ECONOMICS

How low can offshore wind costs go?

***Marc Height* looks at the rapid drop in costs in the offshore wind industry, and asks what the future holds.**

Along with the cost of other forms of renewable generation, onshore wind costs are continuing to fall and a recent Arup report suggests that onshore wind farms could now be built in the UK with a price per MWh similar to that of a new gas power station.

But while the UK government has, for the time being, taken a step back from supporting onshore wind, the UK leads the world in offshore wind capacity, with over 5 GW installed, and further offshore wind development forming a big part of the plan for future energy provision and industrial growth in the country.

Along with onshore, offshore wind has also seen a drop in costs recently – but one that has been perhaps more dramatic and surprising than its onshore equivalent.

The UK government set a target in 2011 for the offshore wind industry to bring its Levelised Cost of Energy (LCOE) down from £142/MWh to £100/MWh, by 2020. At the time this was seen as a serious challenge, but the combination of rapid technology advancement, increased scale and favourable financing has led to the goal actually being achieved four years ahead of schedule, in 2016.

The news of the LCOE target being achieved early has been accompanied by contracts recently awarded across Europe for wind farms with agreed prices for electricity output that took many in the industry by surprise – ranging from €72.70/MWh in the Netherlands, to zero (ie the project will rely on the market price for power) in Germany.

So what is bringing about this faster-than-expected drop in cost, and can it continue?

Cost reduction mechanisms

In July 2011, the then Department of Energy and Climate Change produced a roadmap for renewables which gave a target of £100/MWh for electricity produced by offshore wind by the year 2020. It then set up an Offshore Wind Cost Reduction Task Force, which recommended that an Offshore Wind Programme Board (OFPB) be created, comprised of industry and government representatives, to consider the risks across the industry.

Today the OFPB is responsible for producing an annual Cost Reduction Monitoring Framework (CRMF) report, which is put together by the Offshore Renewable Energy Catapult. The latest CRMF report, published in January this year indicates, using forecast Capex, Opex and generation data, that offshore wind projects that reached a final investment decision (FID) in 2015/16 have an average LCOE of £97/MWh. This 32% reduction from the $142/MWh figure was achieved significantly ahead of the 2020 deadline.

So how was the target achieved so early?

The CRMF report says that the largest contribution to cost reduction so far has been through technology developments. But it also finds two other important factors that have contributed to the drop in costs: competition at the wind farm developer level and, as the sector is becoming more established and a less risky proposition for financiers, the cost of capital is falling.

Turbines are bigger. The projects that reached FID in 2015/16 are dominated by 6 MW+ machines. This compares to wind farms that were instead fully completed in 2015 and 2016 that predominately use three or four megawatt turbines. The larger turbines reduce costs as fewer foundations are needed for an equivalent size wind farm. The early deployment of these machines, and the weight of the turbine factor in the cost reduction process, was a major cause of the quicker-than-expected drop in costs.

Other factors

The CRMF says that integrated design and whole-farm control systems could be improved further. It also says that more certainty about government support would help to secure the growth and scale of the industry. Uncertainty in this area results in headaches for smaller organisations in the supply chain – with a knock-on effect on costs.

Giles Hundleby, a Director at BVG Associates – a renewable energy consultancy specialising in wind and marine – says that, along with the size of turbines and a greater understanding of offshore wind from financial players, the supply chain plays a big part.

'When we are talking about a high number of gigawatts per year being installed, that obviously drives bigger volumes in the supply chain... and so the ability to commonise and get higher volumes out of any particular component or subcomponent increases – and that helps with cost,' says Hundleby.

'But it's not just that,' he continues. 'I think there are conscious attempts by developers to really go back to the supply chain and say: "we've got a pipeline of four gigawatts now. What can you do differently knowing that you've got that amount coming through to standardise and maybe invest to reduce costs?"'

Getting the power from the farm to shore, and also operation and maintenance, are two other areas where Hundleby thinks costs can be driven down from where they are now.

Matthew Wright, the Managing Director of DONG Energy UK, the world's leading offshore wind developer and one of the companies that put in a zero bid in the recent German auction, makes a similar point.

'We are looking at how we can get the projects constructed more effectively, and at how we can operate and maintain the wind farms once they're built,' he says. Standardisation, not just of equipment, but also in terms of an

DONG Energy's Burbo Bank Extension wind farm, which uses MHI Vestas 8 MW wind turbines

Photo: DONG Energy

'What we can expect is another very significant step change downwards in the cost of offshore wind'

Matthew Wright, DONG Energy

approach to building and operating a project is also important, according to Wright. And extensions of existing offshore wind farms can help in this regard.

'If you're building an entirely new wind farm in a part of the ocean that you haven't been in before, then you've got all the costs associated with the start up there,' he says. 'But if you are building out from an existing project then from an operations and maintenance perspective it's more straightforward... you start to get benefits from this clustering of the projects once they're built.'

Bigger turbines are clearly helping, but how large can they become? Hundleby says he wouldn't be surprised if the industry got to 20 MW turbines, but to a certain extent it will depend on the market adopting not just the turbines but also the support vessels that will be needed to transport and construct larger machines.

Wright makes the same point: 'Even though theoretically you can construct something larger, the cost of the support equipment in the manufacturing and construction process may very well be the limiting factor.'

Contracting

It is an interesting time to be speculating about offshore wind costs, as results of the the much-anticipated second UK Contract for Difference (CfD) auction – the process whereby government sets a support level for renewable energy technologies – are imminent. Results are to be released on September 11, after developers have offered sealed bids proposing at what level they are prepared to build a consented project.

The government set the CfD strike price ceiling for offshore wind at £105/MWh for projects coming online in 2021/22, and £100/MWh for projects for 2022/23. This is already around 25% lower than the last auction strike price set in late 2013, which gave ranges from £155/MWh for 2014 projects and £140/MWh for 2018/19 projects.

There is a lot of interest in this bidding round, as elsewhere in Europe some dramatically low bids have been made for offshore wind projects that are due to come online in the 2020s, reaching a nadir (or zenith) of €0/MWh subsidy bid for three wind projects off the German coast in April this year.

These bids are clearly quite something, but it's worth looking at the contract arrangements across the supporting countries to see how they differ in structure. The liabilities taken on by the state, network operators and wind farm developers have a big influence on the prices bid, as well as the nature of the site under consideration for development. In the German auction the developer does not have to pick up the grid connection cost, for example.

But still, there is an air of excitement around the prices that the UK auction could see. Figures around £80/MWh have been suggested from industry players and consultants like BVG Associates in previous forecasts.

Prices could go lower still. 'I think if anything our gut feeling from what we're picking up in the market is that £80 might be the upper end of it,' says Hundleby. 'Perhaps people are talking themselves into slightly lower numbers – mid-to-high 70s or maybe even lower. That could be people just starting to feel comfortable with the numbers from Germany and the Netherlands over the last year, or some expectation management happening.'

DONG is reportedly looking to secure a CfD for its potential 1.8 GW Hornsea Two project off the Yorkshire coast in this auction round. It received consent for the project in August 2016. Wright wouldn't be drawn to estimate an exact figure on what the CfD outcome might be.

'But what we can expect is another very significant step change downwards in the cost of offshore wind,' he says. 'I think people will see that this is a technology that is increasingly competitive and of its time. And I think it will give people a lot of comfort and confidence that actually we can continue that [cost reduction] process – on a trajectory that still has some way to go.'

'In some sense it's surprising how quickly the costs are coming down,' he continues. 'But in others it isn't. This is still a relatively young industry where we're in the steep part of that learning curve, and every time we double capacity or output you can expect a very significant reduction in the unit cost.'

Other farms that have been linked to the auction are Triton Knoll, being developed by Innogy and Statkraft off the coast of Lincolnshire, and Inch Cape off the coast of Angus in Scotland.

Further ahead

There is a lot going on to keep up research and development to help lower costs further. For example, recently the Scottish government injected £1.5mn into the Carbon Trust's Offshore Wind Accelerator to bring forward technology development. DONG and Siemens Gamesa have partnered with Sheffield, Durham and Hull Universities on a five-year research programme to lower the cost of offshore wind. And the Vattenfall-funded Aberdeen-based European Offshore Wind Deployment Centre is to focus on developing new technologies for offshore wind.

Looking further ahead, Bloomberg New Energy Finance's *New Energy Outlook 2017* projects that offshore wind costs will come down a whopping 71% on today's levels by 2040. But Wright points out the difficulty of forecasting accurately so far ahead, nodding to the fact that DONG and others didn't forecast 2020 particularly well (albeit in a positive way). 'It's a brave person that goes all the way out to 2040,' he says.

A resource assessment from BVG Associates for the trade body WindEurope says that, in theory, offshore wind could provide 25% of EU electricity at €54/MWh, and over 100% at €65/MWh by 2030, including the costs of grid connection (see **Figure 1**). 'So that's a third of the cost that we were looking at in the early 2010s,' says Hundleby.

I wondered whether such costs and the sub-100 figures could be maintained as wind farms head into deeper water further from the shore. But Hundleby points out that it is not just distance from shore that is important, factors like water depth, wind speed, distance from the grid and distance from the construction port will all play a part.

'For example in the UK, the southern half of the North Sea where it's shallower and reasonably near the shore has the potential for the same sized wind farm to produce energy at a lower cost than a similar farm further north, and that's because of water depth,' he says. 'And you'll find there are parts even closer in that have poor wind conditions, and it gets better further out towards a sweet spot where the distance effect starts to play in.'

'The good news is that there's plenty of good low-cost areas for offshore wind,' he says.

Wright agrees. 'Of course there are also benefits of being further out – you may very well get higher wind speeds,' he says. 'And as turbines get bigger then that opens up the potential for the wind turbine generators themselves

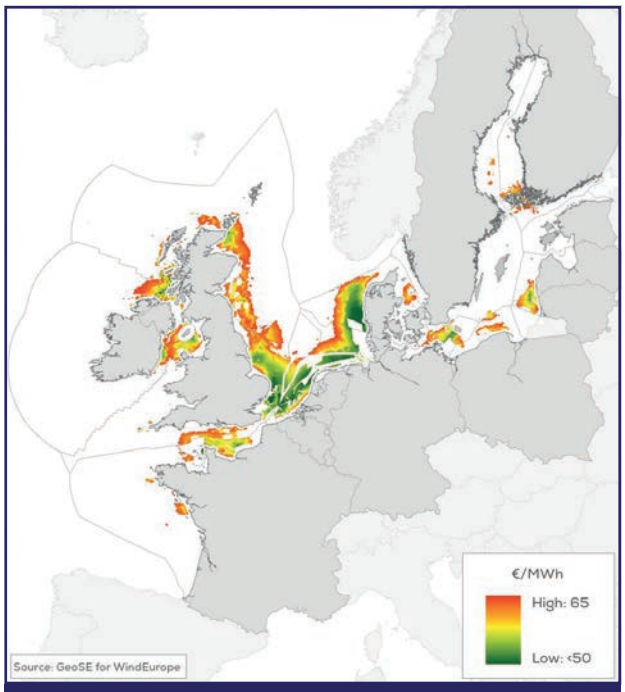

Figure 1. A baseline scenario from BVG Associates of economically attractive offshore wind potential at the end of 2030

Map: BVG Associates

tapping into better winds at higher altitudes.'

There is also an operation and maintenance cost angle for farms further offshore. 'We're looking at different ways of operating these wind farms, like service operation vessels that stay out for a number of days rather than transporting people to and from the shore every day,' says Wright.

Subsidies...

The offshore wind industry has been asking the UK government for clarity for the period post 2020, when the UK's Levy Control Framework (LCF), which controls spending levels on renewables, is due to end. The government announced earlier this year that the LCF will be replaced with another framework for supporting renewables spending, but not what it will be yet. There is expectation that this will happen as part of the Autumn Budget.

'In the interim, the industry as represented by the Offshore Wind Industry Council is working on a sector deal for offshore wind – the bones of which will be a proposal for how we can provide that medium to long-term certainty,' says Wright. Such a deal would be beneficial for the industry, the government, and UK PLC, he argues. 'We have more offshore wind deployed than any other country in the world. We think it's natural for that to continue because we happen to be blessed with the North Sea, the Irish Sea and to a degree the English Channel.'

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'I can't really see the UK saying "okay we we've done what we planned to do and let's now stop",' says Hundleby. 'The low price would be too compelling and would mean they would carry on.'

The CRMF report recommends that the OWPB works to continue cost reduction and support investment in the UK supply chain, with 'a coordinated approach to Industrial Strategy'. It says that there have been successes with UK content in farms as is required in the CfD process, and that this level could be increased further with an ambitious UK government Industrial Strategy.

Wright says that the government 'absolutely gets this', and that the sector is 'pushing against an open door' when it comes to offshore wind being part of the industrial strategy (along with other renewable technologies, and energy storage).

The logical crux of these conversations is: just when will offshore wind be built across Europe without subsidy. But both Wright and Hundleby questioned the usefulness of thinking about offshore wind eventually becoming 'subsidy-free'.

'All forms of generation get some kind of support,' says Wright. 'The important thing is providing some kind of certainty that will allow the supply chain to continue to invest, to allow the developers to continue to invest and to continue to bring the cost of projects down. So we will need some kind of mechanism beyond the next CfD allocation round to bring projects to the market.'

He points out that, as more renewables come onto the system, the marginal cost of extra generation will drop and this will push down the wholesale power price, eventually to a level where it does not support a project that is relying on that rate. 'So you get into a sort of a *Catch 22* situation,' says Wright. 'That's why there is a requirement for some kind of support mechanism to allow the capacity to be built. And it becomes less about the level of subsidy relative to other forms of generation to do that, and more about just having a mechanism to bring projects to market.'

'What I do know is that we are on a trajectory here to subsidy parity with other major forms of generation,' he says. 'And that's the important thing.'

Hundleby also has issues with the term. 'To be honest I find the whole subsidy-free thing somewhat unhelpful, because it does necessitate trying to guess the difference between two somewhat unpredictable numbers and then basing your decisions on that,' he says. 'And that's far harder than basing it on just one slightly more predictable number – which is the cost of the offshore wind energy.'

'Frankly I think the best mechanism for everybody for sharing the benefit and the risk is a CfD, even if that CfD ends up below the regular market price for electricity,' he says. '[In that situation] when the wind blows the bill payer is getting wind energy into the system at a much lower price than the average... and if the developer is bidding competitively they will make their margins as well.'

New coastlines

Despite contracting arrangements, there is an ambition in European countries around the North Sea to move to a level of at least 4 GW of offshore wind per year being installed across the continent. At a WindEurope and RenewableUK conference earlier this year a joint statement was signed by representatives from the German, Denmark and Belgian governments to help facilitate this.

This could result in more collaboration in, for example, coordinated contract allocation timings, which both Wright and Hundleby regard as a good move and one that would help with further cost reduction through a steady pipeline of projects.

With an industry in Europe that is becoming more and more established, and that has a dedicated supply chain, developers including DONG are eyeing coastlines further afield. These will initially not see projects built at the same low costs as in Europe. 'The first projects developed in the US or Taiwan will inevitably not be as low, simply because the supply chain doesn't exist yet so it will take some time to get down to a similar level,' says Wright.

But with the knowledge of the technology built up across Europe, they will be starting at a much more advanced stage. While it takes time to build an industry from scratch, 'it's a pattern that certainly can be repeated in pretty much any country in the world with a coastline,' says Wright.

If this is the case, then more and more countries will eventually benefit from what is becoming an increasingly low cost, truly large-scale renewable energy technology. ●