Annex 1A
Wind power

Introduction

1A.1 The UK's generation map is changing as the UK develops a more diverse and, to help tackle climate change, more non-fossil based energy supplies. Renewable energy technologies including wind power have an important part to play in creating the vision of a low carbon economy as set out in the Energy White Paper 'Our energy future – creating a low carbon economy'. The White Paper set out a clear strategy to reduce carbon emissions, through increased energy efficiency and expanding renewable energy sources.

1A.2 The Government has a target to generate 10 per cent of electricity from renewable sources by 2010 and 15 per cent by 2015. In 2002, the Government introduced the Renewables Obligation (RO) and associated Renewables Obligation Scotland in 2002, as a support mechanism to stimulate growth in the industry, making investment in renewable sources of energy a statutory obligation for all licensed electricity suppliers. The Government expects that the major contribution towards the 2010 renewables target will be met through onshore and offshore wind power, and expect that the renewables sector will become increasingly diverse in the future, with a wider use of energy crops, wave and tidal power.

1A.3 The key benefit of the use of wind energy is the reduction in the levels of emissions, including carbon emissions, caused by burning fossil fuels such as in coal and gas fired power stations. It has been estimated that the UK could save 4 million tonnes of carbon emissions from onshore wind and 7 million tonnes from offshore wind by 2025. These estimates were made by the Inter-departmental Analysts Group, see

http://www.dti.gov.uk/energy/whitepaper/annexes.pdf

1A.4 Other advantages of using wind power are:

- It is freely available wherever there is sufficient wind and the UK is rich in this resource because of its geographical location;
- Wind turbines tend to be more productive when electricity demand is higher on cold and windy winter days, though this is not always the case due to the intermittent nature of wind;
- The technology is simple and, therefore, the risk of technical failure is smaller than for larger generating units using conventional fuel sources such as coal or gas;

- It is easy to dismantle turbines after a lifecycle of around 25 years, and the site can be easily restored to its original state.

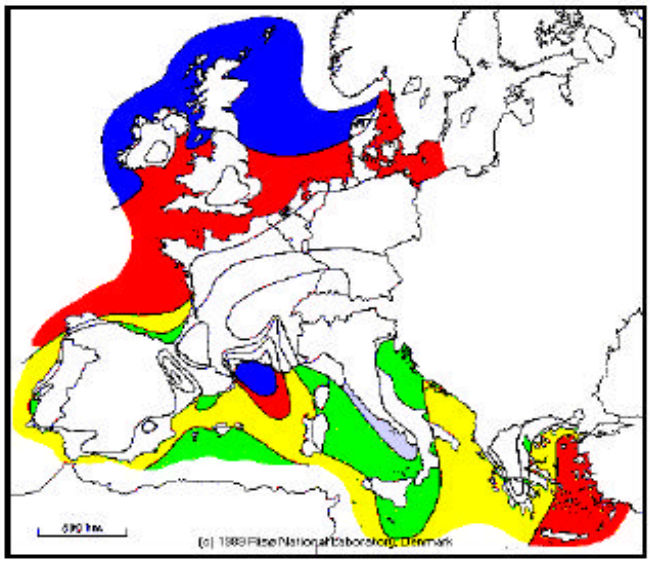
Wind resources in the UK

1A.5 The UK is uniquely located within Europe to exploit available wind resources both at onshore and offshore sites. The European offshore resource is very large; some of the windiest offshore areas are concentrated in the northern section of the North Sea, along the Atlantic coast of Ireland and into the Irish Sea. The UK's wind resource (230 TWh per year) is estimated to be around half the European total.

1A.6 Onshore, the UK's wind resource is greatest in the windy upland areas of the country in Scotland, Wales, Northern Ireland and the North of England, where most of the onshore installations are located.

1A.7 Offshore wind speeds are often significantly higher than onshore though this depends on the nature of the landscape, including altitudes and the shapes of hills etc. Turbulence also tends to be lower offshore than onshore. Map 1A.1 shows the potential annual energy from Europes offshore wind resources.

Map 1A.1 Potential annual energy in Wm^2 generated at 25 meters above sea level in Europe. Wm^2 is the watts per square meter of turbine blade[1]



>700
450-700
300-450
150-300
<150

[1] Excluded from this study were areas less than 5km from the shoreline and shipping

Source: The World Offshore Renewable Energy Report 2002-07

1A.8 The power available from the wind is a function of the cube of the wind speed. Therefore if the wind blows at twice the speed, its energy content will increase eight fold. The map shows how the potential energy from wind resources varies across European waters. However the central overriding issue is not the available wind resource but the level of practical exploitation that can be made and whether a site will be a commercial entity. Many factors play a part including the available technology, grid connection, visual amenity and public perception.

Growth of wind energy

1A.9 The growth of wind power in the 1990's was encouraged through the implementation of a programme of assessment and financial support to renewable industries and the implementation of the Non Fossil Fuels Obligation (NFFO) in England and Wales, the NI NFFO in Northern Ireland and the Scottish Renewable Order (SRO) in Scotland. The NFFO was a competitive scheme aimed at creating an initial market, so that the most promising fuels

would be able to survive in a competitive market place without long term financial support. The RO has now replaced the NFFO as the main instrument of financial support to the renewable industry.

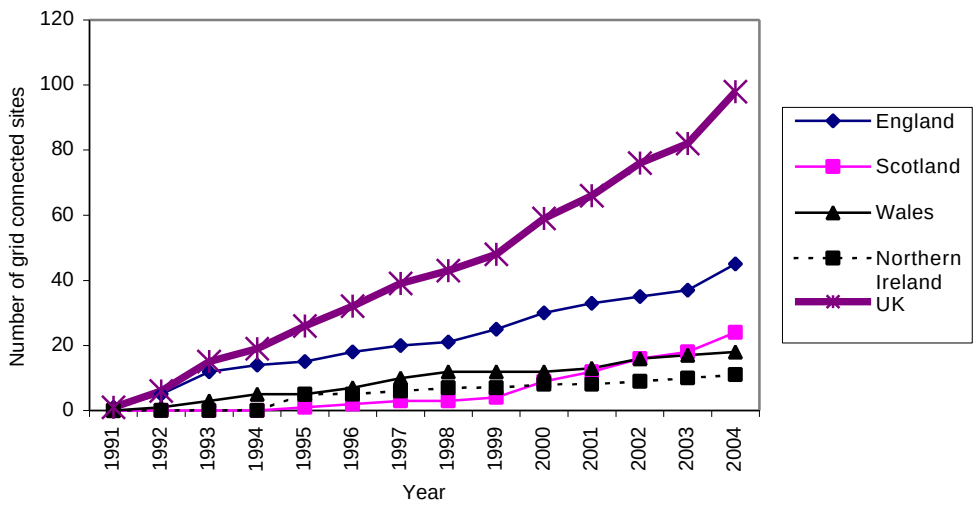
1A.10 The first onshore wind farm connected to the National Grid was completed at Delabole in Cornwall in 1991. Since then, the industry has grown steadily, with nearly 100 onshore sites in operation by June 2005. There were more than 1100 turbines between these sites, though some were single turbines not connected to the national grid, giving a capacity for onshore sites of 809.4 MW representing 1.1 per cent of the UK's total capacity. Generation from onshore sites was 1,736 GWh in 2004 representing 0.4 per cent of total output. See table 1A.1 and chart 1A.1 below for information on the growth of wind capacity, generation and sites in the UK.

Table 1A.1 Installed capacity and generation for onshore and offshore wind farms, 1999 to 2004

	1999	2000	2001	2002	2003	2004
Capacity MW						
Onshore	357.0	408.0	423.4	530.6	678.4	809.4
Offshore	-	3.8	3.8	3.8	63.8	123.8
Generation Levels GWh						
Onshore	850	945	960	1,251	1,276	1,736
Offshore	-	1	5	5	10	199

Source: Digest of UK Energy Statistics 2005

Chart 1A.1 Growth in live grid connected onshore sites by country, by March 2005



Source: British Wind Energy Association

1A.11 Onshore sites are mostly located in lightly populated upland areas of the country and are concentrated in Northern Ireland, Scotland, Wales, the North of England, Cornwall and a few sites along the East Coast of England. The number of turbines varies at different sites, though more recent installations tend to have larger, more efficient turbines, which generate electricity at lower unit cost. Most have a capacity of around 1 MW. For a full list of all grid connected onshore and offshore sites and a location map, use the two web links provided below:

http://www.bwea.com/map/im/map2004.gif
http://www.bwea.com/map/list.html

1A.12 Offshore facilities in the UK are still at an early stage of development. The first offshore site was established at Blyth in 2000, operating with two 1.9 MW turbines, whilst Britain's first major offshore site at North Hoyle, off North Wales, went online in 2003, followed by Scroby Sands off the coast of Norfolk in 2004. Total offshore wind capacity is now 124 MW.

Social and environmental impact of wind power

1A.13 Opposition to planning applications for wind farms, particularly onshore sites, reflect concerns about their impact on the environment, including their visual impact. The Government has, therefore, established guidelines to ensure that the industry can expand in a sensible way, realising the benefits that it offers in terms of a more sustainable energy supply, whilst at the same time protecting sensitive local environments. Developers are obliged to take particular care in the most sensitive areas of the country such as in National Parks and areas of outstanding natural beauty, whilst larger developments are also required to complete an environmental impact assessment.

1A.14 Surveys undertaken at a number of sites around the country that have shown that turbines have a minimal impact on birds, especially when compared to deaths caused in urban areas caused by collisions with buildings and attacks by domestic cats. Developers are encouraged to avoid areas where there are significant numbers of protected birds.

1A.15 Wind turbines create low levels of noise including infrasound, a 'low frequency noise', though levels have fallen in recent years. All available validated evidence suggests levels are insufficient to have any significant effect on human health. They can also cause electromagnetic interference (EMI), both through physical interference and electrical interference. The first leads to a 'scattering' of signals, causing interference on television screens, which in most

instances is rectifiable. The latter leads to signals generated from inside the turbine structure, which has an impact on communications equipment, including radar. All aviation stakeholders are consulted during the planning of windfarms. The Government has set up a group including the DTI, Civil Aviation Authority and Ministry of Defence to assess the impact of wind energy on the civil and defence aviation industry. For more information on planning guidelines for developers please use the link below:

http://www.bwea.com/pdf/bpg.pdf

Performance and intermittency

1A.16 The key factor affecting the performance of wind turbines is the windiness of a site. Turbines in wind farms must be carefully arranged to gain the maximum energy from the wind, which means that they should shelter each other as little as possible from the prevailing wind. Turbines start to operate at wind speeds of four to five metres per second (around 10 miles an hour) and reach maximum power at around 15 metres per second. The turbines are installed with a safety mechanism and shut down in winds exceeding 25 metres per second to prevent damage.

1A.17 There are no technically insurmountable challenges to dealing with intermittance, as a certain amount of backup capacity is retained at all times in case of sudden plant failure. The level of backup required depends on factors such as the overall mix of generating technologies, the wind strength across the country as a whole. In reality, intermittency effects are and will increasingly be mitigated through other options, which will reduce the level of convential backup required. These include:
Geographic dispersion – wind farms are spread around the country so high-pressure systems in one part of the country will not effect wind farms in other parts; improved prediction of weather patterns, and also the shift to more offshore wind, which has a stronger and more consistent wind regime; increasing use of non-intermittent or predictable renewable sources.

1A.18 The Government expects a combination of onshore and offshore wind to make the major contribution towards the 2010 target, but over the longer-term, a more diverse mix of renewables will develop. Biomass power and hydro can supply energy on demand. Also, a mix of different technologies, such as wind and solar have been shown to complement each other and reduce the need for backup.

Differences between onshore and offshore sites

1A.19 The technology used for onshore and offshore sites is very similar, the main difference being the size and power of the turbines; those onshore now typically have around 1 MW capacity, contrasting with the 2 MW offshore turbines at North Hoyle and it is expected that future offshore turbines will be larger still. A typical land based turbine has a tower height of between 30 and 50 metres, with blades between 12 to 25 metres in length, whilst North Hoyle has a tower over 60 metres and blades of between 35 and 40 metres.

1A.20 Due to the considerable distances of offshore wind farms from the coast and the more extreme conditions in which they operate, they are connected to the national grid using submarine cables instead of the overhead cables that are used on land. Larger offshore wind farms require high voltage transmission systems when they feed into the grid and their offshore substations contain more complex technical equipment including transformers and higher voltage switchgear. Capital and maintenance costs are also considerably higher for offshore sites, due to the foundation structures that need to ensure that the turbines are connected to the seabed, and are able to cope with additional factors such as loading from waves, currents and ice, and ship impact.

Conclusion

1A.21 Wind power is a resource with which the UK is well endowed and the harnessing of some of this power is expected to make the biggest contribution of renewable technologies to the Government's 10 per cent renewables target by 2010. Using wind power reduces carbon emissions and reduces our economy's dependence on declining supplies of fossil fuels. Planning guidelines ensure that potential negative environmental impacts, in particular of a visual kind in sensitive areas such as National Parks, are avoided.