LLOYD'S

Risk revealed by Lloyd's:

Offshore wind

Lloyd's Futureset

Tuesday 22nd November

To close out our 2022 cross-sector collaboration efforts, we were pleased to be joined by leading offshore wind experts and Lloyd's market energy underwriters to discuss the opportunities and challenges for the sector.

Thanks to our speakers from the Carbon Trust, Delta Wind Partners, Renewables Consulting Group, Ofgem, Markel and Travelers for taking part.

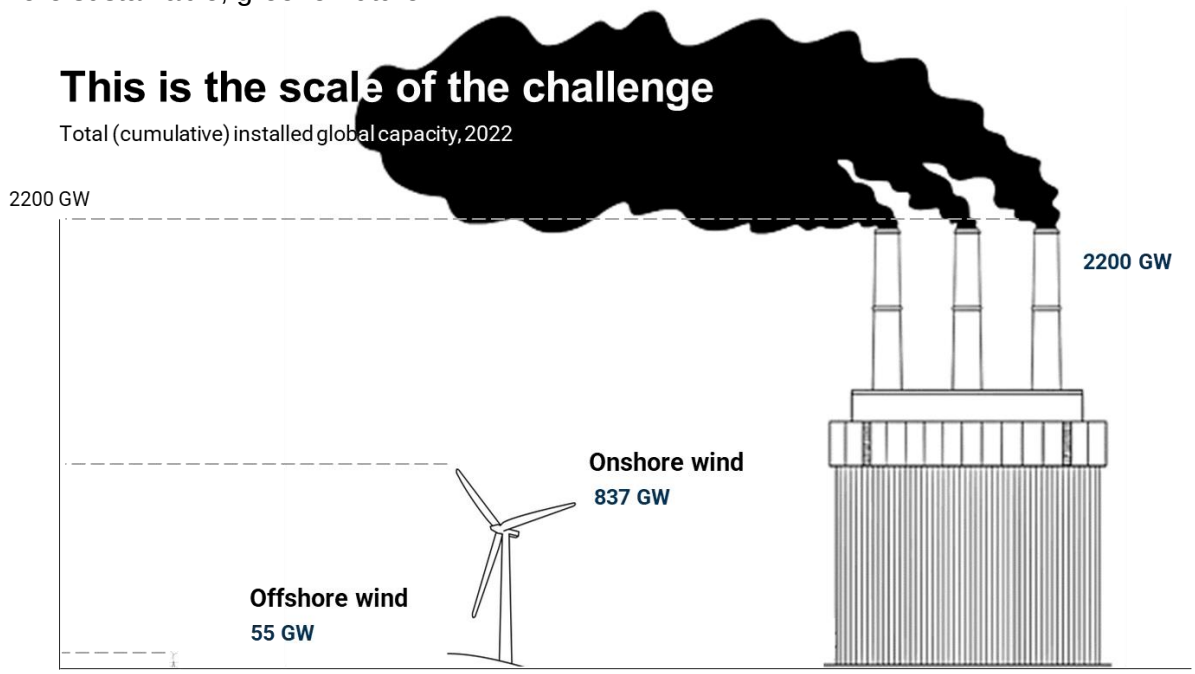
This post event read is a round up of the conversation and insights shared and covers:

- **How is the offshore wind sector evolving and why is it important that the sector innovates and develops new technologies?**
- **What are the near, mid and long-term risks facing the offshore wind industry?**
- **What approaches are developers adopting to increase the efficiency and lower the cost of offshore assets?**
- **What are the key questions that underwriters can ask when assessing relatively new offshore wind technologies?**

How is the offshore wind sector evolving and is it important that the sector innovates and develops new technologies?

Offshore wind is an established source of clean energy, generating around 8% of the world's energy in the first half of 2022. It's also well supported by the Lloyd's market and

featured in our 2021 Climate Action Roadmap and report as a key technology to enable a more sustainable, greener future.



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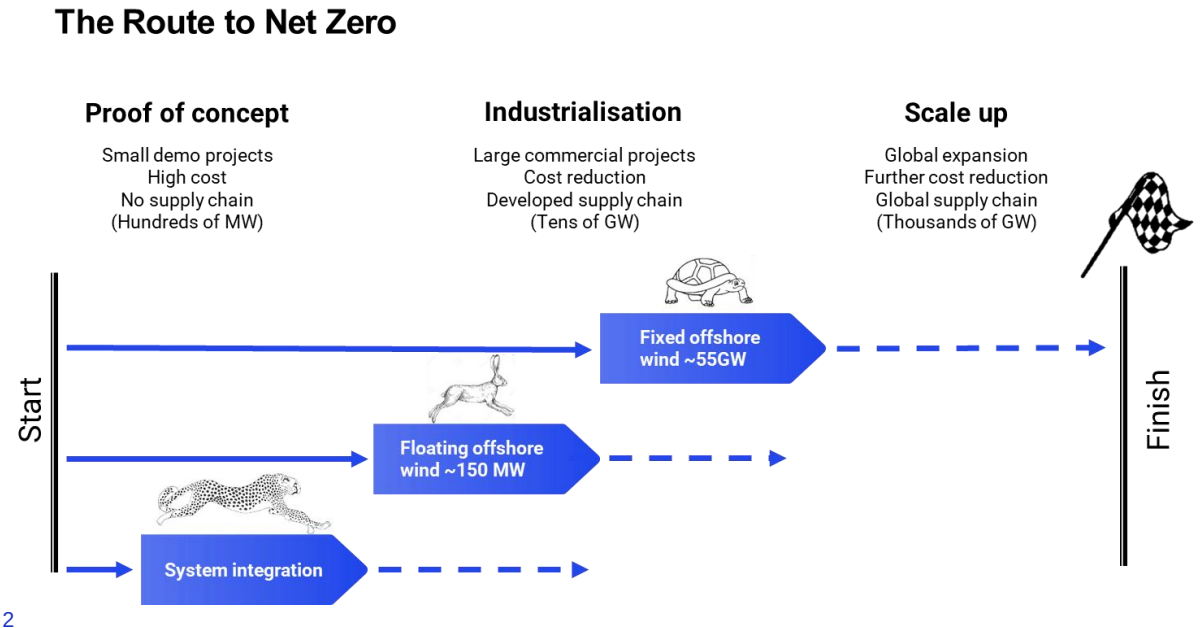
Earlier this month at COP27 in Sharm El-Sheikh, nine new countries signed up to the Global Offshore Wind Alliance including Germany, Ireland, Japan, the Netherlands, Norway and the US, all pledging to ramp up offshore wind production. The potential for growth is significant, with offshore wind capacity currently dwarfed by both onshore wind and traditional hydrocarbons.

Much of this growth is being enabled by new technologies, including larger turbines, floating turbines far away from shore, or the integration of new energy storage solutions as hydrogen to offshore wind projects.



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[1,2] Source: The Carbon Trust

There are three key areas of change for the offshore wind sector I the coming years:

1. **Fixed offshore wind** projects have significantly increased in scale, which means they are becoming cheaper relative to conventional energy sources

2. **New types of offshore wind**, like floating offshore wind have evolved extremely fast. This has in part been enabled by learnings from fixed offshore wind due to the synergies on knowledge and technology transfer. Floating offshore however, is largely still in a pre-commercial stage because it has not yet been fully industrialized to reduce costs and enable a wide scale-up.

3. **System integration** requirements are likely to present a significant challenge for the sector. If offshore wind is to generate 35% of global energy by 2050, which some experts believe, it can only do so by delivering improved and more resilient system integration to dispatch offshore wind energy to end-users. To achieve this, there's a need for significant innovation around energy storage, cables, substations, system services, and turbine structures amongst others.

What are the near, mid and long-term risks facing the offshore wind industry?

Near term

In the near term, the main risks to operators are supply chain disruptions, cost inflation, and natural catastrophes. Some of the challenges include:

– New and existing projects can become interrupted due to supply chain risks, like delays in manufacturing capacity, logistics bottlenecks and freight cost increases impacting the global offshore wind supply chain. Some experts argue that floating offshore wind could suffer even more because manufactures may prioritise large scale fixed offshore wind orders over smaller floating wind projects.

– Project costings are typically negotiated years in advance of manufacturing and delivery, meaning that businesses are absorbing the price volatility of commodities and logistics, negatively affecting the levelised cost of energy of offshore wind.

– There's a lack of data around offshore natural hazard perils in regions being developed for offshore wind, which makes it difficult to understand the risks that projects could face. Most investment to date in modelling offshore perils has focused on the specific needs of the oil and gas industry, however offshore wind projects are typically located in different regions offshore. As a proxy, some underwriters use onshore historic data, but as projects get bigger, more complex, and move further away from the shore, there is a need to increase the skills and capabilities for offshore cat modelling.

Medium and long term

Most net zero scenarios show that by 2050, offshore wind from emerging countries will represent a significant proportion of global capacity. In the medium term the main risks to this growth is a lack of skilled labour and slow production processes to cope with a high demand for offshore wind projects in new regions of the world. It will be important for the industry to accelerate training and upskilling the workforce of manufactures, installers and

[1,2] Source: The Carbon Trust

operators in emerging offshore wind markets and streamline its processes to enable this growth.

Many of the critical minerals needed for offshore wind manufacturing is also dominated by few countries, for example China, Chile and Indonesia. To assure a robust and sustainable supply chain the adoption of best-in-class sustainable practices is needed for the extraction and processing of critical minerals.

What approaches are developers adopting to increase the efficiency and lower the cost of offshore assets?

Cables

A number of research programmes have been set up, aiming to increase cable voltages from 66kV to 132kV in order to enable larger turbines and reduce offshore wind costs. Increasing array cable voltage enables more efficient power collection at wind farms and also reduces the length of cables, reducing costs and minimizing environmental impacts. It is anticipated that the next jump to 132kV will lead to significant cost savings, which will help the industry scale up.

As the market evolves to larger and more complex configurations, multiple offshore wind farms are likely to operate on an integrated network, creating the risk that a failure in one farm could block the energy dispatch of the other wind farms operating as part of the same cluster. To address this, the industry is innovating around direct current (DC) circuit breakers that would isolate the location of any fault, allowing other farms in the cluster to continue dispatching energy.

Storage

With more intermittent energy being injected to the grid, two metrics are used to help understand the total cost of producing a unit of energy. First, the average cost of producing a unit of energy across the lifetime of the project, and second, the integration cost required to match energy supply and demand in real time. The more intermittent an energy source is, the more complex – and expensive – it is to integrate the energy produced into the grid. Offshore wind projects can therefore become more competitive by integrating storage solutions that reduce their integration cost by reducing the uncertainty of when they can dispatch the energy.

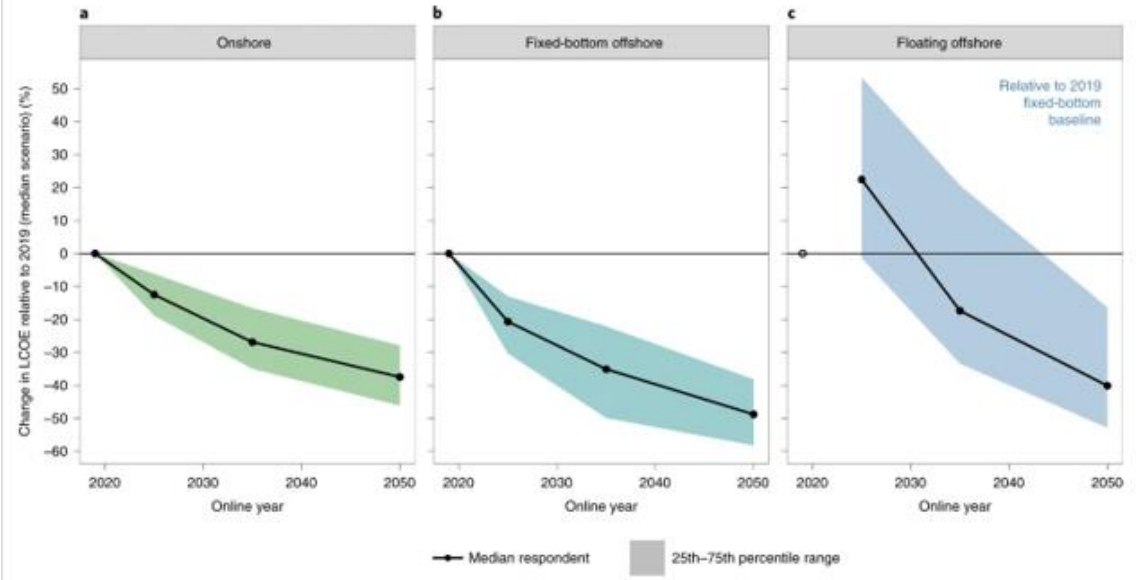
There are different options for storing offshore wind energy. It can be done on a project-by-project basis, with energy storage at each wind farm, or third parties known as auxiliary services can provide energy storage as a service to multiple wind farms. With spot energy prices near zero at certain times of day, there's a clear arbitrage opportunity for the industry to store energy and then sell it later when prices are higher.

Turbines

Another approach the industry is taking to reduce costs is to build larger turbines that generate more power per turbine and require less associated infrastructure than multiple smaller turbines would need. However, larger turbines can be more challenging to install and require a new generation of installation vessels that will need to grow at the pace as the deployment of larger turbines to avoid a capacity installation crunch.

[1,2] Source: The Carbon Trust

Fig. 2: Expected LCOE changes in the median scenario in percentage terms relative to 2019 baseline values.



Source: Wiser et al., 2021

What are the key questions that underwriters can ask when assessing relatively new offshore wind technologies?

One of the key approaches to understand the risks associated with a new offshore wind project is certification, by bringing third party experts into the conversation and analysis. Third party engineering oversight and a full review of contractual obligations is also very important when moving to more innovative technologies, given the number of different parties involved in offshore wind projects involving newer or more prototypical technologies.

Supply chain lead times and the calibre of original equipment manufacturers are also key topics to consider, considering the anticipated growth of the sector and that the supply chain for new technologies is still developing. Typically this means that repairs could have longer lead times, translating into extended business interruption and lost revenues.

[1,2] Source: The Carbon Trust