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Overcoming turbulence in the offshore wind sector key messages

The top-line story:
Offshore wind is already delivering large-scale clean electricity at a competitive cost around the world. In Western Europe, costs fell 60% between 2015-2022. Installations are growing rapidly. From 2015 to 2023, global capacity has expanded 6x from 12 to 74 GW, already producing energy for around 90 million households, and with vast potential to scale further.

But in 2022-2023, inflation, supply chain bottlenecks and higher interest rates led to rising offshore wind costs. A perceived offshore wind "crisis" ensued, in UK and US markets in particular, as many projects and contracts were cancelled.

While increases were significant in the short term, costs in Western markets are already coming back down as most drivers prove temporary in nature (e.g. supply chain bottlenecks due to COVID, a 200% increase in steel costs), though the increase in cost of finance may endure over the medium-term. Continued rapid cost declines in China illustrate that technological progress and large-scale production can deliver further reductions – making offshore wind even cheaper and more competitive in the future.

However, for most countries, projections of installed offshore wind capacity to 2030 fall far short of the installations required in a net-zero-compatible trajectory. Accelerating rapid growth and cost reductions across the world will require large volumes of projects which the supply chain can build towards, key to this will be strong government action. Larger turbine sizes are more efficient, with the potential to reduce costs in the long term, but can cause supply chain issues, especially in the short term; supply chain bottlenecks can emerge in an industry which requires specialist installation vessels and other equipment. There is therefore an urgent need to identify the actions which can relaunch the European and US offshore wind markets back onto a path of rapid cost-effective growth.

The ETC sets out five key recommendations to return confidence in offshore wind around the world and bring down costs:

1. Set clear targets for medium and long-term deployment growth (i.e. to 2035 and beyond), supported by a pre-defined schedule of government-backed auctions.
2. Design government auctions and contracts to increase the certainty that contracted volumes will be delivered.
3. Streamline planning, permitting and grid connection processes while also reinforcing the grid.
4. Encourage harmonisation of turbine components and sizes to provide clarity on the features of turbines which will be installed in the future.
5. Address specific supply chain bottlenecks through targeted action (i.e. through guarantees or subsidies for transportation vessels where appropriate).

Offshore wind has the potential to cheaply deliver lots of clean electricity around the world

To achieve a net-zero economy built on clean electricity, annual global wind generation would need to grow ten-fold, from 2,000 TWh in 2022 to over 20,000 TWh in 2050, complemented by a 30-fold increase in solar generation, from 1,000 TWh to ~30,000 TWh in the same period. This would require over 8 TW of wind capacity and 20 TW of solar capacity globally.

- Offshore wind has the potential to generate more than 420,000 TWh per year worldwide. This is more than 14 times the global electricity generation today.[1]
- Costs and prices bid at offshore wind auctions fell rapidly between 2015 to 2020 in line with cumulative installed capacity growing from 12 GW in 2015 to 74 GW by 2023.
- BNEF projections suggest that total installed global offshore wind capacity could reach ~260 GW by 2030, and grow an additional 230 GW by 2035.

However, for most countries, projections of installed offshore wind capacity to 2030 fall far short of the installations required for a net-zero-compatible scenario. Policy reform should aim to close this gap as much as possible.

A perceived "crisis" in the UK and US offshore wind markets

- In 2023, the **UK and US** experienced high inflation and supply chain bottlenecks. Offshore wind costs rose as much as 40% in the UK in 2022-2023,[2] and 60% in the US[3] between 2021-2023. This led to auctions in which no bids were accepted, and to project and contract cancellations and postponements.
- Projects most impacted by the 2022-2023 cost increases were those that won contracts but had not yet contracted supply chain orders. This relates to 12% of the project pipeline between 2023-2035 outside of China; 78% (~215 GW) are yet to be contracted and should be less affected by cost increases, while the remaining 10% has already reached a financial agreement.

In other markets:

- **Germany, the Netherlands and Ireland** were less affected, and all managed to contract significant new capacity in 2023.
- **Japan and South Korea**, emerging offshore wind markets, both managed to contract new capacity in 2023, although less than European markets.
- **China** saw a record 20 GW of projects reach final investment decision between July 2022-2023 despite national subsidies being phased out from January 1st 2023. China overcame supply chain and contract issues that other countries faced because it benefitted from a low cost of capital, a robust schedule of auctions and an integrated supply chain.

Five key factors drove up costs in 2020-2023. Of these, only the change in real interest rates is likely to be significant in the medium term:

- Steel accounts for 90% of turbine material costs. **Between 2020-2022, European steel prices increased ~200%.** However, as of early 2024, global steel prices have returned close to 2019 levels and are expected to continue falling this year.
- As economies recovered from the COVID pandemic lockdowns, **supply chain bottlenecks resulted in higher shipping and installation costs**.
- **The cost of other key input materials** (copper, aluminium and neodymium) also increased from 2019 levels but only contributes a small proportion of total turbine costs.

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[1] IEA (2019), *Offshore Wind Outlook 2019*.
[2] ECIU (2023), *Offshore wind: All at sea?*
[3] BNEF (2023), *Levelised Cost of Electricity 2H 2023*.

- **Nominal interest rates rose and remained around 5% from 2021-2023**. This increase is manageable for contracts linked to inflation. But **if real interest rates remain higher over time**, this will impact the cost of borrowing and thus the profitability of projects. If a 2% real interest rate increase is sustained over the medium term, this would add ~13% (~$10/MWh)[4] to levelised costs for the foreseeable future.
- **Higher prices set by turbine original equipment manufacturers (OEMs)** to compensate for low or negative profits since 2019.

Offshore wind is a competitively priced renewable energy technology but could be cheaper

Cost reductions in recent years have seen offshore wind become as cheap as fossil fuel generation in Europe and China once a carbon price has been applied, though it remains more expensive than gas-fired generation in the US, with renewable portfolio mandates required to incentivise offshore wind.

Different clean technologies display very different rates of cost reduction over time.

- Globally mass-produced and standardised solar PV and batteries for EVs have achieved 85-95% cost reductions over the last 12 years. These cost reductions derive from economies of scale and learning curve effects associated with the production of millions of units each year.
- In contrast, estimated costs of technologies requiring complex, often localised and bespoke engineering such as CCUS and nuclear power have not significantly declined (indeed nuclear costs have increased in the same period), with these technologies produced in the 0-10s per year.
- Offshore wind is an intermediate technology which entails much smaller numbers of units deployed than solar PV or batteries, but much larger numbers of identical units than in the case of CCUS or nuclear power, generally in the hundreds or thousands of units each year.

The challenge for policy is to support supply chain developments and large-scale production which can make offshore wind as similar to solar PV and batteries as possible. There are two reasons why this is hard:

1. **Offshore wind turbine markets have become more fragmented**
   Turbine manufacturing is often concentrated at the individual country level, not regional level, due to local content requirements and the assembly of large turbines needing to be close to the installation point. In recent years new countries are entering the market (US, wider Europe and Taiwan), which has further fragmented the nascent market, with some manufacturing facilities struggling to scale at pace.
2. **Larger turbine sizes are more efficient but can cause supply chain issues**
   Larger turbine sizes have the potential to significantly reduce levelized costs (LCOE) of offshore wind electricity as a result of:

- Increased energy production/capacity factors; larger turbines sweep a greater area and capture more wind at greater wind speeds.
- More efficient use of space and foundations; fewer total turbines needed to achieve a specific energy output.

[4] Note: Real cost effects estimated by modelling a 2% real interest rate rise, from 5% to 7% based on a project cost of $1.8 bn for a 1GW wind farm with 30% equity, 70% debt.

- Potential to operate at lower wind speeds; larger turbines can work at lower wind speeds opening up more areas for development.
- Fewer wind turbines to service; operation and maintenance make up around 20% of project costs, so fewer turbines result in less expenditure.

But recent European experience shows that very rapid increases in the turbine sizes assumed in auction bids can result in:

- Shorter shelf lives per specific product and thus higher development costs per turbine type.
- Challenges in scaling production lines fast enough to meet commitments, with demand for specific turbine sizes not high enough for significant economies of scale.
- Quality issues arising from insufficient testing before delivery.
- Impacts on the wider supply chain infrastructure (for example, it can take 3-5 years for ports and installation vessels to be built to new specifications).

China's experience shows it is possible to get the cost benefits of growing turbine size if large-scale market development enables high-volume manufacturing and supply chain development, and if the cost of capital is low enough. A crucial question is how far these conditions can be replicated in markets outside China.

Five key recommendations to relaunch the confidence cycle and bring down costs

For other geographies to replicate China's success, governments and international bodies should:

1. **Set ambitious targets and predefined auction schedules, which ensure large-scale volumes committed and delivered year by year.** Large and stable project pipelines at the country/regional level can help overcome market fragmentation issues and provide space for supply chains to grow.

2. **Design contracts and auctions to incentivise completion, through the inclusion of inflation adjustment mechanisms and removal of optionality affecting delivery of government-backed contracts.** Making it harder for developers to pull out of contracts will increase developer risk and therefore the expected returns required to deliver offshore wind projects. Governments should accept paying slightly higher prices for offshore wind power to account for measures to remove optionality, given the benefits of increasing supply chain certainty.

3. **Streamline planning, permitting and grid connection processes.** Planning and permitting can be streamlined to halve project development time and mitigate cost escalation. Grid investment to minimise transmission bottlenecks is crucial and should be combined with streamlined grid connection procedures.

4. **Encourage harmonisation of turbine components and sizes.** The more a given turbine and components can operate in different markets, the more economies of scale gains can be made from mass production. Aligning regulation and non-price criteria in auction processes (e.g., projects favoured which more easily integrate with local power generation and transport/installation systems, have high sustainability, and a good developer track record for delivery) across regional markets can encourage

standardisation and cost reduction.

5. **Address supply chain bottlenecks with targeted interventions such as guarantees and subsidies for transport and installation vessels.** Regulatory barriers should be revisited to facilitate development (e.g., the Jones Act in the USA). Local content requirements must be carefully balanced against the need to achieve economies of scale at a multi-country/regional level.