Project Fact Sheet
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SPatial Deployment of offshore WIND Energy in Europe (WINDSPEED)

Programme area: ALTERNER, offshore wind energy
Status: ongoing

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Objective:
Develop a roadmap for large scale development of offshore wind power in the Central and Southern North Sea basin.

Benefits:
Policy makers and stakeholders will gain better understanding of and insight into the costs, benefits and trade-offs of offshore wind development in the Central and Southern North Sea basin.

Keywords:
Offshore wind energy, spatial priorities, development path up to 2030

Duration:
09/2008 – 02/2011 (extended to 03/2011)
Budget:
€ 1,456,063 (EU contribution: 75%)
Contract number:
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Short description
Offshore wind energy deployment can significantly contribute to increasing the share of renewable energy in Europe’s energy mix. However, competing uses of the sea, costs, grid integration and other barriers are important challenges to the development of offshore wind. WINDSPEED aims to develop a roadmap defining a realistic target and a development pathway up to 2030 for offshore wind energy in the Central and Southern North Sea (Belgium, Denmark, Germany, the Netherlands, Norway and the UK). The roadmap will also identify barriers and potential surplus conditions in the North-European electricity grid along with policy recommendations on how to tackle these.

A sound methodological framework will be developed, consisting of a Geographical Information System (GIS)-based decision support system (DSS), to allow for a spatial representation of wind energy potentials in relation to non-wind sea functions and nature conservation, and calculation rules for quantifying trade-offs between electricity generation costs and constraints due to non-
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wind sea functions and nature conservation. Stakeholders will play a key role in co-defining the DSS tool as well as the roadmap for offshore wind deployment up to 2030. The DSS tool will produce maps indicating relevant offshore wind energy characteristics at feasible sites, including the cost of grid integration, and can thus be a useful tool in helping policy makers in prioritising the sequence of future offshore wind farm allocation.

Expected and/or achieved results

Expected results will be:

- Establish inventories of (i) wind potential, location specific wind energy costs, related infrastructure, and marine planning and regulatory regimes (ii) current and future presence of other sea functions and their interactions.
- Establish a methodological framework for the quantification of spatial marine interactions and the economic impacts of these interactions on the deployment of offshore wind farms.
- Establish a GIS-based decision support system that combines the results of the inventory as well as the interactions.
- Identify barriers for offshore wind deployment, with focus on grid integration, and to define a set of policy recommendations to tackle these.
- Develop scenario forecasts for offshore wind energy.
- Define a realistic target and development path for offshore wind energy Central and Southern North Sea basin up to 2030.
- Run training courses for policy makers and other influential organisations using the GIS-based decision support system.

Lessons learnt

- There are no technical limitations to the deployment of offshore wind energy in the Central and Southern North Sea basin.
- Combining geographical datasets collected from different countries to achieve geographical coverage as required for the WINDSPEED project is an arduous task as the different data structures and coding systems need to be harmonised for use with the DSS. A system such as the DSS needs information to be uniform across countries for use in the calculations and is therefore more demanding than the production of a GIS map showing international datasets.
- To accommodate for different characteristics and availability underlying data, different categories of calculation rules had to be developed. Calculation rules based on economic values could not be defined, as underlying data was unsuitable for defining such a rule. In the case of fisheries, more detail is required on catch composition and catch value than is presently available on an international level. For sand (and gravel) extraction, the reported economic values per unit where too widely spaced to allow a reasonable estimate to be made. In this case another knowledge constraint seen as obstructive was the actual size of the exploitable resource on the sea floor is unknown. As a result the economic value for the resource in its original position cannot be calculated.
- Determining the future development of non-wind sea use functions requires interpreting the available projections as well as the historical development to arrive at an acceptable estimate. Also physical and/or economical limitations may have to be considered as e.g. with the increase in ships sizes. The default estimate represents a ‘most likely’ case, but considerable deviations may occur and could be included in the scenario analysis, as optimistic and pessimistic variations.
Assessments using the DSS tool show that current non-wind sea use functions and nature conservation areas claim relatively large areas of the sea basin, particularly close to shore, where OWE can be developed at a relatively low levelised cost of production.

Assessments, focusing on nature conservation issues, also show that a significant share of the non-freely available areas can be regarded as negotiable areas. The potential for and cost of offshore wind therefore depends on the spatial priorities set by national governments.

While assessing the impacts on non-wind sea use it has become clear that much of the area identified by the DSS as suitable and available for developing OWE, is not likely to be developed for reasons of other constraints. These include 1st order economic constraints basically focussing on the market price and excluding areas that are too expensive to develop and 2nd order economic constraints including grid connection issues (technical as well as financial) and aspects of market integration. As a result the final assessment of impact on non-wind sea use of developing OWE is judged as acceptable within the limits and ambitions of each scenario.

There is limited potential for incremental OWE capacity across most of the southern portion of the North Sea by focussing on relatively near-to-shore and radially connected wind parks without prioritisation of space for OWE.

Changes in the level of prioritisation that is given to new OWE – in terms of looking for co-use with some existing sea uses or assuming some level of compromise on the extent of other certain uses – were found to make a large difference to the potential for incremental OWE; particularly for generation at low to moderate delivered electricity costs. Tied closely to the ability to find new space for OWE is the need to integrate planning of certain existing sea use functions with wind parks.

Relaxing the constraints on the permissible maximum distance to the coast – in anticipation of connecting these far from shore areas via an offshore grid – significantly increases the spatial potential. The In the Deep incremental spatial potential is roughly five times that of the Little Will Little Wind scenario (in effect matched scenarios, as both do not spatially prioritise for OWE) and the Grand Design scenario identifies more than three times the incremental spatial potential as the Going Solo scenario.

There are potential co-use opportunities for OWE and certain sea use functions, due to the low average installed density of wind turbines that is assumed. The corridors between neighbouring parks can be utilised by other sea use functions such as shipping and fishing. Relatively low densities of OWE (at a macro scale) are thus not only necessary to preserve the level of wind resource, but also allow integration or co-use of some other sea uses.

Within the WINDSPEEP scenario analysis, it can be concluded that realising floating technologies effectively potentially doubles the total spatial OWE potential. However, this would be contingent on cost effective floating solutions becoming available. Moreover, the additional capacity is concentrated almost exclusively in the UK and Norway, which suggests that the drive for such technology will likely have to originate in these countries.

Regarding development of wind farms and electrical infrastructure, a total time of 8-10 years (application phase, investment decision and construction) can be assumed per project. A coordinated development of all these projects is needed to allow for flexible and harmonized technical standards regarding technology and technical choices.

Possibilities of T-connections between wind farms and the planned/existing bilateral links are suggested in our analysis. Planning and investment decision of T-connections should be coordinated between the link developers (typically TSOs) and wind farm developers. New market rules that allow trading of power from the link and from the wind farm in the same market are needed to support investment decisions. T-connections could be the first steps from a nationally driven radial connection strategy towards a transnational fully meshed offshore grid solution.
Transnational clustering is suggested between offshore parks nearby the border of UK and NL exclusive economic zones (EEZ), the border between the German and Dutch EEZ as well as nearby the border of the German and Danish EEZ.

Planning to allow for transnational clustering should be done in a coordinated manner at an early stage of the development of the wind farms in the different countries, so the connection to the transnational offshore cluster hub allows for flexible and harmonized technical standards regarding technology and technical choices.

The common connections found in all resulting grid development scenarios should be planned first as they represent the more robust choices regarding uncertainties in offshore wind development.

Conclusions

**OWE could realistically expand to 135GW in the Central and Southern North Sea by 2030**

- WINDSPEED analysis has looked at several possible destinations with respect to OWE deployment, and considers a deployment of 135GW of OWE to be an ambitious yet achievable target for 2030 in the Central and Southern North Sea. This target is premised on key assumptions. Firstly, a deployment of this magnitude can only be achieved if countries are willing to increase spatial prioritisation to OWE (close to shore). Secondly, large clusters of parks in further from shore locations and in potentially deeper waters must be developed along with an offshore grid. The latter assumes the availability of offshore technology components.

**Increased cooperation needed to allow facilitate a significant increase in the deployment rate of OWE in the time frame 2020-2030**

- Three key areas of cooperation between countries will be necessary to achieve this target. Firstly, to realize significant low cost OWE potential and balance the spatial needs of existing cross-border sea uses - such as fishing, shipping and nature value - coordination between member states will be necessary. An optimum configuration of offshore wind parks – with corridors between them to regenerate wind resource – is highly compatible with these sea uses in terms of co-existence but requires high level planning. A second key area for cooperation is in relation to grid infrastructure. A large degree of cooperation will be needed in order to implement infrastructure of this scale given the many cross-border aspects. These aspects relate not only to cross-border infrastructure but also to coordinating OWE planning in the different member states in support of the grid. This is important both in terms of locations and timing of developments. A third area, which will be triggered by an offshore grid, is the implementation of one or more of the three cooperation mechanisms introduced in the Renewable Energy Directive (2009/28/EC). These will need to be put into operation in a manner that supports the development of large clusters of OWE of the type envisaged in combination with an offshore grid.

**Important changes in overall policy framework are required**

- An ambitious target of in the magnitude 135GW in the Central and Southern North Sea by 2030 will require important changes to the approaches used to promote OWE in the North Sea countries. A long term, transparent framework adapted to large scale deployment is necessary. The current approach with national binding RES targets coupled with NREAPs, which provides transparency on the contribution of different RES technologies towards the binding target, should be extended to 2030 or beyond. However, the NREAPs must be developed in a coordinated manner. Open and transparent declarations on OWE ambitions by national governments will give an important foundation for integrated planning, not only in terms of zoning new areas for OWE and grid configuration within national sea basins but also from a more integrated cross-border planning perspective. Maritime spatial planning processes must be revisited to find additional space for OWE, addressing at the same time co-use opportunities, opportunities for compromise between OWE and other sea use functions, cumulative effects and nature, in particular on nature...
conservation and biodiversity and, finally, also on the optimal layout of wind parks. Better coordination of

- Grid configuration is essential for bringing electricity generation from offshore wind parks to consumption centres. Onshore connections and reinforcements will be necessary to bring the generation to the load centres, whereas offshore grids will be necessary to provide flexibility and better balancing of generation and load across a larger geographical region. Optimal expansion is best considered in a transnational perspective rather than at national level. T-connections could be the first steps from a nationally driven radial connection strategy towards a transnational fully meshed offshore grid solution of T-connections between wind farms. Planning and investment decision of T-connections should be coordinated between the link developers (typically TSOs) and wind farm developers. New market rules that allow trading of power from the link and from the wind farm in the same market are needed to support investment decisions. Transnational clustering is suggested between offshore parks nearby the border of UK and NL exclusive economic zones (EEZ), the border between the German and Dutch EEZ as well as nearby the border of the German and Danish EEZ.

- Regulatory regimes must also be revisited to view a view to allowing flexibility on the connection choice and technological. Amongst others, removing the requirement of offshore wind farms to feed their electricity to the onshore grid of the country through which they are subsidised in necessary. Not only is it necessary with a more appropriate match between the ambitions and planning of OWE and support schemes but it is also anticipated that a more common price support level for OWE would be needed in a future with large scale OWE which can be feed to different load centres through an offshore meshed grid.