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Agenda

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Renewables target: is the answer blowing in the wind?

Offshore wind has the potential to meet 70% of the UK's renewable electricity target, but has high costs compared with other renewables technologies such as onshore wind. In light of concerns about rising energy bills and the costs of decarbonisation, as well as the challenges from wind relating to security of supply, what policy action would need to be taken to enable offshore wind to maximise its potential?

The UK is required to obtain 15% of its energy consumption across the electricity, heat and transport sectors from renewable sources by 2020,[1] which is a substantial increase from its current share of around 3%.[2] The drive for renewables is likely to remain over the long term, as highlighted by the European Commission's current consultation on its post-2020 renewables strategy.[3]

Given the relatively high costs of the majority of renewables relative to conventional generation technologies, the UK government has developed policies to provide financial support to stimulate deployment. Support currently comes from the Renewables Obligation (RO), the costs of which are ultimately passed through to end-users in their energy bills.[4] The box below explains how the RO works.

This need to substantially increase renewables deployment in the UK comes at a time of greater consumer and political focus on rising energy bills, which has been highlighted by the government's recent energy summit with stakeholders to consider ways to reduce bills.[5] This reinforces the requirement for the UK government to ensure that renewables targets are met in a cost-effective manner. This, in turn, affects the level of financial support provided to alternative renewables technologies, which have varying costs and resource potential. The resource potential refers to the possible level of deployment given the availability of suitable sites, the state of development of the supply chain, and other technical constraints.

In its Renewable Energy Roadmap, the government has highlighted that electricity generation from onshore wind, offshore wind and biomass have some of the highest resource potential across available technologies.[6] Indeed, offshore deployment has the potential to meet a substantial proportion of the UK's renewables targets.[7] There has been recent policy focus on offshore wind in particular, with the government planning to continue providing high levels of support to offshore wind through the RO.[8] In addition, since offshore wind is a relatively immature technology with higher lifetime costs than either onshore wind or biomass, the government is taking further action to facilitate cost reduction.[9]

Given this focus on offshore wind, this article considers the policy actions that may be necessary to facilitate its deployment while ensuring that potential consumer concerns about the costs of renewables are minimised. The following questions are dealt with in turn.

- Are the support levels provided to offshore wind sufficient? What are the likely implications for energy bills of the government's offshore wind deployment ambition?

How does the Renewables Obligation support renewables technologies?

The RO requires electricity suppliers to procure a percentage of their electricity from renewable sources or pay a buyout penalty. Renewables generators are awarded Renewables Obligation Certificates (ROCs) for each MWh of electricity generated, and are remunerated by selling these ROCs to suppliers in addition to selling the electricity.

The number of ROCs issued per MWh of renewable electricity generation varies by technology (this is known as 'ROC banding'), with a greater number of ROCs being given to technologies that are considered to be higher-cost or relatively immature in order to encourage greater deployment and to reduce costs.

- Given the intermittent nature of wind, what technology options are available to deal with its security-of-supply effects? What policy measures would be required to enable investment in these options?

- Although offshore wind has a high resource potential, the outlook in relation to its costs is driven by global market trends, and is dependent on learning effects (the reduction in costs with an increase in capacity) and government policy. What are the implications of this uncertainty for the appropriate amount of offshore wind in the renewables mix?

Costs and support levels

Offshore wind is a relatively immature technology, with capital and fixed operational costs higher than those of a number of other major renewables and conventional technologies, as presented in Figure 1 below.

Offshore wind costs have shown significant variation, and have increased by over 50% since 2007 (see Figure 2). These cost increases have been reflective of the technology's immaturity, its supply chain constraints, commodity prices, exchange rates, and other market factors. Figure 2 highlights the change in past and proposed ROC banding levels for offshore wind in response to historical and future cost changes.

When deployed at scale, the support levels required for offshore wind could have a significant impact on consumer energy bills. The Committee on Climate Change (CCC) has estimated that meeting the 2020 renewables target could add 1.7p/kWh (or 10%) to electricity bills. The largest component of this increase would be the cost of deploying offshore wind, which the CCC estimates could add 0.8p/kWh to bills.[10] Based on this analysis, the CCC has further stated that:[11]

> If renewable energy targets for 2020 can be met in other ways, a moderation of offshore wind ambition for 2020 could reduce the costs of decarbonisation.

Although offshore wind costs are currently high, with a potentially large impact on energy bills, the government considers it necessary to incur these costs to meet the 2020 target.[12]

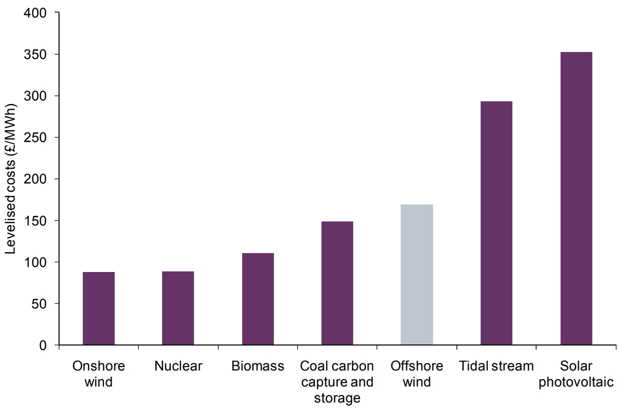
Given the volumes of offshore wind required, and its relative immaturity, there is significant opportunity to reduce costs. By enabling greater offshore wind deployment over the medium term through higher support levels, the government could reduce the costs of renewables deployment over the long term. The extent of this cost reduction would depend on deployment levels, learning rates (see below) and supply chain developments.

The future of offshore wind costs

Analysis carried out for the UK government finds that, in the decades to 2040, there is likely to be upward pressure on offshore wind costs as plant are built in deeper waters. However, this could be compensated for by cost savings reaped through economies of scale, as turbine size increases from the 5GW at present to 10GW by 2020 and 20GW by 2040.[13]

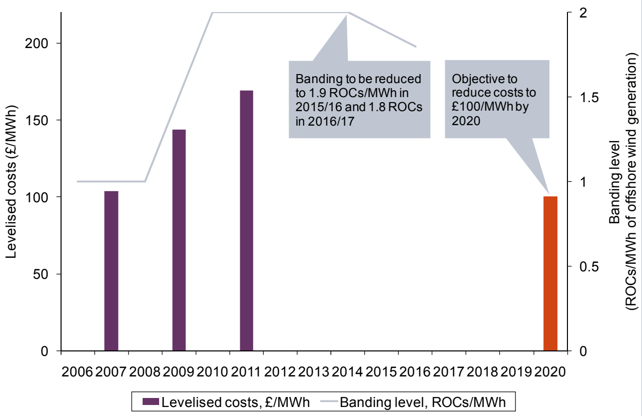
Offshore wind could have substantially greater potential for cost reduction than relatively more mature technologies, such as onshore wind. The Department of Energy and Climate Change (DECC) has estimated that the costs of onshore wind could fall by around 5%

Figure 1 Levelised costs of major electricity generation technologies, 2011



Note: Levelised costs are the discounted lifetime cost of electricity generation from a particular technology, and include capital costs, operational costs and any fuel costs.
Source: Mott MacDonald (2011), 'Costs of Low-Carbon Generation Technologies', May.

Figure 2 Future offshore wind levelised cost estimates and banding proposals



Sources: Department of Energy and Climate Change (2011), 'Consultation on Proposals for the Levels of Banded Support under the Renewables Obligation for the Period 2013–17 and the Renewables Obligation Order 2012', October. Department of Trade and Industry (2007), 'Reform of the Renewables Obligation', May.

between 2010 and 2020, with those of biomass falling by around 6%. This compares to the potential for offshore wind costs to fall by 47%, as estimated in DECC's central scenario (from £149–£191/MWh at present to £95–£121/MWh by 2020).[14]

How likely is such a rate of cost reduction? Looking at historical learning rates, defined as the reduction in costs with a doubling of capacity, there has been a wide variation across technologies, with the learning rate having been estimated to range from 3% to 35% depending on the technology.[15] Analysis of offshore wind costs carried out for the UK government assumes learning rates of 9–15%, lying towards the bottom end of the historical range for other technologies, although it notes that commodity prices and other market developments are relevant additional cost drivers.[16]

The learning effects and cost reductions from early projects, and research and development activity, create spillover benefits for later projects. Since the developers of early projects often cannot realise all of the future benefits of the cost reductions, there could be a role for policy to incentivise these reductions.

The government is taking direct action to reduce the costs of offshore wind, and has set up an industry-led Offshore Wind Cost-Cutting Task Force with a target of reducing the costs of offshore wind to £100/MWh by 2020 through improvements in financing, supply chain efficiency and technology.[17] In addition, the government has allocated £15m of grants to support technological innovation in the offshore wind sector.[18]

Security-of-supply effects

Security of supply is a particular issue in relation to wind plant. Wind output is intermittent, which could have detrimental effects on the security of electricity supply in the absence of policy action. Power generation by wind plant is dependent on wind speed, which tends to vary over time and is characterised by a degree of uncertainty. This can increase the risks of power outages at times when wind output is low.

An increasing share of intermittent wind plant in the electricity system implies that other market participants would have to operate in a more flexible manner in order to compensate for wind variability. For example, other electricity generators could be required to rapidly increase their output if wind output is low, in particular when such low wind output is unexpected. Similarly, electricity consumers would have to operate in a more flexible manner by reducing their consumption at times of low wind output and shifting this consumption to periods of high wind output.

The effects of intermittency could exacerbate the need to support flexible generation technologies. Given the uncertainty around wind output (and periods of high and low energy prices), conventional gas and coal plant might not be able to react quickly to changes in output, and they might not be able to capture high prices in light of the potential uncertainty around when these could occur. The resultant potential reduction in profitability could dampen investment incentives or result in the early exit of gas and coal plant from the market.

The security-of-supply effects of an increasing share of electricity generation being based on wind could be reduced by making the electricity system more flexible. Several routes to providing greater flexibility are available, as shown in Table 1 below.[19]

Policy options to enable greater flexibility

A number of policy proposals have been put forward to deal with the increasing system flexibility requirements, with the government due to publish its electricity systems policy in summer 2012.

Table 1 Flexibility mechanisms

Flexibility mechanism	Route of impact
Flexible electricity generation capacity (eg, gas and coal plant)	Ramping up of output at times of low wind generation
Demand-side response	This could be enabled through smart meters, combined with greater use of tariffs that vary by time of day to incentivise consumers to shift their consumption to periods of high wind (and low prices)
Electricity storage	Allows arbitrage between periods of high and low wind
Interconnection (or an offshore 'supergrid' in the North Sea)	This could enable the UK to export electricity at times of high wind output (and low energy prices) and import at times of low wind output, depending on relative prices in other countries The effectiveness of this route will depend on differences across countries in the generation mix, wind speeds and daily demand profiles

Source: Department of Energy and Climate Change (2011), 'Planning our Electric Future: a White Paper for Secure, Affordable and Low-Carbon Electricity', July.

- **Ofgem's electricity cash-out review**—the electricity System Operator in the UK (National Grid) is responsible for ensuring that electricity generation matches demand at any point in time. When a generator's output is higher or lower than its contracted output, it could cause an imbalance between generation and demand. The cash-out regime charges generators for the costs incurred by National Grid in balancing generation and demand. Having identified some concerns around the effectiveness of the existing regime, Ofgem, the energy regulator for Great Britain, has launched a review.[20] Its aim is to develop mechanisms that would ensure that cash-out prices are reflective of electricity scarcity, and thus provide correct operation and investment incentives.

- **Electricity Market Reform**—given the impact of intermittent wind generation on reducing the profitability of flexible plant, sufficient investment in such plant may not take place if they rely on wholesale electricity prices alone. A capacity mechanism that rewards electricity generation and demand-side technologies for being available to generate (in addition to wholesale electricity price revenues received when they do generate) has been proposed as part of the government's Electricity Market Reform proposals. However, the effectiveness of a capacity mechanism is likely to depend on its precise form, which is currently being formulated by DECC.

- **'Cap and collar' approach to interconnector investment**—with the aim of greater regulatory coordination and certainty, Ofgem has put forward proposals for a cap-and-collar regime for remunerating interconnectors, which has been developed in conjunction with the Belgian energy regulator. Under this approach, returns above a 'cap' would be redistributed to users of the electricity network. The interconnector owners would be refunded if returns are below a 'collar'. These proposals have received broad support from industry, and could be a possible route to enabling future investments.[21]

Implications for the UK's renewables strategy

Offshore wind has significant resource potential and could be critical for meeting a large proportion of the UK's renewables target. In light of concerns about rising energy bills and the challenges of security of supply, it is important that the costs of offshore wind are reduced in order to maximise its role. The work of the Offshore Wind Cost-Cutting Task Force in developing supply chains and technology, funding research and development activity to reduce future offshore wind costs, and changing policy to enhance system flexibility, could be significant.

If offshore wind costs do not fall over time, policy-makers may have to reconsider the other trade-offs associated with changes in the renewables mix—for instance, by adopting a less cautious approach to large-scale biomass deployment, or by reviewing the extent to which the renewables target could be met by 'trading' with other countries under the flexibility mechanisms set out in the European Commission Directive on Renewable Energy.

[1] This is part of the aim under the European Commission's Renewable Energy Directive to obtain 20% of EU-wide final energy consumption from renewable sources by 2020. See European Commission (2009), 'Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC', April.
[2] The Committee on Climate Change states that renewable energy provided 3% of UK energy consumption in 2009. See Committee on Climate Change (2011), 'The Renewable Energy Review', May.
[3] European Commission (2011), 'Public Consultation on Renewable Energy Strategy', December.
[4] The RO has been estimated to have added around £20 to each household's electricity bill in 2011, and this is set to rise to £50 by 2020. See Department of Energy and Climate Change (2011), 'RO Banding Levels from 1/4/13 to 31/3/17. Impact Assessment', November.
[5] Department of Energy and Climate Change (2011), 'Consumer Energy Summit', October 17th.
[6] Department of Energy and Climate Change (2011), 'Renewable Energy Roadmap', May.
[7] Oxera analysis based on data from Department of Energy and Climate Change (2011), 'Consultation on Proposals for the Levels of Banded Support under the Renewables Obligation for the period 2013–17 and the Renewables Obligation Order 2012', October, and ARUP (2011), 'Review of the Generation Costs and Deployment Potential of Renewable Electricity Technologies in the UK', October.
[8] Department of Energy and Climate Change (2011), 'Consultation on Proposals for the Levels of Banded Support under the Renewables Obligation for the period 2013–17 and the Renewables Obligation Order 2012', October.
[9] Department of Energy and Climate Change (2011), 'Members Appointed to Offshore Wind Cost-Cutting Task Force', press release, October 12th.
[10] Committee on Climate Change (2011), op. cit., chapter 5.
[11] Committee on Climate Change (2011), op. cit., p. 11.
[12] Department of Energy and Climate Change (2011), 'Consultation on Proposals for the Levels of Banded Support under the Renewables Obligation for the period 2013–17 and the Renewables Obligation Order 2012', October, p. 35.
[13] Mott MacDonald (2011), 'Costs of Low-Carbon Generation Technologies', May.
[14] Department of Energy and Climate Change (2011), 'Consultation on Proposals for the Levels of Banded Support under the Renewables Obligation for the period 2013–17 and the Renewables Obligation Order 2012', October, p. 123.
[15] Jamasb, T. and Köhler, J. (2007), 'Learning Curves for Energy Technology: A Critical Assessment', October.
[16] ARUP (2011), 'Review of the Generation Costs and Deployment Potential of Renewable Electricity Technologies in the UK', October.
[17] Department of Energy and Climate Change (2011), 'Members Appointed to Offshore Wind Cost-Cutting Task Force', press release, October 12th.
[18] See www.decc.gov.uk/en/content/cms/funding/funding_ops/innovation/historic/wind_demo/.
[19] Department of Energy and Climate Change (2011), 'Planning our Electric Future: a White Paper for Secure, Affordable and Low-Carbon Electricity', July.
[20] Ofgem (2011), 'Electricity Cash-Out issues Paper', November.
[21] Department of Energy and Climate Change (2011), 'Planning our Electric Future: a White Paper for Secure, Affordable and Low-Carbon Electricity', July, pp. 108–9.

If you have any questions regarding the issues raised in this article, please contact the editor, Dr Gunnar Niels: tel +44 (0) 1865 253 000 or email g_niels@oxera.com

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