Offshore wind is changing, and it is changing for the better. In 2006, offshore wind deployment costs started rising significantly, from £1.5m/MW, in 2016 prices, to over £4m/MW in 2012, without a clear indication as to what the price ceiling would be. There was an industry-wide realisation that a significant shift was necessary to avoid losing out on investments to alternative renewable or low-carbon energy sources.

Multiple European initiatives have since emerged, such as the Offshore Wind Cost Reduction Pathways Study in the UK, which aimed to reduce costs and ensure the viability of the industry. The general concern led to challenging targets being defined, steering the sector towards a levelised cost of energy (LCOE) of £108/MWh, in 2016 prices, by 2020, from the £152/MWh levels reached in 2016. As something of a hot topic, the industry had to stand up and deliver the cost reduction message across the board.

According to the latest Cost Reduction Monitoring Framework, not only is the sector well on its way to achieving its goals but it has continued to set increasingly challenging targets. In June this year, 11 major European energy companies signed a declaration stating that offshore wind can achieve a cost of €80/MWh (£62/MWh at that time) and below, including transmission costs, for projects reaching final investment decision by 2025, aiming to achieve grid parity, ie generate power at an LCOE that is less than or equal to the price of purchasing power from traditional technologies without subsidies.

In recent weeks, Dong Energy has achieved competitive prices in its successful bids for Borssele (1 and 2) as has Vattenfall at Kriegers Flag in Denmark, which indicate these target levels can be achieved.

This cost reduction covers both capital expenditure (capex) and operational expenditure (opex). In relation to capex, reductions are being achieved by means of optimised design, with larger wind turbine generators (WTGs) being deployed that require fewer balance of plant elements (fewer foundations and cables per MW).

Opex improvements have been achieved through fewer trips during the operations and maintenance of the WTGs, as contractors gain experience and knowledge from lessons of the past. The lower cost of capital has also helped developers to significantly drive down the cost of energy.

Change has not only been driven by the industry. Governments are modifying the criteria for awarding subsidies, which are still required, for the time being.

Previously projects could simply achieve certain milestones and become eligible to receive subsidies, such as the renewables obligation certificate (ROC) in the UK. In the current market, subsidies in most European countries are awarded following a cost-driven auction process between developers.

This change in the process is fundamental; since the subsidy is no longer guaranteed and developers must compete among themselves to deliver profitable projects successfully at the lowest cost, or miss out entirely.

However, there are technical concerns with current cost reduction measures. At what price will this cost reduction be delivered and what are the associated risks? Are the changes in strategy that have been adopted to reduce capex and opex compatible with a low cost of capital?

Development risk in different markets
The risk of developing offshore wind projects in each country is inherently different. The scope of development varies by means of changing the grid connection arrangements or through the type of studies a developer needs to undertake, all set against the uncertainty of whether a subsidy will be awarded.

In the UK and France the developer needs to construct all transmission assets from the offshore wind farm to the onshore connection point, including the offshore substation, export cable and onshore substation.

The governments in Denmark and the Netherlands provide grid access offshore – hence only WTGs and array cables need to be installed – while the German government provides grid connection beyond the offshore substation, including any possible converter from AC to DC and the export cable link.

Developers in the UK have to undertake the complete site assessments, including geotechnical investigations and metocean studies. However, in Denmark and the Netherlands the government runs most of the site assessment activities, including metocean measurement campaigns and wind resource assessments.

Considering the above points, development risk in the UK is significantly higher than in Germany, the Netherlands or Denmark. Anyone wishing...
to develop a project in UK waters needs to have significant backing to manage the development expenditure (devex) risk they are exposed to.

So, the question is, why invest in pre-construction projects? The answer is, the internal rate of return (IRR) tends to be significantly higher (an increase of 20% or more) than investments in projects already subsidised. This is a significant amount of money when we consider that offshore wind developments routinely exceed the £1.5bn mark.

Key for successful developments
What is meant by a successful development? At SgurrEnergy we consider a successful development to be a project that is set up with attractive investment returns and with a low delivery cost, ie a low LCOE, without being exposed to any major risks. These projects are also more likely to receive a subsidy award while still allowing for project financing without facing major issues or concerns from the lending community.

When considering risks we need to acknowledge the differences in the way an investor and a lender will view risk. Investors tend to have a greater risk appetite in seeking returns and will consider upside potential when making decisions, while lenders focus on ensuring that the debt will be returned in any foreseeable scenario, and tend to be more risk-averse in how they assess the financial model.

As previously stated, bringing capex and opex costs down may mean that the project risks increase. However, there are ways around this cause and effect relationship that allow for both low cost and low risk project developments.

Let’s look in a bit more detail at the LCOE formulation, where the sum of the costs over the project lifetime covering devex, capex, opex and abex (abandonment or decommission costs) is divided by the sum of the electrical energy produced over the project lifetime. This ratio is calculated for each year, adjusted by a discount rate and summed for the complete project lifetime. In order to reduce the LCOE, the developer can either reduce the costs or increase the energy output.

Some of the main factors that enable low-cost, low-risk projects are:

- A robust multi-contracting contractual set-up with strong risk and interface management;
- Design optimisation;
- Comprehensive due diligence to address any novelty.

Looking at procurement, the majority of project developers historically followed an engineering, procurement, construction and installation (EPCI) contracting approach, whereby a developer enters into a few agreements with major contractors for the construction of the wind farm.

This approach could lead to the developers building a project considering only two major contracts, the WTG EPCI and the balance of plant EPCI. Other alternatives considered a few more contracts breaking down the balance of plant into foundations EPCI, substation EPCI and power cables EPCI. By following these approaches developers have passed the interface risk (design and schedule alignment) to the contractor(s), but they have had to pay a price for it, hence increased project capex.
More recently, numerous large and experienced developers have chosen an intensive multi-contracting approach, whereby the developer takes responsibility for many tiers of supply, in an extreme example even purchasing all of the electrical equipment directly and handing it over to the substation fabricator. This has led to significant cost reduction by removing the interface premium that was paid to EPCI contractors in the past. The inflated fees that were paid to have contractors take risks they were not best placed to manage have now been eliminated, which has resulted in leaner costs across all supply contracts. An intense multi-contracting approach whereby the developer enters tens of contracts can bring the cost down by 15% or more.

While this approach can be applied without significantly increasing the risk profile of the project, it needs to be addressed with caution and on a case-by-case basis. Owning thousands of interfaces at a developer level has many pitfalls, and only those with well-resourced and experienced technical teams can provide confidence that interfaces will be well managed.

In terms of optimisation, the incorporation of lessons learned and engineering advances in designs and technological improvements have also contributed to lower costs. An example of design optimisation is an in-depth understanding of the combined loading of WTG and foundation. This has resulted in more refined modelling and consequently has been translated into a reduction in steel weights for towers and foundations.

To put this into commercial terms, if the foundation design is optimised and the project follows an intense multi-contracting approach that also considers new entry suppliers (which offer competitive pricing but need closer monitoring), the foundation supply cost can be up to 50% lower than in projects where the design process follows more conventional methods and is delivered under an EPCI contract. In the right hands this saving could be delivered without significantly increasing the project risk.

In order to achieve grid parity however, innovation will also be required, although this may increase the cost of capital. Current solutions such as monopiles are starting to become highly optimised with little room left for improvement. New technology does not always mean blue-sky thinking; it can mean doing things better, turning the current approaches up a gear with alternative methods or improvements to existing solutions. New technology can lead to lower capex or opex values and to increased yield, by means of going beyond the tried and tested approaches to achieve success.

The good news is that innovation is gradually being implemented in projects, through enhanced features in WTG controllers and aerodynamic improvements that increase energy yield at minimal cost, improved installation tools that lower capex, new crew transfer and service operation vessel designs for operations and maintenance activities that lower opex.

At SgurrEnergy we are committed to supporting the industry bring the LCOE down. We have developed a suite of services, SgurrOptimiser, that enable wind farm owners to increase the yield and lifespan of existing wind farms by making small adjustments to the way WTGs operate. In terms of new technology, demonstration will also play a key role, since it is unlikely that a completely new idea could be applied to a project on a commercial scale. These demonstrations allow developers to understand the potential of new solutions and then refine and apply them on a larger scale.

An example of this is the installation of a single suction bucket jacket by Dong Energy, in collaboration with five other developers, at Borkum Riffgrund 1. Following the successful deployment in real environment conditions, Dong Energy announced that it plans to install 20 of these foundations alongside 36 monopiles at the consented Borkum Riffgrund 2 wind farm. The company is also considering the solution for the much larger HornSea project in the UK.

Dong Energy is not the only party to benefit from this new concept as Vattenfall has announced that it will be installing the same foundation concept at its Aberdeen Bay wind farm in UK waters.

Another factor that can impact the cost of delivering offshore wind projects, and that should not be overlooked, is the existing supply chain and its manufacturing capabilities.

When looking at manufacturing we need to consider the dilemma between competition and optimisation capabilities. If there is only one supplier, it will have the benefit of a strong pipeline ahead and will be able to invest in optimising the fabrication process; however, it is likely to request a large margin for its product.

Conversely, if there are multiple competing suppliers, they will not be able to invest in optimising their processes and will have to reduce their margin to remain competitive.

According to the “Approaches to cost-reduction in offshore wind” report published by the Committee on Climate Change, having three to five major proven suppliers competing for contracts, depending on the product or service they supply, has the highest impact on design optimisation and cost reduction.

Developers with large pipelines of projects have also been able to achieve reduced contract prices by leveraging orders for multiple projects through framework agreements and standardising some elements such as cable and substation design. We have found that the experience and pipeline of each project developer is a significant contributor in offshore wind farm capex. Data from different projects have shown that a strong pipeline and framework agreement for the supply of certain wind farm assets can reduce costs by up to 10%.

Furthermore, an experienced developer will use the lessons learned to be more efficient throughout the project lifecycle, from
development to operation. Data from recent projects show that experienced developers have been able to deliver projects for less than the values assumed at financial close, primarily due to under-spending on the allotted contingency, while less experienced developers tend to use part of the budget contingencies defined before construction starts.

A glance at floating wind technology

Usually when we talk about “offshore wind” we tend to refer to fixed-bottom offshore wind farms; however, the industry will soon start to consider “offshore wind” as an umbrella term for both fixed-bottom and floating technology.

Floating offshore wind should not be considered as a substitute of fixed-bottom offshore wind but an alternative, since it enables developers to take advantage of sites that are relatively close to shore and have a high wind resource, but that otherwise would not be able to be exploited.

Examples of this include the European Atlantic coast, the Mediterranean Sea, island states such as Hawaii, and sites on the east and west coast of the United States that are close to large population hubs.

Many different floating wind platforms have been developed and are currently in demonstration or pre-series stages and will start to compete with fixed-bottom offshore wind farms sooner rather than later. SgurrEnergy expects that by 2025 we will start seeing the first large-scale commercial floating offshore wind farms.

Many of the points outlined above (such as multi-contracting and new technology) are also relevant for floating wind developments, but it also faces many new challenges such as the availability of fabrication sites, maturity of designs, uncertainties in capex figures and variable operations and maintenance strategies.

SgurrEnergy has already undertaken technical due diligence of different floating wind technologies and we are confident that floating wind will become a bankable technology sooner than many expect, providing robust engineering processes are used.

Summary

The offshore wind industry can argue that capex costs are fundamentally decreasing, but projects still need to optimise all aspects that impact the LCOE, mainly capex, opex and yield, without increasing the risk profile, and in turn increasing the financing costs. If developers can balance this, they are much more likely to be awarded feed-in tariffs in an increasingly competitive market.

In mature markets, it is likely that multi-contracting will start to become mainstream since the subsidy auction process will not allow for a premium price to be paid for risk transfer.

Developers also need to continually evaluate a combination of new technologies, currently under testing and implemented within the industry, to reduce the overall project costs while also extracting more energy from the wind. These advances will span from incremental improvements to ground-breaking solutions such as floating wind.

Nevertheless, from a technical advisory perspective, we at SgurrEnergy are convinced that the industry will be able to achieve the demanding targets the sector has set while still delivering profitable and bankable projects.