Vattenfall Vindkraft AB
Vattenfall Vindnät Sverige AB

Kattegatt Syd

Documentation for the Espoo consultation prior to the establishment of offshore wind power in the Kattegat Sea

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Summary

Introduction

Vattenfall plans to apply for a permit to establish an offshore wind farm in the Kattegat sea. The area for the wind farm, called Kattegatt Syd, is located about 25 km outside Falkenberg between the two Natura 2000 areas; Stora Middelgrund and Röde bank, and Lilla Middelgrund. Kattegatt Syd will have the potential to generate 4.7 TWh per year, which is currently equivalent to around 2.5-3% of Sweden's total electricity generation, and the project is therefore an important part of Sweden's and Europe's transition to renewable electricity generation and ambition for a climate-neutral society.

Consultation

The project has the potential to have a significant environmental impact and may affect the environment outside Sweden's borders. This document constitutes the basis for a consultation on transboundary environmental impact, known as an Espoo Consultation. In accordance with Chapter 6, Section 33 of the Environmental Code and the Espoo Convention, the countries concerned must be informed of activities, their possible transboundary consequences and the type of decision that may be taken, as well as being given reasonable time to comment on whether they wish to participate in the Environmental Impact Assessment. In Sweden, notification is handled by the Swedish Environmental Protection Agency. The contacted countries that consider themselves to be affected will be given the opportunity to submit comments prior to the preparation of the Environmental Impact Assessment.

In parallel, a consultation will take place with authorities, stakeholder organisations and those specifically affected in Sweden prior to the major permit applications required for the establishment of the wind farm in Sweden's economic zone, the laying of export cables and inter-array cables, and the laying of underground cables from the landfall point and onto the Swedish national transmission grid.

Description of the project

A significant transboundary environmental impact may result from the installation and operation of the wind farm, consisting of the wind turbines, their foundations and inter-array cables that connect the wind turbines with up to two offshore substations. The project will also include the installation and operation of export cables to connect the wind farm to the Swedish transmission grid. However, these measures are not expected to have any significant transboundary impact and are therefore not described in more detail in this consultation document. However, the export cable corridors under consideration are marked on maps in the consultation documentation in order to illustrate potential locations in relation to territorial waters and Swedish economic zone borders.

According to the preliminary schedule, installation of the wind farm is planned to start in 2028 and to be operational in 2030. As the technology for offshore wind power is rapidly developing, it is not possible to say with certainty exactly which technical solutions will be available once wind farm installation commences. As a result, various examples of potential wind farm designs are presented for the different parts of the project. The maximum height of the wind turbines is estimated to be 350 m and the number of turbines is estimated to be a maximum of 80. The number, size and location of the wind turbines in the area are

presented in two different example layouts (one with a greater number of smaller wind turbines and one with fewer but larger wind turbines). The wind turbines will be visible both from the Swedish coast and from the Danish island of Anholt.

Marine environment

Close to the wind farm there are areas for porpoises, seabirds and spawning areas for cod. In the area of the planned wind farm, the seabed is dominated by soft-sediment communities. The area is close to important shipping lanes and is used by fishermen from Sweden and Denmark.

The installation and operation of the wind farm will affect the marine environment in one way or another. During the installation phase, underwater noise (mainly due to pile-driving foundations) and turbidity (e.g. laying of cables) will occur. Porpoises and other marine mammals are sensitive to underwater noise and risk being affected during the installation phase. Fish are at risk of being affected by both underwater noise and operations that cause turbidity, while the impact on seabirds is believed to be primarily linked to a change in their habitat during the operational phase. The seabed community can be impacted both through permanently changed habitats and as a result of time-limited turbidity during the installation phase.

However, previous studies show that most marine organisms are not disrupted by a wind farm’s presence, once in place. Commercial fishing will be possible in the area even after the wind farm is in place, but it is likely that certain types of fishing such as bottom trawling will need to adapt to the new conditions in the wind farm area.

The wind farm’s potential transboundary impact is primarily related to Natura 2000 sites, mobile species such as marine mammals and birds, benthic species at the wind farm's border with Denmark, commercial fishing, shipping and the visual landscape.

The wind farm area will be thoroughly examined through extensive field studies of birds, porpoises and the seabed community. An analysis of the impact on commercial fishing within the wind farm will also be carried out. Investigations of various impact types, such as turbidity, noise, hydrodynamic conditions, and risk analyses for shipping, etc., will be carried out to enable mitigation of the negative effects to the natural environment, infrastructure and people's well-being.

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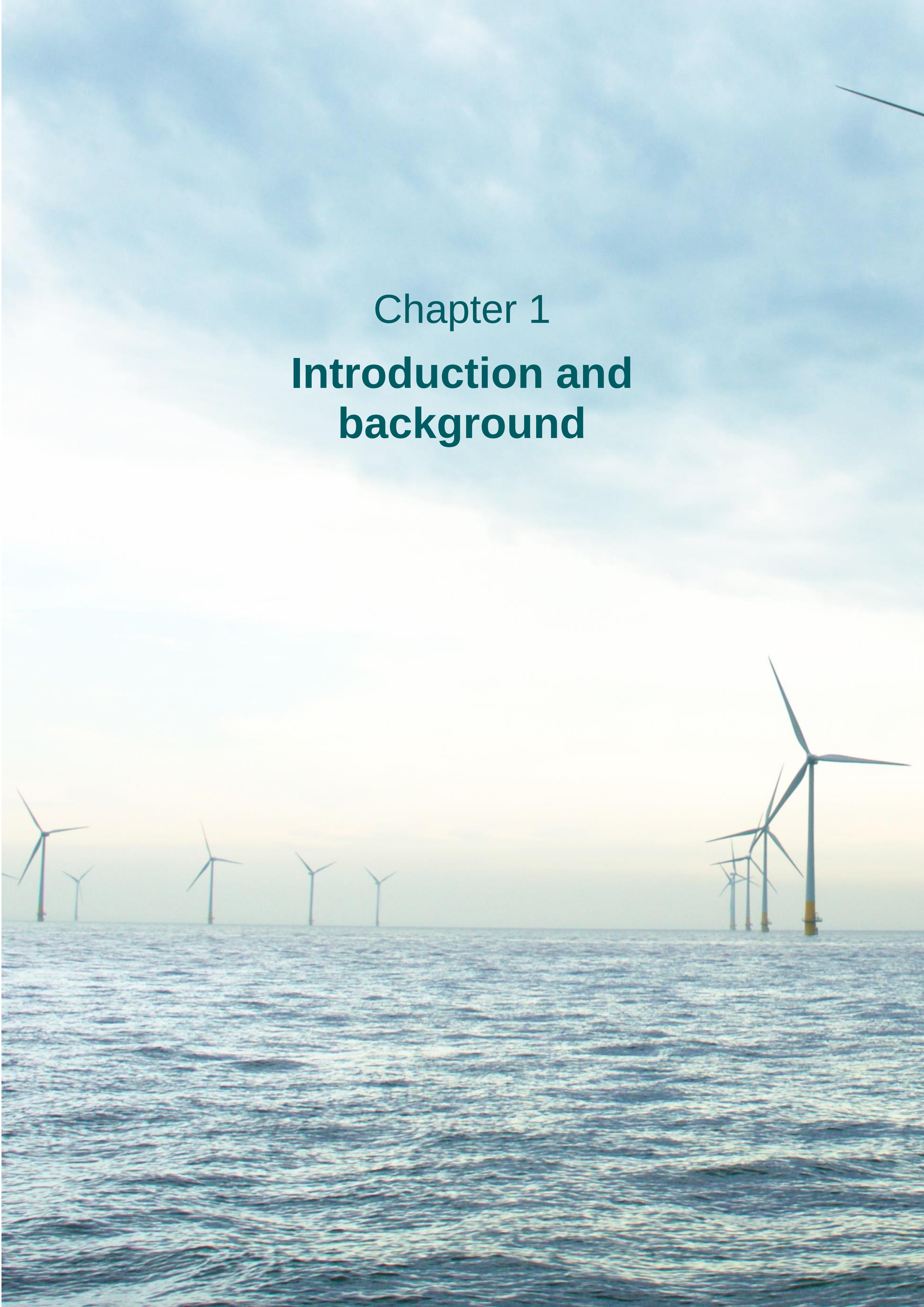
Introduction and background



1. Introduction and background

1.1. Consultation

Vattenfall is conducting a joint consultation process for Kattegatt Syd's various permit applications. (described in more detail in Chapter 2) to get the best possible overall, initial assessment of a project that is of great importance to society. This is in line with the ambition of the Swedish Environmental Code.

As the wind farm part of the project is deemed to potentially have a significant impact on the environment outside Sweden's border, the countries concerned, in accordance with Chapter 6, Section 33 of the Environmental Code and the Espoo Convention, must be informed of the operations, their possible transboundary consequences, the type of decision that may be taken and be given reasonable time to express whether they want to participate in the environmental impact assessment. Other parts of the project (export and underground cables) are not expected to affect the environment outside Sweden's borders.

According to Section 21 of the Environmental Impact Assessment Directive, it is the Swedish Environmental Protection Agency's obligation to inform affected countries about activities (*notification phase*) and to initiate a consultation phase with the countries contacted. If these countries consider themselves to be affected by the operations, they will be given the opportunity to submit comments.

The expected transboundary impact of Kattegatt Syd is described in Chapter 7.3. As stated above, a potentially significant transboundary environmental impact can be expected in installing, operating and decommissioning the wind farm. The wind farm includes wind turbines, inter-array cables and offshore substation(s). Infrastructure outside the wind farm consists of export cables and underground cables for the transfer of generated electricity to the Swedish transmission grid. Installation, operation and decommissioning infrastructure outside the wind farm is not believed to have a transboundary impact.

In terms of time, consultation and the forthcoming Environmental Impact Assessment are limited to the total service life of the wind farm, i.e. its installation, operation and decommissioning. Installation work is planned to start in 2028 with an expected operational phase of 30 years.

1.2. Administrative details

This consultation is being carried out by Vattenfall Vindkraft AB and Vattenfall Vindnät Sverige AB prior to a number of permit applications. Chapter 2 contains a more detailed account of future permits for the part of the project that may result in significant transboundary environmental impact. To simplify, the consultation document will hereinafter refer to these entities as “Vattenfall”.

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Plant name:	Kattegatt Syd Wind Farm
Description of property:	Wind farm
County:	Halland County
Area:	Kattegatt Syd

1.3. Introduction

The Vattenfall Group is one of Europe's biggest generators of electrical energy and heat, and also one of the biggest retailers on the European market. The Vattenfall Group has long and extensive experience in developing wind power projects and of installing and operating wind farms, both onshore and offshore.

Renewable energy sources such as wind power are vital for reducing climate emissions. In 2018, the Swedish Parliament adopted the target that specifies that 100% of Sweden's electricity generation should come from renewable sources by 2040. To achieve this goal, generation from wind power must be multiplied many times over. The energy industry is approaching a tipping point, and today, wind is often the cheapest form of new generation.

Vattenfall’s goal is to make fossil-free living possible within one generation. Today, 35% of the Vattenfall Group’s generation capacity comes from renewable sources, and wind power is a growing pillar of Group strategy. Vattenfall is a market leader in wind power. Vattenfall currently has around 1,100 wind turbines in operation (offshore and onshore), in around fifty farms located in five countries, with a total installed capacity of around 2,800 MW (Figure 1). Vattenfall is aiming for a strong portfolio of onshore and offshore wind to continue to play a strong role in the European energy transition. The realization of the Kattegatt Syd wind farm is an important piece of the puzzle in Vattenfall's work to reduce carbon dioxide emissions that affect the climate.

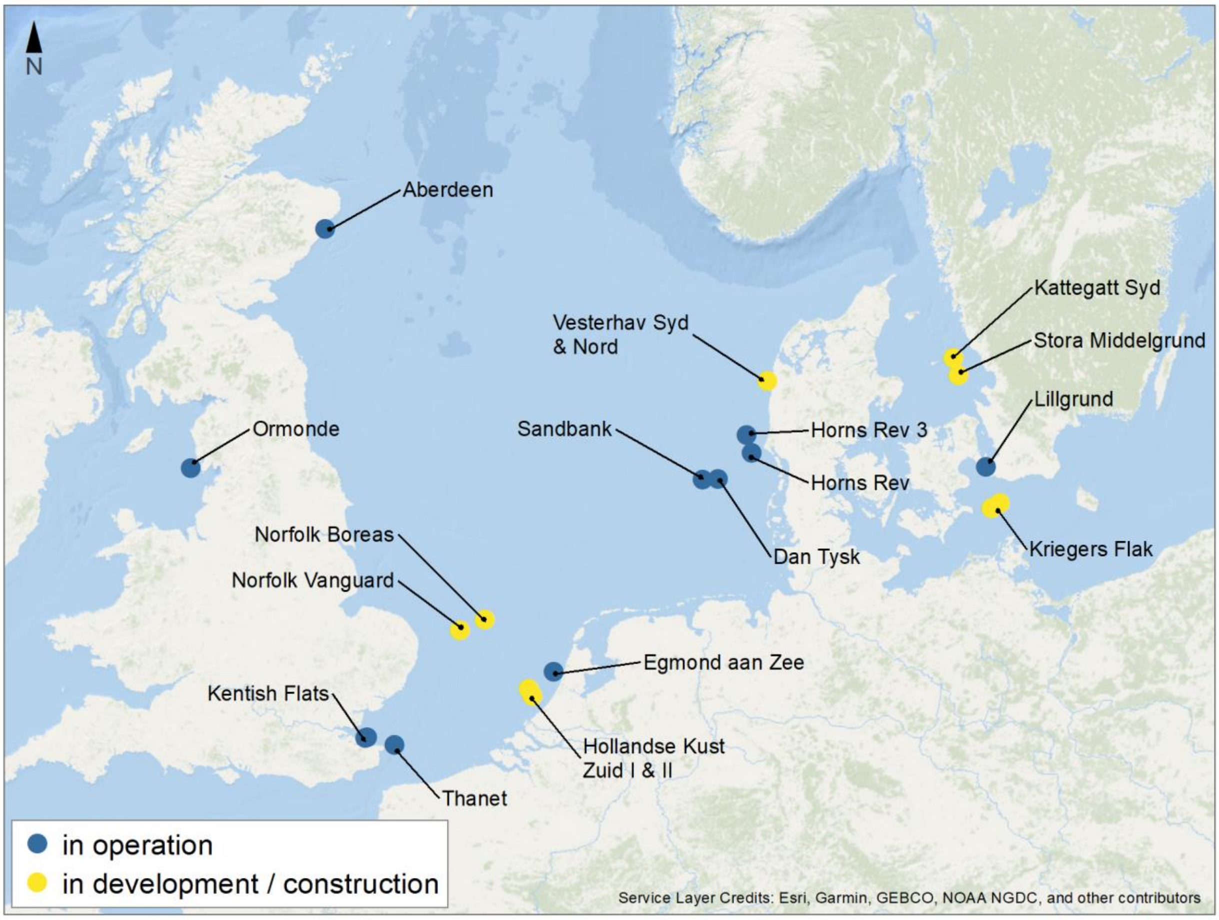


Figure 1. Vattenfall's offshore wind power project in Northern Europe.

1.4. Kattegatt Syd

There are many advantages to building offshore wind power. Wind conditions are generally more favourable offshore than onshore. Vattenfall is investing heavily in offshore wind power and Kattegatt Syd is one of the three projects Vattenfall is developing in Swedish waters. The planned Kattegatt Syd wind farm covers an area approximately 177 km^2 in the Kattegat sea, approximately 20 km from the coast. The area lies entirely within the Swedish economic zone, at the border of the Danish economic zone, just north of Vattenfall's planned offshore wind farm Stora Middelgrund and outside the Natura 2000 areas of Stora Middelgrund and Röde bank, and Lilla Middelgrund (Figure 2).

Export cables from the wind farm are planned to run north towards Väröbacka, Varberg municipality. Various options have been developed for routing the cable corridor and for the cable landfall. At the landfall, the submarine cables are transferred to the underground cable, which is connected to the transmission grid at a suitable connection point. Ultimately, there will be an export cable corridor, a landfall and an underground cable corridor that will be used for installing and operating the project.

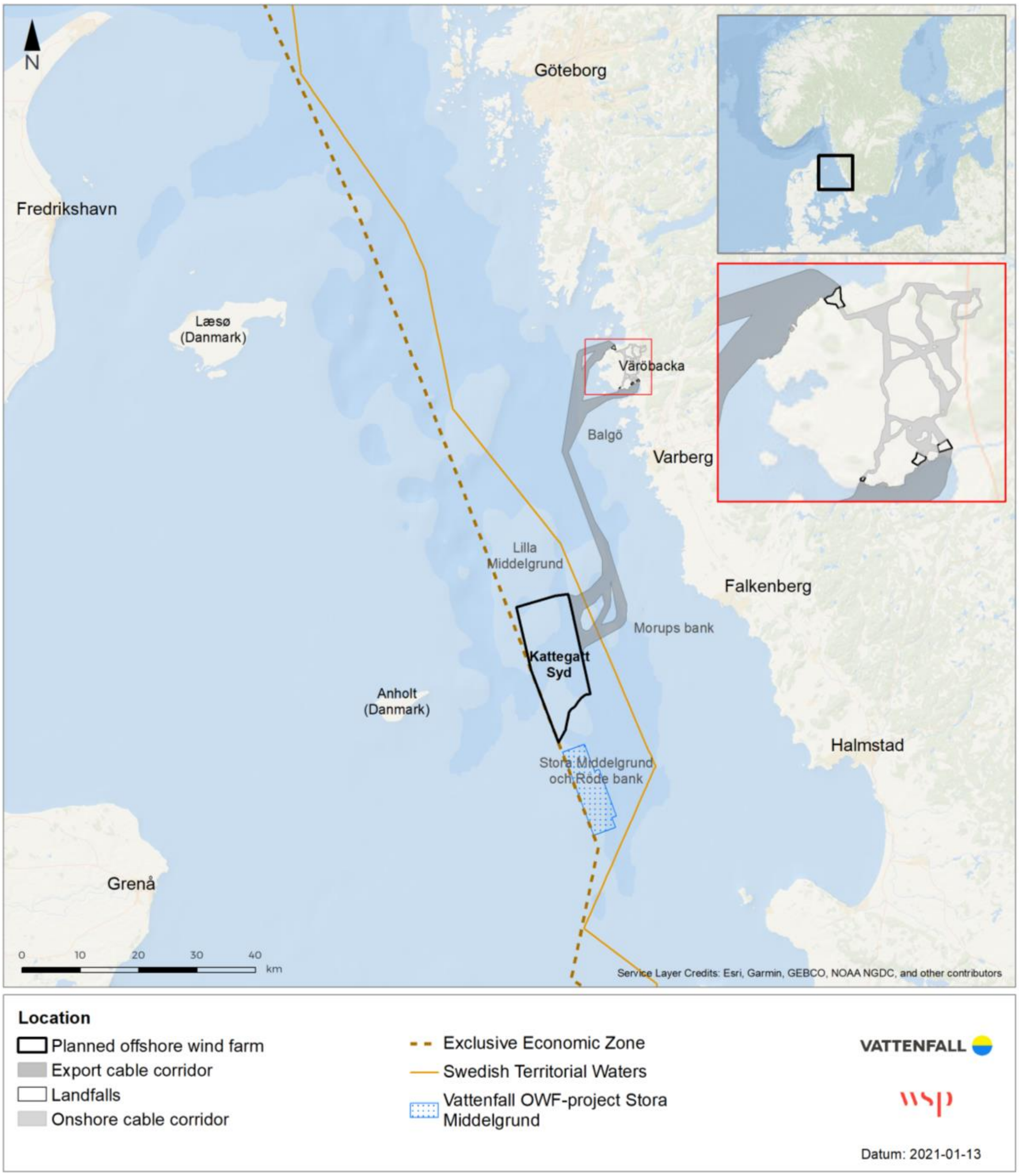


Figure 2. Overview map of the planned Kattegatt Syd wind farm area with alternative export cable and ground cable corridors.

Kattegatt Syd will have an installed capacity of up to 1200 MW and an estimated annual production of approximately 4.7 TWh, which corresponds to the annual demand for renewable household electricity for approximately 780,000 households. According to the Swedish Energy Agency,[1] Sweden's total electricity generation in 2019 was 164 TWh (of which wind power accounted for 19.9 TWh). The estimated output from Kattegatt Syd thus amounts to 2.5-3% of Sweden's

[1]https://www.energimyndigheten.se/nyhetsarkiv/2020/2019-rekordar-for-svensk-elproduktion/

current total electricity production. The project is therefore an important part of Sweden’s and Europe's process of transitioning to renewable energy sources.

Vattenfall's objective is to build a wind farm that is as efficient as possible in an environmentally responsible manner. In order to minimise the effects on the environment, a number of different environmental studies are being conducted and planned (with the help of experts in each area) that will serve as a basis for future permit applications. As a world-leading developer of offshore wind power with its own research team in the field, Vattenfall can benefit from its extensive in-house experience and unique expertise in the field of technology and the environment to find sustainable design solutions for the farm.

Chapter 2

Permits, legislation and reading references

2. Permits and legal areas

Several permits will be applied for to establish the Kattegatt Syd wind farm. These are summarized in Table 1 below. The legal situation for the various permits is described in more detail in Chapter 2.1–2.3.

Table 1. Main permits for the installation and operation of Kattegatt Syd.

Permit	Applicant	Permit authority
Permit and operation of the wind farm in Sweden's economic zone in accordance with the Sweden's Exclusive Economic Zone Act (1992:1140)	Vattenfall Vindkraft AB	Government, Ministry of the Environment and Energy
Permits in accordance with Chapter 7, Section 28a of the Environmental Code for measures that can significantly affect the environment within a Natura 2000 area (Natura 2000 permit)	Vattenfall Vindkraft AB	Halland County Administrative Board
Permit for laying inter-array cables in accordance with the the Continental Shelf Act (1966:314)	Vattenfall Vindkraft AB	Government, Ministry of Enterprise and Innovation

Though the permits are reviewed by different authorities, Vattenfall's ambition is for the permit examinations to be carried out simultaneously.

A prerequisite for all permit examinations is that the impact on the environment is specifically assessed and that an Environmental Impact Assessment (EIA) is prepared in accordance with the provisions of Chapter 6 of the Environmental Code. For further information on the planned limits of the forthcoming EIA, see Chapter 10.

In addition to the above permits, other approvals may also need to be obtained, e.g. a sediment disposal exemption. A number of additional permits will be obtained for the implementation of the project as a whole, including permits in accordance with the Environmental Code, permits for laying export cables in accordance with the Continental Shelf Act (1966:314) and network concessions for lines in accordance with the Electricity Act (1997:857), all related to the export cable.

2.1. Wind farm permit (Swedish Exclusive Economic Zone Act (1992:1140))

According to the Sweden's Exclusive Economic Zone (SEZ) Act, the installation and use of facilities for commercial purposes in the economic zone requires a permit from the Government. According to the Ordinance on Sweden's Exclusive Economic Zone, the application is processed by the Ministry of the Environment.

2.2. Natura 2000 permit (Chapter 7, Section 28 a of the Environmental Code)

Halland County Administrative Board is the permit authority for a Natura 2000 permit for Kattegatt Syd. Before applying for a permit in accordance with Chapter 7, Section 28 a, a specific EIA must be made of the project. The application, according to Chapter 6, Section 36 of the Environmental Code, must include a description of the project's consequences for the purpose of conservation of the area.

The area for the planned wind farm is located between two Natura 2000 areas: Lilla Middelgrund in the north and Stora Middelgrund and Röde bank in the south (Chapter 6.1.5). As significant impact on the environment in these Natura 2000 sites cannot be excluded at this stage, the assumption is that a Natura 2000 permit linked to the installation and operation of the wind farm will be required. The assessment is based on impact factors such as underwater noise, turbidity and sediment deposition associated with the wind farm installation phase, as well as potential displacement of birds during the operational phase. The impact on the environment in these Natura 2000 sites resulting from the wind farm will be further investigated. Further investigation will also clarify whether additional Natura 2000 sites need to be included in a Natura 2000 permit for the installation or operation of the wind farm.

2.3. Permit in accordance with the Continental Shelf Act for laying cables in the Swedish economic zone and in the territorial sea (Section 3a of the Continental Shelf Act (1966:314))

The laying of the submarine cables (both within the economic zone and Swedish marine territory) requires permits in accordance with the Continental Shelf Act (1966:314).

Chapter 3

Planned operations

3. Planned operations

3.1. Wind farm

The wind farm is primarily composed of wind turbines with foundations and inter-array cables that connects the wind turbines via one, or possibly two, substations (Figure 3). In installing the wind farm, the various parts are usually transported by barge or offshore vessel. The various parts are then assembled on site using a crane.

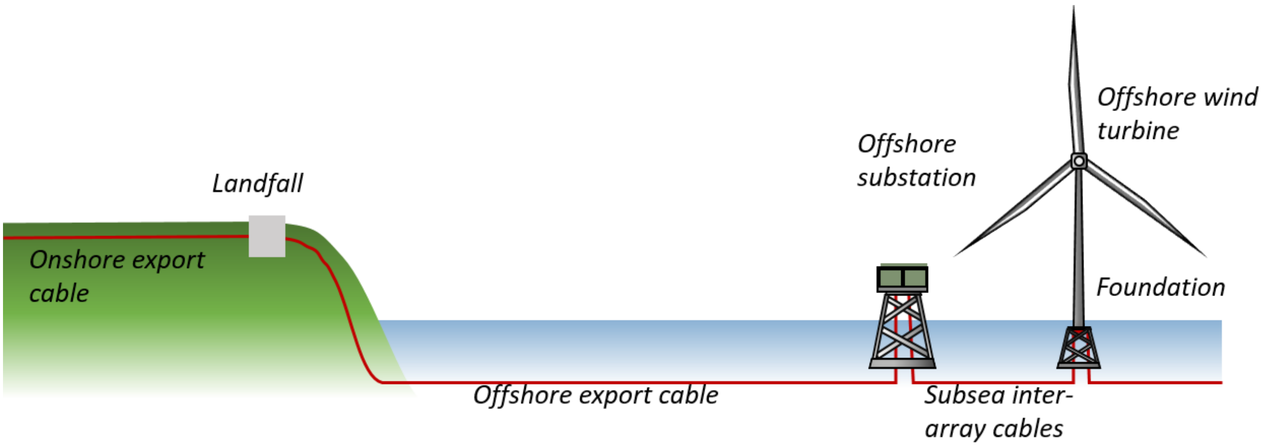


Figure 3. Schematic of an offshore wind farm, including all its parts.

Offshore wind technology is currently developing at a rapid rate. It is therefore difficult to predict which technology will be available at the time of detailed design planning. As a result, no decisions have been made regarding the final design of the wind farm, the choice of foundations and the installation technology. It is important that future technical solutions are taken into account and can be used in the project, i.e., to not yet commit to a specific technical solution.

3.1.1. Turbines

A wind turbine consists of a tower, a hub with rotor blades, and a nacelle. The tower is usually made of steel in shades of white or grey and is mounted on a foundation. The output, size and location of each individual wind turbine will be selected according to the technology available at the time of the tender. The plan is to apply for permits for up to 80 wind turbines and a maximum total height of 350 m. Total height refers to the height from the water surface up to the uppermost tip of the rotor. In order to illustrate possible designs, two example layouts have been presented with two different wind turbine sizes (15 MW and 20+ MW) for which the total number of wind turbines is estimated to be 80 and 60, respectively (see Table 2 and Figure 4. The two examples represent two possible extremes ('worst case' scenarios). Example 1 is the wind farm designed with the maximum number of turbines, achieving a capacity of 1200 MW, whereas Example 2 is the design with the greatest total height. It is not impossible that there will be wind turbines with a higher output than 20MW+ at the time of detail design planning.

Table 2. Example of wind farm layout.

Wind turbine design	Example 1	Example 2
Number of wind turbines	80	60
Maximum total height (m)	260	350
Rotor diameter (m)	230	320
Capacity	15 MW	20 MW+

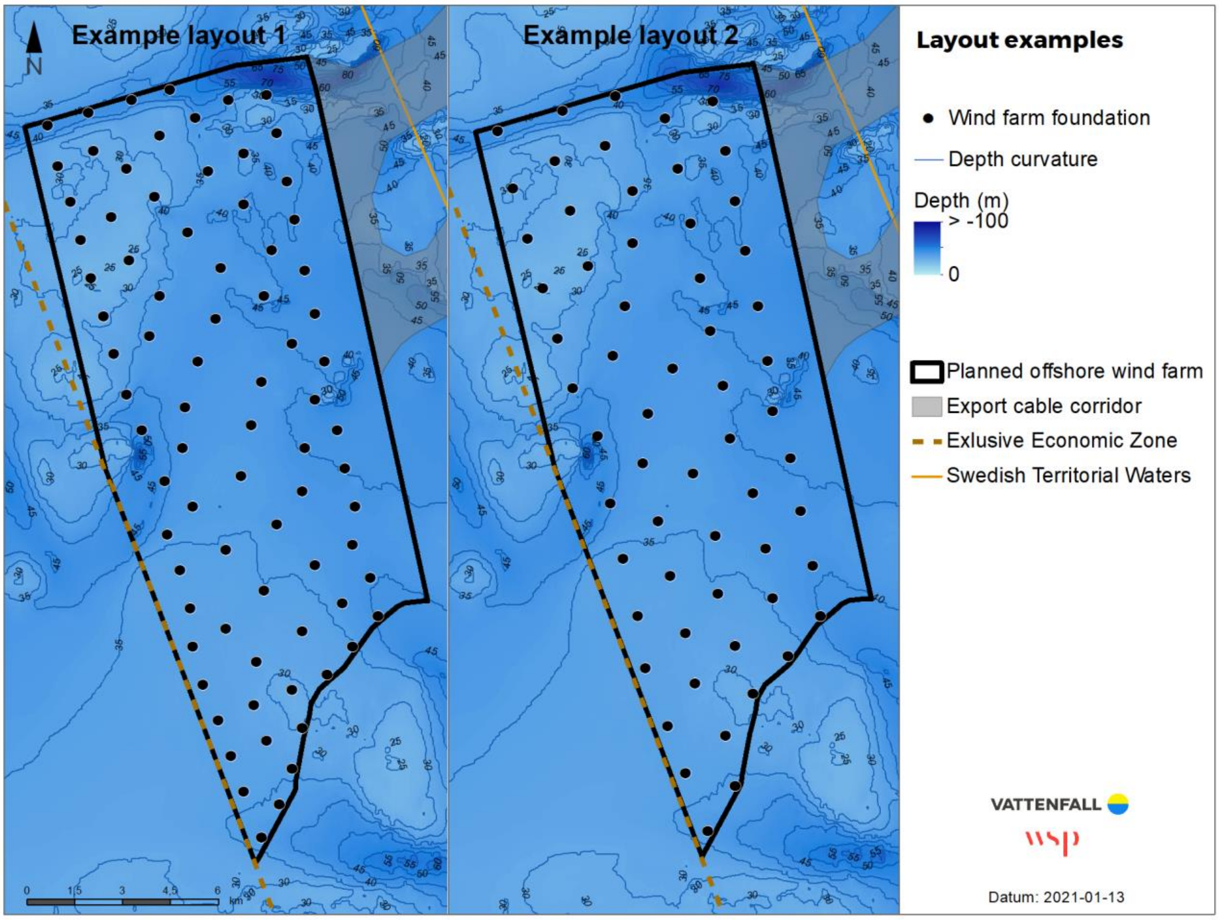


Figure 4. Two different examples of wind farm layouts. Example 1 illustrates 80 turbines with a total height of 260 m. Example 2 illustrates 60 turbines with a total height of 350 m (data source: depth from EMODnet).

Regardless of the size of the wind turbine, the distance between the water surface and the blade is planned to be the same for the two example layouts (minimum 20 m). The average distance between the wind turbine foundations for the 60 wind turbine option is about 1.6 km and for the 80 wind turbine option about 1.2 km. The relative size of the wind turbines in examples 1 and 2 is shown in Figure 5 below. The wind turbines will be equipped with obstruction lighting in accordance with prevailing regulations.

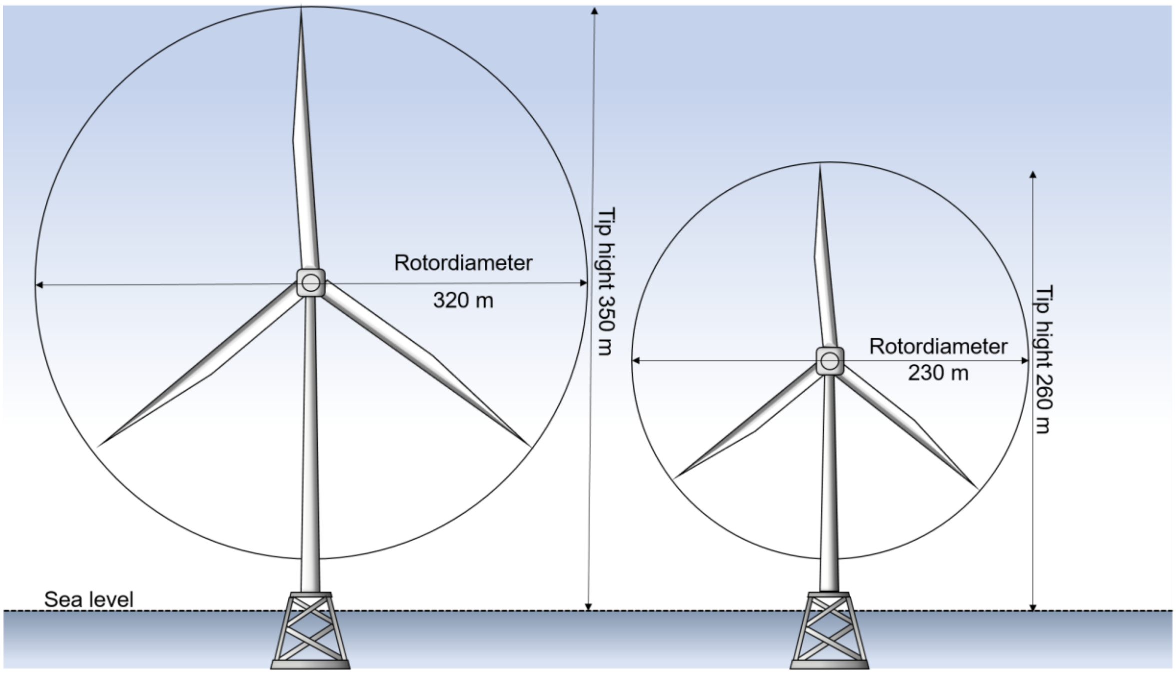


Figure 5. The relative size of the wind turbines for each wind farm layout example.

3.1.2. Foundations

Different types of foundations can be used for offshore wind turbine installation, the suitability of which depends on conditions such as depth, seabed conditions and wind turbine size. Figure 6 shows the types of foundations that are currently being considered for Kattegatt Syd. Normally, all foundations in a wind farm will be of the same type, but in special cases, for example, when geotechnical conditions and depths vary greatly within the wind farm area, it may be preferential to use different types of foundations in the same wind farm. Considering the speed of technological developments, it is possible that other types of foundations may be relevant at the time of installation than those presented in this consultation document.

Some form of scour protection is usually used around the foundation. The need for scour protection and the type of protection used will depend, for example, on the flow rate of the water, the seabed substrate and the type of foundation. A common form of scour protection is to lay several layers of different size stones around the base of the foundation.

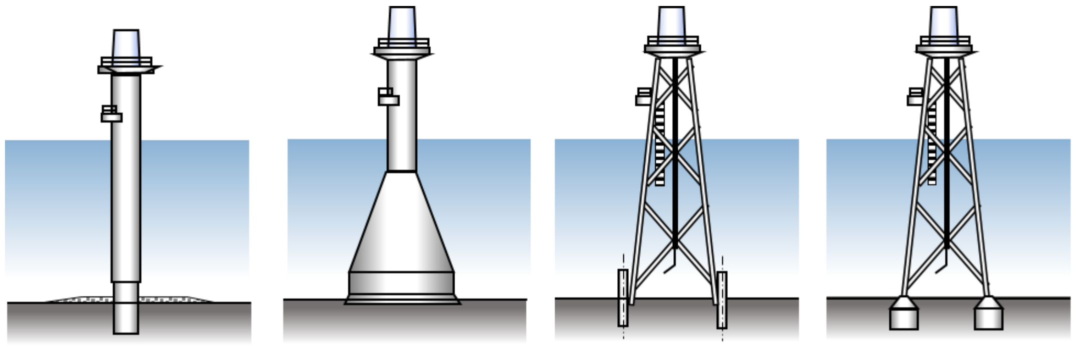


Figure 6. The different types of foundations currently applicable in Kattegatt Syd.

Monopile foundation

Monopile foundations (Figure 6) are the type of foundation most commonly used in offshore wind power. With today's technology, these can be installed down to a water depth of about 40 m. The monopile foundation consists of a steel cylinder pile driven into the seabed (in some cases by drilling or a combination of piling and drilling). This foundation type is suitable when the seabed substrate consists of sand, rock-mixed base or clay with a solid underlying layer and is less suitable in areas of bedrock or in the presence of large boulders. The monopile foundations considered in Kattegatt Syd have a diameter of between 10 and 14 m. Scour protection in the form of stones or equivalent is added and laid approx. 15 to 30 m around the foundation.

The advantages of monopile foundations are their relatively small footprint and relatively quick installation. In general, limited preparation of the seabed is required when installing monopile foundations, but some dredging/levelling may be required, especially when there are sand dunes.

Monopile foundations can be transported out to the wind farm either by towing (floating in the water) or by ship/barge. The foundation is placed on the seabed either from a jack-up vessel or from a floating crane.

Gravity base foundations

Gravity base foundations may have a variety of designs, but usually they are made up of a cylindrical structure on top of a cone-shaped base structure (Figure 6). The foundation usually consists of concrete with steel reinforcement. Before installing a gravity base foundation, dredging/levelling prep work of the seabed surface is usually required, especially in areas with sand dunes. It may also be necessary to construct a hardened plateau before the foundation can be installed. When using this foundation type, the foundation's base diameter is expected to be 50–60 m and its associated scour protection is expected to have a diameter of between approx. 250 and 300 m. Installation takes place by lowering the foundation to the seabed where it is held in place by its own weight. Compared to monopiles and jacket foundations, gravity base foundations have a larger footprint and require considerably more material and longer working time in water. The advantage of gravity base foundations is that no drilling or piling is required during installation, which minimises the generation of underwater noise.

Gravity base foundations are manufactured on land and transported out to the area either by towing (floating in the water) or on board a barge or offshore vessel. The foundation is then lowered to the seabed by means of a crane and then filled with ballast, e.g. sand.

Jacket foundations (*jacket*)

Jacket foundations (Figure 6) consist of a steel tube structure and are available in a variety of designs. Jacket foundations are adapted for use at great water depths (over 40 m). The type of jacket foundation that could be used in Kattegatt Syd is anchored to the seabed either by piling or drilling three to four steel pipes into the seabed or by means of suction buckets (caissons). The suction buckets consist of steel cylinders (diameters between 14 and 20 m) which are lowered into the sediment and installed by sucking water out of each caisson, resulting in a suction force which pulls the foundation down (no drilling or piling required). Stone or equivalent scour protection is added and laid within a distance of approx. 15 to 30 m around the caissons.

When installing by means of piling, the method is similar to that for monopile foundations (see paragraph above), but since the energy required for piling is determined by the size of the steel pipe, significantly less energy is required for installation of jacket foundations. The piles for jacket foundations are relatively narrow (3–4 m in diameter). Stone or an equivalent scour protection is added and laid within a distance of approx. 4 to 6 m per steel pipe. Installation by drilling is primarily applicable for hard seabeds (sometimes piling may also require pre-drilling).

Jacket foundations have the advantage of being suitable for greater depths (than monopiles). In addition, the same degree of piling work is not necessary as for monopile foundations, thus limiting the generation of underwater noise. The base area used for the foundation itself is relatively small. In contrast to monopile, however, more extensive dredging/levelling of the seabed is required when installing jacket foundations as all legs must be level.

Jacket foundations are transported out to the area by barge or offshore vessel. As with monopile foundations, jacket foundations are assembled using a crane from a jack-up vessel or crane vessel.

3.1.3. Internal cable network

The inter-array cables connect the wind turbines to the offshore substation(s). Single wind turbines are likely to be interconnected in groups which are then connected to the offshore substation(s). The cables will be laid by a cable laying vessel and be buried in the sediment at a maximum depth of two meters. A common way to do this is by jetting or ploughing. On harder seabeds where burying is not possible, mechanical protection such as concrete mattresses, aggregate or equivalent may need to be laid on top of the cables.

The cables are approx. 20 cm in diameter and have a preliminary three-phase AC voltage of 66 kV. A cable can handle approx. 80 MW, which means that the wind turbines are grouped in radials out from the substation(s). The total length of the inter-array cables is determined by the final design of the wind farm, but is estimated to be no more than approx. 200 km.

Because the inter-array cables connect the wind turbines to the substation, the location of the inter-array cables depends directly on the location of the wind turbines and the substation within the farm.

3.1.4. Substation(s)

One large or two small offshore substations will be installed for the wind farm and will serve as a hub between the inter-array cables and the export cable. The design and location of this will be determined in the detailed design of the wind farm, based on the seabed conditions and optimal cable routing. Alternative locations for substations are currently being investigated along the eastern side of the wind farm.

Substations are prefabricated modules. The dimensions may vary from supplier to supplier, but one example being investigated for one of the substations is a construction with a length of 170 m, a width of 120 m and a height of 65 m. The substation(s) will be installed on a base approximately 10 m above the water surface. The types of foundation in question are the same as for the wind turbines, but the most likely alternative is a jacket foundation (Figure 6). The substation will be clearly marked so that it is visible to boats and air traffic in accordance with applicable regulations.

Figure 7. Example of substation design with jacket foundation.

3.1.5. Dredged material management

Installation of gravity base and/or jacket foundations requires seabed preparation work that may involve levelling the seabed surface, displacing seabed material or dredging. In some cases, installation of other foundation types may also involve seabed prep work that generates a surplus of excavated material. Alternatives for handling excavated material will be investigated prior to the upcoming EIA for the wind farm, but the goal is to identify solutions that limit the amount of material needing handling as much as possible. For this reason, reuse of project materials will be investigated, e.g. for filling in gravity base foundations or to recreate natural seabed conditions by backfilling over scour protection.

There may be a surplus of excavated material, especially when selecting gravity base and/or jacket foundations. Vattenfall plan to dispose a surplus of dredged material at sea if it has been determined that the material cannot be reused within the project and if the contamination levels of the material permit dumping. Any disposal of material will require an exemption from the disposal ban.

In the process of dredging, dredged material is loaded onto barges or into the dredger ship and transported to a suitable location for disposal. Suitable sites for disposal will primarily be sought within or directly adjacent to the dredging site and within the wind farm area. Another possibility is to utilize existing disposal sites outside the wind farm area or to investigate new disposal site locations.

3.2. Decommissioning the farm

When the wind farm is decommissioned, it is likely that all structures above the seabed surface will be dismantled. Usually this is done in reverse order of the installation process. The components to be dismantled/removed will be determined at the time of decommissioning. Prior to decommissioning, it will be assessed whether the environmental impact of deposing certain components (e.g. components below the seabed surface) would be lower than removing them. The decommissioning will be environmentally assessed in the forthcoming permit review based on the solutions currently available on the market. Vattenfall's previous experience of decommissioning the two offshore wind power projects in Sweden, Yttre Stengrund and Utgrunden, will also be used to inform the environmental impact assessment.

3.3. Preliminary schedule

Establishment of the farm is a comprehensive project that will require several different permits. The permit process is expected to continue until 2024. Detailed design planning and procurement are estimated to take about four years, so it is important that the permit reviews can start as soon as possible. The installation phase is preliminarily planned to begin in 2028 and the wind farm is expected to be in place by the end of 2030 (Figure 8).

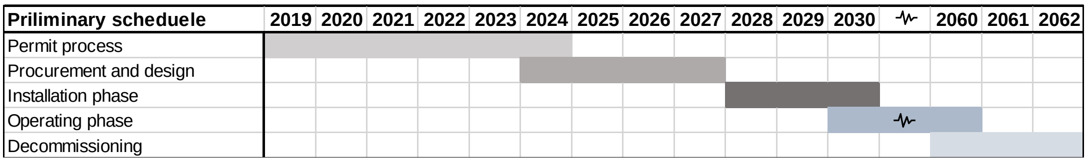
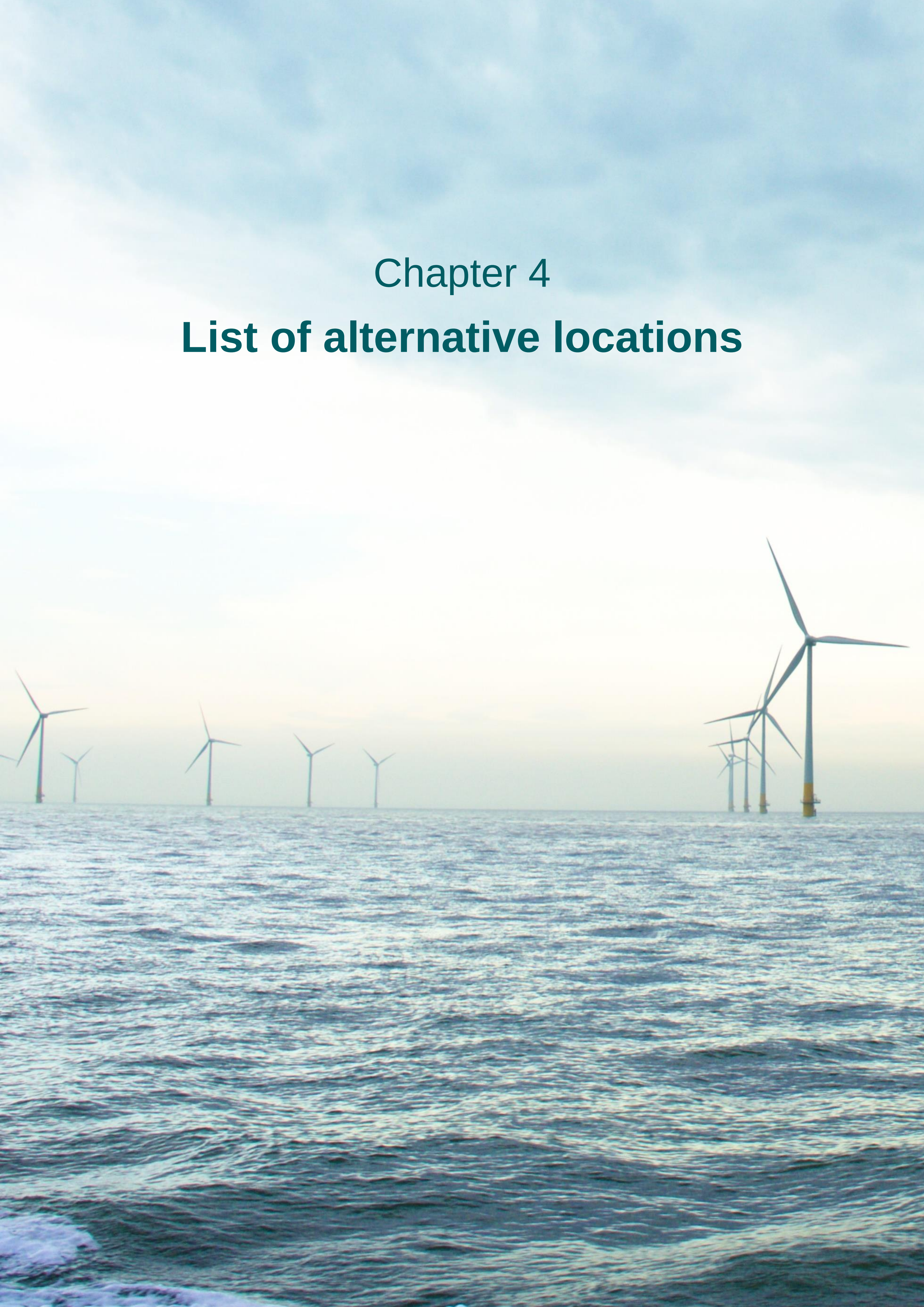


Figure 8. Preliminary, general schedule for Kattegatt Syd project.

Chapter 4
List of alternative locations



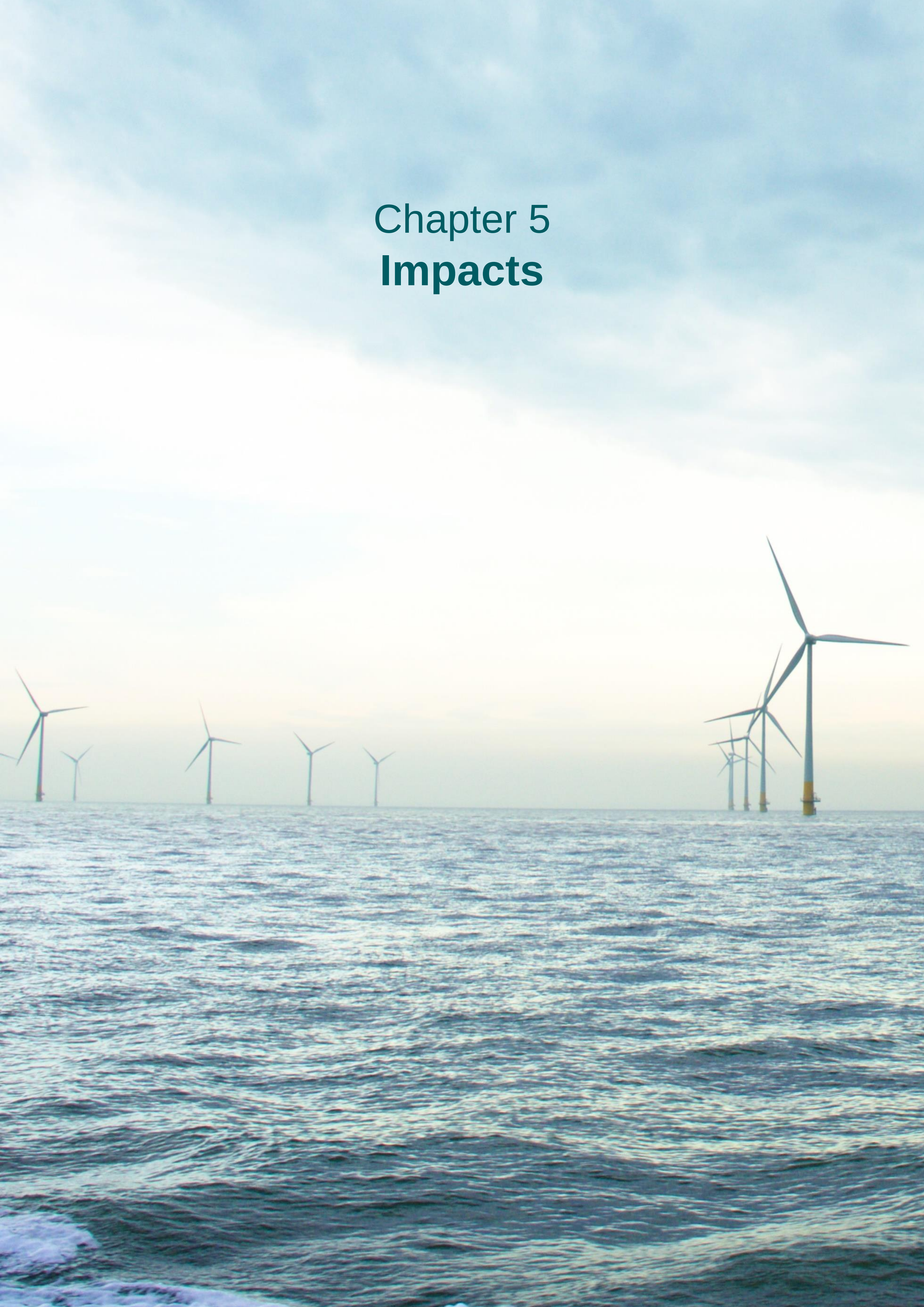
4. List of alternative locations

4.1. Wind farm

The marine environment is complex and encompasses different competing interests, which means that there are many different aspects to consider when choosing a location for offshore wind power. Vattenfall has extensive experience in offshore wind power in other European countries and has a well-founded methodology for identifying the most optimal sites for establishment, taking the environmental and commercial factors into consideration. The proposed location of Kattegatt Syd wind farm was preceded by a comprehensive site investigation and selection process to identify suitable areas along the Swedish coast. The aim of the selection process was to identify a site on which renewable energy can be generated cost efficiently, taking important environmental aspects into consideration, and thereby have the potential to deliver cheap, sustainable electricity to Swedish consumers.

In the first stage of the selection process, about 15 sites along the Swedish coast were identified as potentially suitable for establishing offshore wind power. These locations were identified on the basis of a heat map, which was the result of a spatial GIS model based on physical, technical, environmental and commercial criteria. These locations were then evaluated in more detail by Vattenfall's technical team and experienced environmental consultants. The evaluation included assessments of potential impacts on birds, fish, marine mammals and protected areas (including Natura 2000 areas and national interests), and of how well the establishment of a wind farm in these areas relates to the marine spatial plan and other marine users. The areas identified as having high potential based on these criteria were then further evaluated on the basis of various technical parameters such as seabed conditions, wind conditions and water depth. The result of the selection process showed that Kattegatt Syd was the most promising site for establishing a wind farm in Swedish waters, having a relatively limited environmental impact, the possibility of using protective measures to minimise permanent environmental effects and the possibility of generating cost-effective electricity. In addition to this, the proximity to Vattenfall's Stora Middelgrund wind power project also provides great potential for collaborating on data collection, knowledge sharing, and maintenance during the operational period.

Chapter 5
Impacts



5. Impacts

Below are the main identified impacts of installing, operating and decommissioning the wind farm and its associated infrastructure (Table 3).

Table 3. The most important impacts related to the installation, operation and decommissioning of the wind farm with associated cables and infrastructure. Parentheses (√) indicate a lesser impact.

Impact	Installation phase	Operating phase	Decommissioning
Wind farm			
Noise/underwater noise	√	(√)	√
Loss of seabed habitat	√	√	
Turbidity/sediment deposition	√		√
Collision risk		√	
Displacement/barrier effect		√	
Presence of offshore vessels	√		√
Changed and new habitats		√	
Magnetic fields (cables)		√	
Changed visual landscape		√	

5.1. Wind farm

5.1.1. Installation phase

The following impacts will occur during the installation phase: the generation of underwater noise (above all during pile-driving); turbidity and sediment deposits during seabed preparation work, foundation installation and cable laying; impacts on the seabed surface when erecting foundations; and the presence of offshore vessels and platforms during the course of the work. The table below summarizes the impact of the different foundations investigated (Table 4). The table is indicative and may therefore change in relation to specific conditions and technical solutions.

Table 4. Variations in the degree of impact for different types of foundations.

	Foundation type			
Impact	**Monopile**	**Jacket (piling)**	**Jacket (caisson)**	**Gravity base**
Pile-driving	Yes	Yes	No	No
Turbidity	Yes	Yes	Yes	Yes
Dredging/sediment disposal	No	No	Likely	Likely
Foundation size	10–14 m in diameter	30–40 m between piles (diameter of piles = 3–4 m)	30–40 m between caissons (diameter caissons = 14–20 m)	50–60 m in diameter
Size of scour protection	5 x diameter	4 x diameter (piles) x number of piles	3.5 x diameter (caissons) x number of caissons	5 x diameter

Underwater noise

The amount of underwater noise generated during the installation of the wind turbines and offshore substations depends primarily on the choice of foundations. Underwater noise is primarily related to the installation of foundations by piling, which means high noise levels as they are driven into the seabed with great force. The noise level generated depends on the diameter of the pile. The larger the diameter of the pile, the more force or an increased installation time is required to drive it down to the seabed and thus, in total, more noise will be produced. The sound levels generated by pile-driving monopile foundations are particularly high, as the foundation consists of a single large-diameter pile. Jacket foundations can also be pile-driven, but the sound levels will be considerably lower as the piles are smaller in diameter. When installing gravity base foundations or jacket foundations with caissons, there is no need for pile-driving, thus limiting underwater noise to that which is generated by offshore vessels and general installation noise. Underwater noise associated with establishing the various types of foundations will be modelled in the Environmental Impact Assessment process.

Turbidity/sediment deposition

Turbidity, dispersal of sediment particles and sediment deposition occur as a result of installing foundations for wind turbines and offshore substations and laying cables in the wind farm. Turbidity and sediment deposition can also be expected in the case of sediment disposal linked to seabed preparation work for installing gravity base and/or jacket foundations. The extent of the turbidity and how far the particles spread depends on the seabed substrate and the method chosen. An effect on a seabed of small-particle sediment, such as clay, will cause more turbidity and greater particle spread than the same measure on a seabed consisting of sand or stone, for example. The size of the particles also determines how long it will take before they fall back to the seabed and thereby the extent and thickness of subsequent sediment deposits.

Installing any type of foundation causes turbidity to a certain extent. In installing foundations, the scope of seabed preparation work and the need for pre-drilling in the case of pile-driving are determining factors. Gravity base foundations are the type of foundation that requires the most seabed surface preparation and extensive measures such as dredging and levelling during foundation work, but to some extent, this also applies to jacket foundations. Monopiles and jacket foundations with piles are foundations that may require pre-drilling. The turbidity and sediment deposition associated with the establishment of the various foundations and laying of cables will be modelled during the Environmental Impact Assessment process.

Loss of seabed habitat

Wind turbine foundations, substation foundations and scour protection all impact seabed surface and natural habitats. Different types of foundations (foundation and scour protection included) cover different proportions of the seabed surface. In total, gravity base foundations are the type that have the largest footprint on the seabed (see Table 4). Cable laying in the wind farm makes a temporary impact on the seabed if the cables are buried, but if it requires mechanical protection of the cables, the intrusion may be more permanent. (Overlay of natural material may occur, which will also be temporary.)

Physical presence of vessels

During the establishment of the wind farm, several offshore vessels and work platforms of various kinds will be present in the area, which may cause disturbance in the form of underwater noise and physical presence in the area.

5.1.2. Operational phase

Impacts of the operational phase are primarily the changes made to the physical environment as a result of the newly installed structures, noise from the wind turbines, and magnetic fields from the wind farm cables.

Collision risk

The wind turbines are new physical structures, and as such, there is a risk of collision, not only for ships but also for birds and bats.

Displacement/barrier effect

The physical structures of the wind farm can lead to displacement effects or barrier effects, i.e. birds or fish, for example, choosing to avoid the area.

Changed and new habitats

Wind turbines, substations and their foundations change the physical environment both above and below the water surface, which changes habitats and could potentially create new ones. Though the structures above water level will largely be the same regardless of the type of foundation, the structures below the water level are directly linked to the type of foundation and scour protection. Comparable to the installation phase, gravity base foundations and jacket foundations with caissons cause the greatest change to the physical environment.

Noise/underwater noise

During operations, the turbines emit low frequency underwater noise, caused by blade rotation. The operating noise is within the same frequency range as that from ships. As such, it is assumed that this noise will be largely masked by the noise from nearby shipping lanes. As the wind farm is located far from the coast, the operating noise will not be audible from shore.

Electromagnetic fields

An electromagnetic field will be generated around the cables in the inter-array cables. The force of the magnetic field quickly diminishes the further you get from the cable. If the cable is buried in sediment, the strength of the magnetic field will be less at the seabed surface.

Changed visual landscape

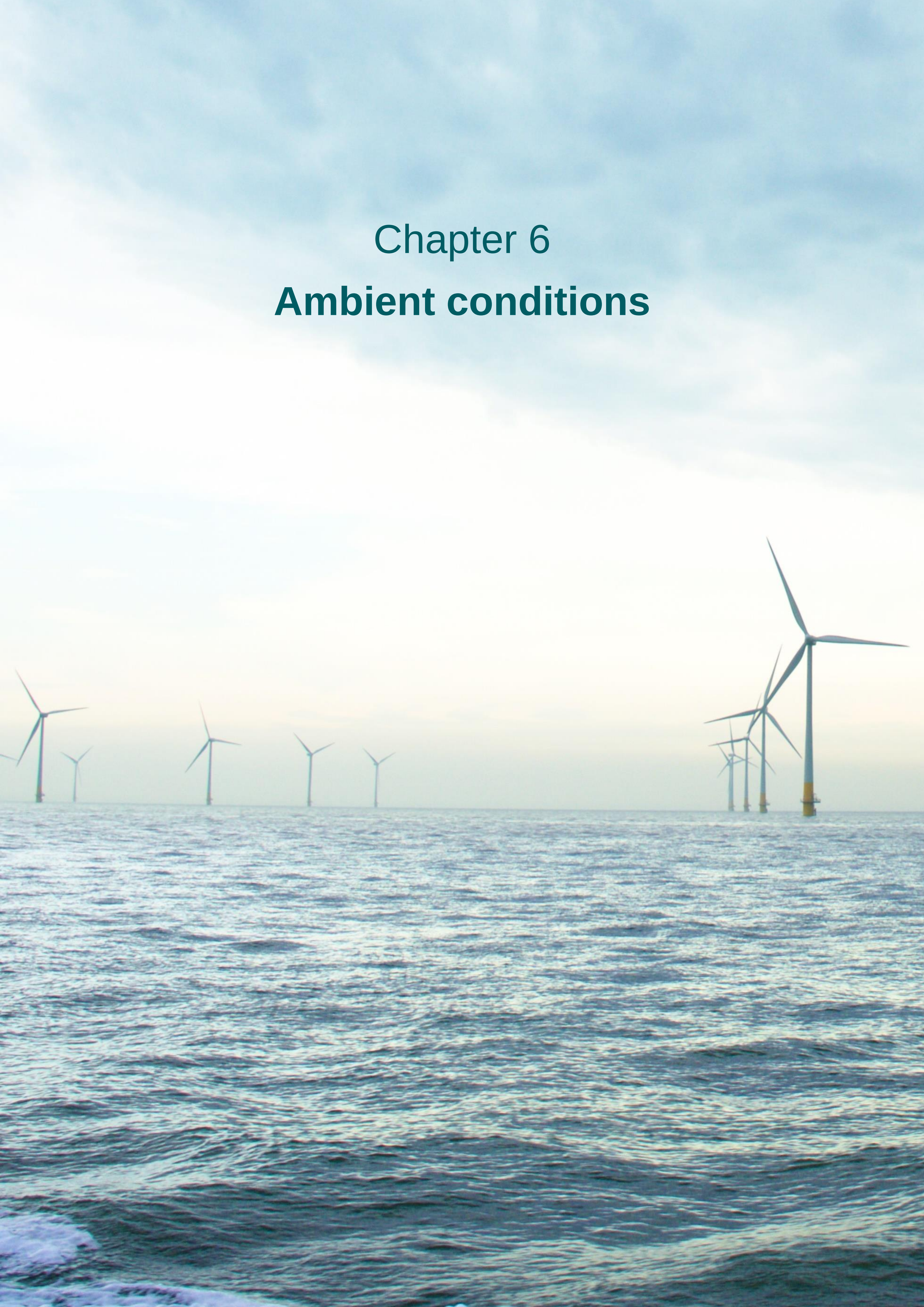
Wind turbines are tall structures and can therefore change the visual landscape at sea as well as from land (Chap. 7).

5.2. Decommissioning of the project

The impacts of decommissioning the wind farm depend on how it is done, and which structures are to be decommissioned. The general rule is to remove the structures unless the environmental damage caused by removing them is deemed to be greater than the environmental benefit.

It is likely that the structures above the seabed will be decommissioned, which would involve the presence of a large number of offshore vessels in the area generating underwater noise while dismantling the various components. However, considering technology and knowledge change rapidly (and the service life of a wind farm is about 30 years), it is unclear just how decommissioning will take place and which parts will ultimately be dismantled. The impact of decommissioning that will be described in the EIA will be based on what is known at the time.

Chapter 6
Ambient conditions



6. Ambient conditions

6.1. Wind farm

6.1.1. Wind and wave conditions

In the Kattegatt Syd area, westerly and south-westerly winds dominate about 40-50% of the time. It is also from this direction that the strongest winds have been measured (Figure 9). The modelled mean wind speed 137 m above mean sea level (msl) is just below 10 m/s (modelling carried out by Vattenfall).

The wave height in the area is limited by surrounding land masses, which means that the expected maximum wave height (significant wave height) over a 50-year period is 5.7 m[2].

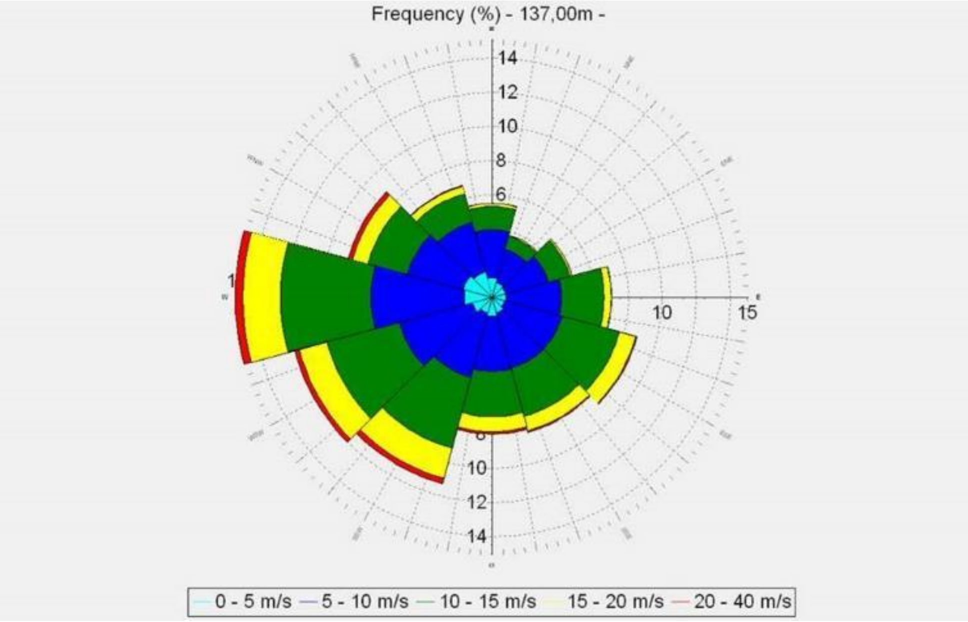


Figure 9. Wind rose for Kattegatt Syd, modelled for 137 m above the mean sea level.

6.1.2. Hydrodynamic conditions

In the Kattegat Sea there are several permanent currents. The permanent Baltic current is caused by annual freshwater surplus from the Baltic Sea and generally flows north as a surface current. This current runs in the opposite direction of the underlying southbound deep-water current of saltier water (SMHI, 1987). Along the Danish North Sea coast, the Jutska current, which transports water with a high salt content (often more than 30 ‰) from the North Sea, into the Kattegat Sea (SMHI, 2011). The Kattegat Sea therefore consists of two layers, the upper surface layer consisting of brackish water from the Baltic Sea and the lower one of sea water from Skagerrak. The Kattegat Sea is also supplied with freshwater from Danish and Swedish watercourses, mainly from the Göta Älv river. The

[2] The wave height is generally stated in terms of significant wave height, which is the mean wave height of the highest third of the waves. Individual waves can be considerably higher.

layers are separated by a strong saltwater layer (halocline)[3] at a depth of approx. 15 m. During spring and summer, a temperature layer is also formed (thermocline)[4].

Current speeds are relatively limited in the Kattegat Sea, although speeds of more than 1.5 m/s have been measured in inflowing water to the Baltic Sea during major storms. Currents connected to tidal water are also weak and the area's tidal difference is limited to approximately 0.5 m.

6.1.3. Water depth

The Kattegat Sea forms part of the transitional area between the North Sea and the Baltic Sea and is shallow, especially on the Danish side. The average depth is 23 m, but depths down to around 100 m can be found in Swedish waters.

The planned wind farm will be located in the deeper territorial sea areas of the Kattegat. The wind farm will be located within a depth range of approximately 20–80 m. The majority of the area is flat, with slightly greater depth variation in the northern part (Figure 10).

Depth information has been obtained from a relatively low-resolution bathymetric map but still gives a good indication of the depth conditions in the area of the wind farm (EMODnet[5]). See appendix 1A for a more detailed illustration of depths.

Hydrographic surveys are planned for the wind farm area to map the depth conditions more accurately.

[3] transition zone between water mixtures with differing salinity
[4] a layer in oceans or lakes where the temperature changes very quickly within a small range of depth
[5] https://portal.emodnet-bathymetry.eu/

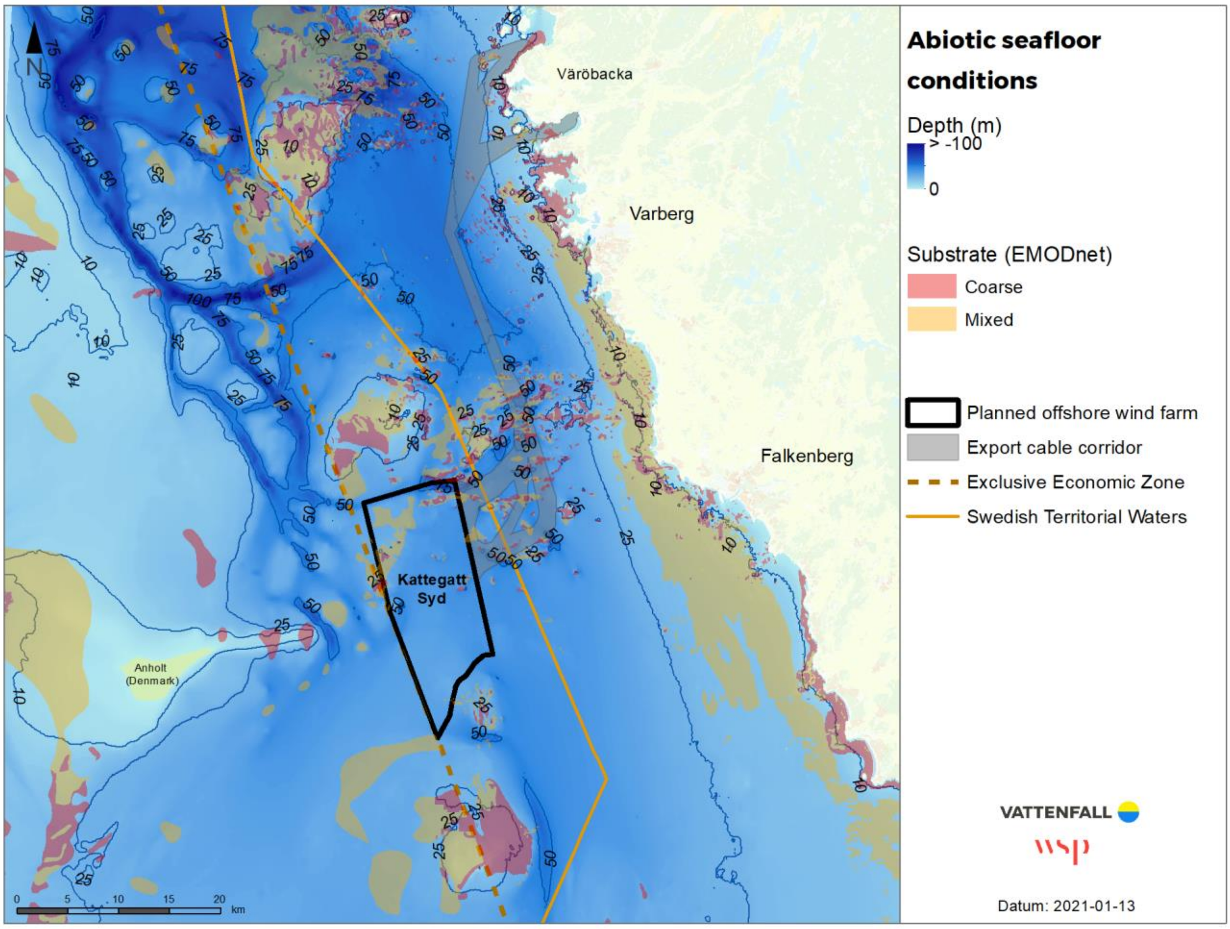


Figure 10. Depth and substrate conditions in the Kattegatt Syd area (data source: EMODnet).

6.1.4. Seabed substrate

In the project, extensive geotechnical, geophysical and sediment surveys are planned for around the proposed wind farm area to map out seabed conditions. The survey results will form the basis for project planning, impact assessments and future permit applications. A summary of the existing information is presented below.

According to available data, the seabed substrate in the planned wind farm area consists primarily of fine clay (Figure 10). However, in the shallow, northernmost parts there are areas of sand, gravel and small stones. For a more detailed diagram of the seabed substrate, see Appendix 1B.

6.1.5. Natura 2000

Detailed surveys of nearby Natura 2000 sites and marine protected areas will be included in future Environmental Impact Assessments. For further detailed descriptions of the marine protected areas, please refer to Chapter 6.1.9.

The planned wind farm is located between two Natura 2000 areas: Lilla Middelgrund in the north and Stora Middelgrund and Röde bank in the south (Figure 11). Five other Natura 2000 sites are 7–16 km away from the wind farm

(Table 5). The export cable corridors under examination border on two Natura 2000 areas: Morup's bank east of the wind farm and Balgö south of Väröbacka.

The marine protected areas in nearby Natura 2000 areas include reefs, cold seeps, shoals, marine mammals and birds (Table 5). Several of the Natura 2000 areas in the vicinity of the planned operations have been identified as Helcom MPAs[6] and/or OSPAR MPAs.

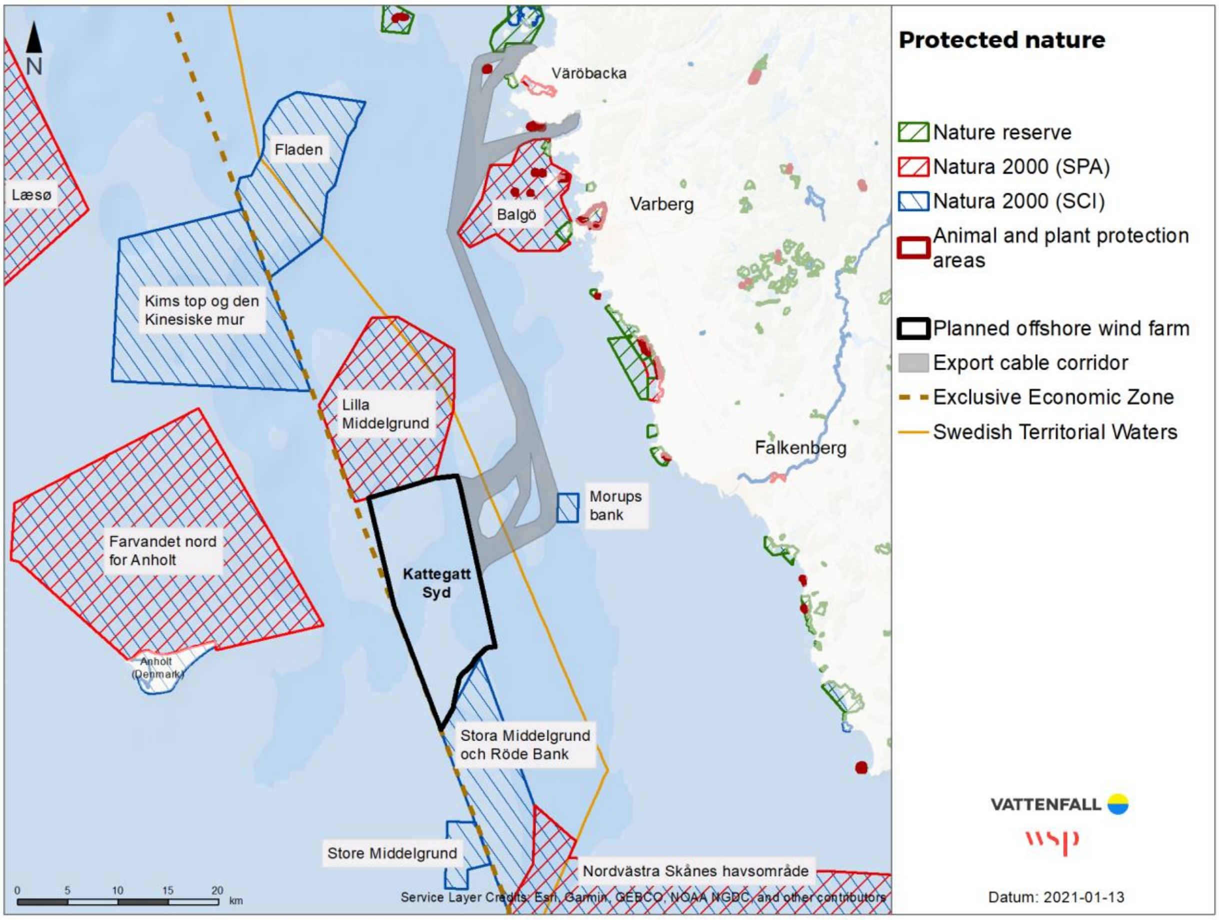


Figure 11. Protected areas near the wind farm and export cable corridor (data source: Swedish Environmental Protection Agency's mapping tool Skyddad natur).

[6] HELCOM Marine Protected Areas

Table 5. Natura 2000 areas close to the planned operations.

Natura 2000 area	Shortest distance from Kattegatt Syd (km)	Type of area protection	Marine Protected Areas (MPAs)
Lilla Middelgrund (Sweden)	0	Habitats & Bird Directives	1110 Shoals, 1170 Reefs, (1180 Cold Seeps according to forthcoming conservation plan), porpoises, guillemots, razorbills, black-legged kittiwakes
Stora Middelgrund and Röde bank (Sweden)	0	Habitats Directive	1110 Shoals, 1170 Reefs, 1180 Cold Seeps, porpoises, (razorbills, guillemots)[7]
Farvandet nord for (Denmark)	7	Bird Directive	Eider, velvet scoter, common scoter
Anholt og havet nord for (Denmark)	7	Habitats Directive	1110 Shoals, 1150 Lagoons, grey seal, harbour seal,
Store Middelgrund (Denmark)	9	Habitats Directive	1110 Shoals, 1170 Reefs, 1180 Cold Seeps, porpoise
Morups bank (Sweden)	9	Habitats Directive	1110 Shoals, 1170 Reefs
Kims top og den kinesiske mur (Denmark)	12	Habitats Directive	1170 Reefs, 1180 Cold Seeps
North-western Skåne sea area (Sweden)	13	Habitats & Bird Directives	1110 Shoals, 1170 Reefs, porpoise, harbour seal, grey seal, seabirds

6.1.6. Natural environment

Seabed community

There are plans to thoroughly survey the wind farm area to supplement existing data, get a detailed picture of the seabed habitat and to define any sensitive sub-areas. The survey results will form the basis for project planning, impact assessments and future permit applications. Below is a summary of the existing information primarily from surveys carried out by the County Administrative Board in Halland (Halland County Administrative Board 2018a), unless otherwise stated.

Video surveys of the deeper parts of the Kattegat Sea show that the seabed community in the wind farm area is dominated by the sea-pen and burrowing megafauna OSPAR habitat. Reef and shoal Natura 2000 habitats, which are included in the conservation plans for adjacent Natura 2000 sites, are mainly found in the northern part of the wind farm (Figure 12). According to fishing data from the Swedish Agency for Marine and Water Management, trawling for Norway lobster and other species is carried out in the area, which has resulted in recently incurred trawling damage in the northern and middle areas.

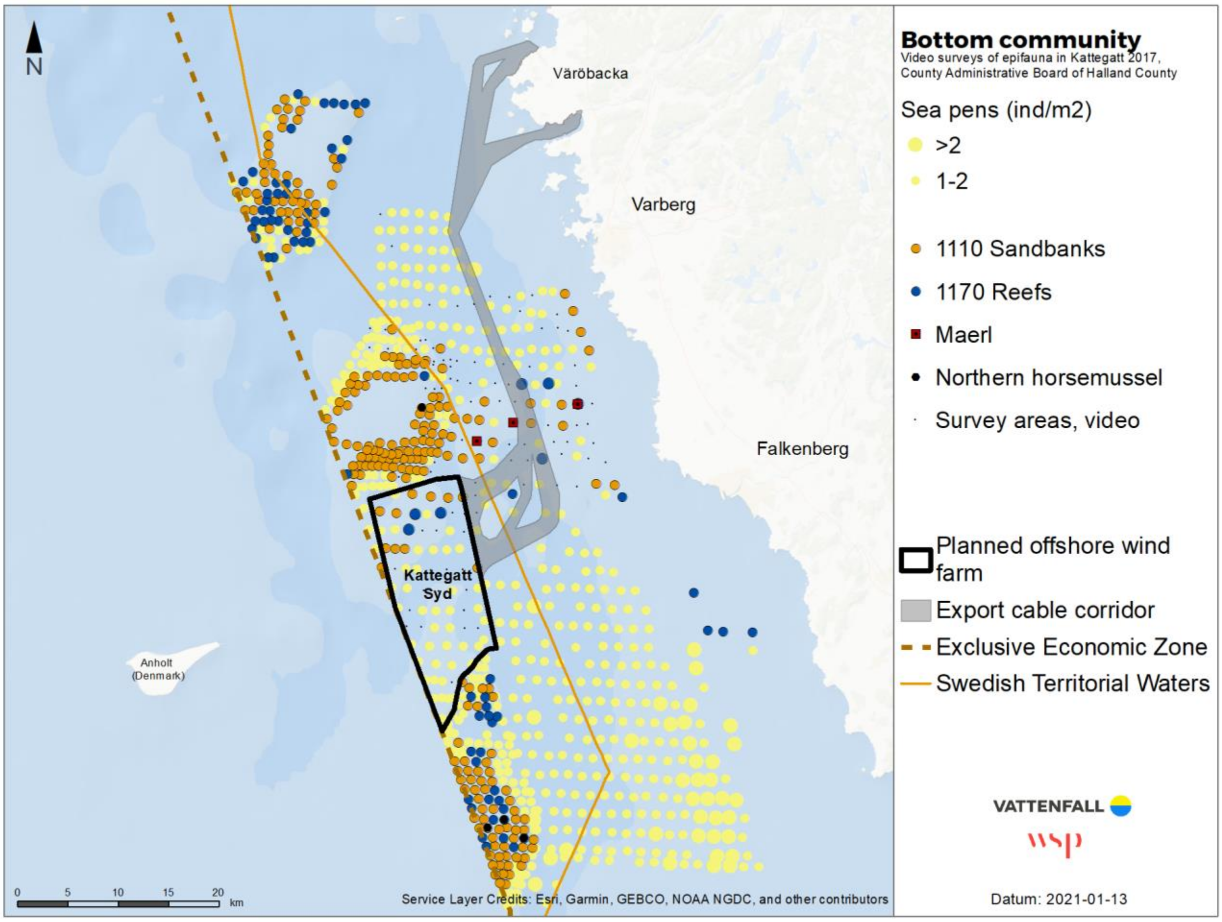


Figure 12. Nature types and habitats in the wind farm and surrounding area (data source: Halland County Administrative Board, 2018a & b).

For a more detailed map of the seabed community, see Appendix 1C.

Fish community

A more detailed analysis of the fish community around the wind farm has commenced and will be presented in future EIAs. Abundance and species diversity detailed in existing documentation will be presented relative to other areas of the Kattegat Sea. A short summary of the existing information is presented below.

The fish community on nearby territorial shoals, and on territorial shoals of the Kattegat in general, consists of common west coast species such as cod, poor cod, common sole, dab, goldsinny-wrasse, plaice, greater weever and whiting (Swedish Environmental Protection Agency 2010). However, the fish fauna on the territorial shoals is probably not entirely representative of the wind farm area, as the depth of the water there is greater and the substrate is generally softer and more homogeneous. According to fishing data from the Swedish Agency for Marine and Water Management, catches from the wind farm area consist primarily of herring, Norway lobster, cod, greater weever, plaice and other flatfish. Previous studies show that cod occasionally spawn off the coast of Falkenberg (Vitale, et al., 2008).

The species believed to use the wind farm area as a migration route are primarily eel, salmon, sea trout and broad-leaved pike. The Viskan river flows all the way into Klosterfjorden, and SLU's electrofishing data (2009–2019) shows that both salmon and eel migrate up into the watercourse to spawn.

Marine mammals

Three species of marine mammals can be found in the Kattegat Sea: harbour porpoises, harbour seals and grey seals. Surveys are underway to discover how relevant the wind farm area is to marine mammals (primarily harbour porpoises) during different parts of the year. With the help of leading experts in the field, analyses of historical data for the Kattegat Sea and passive acoustic monitoring devices placed in the water column, data will be analyzed to supplement the existing documentation. Data and detailed knowledge are available from work on the planned Stora Middelgrund wind farm nearby. The presence of marine mammals will also be measured as part of the various aerial surveys that have been started in the project area. Overall, the knowledge obtained of marine mammals in and around the planned wind farm will be very good. A short summary of the existing information is presented below.

Porpoises
An adult porpoise is about 1.5-2 m long, with a maximum weight of 90 kg. It is timid and hard to detect. Porpoises communicate and echolocate by means of high-frequency clicking sounds (115–130 kHz). The species is divided into three well-known populations: the Baltic Sea population, the Danish Straits population and the North Sea population. The porpoises that are located in the area around the planned wind farm belong primarily to the Danish Straits population

Harbour porpoises on the west coast of Sweden are classified as a least-concern (LC) species and are therefore not on the red list. However, the species is protected by the EU's Habitats Directive, Annexes 2 and 4, and in accordance with the Swedish Species Protection Ordinance (2007:845) Sections 4 and 5. Monitoring data shows that harbour porpoises are present in the southern Kattegat Sea to a greater extent during the summer (May-August) (Sveegaard, et al., 2017). Stora Middelgrund Natura 2000 area, south of the wind farm area (Figure 13) has been identified as important for harbour porpoises, above all during the reproduction period in the summer, while an area north of Lilla Middelgrund (between Fladen and Balgö) which overlaps with the export cable corridor has been identified as important for harbour porpoises during the spring (Carlström and Carlén 2016). Harbour porpoises are listed in the conservation plans for both Stora Middelgrund and Röde bank, Lilla Middelgrund and Balgö.

Harbour seals (classified as a *least-concern* (LC) species in both Sweden and Denmark) are common in the Kattegat Sea, on both the Swedish and Danish sides. Studies show that the species moves in the area of the planned wind farm (Dietz, et al., 2013). The species is listed in the conservation plan for the Balgö Natura 2000 area.

The population of grey seals in the Kattegat Sea is small, and according to the available data it is unclear whether and to what extent grey seals are present in the wind farm area (Hansen, J.W. & Høgslund, S. 2019). Grey seals were extinct from Swedish and Danish waters in the early 1900s, but the population is now increasing thanks to inward migration of adult individuals. However, very few cubs are born per year in the Kattegat Sea (Hansen, J.W. & Høgslund, S. 2019). Sweden considers grey seals in the Kattegat Sea to belong to the North Sea population and deems them to be a *least-concern* (LC) species, while in

Denmark, the species is deemed to be *vulnerable* (VU). Like harbour seals, grey seals are listed in the conservation plan for the Balgö Natura 2000 area.

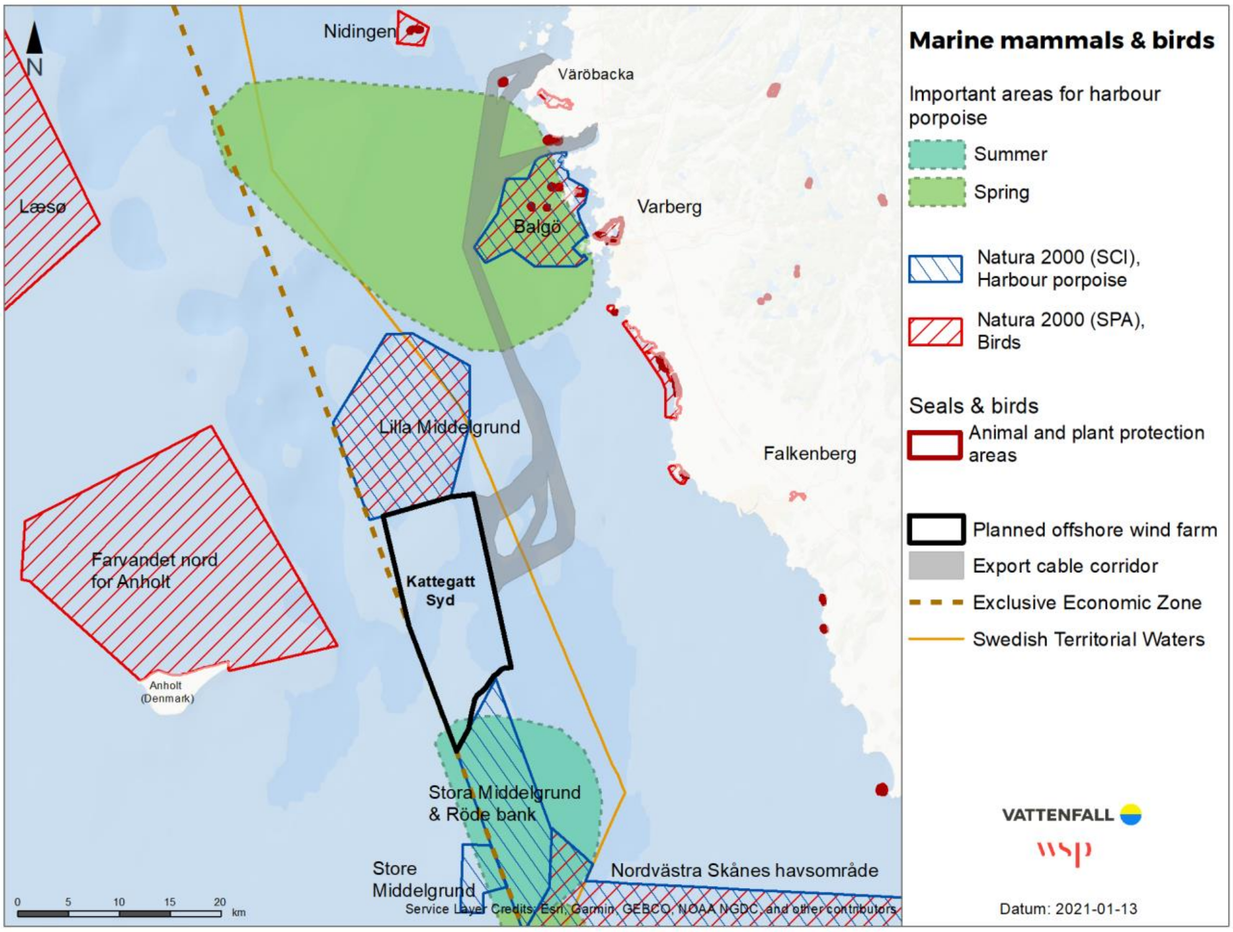


Figure 13. Important areas for marine mammals and birds near the wind farm and export cable corridor (data source: Skyddad natur and Carlström and Carlén, 2016). For a more detailed diagram of the bird, fish and porpoise areas, see Appendix 1D.

Seabirds

Boat-based and aerial surveys of birds have been initiated in the wind farm area, and aerial mapping of birds (and marine mammals) has been initiated to investigate which species and densities of birds occur, as well as how they use the area. Aerial image mapping is a digitised methodology that has been tried and tested in other European countries, but has not previously been used in Sweden. The method is based on the interpretation of high-resolution digital aerial images taken from a relatively high altitude using standardised methods. Among other things, this inventory method has the advantage that the results can be followed up at a later date as the photo documentation remains. The purpose of including the methodology is to increase the quality of inventory data, and to investigate whether the methodology can replace traditional aerial and boat-based surveys in the long term, in dialogue with the County Administrative Board. The results will form the basis for project planning, impact assessments and future permit applications. The existing information about the occurrence of seabirds in the surveyed area is summarised below.

Stora Middelgrund has not been identified as a Natura 2000 area under the Bird Directive, but auks (razorbills and guillemots) are included in the Natura 2000 area's conservation plan. Thanks to the inventories and surveys carried out within the adjoining trial project at Stora Middelgrund, Vattenfall have acquired good knowledge of the auks in the area. Additional bird inventories are now also underway in the area around Kattegatt Syd's planned wind farm area.

The inventories carried out by Vattenfall between 2018 and 2020 show that auks are at their greatest concentration on the outskirts of Stora Middelgrund during the winter. At the same time, it is important to bear in mind that Stora Middelgrund and nearby Röde bank are not considered to constitute areas of international significance for seabirds in the Kattegat Sea in the inventories that have been carried out (Durinck 1994). Kattegatt Syd's planned wind farm area constitutes a small part of a larger winter area for the auks, which is primarily concentrated to the deeper parts of the northern Kattegat Sea.

Bats

The planned wind farm is located far out at sea, where it can be assumed that considerably fewer bats would be present than closer to the coast. Prior to the permit application for the installation of a wind farm on the Fladen territorial shoal, common noctules and grey long-eared bats were primarily believed to potentially have migration routes (Environmental Protection Consultant Gerell 2002). According to experts in the Stora Middelgrund wind power project, headlands pointing in the south-westerly direction can serve to guide bats and thus make them leave the coast. No such significant headlands pointing toward Stora Middelgrund were identified along the coastline and investigations for the Kattegatt Offshore project showed that movements only take place along the coast. The likelihood of bats migrating from the Danish side over the Kattegat Sea has also been investigated in conjunction with work on the planned Stora Middelgrund wind farm nearby.

Bats

Surveys have found almost all of Sweden's bat species to be present in Halland County (Halland County Administrative Board 2016). Bats can be found over water when hunting insects and migrating (Swedish Energy Agency 2006) and may use offshore wind turbines as a resting place during insect hunting. Most bats migrate, but only a few migrate longer distances and over the sea. During migration, bats usually follow the coast.

Cultural heritage

Extensive seabed surveys are planned in this wind farm. The surveys will provide comprehensive high-resolution images of the seabed. The images will be analysed by marine archaeologists to discover cultural historical remains such as wrecks.

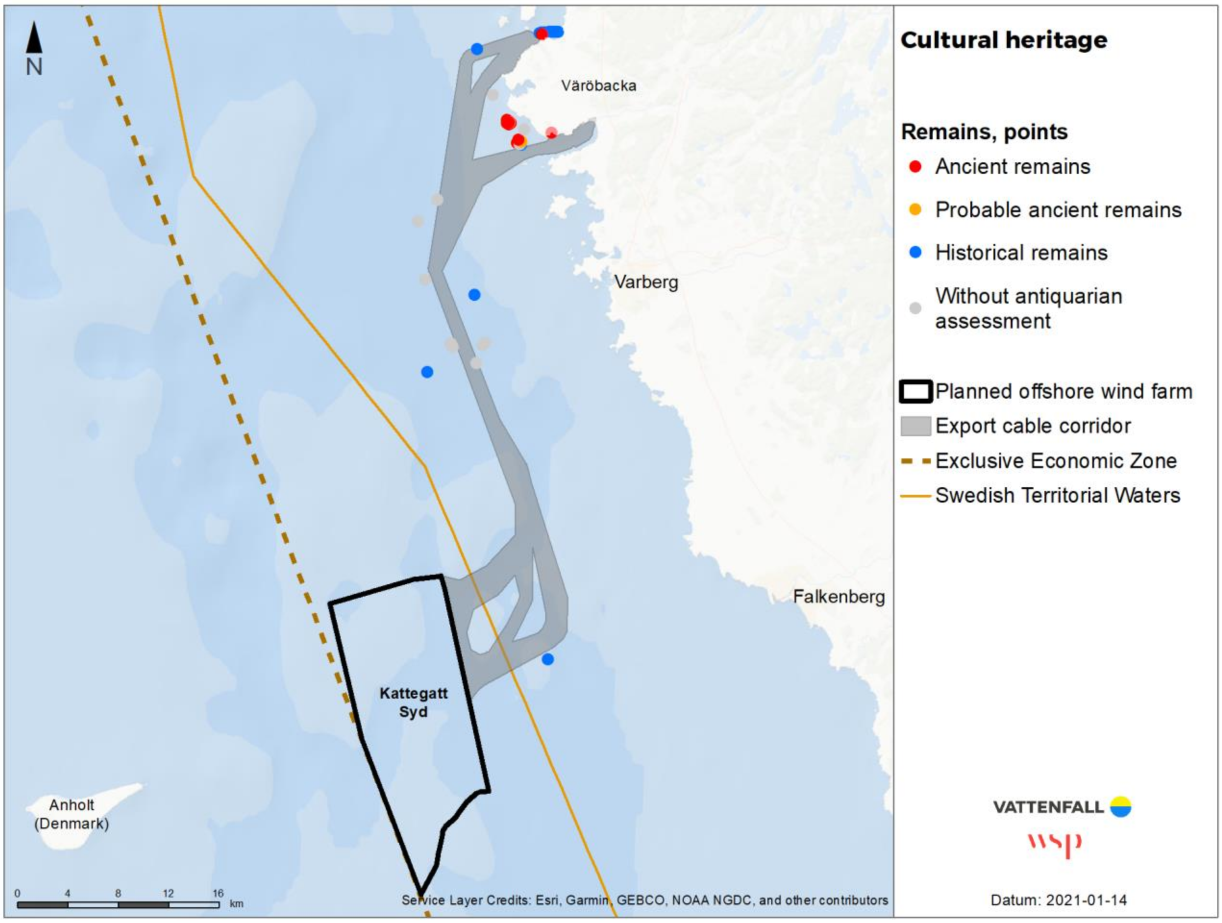


Figure 14. Areas of historical interest near the wind farm and export cable corridor (data source: The Swedish National Heritage Board's database).

There are no recorded cultural/historical remains in the wind farm area according to existing documentation. A detailed analysis of the existing knowledge of remains, together with the supplementary knowledge from planned seabed surveys, will form the basis for project planning, impact assessments and future permit applications.

6.1.7. Recreation and outdoor activity

Tourism is an important industry in Halland County, primarily during the summer months. The sea area for the planned wind farm provides the conditions for outdoor activities such as boating, sport fishing and seal safaris.

6.1.8. Business and infrastructure

Both east and west of the wind farm there are well-trafficked shipping lanes for commercial traffic. As of 1 July 2020, a new traffic separation scheme and a new vessel route, known as the S-Route, were introduced closer to the Swedish coast for traffic between Skagen and Öresund. The new scheme was introduced to create greater safety and to relieve the existing, heavily trafficked T-Route. The cable corridor will pass south ofthe new traffic separation scheme (TSS) on the S-Route (Figure 15).

Around Halmstad Airport there is an MSA (Minimum Sector Altitude) area that extends over the southern parts of the wind farm. The MSA area has a radius of 55 km. Within this area, aircraft shall maintain a safety margin of 300 m from the highest object. An obstruction evaluation must be done in an MSA area when constructing buildings or other objects that are taller than 20 m. A fibre-optic telecom cable called Kattegatt 2[8] extends between Sweden and Denmark. The cable became operational in 2001 and is owned by the Danish telecommunications company TDS. No known military areas are affected by the project.

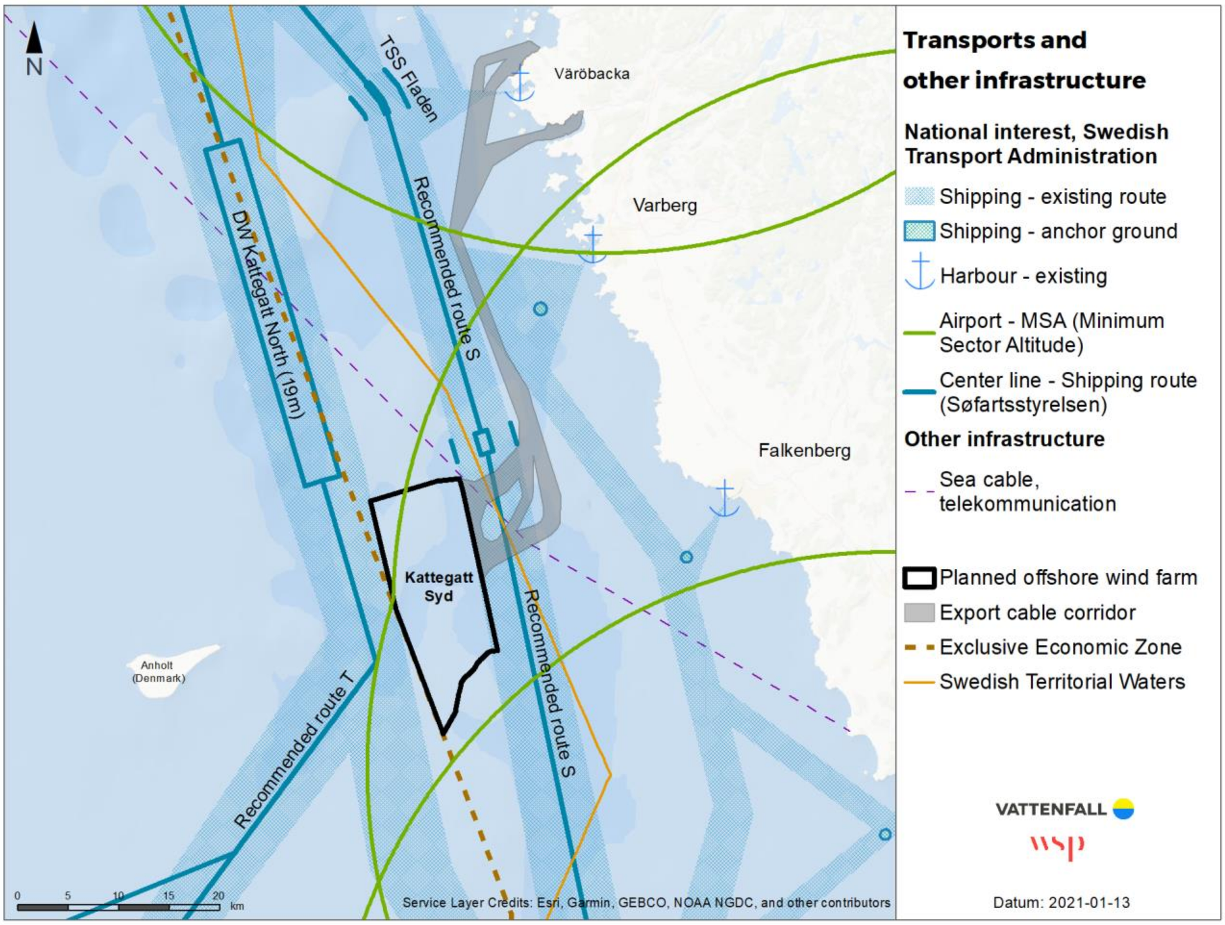


Figure 15. Transport and other infrastructure in the Kattegat Sea (data source: Swedish Transport Administration and EMODnet).

6.1.9. Fishing

As part of the Environmental Impact Assessment process and prior to submission of the permit application, an in-depth study is planned on how the area is used for commercial fishing.

Commercial fishing takes place both within the planned wind farm area and in nearby areas. According to catch data from the Swedish Agency for Marine and Water Management, trawl fishing for herring/Baltic herring, Norway lobster, cod, greater weever, plaice and other flatfish is primarily carried out in the area. In

[8] http://www.fiberatlantic.com/system/XD5Em

particular, trawl fishing of Norway lobster is important in the wind farm area (Figure 16 and Appendix 1H).

The planned wind farm is partly within a buffer zone (for fish-free areas) where fishing is regulated during cod spawning periods.

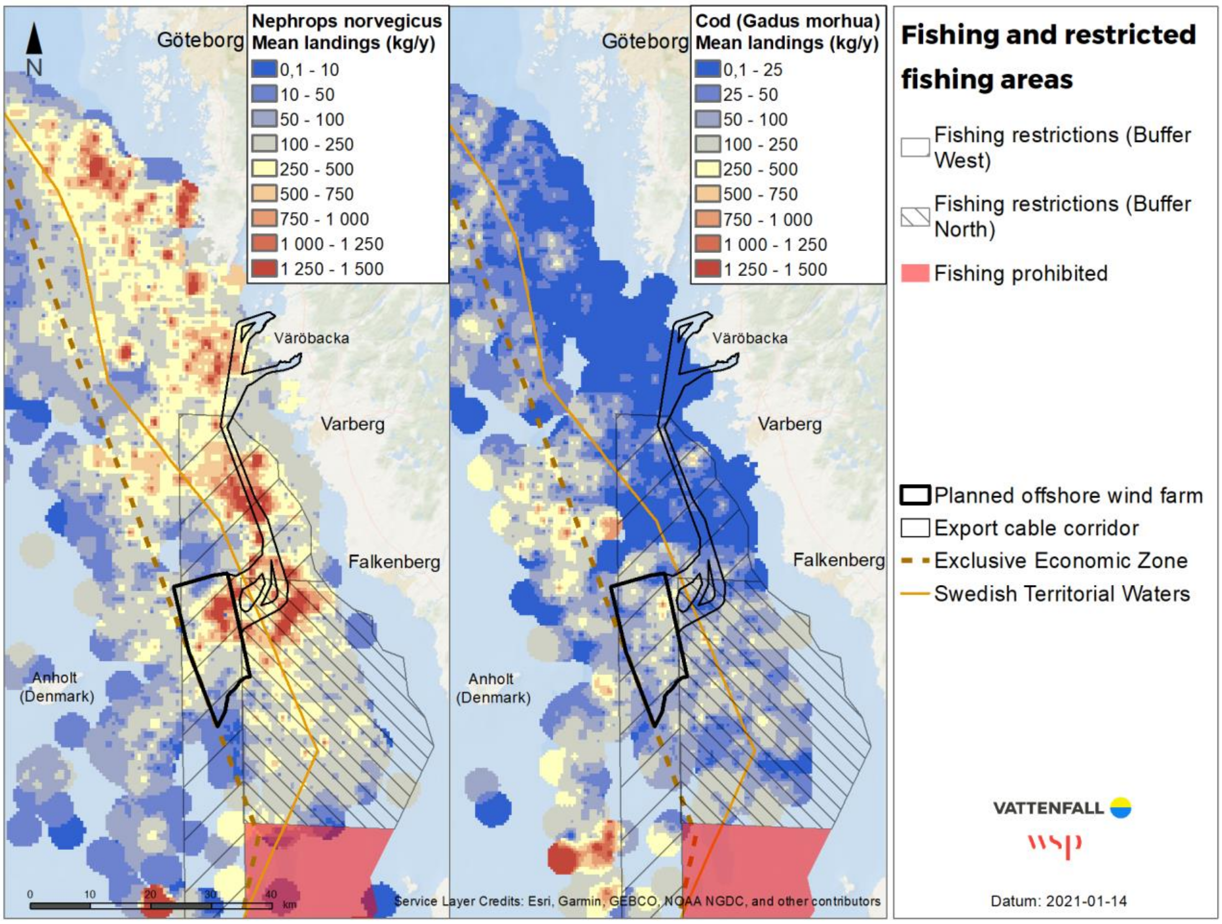


Figure 16. The maps show the average catch of Norway lobster and cod in 2015–2019.

6.1.10. Pollution and environmentally hazardous areas

In a particular area of the wind farm there is a risk of unexploded ordnance (UXO). The environmentally hazardous Altnes wreck is also located in the centre of the wind farm. The ship sank in 1998 and is believed to contain heavy fuel oil and *petroleum coke*, a substance used in aluminium production (Swedish Maritime Administration 2011). The planned seabed surveys are intended to identify any UXO and other environmentally hazardous objects in the area.

6.1.11. Marine spatial planning

The planned wind farm is located in the South West Sea, which makes up most of the Kattegat Sea (Swedish Agency for Marine and Water Management 2019). Proposed marine spatial plans include most of the territorial sea and the Swedish economic zone as a whole (Figure 17). In the South West Sea's marine spatial plan, the area of the wind farm is described as having good conditions for wind power due to high wind speeds, suitable shoal depths and a well-developed transmission grid on land.

The wind farm area overlaps an area designated for commercial fishing (Figure 17). The proposal for the marine spatial plan also states that, for energy expansion in general, special consideration should be given to the cumulative impact on the interests of total defence when a number of wind farms are to be installed. In the establishment of wind power, consideration should also be taken to the value of the natural artefacts present and to the local commercial fisheries, to enable coexistence. The shoals with the highest natural value should be kept clear of energy extraction (Fladen and Lilla Middelgrund).

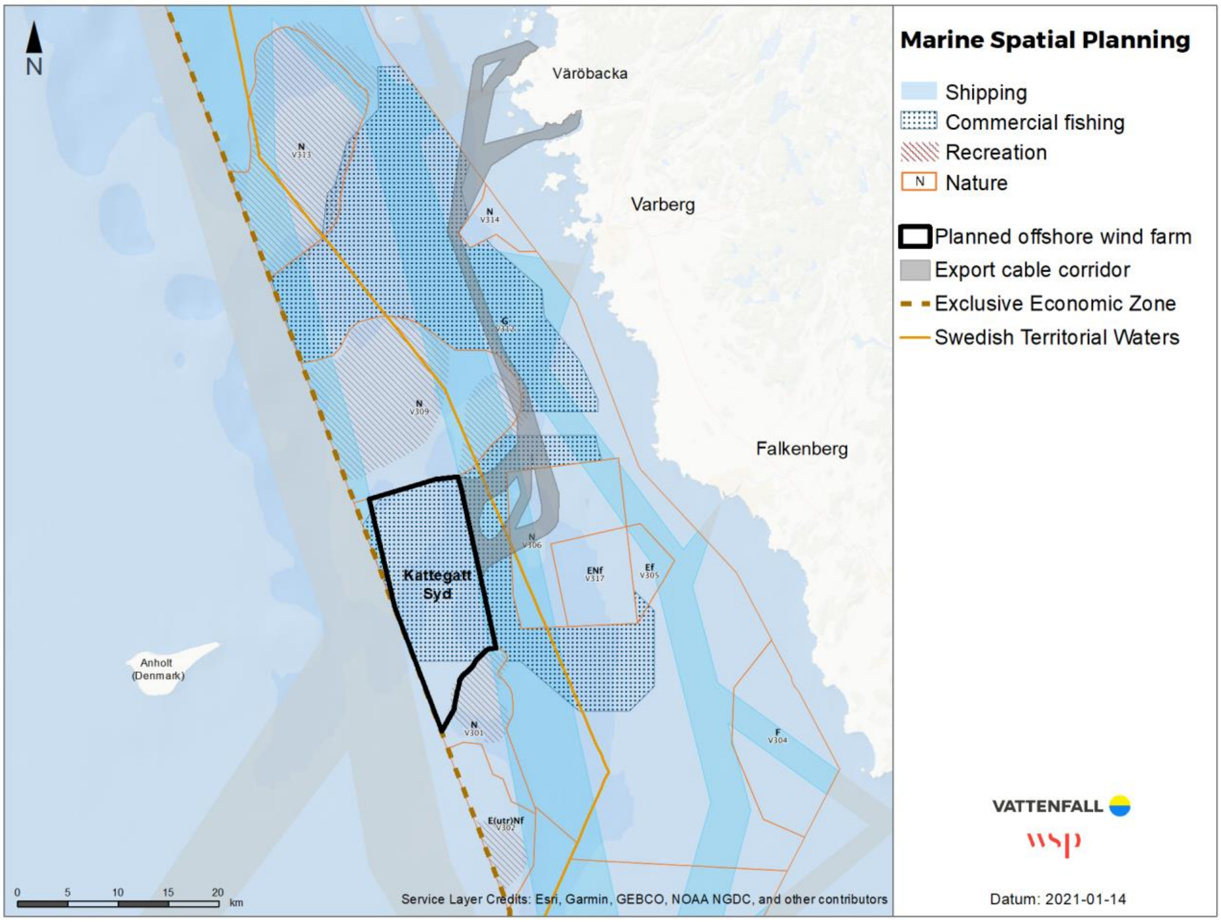


Figure 17. Marine spatial planning in the South West sea area (data source: The Swedish Agency for Marine and Water Management).

Chapter 7

Potential environmental impact

7. Potential environmental impact

In the forthcoming EIA, the environmental impact to be described will be based on the results of investigations and modelling related to various influencing factors. Below is a preliminary assessment of the possible impact of the project on relevant environmental aspects.

7.1. Wind farm

7.1.1. Hydrodynamic conditions

Establishing structures in the aquatic environment can potentially affect the hydrodynamic conditions (waves, currents and mixing in the water column). Areas where hydrodynamic conditions are most likely to be affected are in narrow passages such as narrow channels (Hammar et al., 2008). Modelling from Skottarevet and Lillgrund shows that the impact on hydrodynamic conditions is extremely small when installing wind farms (Hammar et al., 2008). Modelling carried out prior to the construction of the Öresund Bridge also showed a very small impact.

Hydrodynamic modelling will be carried out for Kattegatt Syd. The results of the modelling will be reported in the forthcoming EIA and form the basis for assessing the impact on hydrodynamic conditions.

7.1.2. Natura 2000

The potential impact risk on nearby Natura 2000 areas during the installation phase is primarily believed to be the impact of turbidity on Natura 2000 habitats, as well as the impact of underwater noise on marine protected areas, primarily harbour porpoises. In addition, there is a possible impact on marine protected areas in terms of bird displacement during the operating phase. In the forthcoming EIA, assessments of the consequences of marine protected areas and habitats in Natura 2000 areas will be based on the surveys and studies planned (including turbidity modelling and underwater noise impact assessments). A preliminary assessment is shown below.

The risk of negative impact from turbidity due to wind farm activities on habitats in nearby Natura 2000 areas is preliminarily believed to be limited, as the installation areas are relatively small in relation to the distance to the surrounding Natura 2000 areas. Mitigation and the need for safety distances to Natura 2000 sites for turbid operations will be investigated to ensure that habitats and marine protected areas are not adversely affected.

Harbour porpoises are listed in the conservation plans for both Stora Middelgrund and Röde bank, as well as Lilla Middelgrund. The relevant impact factor for the species is the same as for the wind farm itself, i.e. underwater noise. Careful modelling will be used to assess the effects on harbour porpoises in Natura 2000 areas. See further assessments of the impact on harbour porpoises in Chapter 7.1.4.

There is a certain risk that the species of seabirds included in the conservation plans for nearby Natura 2000 areas are displaced. Extensive inventories of the presence of seabirds in the wind farm area have been initiated, see also Chapter 7.1.4. Together with data from previous inventories carried out in the Stora Middelgrund wind power project, the results of these studies will form the basis for assessing the impact on and need for mitigation measures for seabirds in the coming Natura 2000 assessment.

7.1.3. Other protected areas

No negative impact is expected to arise in other protected areas.

7.1.4. Natural environment

Seabed community

The two factors that are deemed to have the greatest impact potential on the seabed community when establishing the wind farm are loss/creation of habitats and turbidity/sediment deposition. The loss/creation of habitats will occur during the installation phase. The effects are small geographically, but will have a long-term effect during the operating phase (Wilhelmsson, et al., 2010). Turbidity occurs primarily during the installation phase when installation foundations or laying cables and during any disposal of dredged material arising during preparatory work, mainly for gravity base foundations (see Chap. 3.1.5). The specific conditions for Kattegatt Syd will be investigated ahead of the upcoming EIA with an analysis of the impact and consequences for the seabed community in relation to the degree of sedimentation/turbidity and loss/creations of habitats.

The majority of the seabed in the wind farm consists of the sea-pen and burrowing megafauna habitats (Halland County Administrative Board 2018a), which is sensitive to bottom trawling and sediment cover.

To establish wind turbine foundations, hard surfaces need to be laid in the wind farm area, which currently consists mainly of soft seabed. These new hard surfaces primarily cause local changes around the foundations, and the impact on soft seabed animals has in many cases proved to be minor, despite establishing new hard substrates (CMACS 2008). Over time, the artificial reef effect can result in a greater number and increased biomass of sessile species and plants in the area, which can lead to changed (increased) food availability for more mobile species such as fish and birds (Bergström, et al., 2012).

The establishment of hard structures at sea can potentially act as a way of proliferating alien species living on hard seabeds. Alien benthic organisms have been found in inspection programs for wind farms in areas such as Belgium (Kerckhof, et al., 2012). The risk of introducing alien species will be highlighted in the upcoming EIA.

Fish community

The three factors that are deemed to have the greatest impact potential on the fish community when establishing the wind farm are underwater noise, loss/creation of habitats and turbidity. Both underwater noise and turbidity are temporary, while the loss/creation of habitats in the wind farm area and subsequent artificial reef effect have a longer duration. The artificial reef effect means that the installation of structures in marine environments creates new habitats with potential positive abundance and biodiversity consequences. However, it is not entirely clear whether the artificial reef effect actually increases or only redistributes the biomass of fish within an area (Bergström, Lagenfelt, et al., 2013). The artificial reef effect's impact on and consequences for the fish community will be investigated in more detail in the upcoming EIA.

Fish, fish eggs and larvae can be adversely affected by high levels of underwater noise, especially when pile-driving foundations (Anderson M.H. et al., 2016). Different fish species vary in sensitivity to underwater noise depending on whether or not they have a swim bladder, and on the appearance of the swim bladder. In the operational stage, the sound levels are lower but continuous. The impact on fish communities of underwater noise in both the installation and operating stages as well as potential protective measures will be investigated in more detail in the upcoming EIA.

Adverse effects such as reduced hatching and lower survival rates can affect fish, and in particular fish eggs and larvae. The impact of turbidity on fish, fish eggs and larvae will be investigated in more detail through turbidity modelling in the upcoming EIA.

The primary species believed to have migration routes through the farm area are eel, salmon, sea trout and garfish. Relatively little is known of the effects of electromagnetic fields on fish. However, eels have been identified as being one of the more sensitive species. The impact on migratory fish will be further investigated and assessments based on current knowledge will be included in the upcoming EIA.

Marine mammals

The impact factor determined to be of greatest significance for marine mammals is underwater noise in the installation phase, especially when pile-driving foundations. The area of the wind farm is already heavily affected by ship noise, as it lies in the middle of two well-trafficked shipping lanes, which means that the significance of the impact of increased sea traffic in the area is preliminary deemed to be minor. Noise levels in the operational phase will be lower, but continuous, throughout the service life of the wind farm. Studies from existing farms show that marine mammals generally avoid the wind farm area in the installation phase, but in most cases return once it is in operation (Tougaard, J., & Michaelsen, M. 2018).

In the EIA work, more detailed investigations will be made of various types of damage or disruption (temporary/permanent) that can arise for marine mammals from underwater noise as well as which, if any, limit values for underwater noise should be applied. An investigation of the propagation of underwater noise and the anticipated maximum noise levels will form the basis for assessing the general impact of the planned wind farm, and specifically for the surrounding Natura 2000 areas. The investigation will also highlight whether the choice of wind farm layout (see Chapter 3.1.1) is of significance for impact severity. To reduce the risk of marine mammals being in the vicinity during pile-driving, operations will be started gradually, and seal deterrents will be used. Within the framework of the Environmental Impact Assessment, existing monitoring data and data from passive acoustic monitoring devices within Kattegatt Syd and nearby Stora Middelgrund will elucidate the presence of marine mammals in the wind farm area and nearby areas.

Based on the results of these investigations, the need for noise-reducing measures will be further analysed and potential measures proposed to ensure that the risk of significant impact on individuals and populations is avoided. The impact of underwater noise in the installation phase can be reduced through technology and noise-reducing measures (e.g. air bubble curtains, insulation pipes).

Seabirds

The impact factors that are generally highlighted for birds are collision, displacement and barrier effects (Rydell, et al., 2011). Studies from existing offshore wind farms show that birds usually avoid the wind farm in the installation phase, while in many cases the effect during the operational phase depends on the species. Migrating birds generally bypass wind farms, which contributes to an increased flight distance but also a reduced risk of collision. For the majority of species, the collision risk in offshore wind farms is generally considered minor (Enhus, et al., 2017).

The impact on seabirds from the presence of vessels for installing the wind farm can be assumed to be minor, partly because installation can generally be assumed to be limited in time and partly because the area around the wind farm is close to several busy shipping lanes. There is a certain risk of displacement and loss of habitat for the species of birds in the area. Aerial and boat-based surveys of birds have been started in the wind farm area. Together with information from surveys at Stora Middelgrund, the results of these will form the basis for assessing the impact on birds in the forthcoming EIA and permit applications. Based on this, the need for any mitigation measures will be reviewed to ensure that local populations of protected species are not adversely affected. The forthcoming EIA will also highlight whether the choice of wind farm layout (see Chapter 3.1.1) is of significance for the degree of impact.

Bats

The potential impact on bats will be assessed by experts in this area. The assessments will include an analysis of the likelihood of routes passing through the area.

Prior to the permit application for the installation of a wind farm on the Fladen territorial shoal, it was assessed that the risk of impact on bat populations was very small.

7.1.5. Cultural heritage

The planned seabed surveys are intended to serve as a basis for a marine archaeological investigation. The interpretation of data from the seabed surveys and identification of any marine archaeological objects will be carried out by marine archaeology experts. The presence of potential remains, such as wrecks, will be compiled in a report submitted to the County Administrative Board in a *voluntary stage 1 site investigation*. Planned activities will then be adapted to possible further investigations (*stage 2 site investigation*, preliminary archaeological investigation) to ensure that there is no unauthorized impact on cultural historical remains as a result of the project. If previously unknown marine archaeological objects are identified in the area, these will be avoided to the greatest degree possible when establishing the wind farm.

7.1.6. Recreation and outdoor activity

Some impact on recreation and outdoor activity can be expected in the installation phase as a result of the presence of offshore vessels and any work platforms in the work area that may temporarily disrupt activities such as recreational fishing and sailing in the area.

7.1.7. Business and infrastructure

Offshore vessels will need to cross at least one of the heavily trafficked shipping lanes surrounding the farm, which means that a certain impact on shipping can be expected. When establishing the wind farm, special consideration will be given to ship traffic in routes S and T. Risk analyses of the impact on shipping traffic in surrounding shipping lanes resulting from the planned wind farm will be attached to the future applications. In the EIA, an impact assessment will also be carried out regarding increased sea traffic due to the establishment of Kattegatt Syd.

During the establishment phase, seafarers will continuously receive marine traffic notifications of work in progress.

A degree of impact on aviation cannot be excluded as the wind farm is situated on the outskirts of the MSA area for Halmstad Airport. An obstruction evaluation will be carried out prior to submitting permit documents. The results of the obstruction evaluation will be described in future EIA's and any adverse effects on air traffic will be assessed accordingly.

7.1.8. Fishing

The impact on fishing is primarily related to the wind farm. The area will be open to ship traffic, including fishing vessels, during the operating phase, but certain fishing methods, such as bottom trawling, may need to be adapted to the new conditions of the farm. Fishing using other methods, such as cage fishing, longlining and pelagic trawling, is likely to continue as usual, as in most existing wind farms in Europe. Large parts of the wind farm are located in an area where trawling is already regulated during parts of the year.

Offshore wind farms can also have a positive impact on fishing. Studies have shown generally high fish species diversity and abundance around artificial structures in the sea, though the reason for this is unclear (Hammar et al., 2008). The conditions for fishing and any impact on it in the area of the planned wind farm will be further investigated in the upcoming EIA.

7.1.9. Pollution and environmentally hazardous areas

In turbid operations, such as cable laying and seabed preparation work for installing wind turbine foundations, there is a risk of local dispersion of pollutants. The planned sediment surveys aim to investigate the presence of contaminated sediment in the investigation area and, where applicable, the risk of their spreading to the water column.

The planned seabed surveys include identifying areas with potentially unexploded ordnance (UXO). Such areas will be avoided as far as possible during wind farm establishment, and close discussions will take place with the Armed Forces to ideally mitigate risks. The environmentally hazardous wreck in the middle of the wind farm area will also be avoided as far as possible during establishment. It will be possible to use planned sediment surveys to clarify whether the environmentally hazardous substances present in the wreck have spread to the surrounding sediment.

7.2. Climate impact

The wind farm and its associated facilities may have a short-term negative impact on the climate during the installation phase due to greenhouse gas emissions associated with material production, transport and work equipment. During the operational phase, the wind farm will have a positive climate impact and contribute to achieving Sweden's energy and climate targets. According to the Swedish Environmental Protection Agency, a wind turbine produces between 20 and 100 times more energy than the input required for installation (Swedish Environmental Protection Agency 2020). Large turbines are more efficient from this perspective due to higher installed capacity. Kattegatt Syd's estimated annual generation will amount to 4.7 TWh, which corresponds to the annual supply of domestic electricity for up to 780,000 households. The estimated output amounts to approx. 2.5-3% of Sweden's total electricity generation. The project is therefore an important part of Sweden's and Europe's process of transitioning to renewable energy sources. The wind farm is expected to have a significant impact on Sweden's ability to achieve 100 per cent renewable electricity generation by 2040.

7.3. Transboundary impact

The wind farm's potential transboundary impact is primarily related to Natura 2000 sites, mobile species such as marine mammals and birds, and benthic species at the wind farm's border with Denmark, commercial fishing, shipping and the visual landscape.

7.3.1. Natura 2000

Protected areas outside Sweden's border that may be affected are primarily the Danish Natura 2000 areas *Anholt og havet nord for* and *Farvandet nord for Anholt* (overlapping each other, approx. 7 km from the wind farm), and the Danish *Store Middelgrund* (approx. 9 km from the wind farm), all of which have marine mammals and/or birds listed in the conservation plan. Marine protected areas, such as marine mammals, in adjacent Danish Natura 2000 areas can potentially be adversely affected by underwater noise during the wind farm's installation stage. The impact on nearby Natura 2000 areas will be further investigated within the framework of the EIA, based on the planned underlying data investigations and modelling (see Chapter 9). Any potential transboundary impact on connectivity between Natura 2000 areas will also be investigated. Potential impacts on Natura 2000 sites are further described in Section 7.1.3, Natura 2000.

7.3.2. Natural environment

Potential transboundary impact on the natural environment applies primarily to mobile species that travel over large sea areas, such as marine mammals, seabirds and fish, but also to seabed communities directly adjacent to the wind farm on the Danish side. The possible impact of the wind farm on these species groups is described in more detail in Chapter 7.1.6 and will be investigated in more detail in future EIAs. Below is a summary of the transboundary effects applicable to the different species groups.

Harbour porpoises are protected not only by the Swedish Species Protection Ordinance and the Habitats Directive, but also by the Agreement on the Conservation of Small Cetaceans (ASCOBANS[9]), for the particular reason that

[9] https://www.ascobans.org/

the species moves across the sea areas of several countries. Individual harbour porpoises on the Danish side may possibly be affected by underwater noise that stretches over the border during the installation stage. The species moves seasonally across the Swedish-Danish border, and the impact on individuals in Sweden can therefore also have an indirect effect on the species in Danish waters.

According to monitoring data, **harbour seals**, which are common in the Kattegat Sea on both the Swedish and Danish sides, move within the planned wind farm area. The population of **grey seals** in the Kattegat Sea is small. It is primarily the Danish population that moves over the Kattegat Sea. Individual seals moving in the area can potentially be affected by underwater noise and increased boat traffic in the installation phase.

As a supplement to existing documentation, a survey has been initiated prior to the permit application to discover how important the wind farm area is to porpoises and seals during different parts of the year in relation to other parts of the Kattegat Sea. The distribution of underwater noise in the installation phase will be modelled. These models will be used to determine the need for noise mitigation. Based on these results, it will also be possible to draw conclusions on any transboundary impact on marine mammals in the Kattegat Sea. The preliminary assessment is that the impact on marine mammals is only relevant in the installation stage.

The transboundary impact on **seabirds** consists primarily of possible habitat loss, barrier effect and impact on migration routes. The Kattegat Sea has areas for overwintering and food supply for seabirds. These birds move continuously across the border between Sweden and Denmark. There is a certain risk of displacement and loss of habitat for the species of birds in the area, which may possibly affect seabirds on the Danish side. As mentioned earlier, the collision risk for most species at offshore wind farms is generally considered low.

Boat-based and aerial surveys and aerial mapping of birds in the wind farm area have begun. Together with existing data from Stora Middelgrund and all other available scientific information on the distribution of seabirds in the Kattegat Sea, the results of the surveys will form the basis for assessing the transboundary impact on seabirds in the forthcoming EIA.

7.3.3. Fishing industry

The project is not expected to have an impact on commercial fishing in catch areas outside the Swedish economic zone. Nevertheless, any vessels using the wind farm area for fishing may be impacted by fishing restrictions, including vessels from the Danish side.

7.3.4. Shipping

No transboundary impact on shipping is expected as a result of installing Kattegatt Syd. Highly trafficked shipping lanes for international commercial traffic pass both east and west of the wind farm (see section 6.1.13, Business and Transport Infrastructure), but the actual area of the wind farm lies outside the shipping lanes. The Danish T-route (west of the farm) is not expected to be impacted. However, this will be further investigated in the risk analysis for shipping done in the EIA. During the installation phase, shipping may be negatively impacted in Swedish shipping lanes due to increased boat traffic and temporary closures in the export cable corridor.

7.3.5. Visual landscape

Kattegatt Syd is about 70 km from the Danish coastline and about 18 km from the Danish island of Anholt. The wind farm will be visible from both the Swedish coast and Anholt. Photomontages from a viewpoint on Anholt will be developed to give an idea of how the landscape may change when the wind farm is in place. Wind turbines from the Anholt wind farm have already impacted the visual landscape of the Kattegat Sea.

7.4. Environmental risk and safety

In accordance with Chapter 2, Section 3 of the Environmental Code, anyone who conducts or intends to conduct an activity must take protective measures, observe limitations and take other necessary precautions to prevent, impede or counteract the operation or measure causing damage or inconvenience to human health or the environment. For the same purpose, professional activities must use *the best possible technology*, as far as this is reasonable.

Vattenfall will comply with the OSPAR Convention on the Handling and Elimination of Chemical Substances in the Marine Environment (OSPAR 1992), which aims to protect the environment in the Northeast Atlantic. This includes the North Sea, Skagerrak and parts of the Kattegat Sea. The Convention has been jointly developed by Belgium, Denmark, Finland, France, Ireland, Iceland, Luxembourg, Norway, Portugal, Switzerland, Spain, Sweden, Germany, the UK, the Netherlands and the EU.

During the wind farm’s installation phase, there is a risk of emissions of fuel and lubricating oils as a result of increased transport and risks of collision resulting from increased sea traffic and land transport and from the presence of work vehicles and machinery. There are also environmental risks in the operating phase associated with the grease and oil contained in the turbine's nacelle. In the event of emissions, leakage or breakdown, these chemicals may end up in the water and affect marine organisms.

Environmental risks will generally be mitigated by drawing up risk protocols and environmental plans during the detailed project planning stage and by applying the rules of conduct and precautions stipulated in the Environmental Code linked to *the best possible technology* and the *best available technology*, and applying the OSPAR Convention's regulations in its work.

To be included in future applications is an analysis of the risk of ship collision due to an increase in traffic in the area to and from the wind farm during the installation phase and ship traffic in surrounding shipping lanes as a result of the planned wind farm and export cable corridor.

The project will be planned, installed and managed based on Swedish environmental legislation and with a maximum focus on removing and reducing work environment risks. Further management of work environment risks will come in the project's detailed design phase.

Chapter 8

Cumulative environmental impact

8. Cumulative environmental impact

Effects from several sources can interact and contribute to cumulative effects. Cumulative impacts can arise *in* a wind farm from different activities in progress at the same time, or *between* wind farms on larger geographical and time scales.

Cumulative environmental impact *in* a wind farm can, for example, be due to an increased noise level during a period of increased turbidity, which can potentially have greater environmental consequences for a receptor than if the impact factors occurred individually. Cumulative effects *between* offshore wind farms can arise if several wind farms are installed in the same sea area at the same time, but also over time. This can result in, e.g., a greater barrier effect, changed hydrodynamic conditions or changed visual landscape.

Cumulative effects will be analysed from a project perspective. This means that all of the various parts of the project will be included in an analysis of cumulative impact.

The preliminary assessment for the Kattegatt Syd project is that the analysis of cumulative effects is particularly important for assessing consequences to marine mammals, seabirds, fishing and the visual landscape. Regarding marine mammals, a decisive factor is the timing of the installation phase related to other activities. With regard to seabirds, on the other hand, it is assessing whether the installation of several wind farms in the Kattegat Sea will eventually increase the degree of environmental impact, such as barrier effect and collision risk (during operation).

Understanding the spatial distribution of seabirds and marine mammals in the sea pools in the Kattegat Sea is central for assessing which projects should be included in the analysis of cumulative environmental impact. The visibility analyses performed and the study of commercial fishing in the Kattegat Sea will also form the basis for future assessments of cumulative impact.

In the Kattegat Sea, several offshore wind farms are planned. Those that will preliminarily be included in the assessments of cumulative effects in the upcoming EIA for Kattegatt Syd are (Figure 18):

- Anholt (existing)
- Kattegatt Offshore (permit granted)
- Stora Middelgrund (permit granted, ongoing application for change permit)
- Galene (part of the planned Galatea-Galene wind farm)
- Hesselö (early planning)

For cumulative effects linked to the visual landscape, the impact analysis will be limited to Stora Middelgrund and Kattegatt Offshore.

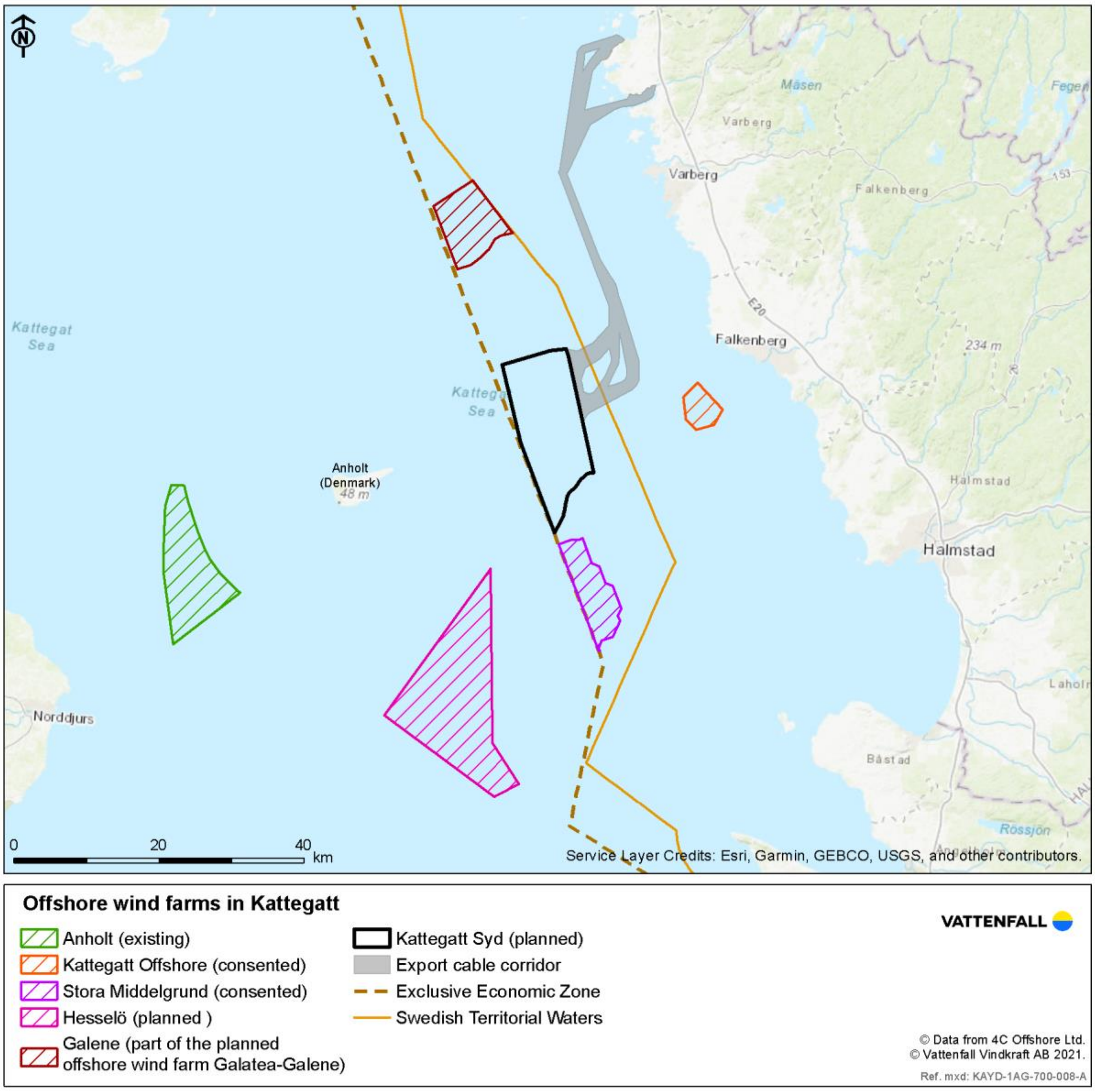


Figure 18. Existing and planned wind farms in the Kattegat Sea.

An analysis of which of these wind farms should be included in the assessment of cumulative effects will be made on the basis of the likelihood that these wind farms will be built prior to the upcoming EIA.

Chapter 9

Planned investigations

9. Planned investigations

Extensive investigations are currently underway and further investigations will be conducted in 2021 prior to the submission of various permit applications. If necessary, investigations can be expanded or extended to support the conclusions in the upcoming EIA, which will be submitted in accordance with the Environmental Code.

The investigations planned/carried out for the wind farm area are:

Seabed surveys

- Geophysical surveys (*Side Scan Sonar* (SSS), *Multibeam Sonar* (MBS)).

- Sediment survey (regarding the sediment's particle distribution and contamination level).

Cultural heritage

- Marine environment (desktop studies and marine archaeological assessment of data from geophysical surveys).

Natural environment

- Seabed habitat survey (drop-down video survey or equivalent in the wind farm and export cable corridors).
- Fish (desktop study of the fish community in the wind farm).
- Birds (aerial and boat-based surveys and digital aerial photograph analysis in the wind farm area and buffer area).
- Marine mammals (placement of passive acoustic monitoring devices in the wind farm area, evaluation of existing data on the presence of marine mammals, assessment of impact on marine mammals based on sensitivity and dispersion of underwater noise).
- Bats (desktop survey).

Other investigations

Some of the following listed investigations, or selected parts of them, may constitute a direct part of the EIA and will therefore not be attached separately to the application.

- Hydrodynamic modelling and validation (for impact on hydrodynamic conditions during wind farm installation).
- Field survey of wave and current conditions by ADCP measurement.
- Turbidity modelling (for turbid work in the wind farm and in the export cable corridor).
- Noise survey (modelling of propagation of underwater noise in the establishment of the wind farm - *worst case scenario*).
- Fishing survey (investigation of the impact the establishment of the wind farm will have on the fishing industry).

- Survey of shipping traffic (risk analysis of impact on shipping traffic in connection with the establishment and operation of the wind farm, and impact analysis of increased shipping during installation).
- Air traffic (risk analysis regarding impact on air traffic in connection with establishment and operation of the wind farm).
- Visual landscape analysis (photomontage of visibility of wind farm from land).
- Natura 2000 survey (potential investigation of the impact of export and underground cables on nearby Natura 2000 areas).
- Cumulative effects (investigation of cumulative effects related to nearby wind power projects and other relevant activities). Can also form part of the EIA.

Chapter 10

Environmental impact assessment design proposal

10. Environmental impact assessment design proposal

As described above, a number of permits must be obtained for the installation and operation of the wind farm, and additional permits are necessary for the implementation of the project as a whole. Before the upcoming permit applications, one or more Environmental Impact Assessments will be prepared to meet the requirements for content set out in Chapter 6, Sections 35–37 of the Environmental Code and Sections 15–19 of the Environmental Impact Assessment Directive. Each respective Environmental Impact Assessment will thereby identify, to an appropriate extent, the direct and indirect effects that the operations in question may have on people and the environment, as well as the cumulative effects resulting from consequential activities and other activities in the area.

The intention is, if possible, to produce an overall environmental impact assessment for the permits required for the installation and operation of the wind farm, see Table 6.

Table 6. Permits and arrangements for planned EIAs.

Permit	EIA
1.Permit to establish the wind farm in Sweden's economic zone in accordance with Sweden's Exclusive Economic Zone A**ct** (1992:1140)	**Wind farm EIA:** Permit applications nos. 1-3
2.Permit in accordance with Chapter 7, Section 28 a of the Environmental Code for measures that can significantly affect the environment within a Natura 2000 area	
3.Permit for laying of inter-array cables in accordance with the Continental Shelf A**ct** (1966:314)	

The consequences of all operations in the project as a whole will be described within the framework of the cumulative impact assessment.

In summary, the planned EIA for the wind farm will contain the following information:

- Presentation of applicants and activities;
- Background and conditions for the business;
- The environmental impacts of each activity in all relevant environmental aspects (see below for a preliminary assessment of relevant environmental aspects);
- Cumulative effects with relevant close-proximity projects and cumulative effects for part of Kattegatt Syd operations described in another section of the EIA;
- The project's environmental impacts on Natura 2000 (primarily related to the Natura 2000 EIA);
- Environmental impacts of operations on other protected areas;

- Listing of alternatives (location and choice of technology as well as zero alternative) and a justification for the selected alternative;
- Reporting of protective measures to prevent, reduce, counteract or remedy any negative environmental effects;
- Any impact of operations on Good Environmental Status indicators and environmental goals, and how the project has taken the general rules of consideration into account;
- Non-technical summary;
- Consultation report;
- Disclosure of the expertise of those who contributed to the development of the environmental impact assessment;
- List of references.

<u>The relevant environmental factors for the wind farm EIA are deemed to be the following:</u>

Impact at sea: Hydrodynamic conditions, national interests, protected areas, natural environment, cultural environment, visual landscape, recreation and outdoor activity, fishing, other businesses and infrastructure.

Relevant transboundary environmental impacts will be investigated and reported to the relevant extent in the forthcoming wind farm environmental impact assessment.

As no significant transboundary environmental impact can be foreseen as a result of other parts of the project, such as the installation of the export cable, the transboundary impact will not be specifically described in the environmental impact assessment for these parts of the project.

Chapter 11

Figures and tables

11. Figures and tables

Figures

Tables

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