

1 INTRODUCTION

Offshore renewable energy production in Norway is governed by the Offshore Energy Act. Under this act, the construction of offshore wind power and other renewable energy production units/facilities at sea can only take place after the Norwegian Government has opened specific geographical zones for licence applications. The opening of zones requires that a strategic environmental assessment (SEA) is carried out. The work with the SEA has been carried out by the Norwegian Water Resources and Energy Directorate (NVE) and was presented to the Ministry of Oil and Energy (OED) on January 4, 2013. The Ministry will decide which zones are to be opened for licence applications.

Several other directorates and government bodies apart from the NVE have contributed with their expertise in the SEA, and NVE wishes to thank the Norwegian Directorate of Nature Management, The Norwegian Directorate for Fisheries, The Norwegian Coastal Administration, and the Norwegian Petroleum Directorate for their involvement.

This document summarises the main findings in the SEA and NVE's recommendations to the OED.

The SEA is carried out on an overall level, and is not a substitute for project-specific impact assessments. The goal of the SEA is to provide the best possible basis for deciding which of the zones should be opened for licence applications.

The 15 zones considered in the SEA include zones considered for bottom-fixed installations and floating turbines. In total, the 15 zones have a capacity from 4600–12600 MW, with an estimated normal production of 19–50 TWh. On average, wind speeds are considerably more favourable offshore than onshore, and the capacity factor of turbines is estimated to be in the range of 36–50%.

The areas differ in size. The two southernmost zones, Sørlige Nordsjø I and Sørlige Nordsjø II, cover areas of 1300 $\rm km^2$ and 2500 $\rm km^2$ respectively. The areas of the zones

considered for floating turbines range from $500-1000 \text{ km}^2$, and the zones considered for bottom-fixed installations range from $50-300 \text{ km}^2$. In total, the areas considered cover a total area of 9000 km^2 , approximately 1% of the Norwegian Exclusive Economic Zone.

Offshore turbines are increasing in size, with larger turbine blades and increased installed capacity. In the SEA, turbines with an installed capacity of 10 MW per unit are considered1. It is estimated that the levelised cost of energy in the considered zones will be 90–120 øre/kWh in 2020, with investment costs in the range of 26-31 MNOK/MW.

Developing wind power projects in the Norwegian zones poses technical challenges. Deep waters, excessive wave heights, and non-homogeneous seabed conditions make the Norwegian zones less likely to be developed in the near future. However, European trends show a clear tendency towards wind power projects being consented and planned in deeper waters. The wind resources off the Norwegian coast are generally more favourable than in other European zones. As technology matures and costs are reduced, it is therefore likely that development of the Norwegian zones will be cost-competitive with other European offshore wind projects post-2020. However, developing offshore projects in the Norwegian zones are likely to remain more expensive than developing onshore wind projects on the Norwegian mainland in the conceivable future.

Norwegian industries are world-leading in offshore and subsea construction, and many companies are exporting technology and know-how to offshore wind developers all over Europe. A development of offshore wind in Norway would strengthen Norwegian know-how, allowing the industry to specialise in developing offshore wind in deeper waters.

For production and cost estimates, turbines with known effect curves in the 6-7 MW range were used.

2 ENVIRONMENTAL IMPACTS

2.1 BIRDS

Impacts on seabirds and migrating birds are found to be small to moderate in all zones. Assessments have been carried out for breeding populations in, and close to, the 15 zones. The zones where wind farms are considered to have the least impact on birds are Sørlige Nordsjø I and Sørlige Nordsjø II, and Sandskallen - Sørøya nord. These zones are located far away from established bird colonies and the zones have low bird densities. For all the other zones, negative impacts on birds are found to be moderate, with differences in impact levels within the zones.

2.2 FISH, MARINE MAMMALS AND BENTHIC ORGANISMS

Negative impacts of wind farms on fish are found to be small or even non-detectable. The exceptions are in the zones Stadthavet, Frøyabanken and Sørlige Nordsjø II, where construction can have impacts on blue lings, haddocks and sandeels respectively. Impacts can be reduced by not allowing construction work during spawning-periods.

Killer whales are sensitive to sound. Noise from the construction phase can have an impact on their behaviour, possibly preventing them from hunting close to construction sites. It is found that behavioural impacts can be expected in an area of 8 km around the construction site. Behavioural impacts for killer whales can be expected in the northern zones, and measures should be taken to prevent noise-generating construction activities in periods when presence of killer whales can be expected.

Impacts on benthic organisms depend on the size and form of the wind turbine foundations. In general, impacts are found to be small to moderate within the 15 assessed zones. However, both the seabed geology and ecology are poorly mapped in many of the zones, and specific impacts on benthos will need to be studied closer in later project-specific assessments.

2.3 ENVIRONMENTAL RISK

In the SEA, environmental risk is measured as the potential for a given type of accident to occur, and the severity of the pollution potential of said accident. The relative potential for accidents is highest in the zones Utsira nord, Stadthavet, Frøyabanken, Frøyagrunnene and Olderveggen, while the

presence of wind farms in the zones Sandskallen - Sørøya nord, Stadthavet, and Utsira nord would generate the highest pollution potential. In total, wind farm development in Utsira nord and Stadthavet are associated with the highest environmental risk. It is, however, important to note that the actual risk of accidents is considered as low in all zones.

3 IMPACT ON BUSINESS AND PUBLIC INTERESTS

There is a potential for value-creation by developing offshore wind power. The value-creation related to developing the proposed zones is estimated to 98-111 MNOK/MW over the lifetime of the projects. Labour demand is estimated to be in the region of 71-86 man-labour years/MW over the lifetime of the project, most of which (80%) will be associated with the construction phase.

3.1 PETROLEUM INTERESTS

Potential impacts for the petroleum industry are related to the petroleum resource potential within each zone. The highest petroleum resource potential is found within Sørlige Nordsjø I and II, and the conflict of interests is therefore considered to be highest here. Within the zones Stadthavet and Frøyabanken, the resource potential is also considerable. The Norwegian Petroleum Directorate nevertheless assumes that the coexistence of wind power and petroleum installations is possible within all zones.

3.2 SHIPPING

Wind farm development in the zones Frøyabanken and Træna vest is expected to cause the highest impact on shipping. Also, development in the zones Olderveggen and Trænafjorden can adversely affect shipping due to their location in relation to established shipping lanes and leads. The Norwegian Coastal Administration has proposed new boundaries for some of the zones due to conflicts with existing leads. Co-existence between wind power and shipping is possible in most of the areas, but may require alterations of existing leads and rearranging of beacons/lighthouses.

3.3 FISHERIES

The Norwegian Directorate for Fisheries has made a general conclusion that co-existence between wind farms and fishery activities will not be possible within a zone. The Directorate recommends that 7 of the 15 areas are not opened for licence applications. These zones are Sandskallen - Sørøya nord, Nordmela, Olderveggen, Frøyagrunnene, Trænafjorden - Selvær, Træna vest and Nordøyan - Ytre Vikna.

3.4 LANDSCAPE

Visual impacts from offshore wind turbines on the landscape

generally increase the closer the turbines are situated to shore. Development of the zones Gimsøy nord and Nordmela will yield the highest negative impacts on landscape as the zones are close to shore and the landscape is considered vulnerable to the visual intrusion represented by the wind turbines. Wind farm development in the zones Trænafjorden - Selvær, Nordøyan - Ytre Vikna, Utsira nord and Frøyagrunnene will also impact the surrounding landscape. Nevertheless, the visual impact from wind turbines is not considered to be unacceptable in any of the 15 zones.

3.5 OUTDOOR RECREATION AND TOURISM

The presence of offshore wind turbines can have an impact on leisure yachting and fishing activities in the developed areas through restricted access and complicating navigation. However, it is generally the visual intrusion of the turbines that is considered to represent the most important impact for outdoor activities. Visual intrusion is expected to be strongest in the zones Gimsøy nord and Nordøyan - Ytre Vikna. Nevertheless, the visual impact from wind turbines on outdoor activities is not considered to be unacceptable in any of the 15 zones

Offshore wind power is also found to have a potential negative impact on tourism in some zones. This is particularly the case in the zone Nordmela. Impact is also expected to be negative in the zones Gimsøy nord and Frøyagrunnene. In the zone Utsira nord, however, a slight *positive* impact on tourism is expected.

3.6 HISTORICAL MONUMENTS AND CULTURAL HERITAGE SITES

Wind power development in the zones will not directly impact any known historical monuments or cultural heritage sites. However, development in the zones Trænafjorden, Selvær and Gimsøy nord may result in some visual impact on cultural heritage sites.

3.7 OTHER INTERESTS

The zones Gimsøy nord and Utsira nord overlap with areas used by the Norwegian Air Force and the Norwegian Navy for practice purposes, and development of wind power will be in direct conflict with today's use of the areas. In Gimsøy nord,

development of wind power is not recommended as long as the area is in use by the Norwegian Navy. When it comes to Utsira nord, however, only a small part of the proposed development area overlaps with the military training area. Subsequently, the potential conflict of interest in this area can be easily avoided by not developing in the overlapping areas.

Wind power development in the proposed zones will not impact meteorological or civil aviation radars. The Norwegian Meteorological Institute and Avinor recommend that wind turbines are not sited closer than 5 and 10 km from meteorological and aviation radars respectively.

Utsira nord is the only zone where there are pipelines on the seabed. The pipelines are located in the south-eastern corner of the zone. There are no subsea power cables in any of the zones.

4 FINDINGS IN THE SEA AND NVE'S RECOMMENDATIONS TO OED



FIGURE 4.1: Zones considered for offshore wind power in Norway. Category indicates NVE's recommendations for the further process based on the degree of possibilities and challenges regarding wind power development. See the text for description of the categories.

The 15 zones considered in the SEA are located along the Norwegian coast from the Barents Sea in the north to the southern parts of the North Sea. In the following the main results from the SEA in each zone will be presented along with NVE's recommendations to the OED .

Based on the results from the SEA, NVE has divided the considered zones into three categories:

- Category A: Wind power development within the zone is technically and economically feasible, and will have relatively few negative impacts. Grid connection is possible before 2025.
- Category B: Wind power development within the zone will have challenges related to either technical aspects or conflict of interests/negative impacts. The challenges might be resolved in the future through technology development, grid measures and/or mitigation measures. NVE considers that zones in this category can be opened when technology matures, or when existing use of the areas changes.
- Category C: Wind power development within the zone represents greater challenges than in the other two categories. Conflicts of interest in the areas are not easily resolved. Foreseen negative impacts are still considered acceptable. Zones in this category should not be opened at the expense of zones in the two other categories.

4.1 SANDSKALLEN - SØRØYA NORD

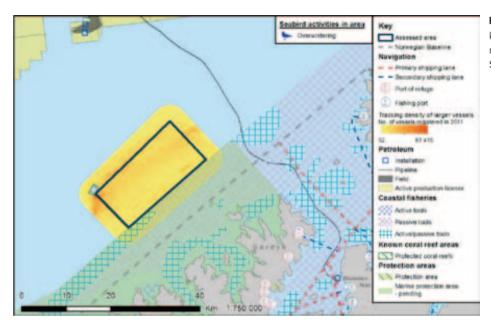


FIGURE 4.2: The most important known activities and environmental interests in and around Sandskallen - Sørøya nord.

DESCRIPTION

This zone is located in the Barents Sea, approximately 14 km outside Sørøya in Finnmark County. Average wind speed is estimated to 9.4 m/s, and the zone covers an area of 260 km². There is moderate shipping activity in the area, mainly consisting of fishing vessels and freighters. Traffic patterns must be adjusted to ensure safe passage for ships if the area is developed for wind power. The fishing activity in the area is high, with fishing mainly from larger vessels. A low density of seabirds in the area suggests that the area can be developed with little or no impact for seabirds. Care must be taken to minimize impacts for puffins, black-backed gulls and black-legged kittiwakes. There are also harbour seals in the area.

NVE's COMMENTS

With water depths varying between 40 and 80 meters, this zone can be suitable for both floating and bottom-fixed technology. Relative to the other zones, wind conditions are not among the best, but the wind resources in the zone are considered as superior to onshore wind resources in Finnmark, and also superior to those of many existing European offshore projects. It is expected that electricity demands will rise in the region due to an increase in mining and petroleum activity. Development of wind power in the zone might impact local fishery activities, and the Norwegian Directorate of Fisheries recommends that this zone is not opened for development of wind power. NVE still considers that parts of the zone can be opened with limited impacts on fisheries. However, care must be taken to ensure that fishing interests are appropriately included in the planning process.

4.2 VANNØYA NORDØST

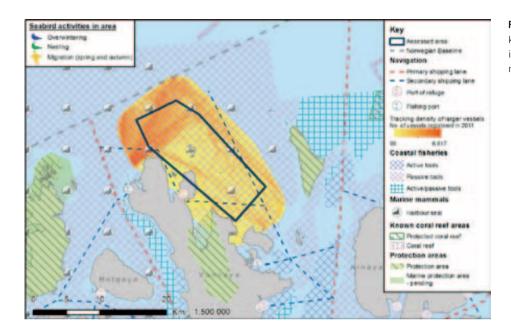


FIGURE 4.3: The most important known activities and environmental interests in and around Vannøya nordøst.

DESCRIPTION

This zone is located in the Barents Sea close to Vannøya in the municipality of Karlsøy, Troms County. Average wind speed is estimated to 9.2 m/s, and the zone covers an area of 154 km². Grid access will require significant investments, and is not likely to be available until 2025. Shipping activity in the area is low, and consists mostly of smaller fishing vessels. There is limited existing knowledge of seabird activity in the area. It is known, however, that there are herring gulls and black-backed gulls in the area, and that kittiwakes and razorbills are using the area for foraging. There are established populations of harbour seals in the area, and killer whales can be present during winter.

NVE's COMMENTS

With water depths between 20 and 80 m, the zone can be suitable for both floating and bottom-fixed technology. However, investment costs are considered to be higher than average if compared to the other zones. This is mainly related to varying wind resources across the zone and high costs associated with gaining grid access. If wind power development is carried out within this zone, care must be taken to minimize potential negative impacts on marine mammals during the construction phase.

4.3 AUVÆR

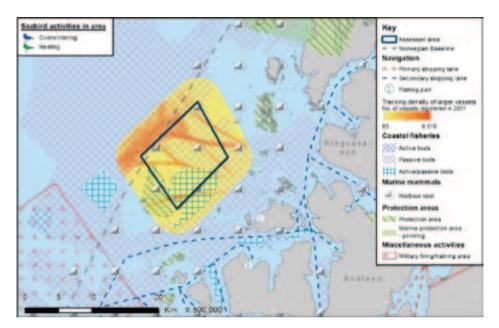


FIGURE 4.4: The most important known activities and environmental interests in and around Auvær.

DESCRIPTION

This zone is located in the Barents Sea, approximately 15 km outside Kvaløya in Troms County. The zone covers an area of 105 km², and the average wind speed is estimated to 9.3 m/s. Grid access will require significant investments. There is relatively high fishing activity in the area. The zone overlaps partially with Auvær Nature Reserve, and includes a wintering area for marine ducks and an important area for common eider ducks and terns. The zone also overlaps with a foraging area for guillemots and auks. Killer whales can be present during parts of the year.

NVE's COMMENTS

With water depths between 20 and 40 m, this zone is suitable for bottom-fixed installations. Although depths alone suggest low investment costs, distance to existing infrastructure and varying wind conditions within the zone suggest high levelised cost of energy (LCOE) compared to the other zones. Developing of wind power in the zone can have impacts on seabirds and fisheries, and parts of the zone overlaps with Auvær nature reserve. NVE recommends that the part of the zone which overlaps with the nature reserve should be excluded from future development considerations.

4.4 NORDMELA

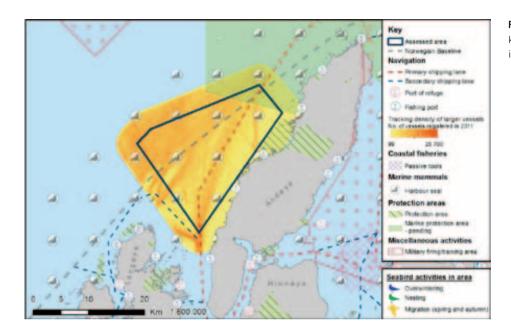


FIGURE 4.5: The most important known activities and environmental interests in and around Nordmela.

DESCRIPTION

Nordmela is located close to the island Andøya in the municipality of Andøy, Nordland County. Average wind speed in this zone is estimated to 9.2 m/s, and the zone covers an area of 332 km2. Grid access will require significant investments, and might not be possible until after 2025. The island of Andøya is an important area for many seabirds, and two nesting cliffs are located adjacent to the zone. Within the zone there are breeding sites for razorbills, puffins, guillemots and kittiwakes. On Andøya, there are also important areas for barnacle geese and pink-footed geese. Within the influence area, there are also important areas for harbour seals. Killer whales are known to be present during winter. Parts of the zone overlap with Skogvoll Nature Reserve. Shipping activity in the area consists of freighters and fishing vessels, and wind farm development within the area will trigger a need for changes in existing routes in the area. Any wind turbines erected within the zone will be visible from Andøya.

NVE's COMMENTS

With water depths varying between 20 and 80 m, this zone can be suitable for both bottom-fixed and floating installations. The wind resources are varying within the zone, though the best wind resources are found in the areas furthest from the shore. Grid access is difficult and will require significant investments. There are important fishing activities in the area. The potential for conflict of interests between wind farm development and local fisheries is considered as high.

4.5 GIMSØY NORD

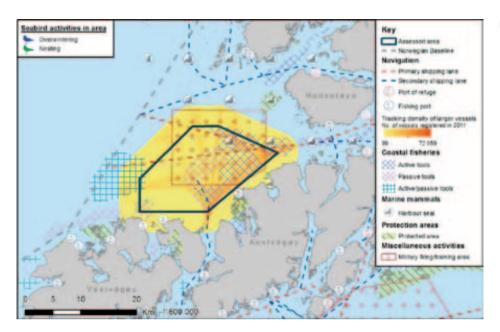


FIGURE 4.6: The most important known activities and environmental interests in and around Gimsøy

DESCRIPTION

Gimsøy nord is located northwest of Gimsøy in the municipality of Vågan, Nordland County. Average wind speed in the area is estimated to 8.9 m/s, and the zone covers an area of 245 km2. Grid access is unproblematic in the area. A large part of the zone coincides with a training area used by the Norwegian Navy. It is assumed that development of the area cannot commence while the Navy are actively using the area for training purposes. The zone is also located within an area important for seabirds, with many species overwintering in the area or using the zone for foraging. In addition, a bird migration route from Svalbard crosses the zone. Within the influence area of the zone there are locations with high densities of harbour seal, and killer whales might be present during winter. Parts of the zone overlap with Hovsflesa Nature Reserve.

There is dense traffic in the area, mostly consisting of freighters and fishing vessels. Fishing activity within the area is high, mostly involving smaller fishing vessels. The zone is located close to shore, and a wind farm development in the area will be visible from areas where landscape values are of national importance.

NVE's COMMENTS

With water depths between 20 and 40 m, this zone is considered to be suitable for bottom-fixed installations only. The area is considered to be suitable both technically and economically, but NVE recommends that this area is not given priority due to the high possible impacts for birdlife, and high visual impact on the surrounding landscape. Moreover, development of offshore wind power within this zone is not consistent with the Navy's current use of the area.

4.6 TRÆNAFJORDEN – SELVÆR

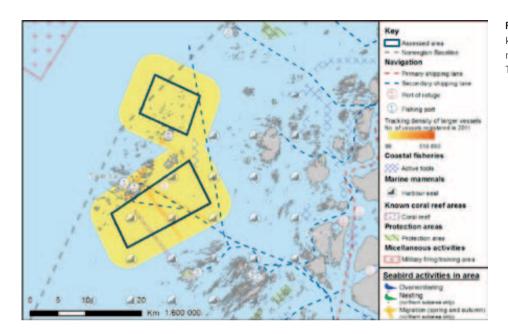


FIGURE 4.7: The most important known activities and environmental interests in and around Trænafjorden - Selvær.

DESCRIPTION

Trænafjorden - Selvær is located in the Norwegian Sea, approximately 26 km from the Nordland County coast. The zone is divided in two sub-areas where Trænafjorden is the southernmost and Selvær the northernmost area. The latter sub-area is an area with many smaller islands and access to this part of the zone might be challenging. This zone covers an area of 197 km2, and average wind speed is measured to 10 m/s. The zone, and especially the Selvær sub-area, is used as a foraging area for migrating barnacle geese, and there are known areas of coral reefs within the zone.

Traffic is dense in the zone, and the Trænafjorden sub-area is the most heavily trafficked of all the zones considered. The traffic consists mainly of fishing vessels and passenger ferries. There is also high fishing activity within the zone. A wind farm development within the zone will be visible from populated areas like Husøya, and from cultural heritage sites on the islands.

NVE's COMMENTS

With water depths in the zone varying between 0 and 60 meters, the area can be suitable for both bottom-fixed and floating installations. The wind resources are good across the zone, but wind farm development within the Selvær sub-area will offer challenges regarding access. The zone is located far from existing grid infrastructure, and grid access will require significant investments. Development of wind power in the area can have impact on fisheries and on birdlife, and will be visible from the islands of Træna.

4.7 TRÆNA VEST

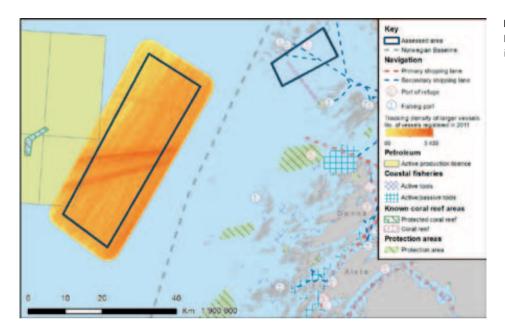


FIGURE 4.8: The most important known activities and environmental interests in and around Træna vest.

DESCRIPTION

Træna west is located in the Norwegian Sea, approximately 45 km off the Nordland County coastline. This zone covers an area of 773 km2, and average wind speed in the area is estimated to 9.8 m/s. Occurrences of horse mussels and sponges have been registered in the area, and these nature types are categorized as threatened by OSPAR. Very little is currently known about seabird activity in the area.

There are shipping routes through the zone. The traffic in the area is largely consisting of offshore supply ships and freighters. However, chemical freighters and fishing vessels also use the area. Fishing activity in the zone is high.

The zone is located far away from shore, and wind power development will not cause any visual impacts.

NVE's COMMENTS

With water depths between 181 and 352 meters, this zone is suitable for floating installations. Grid connection is considered to be impossible before 2030 and will require significant investments. The wind resources in the area are considered as lower than in the other zones considered for floating installations. Based on existing knowledge, a development in the area will not have significant impact on environmental interests. Impacts from wind power developments on birdlife are not considered, however, due to lack of existing data.

4.8 NORDØYAN - YTRE VIKNA

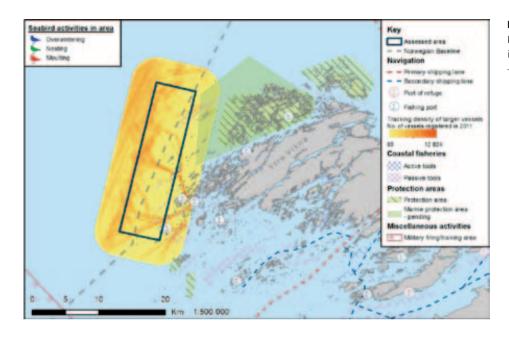


FIGURE 4.9: The most important known activities and environmental interests in and around Nordøyan – Ytre Vikna.

DESCRIPTION

Nordøyan - Ytre Vikna is located in the Norwegian Sea, more than 10 km off the island Ytre Vikna in the municipality of Vikna. Average wind speed in the area is estimated to 9.7 m/s, and the zone is covering an area of 140 km2. Traffic density in the area is low, and traffic consists mainly of smaller fishing vessels. The zone is located in an area considered as important to seabirds and there are colonies of kittiwakes, puffins, razorbills and guillemots close to the zone. Fruflesa and Nordøyan Nature Reserves are located adjacent to the zone.

Parts of the zone are located close to shore, and a wind power development in these parts of the zone will consequently have visual impacts on the landscape.

NVE's COMMENTS

With water depths of less than 60 meters in most of the zone, this zone is considered for bottom-fixed installations. The depths, however, are varying greatly within the zone, and development of wind power is considered to be challenging. Grid connection will require upgrading of onshore grid, but is considered possible. Development of wind power might impact bird life in the area, and might also have impacts on local fishing activities, as the smaller vessels using the area have few alternative sites.

4.9 FRØYABANKEN

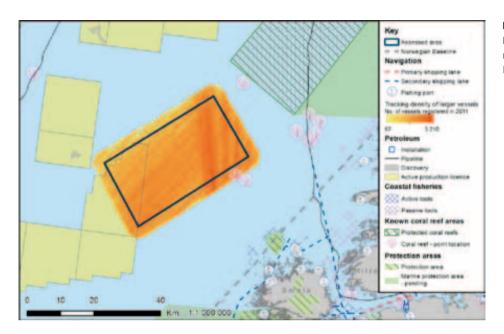


FIGURE 4.10: The most important known activities and environmental interests in and around Frøyabanken.

DESCRIPTION

Frøyabanken is located approximately 34 km off the coast, and covers an area of 819 km2. Average wind speed is estimated to 9.8 m/s. There is a spawning area for haddock within the zone, but impacts for this species are considered to be few. The zone also overlaps with spawning areas for cod and redfish.

Traffic density in this zone is relatively low, with traffic consisting of larger ships and towing vessels. Towing and other activity in the area is mostly related to petroleum installations, and it must be noted that towing vessels have lower manoeuvrability than other vessels. There is also fishing activity in the area.

NVE's COMMENTS

With water depths between 160 and 310 meters, the area is suitable for floating installations. The wind resources are considered as low compared to the other areas suited for floating installations. Grid connection will require significant investments, and might not be possible until after 2030. Developing wind power in the zone will have the highest impact on shipping activities compared to the other zones. Also, the zone overlaps with spawning areas for haddock, which is considered to be an important commercial species. Impacts from wind power development on bird life in this zone are unknown due to lack of existing data.

4.10 STADTHAVET

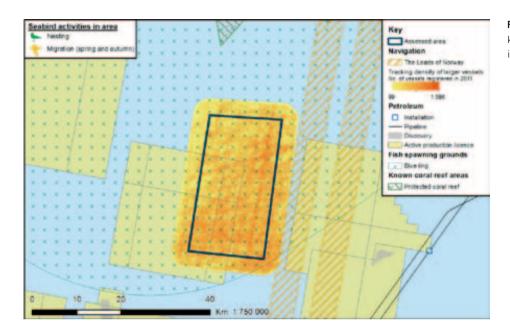


FIGURE 4.11: The most important known activities and environmental interests in and around Stadthavet.

DESCRIPTION

Stadthavet is located in the Northern Sea, approximately 58 km from the coast of Nordfjord in Sogn and Fjordane County. The zone covers an area of 520 km2. Average wind speed within the zone is estimated to 11 m/s, and this zone is considered to have the overall roughest weather conditions of the 15 zones considered. The zone overlaps with around 20% of Norway's sole spawning area for blue ling, a Red List-classified fish species. Construction noise may impact the behaviour of this species, and construction and other noise-generating activities should be avoided during the spawning periods. Coral reefs are registered close to the zone, but not within the zone. Fishing activity in the area is high.

NVE's COMMENTS

With water depths between 170 and 210 meters, this zone is suitable for floating installations. The wind resources in the area are excellent, but rough weather condition might limit accessibility of the zone. Grid connection will require significant investments, and might not be possible until after 2030. Development in the zone might have impact on blue ling, a species which is on the Norwegian Red List. In a case of wind power development in the area, care needs to be taken to minimize impacts on blue ling. Due to rough climate, and moderate shipping activity, wind power development of the zone also carries higher environmental risks than the other considered zones.

4.11 OLDERVEGGEN

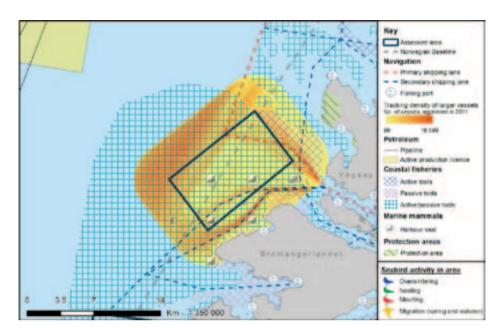


FIGURE 4.12: The most important known activities and environmental interests in and around Olderveggen.

DESCRIPTION

Olderveggen covers an area of 76 km2, and is located in the North Sea outside Måløy, in Sogn and Fjordane County. This zone is located close to the zone Frøyagrunnene. Average wind speed is estimated to 10.8 m/s. With water depths between 5 and 60 meters, the zone is considered for bottom-fixed structures. Both Olderveggen and Frøyagrunnene are located close to shore, and in close proximity to existing infrastructure. Either one of the two zones, but not both, can be connected to the existing grid before 2025. Olderveggen is located close to the main shipping lane to Måløy, Sandane and Olden, all of which are cruise destinations. There is also high fishing activity within the zone

Olderveggen is also close to several bird colonies and many important nesting areas for seabirds in the Sogn and Fjordane region. Parts of the area that is covered by the zone is considered to be an important area for several Red List-classified species, and parts of the nature reserve Veststeinen is located within the area.

NVE's COMMENTS

Olderveggen is located close to the zone Frøyagrunnene. The two zones are mutually excluding, and NVE recommends that Frøyagrunnene is opened before Olderveggen. For more info see NVE comments Frøyagrunnene 4.12.

4.12 FRØYAGRUNNENE

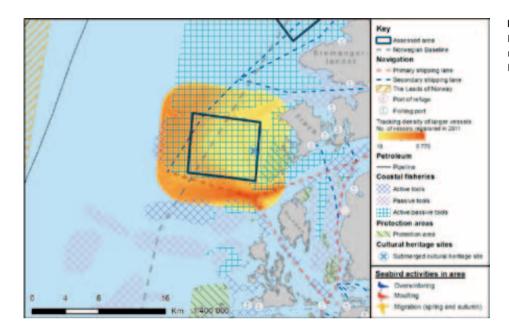


FIGURE 4.13: The most important known activities and environmental interests in and around Frøyagrunnene.

DESCRIPTION

Frøyagrunnene covers an area of 58 km2, and is located 10 km southwest of Bremangerlandet in Sogn and Fjordane County. Average wind speed in this zone is estimated to 10 m/s. With water depths between 5-60 meters, the zone is considered for bottom-fixed structures. The zone is located close to the zone Olderveggen. Both zones are located close to existing infrastructure and there is grid capacity in the existing grid, allowing one of the two zones to be connected before 2025

Traffic in the area consists mostly of freighters and fishing vessels, and the area is used extensively for fishing. If the zone is developed for wind power the traffic patterns must be adjusted. The zone is located relatively close to shore, and any wind farm development will be visible from parts of the coast, including the tourist destination Kalvåg. Developments will also be visible from Hurtigruten, a popular ferry/cruise liner, which sailing route passes the zone.

NVE's COMMENTS

The zones Frøyagrunnene and Oldeveggen are in close proximity to each other and are technically similar zones. Both zones have water depths between 5 and 60 meters and wind conditions are excellent. Of the zones close to shore in shallow water, Frøyagrunnen and Olderveggen are considered to be those with the highest technical feasibilities. Both zones are also close to existing infrastructure, and there is currently grid capacity for one of the two zones. NVE recommends that Frøyagrunnene is opened for development before Olderveggen due to possible impacts for shipping and seabirds, which are

considered to be lower in Frøyagrunnene than in Olderveggen. The Directorate for Fisheries has considered both zones as one, and recommends that neither of the zones is opened.

4.13 UTSIRA NORD

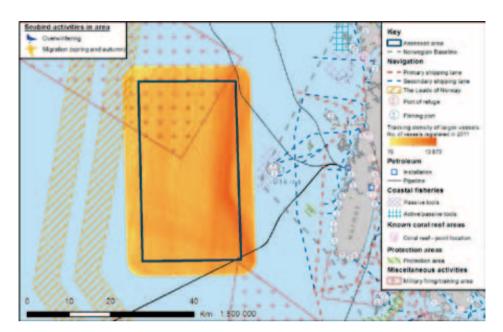


FIGURE 4.14: The most important known activities and environmental interests in and around Utsira nord.

DESCRIPTION

Utsira nord is located west of Haugesund, approximately 22 km off the coast. The closest populated area is Utsira. The zone covers an area of 1010 km2, and average wind speed in the area is 10.2 m/s. The area is heavily trafficked, mainly by larger freighters and fishing vessels. Many of the freighters are carrying potentially polluting cargo. Parts of the zone coincide with a training area used by the Norwegian Air Force. Development in the zone will be visible from parts of the island of Utsira.

NVE's COMMENTS

With water depths between 185 and 280 meters, this zone is considered for floating structures. The wind conditions in this zone are among the best of the 15 considered zones, and the foreseen negative impacts of a wind power development in the area are relatively few. The area is, however, heavily trafficked. This, coupled with its proximity to shore, means a development in this zone may be associated with a relatively high environmental risk. NVE recommends that this zone is opened for wind power development, but stresses that such a development will require close co-ordination with the Norwegian Coastal Administration to ensure navigational interests are maintained.

4.14 SØRLIGE NORDSJØ I

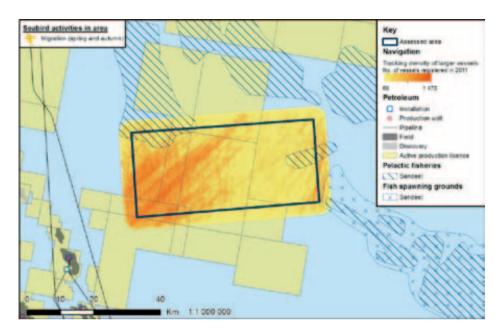


FIGURE 4.15: The most important known activities and environmental interests in and around Sørlige Nordsjø I.

DESCRIPTION

Sørlige Nordsjø I is located in the southern parts of the North Sea, some 150 km off the Norwegian coast. Average wind speed in the area is estimated to 10.5 m/s, and the zone covers an area of 1375 km2. The distance to the nearest grid connection point is approximately 200km. Petroleum sectoractivity is high in the southern North Sea, and this zone is located between the petroleum fields Yme and Ula.

NVE's COMMENTS

The zones Sørlige Nordsjø I and Sørlige Nordsjø II are located relatively close to each other and are technically similar zones. These two zones have therefore been evaluated together. See Sørlige Nordsjø II (4.15) for more information.

4.15 SØRLIGE NORDSJØ II

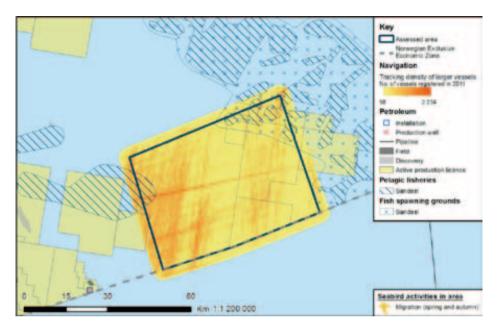


FIGURE 4.16: The most important known activities and environmental interests in and around Sørlige Nordsjø II.

DESCRIPTION

Sørlige Nordsjø II is located some 140 km off the southern coast of Norway. This zone is the largest of all the considered zones, covering an area of 2591 km2. Wind speed in the zone is estimated to 10.5 m/s. The distance to the nearest grid connection point is approximately 200km. Petroleum sector-activity is high in the southern North Sea, and this zone is located between the petroleum fields Ekofisk and Tor. The area is heavily trafficked, with most of the traffic relating to the petroleum industry.

Parts of the zone overlap with around 20% of Norway's spawning grounds for sandeel, an ecologically important species.

NVE's COMMENTS

NVE recommends that both Sørlige Nordsjø I and Sørlige Nordsjø II are opened for development. This is due to excellent wind conditions, and due to the relatively low impact of developing the zones. The areas both have water depths between 40 and 70 meters, and NVE has considered that both floating and bottom-fixed structures could be feasible in the zones. There is, however, only grid capacity to handle electricity production from one of the two zones in the foreseeable future. NVE does not want to prioritise one of the zones over the other as they are both very similar in regard to both technical feasibility and possible negative impacts. There are some small differences, however, such as a slightly lower traffic density in Sørlige Nordsjø II. Both areas overlap with spawning areas for sandeel, and if wind power development is carried out in one or both areas, NVE recommends that appropriate measures are taken to prevent disturbances during the sandeel spawning periods.

