Offshore Wind Projects Take Off As Technology Improves And Costs Fall

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Rising investments in renewable energy to meet climate change goals, as well as falling costs for renewables technology, are spurring massive increases in offshore wind power capacity worldwide. Global cumulative offshore wind capacity increased by 2,219 megawatts (MW) or 18% in 2016, and the Global Wind Energy Council estimates that it could expand by another 3 gigawatts (GW) in 2017.

S&P Global Ratings expects pricing in pending offshore wind projects will fall further in mature markets as generation costs continue to drop, mainly because of technical evolution and supply chain involvement.

Overview

– Improving technology is making offshore wind power an increasingly viable energy source worldwide.

– Yet technological, geographical, and regulatory limitations could still limit the credit quality of offshore wind projects.

– Europe’s offshore wind industry is the most mature, while further development of the nascent industry in the U.S. will depend on wind regimes, site conditions, supporting infrastructure, and favorable regulation.

– China’s offshore wind capacity looks set to increase fourfold by 2020, but in Latin America the industry’s development will likely take longer.

Still, the industry faces many limitations that could have credit consequences if the risks are not overcome. These include technological risks, such as the need for larger vessels during the construction phase, a limited number of players able to conduct construction, limited market availability, a complex and long design process, and a lack of industry standardization. Exposure to fluctuating steel prices should also not be ignored. However, if the lower costs for offshore wind are sustainable, and if they can be transferred to the nascent U.S. industry, the future for the emergent offshore industry will be brighter.

Against this background, we believe three major factors will affect the creditworthiness of projects in this fast-developing sector: regulatory and political risks in new markets; the extent to which further technological developments can decrease costs; and grid connection limitations given the rapid increase in new projects due to go live over the next few years. (For further details see “With Offshore Wind Projects Set To Take Flight, What Factors Will Move Ratings?,” published Feb. 12, 2016, on RatingsDirect.)

Technologies Are Improving

The cost of energy from offshore wind has fallen considerably over the past five years. In the U.K., where offshore wind power generation is well advanced, it has fallen by 32%. Projects reaching Final Investment Decision in 2015/2016 achieved an industry average levelized cost of energy, which measures lifetime costs divided by expected power output (LCOE), of $121 per megawatt-hour (MWh), compared with $181/MWh (€95/MWh from €142/MWh) in 2010/2011, according to the Offshore Wind Programme Board. This means the $127 (£100) LCOE was achieved four years ahead of the government’s 2020 target.
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Technological developments have contributed most to cutting costs, although final price reductions resulting from lower internal rate of return (IRR) requirements and financial optimization have also played a part. Now, however, governments are moving toward more market-oriented projects, either through auctions or tenders. Auctions require project owners to assume overall responsibility for developing projects, including site selection, project development, and construction of the wind farm and transmission grid. These are prevalent in countries such as the U.K., Germany, and the U.S.. German auctions differ in that they do not include the onshore substation, transmission cables and offshore converter station, which are provided by the transmission system operator. Projects in these countries require project owners to have high-level execution skills and entail considerable capital requirements and investments up until project approval. Tenders, by contrast, involve governments inviting tenders for predefined projects on sites selected by the national energy authorities, which have already carried out the necessary technical pre-investigations of the seabed and wind conditions. These are prevalent in Denmark and the Netherlands. Compared with full-scope projects, they require significantly lower up-front investments, and project owners need not have such high technical competence, entailing lower risk for the project owners.

We expect pricing in future offshore wind projects will fall further in mature markets as technology costs continue to decline and project sizes continue to increase. Up to now, bid prices have depended on:

– Technical evolution that has led to larger, more effective turbines and improved foundations;
– The inclusion of supply chain in the industry, which has brought greater construction and operating and management (O&M) synergies due to economies of scale;
– Site specifics, such as the wind resource available, sea bed surface, water depth, and distance to shore;
– The cost of developing and installing the grid to transmit the electricity;
– Cost of capital; and
– Market conditions (subsidy scheme, duration, inflation, tax).

Given that wind turbine generators (WTGs) account for most capital and operating expenses, rotor sizes will continue to increase in the pursuit of economies of scale. In turn, this will reduce the number of foundations and the cost per MW, improving yield and O&M efficiencies. Increasing availability of offshore wind purpose-built vessels on the market, greater involvement of oil and gas majors, and a good range of specialized vessels for specific operations (such as WTGs, foundations, and cables) are set to lower costs further. Cable routes that avoid port areas could help limit costs because greater marine traffic leads to tighter operational constraints and cable burial depth requirements.

Despite this progress, the industry still faces many challenges, which could affect the credit quality of projects if the risks are not sufficiently mitigated. For example, current technology requires larger vessels during the construction phase, which only a limited number of players are equipped to handle. Other hurdles include market availability of vessels to install the equipment, a complex design process, a need for standardization, and steel price fluctuations. To help installation and logistics, offshore wind farms still need to become less weather-sensitive, and ships need faster navigation, higher crane capacity, and increased deck space. Furthermore, grid connections lag behind the rate of new projects coming on line, which sometimes limits the construction program, owing to time discrepancies between planning and building wind turbines and transmission lines.
In addition, new adaptations, including bigger turbines and larger foundations, might benefit from higher availability that could take time to realize due to "infancy failures". However, O&M warranties from counterparties with strong creditworthiness could offset risk from limited track record. The establishment of a professional and experienced supply chain will remain highly important for cost reductions in new markets, such as the U.S.

**European Grid Connections Are Growing Rapidly**

In 2016, operators connected 1.6GW of new offshore wind power capacity to the grid in Europe, representing 70% of global installed capacity. In 2015, capacity had been even higher—at about 2.4GW—making for an exceptional year following the resolution of grid-connection delays in Germany. By 2020, WindEurope estimates total European offshore wind capacity will be 24.6GW based on the high number of offshore wind projects in construction. Over the medium term, the North Sea appears likely to stay the main region for offshore deployment (78% of the European total; see chart 1) followed by the Baltic Sea (14.1%).

Europe's persistently low interest rates and narrowing investment returns look set to create the conditions for lower bids because cheaper financing to develop wind farms will mean lower bids. The information provider Bloomberg New Energy Finance (BNEF) estimates bids will be in a record-low range of $65 to $82 (€61 to €77) per MWh in the Baltic Sea and $58/MWh to $77/MWh (€55/MWh to €73/MWh) in the North Sea. This follows the record bid of 0.005 U.S. cents (0.0049 euro cents) per MWh for North Sea capacity last year by Vattenfall AB for a project off the Danish coast.

Overall, investment in the offshore wind industry in Europe has grown at an annual average rate of 30% in the past five years. New investments in offshore wind in Europe continued to grow strongly during 2016 (see chart 2). Eleven projects reached Final Investment Decision (FID) in 2016, with a total investment value of $19.3 billion (€18.2 billion). A total 4.9GW of new capacity was financed across five countries. Nonrecourse debt hit a record of $8 billion (€7.6 billion) in 2016 for the financing of both new and operational wind farms. Transactions so far in 2017 have continued to reflect the general trend of easing loan terms, supported by commercial banks,

**Chart 1 - Europe’s Project Pipeline: Five-Year Outlook**

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export credit agencies, and policy-driven lenders. The European Investment Bank (EIB) alone, backed also by the European Fund for Strategic Investments (EFSI), provided a combined value of $1.2 billion (€1.1 billion) in 2016 for the construction of new offshore wind farms. The equity mix continues to diversify, with more corporate, financial, and in particular, overseas investors coming to the sector.

Can The U.S. Drive Down Costs To Boost The Industry?

Offshore wind energy in the U.S. is generally—with a few exceptions—more costly relative to other sources of power. Block Island Wind Farm, developed by Deepwater Wind, the first commercial offshore wind farm in the U.S., went online in December 2016. The five-turbine, 30MW project is small compared with its European counterparts—the average size of an offshore wind farm in Europe in 2016 was 380MW. It is therefore comparatively high-cost, at about $290 million. Financing is supported by a 20-year power purchase agreement with National Grid, priced at around 24.4 cents per KWh. Opponents of offshore wind power in the U.S. point out that this is about twice the wholesale price paid by National Grid, especially in a diminished power price environment. Nevertheless, supporters counter that the project’s wind power is replacing the diesel fuel oil generators that were supplying the 1,100 consumers at a price reported at about 50 cents per KWh. This demonstrates the value of offshore wind for remote and resource-constrained areas.

Developments in Europe show that offshore power costs fall significantly as the industry matures and projects scale up. Recent auction bids, demonstrate that prices are falling. The German government is running an auction for 1.55GW of new offshore wind capacity. The results, announced in April 2017, have ushered in a new era for the sector, after DONG Energy and EnBW bid at zero, meaning no subsidies, but only market prices. In structuring their assumed costs, the utilities have taken a punt on future electricity prices and also on technology improving between now and 2021, when the projects will be built.
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Zero bids point to the increasing pressure on the profitability of offshore wind plants, notably in Europe, resulting from technological improvements and increasing competition.

However, the U.S. also faces certain specific geographic and regulatory obstacles, as follows.

Geographic considerations
Wind speeds, water depths of offshore projects, and distance to shore affect their economic viability. A 2012 study by the U.S. government-owned National Renewable Energy Laboratory (NREL) estimates that the U.S. has over 4,200GW of offshore potential. Wind speeds off the Atlantic coast and in the Gulf of Mexico are generally lower than wind speeds off the Pacific Coast and Hawaii, but the Atlantic has shallower waters that are more economically attractive due to the likely lower costs of installing turbines (see chart 3). The Gulf Coast, which is host to significant offshore rig installation capacity, lacks the wind resources required to make such investments viable.

The further offshore a project is, the higher the grid interconnection costs for developers. Similarly, the deeper and harsher the water conditions, the higher the costs and greater the risk. The average water depth of wind farms completed, or under construction in Europe in 2016 was 29 meters and the average distance to shore was 44km. Similarly, the Block Island wind project water depth is about 27 meters, and has a cable length of about 31km. Other wind projects in the Atlantic have interconnection distances that range from about 20km to 80km.

Block Island used jackets, and Europe has seen both monopiles and jackets used. The expectation is that Massachusetts offshore wind farms will use jackets given water depths of 40-50km, whereas farms offshore New Jersey may use monopile structures. Given the deeper waters in the Pacific, the large offshore wind potential in the U.S. would likely require floating structures that introduce greater technical risk.

Chart 3 - Potential U.S. Wind Capacity By Water Depth

<table>
<thead>
<tr>
<th>Region</th>
<th>0-30</th>
<th>30-60</th>
<th>&gt;60</th>
</tr>
</thead>
<tbody>
<tr>
<td>New England</td>
<td>100.2</td>
<td>136.2</td>
<td>250.4</td>
</tr>
<tr>
<td>Mid Atlantic</td>
<td>298.1</td>
<td>179.1</td>
<td>92.5</td>
</tr>
<tr>
<td>South Atlantic Bight</td>
<td>134.1</td>
<td>48.8</td>
<td>7.7</td>
</tr>
<tr>
<td>California</td>
<td>4.4</td>
<td>10.5</td>
<td>573.0</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>15.1</td>
<td>21.3</td>
<td>305.3</td>
</tr>
<tr>
<td>Great Lakes</td>
<td>176.7</td>
<td>106.4</td>
<td>459.4</td>
</tr>
<tr>
<td>Gulf of Mexico</td>
<td>340.3</td>
<td>120.1</td>
<td>133.3</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2.3</td>
<td>5.5</td>
<td>639.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,071.2</td>
<td>628.0</td>
<td>2,451.1</td>
</tr>
</tbody>
</table>

Source: National Renewable Energy Laboratory.
Proximity of supporting infrastructure to offshore wind farms

The proximity of supporting infrastructure is an important cost factor in both construction and operations phases, such as ports and fabrication yards. Europe benefits from an offshore industry that has developed fabrication yards close to offshore wind locations, as well as ports that have crane capacity, channel depth, and air draft clearance. Recognizing the importance of infrastructure to the development of a competitive offshore wind industry, Massachusetts invested in the New Bedford Marine Commerce Terminal. This port is designed to support offshore wind construction including heavy lift cranes, 800 feet of deep-draft berthing and 400 feet of barge berthing space, 29-foot controlling depth in the New Bedford Harbor, and 26 acres of terminal storage.

Maryland is moving forward with its plans for offshore wind and has recently awarded offshore renewable energy credit to Deepwater Wind and US Wind, which have agreed to invest $115 million in manufacturing and port facilities in the Sparrows Point/Tradepoint Atlantic area. These facilities would benefit future projects up and down the Atlantic East Coast.

Regulation

One challenge unique to the U.S. offshore wind industry is the Jones Act, which restricts certain activities in U.S. waters to U.S.-built vessels owned and operated by U.S. citizens. U.S.-built and flagged vessels that contain the heavy-lift equipment required for offshore wind installation are limited. We note, however, that the oil industry has so far been able to navigate this act.

North American Projects Are Still In Their Infancy

Offshore wind development in North America has long lagged behind Europe, but is now beginning to emerge amid changing circumstances. Proposed developments are concentrated in the northeast and Mid-Atlantic regions, which are densely populated metropolitan areas with strong energy demand, high electricity prices, and shallow continental shelves, as well as generally favorable regulatory initiatives.

Developers have so far secured 11 commercial leases from the Bureau of Ocean Energy Management (BOEM), which oversees federal waters, to build over 14GW of offshore wind off the coasts of Rhode Island, Massachusetts, Virginia, Maryland, New Jersey, Delaware, and New York. In March 2017, North Carolina was added to that list via a BOEM lease sale, with the next such sale slated for 2018. Projects are also being considered along the Great Lakes, the Gulf of Mexico, and on the Pacific Coast. But they remain in very early planning stages and suffer from inherent limitations, such as less supportive regulation or more modest wind conditions, among others. The number of industry players has grown from eight in 2013, since the first lease sale, to 14 in the recent New York lease sale.

In Canada, the offshore wind industry is even less developed than in the U.S. The first project, the 180MW St. George's Bay project, is in the early planning stage. A moratorium in Ontario on offshore development has stalled activity in the Great Lakes. However, the industry may benefit from actions by the Canadian government, which is in the process of developing new rules for approving and monitoring new offshore projects and a single regulatory oversight board.
Offshore Wind Projects Take Off As Technology Improves And Costs Fall

With more than 4,200GW of offshore wind energy technical potential in the U.S. alone, the North American offshore wind industry has significant untapped potential. A project pipeline is beginning to take shape. However, stable and coordinated policy at all levels of government will be required to encourage adequate, non-prohibitive investment, and drive deployment during the next decade. A protracted set of incentives would also likely lead to improved technology and decreased costs over time.

**U.S. offshore wind farms carry greater regulatory risks**

Given its still-high cost, further development of the U.S. offshore wind industry will depend on more favorable regulation. While European developers typically have the credit benefit of comprehensive feed-in tariffs, American developers may need a more patchwork approach, cobbling together incentives across multiple levels of government. This could create more significant risks, and the current lack of clarity surrounding energy policy in the U.S. could accentuate this risk.

To offset substantial construction and operating costs, wind farms will need to tap either the Investment Tax Credit or Production Tax Credit (PTC). The former allows projects to recoup a portion of their investment, while the latter compensates projects based on actual generation at $.023/KWh. This has benefitted onshore wind projects. These credits have spurred the growth of the renewables industry during recent decades. However, in recent years, they have become more politicized. Their last extension, in late 2015, was part of a last-minute budget deal, and uncertainty surrounding their extension creates additional risk, especially for the PTC where the majority of the benefit for a long-lived asset would take place after its current expiration. During the nascent Trump administration, which we expect will weaken or abandon the Clean Power Plan, the value of these tax credits is substantial. This is particularly the case for newer, less developed asset classes, such as offshore wind.

State-level incentives for offshore wind development are also likely be necessary over the next few years. These are often indirect, for example in the form of renewable portfolio standards (RPS), stipulating that utilities operating in the state obtain a proportion of their generation from renewable energy. While 29 states currently have binding RPS standards, others still have non-binding targets. Nevertheless, a broad mandate for renewable power doesn’t necessarily create abundant incentive for offshore wind in the face of less expensive, better-proven technologies, such as onshore wind or thermal solar. We expect certain states may consider carve-outs for offshore wind. New York, for instance, has recently announced an ambitious renewable energy mandate of 50% of supply by 2030, and has stated its intention to have a portion of that (about 2,400MW) from offshore wind. This goal prompted the agreement with the Long Island Power Authority to build a large farm off the coast of Montauk, NY. Similarly, Massachusetts, while failing to see the Cape Wind project to fruition, has established a requirement for utilities to purchase 1,600MW from offshore wind by 2027, and with its ample offshore wind resources, may be in a good position to spur investment.

Lastly, transmission policies must have a high degree of certainty to support further offshore wind development. In key unregulated markets, many projects face the risk of transmission curtailment, potentially for both reliability and economic reasons. Wind projects may be the lowest marginal cost provider for a given time, but if running these assets causes baseload assets to shut down (in a way that
prevents them from ramping up quickly and compromises reliability), they could be called off out of fear that wind resources could diminish or transmission could be interrupted, leaving the grid less stable. While most U.S. wind farms faced relatively little curtailment for economic reasons, the effects can be significant when it does happen, especially for projects with very high fixed costs (offshore costs are generally much higher than for onshore wind farms).

Consequently, for offshore wind projects to become successful, the risk of transmission curtailment must be mitigated, as is the case for certain European offshore projects. U.S. grids have had varying levels of success offsetting curtailment risk. MISO, for instance, with its historical policy of using manual curtailment, saw higher curtailment rates, making wind farms under power purchase agreements less profitable than their wind regime would suggest. Meanwhile, California has changed its bidding rules so as to allow wind assets to run at virtually any time in which they can generate.

China’s Offshore Wind Capacity Will Increase Fourfold By 2020, And Taiwan’s Capacity Is Developing Briskly

Although China is a global leader in onshore wind farm capacity, offshore wind accounts for only a small part of the operating capacity and capital expenditures of Chinese wind operators. Offshore development is accelerating, though, on the back on continuous cost-cutting, government support, and growing operational experience. The Chinese government’s 13th Five-Year Plan On Wind Energy Development (covering 2016-2020) targets an increase in total offshore wind farm capacity to more than 5GW in operation and another 10GW in construction. This represents 2.4% of total wind farms in operation in China by 2020 (see chart 4). Total investments in onshore and offshore wind farms will be more than $92 billion and $9 billion, respectively, over this period. This will increase capacity by about four times.

Chart 4 - China Offshore Wind Lagged Behind Global Peers But Is Accelerating

<table>
<thead>
<tr>
<th>Region</th>
<th>Total wind (2016, MW)</th>
<th>Offshore wind (2016, MW)</th>
<th>Offshore wind as % of total wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>China (2020 target)</td>
<td>2.4%</td>
<td>0.1%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>China</td>
<td>1.0%</td>
<td>0.1%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>U.S.</td>
<td>8.2%</td>
<td>25.8%</td>
<td>35.5%</td>
</tr>
<tr>
<td>Germany</td>
<td>24.3%</td>
<td>25.8%</td>
<td>35.5%</td>
</tr>
<tr>
<td>U.K.</td>
<td>24.3%</td>
<td>25.8%</td>
<td>35.5%</td>
</tr>
<tr>
<td>Denmark</td>
<td>24.3%</td>
<td>25.8%</td>
<td>35.5%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>24.3%</td>
<td>25.8%</td>
<td>35.5%</td>
</tr>
</tbody>
</table>

Sources: 13th Five-Year Plan By National Energy Administration, Global Wind Energy Counsel.
Offshore Wind Projects Take Off As Technology Improves And Costs Fall

Tariff support
In December 2016, the Chinese government decided to maintain the benchmark tariff for intertidal and offshore wind farms commissioned before Dec. 31, 2018, at Chinese renminbi (RMB)0.75/KWh and RMB0.85/KWh, respectively. However, the tariff for onshore wind farms was cut by 2%-9% to RMB0.40–RMB0.57/KWh (see table 1).

The government is also working to increase the construction pace of offshore wind farms, shortening their approval procedures, and improving tariff mechanisms. It aims to strengthen standards, policy-setting processes, and information monitoring. Given the lack of other renewable energy alternatives, provincial governments in eastern coastal regions also support offshore wind farm development to meet the central government’s environmental goals. These provinces are also major power demand centers in China, with low risk of wind curtailment.

At the end of 2016, China Longyuan Power Group Corp. Ltd., the largest wind farm operator in China and the second-largest globally, had total installed wind capacity of 17.4GW, with only 496MW of it in offshore wind farms. However, it is accelerating its offshore development by commissioning 500MW capacity in 2017 and another 400MW in 2018. As of end-2016, Longyuan had total reserves exceeding 8GW in offshore wind farms, of which 1.1GW has been approved by government authorities for construction. We think the acceleration in offshore wind development is mainly driven by declining investment and operational costs, and a stable tariff.

Longyuan has been emphasizing project returns when developing offshore projects due to their inherently higher capex, longer gestation periods, heightened logistical difficulties, and lack of turbine suppliers. Equity IRRs on the existing offshore projects could reach around 15%, similar to the company’s onshore projects, amid the other risks.

In neighboring Taiwan, offshore wind farm capacity was less than 10MW as of end 2016, but we expect it will develop rapidly. Taiwan targets significant growth to more than 500MW of offshore wind farms by end 2020 and to more than 3GW by end 2025. The development strategies involve three phases:

– An offshore demonstration incentive program, which was introduced in 2012, under which the government will provide subsidies for both equipment and developing processes;

Table 1 - China Has Cut Tariffs For Onshore Wind Farms But Not Offshore Wind Farms

<table>
<thead>
<tr>
<th>(Unit: RMB/KWh, including VAT)</th>
<th>Announcement on Dec. 22, 2015</th>
<th>Announcement on Dec. 26, 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Projects approved before 2016</td>
<td>Projects approved before 2018</td>
</tr>
<tr>
<td>Onshore wind farm tariffs</td>
<td>US$0.068-0.087 (RMB0.47-0.60)</td>
<td>US$0.064-0.084 (RMB0.44-0.58)</td>
</tr>
<tr>
<td>Intertidal wind farm tariffs</td>
<td>US$0.109 (RMB0.75)</td>
<td></td>
</tr>
<tr>
<td>Offshore wind farm tariffs</td>
<td>US$0.124 (RMB0.85)</td>
<td></td>
</tr>
</tbody>
</table>

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- Processing of applications for planning, including 36 zones for possible development. Developers must acquire approved environmental impact assessments by 2017 and preparation permits by 2019; and

- Development of offshore zones, aiming for commercial-scale operations that enable cost reductions.

Latin America: Offshore Wind Is A Long-Term Prospect

We expect renewables will maintain their rapid growth as a source of electricity generation in Latin America, taking advantage of the decreasing costs for wind and solar power generation in recent years, as a result of technological improvements and economies of scale (see chart 5). Although we don’t expect offshore wind will develop in the short term in the region, the potential is very promising.

With the longest coastline in the region, the Brazilian government estimates that offshore wind potential in Brazil would be about 12 times greater than the potential capacity for onshore wind power (143GW). Chile, with the second-longest coastline in Latin America, has a continental shelf with a width ranging from 3km to 60km, at depths of between 200 meters and 300 meters.

Chart 5 - Renewable Capacity In Latin America

<table>
<thead>
<tr>
<th>Capacity (GW)</th>
<th>2009-2015</th>
<th>2015-2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroelectric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bioenergy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onshore wind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offshore wind</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar photovoltaic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geothermal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermosolar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Offshore Wind Is Poised For Growth

Costs for offshore development have continued to fall and technology has become more viable, fueling projects to expand offshore wind capacity. The maturation of the industry, particularly in Europe, has enabled greater transparency and a better understanding of the key risks, especially during the construction phase, which in turn has supported further cost reductions. Regulatory and political risk remain the main challenges for this sector and will continue to play an important role in driving development, particularly in the nascent North American offshore wind industry. Nonetheless, a strong pipeline of projects is building to leverage the vast untapped potential of offshore wind around the globe.
Appendix: Lessons Learnt From The U.K. Offshore Wind Industry

The extent of financial exposure to the risk of subsea cable failures varies in different countries depending on the regulatory set-up. In the U.K., the onshore substations and associated works, export cables, and offshore substations are not part of the generation project in the operational phase, as they are owned by independent regulated companies (OFTOs). The offshore regulatory regime, developed by DECC (now BEIS) and Ofgem, was launched in 2009 and uses competitive tendering for licensing offshore electricity transmission systems. The regime is flexible, allowing Ofgem to run tenders for projects where:

- Offshore transmission owners (OFTOs) design, build, operate and maintain the transmission assets; or
- Generators build the transmission assets and then transfer them to OFTOs at construction completion.

With 15 OFTOs in place as of today and 16 projects in the first four tender rounds, 4.6GW will be connected. The fifth tender round, which started in October 2016, consists of five projects and is expected to account for an investment opportunity of 2.37GW, or above £2 billion. Each transmission system is being constructed by the offshore wind farm developer and will include offshore substation platform(s), offshore and onshore export cables, and an onshore substation. The preferred bidder for the first project coming live under tender round five, Dudgeon (402MW), will likely be announced by Ofgem in the last quarter of 2017.

As we stated in our “Examining The Key Credit Features Of U.K. Offshore Transmission Owner Projects,” published Feb. 11, 2013, we consider these projects to have stable revenues but with exposure to low-probability, but high-impact, operating events and the relatively high cost volatility associated with low-probability unplanned maintenance.

As the sector matures, more is being learned. Some OFTOs have suffered issues related to subsea cable exposure and free spanning, due to scour caused by current flow or seabed mobility, the impact of which can be mitigated by undertaking subsea surveys and reburial campaigns. In addition, there have been several subsea cable failures. The result has been unexpected costs to undertake cable reburial campaigns or subsea cable repair campaigns. Due diligence on assets prior to acquisition is essential to ensure fit-for-purpose assets are transferred to the OFTO. The OFTO can also mitigate this risk through maintenance contracts and insurance, passing off some of the risk to other parties. Also, the time taken to obtain additional permits and licenses required for subsea cable reburial and repair works can be mitigated by the use of preemptive marine licenses in order to reduce what otherwise could be a very lengthy process.

For OFTOs, the risk of higher future insurance premiums after a cable failure is a concern, given the limited number of brokers experienced in the area. Property damage, business interruption, and third-party insurance might be required in some form as a result of industry standards or financiers’ requirements. Ultimately, however, insurance coverage is a commercial decision, with the aim of being as efficient as possible.

The exposure to low-probability, but high-impact operating events also relates to Ofgem’s retention of a significant degree of discretion as to how the OFTO exercises its rights of compensation for revenue loss or cost increases under the license. Whether an OFTO will be penalized depends on whether Ofgem regards the outages as being the result of an Exceptional Event (protects revenue) or an Income Adjusting Event (protects against additional costs). To date, Ofgem has completed its review of a number of subsea cable failure Exceptional Event claims and to date all claims have been successful, although there has been some disallowance where Ofgem has determined work was not undertaken in line with good industry practice. In contrast, Income Adjusting Events (costs above the STC threshold amount of £1 million per financial year, as defined in most licenses) have not been accepted by Ofgem for remedial scour, due to not being an “extreme” unforeseeable event (for example, reasoning that they could have been picked up at the asset-transfer due diligence, although OFTO disputes this).

Cable maintenance strategies in the form of geophysical surveys (subsea surveys) and condition monitoring through distributed temperature sensing, which monitors for any cable overload, cold spots (potential cable exposure), or hot spots (potential for the cable being buried too deep), is mature and well understood. However, at present, although there are several cable-testing techniques that may determine the asset health of a subsea cable—for example, partial discharge and 4-wave optical time domain reflectometry—these tests at present cannot predict with any confidence a subsea cable defect that may lead to future failure. Still, work is ongoing in this area. We view positively the framework agreements being put in place with different cable repair companies to shorten cable repair response times if needed.
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