Joint Marine Programme

Marine update 49

December 2001

Offshore Wind Energy

Introduction

A growing interest is being expressed in developing offshore wind in our waters as part of a wider programme to increase renewable energy sources in the UK. This Marine Update looks at the present situation in the UK, and at some of the issues surrounding the construction of offshore wind farms.

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Why develop renewable energy?

The main driver behind the development of renewable energy is the need to reduce emissions of greenhouse gases. Under the Kyoto Protocol of 1997, the UK has committed itself to a 12.5 per cent reduction in greenhouse gases on 1990 levels by 2008-2012. In addition, the government has a domestic target to reduce emissions of carbon dioxide (CO_2) by 20 per cent on 1990 levels by 2010.

At present, around 30 per cent (58.7 million tonnes of carbon [MtC]) of the UK's greenhouse gas emissions are from the production of energy – 90 per cent of which are in the form of CO_2.

As part of the package of measures introduced to reduce the UK's emissions, the government wants 10 per cent of electricity supplies to be from renewables by 2010. If this target is reached, it will deliver estimated savings of around 2.5 MtC. Just as important is the need to continue reducing greenhouse gas emissions over the long term. Action is needed now to ensure that we develop technologies and skills so that these long-term reductions can be achieved.

Potential for offshore wind in the UK

Being an island nation, the UK's offshore wind resource is very large, and could potentially meet up to three times the UK's energy needs. Conservative estimates suggest that wind alone could meet the government's 10 per cent renewables target by 2010 – something that would require 12,000 MW of turbines. Assuming a typical offshore turbine to be 2 MW, this works out at 6,000 turbines in an area of seabed covering 1,200 sq km – an area roughly the size of Greater London.

If the UK were to match the more ambitious plan put forward by Denmark and generate 40 per cent of our electricity needs from offshore sources by 2030, that would require 48,000 MW from 24,000 turbines in an area covering roughly 4,800 sq km. The problem, however, would be that much of the area is too deep for wind power development. Further estimates indicate that a square of seabed with sides 124 km long would provide enough offshore wind energy to match the UK's total electricity supply.

At present, there is only one offshore wind farm operating in the UK. This comprises two 2 MW Vestas turbines erected one kilometre off the coast at Blyth, Northumberland, in an average water depth of eight metres. Construction began in July 2000 and the turbines started generating five months later.

In April 2001 the Crown Estate released details of 18 further developments that have qualified to lease parts of the seabed, subject to further conditions. These are expected to be the first tranche of offshore wind development in the UK (see table below).

name	development	location	distance to shore
Solway Firth	2 x 30 turbines	off Maryport and Rockcliffe	9.5km Eng 8.5km Scot
Barrow	1 x 30 turbines	off Walney Island	10km
Shell Flat	3 x 30 turbines	off Cleveleys	7km
Southport	1 x 30 turbines	off Birkdale	10km
Burbo	1 x 30 turbines	off Crosby	5.2km
North Hoyle	1 x 30 turbines	off Prestatyn	6km
Rhyl Flats	1 x 30 turbines	off Abergele, N Wales	8km
Scarwaether Sands	1 x 30 turbines	off Porthcawl	9.5km
Kentish Flats	1 x 30 turbines	off Whitstable/Herne Bay	8km
Gunfleet Sands	1 x 30 turbines	off Clacton-on-Sea	7km
Scroby Sands	1 x 30 turbines	off Caister	2.3km
Cromer	1 x 30 turbines	off Mundesley (Foulness)	6.5km
Lynn	1 x 30 turbines	off Skegness	5.2km
Inner Dowsing	1 x 30 turbines	off Ingoldmells	5.2km
Teesside	1 x 30 turbines	off NE Teesmouth and Redcar	1.5km

Under the terms of lease agreement, the successful applicants must gain all necessary consents within three years. Meanwhile, the developers must obtain their consents from the Department of Trade and Industry and/or DEFRA (Department of Environment, Food and Rural Affairs) and DTLR (Department of Transport and Local Regions), as appropriate before work on the sites can begin (see Licensing procedure for offshore wind below).

Mechanisms to support the development of offshore wind in the UK

Prior to 2000, support for the development of renewable energy was given via the Non Fossil Fuel Obligation (NFFO), a series of competitions for licences to supply renewable energy funded through a fossil fuel levy on every electricity customer's bill. However, the Utilities Act 2000 replaced NFFO with the Renewables Obligation, a system under which all electricity suppliers must supply a proportion of their electricity from renewable sources. To meet this obligation, suppliers will be able to purchase renewable electricity at a higher price than the standard electricity price. This is to reflect the fact that most renewable technologies currently cost more than the traditional electricity generating technologies. However, the price they will pay for renewable energy will be capped in order to avoid excessively high prices being passed onto customers.

Even with this higher price (expected to be about 3p above the standard electricity price), it is unlikely that technologies such as offshore wind will be able to compete in the market. That is why an additional grant scheme has been introduced to help bring the price of offshore wind technology down. The government has allocated some £39m to this scheme over the next three years. Details of how these two mechanisms will operate should be finalised towards the end of 2001.

Licensing procedure for offshore wind

In 2001, the DTI has been consulting on the precise mechanism for licensing the development of offshore wind farms, and it is expected to involve the following:

- a lease from the Crown Estate Commissioners to place structures on the seabed;
- consent from the DTI under section 36 of the Electricity Act 1989 (if generating capacity above 50 MW, but see environmental assessment of offshore wind proposals opposite)

- consent from DEFRA under section 5 of the Food and Environment Protection Act 1985 (FEPA);
- consent from DTLR under section 34 of the Coast Protection Act 1949 (CPA)*

* Developers may apply for an Order under Section 3 of the Transport and Works Act 1992 (if development interferes with rights of navigation in waters within or adjacent to England and Wales, up to the seaward limits of the territorial sea). There is no statutory requirement for developers to obtain such an Order, but where they do it obviates the need for a consent under the CPA.

Depending on the nature of the site and the onshore development, other statutory consents that may be required include:

- Section 57 or 90 of the Town and Country Planning Act 1990 (eg for an onshore substation);
- Section 37 of the Electricity Act 1989 (for onshore overhead lines);
- Section 109 of the Water Resources Act (if erecting a structure in a water course)

The DTI is proposing to operate a one-stop shop for the licensing of offshore wind developments. It is anticipated this will coordinate the acquisition of different consents from the various government departments, consultation with the statutory agencies and preparation of the Environmental Impact Assessment (EIA).

Environmental assessment of offshore wind proposals

As with any development in the marine environment, there is potential for the construction of offshore wind farms to have an adverse impact. To ensure that any impact is minimised, The Wildlife Trusts and WWF believe:

1. The development of offshore wind energy, as well as all offshore development, should be preceded by a Strategic Environmental Assessment (SEA). This would assess the ecological resources of UK waters as well as existing and predicted demands, and would identify "preferred locations" for offshore wind development. In this way, environmental impacts and conflicts with other marine uses would be minimised and cumulative and synergistic impacts would be taken into account.

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2. There should be a presumption against offshore wind energy development within Marine Protected Areas (MPAs). This does not mean that there would never be a development within an MPA, but rather that only on rare occasions and pending a comprehensive EIA would a development be permissible.

3. All offshore wind farms should be subject to rigorous EIA.

The current consents procedure for offshore wind development does not require the submission of an Environmental Statement for any developments below 50MW. This is undesirable because it may allow some projects to go ahead without adequately assessing the environmental impacts and may not be in compliance with the EIA Directive.

The DTI is proposing to bring all offshore wind and water-driven generating stations within the scope of Section 36 of the Electricity Act, by lowering the threshold for inclusion of these developments to 1 MW. They would then become subject to the EIA regulations and would have to produce an Environmental Statement. The Wildlife Trusts and WWF support this proposal, which will ensure that the full impact of proposed offshore wind farms can be evaluated before construction goes ahead.

While welcoming this DTI proposal, The Wildlife Trusts and WWF are concerned that there is a lack of strategic coordination in assessing the environmental impact of all offshore developments. A myriad of policies exists to protect and regulate the marine environment, which places varying degrees of environmental responsibility on relevant bodies to take account of nature conservation when carrying out their functions. In addition, there is no framework for making strategic decisions about areas of sea or coast which are ecologically sensitive and where developments would not be permitted and/or licensed.

The Wildlife Trusts and WWF believe that it is time to introduce an integrated, coordinated and strategic approach to the management of the whole marine environment which incorporates an ecosystem approach. Through this a wide range of environmental, economic and social objectives could be delivered, including marine conservation. For more information about our recommendations concerning this coordinated approach, see Marine Update 45.

Environmental impacts of offshore wind

As no large-scale commercial offshore wind farms exist in the UK, it is difficult to comprehensively assess the nature and scale of the impacts associated with such development. Work has been done to assess the environmental impacts of offshore wind in other countries, but so far these have been inconclusive or not directly relevant to the UK environment. Even so, it is possible to make some general observations as to the sort of impacts an offshore wind farm might produce, and on priority areas that the EIA process should address.

Disturbance of the seabed

Offshore wind turbines will require foundations, which will be built on or in the seabed. This is likely to cause some degree of disturbance of benthic flora and fauna through direct physical perturbation, smothering, or the displacement of sediment. The exact amount of seabed disturbance resulting from a particular offshore wind farm will be related to the size and type of foundations utilised, the number of turbines installed and the relative sensitivity of the seabed habitats.

It will also be necessary to connect the turbines to the electricity grid system by means of cabling. It is standard practice to encase and/or bury sub-sea cables so that they are not snagged by anchors or fishing gear. But cable burying is also likely to disturb benthic organisms. The degree of impact is likely to depend upon the length and thickness of the cables, how deep they are buried and the relative sensitivity of the benthos.

Therefore, any EIA should also seek to establish that components placed on the seabed or in the water column will not significantly affect marine sediment transport processes. Such interference might result in

either increases or losses of sediment within, and possibly adjacent to, the areas occupied by wind farms.

Danish research into pilot offshore wind farm projects indicates that they affect and alter the marine environment, including increased fishing yields, colonisation of foundations by organisms favouring hard substrate, and increased diversity of flora and fauna encountered within the area of the wind farm. Such changes need to be fully investigated. Previous work looking at the role of "dumped" installations has shown that increases in productivity are very small and are largely due to the attraction of fish from the surrounding area to the physical structure. Management of an ecosystem should be focused on maintaining and restoring natural diversity and productivity in the marine environment: the role of artificial reefs needs to be considered strategically, particularly in the context of ecosystem recovery plans.

Interactions with birds

Given that wind turbines are tall structures, the potential exists for bird collisions. This could be a particular problem with offshore wind farms in the UK, due to its importance for wading and seabird populations, and the fact that the British Isles' coastal waters are an important refuelling stopover on many bird migration routes.

These concerns have also been a high priority in Denmark, where research has been undertaken to assesses the impact of a substantial pilot offshore wind farm – Tunø Knob – on internationally important populations of resident scoter and eider sea ducks. A three-year study commissioned by the Danish government revealed that the wind farm did not appear to affect either the abundance or distribution of these species in the general area of the project. Results indicated that the ducks avoided the immediate area: rates of flying and landing were significantly lower within 100m of the turbines, compared with 300m and 1,000m away. This was irrespective of whether the rotor blades were turning or stationary.

This and other studies indicate that while operational wind turbines can affect individual birds, the number of losses and degree of disturbance have not been shown to affect bird populations detrimentally. However, in instances where turbines are sited in areas inhabited by rare or endangered bird populations, particular care must be taken, because even small losses can have dramatic effects on population integrity.

It is important that all offshore wind developers investigate and evaluate the potential impact on birds as part of the EIA. Such evaluation might include disturbance to bird feeding and breeding sites in the vicinity of the turbines, bird collisions (especially rare and endangered species) with the turbines, effects on bird flight patterns, the risks of attracting birds to the structures, and indirect effects caused by changes to food sources.

Vibration and sonic disturbance

So far, little research has been done to quantify the noise emitted underwater by turbines, or to assess vibration effects on benthic communities. However, unless vibration brings about changes in the physical composition of the seabed, little effect on benthic communities is anticipated.

Despite inadequate research, there is a greater chance of impacts on fish communities. These are likely to be more significant during the operational phase than the construction phase, when any disturbance would be temporary. Marine mammals, and cetaceans in particular, are vulnerable to interference from underwater noise because they rely on sound to communicate, sense food and understand their local environment. Although there is data on the sensitivity of marine mammals to different levels of noise, very little is known about the characteristics of underwater noise generated by offshore wind turbines.

The potential effects of noise and vibration on local marine wildlife must be investigated as part of each project's EIA. Research must continue so that we can understand the noise and vibration characteristics of offshore wind turbines.

Other conflicts

Navigation and oil spill risks may be increased if offshore developments are located inappropriately. There are also likely to be conflicts with other sea users, particularly in terms of access to the waters and the seabed. Any potential conflicts should be fully assessed both as an element of the SEA and in relation to the individual project EIAs.

Conclusions

The Wildlife Trusts and WWF support the development of offshore wind as part of the UK's climate change programme. However, it is imperative that the correct mechanisms are put in place to ensure that there are no adverse impacts on the marine environment.

The Wildlife Trusts and WWF support the proposal by the DTI to bring the development of all offshore wind and water projects under the control of the Electricity Act, thereby requiring all projects to undergo a comprehensive EIA.

There must, however, be a strategic, integrated and coordinated approach to managing the marine environment, based on an ecosystem approach.

There is a lack of data as to the potential effects of offshore wind turbines on habitats, wildlife and the wider marine environment. More research is needed, particularly to quantify the noise and vibration patterns of offshore wind turbines and the effects these have on marine wildlife.

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