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Renewing Britain's Energy Technologies

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John Callaghan from the Carbon Trust reports on how wind, wave and tidal power can help Britain meet its climate change targets

To reduce carbon emissions from the power sector, meet EU renewable energy targets, and help maintain our energy security, the UK will need to generate about a third of its electricity from renewable resources by 2020, up from less than 5 per cent today.

Meeting these targets will require giant steps forward to enable key renewable energy technologies, such as offshore wind and marine energy, to reach commercial maturity and be deployed at scale. The UK is in a strong position to accelerate the development of such renewables as we benefit from some of Europe's largest wind, wave and tidal resources, as well as being home to extensive offshore engineering expertise.

Our wind resource is not only the best in Europe, it also blows most strongly when demand is highest, according to research from Oxford University. The wind is strongest during the winter months and also blows more during the day, when the need for electricity is higher than at night. The UK is also blessed with a shallow sea-bed close to shore that allows offshore wind farms to be constructed more easily than if they were further out to sea (although deeper water sites are now being considered). Our wave and tidal energy resources are also substantial and, in theory, could provide up to a fifth of current UK demand. However, marine energy is a longer-term prospect than wind, since generation device technologies are at relatively early stages of development.

There is also a range of general challenges to increasing renewables capacity that need to be overcome. Some of these are structural issues related to UK regulations and infrastructure, some are related to the characteristics of renewable energy and some are to do with the current stage of development of the various renewable technologies and industries.

Currently, the planning system and the grid transmission system are not set up to support rapid introduction of renewable energy. According to trade publication *New Energy Finance*, last year more than 11,000MW of wind projects were stuck in the planning pipeline. An important factor in planning has been objections from the Ministry of Defence, which has concerns that a number of projects might interfere with its radar systems. Fortunately, a deal has now been reached that will see regulators working more closely in partnership with wind project developers to address these concerns and get the projects back on track.

Some projects are also delayed because of grid infrastructure issues. The national grid was designed to transmit electricity from a small number of large-scale power stations, often situated close to their fuel resources (e.g. Yorkshire coal fields). Renewable energy, by contrast, involves generation at a range of scales and resources in different locations. Much of the UK's onshore wind resource is in Scotland, for example, while the area of greatest electricity demand is Southern England. To make best use of the resource, the transmission system between Scotland and England needs to be upgraded.

All these issues are being addressed, but will the changes come fast enough? There are some encouraging signs. The Planning Bill should make it easier to get approvals for large-scale renewables projects, while small-scale ones are being helped by new permitted development rights. Other issues will be eased by the Transmission Access Review and the Offshore Transmission Regime, which will set out improvements and development of onshore and offshore connections to the grid. These changes should greatly assist the development of renewable energy projects in the UK.

Due to the large UK wind resource, plus the maturity of wind power compared to other renewable energy technologies, it is expected that onshore and offshore wind farms will provide a significant proportion of the UK's renewable energy requirements. The UK should overtake Denmark some time this year to become the world leader in offshore wind energy, with more than 500MW of installed capacity. However, this is tiny compared with the UK's 2.5GW of onshore capacity and even less impressive when compared with Germany's 22GW, so there is still a long way to go.

The government has suggested there could be more than 3,000 turbines offshore by 2020. Onshore, up to another 4,000 turbines could possibly be installed. However, this potential comes against a backdrop of shortages at almost every stage of the wind industry supply chain, from qualified engineers to installation ships, from gearboxes to the steel for the turbines themselves, as a result of increasing global demand. On top of that, the high oil price and soaring commodity prices have drastically increased costs.

Offshore wind offers many potential advantages — winds are more powerful, you can use bigger turbines and there are fewer planning issues. In addition, the UK has significant expertise in offshore engineering and operation thanks to its North Sea oil industry. On the other hand, it is more expensive than onshore wind, the marine environment is extremely difficult to operate in and there are major logistical challenges to overcome in installing and maintaining the turbines.

While there has been a lot of interest in offshore wind, it is still a relatively new industry with significant potential for further technological development. For example, most current projects use turbines designed originally for onshore use, which means that they are not specifically optimised for the marine environment or for maintenance in the middle of the sea. Further work is needed to create offshore-specific turbines, as these could significantly improve performance and reduce costs. In addition, there is significant potential to reduce the costs of constructing and operating offshore wind farms.

The Carbon Trust's Offshore Wind Accelerator has been set up to exploit this potential. The multi-£m initiative, which is in collaboration with offshore wind farm developers, will explore the best way to configure wind farms, innovative foundations for turbines and seemingly simple but crucial issues such as how to access the turbines for maintenance purposes.

Further back in the technology development process is the nascent marine energy sector. This is also an area where the UK is blessed with abundant resources in the form of both wave and tidal power. Although there are only a handful of prototype devices currently in the water, the industry is building momentum and further significant progress is expected over the coming years.

In tidal energy, 2008 has seen the first turbines to provide electricity to customers in the UK, and a number of other devices are soon to be tested at the European Marine Energy Centre in Orkney. The government has also commissioned a feasibility study on creating a tidal barrage on the River Severn, which has one of the highest tidal ranges in the world. A barrage could generate 5 per cent of UK electricity demand if it went ahead.

Meanwhile, in wave energy, the first commercial farm in the world is set to come on-line shortly off the coast of Portugal, using machines made in Scotland by Edinburgh-based Pelamis Wave Power. This is one of a number of wave energy device designs — in fact, over 60 different concepts are battling it out for supremacy.

The Carbon Trust is working to accelerate progress in the marine sector and sees the key to this as supporting those devices which have the potential to generate energy

cost-effectively in the long term. Its £3-million Marine Energy Accelerator is working with a range of technology developers as well as engineering experts from outside the sector, to find ways to bring down the costs of devices and make them commercially viable as quickly as possible. Areas of work include identifying the most cost effective device concepts, reducing the costs of components that are common across devices, and optimising offshore installation, maintenance and operation approaches.

Work such as the Marine Energy Accelerator is important because in the longer term, to meet our carbon reduction targets we not only need to significantly ramp up the deployment of existing renewable energy technologies, such as offshore wind, we also need to accelerate innovation to develop the vital next generation of technologies, such as wave and tidal stream devices.

As well as significantly reducing carbon emissions, delivering on our renewables targets can provide increased energy security, replace conventional power stations which need to be decommissioned, and offer major new economic development opportunities for UK-based companies. At the Carbon Trust we look forward to the exciting growth of renewable energy which lies ahead.

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