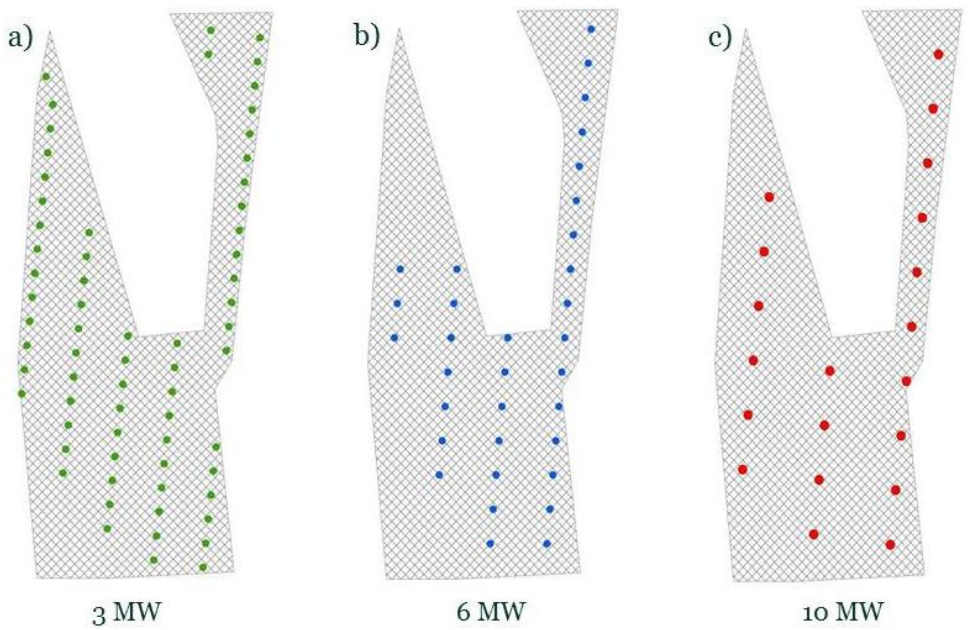

Figure 2-3. Examples of site layouts using 66 wind turbines of3 MW, 33 wind turbines of 6 MW, and 20 wind turbines of 10 MW respectively.

2.2 Construction of Offshore Wind Turbines and Cable array

The wind turbine towers must be fastened to foundations on the seabed. Several types of foundations may be used and require different construction methods.

It is expected that the foundations used for the Vesterhav Syd Offshore Wind Farm will be of one of the following types:

- A *monopile foundation* which is mainly a tube of steel which is driven into the seabed.
- A *gravity foundation* made of concrete and stays in place on the seabed due to the weight of the structure.
- A *jacket foundation* is a three or four legged steel structure which is typically used for large offshore wind turbines and deep waters.
- A *suction bucket foundation* consists of an upside down bucket-like structure which is attached to the seabed using a vacuum.

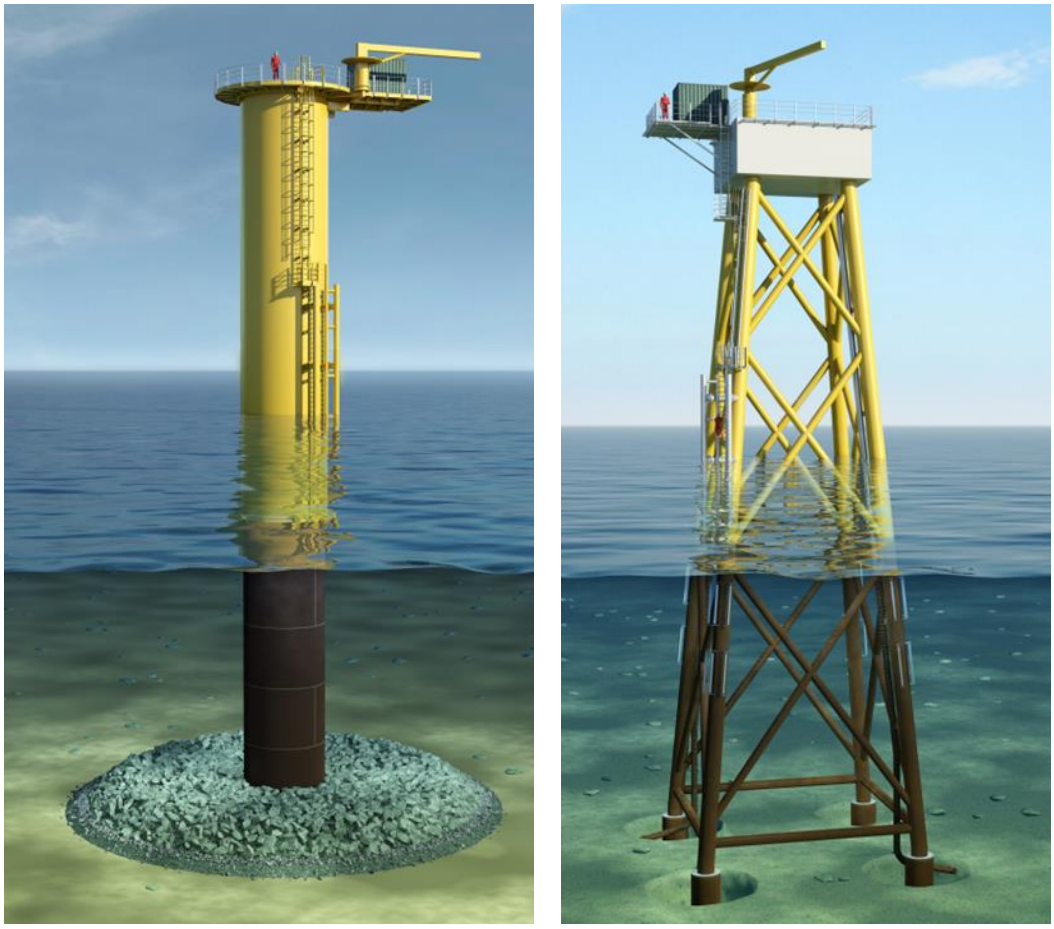

Figure 2-4. Monopile of steel (left). Monopiles have been utilized for a large number of offshore wind farms, including offshore wind farm Horns Rev 1, offshore wind farm Horns Rev 2 and Anholt Offshore Wind Farm (Drawing: Rambøll). Jacket foundations (right) have not been used in Danish offshore wind farm construction, but have been used by British offshore wind farms, among others (Drawing: Rambøll).

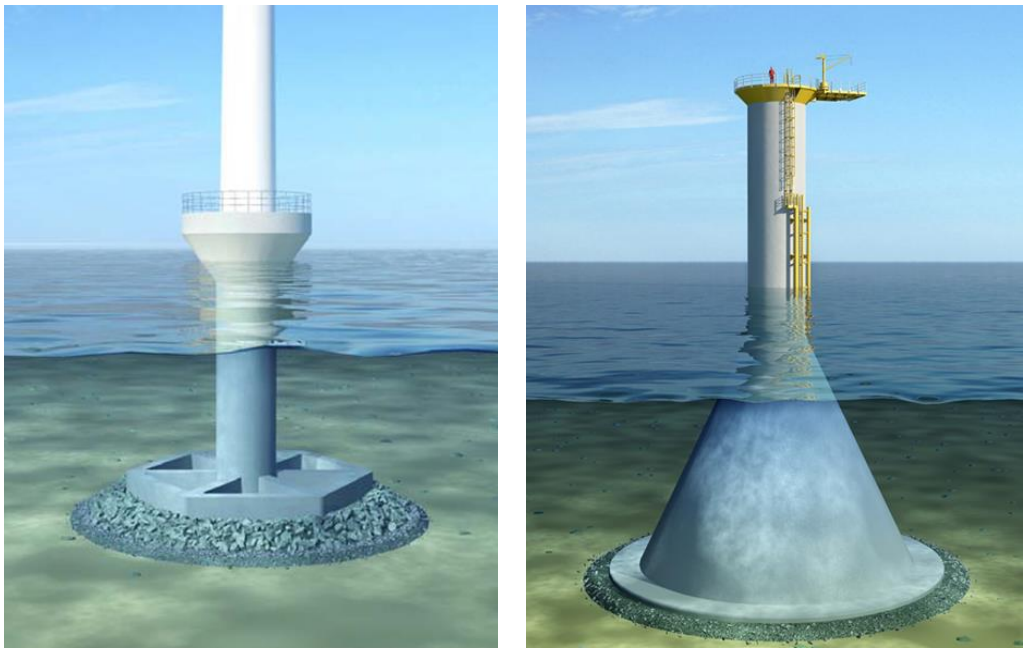

Figure 2-5. Gravity foundations have been used by a number of Danish offshore wind farms, including Middelgrunden, Nysted Offshore Wind Farm, Rødsand II and Sprogø Offshore Wind Farm. The figure shows principle sketches of two different types of gravity foundations with erosion control made of rocks (Drawing: Rambøll).

Offshore wind turbine installation is typically carried out by one or more installation vessels. The wind turbine components are either transported from the port of discharge on barges or on the installation vessel itself. The large wind turbine components (tower, nacelle including rotor hub and 3 rotor blades) are lifted into place one at a time using a crane on board the installation vessel. The installation is supported by a number of smaller supporting vessels carrying equipment and personnel.

Around the wind turbine foundations there is a risk that the ocean current will remove sediment from the seabed and leave large holes. To prevent this erosion a protective layer of rocks is placed around the foundations. The design of the erosion control depends upon the type of foundation.

The offshore wind turbines are connected by cables and subsequently to the coastal cable station. All submarine cables will be buried in the seabed to prevent damage by fishing equipment, dragging anchors, etc.

Depending upon the seabed conditions the array cables will be jetted or ploughed into the seabed or laid in a prepared trench at a depth of 1-1.5 m below the seabed, depending on the method used. It may be necessary to cover the cables with rocks if the seabed conditions prevent laying the cables at the desired depth.

Figure 2-6. The use of suction bucket foundations is relatively recent. In Denmark this type of foundation has been used for the measuring mast at Offshore Wind Farm Horns Rev 2 and for a test wind turbine near Frederikshavn. Typically this type of foundation functions like a combination of a gravity foundation and a monopile foundation. (Photo: Aalborg University/Scanpix).

2.3 Decommissioning the Offshore Wind Farm

The lifespan of the offshore wind farm is estimated to be up to 30 years. A plan for removing the offshore wind farm is expected to be made two years before the end of the lifespan of the offshore wind turbines. The extent of the decommissioning is not known at this time but would be expected to include the following:

- Offshore wind turbines are removed completely.
- Foundations are removed wholly or partially to the level of the seabed.
- The inter array cables, which connect the wind turbines, are removed or left below the seabed and protected with a layer of rocks.
- Array cables between the offshore wind farm and the coast are left below the seabed level or protected with a layer of rocks.
- Erosion control rock layers surrounding wind turbine foundations are left in place on the seabed.

In the case of the foundations, it is likely that monopile and jacket foundations will be cut just below the seabed. Gravity foundations may possibly be left stand-

ing, since they may have acquired an important function as artificial reefs with rich plant and animal life during the operational phase. If the foundations are left on the seabed after decommissioning the offshore wind turbines they may present a risk to navigation or fishing. For this reason, government demands to ensure safe navigation in the area are to be expected. Suction bucket foundations can be removed immediately by increasing the pressure inside the bucket.

2.4 Investigated Alternatives

This Environmental Statement for Vesterhav Syd Offshore Wind Farm only covers the main proposal and the 0-alternative, which is the situation in which the offshore wind farm is not developed. Vesterhav Syd Offshore Wind Farm is located in one of the six total areas which were chosen for investigation and tender for nearshore wind farms and planning for landfall and onshore facilities according to the 2012 energy policy agreement.

Accordingly, the location and delineation of the investigated area for the offshore wind farm was decided politically. Based on this, no additional alternative locations beyond the six areas chosen by the political parties to the energy policy agreement will be assessed.

2.5 Time Table

Since the developer has not been chosen yet, a detailed time table for the project is currently unknown. The developer is expected to be chosen at the beginning of 2016 and immediately following that the planning will begin. Vesterhav Syd Offshore Wind Farm is expected to be ready and operational by 2020 at the latest. Construction of the offshore wind farm and the associated onshore facilities will be completed over a period of approximately two years. Figure 2-7 shows the overall time table for the project.

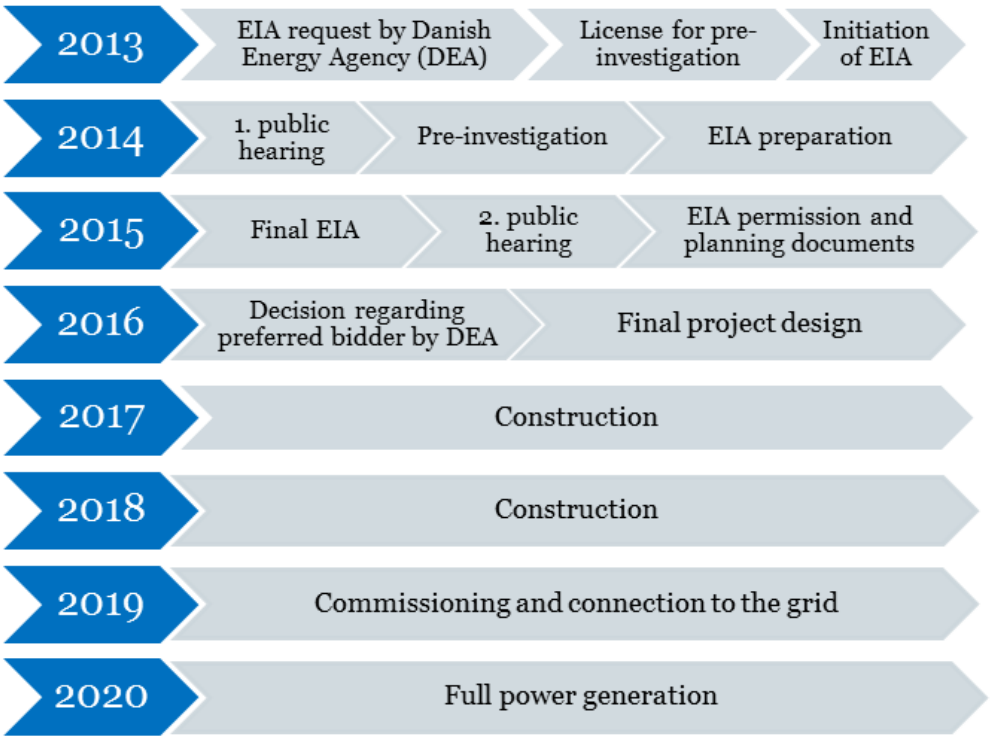

Figure 2-7. Overall time table for the expected project sequence.

2.6 Environmental Impacts and the Environmental Impact Assessment as a Worst Case Scenario

The design of Vesterhav Syd Offshore Wind Farm is not yet firm, and the choice of wind turbine type also remains to be made, since a defined construction project will not be available, until the future owner and developer receives a construction license.

Accordingly, this Environmental Statement has been completed, based on a worst case scenario, meaning that assessments were made assuming the worst possible impacts within the technical limits of the project. Included in the environmental impact assessments are the impacts of a variety of site layouts, wind turbine types, foundations, and construction methods for the offshore wind farm.

The purpose of investigating a number of differing project designs is to assess environmental impacts and requirements for construction of the final project. The future owner and developer of the offshore wind farm will choose the design of the offshore wind farm including choice of wind turbine size, type of foundation, etc. and may also choose to erect an offshore wind farm with a production of less than 50 MW.

Design and construction solutions which result in environmental impacts exceeding those described in this Environmental Statement are not permitted, as this assessment is considered the 'greatest impact assumed' – also known as 'worst case'.

3 Landscape and Visual Impacts

The coastal landscape surrounding the investigated area for Vesterhav Syd Offshore Wind Farm is described following the principles of a Danish method for describing landscapes which is called the 'Landscape Character Method' (Landskabskaraktermetoden). The description includes the existing landscape and cultural heritage conditions and the spatial and visual conditions, vulnerabilities, and character of each individual area. In order to assess the visual impact of the offshore wind farm the description is supplemented with visualizations of the offshore wind farm from several points on the coast, from areas with summer cottages, and from the area around Ringkøbing Fjord among others. The visualizations have been completed showing clear weather, overcast/foggy weather, and finally night time darkness.

3.1 Landscape, Cultural Heritage and Visual Conditions

The Danish landscape shows clear evidence of how Denmark has developed geologically over time. The landscape surrounding Ringkøbing Fjord, Stadil Fjord, and West Stadil Fjord in particular and its relation to the West Coast showcases an important story of both the creation of the landscape and also how the coast profile is constantly changing and how all of this is characteristic of large areas along the West Coast. From a national geological perspective, this makes the area one of the most highly valued national coastal landscapes.

There are several conservation areas in the onshore areas close to Vesterhav Syd Offshore Wind Farm. The conservation areas which relate to the large dunes and dune heaths along the West coast and their relationships with the adjacent fjords of western Jutland are the most relevant to this assessment as it relates to developing offshore wind farm. In particular, the conservation area(s?) at Husby Klit and West Stadil Fjord are intended to conserve and showcase the overall geological and cultural histories as presented by the relationships between the dunes and the fjords. To a somewhat smaller extent this is also the case for the area surrounding Nørre Lyngvig Lighthouse by Nørre Lyngvig.

For these reasons, the investigated area for the landscape impacts of the offshore wind turbines includes these landscapes inside a radius of approximately 15 km surrounding the offshore wind farm. The assessment particularly focuses on assessing the degree of impact upon the especially characteristic and experientially significant landscapes by the proposed nearshore wind turbines.

Parts of the investigated area for onshore facilities are also located in these particularly highly valued and vulnerable landscapes, and this includes the investi-

gated areas for substations along the coast, while large parts of the investigated area for the cable trace are in farm land areas.

Figure 3-1. View of the dune heath south of Vester Husby in the most northern part of the investigated area. Here individual summer cottages are highly adapted to the landscape.

3.1.1 The Offshore Wind Farm

The great height of the offshore wind turbines means that they can be seen across a very large area. In this Environmental Statement the 3 MW, 6 MW and 10 MW wind turbines in the visualizations are shown with a total height of 137 m, 179 m and 220 m respectively. Figure 3-2 shows the onshore areas which are deemed to be inside the immediate and intermediate zones of the offshore wind farm respectively. In the immediate zone the offshore wind turbines will be experienced as a very visible and dominating element in the landscape. In the intermediate zone, the offshore wind turbines will still be clearly visible but less impactful in the landscape.

In the main part of the area inside the immediate and intermediate zones national, regional and local conservation interests in the landscape and the experience of the landscape exist. The investigated area for the offshore wind farm stretches along 14 km of the coast and when experiencing the particularly highly valued landscapes the offshore wind turbines will span the entire background in many places.

On the coast and the high dunes the wide and undisturbed views across the sea and along the coast account for a substantial part of the experience of the landscape. From the beach the landscape is experienced as a clearly delineated coastal space bordered by high dunes to the east and open to the Northern Sea on to the west.

The visual impression of a site layout with 3 MW and 10 MW wind turbines respectively is seen in Figure 3-3.

Figure 3-2. The location of the offshore wind farm and the borders of the immediate and intermediate zone.

Figure 3-3. Southwestern view across the sea from the beach by Nørre Lyngvig. The top image shows no offshore turbines, subsequent images show 3 MW(middle images) and 10 MW (bottom) offshore wind turbines respectively.

Selected visualizations have been reproduced in this part of the report as examples. It is emphasized that the images have been reduced significantly from their original size (A3) and that in this report they are only intended to provide a general impression and should not be construed as showing accurate visual impact. It is also emphasized, that the offshore wind turbines seen in the images are not always all of the offshore wind turbines. In Part 3 of the Environmental Statement and in a separate report more examples are given of visualizations of the wind turbines from other viewpoints in clear weather, foggy weather, at dusk and in the dark of night.

From the beach at Nørre Lyngvig the offshore wind turbines will fill the entire visual field when looking from a given point in the landscape towards the sea to the northwest and the southwest. Immediately behind the tall dunes closest to the coast the dunes will have a screening effect, however, just a bit further inland the offshore wind turbines will be very visible above the dunes.

Due to the statutorily required warning lighting of the offshore wind turbines, the visual impact will also be present at dusk, at night and in poor weather, during which one will be able to see the blinking lights on the wind turbines. The lighting at night will consist of red lights attached to the nacelle of the offshore wind turbines. The lights will flash at regular intervals. During the day the same lighting as at night will be used on wind turbines at a height lower than 150 m, while lighting on wind turbines over a height of 150 m (e.g. 10 MW wind turbines) will be different. For wind turbines over 150 m an intensive white blinking light must lit during the day. In addition the offshore wind turbines will be outfitted with a yellow blinking navigational light and the bottom part of the foundations will be painted yellow as well. The visualization below illustrates a situation in which the lights are 'on' but the visualization cannot illustrate the effect of the blinking itself. The blinking of the lights is assumed to accentuate the visual impact somewhat.

Both at the coast and in the dunes along the coast as well as in large areas surrounding Ringkøbing Fjord and Stadil Fjord the offshore wind turbines will be so prominent in the landscape that this will disturb the landscape to a very large extent resulting in a *major* impact. In the remainder of the fjord landscape, including the views across the fjords, the experiential value of the landscape is particularly vulnerable to the impact off the offshore wind turbines which will comprise a long row of technical facilities which rise above the dunes along the West Coast. In this area, the impact of the offshore wind farm is expected to be *moderate*.

The lighting means that the landscape will also be impacted during the night.

Figure 3-3. View from the beach by Søndervig during overcast weather approximately 4.3 km from the closest 10 MW offshore wind turbine.

Figure 3-4. View from the beach by Søndervig at night approximately 4.3 km from the closest 3 MW offshore wind turbine (the visualization does not show all wind turbines).

4 Population and Health

Construction and operation of an offshore wind farm may impact the people who live close to the installations or use those areas for recreational and outdoor activities.

4.1 Emissions and Noise

There will be noise during the construction. In particular, noise from driving monopile foundations into the seabed warrants attention. This activity can result in short term noise impacts above the recommended limits for construction during the night. It takes approximately six hours to drive a monopile into the seabed. Since this noise impact is very limited and of short duration, it is not expected to produce significant noise impact. If other types of foundations are used, no noise exceeding the noise level guidelines is expected.

Substations emit noise and this noise will be constant around the clock, however, the noise level from the new facilities will conform to the current limits for industrial noise of 35-40 dB(A) during the night at the nearest neighbouring residential property.

Operational noise - including low frequency noise - from the offshore wind farm is within the limits at the coast, in some places with a substantial margin even.

As such, there will be no significant impact on the population due to noise and also no impact on health.

4.2 Fishing

Construction and operation of the offshore wind farm may impact fishing in the area. During the construction phase a fishing ban will be in effect and only construction related vessels will be allowed in the construction area. Once the facility has been completed fishing with nets and other passive equipment is expected to be allowed both at the offshore wind farm and in the cable corridors, and thus no economic loss is expected for this type of fishing. Fishing with trawling equipment is expected to be banned in the offshore wind farm as well as the cable corridors.

Currently trawl fishing of some significance occurs in the investigated area -both fishing for sand lance in the northeastern part of the area and fishing for table fish in the southern and western parts of the area. Beam trawl fishing is much less frequent in the investigated area.

Intensive fishing in a north-south pattern with beam trawl (common shrimp) and trawl (flatfish, sand lance, and sprat) occurs along the coast east of the investigated area. The ban on fishing using trawling equipment in areas where submarine

cables are laid will reduce the efficiency of fishing and the catch in the area.Plant and Animal Life

The plant and animal life has been investigated and assessed. Relevant nature interests offshore include conditions for fish, marine mammals and birds, among others. The investigated offshore area is located in a part of the North Sea which has abundant bird life. In addition, the area also features good conditions for populations of several species of fish and the area is of some significance for porpoises and seals. Since porpoise are a so-called Annex IV-species and listed in the designation basis for Natura 2000-areas in the North Sea, porpoises will be discussed in section 5.1 on international conservation and in section 5.2 on the marine environment.

Particularly relevant are those species and habitats which are covered by international wildlife conservation interests (so-called Annex IV-species and Natura 2000 Areas).

The descriptions and assessments of conditions related to plant and animal life are partially based on existing knowledge and partially on a number of field surveys carried out in connection with the project.

4.3 International Nature Conservation

Natura 2000 is the name of the international ecological network of a number of natural areas in the EU, the so-called habitat areas and bird conservation areas. These areas are chosen based on the Habitat Directive and the Bird Directive. For each Natura 2000 area there is a list - the so-called designation basis – which lists habitat types and species which that particular area was chosen to conserve. The purpose of the Natura 2000 network is to ensure favourable conservation status for those species and habitats which are included in the designation basis for the individual Natura 2000 areas.

Annex IV of the Habitat Directive contains a list of specific animal and plant species which the member countries are committed to protect in general both inside and outside Natura 2000 areas. These species are called Annex IV-species.

4.3.1 Natura 2000 Areas

Natura 2000-areas are found near the investigated area are shown in Figure 4-1. A maritime Natura 200-area is located approximately 12 km north of the offshore wind farm. (No. 220 Sandbanker ud for Thorsminde).

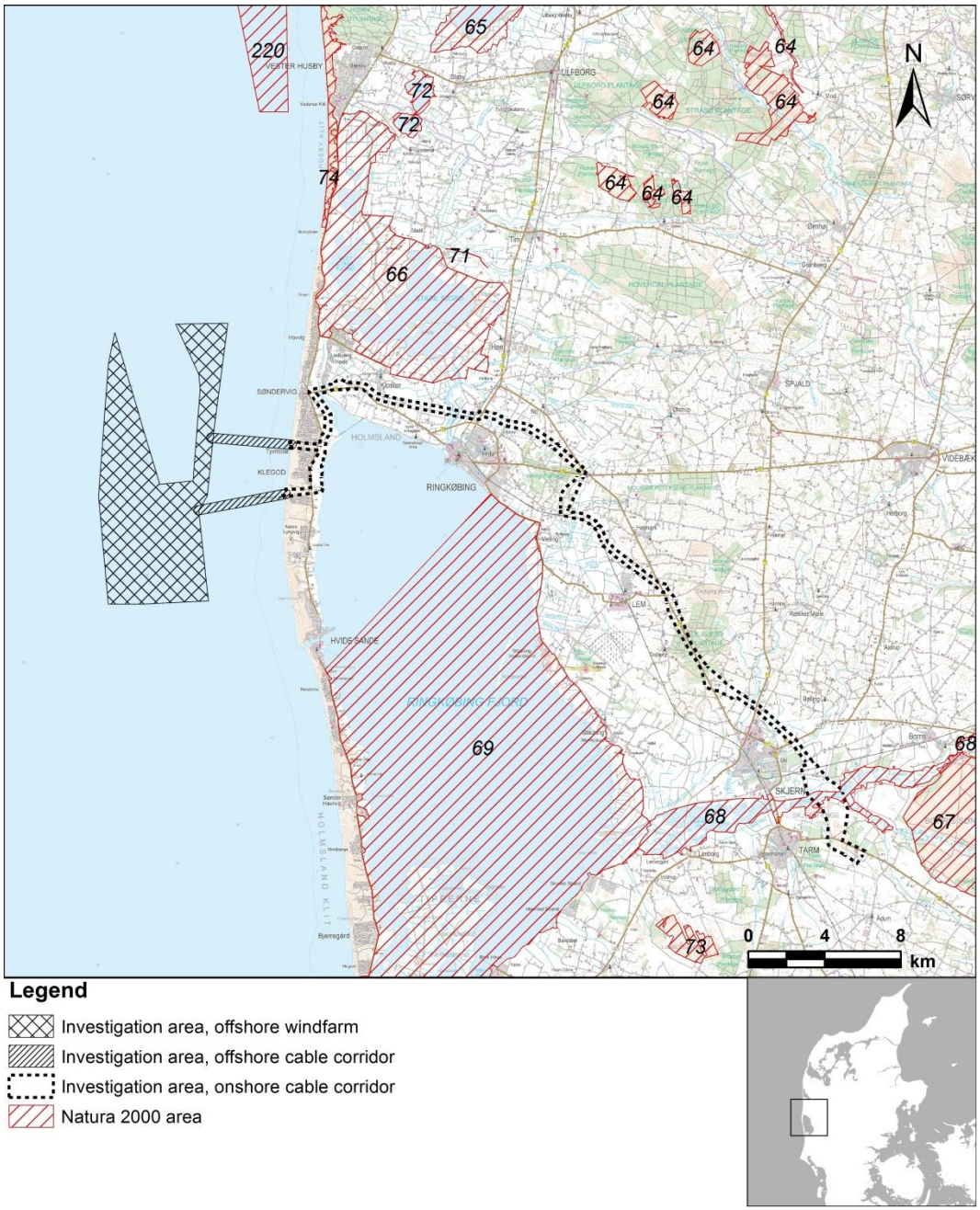

Figure 4-1. The investigated area and nearby Natura 2000 areas. The investigated area onshore passes Natura 2000 area No. 68, Skjern Å.

The species listed on the designation basis for Natura 2000-areas which are relevant to the impact assessment for the offshore wind farm, are seals (harbour seal and grey seal) as well as harbour porpoises. The closest habitat areas where these species are listed on the designation basis, are located more than 50 km south of the investigated area. The project is not expected to result in any major impacts on the seals and porpoises in these areas.

Impacts on birds listed on the designation basis for the bird conservation areas include among others the risk of collision with the offshore wind turbines and this

may impact bird conservation areas at a great distance from the offshore wind farm. Based on an examination of bird conservation areas in a radius of 150 km from the investigated area for Vesterhav Syd Offshore Wind Farm, an assessment of potential breeding birds and migratory birds has been completed.

As far as breeding birds only sandwich terns, common terns, and artic terns are considered relevant. There is no risk of major impacts on the breeding birds listed on the designation basis for nearby bird conservation areas.

Relevant migrating anatidae include the pink-footed goose, graylag goose, barnacle goose, dark-bellied brent goose, light-bellied brent goose, eurasian widgeon, eurasian teal, and northern pintail. The overall assessment is that there is no risk of major impacts on migrating birds listed on the designation basis for the nearby bird conservation areas.

This risk assessment for both migrating and breeding birds also applies when taking into consideration the cumulative impacts of other offshore wind farms at Vesterhav Nord and Nissum Bredning and Offshore Wind Farm Horns Rev 3.

The assessment of onshore impacts only addresses the impacts on the designation basis for Natura 2000-area No. 68 Skjern Å. Additional Natura 2000-areas are located at a minimum distance of 1.2 km from the investigated area. There is no risk of impacts on the species or natural habitats on the designation basis for these Natura 2000-areas.

Construction in Natura 2000-area No. 68 Skjern Å will utilize horizontal directional drilling. This method will ensure that no physical changes are made in the Natura 2000-area. Horizontal directional drillings typically do not physically impact streams.

4.3.2 Annex IV-species

In accordance with the habitat regulations, damage or destruction of the breeding and staging areas of the Annex IV-species caused by the project must be prevented.

Based on the results of the field surveys conducted in 2014, existing knowledge about Annex IV-species within and near the investigated area onshore and offshore, as well as knowledge of the expected impacts of the project, the assessment has been limited to include the following species: porpoises and bats.

The assessment concludes that if the recommended mitigation measures are implemented the ecological functions of the Annex IV-species' breeding and staging areas will not be impacted.

4.3.3 Current and Wave Conditions

Current and wave conditions are some of the most crucial conditions of life in the ocean. The offshore wind turbine foundations will provide some resistance to the current in the area, but model calculations show that the impacts on both wave

and current conditions will be very limited. Overall the impact on sea current during the construction phase will be *negligible*. Impacts on wave conditions will be *negligible* during the construction and decommissioning phases and *minor* during the operational phase.

4.3.4 Sediment

During the construction phase, the seabed may be impacted by the construction of the offshore wind turbine foundations and inter array cables. This may result in spilling and dispersion of sediment from the seabed. Considerable natural variations exist along the West Coast caused by seabed sediment dispersion due to large waves among other things. Thus, the impact on e.g. the light conditions at the seabed due to elevated sedimentation concentration levels in the sea water during construction is expected to be equal to or less than the natural variations.

4.3.5 Seabed Animal and Plant Life

The wind turbine foundations and the protective layer of rocks (erosion protection) around the foundations will take up space on the seabed. Both will function as so-called artificial reefs where species that do not live on the soft areas of the seabed can live on the rocks.

The majority of the seabed in the area is sandy and the animal life on the seabed is characterized by species which are especially adapted to this type of environment. Species such as marine worms and mussels dominate the animal life. Field surveys in the investigated area conducted as part of this investigation found no plants growing on the seabed.

Overall, the impacts on the animal and plant life of the seabed will be *negligible* to *minor*. The seabed community is expected to be able to retain its current composition.

4.3.6 Fish

The seabed conditions also highly influence which fish are able to live in the area. Many fish need specific seabed types, especially flatfish.

Species which are abundant, ecologically very significant, and/or important for the fishing industry are called 'keystone species'. Keystone species in the area surrounding the investigated area include among others: cod, plaice, sole, turbot, dab, herring, sprat, sand lance, solenette, dragonet, and sand goby.

During the construction phase, periods of physical disturbance of the seabed will occur, including dispersal of sediment. Due to the combination of the short term nature of the impact, the relatively low increase in concentration and the small size of the affected area, combined with the dynamic characteristics of the area, there will be no impact on fish.

In connection with construction, underwater noise from driving monopile foundations may have a short term impact on the fish community. The assumption is

that one foundation can be completed per day and that the pile driving will take up to six hours per monopile foundation. Based on the planned number of wind turbine foundations the total period of pile driving noise will be very limited meaning less than 400 hours during the first half of the construction phase. This fact combined with the ample opportunity for fish to leave the construction area leads to the conclusion that the noise from pile driving will result in only a *minor* impact on fish.

Around the inter array cables between the wind turbines and around the export cables an electromagnetic field will be created. The intensity of the field will quickly decline with increasing distance to the cables, and it is estimated that it will not impact the ability of fish to navigate.

Construction of the offshore wind turbine foundations will replace the naturally occurring seabed with a new environment in the form of concrete, rock beds and steel. The foundations and erosion control will function as so-called artificial reefs. Within a short time frame, the artificial reefs are expected to attract fish species such as wrasse, butterfish and cod which take advantage of the great hiding places and feeding grounds. The impact of the artificial reefs on the fish and fish communities will be limited since hard bottom areas already cover significantly larger areas than those which will be introduced.

4.3.7 Marine Mammals

Harbour porpoise is the most common species of whale in Denmark and can be seen year round in Danish waters. The harbour porpoise is an internationally protected species. The importance of the area to harbour porpoises is minor to average, particularly when compared to areas with a much higher density of harbour porpoises such as Horns Rev further to the south. The harbour porpoises in the investigated areas are a part of a subpopulation in the Northern Sea which numbers approximately 230,000 animals.

Harbour seal is the most commonly found seal species in Denmark. It is found mainly in coastal waters where there is ample food. The food is primarily fish, but also squid and crustaceans.

Seals by Vesterhav Syd Offshore Wind Farm will almost exclusively come from resting and breeding areas in the Limfjord and the Wadden Sea. A total of approximately 42,000 animals live in these areas.

The nearest resting and breeding areas are far away in the Limfjord and the Wadden Sea. During aerial observations a total of 25 harbour seals were observed in and around the investigated area.

If a monopile foundation type is chosen, the pile driving will produce very loud noise which can inflict both temporary and permanent hearing loss on marine mammals which are in the immediate vicinity of the source of the noise. In addition, the noise may cause behavioral changes particularly in harbour porpoises. Thus, it will be necessary to scare the marine mammals away from the area before

pile driving begins. In relation to the worst case scenario used in the ES to describe the noise distribution it is necessary to further reduce the noise to secure that no harbour porpoises contract permanent hearing damage. For seals fewer animals and a smaller portion of the total number of individuals will be at risk for hearing loss than is the case for porpoises. In addition, seals are more capable of avoiding hearing loss than porpoises since they can simply keep their heads above water.

4.3.8 Birds

The North Sea is an important area for waterfowl which either live in the area permanently, use the area as a staging area, or pass the coast during migration.

Staging Birds

Staging birds either live permanently in the area or stage for a shorter or longer period of time along the west coast of Jutland.

The staging birds have been counted using aerial observation. In all 17 separate species were registered. The most numerous species is the common scoter followed by common gulls and divers (among others red throated-divers). In addition a large number of auks were observed, including guillemot.

An offshore wind farm can negatively impact staging birds because of changes to or loss of habitat and by disturbing or displacing birds from the area. When the offshore wind turbines have been erected and the offshore wind farm is in operation, the impact on divers and common scoters will be *moderate,* the impact on velvet scoters and auks will be *minor,* and the impact on the remainder of staging bird species will be *negligible*.

Minimization of the offshore wind farm area, e.g. by erecting few but powerful wind turbines instead of many wind turbines with lower output, may mitigate the impact on divers during the operational phase. The moderate impact on common scoters is primarily caused by the fact that the common scoters live in the north-eastern part of the investigated area. Should this area not be used for the erection of offshore wind turbines the moderate impact on common scoters may be reduced to a minor impact.

Figure 4-1. Common Scoter (Photo: Stefan Pfützke, www.green-lens.de).

Migratory Birds

Migratory birds perform directional migrations between a breeding area and the areas where they live during the rest of the year. On the way, a number of species stop over along the Danish west coast.

Depending on the sensitivity of the species and the migration routes of the birds the barrier effect and collision risk may negatively impact birds. Staging birds in the area are also subject to this risk and will also experience a higher risk of collision with the offshore wind turbines.

The potential impacts have been assessed for the following migratory birds: common eider, scoter, red-breasted merganser, red-throated diver, arctic skua, kittiwake, black-headed gull, little gull, common gull, lesser black-backed gull, herring gull, great black-backed gull, sandwich tern, common tern and arctic tern.

Overall, sea bird species will experience a *minor* impact from the collision risk and/or the barrier effect created by the construction of Vesterhav Syd Offshore Wind Farm.

Figure 4-2. Eurasian Wigeon (Photo: Stefan Pfützke, www.green-lens.de).

5 Other Environmental Concerns

In addition to the plant and animal life, there are a number of other areas in which the environment may be impacted by the project.

5.1 Air Quality and Climate

The emission of airborne pollutants during the construction phase is relatively small and will not result in adverse effects.

During the operational phase the power production from the offshore wind farm will replace the equivalent power production from power plants using fossil fuels. This will result in an annual reduction of approximately 160,000 tons CO2, and also a reduction in the emission of acidic gasses, primarily nitrogen (NOx). During the expected operational phase off the offshore wind farm of up to 30 years, the greenhouse gas emissions from power plants will be reduced by approximately 4 million tons CO2 with the construction of a 200 MW offshore wind farm. The annual savings are equal to the CO2 emissions of approximately 15,000 people based on emissions of 7.9 tons CO2 per inhabitant in 2012.This is equal to approximately 0.3 percent of annual Danish CO2 emissions.

5.2 Archaeological Cultural Heritage

There may be stone-age sites located in the northern and eastern part of the investigated area at sea. In addition, a few archeologically significant objects have been found, likely ship wrecks or parts from ship wrecks.

Should the final project design involve some of the objects or areas which have been identified as potentially archeologically significant, those objects or areas must be inspected or further investigated prior to construction in order to ascertain the actual cultural heritage potential and mitigation measures can be implemented. This will insure that the archaeological cultural heritage is not damaged.

5.3 Radar and Radio Links

There are no radio links that could be impacted by the offshore wind farm.

The existence of the offshore wind farm may, however, disturb signals from radar systems used for a variety of purposes. Radar signals have a certain reach depending on the objects to be observed (e.g. air craft or ships).

The closest stationary civilian (DMI weather radar at Rømø and Esbjerg Airport) and military radar systems (Thyborøn and Oksbøl) are located so far from the offshore wind farm that they will not be impacted by the offshore wind farm.

5.4 Aviation

Vesterhav Syd Offshore Wind Farm is located outside the approach plan for the nearest airport and more than 4 km from the closest airstrip. Further, no civilian aviation over the offshore wind farm area is known, and the likelihood of civilian aviation using small aircraft over the offshore wind farm is minimal.

The Royal Danish Air force generally view the North Sea as a training area used for flying at high speeds. Offshore wind turbines that are stationary and erected inside a small area will not immediately affect the training flights.

Search and rescue efforts will likely involve flying rescue helicopters at low altitude and if necessary helicopters may fly in between the offshore wind turbines. However, the assumption is that the number of flights in the offshore wind farm area will be minimal.

5.5 Navigation

Ships arriving and departing to and from Hvide Sande Harbour make up the ship traffic near Vesterhav Syd Offshore Wind Farm. These are primarily smaller vessels such as fishing vessels. Recreational sailors will also be concentrated around Hvide Sande Harbour, but not particularly in the offshore wind farm area.

The remainder of the ship traffic primarily utilizes north-south routes located approximately 20 nautical miles from the investigated area.

Analyses, assessments, and calculation of the risk of collision with the offshore wind turbines by ships under power as well as by drifting ships have been performed. Traffic related to the extraction activities near the offshore wind farm area contributes the most to the risk. The collision risk is low.

In addition, the change in the risk of ship colliding and running aground has been assessed based on knowledge of current conditions and will be marginal. Several risk reduction measures will be implemented such as marking the offshore wind farm.

5.6 Commercial Fishing

As is the case nationally, the number of fishing vessels harboured on the west coast of Jutland has been declining throughout the last 10 years. The three central fishing harbours in Hvide Sande, Thorsminde, and Thyborøn have seen numbers drop from 360 vessels in the mid-2000s to the current level of approximately 280 vessels. In addition to full-time commercial fishing vessels, there are a number of part-time commercial fishing vessels, and their number has shown a slight in-

crease during the same period. This group primarily consists of small vessels with relatively low levels of activity and consequently their part of the total catch amounts to just a few percent.

North of Hvide Sande, between the shore and the investigated area intensive fishing using trawl, common shrimp boom trawl, and nets occurs. In the area which would contain the cable corridors fishing is particularly intensive. The primary targeted species for fishing in the area are flat fish (sole, plaice) and common shrimp.

In addition, extensive fishing targeting sand lance occurs in a belt stretching from the area surrounding the cable corridors in the northwestern part through the north eastern part of the investigated area to the sand extraction area. In the investigated area itself and especially in the southern and western parts, fishing with trawl and nets occurs, but fishing with boom trawl is limited. The area is particularly important to the small trawl and net vessels. The target species for the fishing is cod and flatfish.

Construction of the offshore wind farm will lead to limited fishing opportunities in the area which may lead to financial losses unless fishing can be moved to other areas.

6 Cumulative Impacts

The cumulative impacts are the enhanced environmental impacts that result from several facilities and activities being present in the same area where each facility and activity impacts the environment in similar ways.

The purpose of including cumulative impacts is to assess the overall environmental impact of the current project as it relates to the environmental carrying capacity of the area. The assessment of cumulative effects must take into account existing facilities as well as future land use and activities based on permits that have been granted, and plans that have been passed.

6.1 The Marine Environment

There may be cumulative impacts on marine mammals, on birds and on commercial fishing. The existence and planning of other offshore wind farms in the North Sea contribute to these impacts.

If Vesterhav Syd Offshore Wind Farm, Vesterhav North Offshore Wind Farm and/or Horns Rev 3 Offshore Wind Farm are erected simultaneously, and the offshore wind farms utilize monopile foundations which entail the noisiest construction methods, major cumulative noise impacts cannot be ruled out in advance.

For divers, common scoters, light-bellied brent goose and herring gulls, *moderate* cumulative impacts are expected during the operational phase due to loss of habitat, habitat change and disturbance, as well as collision risk. Lesser impacts related to displacement, changing habitats or collision risk are expected for a variety of birds during the operational phase.

Sand extraction is permitted between the northeastern and northwestern part of the investigated area. Fishing is possible within the sand extraction area when sand is not being extracted. Erecting the offshore wind farm, particularly if erected in the northeastern part of the investigated area, will dramatically decrease the options for fishing with trawl in the sand extraction area because it will not be possible to optimize fishing with long trawl.

A certain level of cumulative impact on commercial fishing at Vesterhav North Offshore Wind Farm and Horns Rev 1-3 Off Shore Wind Farms cannot be ruled out.

7 Mitigation Measures

An important purpose of an environmental impact assessment is to point to solutions, so that substantial negative environmental impacts caused by the current project may be reduced, compensated for, or completely avoided. Such solutions are called mitigation measures and can be implemented both before and during the construction phase and during the operational phase.

During the construction permitting process a construction permit will be issued by the Danish Energy Agency, an EIA permit will be issued by the Danish Nature Agency, and requirements will be identified such as the framework for project implementation, mitigation measures to be implemented to potentially lessen or avoid possible environmental impacts including monitoring certain environmental features after the construction phase.

7.1 The Marine Environment

Divers and Common Scoters will be *moderately* impacted by changes in and loss of habitat as well as disturbance or displacement during the operational phase.

By minimizing the extent of the offshore wind farm, for example by erecting fewer but more powerful wind turbines, the moderate impact on divers during the operational phase may be mitigated

The moderate impact on Common Scoters is primarily caused by the fact that the scoters live in the northeastern part of the investigated area and if this part of the investigated area is not utilized, the moderate impact on Common Scoters can be avoided and reduced to a minor impact.

The noise transmission under water has been modelled for monopile foundations with a 10 m diameter. Driving large monopile foundations into the seabed causes significant noise which can harm marine mammals. Consequently, it is necessary to implement mitigation measures to prevent permanent hearing loss and other serious impacts on porpoises and seals if this type of foundation is chosen. Mitigation measures such as frightening animals away and noise reduction measures are proposed or a type of foundation which leads to less noise impact may be chosen. If a different type of foundation, such as gravity foundations, pile driving will not be necessary and neither will implementation of mitigation measures.

Moderate impacts on fishing with nets, trawl and boom trawl have been found at Vesterhav Syd Offshore Wind Farm. In general, erecting the offshore wind farm in stages allowing for fishing in those areas not currently under construction will reduce the impact. Similarly construction outside of the primary fishing season will also reduce the impact.

The above mitigation measures are also applicable to socioeconomic impacts.

8 Conclusion

An assessment of the possible environmental impacts of construction, operation, and decommissioning of Vesterhav Syd Offshore Wind Farm has been completed.

The impact of construction and operation of the project on common scoters will be *moderate*. The moderate impact on common scoters is caused primarily because a concentration of common scoters overlaps with the north eastern part of the investigated area. The impact on common scoters can be reduced to a *minor* impact if no offshore wind turbines are erected in the northeastern part of the investigated area.

Based on the above, it is necessary to adapt the project area to reduce the area available for erecting offshore wind turbines.

The final area for erecting offshore wind turbines is shown in Figure 8-1.

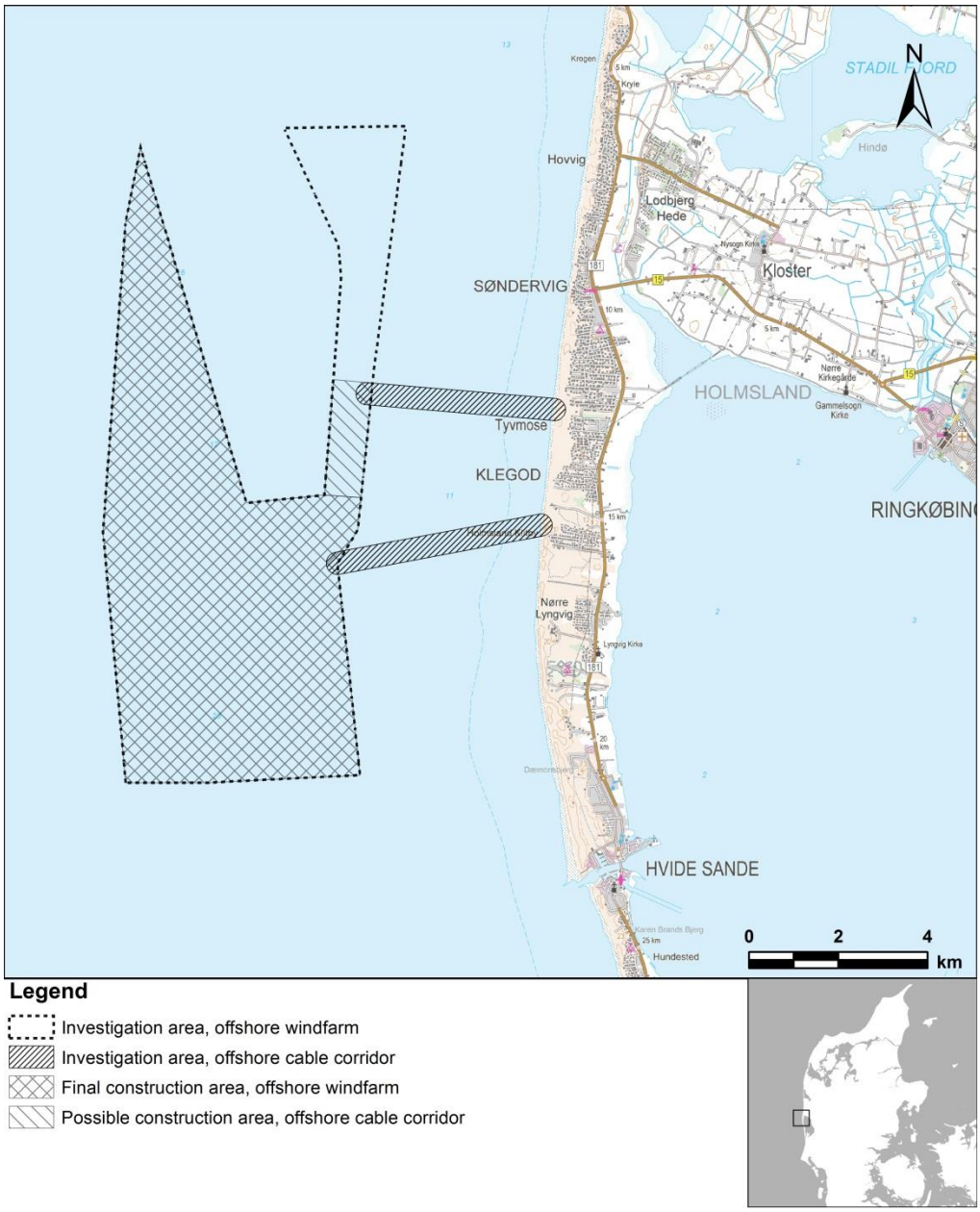

Figure 8-1. Final area for offshore wind turbine erection.

Furthermore, the impact on the landscape in the area north of Søndervig will be reduced by not erecting offshore wind turbines in the northeastern part of the investigated area off Holmsland Klitby. By limiting the extent of the wind turbine area along the coast, the degree to which the offshore wind turbines fill the horizon in the entire field of sight is reduced. This will somewhat reduce the impact on the rich landscape experience surrounding in the areas surrounding the fjords, although it will not change the delineation of the areas of *major* landscape impact.

Figure 8-2 shows visualizations of 6 MW wind turbines seen from the beach at Søndervig for the original and the reduced wind farm areas.

Figure 8-2 *Panoramic view from the beach at Søndervig. The left half of the panoramic view is seen on this page, the right half of the panoramic view is seen on the opposite page. The top image shows the original wind farm area with 6 MW wind turbines and a distance to the closest wind turbine of approximately 4.6 km. The bottom image shows the reduced wind farm area with 6 MW wind turbines and with a distance to the closest wind turbine of 7.2 km. Note that only 22 of the total 33 6MW offshore wind turbines are visible in the visualizations, the remainder of the offshore wind turbines are located to the left of the images. (NIRAS 2015b)*

A variety of solutions aimed at further reducing the impact on the landscape should be considered, such as adapting the site layout and erecting fewer but larger offshore wind turbines, rather than many offshore wind turbines with a lower output.

The impacts are primarily related to construction phase activities. The impacts are primarily temporary and can be characterized as *negligible* or *minor*.

During construction offshore, driving monopile foundations into the seabed, should this type of foundation be chosen, will result in *major* noise impact in particular on harbour porpoises who may suffer temporary as well as permanent hearing loss. This necessitates scaring the animals away from the area at the beginning of the construction phase. In relation to the worst case scenario used in the ES to describe the noise distribution it is necessary to further reduce the noise to secure that no harbour porpoises contract permanent hearing damage with the assumptions given for the worst case scenario.

There will be no major impacts on international nature conservation areas or protected animal or plant species.

The impact on common scoters is reduced to a *minor* impact by reducing the area where wind turbines may be erected.

For the remainder of the assessed environmental and nature impacts the assessment shows that impacts will be *minor* or *negligible*.

Completion of the project ensures long term reductions in CO_2 emissions and will contribute to reaching the energy policy goal of improving the climate.

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