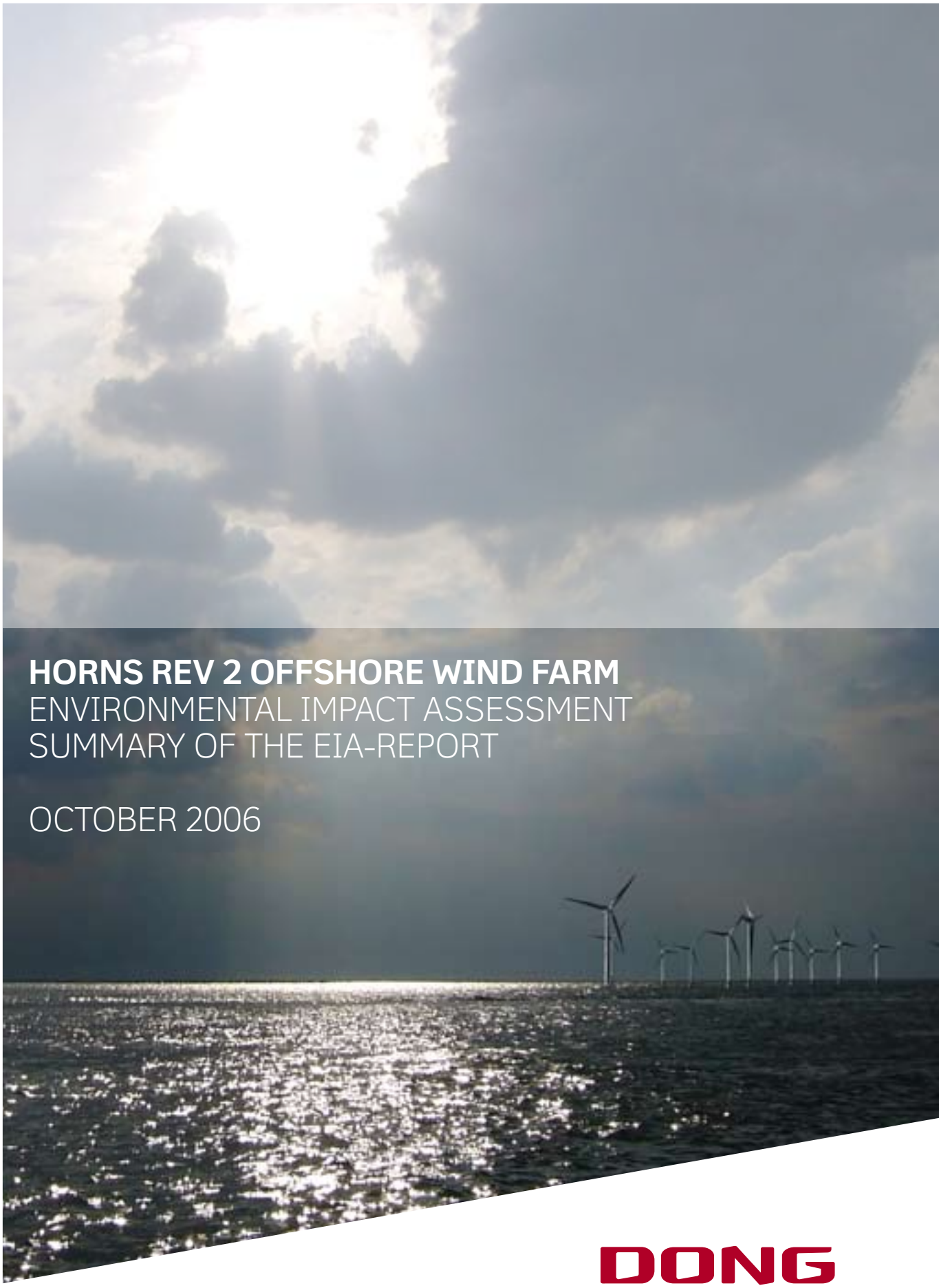

HORNS REV 2 OFFSHORE WIND FARM

ENVIRONMENTAL IMPACT ASSESSMENT
SUMMARY OF THE EIA-REPORT

OCTOBER 2006

DONG energy

Horns Rev 2 Offshore Wind Farm
Environmental Impact Assessment
Summary of the EIA-report
October 2006

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1 Introduction and background

In the summer of 2002, a broad political agreement was made between the Danish Government and a number of parties concerning wind energy and energy savings. In continuation of this agreement, another political agreement was made in the spring of 2004. Among other things this agreement implied the establishment of two offshore wind farms each of 200 MW. Tenders were to be invited for the two offshore wind farms to obtain the lowest possible electricity price for the consumers.

The aim of the agreement was to locate the two wind farms in areas at Horns Rev and Omø Stålgrunde. Screening of the areas resulted in the area at Horns Rev being selected for further development.

On 2 July 2004, the Danish Energy Authority published an invitation to tender for construction of an offshore wind farm at Horns Rev. On 30 June 2005, shortly after the deadline for submission of tenders, the Danish Energy Authority granted DONG Energy (former ENERGI E2) the concession of Horns Rev 2 Offshore Wind Farm.

On 25 August 2005, DONG Energy received permission to perform preliminary investigations at Horns Rev, and was thus ready to start work on the EIA.

The EIA for Horns Rev 2 Offshore Wind Farm is based on a base case layout comprising 95 2.3 MW wind turbines and three large demonstration wind turbines with a total maximum power output of 15 MW. Due to the current rapid development of wind technology, it cannot be ruled out that the layout may be amended to comprise fewer but larger wind turbines. From an environmental point of view, the layout comprising many small turbines will have the largest environmental impact in terms of number of wind turbines, foundations, cable lengths, etc.

The possibility of an increase in the number of wind turbines in relation to the draft layout cannot be precluded; such an increase would nevertheless be marginal. However, the total area of the wind farm will definitely not exceed 35 km^2, including the tree demonstration wind turbines.

The EIA comprises the offshore wind farm and the three demonstration wind turbines, including wind farm internal cabling up to connection of the submarine cable to the off-shore and an accommodation platform. Conditions in relation to the off-shore substation and cabling to shore are handled by Energinet.dk. Energinet.dk are not obliged to submit an EIA. However, the offshore substation will be included in the visualisation of the wind farm.

Throughout the planning and performance of the individual investigations, the knowledge obtained in connection with the extensive environmental monitoring programme at Horns Rev Offshore Wind Farm in the North Sea off Blåvands Huk and Nysted Offshore Wind Farm at Rødsand south of Lolland has been used. The methods, which were developed and used in connection with these two demonstration offshore wind farms, have been considered to the widest possible extent.

This present report is a summary of the EIA for Horns Rev 2 Offshore Wind Farm. The entire EIA may be downloaded from DONG Energy's homepage (www.dongenergy.com) and from the Danish Energy Authority's homepage (www.ens.dk).

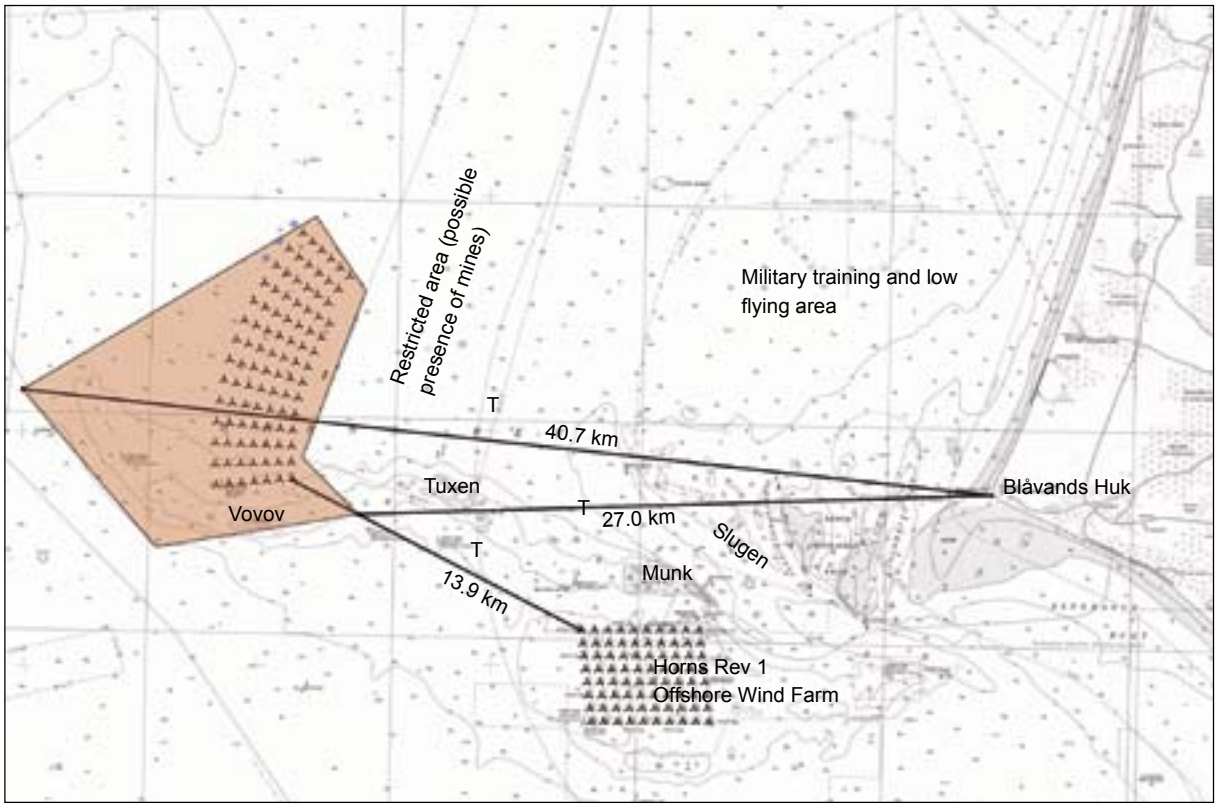


Figure 1 Definition of the preinvestigation area, base case scenario, toponomy, distance to Horns Rev 1 Offshore Wind Farm and shortest and longest distance to the nearest point on shore, Blåvands Huk.

2 Project location and scope

Horns Rev extends from the coast at the westernmost point of the Danish coast, Blåvands Huk, and approx 40 km to the west. The reef consists of an inner and an outer part only separated by the channel "Slugen".

The base case scenario for the offshore wind farm is located on the outer reef. The wind turbine closest to shore is located approx 30 km west of Blåvands Huk, which is the nearest coast. The wind farm is thus located on the western part of the reef and extends towards north from the reef. The area of the wind farm, including the three demonstration wind turbines will be 35 km^2. The shortest distance between Horns Rev 2 and the existing Horns Rev Offshore Wind Farm is approx 14 km – see figure 1. The water depth in the area varies between 9 and 18 metres, and in the greater part of the area the water depth is between 11 and 14 metres.

The maximum power output of the offshore wind farm will be 215 MW net in the grid connection point, of which 15 MW are reserved for demonstration wind turbines, if any. The wind farm will be able to produce approx 800 million kWh a year, corresponding to the electricity consumption of approx 200,000 households.

The offshore wind farm is scheduled for commissioning by late 2009, and according to the time schedule all wind turbines are to be commissioned before 1 October 2009.

The 95 wind turbines assumed in the base case layout are placed in 14 rows in 6-7 radial circles. The three demonstration wind turbines are located at the largest water depth possible in the area and are exposed to the predominantly western winds.

The wind turbines will be three-bladed wind turbines with tapered tubular steel towers. Wind turbine and tower will be of a discrete light grey colour.

The most likely foundation types to be used are the monopile or gravity foundations – figure 2. Scour protection consisting of rocks of varying sizes will be installed on the seabed around the foundation. Foundations, including scour protection will cover less than 0.3 % of the entire wind farm area.

Each row of wind turbines is interconnected from west towards east by a 36 kV submarine cable. To prevent damage

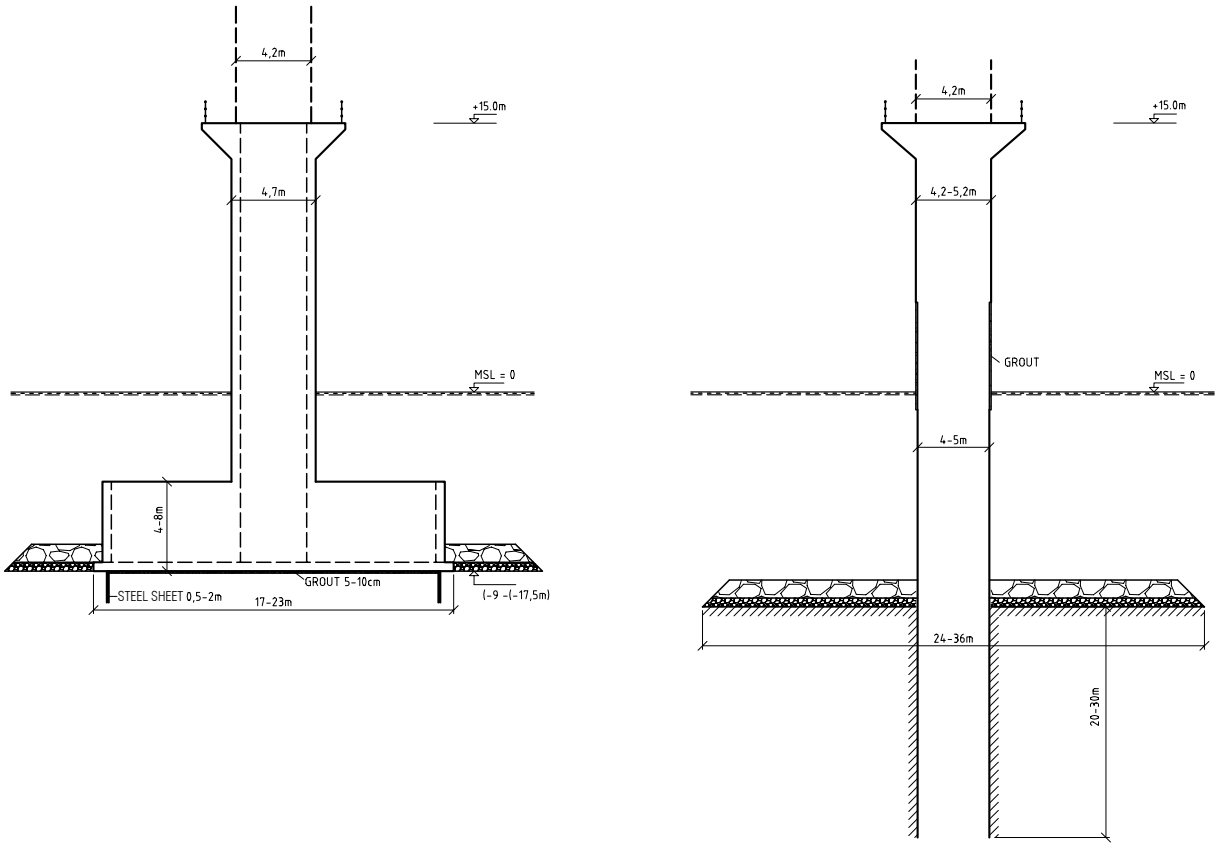


Figure 2 Illustration of a monopile and gravity foundation respectively.

to the cables, all submarine cables will be trenched/jetted/ploughed at least 1 metre into the seabed.

Assuming that the base case layout of 14 wind turbine rows divided into seven groups, each group consisting of 12-14 wind turbines, is used, the easternmost wind turbine of each group will be connected to the substation by a submarine cable. The total 36 kV cable route will be approx 68 km. Combined with cabling to and from the seabed, the total cable consumption will be approx 72 km.

It is assumed that PEX cables or similar single-armoured submarine cables will be used. The submarine cables include built-in fibre-optic cables for communication, etc. The submarine cables will not contain oil.

The connection point to the onshore high-voltage transmission grid is assumed to be at Blåbjerg. A 150 kV submarine cable is installed from the offshore substation to the coast at Blåbjerg. From Blåbjerg an onshore cable connects the wind farm to the high-voltage transmission grid.

Navigation marking of the offshore wind farm is required to ensure safety in connection with marine navigation as well as air traffic - see figure 3.

Temporary marine navigation marking in connection with the construction phase will consist of yellow special-purpose marking. The marking will indicate the entire area, including a safety zone. The safety zone is expected to be approx 500 m. However, the final size of the safety zone will be agreed in co-operation with the Royal Danish Administration of Navigation and Hydrography. Before the area is established it must also be approved by the Danish Maritime Authority.

After the construction phase, permanent marine navigation marking of the wind turbines will be installed. The marking will as a minimum consist of a number of yellow lanterns. The extent and nature of the marking will be agreed in detail with the Royal Danish Administration of Navigation and Hydrography.

It is proposed to establish air navigation marking of the corner wind turbines with medium intensity white lights. Intermediate wind turbines where the distance to other wind turbines exceeds 5 km must also be marked with medium intensity white lights. Other wind turbines must be marked with low intensity red lights. The final proposition for marking must be approved by the Danish Civil Aviation Administration.

Even though the distance between the two outer demonstration wind turbines does not exceed 5 km, all three demon-

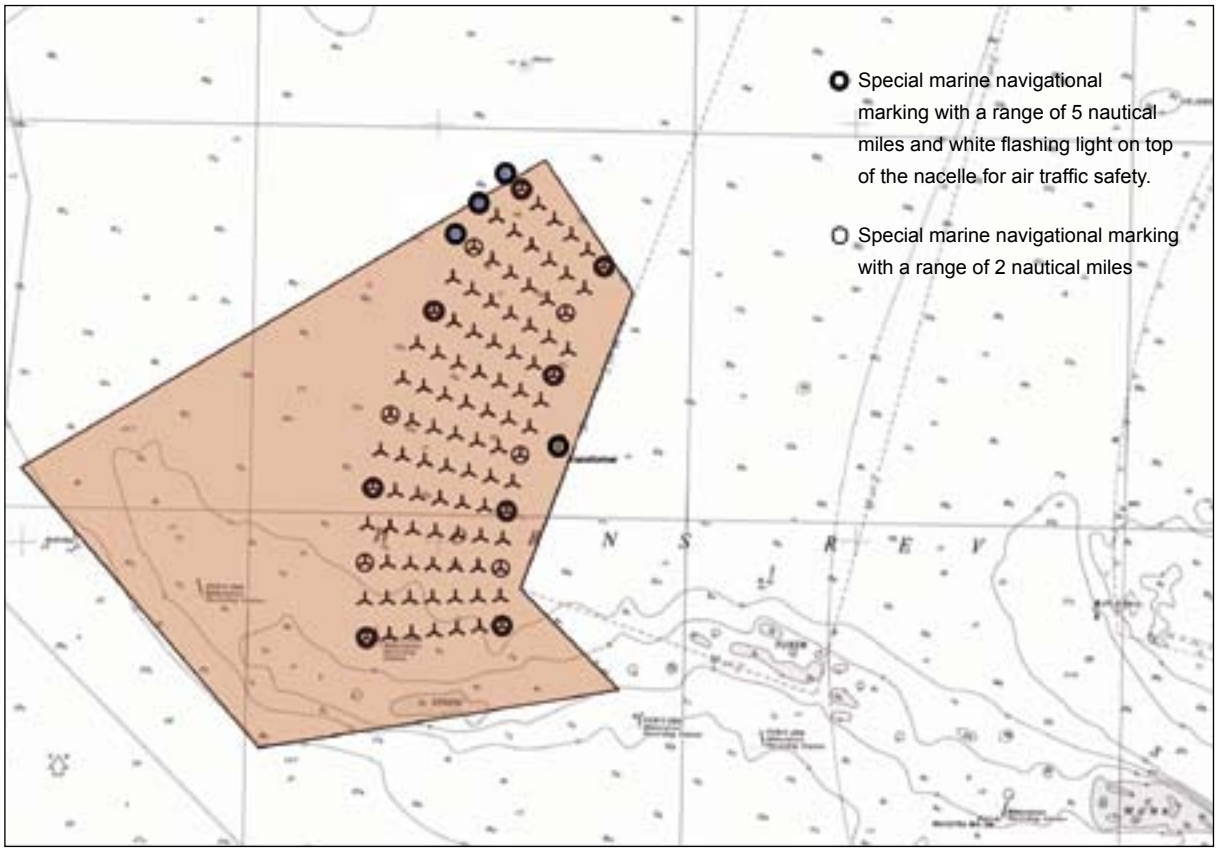


Figure 3 The figure shows the proposed permanent marking for marine and air navigation.

stration wind turbines, if erected, will be marked with flashing white lights (adjusted to the background luminance). The intensity of the lights will depend on the final height of the demonstration wind turbines.

In the operation period, trawling will be prohibited in the wind farm area. This is the only limitation in the general use of the area. However, for safety reasons, it will be prohibited to disembark onto the wind turbines and the offshore substation.

Land areas

It will be necessary to make use of land areas for the project, both during the construction and the operation phases.

During the construction phase, harbour areas for installation, temporary storage and shipping of components will be required. These activities are expected to be performed from existing harbours in either Esbjerg or Hvide Sande. From both harbours, the distance will be approx 60 km. The construction work is scheduled to begin in 2008, at which time a harbour area of approx 30,000 m^2 is expected to be required, and continues in 2009, at which time a harbour area of approx 60,000 m^2 is expected to be required. Furthermore, berths for vessels used in the construction of the offshore wind farm will be required.

In the operation phase, the required area is reduced to around 500 m^2 for storage of spare parts and operation and maintenance facilities located in the immediate vicinity of the quay. In connection with major repair works, temporary storage of materials and components will also be required at the quay.

In general, the land areas required for the construction and operation phases are expected to be in local harbours either in Esbjerg or Hvide Sande where the provisions of the town plans allow for such areas.

Activities in the wind farm area

The work in connection with construction of the wind farm is scheduled to start in the spring of 2008 with installation of foundations. The construction of the wind farm is expected to take place over two seasons with fewer activities in the winter months. Hence, wind turbines and cables will mainly be installed in the spring, summer and autumn of 2009, and the wind farm is scheduled for commissioning in October 2009.

In the construction period, there will be an increased traffic of vessels in the wind farm area and in the navigation routes to and from the port of disembarkation. It is not possible to determine the extent of this traffic until type of wind turbine and foundation have been selected. However, it is estimated that the number of vessels in the construction phase will vary between 3 and 15 on a daily basis, with the highest number

in the summer months and the lowest number in the autumn/winter. In addition to these vessels, traffic of smaller boats for personnel transportation and other service navigations must be foreseen.

The operation and maintenance concept for Horns Rev 2 will be established in connection with choice of wind turbines for the project, as it is expected that a service agreement will be made with the wind turbine supplier.

During ordinary operation, the wind farm will be unmanned and remote monitoring will be performed from an onshore control room. However, the wind turbines are inspected and service is performed at intervals of 6-12 months or more. Moreover, there will be annual overhauls in the summer, when scheduled maintenance is carried out on all wind turbines. Even though the project is to be based on established and well-tested technology, it may become necessary to perform additional remedy of defects and repairs. This is estimated to entail approx 1-2 visits per wind turbine per year.

At present, permanent stationing of service personnel in the wind farm is not considered a solution in connection with ordinary operation and maintenance. However, it may become relevant to station service personnel in the wind farm in connection with certain service jobs, eg annual overhauls. In this connection, an accommodation platform for approx 20 persons is proposed. The total area of the accommodation platform will be 600-700 m^2 distributed onto 3-4 floors, and it will be established in connection with the offshore substation or on a separate foundation pile with a bridge between the accommodation platform and the substation.

Decommissioning

The offshore wind farm is designed for a lifetime of 25 years, after which period, the wind farm is to be decommissioned and removed.

The decommissioning schedule will contain a statement on how to remove the plants. Furthermore, the decommissioning plan will contain a statement on and an assessment of the environmental and safety impacts of the plan as well as a decommissioning time schedule.

At present, it is not possible to predict the requirements, which will apply to sorting and recycling of the individual components of the offshore wind farm at the time of decommissioning.

However, the offshore wind farm will be established in a manner, which enables reestablishment of the previous conditions and handling of the individual materials in compliance with the applicable legislation in force at the time of decommissioning. Wind turbines, cables and any met masts may be dismantled and scrapped after use. Removal of the foundation will depend on the selected foundation type. The monopile is assumed cut off one metre below the seabed and scrapped after the transition piece has been stripped of concrete. The gravity foundation may be removed in one piece, crushed and shredded after which the materials are sorted. Similarly, the cables may be dismantled, shredded and sorted for reuse.

3 Alternatives

As part of the EIA, a number of alternatives have been assessed; other types of renewable energy, alternative onshore wind energy solution and an alternative location within the assigned pre-investigation area.

The no-action alternative

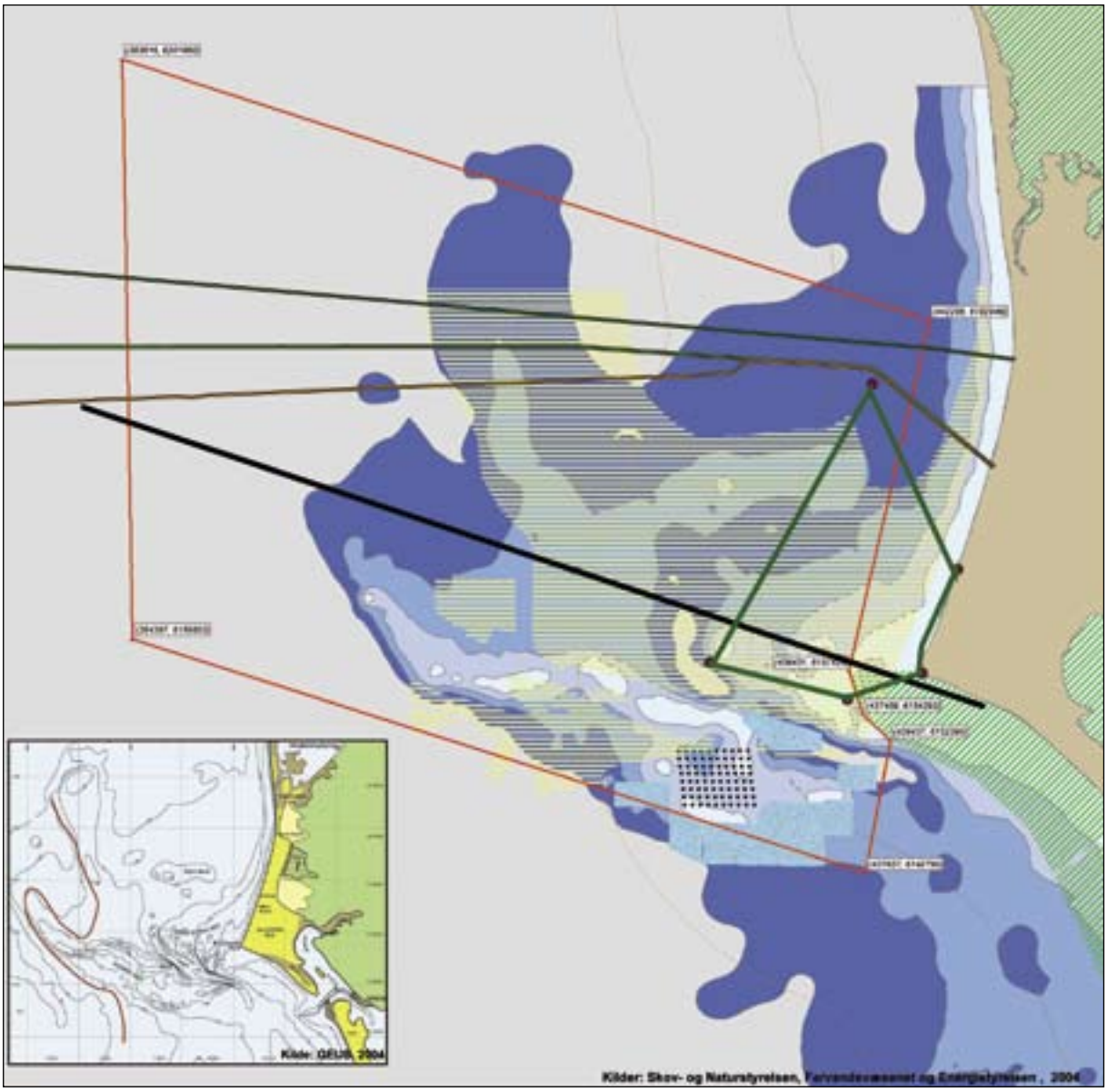
The assessment of the no-action alternative, ie the alternative where Horns Rev 2 Offshore Wind Farm is not established, assumes that the political objectives stated in "Energistrategi 2025" (Danish Energy Strategy 2025 from 2005) are maintained. This means that the energy contribution of the offshore wind farm is to be replaced by other renewable energy. In general, this replacement of renewable energy may be provided by:

- solar cells and/or wave power
- geothermal plants
- biomass-fired power plants
- onshore wind turbines

Even though the technological development within solar cells and wave power has been enormous in the past years, these technologies have not achieved a level of efficiency, which can compete with wind technology on commercial terms. Hence, solar cells and wave power are currently not considered viable alternatives to wind power.

Utilisation of heat from the underground is a well-established technology. In Denmak geothermal plants are so far only able to produce heat as the water from the Danish underground is not warm enough for electricity production. It is therefore not considered possible to replace the energyproduction from Horns Rev 2 with geothermal power.

Over the last nearly ten years several Danish power plants have been upgraded to use biomass as fuel. The biomass technology for combined production of heat and power has thus reached a level where it is no longer a technical problem to make use of large volumes of biomass. Nevertheless, only a limited amount of the biomass resource is available to the energy sector, and a potential substitution of the power generated from the wind farm with power produced from Danish biomass will call for a comprehensive mapping of the available resources. Within the past few years, the biomass incineration target of the "biomass agreement" from 1993 has been met, and at present there are no future subsidy plans for biomass energy. Therefore it is uncertain to assume that biomass power plants can replace the energy from Horns Rev 2 offshore wind farm.



Legend

- Shipping routes
- Existing offshore wind turbines
- Potential raw material ressources
- Disposed extraction areas
- International bird protection areas
- 20” oil pipe
- 24” gas pipe
- 30” gas pipe
- 12.5 km distance to coast
- 25 km distance to coast
- Exclusive economic zone
- Potential development areas
- The military is planning a training area for low flying south of the line
- Military shooting-/training area
- Depth < 6 m
- Depth 6-10 m
- Depth 10-15 m
- Depth 15-20 m
- (Inserted map) ”All areas south of the red line could contain raw materials of interest, source GEUS”

X, Y coordinats given in UTM32, datum ED50

Figure 4 The red line delimits the gross area assigned by the Danish Energy Authority.

The possibility of further extension of onshore wind power is very limited in Denmark. After several rounds of replacement-programmes the utilisation of the best wind resources onshore has been optimised. Further extension of onshore wind power would thus have to involve locating the wind turbines in less favourable areas resulting in increased costs.

Moreover, lately there has been a tendency towards it becoming increasingly difficult to obtain approval of new sites onshore, eg increasing wind turbine sizes lead to increasing resistance from the local population. This may also be seen as an indication that the limit of the number of wind turbines in the Danish landscape has been reached.

Therefore, even though some possibilities of increasing the wind power contribution by exchanging less efficient old onshore wind turbines remain, this is not considered a realistic alternative to the establishment of a second offshore wind farm at Horns Rev.

Other alternatives

An alternative to electricity production by means of wind turbines could be an increased effort to obtain energy savings, as this would also be a way to reduce CO_2 emissions. At present, this is not a realistic alternative, as the energy demand has shown an upward tendency in recent years rather than a downward tendency.

Based on the above argumentation, the only viable alternative to providing the renewable energy otherwise to be produced at Horns Rev 2 Offshore Wind Farm is to find another offshore location for the wind farm.

Alternative location

In connection with tendering for Horns Rev 2 Offshore Wind Farm, a large area at Horns Rev was assigned by the Danish Energy Authority for location of the wind farm (see figure 4).

Based on environmental, technical, financial and planning considerations, DONG Energy proposed a possible location of the wind farm within this area. After the concession was granted and according to consultation with the Danish Energy Authority a pre-investigation area was selected within the assigned gross area. Within this pre-investigation area, two location options are considered; a base case location and an alternative location (see figure 5).

The base case location and the alternative location are described in the EIA. In compliance with the Danish EIA regulation guidelines an actual alternative to the proposed location is presented.

Both locations are described in the EIA-report.

At present a new plan of action for offshore wind turbines is being prepared as a replacement for the previous "Havmøllehandlingsplan for de danske farvande" (the Offshore wind turbine strategy for Danish waters) from 1997, and this plan is expected to be available in late-2006/early-2007.

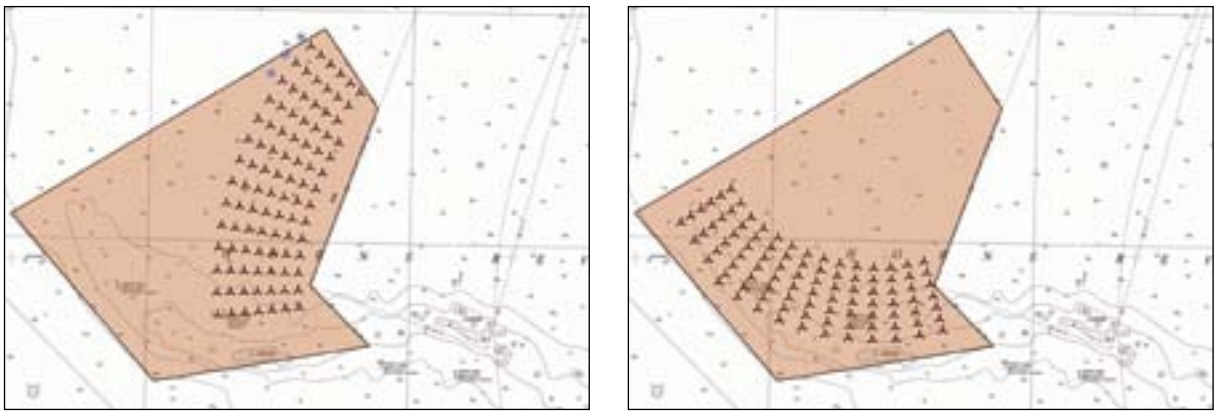


Figure 5 The figure shows the base case (a) and the alternative location (b). The pink area marks the pre-investigation area.

Figure 6 Visualisation of the offshore wind farm from Blåvands Huk app. 30 km from from the nearest turbine under very clear weather conditions. Notice Horns Rev 1 Offshore Wind Farm in the foreground to the left.

4 The wind turbines in the Horns Rev area

For periods after the last Ice Age when the sea level has been approx 14-22 metres lower than today, there have been littoral regions where Mesolithic and/or Neolithic settlements may have occurred. However, traces of such settlements have not been found and neither have wreckages, ballast piles or other preservation-worthy objects.

The relatively distant location of the wind farm from the shore means that the wind farm will only be visible from the coast to a limited extent in very clear weather conditions - see figure 6. The large demonstration wind turbines are located as far from the coast as possible in the northwestern corner of the area.

The selected wind farm layout is very distinct from the traditional row or group layout. In the design of the layout, emphasis has been placed on establishing a layout to which several individual wind turbines can be added or to which subsequent wind farms may be added thus providing a higher level of flexibility than the traditional row or group layout.

The layout is based on a radial/circular structure, which makes it possible to reduce/increase the distance between the individual radials or circles without disrupting the layout.

The selected layout makes it possible to expand the wind farm with other wind turbine dimensions and other distances between the wind turbines without it impacting the visual appearance of the wind farm.

The selected layout provides flexibility in connection with minor adjustments of difinite wind turbine locations due to eg foundation conditions. It is a significant improvement of the project that it is possible to change the location of individual wind turbines, if the results of the preliminary investigations in the area show critical foundation conditions at some of the selected wind turbine locations or other conditions which makes it preferable to change the wind turbine location.

Another advantage of placing the wind turbines in radial circles is that the wind farm is "opened up" towards the dominant wind directions, ie the distance between the rows is largest towards west and smallest towards east. At the same time, the limited distance between the rows in the east means that the length of the interconnecting cables up to the connection of the submarine cable to the offshore substation is reduced. Finally, the central point of the radial circles is located in the sea. The maximum visual impact of the wind turbines will only be experienced at the central point, which means that the visual impact on shore will never be as significant as at the central point.

The wind turbines will all have the same colour; a light grey colour. This choice of colour ensures that the appearance of the wind turbines is light and bright, and the colour blends easily with the colours of the sea and the sky. At the same time the light grey colour ensures that the wind turbines are not too bright and white which would significantly increase the visibility.

5 Environmental impacts

The construction and operation phases of Horns Rev 2 Offshore Wind Farm may impact the environment in the area surrounding the wind farm. Based on a baseline description of the area, analyses and assessments of the potential environmental impacts of the wind farm have been made for this EIA using a broad range of methods.

The environmental impacts may be temporary, thus primarily relating to the construction period, or they may be permanent, thus primarily relating to the operation period. As it is the first time that two large wind farms are established in the same local area, it is important to uncover any potential cumulative impacts, which might result from Horns Rev 1 being located only approx 14 km east-south-east of Horns Rev 2 Offshore Wind Farm.

The distance between the wind farm and the existing nature reserves in the Wadden Sea and the southern part of the North Sea is relatively large.

Construction phase

During the construction phase, impacts in the wind farm area and the immediate surroundings are expected to be more intense but of a shorter duration than the impacts in the operation phase. Depending on choice of foundation type, the primary impact sources during construction will be:

- Impact on seabed and resuspension of sediment caused by levelling for gravity foundation
- Noise in connection with pile driving for monopile foundations

In addition, the construction works will entail:

- Impact on seabed caused by trenching of cables
- Other impacts such as increased navigation of construction vessels, limitations to the commercial fishing, etc.

Suspended sediment

If the wind turbines are erected on gravity foundations, this entails of excavation works, which may cause resuspension of sediment. Trenching of interconnecting cables will also disrupt the seabed. As the top seabed layer in the entire wind farm area consists of predominantly medium-coarse grained sand with a high settling velocity, no environmental impacts from suspended sediment are expected. In addition, there is a natural very high general concentration of suspended sand due to the interaction of the rough wave and current conditions and the active seabed contours in the very dynamic marine environment.

The absence of fine-grained and organic material in the sediment is also reflected in the total absence of bottom vegetation in the area.

Noise

Provided that the monopile foundation type is selected, the most significant noise impact during the construction phase will be from pile driving. Moreover, trenching of cables, possible excavation works, navigation, etc. will provide minor contributions to the noise impact.

The noise is particularly expected to affect porpoises, seals, fish and birds in the area. In connection with pile driving, sonic equipment will be used to actively scare away the mammals from the area. Furthermore, pile driving will start with small impacts and gradually be intensified to give the fish and mammals time to leave the area. Noise impacts during construction are expected to be temporary. In connection with pile driving at Horns Rev 1, porpoise activity was recorded to return to its original level a few hours after pile driving ceased.

Impacts in relation to birds are also expected to be temporary and in addition the construction activities will be concentrated in the summer months when very few birds are present in the Horns Rev area compared to the rest of the year.

Other impacts during construction

For safety reasons, the construction area will be closed off to prevent unauthorised traffic. This will entail restriction of commercial fishing in the area. DONG Energy has initiated a dialogue with the affected fishermen in order to limit the inconveniences to the widest possible extent.

Closing off the construction area will also affect yachts, sea hunters, etc. who might use the area. However, it is assessed that due to the distance to the coast and the rough wave and current conditions, the use of the area for recreational activities is very limited.

Operation phase

Compared to the construction phase, the impacts in the operation phase will be permanent impacts in the entire 25-year lifetime of the wind farm. The impacts in the operation phase will primarily be caused by:

- the physical presence of the offshore wind farm
- noise and vibration from the wind turbines
- other impacts of the offshore wind farm

Physical presence of the offshore wind farm

The wind turbine foundations potentially affect the water movements; locally as well as in the area around the wind farm. Based on conservative estimates, it is assessed that the reduction of the wave height in immediate lee of the wind farm will be 2-4%. Waves close to the shore will therefore virtually be unaffected by the presence of the wind farm. Similarly, the reduction of the current velocity through the wind farm is also assessed to be insignificant, and it will thus not impact sediment transportation or coastal morphology in the area.

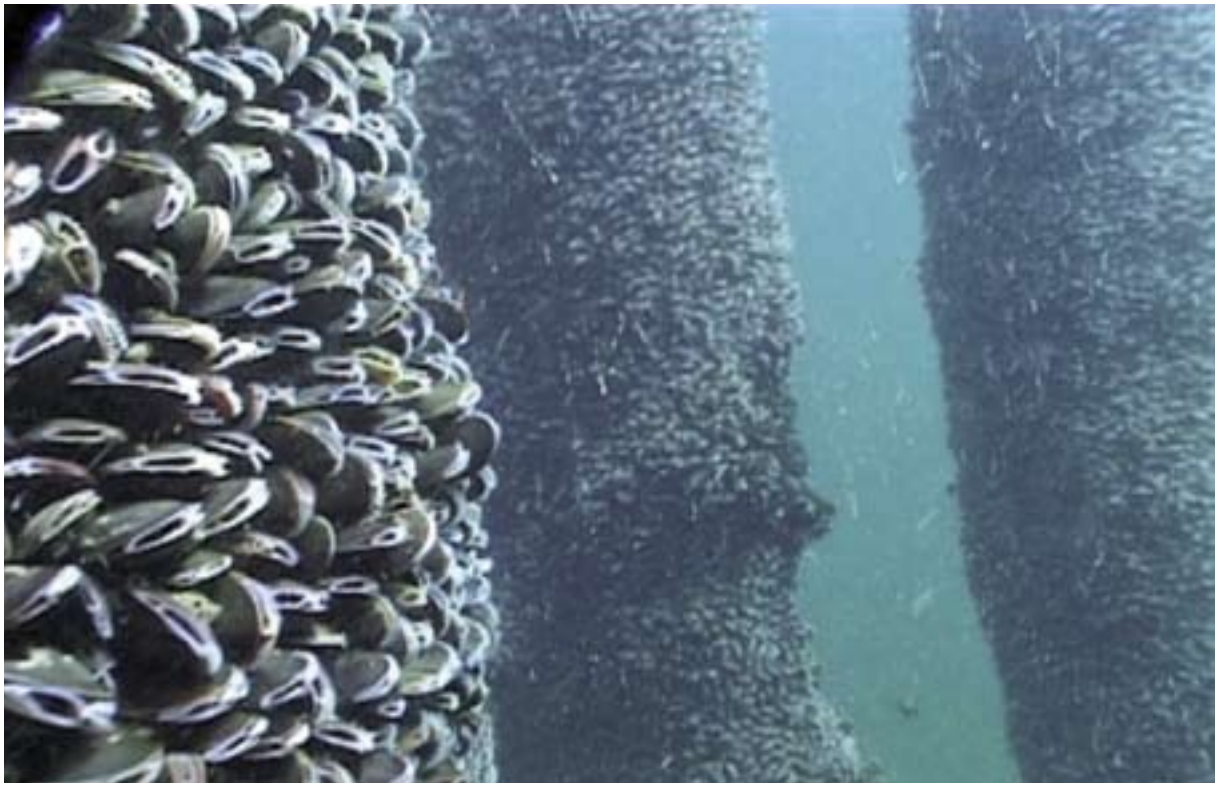


Figure 7. Fouling on foundation at Horns Rev 1 Offshore Wind Farm. Photo: BioConsult a/s.

Locally around the foundations, increased turbulence with the risk of consequential erosion must be expected. Putting down large rocks as scour protection around the foundations will limit the sand transportation close to the turbines to a minimum.

Physically speaking, foundations and scour protection, regardless of choice of foundation type, cover max 0.3% of the seabed in the wind farm area. This will cause a direct, though very limited, loss of habitat for seabed fauna. No bottom vegetation has been observed in the area.

In the long term, the foundations will be colonised by more animals and plants than the surrounding soft seabed. Investigations performed in connection with Horns Rev 1 have shown that the biomass on foundations and scour protection is up to 60 times that of the biomass of the sandy seabed. This may potentially attract eg fish, which may find shelter between the rocks and food on the firm structures. As the changes of the physical conditions compared to the wind farm area are limited, no large direct impacts on marine fauna in the area are expected.

However, in relation to birds, there is a risk of collision between rotating turbine blades and migrating birds, and also there is the possibility that birds might avoid using the wind farm as resting and foraging area due to the presence of the wind turbines.

At the two demonstration offshore wind farms at Horns Rev and Nysted, studies have been made of the reaction behaviour of migratory birds to the turbines in the years after erection of the wind farm. Studies have shown that the risk of collision is minimal – the migratory birds register the wind farm at large distance in the daytime as well as at night. The birds that enter the wind farm either fly through the wind farm along the wind turbine rows or leave the wind farm again immediately. The collision risk is thus estimated to be negligible.

The general image of the area is that it is not an important resting and foraging area for most species with the exception of common scoter. Since 1999, when aerial bird counts were initiated in connection with the preliminary investigations for Horns Rev 1, and up until the spring of 2006, a large number of common scoters have been recorded along the coast and on the reef. In general, the common scoter has concentrated on particular areas, and the location of these areas has varied from season to season. It is very likely that the common scoter moves around after its preferred food in the area – American razor shell.

In the winter 2005/2006 between 2,576 and 21,888 common scoters were recorded on the entire reef at six aerial bird counts. A significant part of these common scoters was recorded within the wind farm area. Though there is a potential tendency towards habituation at Horns Rev 1, it is still too soon to draw any conclusions. Hence the worst-case scenario

Figure 8. Common scoter. Photo: Daníel Bergmann.

is that the presence of the wind farm will entail loss of common scoter habitat corresponding to the size of the wind farm area.

Noise and vibration from the wind turbines

During operation, the wind turbines will emit noise and vibrations to the surroundings. Underwater noise from the wind turbines will be audible to porpoise and harbour seal at a distance of 100-200 m. At a distance of 1,000 m the noise will be too low for porpoise to hear it, but harbour seal, however, may be able to hear the wind turbines at this distance.

The impact zone is thus limited, and the noise level is furthermore too low to cause behavioural reactions, to affect animal communication or to cause temporary physical harm to the hearing of porpoises. Experience from Horns Rev 1 indicates that operation noise does not cause any behavioural reaction. Porpoises and harbour seals are observed regularly within the wind farm.

It is uncertain whether a possible choice of a larger wind turbine will entail more noise. However, it seems reasonable to expect that a possible increase of the noise level will primarily be in the lower frequency range below 100 Hz. As neither mammal species is assumed to be particularly sensitive in this frequency range, it is doubtful if choice of a larger turbine will have a different effect.

The reaction to noise and vibration in fish varies from species to species depending on whether the fish have developed anatomical structures, which enhance their hearing abilities. There is thus a variability in the ability of fish to perceive sound (noise and vibrations), and therefore the impact of noise on fish is expected to vary according to species. As Horns Rev is a very dynamic area with a high natural level of background noise the impacts of noise and vibrations from wind turbines on the fish society are assessed to be negligible. This assessment is supported by the conditions observed at Horns Rev 1.

Other impacts of the offshore wind farm

Accidents in connection with operation of the wind farm may either be loss or spillage in connection with maintenance or collisions between large vessels and wind turbine foundations.

Minor spillage of oil can be cleaned up by the service vessels on the site.

An analysis of the navigation traffic in the area has shown that the collision frequency (vessel-turbine) in the operation phase of the base case scenario is 0.0043 collisions per year corresponding to a return period of 230 years. The very limited collision frequency is primarily due to the wind farm being protected by Horns Rev.

The Danish Executive Order on Cabling protects an area of 200 m around submarine cables against eg anchoring, trawling and recovery of raw materials. In practice this renders these activities impossible in the wind farm area in the entire lifetime of the wind farm.

Prior to establishment of the base case layout, meetings with local fishermen in the area have been held with the intention to limit the inconveniences to the fishing industry as much as possible. This has resulted in the location being adjusted to consider most importantly sand eel fishing on the reef, but also shrimping in the northernmost part of the pre-study area.

So far, no raw material recovery areas have been designated within the wind farm area, and therefore there are no impacts in relation to existing areas. The geophysical surveys have shown that there are no large occurrences of important materials in terms of raw materials such as gravel, pebble gravel and stone, and the wind farm is thus not expected to occupy areas of importance in terms of raw material in the future.

Electro-magnetic fields may be formed around the cables in the wind farm. As the cables are trenched to a minimum depth of one metre into the seabed, and as the voltage of the interconnecting cables does not exceed 36 kV, the electromagnetic fields are not expected to influence neither fish nor mammals in the area.

Service and maintenance of the wind turbines will require a certain amount of navigation in small vessels in the area. Trips will also be made between the port of disembarkation and the accommodation platform, and navigation in connection with distribution of service personnel between accommodation platform and the individual wind turbines. This type of navigation will not contribute significantly to the total navigation in the area. Maintenance work at the wind turbines will mainly be performed inside the tower or in the nacelle, which will limit the environmental impact.

Cumulative impacts

It is the first time that two large offshore wind farms are located in the same local area, and therefore it is not possible in advance to determine which cumulative impacts will occur.

The distance between the wind turbines of the two wind farms, which are located closest to each other, is approx 14 km, and the wind farms will as such be considered as two separate units. Therefore it is considered unlikely that the wind farms will constitute a barrier to migrating birds, just as they are not expected to have a blocking effect for the movement of fish and marine mammals.

The worst-case scenario is that the presence of the two wind farm will entail loss of common scoter habitat corresponding to the size of the two wind farm area. The individuals would have to forage in other parts of the area, hence increasing the pressure on forage locations in general in the area.

There could also be cumulative impacts related to the visual impression of the two wind farms. From coastal areas north of Blåvands Huk a significant stretch of the horizon will appear covered by wind turbines on a day with very clear weather conditions. However, considering the distance from Horns Rev 2 to the coastline, the additional visual impact from this wind farm is considered to be of minor importance.

6 Mitigation measures

In connection with detailed planning of the wind farm, a number of procedures will be established to limit negative environmental impacts from the offshore wind farm. An environmental management system will be established for both construction and operation. When planning the activities of both phases, DONG Energy will aim to ensure that the work is planned to minimise the environmental impacts under consideration of technical, financial and time aspects. Moreover, as already mentioned, environmental and planning conditions have been considered in the final design of the wind farm.

Experience from the construction of the two existing offshore wind farms at Horns Rev and Rødsand has shown that by means of relatively simple measures it has been possible to establish the wind farms without them causing significant long-term impacts on the surrounding environment.

7 Environmental monitoring programmes

The large-scale environmental monitoring programme launched in connection with the demonstration offshore wind farms has contributed valuable knowledge about the impacts involved in the establishment of large wind power systems in marine environment. The impacts of Horns Rev 2 Offshore Wind Farm are thus not expected to deviate significantly from the general observations made particularly at Horns Rev 1. However, as mentioned environmental impacts may occur as a result of the cumulative impression of the two wind farms in combination.

Even though it is considered unlikely that the birds will not use the 14 km wide "opening" between the two wind farms to migrate, no previous results unambiguously indicate that this will be the case. An environmental monitoring programme for migrating birds would thus be able to contribute with knowledge about this subject.

The high number of common scoter recorded in the area, also calls for a proposal of an investigation of the species's future use of the area. An environmental monitoring programme on common scoter should furthermore be planned to include the many years of already existing data from the area in addition to new observations. The interaction between Horns Rev 1 and 2 in relation to the location of the common scoter should also be included in the programme. Moreover, it will be possible to establish any habituation tendencies by including both wind farms and existing knowledge.

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