ENVIRONMENTAL IMPACTS OF OFFSHORE WIND FARMS: ASSESSMENT AND LONG-TERM MONITORING IN DENMARK

Environmental Impact Assessment

During the tendering process of an offshore wind farm in Denmark, an exhaustive Environmental Impact Assessment (EIA) of the designated offshore area, export cable route, and onshore grid connection is completed by the Danish Transmission System Operator (TSO), Energinet, and fully consented before the bidding date.

The offshore investigation area is larger (about 40% larger) than the actual area needed for the planned installed capacity (0.22 km2 / MW), in order to leave flexibility for the Concessionaire to develop the most optimal wind farm.

The EIA report is based on the principle of the greatest conceivable environmental impact, through a combination of a "most likely" and a "worst case" approaches, to ensure that subsequent EIAs are not necessary for the specific project. The EIA aims at evaluating the largest possible environmental impact, along with the potential cumulated effects with the other nearby offshore wind farms.

The EIA's technical specifications provide the framework which a concessionaire can navigate within by describing the main technical parts of the offshore wind project: wind turbines, layouts, foundations design, inter-array cables, installation methods, and so forth. The technical specifications are designed through a continuous and transparent dialogue with the industry, in order to reflect the actual needs of the potential bidders.

Since the last tender, the technical background reports are now published sequentially as they are finalized in draft versions. The decision to publish the technical background reports as drafts constitutes a new practice, which reflects the general commitment to maximum openness in the Danish tenders. Bidders can benefit from the information even though the reports may still be amended following the scrutiny and approval by the authorities.

After being approved by consultation by the relevant authorities, the final EIA reports are then jointly published by the Nature Agency and the Danish Energy Agency (DEA) for public consultation. Like for the authorities, the period of public consultation is eight weeks. Within this period the two agencies together with Energinet conduct several public meetings, in which local citizens have the opportunity to ask questions about the environmental aspects of the project.

Long-term monitoring

Denmark has commissioned an environmental monitoring follow-up programme focusing on long-term and cumulative effects on fish, harbour porpoises, common scoters, and red-throated divers. The new studies provide planners and developers with tools to address the cumulative effects of wind farms and to mitigate injury to harbour porpoises during construction.

The Danish environmental monitoring follow-up programme has led to the important conclusion that, with proper spatial planning, it is possible to construct offshore wind farms in an environmentally sustainable manner that does not lead to significant impact on nature.

Fish: Wind farms as a refuge for fish

Extending seven years after the deployment of the wind farm in 2003, the study on Horns Rev is the first long-term study of the effects of offshore wind farms on fish communities. Many fish species showed attraction towards the wind turbine foundations, and this has now resulted in a higher number of species inside the wind-farm area compared to areas outside the wind farm. Overall the studies showed that offshore wind farms did not have any negative impact on fish abundance. Some species appear to use the foundation and associated scour protection as refuge

areas for hiding and forage.

The positive effect may be enhanced by the exclusion of commercial fishing inside the wind farm area and thus function as a small marine protected area. However, the area occupied by an offshore wind farm is relatively small compared to the spatial use of most migratory species with a broad distribution pattern. The cumulative effect of multiple wind farms located close together within the same region might therefore be beneficial to fish communities.

Marine mammals: Injury and population impacts can be mitigated

The first part of the follow-up programme focused on construction noise effects on the harbour porpoise, looking at long-distance disturbance effects as well as the effectiveness of devices to deter harbour porpoises from zones of potential injury. The second part of the study developed and tested a computer model to predict the cumulative effects on harbour porpoise populations of wind turbines, ships, and by-catch.

The first study documented considerable noise effects on harbour porpoises during pile driving, with possible temporary hearing impairment as a consequence. However, the effect was also shown to be short-lived. Furthermore, researchers investigated the effect of seal scarers on harbour porpoises and found that the sound-emitting device indeed has a deterrent effect on harbour porpoises, thus protecting against injury from piling noise.

In the third study, researchers developed a computer model to predict the effects of wind farms, ships, and by-catch over time on harbour porpoise populations. In the model, each animal moved around in a virtual landscape and reacted to noise and variations in food availability in a way that closely resembled that of real animals. The model predicted that noise from ships and wind farms has a minor effect on harbour porpoise population size. By-catch in commercial fisheries may, in contrast, reduce the population size substantially. These results need to be treated with some caution; however, as uncertainties exist about some of the input data and assumptions on which the model is based.

Birds: Models as tools to predict impacts on birds

The results from the 2000-2006 first part of the monitoring programme suggested that the common scoter and the red-throated diver were adversely affected by the Horns Rev wind farm. To follow up on this for common scoters, two additional studies were conducted: one aiming to improve the understanding of the availability and changes in the food supply for common scoters in the Horns Rev area, and another documenting the distribution of common scoters in the area in 2007. For red-throated divers, a study was conducted aiming at modelling the cumulative disturbance effects of large-scale wind farm development in Danish and Baltic waters.

In the first study, a habitat suitability model was developed for cut trough shells and razor clams – the two main prey species for the common scoters. This model has provided a means for extrapolating the results of the biological sampling carried out to the whole area around Horns Rev. The model also makes it possible to make estimates for the whole period of the baseline and post-construction investigations (2000-2010). The habitat-suitability model has proved useful in describing the relationship between distribution patterns of common scoters and their prey. The model may serve as a predictive tool in the planning process for the development of future offshore wind farms.

Aerial surveys conducted in 2007 found high common scoter densities within the Horns Rev 1 offshore wind farm, but this is only likely to happen everal years after construction. It could not be excluded, however, that this reflects changes in food supply rather than a change in the behaviour of the birds.

The computer model developed to assess the cumulative effects of multiple wind farms on the red-throated diver population suggested there would be minimal impacts from the three wind-farm development scenarios considered for Danish waters and the Baltic Sea. Even in the scenario where 15,000 km2 were classified as wind farms, a less than 2% change in the population level was predicted. Further development of the model, and better knowledge on the biology of red-throated divers are needed to be able to conclude with more certainty.

For further information, please contact:
Lucie Roubin
lrn@ens.dk
+45 3392 6779